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# Impacts of Basic Rural Energy Services in Bangladesh

An Assessment of Solar Home System  
and Improved Cook Stove Interventions

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## Foreword

The Centre for Advanced Training in Rural Development (Seminar für Ländliche Entwicklung, SLE) at the Humboldt University in Berlin has trained young professionals in German and international development cooperation for over 45 years.

Three-month consulting projects conducted on behalf of German and international cooperation organisations form part of the one-year postgraduate course. In multidisciplinary teams, young professionals carry out studies in innovative future-oriented topics and act as consultants. Including diverse local actors in the process is of great importance here. The outputs of this “applied research” are an immediate contribution to solving development problems.

Throughout the years, SLE has carried out over one hundred consulting projects in more than 80 countries, and regularly publishes its results in this series.

In 2009, SLE teams have completed studies in Bangladesh, Bolivia, Morocco and Tanzania, all dealing with topics that are relevant to recent discussions in international development cooperation.

The present study was commissioned by GTZ, i.e. the Poverty-Oriented Basic Energy Services (HERA) Sector Project in cooperation with the Sustainable Energy for Development Programme (SED) in Bangladesh and in collaboration with Energising Development (EnDev), the partnership between The Netherlands Ministry for Development and The *Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung* (BMZ) executed by GTZ. The study analyses the impacts, the poverty orientation, and the sustainability of the dissemination structure of Solar Home Systems and Improved Cook Stoves and gives recommendations for the improvement of the SED programme.

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The study was conceptualised by Marlis Kees and Michael Blunck of the GTZ Sector Project Poverty-Oriented Basic Energy Services in collaboration with SED, Bangladesh. We are most grateful for their initiative and valuable support. In addition, we would like to thank Robert Heine of the Dutch-German cooperation programme Energising Development (EnDev) at GTZ for the insights into this programme.

We are grateful to Carola Jacobi-Sambou and the scientific staff at the Centre for Advanced Training in Rural Development (SLE) for their advice, professional support and critical input. In addition, we would like to express our appreciation to all other SLE staff for their support and cooperation.



## Executive Summary

Improved energy supply is essential for socio-economic development and environmental sustainability. It has a direct impact on the life situation of the rural poor, influencing their productivity, health, education, and gender-related issues. As at least 1.6 billion people worldwide do not have access to electricity and 2.4 billion rely on traditional biomass fuels for cooking, it is crucial to understand how access to basic rural energy services can be improved.

The present report compiles the findings of a study carried out on behalf of the sector project Poverty-Oriented Basic Energy Services (HERA) of the German Technical Cooperation (GTZ) in collaboration with the Sustainable Energy for Development Programme (SED) in Bangladesh. The interventions made by SED include support for the dissemination of Solar Home Systems (SHS) and Improved Cook Stoves (ICS) in Bangladesh through financial as well as technical assistance. The aim is to establish a self-sustaining market for both technologies. The study assessed the impacts and the poverty orientation of both the SHS and the ICS interventions as well as the sustainability of the dissemination structures for these technologies.

SHS are small photovoltaic systems with a peak capacity of between 40 and 130 Watts, and are currently sold at a subsidised price of between 220 and 680 Euros. Hire-purchase arrangements for SHS are offered by all 16 organisations participating in the distribution scheme under the government owned Infrastructure Development Company Limited (IDCOL). SHS are used mainly by middle-class households and micro- and small enterprises (MSE) in off-grid rural locations to operate light bulbs, and small electrical appliances like mobile chargers and black and white TVs. SED provides a 30-Euro grant for each SHS sold, a management fee for IDCOL, financial support for the institutional development of the partner organisations and training.

In contrast to traditional clay stoves, ICS have a closed surface and a chimney. They are designed to burn biomass fuel more efficiently and to reduce smoke pollution in the cooking environment. ICS are presently marketed and sold by 165 partner organisations at a price of between eight and 12 Euros for a typical domestic stove. SED support includes financial support for training, marketing and institutional development of the partner organisations, financial incentives for stove builders, and facilitating an experience exchange between the organisations.

The dissemination of both technologies comprises special approaches to reach poor target groups. Through a pilot project, SED has introduced small, 20 Watts-peak solar home systems (SSHS) into the dissemination scheme. With additional financial support from SED, ICS are sold at a lower price or provided free of charge by some partner organisations to poor households.

The findings of this study are based on qualitative and quantitative assessments, involving a four-week period of field research mainly in the Rajshahi division in North-Western Bangladesh. This was complemented by workshops with stakeholders, literature reviews, and the analysis of information from programme documentation. The field research comprised of key informant interviews and group discussions with partner organisations, intermediaries such as SHS technicians and stove builders, open and standardised interviews in SHS- and ICS-using households and MSEs, and interviews with non-users. In total, around 260 SHS-related interviews and around 450 ICS-related interviews were conducted. In the SHS sample, 75% of the respondents were male compared to over 90% female respondents in the ICS sample, women being the main users of stoves.

Access to solar electricity was found to enhance the general life quality of SHS owners, a great majority of whom named improved lighting as the most important benefit. Improved study conditions for children and more customers are related benefits that were classified as second most important by domestic and commercial users, respectively. Further impacts are improved access to information, better communication options, a perception of improved safety in some cases, and greater working comfort in the household, which is appreciated especially by women. Savings in energy expenditure hardly occur during the hire-purchase period but are expected by users in the long run. However, purchase of a replacement battery after six or seven years constitutes a significant second investment and a critical juncture for sustainability in terms of long-term use. While domestic SHS are rarely used for income generation, the majority of commercial users, e.g. owners of tea shops and small restaurants, reported increased profits since the acquisition of an SHS. The money is invested privately and in business expansion, but rarely to create new jobs. Job creation related to SHS dissemination was found to occur mainly for less poor, male workers in technical and management positions. The most relevant unintended impacts are a risk of debt for comparatively poor SHS users, as well as environmental hazards related to improper treatment of defective batteries.

With respect to ICS, health benefits were the most obvious improvement found, followed by fuel, money and time-saving. A great majority of users reported significantly less smoke in their kitchen and a perception of better health, mentioning positive impacts on their eyes as well as less coughing and respiratory diseases. Reported fuel saving ranged between 14 and 70% with an average of 33%; however, more than one third of the respondent households were not able to quantify fuel saving at all. For a great majority of women, time-saving that resulted mainly from faster cooking was an important impact. Women use a large proportion of the average seven hours of saved time per week for other household work. Money saving due to reduced fuel consumption was stated by one third of the households. In MSE and social institu-



tions, both money and fuel saving are far more pronounced, as expenditure for cooking fuel constitutes a substantial part of their operating costs. Furthermore, ICS dissemination can lead to the creation of low-skill jobs for men working as stove builders and in chimney manufactories.

Poverty distribution in both the SHS and ICS samples suggest that the dissemination of both technologies is currently not pro-poor oriented according to the definition of the German Federal Ministry for Economic Cooperation and Development (BMZ), as the proportion of poor people among the respondents is below the regional average of 48% in the research region. The share of poor people is greater in the ICS sample with almost 40% of the respondents living below the upper poverty line, compared to 23% in the SHS sample. In the cases of both SHS and ICS, poverty-reducing impacts exist, but some of these materialise to a lesser degree for the relatively poorer users. Poor SHS users and SSMS owners benefit from lighting-related impacts only, as they are usually not able to afford and/or operate additional electrical appliances. Poorer households using ICS tend to collect fuel rather than buy it, thereby benefiting from time-saving, but not saving money.

Beyond the distribution of SSMS and solar lanterns, the approaches considered promising to bring solar technology to poorer target groups are extended hire-purchase periods with reduced down-payment and flexible payment patterns, as well as the promotion of sharing SHS between potential users who live in close vicinity to one another. Poverty-reducing impacts could also be created by promoting larger capacity SHS that can be used for income-generating activities.

Of the three approaches surveyed to reach poorer people with subsidised ICS, two gave a positive impression, with the median income among the target groups lying below the poverty line. In a third approach that made it obligatory for Bangladeshi vulnerable group card holders to buy a subsidised ICS for 100 Taka (1 Euro), people among the target group reported to have been forced by local government officials to pay varying amounts of money for the ICS. Nevertheless, only a few of them were then provided with functioning stoves.

The analysis of the technology dissemination structures concludes that SHS dissemination is well ahead on the way to a self-sustaining market, while ICS dissemination is not quite as far advanced. This can be partly attributed to the fact that the development of a market for SHS started in 2003, while the ICS intervention was only introduced in 2007. This study considers the overall set-up of SHS dissemination as a role model for approaches elsewhere due to its quality-assuring mechanisms and other factors. With regard to financial support for the SHS scheme, the management fee for IDCOL is considered to fulfil the most important function, whilst the 30 Euro subsidy is significant for less affluent users, but on the whole shows a small demand-creating effect. It influences the purchase decision of only one fourth of the users.

The study perceives a lack of local technical expertise and good quality after-sales service as the most prominent weaknesses in the dissemination structure. Users are generally more satisfied with the SHS itself than with the providers' services. SED's aim that every customer should be able to choose between at least two SHS providers has been reached for 40% of the customers in the present sample. This leaves room for increasing the market power of users in the future by extending local supply and services within and beyond the current provider structure.

The ICS dissemination structure is found to be characterised by a very large network of partner organisations, which has been created at a high pace, along with financial incentives whose aim is to produce large quantities of stoves. At the same time, insufficient control and monitoring pose a risk of improper development and severe omissions, in the view of the authors. While the installation of impressive numbers of ICS is reported to the SED, different auditing and consultancy reports yield contradictory results on the actual existence and functioning of these stoves. In line with preliminary results from another independent study, this study found a significant number of listed households who had never received an ICS or whose stoves were not working properly. Only 10% of the interviewed households received any after-sales services, and stove builders are usually not being rewarded for providing maintenance. The interviewed stove builders expressed dissatisfaction about low salaries, and only an estimated 10% of trained stove builders actually engage in the business after having participated in the training offered by the partner organisations. Moreover, positive environmental impacts of ICS may be mitigated if inaccurate ICS installation figures and fuel-saving rates are assumed to implement ICS dissemination in the Clean Development Mechanism, as is planned for the future. Yet a demand for ICS and an acceptance of the technology seem to exist, with high levels of satisfaction among ICS users that are functioning.

Recommendations given with respect to the SHS intervention include minor reconsiderations of how grants shall be targeted and phased out, as well as how different local capacity building measures are better geared towards enhancing user satisfaction, creating job opportunities and improving the local availability of SHS supply and know-how. The study suggests the establishment of result-oriented monitoring involving an exchange between SHS users and providers, enabling the latter to assess their own institutional development. Moreover, the study advises the maintenance of the current hire-purchase model but also the development of more flexible pro-poor payment options beyond it. It also recommends the introduction of a hire-purchase system for SHS batteries combined with a strengthening of incentives for recycling.

With regard to the ICS intervention, a critical review and an evaluation of current activities is recommended, to examine the performance of present partners. The study also recommends a shift from financial to more sophisticated technical support, along

with the establishment of a continuous monitoring system involving all stakeholders and ensuring orientation on the goals of SED. Various measures and incentives are suggested to encourage better maintenance of ICS and to motivate stove builders to remain in their job. Further recommendations address poverty orientation and global carbon trading, suggesting that ICS pricing and payment models should be adapted to the needs of poor households and that CDM funding should be used for the benefit of ICS owners, while simultaneously making every effort to mitigate potential negative impacts on the environment.



## Bengali Summary

### কার্যাবলীর সারসংক্ষেপ

আর্থ-সামাজিক উন্নয়ন এবং নিরবিচ্ছিন্নভাবে পরিবেশের ভারসাম্য বজায় রাখার জন্য উন্নত শক্তির সঠিক ব্যবহার অপরিহার্য। এর সরাসরি প্রভাব গ্রামীণ দরিদ্র জনগোষ্ঠীর জীবনযাত্রার উপর, এবং প্রভাবিত করে তাদের উৎপাদনক্ষমতা, স্বাস্থ্য, শিক্ষা এবং নারী - পুরুষ সম্পর্কিত বিষয়েও শক্তির ব্যবহারের প্রভাব অপরিসীম। এক হিসেবে দেখা গেছে, সারাবিশ্বে ন্যূনতম ১৬০ কোটি জনগোষ্ঠী বিদ্যুৎ বিতরণ ব্যবস্থার বাইরে এবং ২৪০ কোটি জনগোষ্ঠী তাদের দৈনন্দিন চাহিদা পূরণের জন্য জৈব জ্বালানীর উপর নির্ভরশীল। এটা গুরুত্ব সহকারে বিচার্য, কিভাবে গ্রামীণ জনগোষ্ঠীর মধ্যে ব্যবহারযোগ্য শক্তি ব্যবহারের সুযোগ আরও উন্নত করা সম্ভব।

এই সমীক্ষায়, দারিদ্র বিষয়ক শক্তি সেবা বিভাগীয় প্রকল্পের (এইচইআরএ) পড়া থেকে জার্মান টেকনিক্যাল কোঅপারেশনের (জিটিজেড) আওতাধীন এবং “সাসটেইনেবল এনার্জি ফর ডেভেলপমেন্টের (এসইডি)”, যৌথ উদ্যোগে পরিচালিত বাংলাদেশে এক গবেষণার প্রাপ্ত ফলাফল তুলে ধরা হয়েছে। বাংলাদেশে গৃহে ব্যবহারযোগ্য সৌর বিদ্যুৎ প্রযুক্তি এবং উন্নত চুলা ব্যবহার পরিচিতি সম্প্রসারণে আর্থিক এবং প্রযুক্তিগত উভয় প্রকার সাহায্য প্রদান করা এসইডি'র কর্মপরিকল্পনার একটি উল্লেখযোগ্য দিক। উভয় প্রযুক্তির জন্য স্বনির্ভর এবং স্থিতিশীল বাজার তৈরি এই প্রকল্পের প্রধান লক্ষ্য। এই গবেষণা সৌর-বিদ্যুৎ এবং উন্নত চুলা পরিচিতি, এই উভয় প্রযুক্তির প্রয়োগের প্রভাব এবং তাদের দারিদ্র সম্পৃক্ততা মূল্যায়ন করেছে, তার পাশাপাশি এই প্রযুক্তির স্বনির্ভরশীলতা ও সম্প্রসারণ পদ্ধতিরও।

গৃহে ব্যবহারযোগ্য সৌর বিদ্যুৎ হচ্ছে এক বিশেষ ধরনের আলোক-রাসায়নিক ব্যবস্থা যার উৎপাদন ক্ষমতা সর্বনিম্ন ৪০ ওয়াট থেকে সর্বোচ্চ ১৩০ ওয়াট পর্যন্ত হতে পারে। এই প্রযুক্তি বর্তমানে ভূরুকিপ্রাপ্ত দামে ২২০ থেকে ৬৮০ ইউরোতে বিক্রি হচ্ছে। বাংলাদেশ সরকারের অবকাঠামো উন্নয়ন প্রতিষ্ঠান (ইডকল)-এর অধীনে ১৬টি বিক্রয় সহযোগী সংস্থা, বিক্রয় এবং ভাড়া উভয় পদ্ধতির মাধ্যমে এই প্রযুক্তি বিতরণে কাজ করে আসছে। বৈদ্যুতিক বিতরণ ব্যবস্থার আওতার বাইরে অবস্থিত গ্রামীণ মধ্যবিত্ত পরিবারগুলো যাতে করে ক্ষুদ্র বৈদ্যুতিক যন্ত্র যেমন মোবাইল চার্জার এবং সাদা-কালো টেলিভিশন ব্যবহার করতে পারে, সেই লক্ষ্যে এসইডি, বাংলাদেশ প্রতিটি সৌর বিদ্যুৎ ইউনিটের ক্ষেত্রে ৩০ ইউরো এবং এছাড়াও ইউকলের জন্য ব্যবস্থাপনা ফি এবং সহযোগী সংস্থাগুলোর সাংগঠনিক উন্নয়ন এবং প্রশিক্ষণের জন্য সহায়তা প্রদান করে থাকে।

সৌর বিদ্যুতের বিপরীতে উন্নত চুলা হল সনাতন পদ্ধতিতে কাঁদামাটি দিয়ে তৈরি চিমনিযুক্ত এক বিশেষায়িত চুলা। কাঁদামাটি দিয়ে তৈরি হলেও এর বিশেষত্ব হচ্ছে এর নকশা। এর নকশার কারণে এটি জৈব জ্বালানী ব্যবহারের দিক দিয়ে অধিক সাশ্রয়ী এবং রান্নার পরিবেশে বায়ুদূষণ রোধে অধিক কার্যকরী। বর্তমানে (আইসিএস) ১৬৫টি সহযোগী সংস্থার মাধ্যমে গৃহে ব্যবহারের জন্য উন্নত সনাতনী চুলা সর্বনিম্ন ৮ থেকে সর্বোচ্চ ১২ ইউরো দামে বিক্রয় ও বাজারজাত করছে। এক্ষেত্রে এসইডি সহযোগী সংস্থাগুলোর প্রশিক্ষণ, প্রাতিষ্ঠানিক উন্নয়নের জন্য আর্থিক সাহায্য, চুলা প্রস্তুতকারীদের জন্য আর্থিক সাহায্য প্রদান এবং বিভিন্ন সংস্থার মধ্যে মতবিনিময়ের সুযোগ সৃষ্টি করে থাকে।

উভয় প্রযুক্তি সম্প্রসারণের ক্ষেত্রেই এক বিশেষ পছন্দ অবলম্বন করা হয় যাতে করে তা দরিদ্র জনগোষ্ঠীর নাগালের মধ্যে পৌঁছায়। এক পাইলট প্রকল্পের আওতায় এসইডি সর্বোচ্চ ২০ ওয়াট ক্ষমতায়ুক্ত ক্ষুদ্র সৌর বিদ্যুৎ ইউনিট এই সম্প্রসারণ প্রকল্পে নিয়ে

এসেছে এবং এসইডি এর বাড়তি আর্থিক সহায়তায় আইসিএস কমমূল্যে উন্নত চুলা বিতরণ এবং কোনো কোনো ক্ষেত্রে তাদের সহযোগী কিছু সংস্থা সম্পূর্ণ বিনামূল্যে এই চুলা বিতরণ করছে।

বাংলাদেশের উত্তর-পশ্চিমাঞ্চলে রাজশাহী বিভাগের বিভিন্ন অঞ্চলে চার সপ্তাহ ব্যাপী পরিচালিত জরিপ এবং তার গুণগত ও পরিমাণগত উভয় রকম তথ্যের ভিত্তিতেই গবেষণার ফল নিরূপণ করা হয়েছে। এর সাথে আরও যুক্তছিলো ব্যবহারকারী এবং বিতরণ প্রতিষ্ঠানগুলোর সাথে কর্মশালা, সাহিত্য পর্যালোচনা এবং কর্মসূচির বিভিন্ন তথ্য পর্যালোচনা। মাঠ পর্যায়ে জরিপের ক্ষেত্রে সহযোগী প্রতিষ্ঠানগুলোর সাথে দলগত আলোচনা, সৌর বিদ্যুৎ এবং উন্নত চুলা প্রযুক্তির মাঠ পর্যায়ের প্রকৌশলী ও কারিগরদের সাথে সাক্ষাৎকার ও আলোচনা এবং সৌরবিদ্যুৎ ও উন্নত চুলা ব্যবহারকারী গৃহ ও ক্ষুদ্র-মাঝারি শিল্পে উন্মুক্ত ও আদর্শায়িত প্রশ্নপত্রের মাধ্যমে তথ্য সংগ্রহ করা হয়েছে। সৌর বিদ্যুৎ ব্যবস্থার ক্ষেত্রে সর্বমোট ২৬০টি এবং উন্নত চুলার ক্ষেত্রে ৪৫০টি প্রশ্নপত্র পূরণ করা হয়েছে। সৌর বিদ্যুতের ক্ষেত্রে ৭৫ শতাংশ উত্তর দাতাই ছিলেন পুরুষ এবং সেই তুলনায় উন্নত চুলার ক্ষেত্রে ৯০ শতাংশ উত্তরদাতাই ছিলেন মহিলা। কারণ উন্নত চুলার প্রধান ব্যবহারকারীরাই হলেন মহিলা।

সৌর বিদ্যুৎ ব্যবস্থার সহজলভ্যতার ক্ষেত্রে ব্যবহারকারীদের কাছ থেকে সবচেয়ে গুরুত্বপূর্ণ যে উপকারের কথা জানা গেছে তা হলো, গৃহে আরো বেশি উজ্জ্বলতা, শিশুদের জন্য উন্নত পড়ার পরিবেশ এবং ক্ষুদ্র-মাঝারি শিল্পের ক্ষেত্রে ক্রেতাদের সন্তুষ্টিকেও দ্বিতীয় সর্বোচ্চ উপকারীতা হিসেবে ধরা হয়েছে। এর সাথে আরও যোগ হয়েছে তথ্য প্রাপ্তির ক্ষেত্রে সহজলভ্যতা, কোনো ক্ষেত্রে নিরাপত্তাকে গুরুত্ব দেয়া হয়েছে এবং গৃহে কাজের ক্ষেত্রে আরও আরামদায়ক পরিবেশ মহিলাদের কাছে সর্বোচ্চ গুরুত্ব পেয়েছে। ভাড়া এবং বিক্রয় এই বিতরণ ব্যবস্থার কারণে, সৌর বিদ্যুৎ ইউনিটের ক্ষেত্রে খরচহ্রাসের কোনো পরিস্থিতি তৈরি হয় না, কিন্তু ব্যবহারকারীদের আশা অদূর ভবিষ্যতে বিদ্যুৎ ব্যবহারের খরচ কমবে। অবশ্য ছয়-সাত বছর পরপর উচ্চমূল্যে ব্যাটারী পরিবর্তন দীর্ঘ সময় ধরে এই সৌর বিদ্যুৎ ব্যবহারে আরেকটি বড় বাধা। গৃহে এই সৌর বিদ্যুৎ ব্যবস্থা অর্থ উপার্জনে খুবই কম ব্যবহৃত হলেও চা বিক্রেতা, ক্ষুদ্র রেস্টুরেন্টের মালিকদের মত ক্ষুদ্র-মাঝারি ব্যবসায়ীরা সৌর বিদ্যুৎ ব্যবস্থা গ্রহণের পরে তাদের বর্ধিত লাভের কথা বলেছে। এই অর্থ তারা ব্যক্তিগত খাতে এবং ব্যবসা সম্প্রসারণে ব্যবহার করলেও নতুন কর্মসংস্থান সৃষ্টিতে এর ব্যবহার এখনও সীমিত। তবে অনিচ্ছাকৃত সবচেয়ে বড় যে প্রভাবটি রয়েছে, সেটি হল-- সৌর বিদ্যুৎ ব্যবস্থা ব্যবহারের ফলে একেবারেই প্রাপ্তিক জনগণ দীর্ঘ সময়ের জন্য ঋণের চাপে আবদ্ধ হবে এবং ত্রুটিযুক্ত ব্যাটারী যেখানে-সেখানে ফেলে দেয়ার ফলে পরিবেশের ক্ষেত্রে তার বিরূপ প্রভাব পড়বে।

উন্নত চুলার ক্ষেত্রে সবচেয়ে বড় যে উপকারীতা পাওয়া গিয়েছে তা হল- স্বাস্থ্য উপকারিতা। যার পরেই, অধিকাংশ ব্যবহারকারী উন্নত চুলা ব্যবহারের ফলে রান্নাঘরে উন্নত পরিবেশের কথা খুব গুরুত্বসহকারে বলেছে, যার প্রধান কারণ হল- কম ধোঁয়া, আর এর ফলে তারা স্বাস্থ্যগত দিক দিয়েও বিরাট সুবিধা পাচ্ছে। ধোঁয়া কম সৃষ্টি হওয়ার ফলে ব্যবহারকারী শ্বাসকষ্টজনিত সমস্যায় যেমন কম ভুগছেন, তেমনি চোখের সমস্যাও তাদের অনেক কমে গেছে। জ্বালানী সাশ্রয়ের ক্ষেত্রে দেখা গেছে, এ চুলায় ১৪ থেকে ৭০ শতাংশ পর্যন্ত জ্বালানী সাশ্রয় সম্ভব। তবে গড়ে জ্বালানী সাশ্রয় দাঁড়ায় ৩৩ শতাংশ এবং এক তৃতীয়াংশেরও বেশি ব্যবহারকারী তাদের জ্বালানী সাশ্রয়ের পরিমাণ নির্ণয় করতে অপরাগ। অধিকাংশ মহিলাই সময় সাশ্রয়ের ক্ষেত্রে রান্না তাড়াতাড়ি হওয়ার উপর গুরুত্ব দিয়েছে। মহিলারা সপ্তাহে গড়ে ৭ ঘন্টার মত সময় বাঁচাতে পারে এবং তার অধিকাংশই ব্যয় করে গৃহের অন্যান্য কাজে, জ্বালানী সাশ্রয়ের ফলে অর্থ সাশ্রয়ের ব্যাপারে মতামত এক-তৃতীয়াংশ ব্যবহারকারীর কাছ থেকে পাওয়া গিয়েছে। ক্ষুদ্র-মাঝারি শিল্প এবং বিভিন্ন সামাজিক প্রতিষ্ঠানগুলো থেকে জ্বালানী সাশ্রয় এবং তার ফলশ্রুতিতে অর্থ সাশ্রয়ের কথা ব্যাপকহারে উচ্চারিত হয়েছে, কারণ রান্নার জ্বালানীর খরচ তাদের অন্যান্য খরচের মধ্যে বড় অংশ। এ ছাড়াও, উন্নত চুলা-ব্যবহার সম্প্রসারণের ফলে চুলা ও চিমনী প্রস্তুতকারক কারখানায় কম দক্ষ পুরুষদের কর্মসংস্থান সৃষ্টি সুযোগ রয়েছে।

জার্মান কেন্দ্রীয় সরকারের অর্থনৈতিক ও উন্নয়ন সমন্বয় সহযোগী প্রতিষ্ঠানের সংজ্ঞা অনুযায়ী দেখলে বলা যেতে পারে, সৌর বিদ্যুৎ ব্যবস্থা এবং উন্নত চুলা এই দুটো প্রযুক্তির কোনটিই, এখন পর্যন্ত দরিদ্র জনগোষ্ঠীর সহায়ক হতে পারে নাই। উত্তরদাতাদের মধ্যে আনুপাতিক হার দেখলে দেখা যাবে, দরিদ্র জনগণের অনুপাত এই অঞ্চলের গড় দারিদ্রতা ৪৮ শতাংশ থেকে কম। উন্নত চুলার ক্ষেত্রে দারিদ্রের উচ্চ সীমার নিচে বাস করে এমন লোকের সংখ্যা ৪০ শতাংশ এবং সৌর বিদ্যুৎ ইউনিটের ক্ষেত্রে তা মাত্র ২৩ শতাংশ। এই দুই প্রযুক্তির ক্ষেত্রেই দরিদ্র বিমোচনে সহায়ক ভূমিকা রাখার সামর্থ্য থাকলেও আপেক্ষিকভাবে বেশি দরিদ্র জনগণের ক্ষেত্রে তার কোনো প্রভাব পড়ে না। দরিদ্র বাসাবাড়ি গুলোতে তারা ক্ষুদ্র সৌর বিদ্যুৎ ব্যবস্থা দিয়ে শুধুমাত্র বাতি জ্বালাতে পারে। এছাড়া অন্য কোনো বৈদ্যুতিক যন্ত্র ব্যবহারের সামর্থ্য তাদের নেই। আবার উন্নত চুলার ক্ষেত্রে দেখা গিয়েছে যে, দরিদ্র জনগণ তাদের জ্বালানীর অধিকাংশই কেনার থেকে সংগ্রহ করে থাকে। যার কারণে তারা সময় বাচানোর ক্ষেত্রে লাভবান হয়, কিন্তু অর্থ বাঁচাতে পারে না।

সৌর বিদ্যুতের সার্বিক বিতরণ ব্যবস্থাকে বেশ সম্ভাবনাময় মনে হয়েছে এর বিতরণে অর্থনৈতিক শীথিলতা এবং এককালীন প্রদেয় অর্থের হ্রাসকৃত পরিমাণের কারণে। দারিদ্র-বিমোচনের সহায়ক ভূমিকা আরও ত্বরান্বিত করার জন্য আরও উচ্চ ক্ষমতার সৌর বিদ্যুৎ ইউনিট ব্যবহার করে নতুন নতুন আয়ের উৎস তৈরি করা যেতে পারে।

ভুক্তিপ্রাপ্ত উন্নত চুলা দরিদ্র মানুষের মধ্যে বিতরণের ক্ষেত্রে যে তিনটি পছন্দ অবলম্বন করা হয়েছে, তার মধ্যে দুইটিই লড়াই গ্রন্থের দরিদ্র সীমার নীচে বসবাসকারী মাঝামাঝি আয়ের মানুষদের মধ্যে ইতিবাচক ছাপ রেখেছে। জিজ্ঞাসা বাদের মাধ্যমে জানা গিয়েছে যে, তৃতীয় পছন্দ অনুসারে গ্রামীণ জনগোষ্ঠীর 'ভিজিডি' কার্ড গ্রাহকদের কাছ থেকে ১০০ টাকার (১ ইউরো) বিনিময়ে বাধ্যতামূলকভাবে উন্নত চুলা সরবরাহের কথা এবং এই কাজে স্থানীয় কিছু সরকারী প্রভাবশালী ব্যক্তি জড়িত। আরও দেখা গিয়েছে যে, ব্যবহারকারীর কাছ থেকে ভিন্ন ভিন্ন পরিমাণ টাকা নিয়ে সেই চুলা সরবরাহ করা হয় এবং যখন তাহা সরবরাহ করা হয়, তখন খুব কম সংখ্যক চুলাই পুরোপুরি ব্যবহারযোগ্য ছিলো।

প্রযুক্তি সম্প্রসারণ পরিস্থিতি বিশ্লেষণ করে দেখা গিয়েছে যে, স্বনির্ভর বাজার তৈরির ক্ষেত্রে সৌর বিদ্যুৎ ব্যবস্থা অনেকটাই এগিয়ে গিয়েছে। কিন্তু সেই দিক দিয়ে বিচার করলে, (আইসিএস) উন্নত চুলা-ব্যবহার সম্প্রসারণ অতটা এগিয়ে যায়নি। এর একটা কারণ হিসেবে বলা যেতে পারে যে, সৌর বিদ্যুৎ ব্যবস্থা সম্প্রসারণের কাজ শুরু হয়েছিল ২০০৩ সালে এবং অন্যদিকে সে জায়গায় আইসিএস প্রয়োগের পরিচিতি শুরু হয় ২০০৭ সাল থেকে। এই গবেষণার ধারণা যে, সৌর বিদ্যুৎ প্রযুক্তি সম্প্রসারণের ক্ষেত্রে সম্পূর্ণ ব্যবস্থাটা অন্যান্য জায়গায় প্রয়োগের মডেল হিসাবে গন্য হতে পারে- এর গুণগত পদ্ধতি ও অন্যান্য আরো কিছু কারণে। সৌর বিদ্যুৎ প্রযুক্তি সম্প্রসারণ প্রকল্পে ব্যবস্থাপনা ফি বাবদ (ইডকল) কে যে সাহায্য দেয়া হয় তা তাদের সবচেয়ে গুরুত্বপূর্ণ কাজগুলো পূরণের খুবই প্রয়োজনীয় এবং ৩০ ইউরো ভুক্তি তুলনামূলক অস্বচ্ছল ব্যবহারকারীদের জন্য খুবই গুরুত্বপূর্ণ। কিন্তু তবুও সার্বিক ব্যবস্থাটি অধিক চাহিদা তৈরির ক্ষেত্রে তেমন কার্যকরী হয়নি। এটা মাত্র এক চতুর্থাংশ ব্যবহারকারীর ক্ষেত্রে ক্রয় সংক্রান্ত সিদ্ধান্তে প্রভাব বিস্তার করতে সমর্থ হয়েছে। গবেষণার ফলে এ বিষয়ে অবহিত হওয়া গিয়েছে যে, মাঠ পর্যায়ে দক্ষ প্রকৌশলী এবং ভালো বিক্রয়স্তরের সেবার অভাব এ ব্যবস্থায় প্রকট, ব্যবহারকারীরা সরবরাহকারীদের কাছ থেকে সেবা পেয়ে যতটা না সন্তুষ্ট, তার থেকে বেশি সন্তুষ্ট এই সৌর বিদ্যুৎ যন্ত্রটি নিয়ে। আমাদের বর্তমান নমুনায় দেখা গিয়েছে, এসইডি'র যে লক্ষ্য আছে প্রত্যেক ব্যবহারকারী অসম্মত দুইটি সরবরাহকারী প্রতিষ্ঠানের মধ্য থেকে নিজেদের পছন্দমত বেছে নেয়ার সুযোগ পাবে-- ৪০ শতাংশ ক্ষেত্রে তা অর্জিত হয়েছে। এর ফলে এই সুযোগ থেকে যাচ্ছে যে ভবিষ্যতে স্থানীয় পর্যায়ে অধিক জোগান এবং বর্তমান সরবরাহকারীদের আওতার ভেতর এবং বাইরের বিভিন্ন সেবা প্রদান ব্যবস্থা আরও শক্তিশালী করা যেতে পারে।

উন্নত চুলা সম্প্রসারণ ব্যবস্থাকে বিশেষায়িত করলে দেখা যায় যে, এখানে বহু সংখ্যক সরবরাহকারী প্রতিষ্ঠান যুক্ত, আর্থিক সাহায্য প্রদানের মাধ্যমে যাদেরকে বেশ দ্রুততার সাথে এই প্রকল্পে সম্পৃক্ত করা হয়েছে - বিপুল সংখ্যক চুলা স্থাপনের লক্ষ্যে। এর সাথে সাথে গবেষকদের মতে, এখানে পর্যাপ্ত নিয়ন্ত্রণ এবং পর্যবেক্ষণের অভাবে, উন্নত চুলা ব্যবহারের সার্বিক পরিস্থিতিতে মারাত্মক রকমের অবনতি ঘটতে পারে যদিও এসইডি'র কাছে অনেক সংখ্যক উন্নত চুলা স্থাপন এবং তার ব্যবহারের ব্যাপারে বিভিন্ন হিসাবের এবং পরামর্শের প্রতিবেদন প্রদান করা হয়েছে তথাপি বিভিন্ন শুদ্ধতাপরীক্ষণ এবং বিশেষজ্ঞ মতামতের প্রতিবেদনে এ ব্যাপারে ভিন্নমত পাওয়া গিয়েছে। পূর্ববর্তী একটি নিরপেক্ষ ধারাবাহিক গবেষণা থেকেও পাওয়া গিয়েছে যে, উল্লেখযোগ্য সংখ্যক বাসাবাড়ি যারা উন্নত চুলা ব্যবহারকারী হিসেবে তালিকাভুক্ত, তারা আদৌ এ চুলা পায়নি অথবা তাদের চুলা ঠিকমত কাজ করছিলো না। শুধুমাত্র ১০ শতাংশ ব্যবহারকারী সরবরাহকারী প্রতিষ্ঠানের বিক্রয়োত্তর সেবা নিয়ে সন্তুষ্টি প্রকাশ করেছে। আবার, চুলার কারিগরদের ক্ষেত্রে দেখা গিয়েছে যে, তারা কেউই চুলা বিক্রয় পরবর্তী সেবা প্রদানে কোনরকম কোনভাবে আর্থিক সাহায্য পায় না। যে সকল কারিগরদের সাক্ষাৎকার আমরা নিয়েছিলাম তারা প্রায় সকলেই তাদের কম বেতনের ব্যাপারে অসন্তোষ প্রকাশ করেছে এবং দেখা গিয়েছে যে, প্রশিক্ষণপ্রাপ্ত কারিগরদের মধ্যে মাত্র ১০ শতাংশ কারিগর এ পেশায় জড়িত থাকে। অনেক সময় উন্নত চুলার ত্রুটিযুক্ত সংযোজনের কারণেও ব্যবহারকারীরা এর সর্বোচ্চ সুবিধা পায় না। এসবের পরেও যে সকল চুলা সঠিকভাবে কাজ করছে সেগুলোর ব্যবহারকারীরা এর ব্যাপারে খুবই সন্তুষ্ট।

সুপারিশ হিসেবে বলা যেতে পারে যে, সৌর বিদ্যুৎ প্রযুক্তির পরিচিতির ক্ষেত্রে ছোটখাট পুনর্বিবেচনার মধ্যে থাকতে পারে। কখন, কোথায় এবং কিভাবে আর্থিক সাহায্য সরবরাহ করা হবে সে বিষয়ে লক্ষ্য ও স্ফূর্তির নির্ধারণ করতে হবে এবং সেই সাথে স্থানীয় পর্যায়ে সৌর বিদ্যুৎ ব্যবস্থাকে আরও জনপ্রিয় করার জন্য ব্যবহারকারীদের সন্তুষ্টি বৃদ্ধি, এ সংক্রান্ত নতুন কর্মসংস্থান সৃষ্টি এবং এর স্থানীয় ভাবে সহজলভ্যতা আরও বৃদ্ধি করা যেতে পারে। গবেষণা থেকে আরও পাওয়া গিয়েছে যে, প্রযুক্তি সরবরাহকারী এবং ব্যবহারকারীদের মধ্যে পারস্পরিক যোগাযোগ আরও ইতিবাচক ফল পাওয়া যেতে পারে, যাতে শেষোক্তর নিজস্ব প্র-তষ্ঠানিক উন্নয়ন নিরূপণ সম্ভব হয়। ব্যবহারকারীদের হাতে পৌঁছানোর ক্ষেত্রে বর্তমানের পদ্ধতি ভবিষ্যতে অবলম্বন করলেও দরিদ্র জনগণের জন্য বিশেষ কোন উপায় বের করা যেতে পারে। পরবর্তীতেও ব্যাটারী সরবরাহের ক্ষেত্রে বর্তমান পদ্ধতি অবলম্বন করা যেতে পারে এবং পুনর্ব্যবহারের ক্ষেত্রেও আর্থিক সাহায্য প্রদান করা যেতে পারে।

উন্নত চুলা পরিচিতি সম্প্রসারণ প্রকল্প কিছুটা সমালোচনার দৃষ্টিতে দেখা হয়েছে। এখানে আর্থিক সাহায্যের পরিবর্তে কারিগরি বিষয়ে সহায়তা আরও বাড়ানো যেতে পারে এবং সেই সাথে সরবরাহকারী ও ব্যবহারকারী উভয়ের উপর সার্বক্ষণিক পর্যবেক্ষণ এবং সরবরাহকারীদেরকে এসইডি'র কাছে আরও অধিকমাত্রায় জবাবদিহিতার আওতায় আনা যেতে পারে। চুলার কারিগরদের জন্য আর্থিক সুবিধার পরিমাণ আরও বৃদ্ধি করা যেতে পারে। যাতে করে তারা তাদের কাজ ছেড়ে চলে না যায়। ভবিষ্যতে এ প্রযুক্তি আরও বেশী দারিদ্র সহায়ক ও কার্বন অর্থায়নের ক্ষেত্রে আরও বেশি কার্যকরী করার জন্য উন্নত চুলার মূল্য দরিদ্র জনগোষ্ঠীর নাগালের মধ্যে রাখা প্রয়োজন এবং 'পরিচ্ছন্ন উন্নয়ন পদ্ধতি'র (সিডিএম) তহবিল যেন চুলা ব্যবহারকারীদের হাতে পৌঁছায়, সেইদিকে খেয়াল রাখতে হবে। একই সাথে পরিবেশের উপর যেন কোনো রকমের সম্ভাব্য বিরূপ প্রভাব না পড়ে সেইদিকেও সব রকমের প্রচেষ্টা থাকতে হবে।



## Zusammenfassung

Verbesserte Energieversorgung ist eine wichtige Grundvoraussetzung für sozioökonomische Entwicklung und ökologische Nachhaltigkeit. Zugang zu Energie wirkt sich unmittelbar auf die Lebenssituation armer ländlicher Bevölkerungsgruppen aus und beeinflusst deren Produktivität, Gesundheit sowie Bildung und hat Auswirkungen auf die Geschlechterverhältnisse. Da weltweit mindestens 1,6 Milliarden Menschen keinen Zugang zu Elektrizität haben und 2,4 Milliarden auf Biomasse zum Kochen angewiesen sind, ist es entscheidend, zu verstehen, wie der Zugang zu ländlicher Energiegrundversorgung verbessert werden kann.

Der vorliegende Bericht präsentiert die Ergebnisse einer Studie, die im Auftrag des Sektorvorhabens „Armutorientierte Energiegrundversorgung“ (HERA) der Gesellschaft für Technische Zusammenarbeit (GTZ) in Kooperation mit dem „Sustainable Energy for Development Programme“ (SED) in Bangladesch durchgeführt wurde. Das SED Programm fördert durch finanzielle sowie technische Unterstützung unter anderem die Verbreitung zweier Technologien mit dem Ziel, selbsttragende Märkte in Bangladesch für diese Technologien zu schaffen. Dabei handelt es sich um Solaranlagen, sogenannte Solar Home Systems (SHS) und um verbesserte Kochherde, die Improved Cook Stoves (ICS). Die Studie untersuchte sowohl Wirkungen und Armutorientierung der zwei Interventionen als auch die Nachhaltigkeit der Verbreitungsstrukturen für diese beiden Technologien.

SHS sind kleine photovoltaische Anlagen mit einer Leistung von 40 bis 130 Watt (Wp), die gegenwärtig zu einem Preis zwischen 220 und 680 Euro verkauft werden. Alle 16 Organisationen, die am Verbreitungsansatz unter der staatlichen Infrastructure Development Company Limited (IDCOL) teilnehmen, bieten Ratenzahlung für SHS an. Die Solarsysteme werden von Privathaushalten, Kleinst- und Kleinunternehmen (KKU) in netzfernen Gebieten genutzt, um Lampen und kleine elektrische Geräte zu betreiben, zum Beispiel Handyladegeräte oder Schwarz-Weiß-Fernseher. Die Nutzer kommen hauptsächlich aus der Mittelschicht. SED subventioniert jede Anlage mit 30 Euro und zahlt pro verkaufte Einheit einen Betrag zur finanziellen Unterstützung für die institutionelle Entwicklung der Partnerorganisationen sowie eine Managementgebühr an IDCOL. Außerdem bietet das Programm Trainings an.

Im Gegensatz zu traditionellen Kochstellen aus Lehm sind verbesserte Herde geschlossen und haben einen Schornstein. ICS sind so konstruiert, dass Biomasse effizienter verbrennt und die Rauchbelastung beim Kochen sich verringert. Gegenwärtig vertreiben 165 Partnerorganisationen die Herde zu einem Preis zwischen acht und zwölf Euro für ein typisches Haushaltsmodell. Die Förderung von SED umfasst finanzielle Unterstützung für Trainingsmaßnahmen, für Marketing und die institutio-

nelle Entwicklung der Partnerorganisationen, finanzielle Anreize für Herdbauer sowie die Organisation eines Erfahrungsaustausches zwischen den Partnerorganisationen.

Für die Verbreitung beider Technologien gibt es spezielle Ansätze, um arme Zielgruppen zu erreichen. Im Rahmen eines Pilotprojekts hat SED in die Verbreitungsstruktur kleine Solaranlagen mit 20 Watt eingeführt, sogenannte Small Solar Home Systems (SSHS). Mit zusätzlicher finanzieller Unterstützung von SED verkaufen einige Partnerorganisationen verbesserte Herde zu einem niedrigeren Preis an arme Haushalte oder stellen die ICS umsonst zur Verfügung.

Die Ergebnisse der vorliegenden Studie basieren auf qualitativen und quantitativen Erhebungen mit einer vierwöchigen Feldphase, die hauptsächlich in der Rajshahi division im Nordwesten Bangladeschs realisiert wurde. Ergänzt wurde die Feldphase durch Workshops mit verschiedenen Akteuren, Literaturrecherche und die Analyse von Programmdokumenten. Die Feldforschung umfasste Expertengespräche und Gruppendiskussionen mit Partnerorganisationen und anderen Akteuren in der Technologieverbreitung, zum Beispiel mit Solartechnikern und Herdbauern. Es wurden offene und standardisierte Interviews mit privaten und kommerziellen Nutzern beider Technologien sowie mit Nicht-Nutzern geführt. Insgesamt wurden ungefähr 260 Interviews zu SHS und 450 Interviews zu ICS durchgeführt. Während in der Stichprobe zu SHS 75% der Befragten Männer waren, machten Frauen, die Hauptnutzerinnen der Herde, über 90% der zu ICS Interviewten aus.

Wie die Studie zeigt, erhöht der Zugang zu Solarenergie die allgemeine Lebensqualität der SHS-Besitzer. Eine große Mehrheit der Interviewten benannte verbesserte Beleuchtung als wichtigsten Vorteil der Solaranlagen. Damit in Verbindung stehen weitere Vorteile: Private Nutzer nannten verbesserte Lernbedingungen für Kinder als zweit wichtigsten Vorteil, kommerzielle Nutzer hingegen mehr Kunden. Weitere Wirkungen sind ein verbesserter Zugang zu Informationen, bessere Kommunikationsmöglichkeiten und für einige Nutzer auch ein Gefühl verbesserter Sicherheit. Insbesondere Frauen schätzen außerdem den höheren Komfort bei Arbeiten im Haus. Einsparungen durch geringere Energieausgaben treten selten schon während der Rückzahlungszeit ein, werden aber von den Nutzern langfristig erwartet. Der Kauf einer Ersatzbatterie nach sechs oder sieben Jahren stellt allerdings eine erhebliche zweite Investition dar und ist ein kritischer Punkt in Bezug auf die Nachhaltigkeit im Sinne einer langfristigen Nutzung. Während SHS im Privatbesitz kaum genutzt werden, um zusätzliches Einkommen zu erwirtschaften, berichtet die Mehrheit der befragten kommerziellen Nutzer – zum Beispiel Besitzer von Teestuben und kleinen Restaurants – über höhere Umsätze seit dem Kauf der Solaranlage. Die Mehreinkünfte investieren diese neben privaten Zwecken in die Erweiterung ihres Geschäfts. Dabei werden nur selten neue Arbeitsplätze geschaffen. Arbeitsplätze entstehen im Rahmen der SHS-Verbreitung vor allem für verhältnismäßig wenig arme

Männer, die als Solartechniker oder im Management arbeiten. Als wichtigste unbeabsichtigte Wirkungen sind das Risiko einer Verschuldung für vergleichsweise arme SHS-Nutzer sowie Umweltgefahren durch unsachgemäßen Umgang mit defekten Batterien zu nennen.

Was die verbesserten Herde angeht, sind Gesundheitswirkungen die offensichtlichste Verbesserung, die beobachtet werden konnte, gefolgt von Brennstoff-, Geld- und Zeiteinsparung. Eine überwältigende Mehrheit der Nutzer gab an, erheblich weniger Rauch in der Küche zu haben und sich gesünder zu fühlen. In diesem Zusammenhang wurden sowohl positive Wirkungen für die Augen als auch weniger Husten und Atemwegserkrankungen erwähnt. Die genannte Brennstoffeinsparung liegt bei durchschnittlich 33% mit einer Streuung zwischen 14% und 70%. Allerdings konnte mehr als ein Drittel der Interviewpartner die mögliche Brennstoffeinsparung nicht quantifizieren. Für eine große Mehrheit der Frauen waren Zeitersparnisse eine wichtige Wirkung, die vor allem durch schnelleres Kochen auftreten. Einen Großteil der durchschnittlich gesparten sieben Stunden pro Woche nutzen die Frauen für andere Hausarbeiten. Finanzielle Ersparnisse durch geringeren Brennstoffverbrauch wurden von einem Drittel der Haushalte erwähnt. In KKU und sozialen Einrichtungen sind sowohl finanzielle Einsparungen als auch Brennstoffersparnisse viel stärker ausgeprägt, da Ausgaben für Brennstoffe zum Kochen einen beachtlichen Teil der Betriebskosten ausmachen. Durch die Verbreitung von ICS können zudem im Herdbau und in der Schornsteinproduktion Arbeitsplätze für ungelernete Männer geschaffen werden.

Die Armutsverteilungen in den Stichproben zu SHS und ICS legen nahe, dass die Verbreitung beider Technologien gegenwärtig als nicht unmittelbar armutsorientiert (pro-poor) entsprechend der Definition des Bundesministeriums für Wirtschaftliche Zusammenarbeit und Entwicklung bezeichnet werden kann, da der Anteil armer Haushalte unter den befragten Personen niedriger ist als der Anteil Armer im regionalen Durchschnitt des Untersuchungsgebiets. Letzterer liegt bei 48%. Der Anteil armer Personen unterhalb der oberen Armutslinie ist in der ICS-Stichprobe mit fast 40% höher als in der SHS-Stichprobe, in der 23% der Nutzer unterhalb der oberen Armutslinie lagen. Im Falle beider Technologien existieren armutsreduzierende Wirkungen, von denen jedoch einige nur zu einem geringeren Ausmaß für die jeweils ärmeren Nutzer eintreten. So beschränkt sich der Vorteil für arme SHS-Nutzer bzw. Besitzer von SSHS auf Wirkungen durch elektrisches Licht, wenn sie sich zusätzliche elektrische Geräte nicht leisten können bzw. die Kapazität der Anlagen für deren Betrieb nicht ausreicht. Da arme Haushalte Brennmaterial zum Kochen mit den ICS eher sammeln als kaufen, sparen sie in der Regel zwar Zeit, profitieren aber nicht von finanziellen Ersparnissen.

Viel versprechende Ansätze, um arme Zielgruppen mit Solartechnologie zu erreichen, sind neben der Verbreitung von SSHS und Solarlaternen auch verlängerte Rückzahlungszeiten mit reduzierter Anzahlung und flexiblen Zahlungsmodalitäten und die Förderung der gemeinschaftlichen Nutzung von Solaranlagen durch potenzielle Kunden in direkter Nachbarschaft. Armutsreduzierende Wirkungen könnten auch durch die Förderung von leistungsfähigeren SHS erreicht werden, die für einkommensschaffende Tätigkeiten genutzt werden können.

Von den drei beobachteten Ansätzen, um arme Haushalte mit verbesserten Herden zu einem subventionierten Preis zu erreichen, hinterließen zwei einen positiven Eindruck. Bei diesen Ansätzen lag das Median-Einkommen der jeweiligen Zielgruppe unterhalb der Armutslinie. Im dritten Ansatz wurden Inhaber der staatlichen „vulnerable group development card“ verpflichtet, einen subventionierten Herd für 100 Taka (1 Euro) zu erwerben. Personen aus der Zielgruppe berichteten, dass sie von lokalen Regierungsvertretern gezwungen worden waren, verschieden hohe Beträge für einen ICS zu bezahlen. Nichtsdestotrotz erhielten nur wenige von ihnen daraufhin einen funktionierenden Herd.

Aus der Analyse der Technologieverbreitungsstrukturen wird hier der Schluss gezogen, dass die Verbreitung der Solarsysteme sich auf gutem Wege zu einem selbsttragenden Markt befindet, während die Entwicklung der ICS-Verbreitung noch nicht so weit fortgeschritten ist. Dies kann zum Teil darauf zurückgeführt werden, dass die Entwicklung eines Marktes für SHS bereits im Jahr 2003 begann, während die ICS-Intervention erst 2007 eingeführt wurde. Die Gesamtstruktur der SHS-Verbreitung wird aufgrund der darin enthaltenen qualitätssichernden Maßnahmen und weiterer Aspekte als Vorbild für Ansätze an anderen Standorten betrachtet. Was die finanzielle Unterstützung der SHS-Verbreitungsstruktur betrifft, wird die Managementgebühr für IDCOL als diejenige angesehen, die die wichtigste Funktion erfüllt. Während die 30-Euro-Subvention für weniger wohlhabende Haushalte wichtig ist, hat sie insgesamt nur einen geringen Nachfrage schaffenden Effekt: sie beeinflusst die Kaufentscheidung nur bei einem Viertel der Nutzer. Ein Mangel an lokalem technischen Wissen sowie das Fehlen von qualitativ hochwertigen Servicedienstleistungen nach dem Kauf eines Solarsystems werden als die größten Schwächen in der Verbreitungsstruktur betrachtet. In der Regel sind die Nutzer zufriedener mit dem Solarsystem selbst als mit dem Service der Anbieter. Das Ziel von SED, dass jeder Kunde zwischen mindestens zwei SHS-Anbietern wählen können sollte, war in der hier analysierten Stichprobe für 40% der Kunden erreicht. Das bedeutet, dass es noch Potenzial gibt, die zukünftige Marktmacht der Kunden zu steigern, indem das lokale Angebot und lokale Dienstleistungen innerhalb und außerhalb der gegenwärtigen Anbieterstruktur ausgebaut werden.

Die ICS-Verbreitungsstruktur ist geprägt durch ein großes Netzwerk von Partnerorganisationen, das in sehr kurzer Zeit geschaffen wurde, und durch finanzielle Anreize, die auf die Produktion einer großen Anzahl von Herden abzielen. Gleichzeitig stellen unzureichende Kontrolle und Monitoring aus Sicht der Autoren ein Risiko für gravierende Fehlentwicklungen und Versäumnisse dar. Während die Installation von beeindruckenden Zahlen von Herden an SED berichtet wird, liefern unterschiedliche Berater- und Prüfberichte widersprüchliche Ergebnisse zur tatsächlichen Existenz und dem Funktionieren dieser Herde. In Übereinstimmung mit den vorläufigen Ergebnissen einer anderen unabhängigen Studie hat diese Studie viele Haushalte vorgefunden, die keinen ICS erhalten hatten oder deren Herde nicht richtig funktionierten. Nur 10% der befragten Haushalte erhielten irgendeine Form von Service nach dem Kauf des Herdes. Zudem werden Herdbauer für Instandhaltungsarbeiten in der Regel nicht entlohnt. Die interviewten Herdbauer äußerten sich allgemein unzufrieden mit dem niedrigen Lohn. Nur geschätzte 10% der ausgebildeten Herdbauer arbeiten tatsächlich im ICS-Geschäft, nachdem sie an einem der Trainings teilgenommen haben, das von den Partnerorganisationen angeboten wird. Wenn überhöhte Vertriebszahlen und Brennstoffspargraten als Grundlage dienen, um die ICS-Verbreitung, wie in Zukunft geplant, in den Clean Development Mechanism (CDM) zu implementieren, können dadurch außerdem positive Umweltwirkungen der ICS gefährdet werden. Es scheint jedoch, dass eine Nachfrage nach den verbesserten Kochherden existiert und die Technologie akzeptiert ist, denn die Zufriedenheit unter Nutzern, die einen funktionierenden ICS besitzen, ist hoch.

Die Empfehlungen zur SHS-Intervention umfassen kleinere Anpassungen hinsichtlich der Zielrichtung und schrittweisen Reduzierung der finanziellen Zuschüsse sowie Vorschläge für verschiedene Förder- und Trainingsmaßnahmen. Hierdurch soll die Nutzerzufriedenheit erhöht, Arbeitsplätze geschaffen und die lokale Verfügbarkeit von SHS verbessert werden sowie lokales Wissen über die Solartechnik entwickelt werden. Die Studie regt an, ein wirkungsorientiertes Monitoring einzurichten, das einen Austausch zwischen SHS-Nutzern und Anbietern beinhaltet und letztere dazu in die Lage versetzt, ihre eigene institutionelle Entwicklung zu beurteilen. Darüber hinaus rät die Studie, das gegenwärtige Ratenzahlungsmodell aufrechtzuerhalten und zusätzlich flexiblere, armutsorientierte Zahlungsmöglichkeiten zu entwickeln. Sie empfiehlt außerdem, ein Ratenzahlungssystem für SHS Batterien einzuführen und dabei gleichzeitig Anreize für das Recycling zu verstärken.

Zur Weiterentwicklung der ICS-Intervention werden eine kritische Überprüfung und eine Evaluierung der gegenwärtigen Aktivitäten empfohlen, in der die Leistungen der derzeitigen Partner untersucht werden. Die Studie empfiehlt auch eine Verlagerung des Schwerpunkts weg von finanzieller hin zu einer stärker differenzierten technischen Unterstützung. In Verbindung damit wird empfohlen, ein fortlaufendes Monito-

ringsystem einzurichten, das alle Akteure einschließt und auf die Ziele von SED ausgerichtet ist. Verschiedene Maßnahmen und Anreize werden vorgeschlagen, um eine bessere Instandhaltung der ICS sicherzustellen und die Motivation der Herdbauer zu fördern, ihre Arbeit fortzusetzen. Weitere Empfehlungen betreffen die Armutsorientierung und den weltweiten CO<sub>2</sub>-Handel. Die Preise und Zahlungsmodalitäten für verbesserte Herde sollten an die Bedürfnisse armer Haushalte angepasst und CDM-Gelder zum Vorteil der ICS-Besitzer genutzt werden. Gleichzeitig sollten die größtmöglichen Anstrengungen unternommen werden, um mögliche negative Umweltwirkungen zu vermindern.

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## Abbreviations

BBS	Bangladesh Bureau of Statistics
BMZ	Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung/ German Federal Ministry for Economic Cooperation and Development
BRAC	Bangladesh Rural Advancement Committee
CBN	Cost of Basic Needs (an approach to determine poverty)
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
DFID	Department for International Development, United Kingdom
EnDev	Energising Development Programme, Dutch-German Cooperation, GTZ
GEF	Global Environment Facility
GHG	Greenhouse Gas
GoB	Government of Bangladesh
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit/German Technical Cooperation
GWh	Gigawatt hour
HERA	Poverty-Oriented Basic Energy Services, GTZ Sector Project
HH	Household[s]
HIES 2005	Household Income and Expenditure Survey, Bangladesh 2005
HU	Humboldt University
ICS	Improved Cook Stove[s]
ICDDR	International Centre for Diarrhoeal Disease Research, Bangladesh
IDCOL	Public Infrastructure Development Company Bangladesh
KfW	Kreditanstalt für Wiederaufbau/ German Development Bank
kWh	Kilowatt hour
LED	Light Emitting Diode
MDG	Millennium Development Goals
MoPEMR	Ministry of Power, Energy and Mineral Resources, Bangladesh
MSE	Micro and Small Enterprises
MW	Megawatt
NEP	National Energy Policy, Bangladesh
NGO	Non-Governmental Organizations
OECD/DAC	Organization for Economic Cooperation and Development / Development Assistance Committee of OECD
PO	Partner Organization[s] of SED or IDCOL
PRA	Participatory Rural Appraisal
PRSP	Poverty Reduction Strategy Paper
PV	Photovoltaic

REREDP	Rural Electrification and Renewable Energy Development Project IDCOL
RSF	Rural Services Foundation
RWEDP	Regional Wood Energy Development Programme
SED	Sustainable Energy for Development Programme, GTZ
SHS	Solar Home Systems
SLE	Seminar für Ländliche Entwicklung
SSHS	Small Solar Home System[s]
UNDP	United Nations Development Programme
VGD	Vulnerable Group Development
WB	World Bank
Wp	Watt-peak





# 1 Introduction

Energy is central to sustainable development and efforts to reduce poverty. It affects social, economic, and environmental aspects of development, influencing people's livelihoods, their productivity, health, education, and gender-related issues. In order to promote renewable energy and increase energy efficiency, the Sustainable Energy for Development Programme (SED) in Bangladesh supports the dissemination of Solar Home Systems (SHS) and Improved Cook Stoves (ICS). The present study compiles insights and data on the economic and social impacts of the ICS- and SHS-related interventions. On the basis of conclusions drawn from these insights and data, recommendations on how to enhance positive impacts and mitigate negative impacts have been formulated. Furthermore, the study identifies to which extent poor households are reached by the programme, and discusses whether the technologies are suitable to contribute to poverty reduction. Finally, the study assesses key aspects that are relevant to the sustainability of the dissemination approach, and identifies possible entry points and measures to enhance them.

In the following chapters the study presents background information on the poverty and energy situation in Bangladesh [2]; followed by an introduction to the programme and the assessed components [3]; subsequently, a description of the methodological approach of this study is given [4], followed by the research results regarding impacts and poverty orientation, as well as the analysis of the structure for distributing SHS [5] and ICS [6], respectively. Each of the result chapters includes conclusions and recommendations.

## 2 Background

### 2.1 Poverty situation

Bangladesh is one of the world's poorest and most densely populated nations (population of 154 million, 1,000 inhabitants/km<sup>2</sup>), with a high proportion of its people living in poverty. Data from the last Household Income and Expenditure Survey 2005 [BBS 2007] revealed that 40% of the country's population was classified as poor, with incomes below the upper national poverty line<sup>1</sup>. In rural areas, this rate is even higher, with 44% of the population classed as poor (urban areas 28%). One fourth of the population is considered extremely poor (urban: 15%; rural: 29%), having incomes below the lower poverty line.

In the last decades Bangladesh has made considerable progress in reducing the share of people suffering from income poverty (1991/1992: 57%; 2000: 49%; 2005: 40%) [BBS 2007]. The progress in reducing the absolute number of people classified as poor was more moderate from 61 million in 2000 to 56 million in 2005 because of population growth [Asian Development Bank 2009]. Starting from a relatively moderate level, inequity in the income distribution slightly increased, with a Gini coefficient<sup>2</sup> of 0.451 in 2000 and 0.467 in 2005 [BBS 2007].

The country has also experienced progress in human development and has been positioned in the medium human development category by the United Nations Development Programme (UNDP) since 2003. The Human Poverty Index (HPI) fell from 47% in 1993/94 to 37% in 2006 [Asian Development Bank 2009]. Currently Bangladesh is ranked 147<sup>th</sup> amongst 179 countries in the Human Development Statistics of UNDP [UNDP 2008b].<sup>3</sup>

Especially rural poor are exposed to external shocks as their economic situation is mainly dependent on day labour. They are prone to be hit by the effects of global climate change, like severe floods and heavy rainfall, inflicting damage on housing and

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<sup>1</sup> In Bangladesh, income poverty is assessed on the basis of cost-of-basic needs: Poverty lines represent the level of per capita expenditure at which basic needs (food and non-food) can be expected to be met. A food poverty line is estimated by the cost of a basic food-basket corresponding to 2,122 kcal/day/person. A non-food poverty line is calculated by adding an "allowance" for non-food consumption to the food poverty line. Extremely poor households' total expenditures are less than the food poverty line (lower poverty line). Moderately poor households' total expenditures are less than the non-food poverty line (upper poverty line). The poverty lines are estimated for different geographical regions, as prices and consumption patterns vary.

<sup>2</sup> The Gini coefficient is a measure for income inequality. A low coefficient indicates more equity (0 = everyone has the same), whilst a higher one shows more inequity (1 = one person has everything). Compare: Germany 2008: 0,283 [UNDP 2008a]

<sup>3</sup> The Human Development Index (HDI) is an index used to rank countries by their level of "human development", taking education, health and income into account. The Human Poverty Index (HPI) indicates the standard of living.

farmland [Asian Development Bank 2009]. Overall, the rural poor tend to be landless and live in remote areas. They have inadequate access to basic infrastructure and services. The grand majority of the poorest households are headed by individuals with an educational level below primary school [BBS 2007].

## **2.2 Energy situation**

"Energy is both an engine of development and a source of many of today's economic and environmental problems. Access to affordable energy is essential to keep economies running." [Trossero 2009] This statement corresponds with the renewable energy policy of Bangladesh claiming that "Energy is one of the basic ingredients required to alleviate poverty and socio-economic development" [MoPEMR 2008b], and with the prioritisation of the electricity sector by the Government of Bangladesh. This focus is supposed to upgrade the socio-economic condition of the country and to alleviate poverty [MoPEMR 2008a].

Energy supply in Bangladesh poses great challenges. The country avails of few renewable and fossil resources for energy generation. Commercial energy carriers – except for kerosene – are not affordable for many people. Access to biomass, the most important energy source, is becoming more expensive and scarce due to high demand. Additionally, the infrastructure for energy generation and distribution is deficient and is not sufficiently extended to match the high demand. Electricity supply is often unreliable due to insufficient power generation capacities.

### **2.2.1 Energy situation for the poor**

As wood fuel has become scarce over the last few years through deforestation, poor people increasingly struggle to meet their energy needs for cooking, besides from existing shortages of food and water. The share of wood as a percentage of total biomass fuel had decreased from 63% in 1981 to 22% in 1990, while prices have risen. As a consequence, households frequently have to gather lower-grade biomass fuels in the form of agricultural and animal residues [Biswas 2001].

Among rural households living near subsistence levels, the ability to pay for electricity is low. Due to lower population densities in rural areas, electricity distribution costs must be spread over relatively few people. Transmission lines serve the most highly populated areas first [Asaduzzaman 2009]. For this reason and due to the lack of generating capacities, large numbers of rural people will remain unconnected throughout the next decades [Marinot 2000].

### 2.2.2 Energy resources

In Bangladesh, biomass (wood fuel, leaves, crop residues and animal residues) is the principal form of energy used by the people, and particularly of those living in the rural areas [GoB 2005]. An overwhelming number of rural households (> 95%) use biomass for cooking [Hossain 2005/2006, Asaduzzaman 2009].

Lessons from cook stove programmes in Asia [RWEDP 1998] show that contrary to common belief, most of the wood fuels in Asia are used on a sustainable basis. Wood fuel use is therefore not considered a main or major cause of deforestation. For the case of Bangladesh, however, Lefevre [1997] states that the share of wood fuels within total wood consumption is one of the highest in the world, reaching 98%.

The per capita consumption of timber and wood fuel is one of the lowest in the world. Nevertheless, the supply is inadequate even to meet this low level of consumption as population pressure on land has been leading to the conversion of forest land and land under tree cover into other uses. This further lowers the supply of biomass. Consequently, the market value rises lead to further deforestation and felling of trees [GoB 2005].

Another relevant resource is natural gas. In 2005 natural gas made up 44.7% of the total primary energy supply in Bangladesh [UNDP 2008b]. The precise extent of gas reserves is disputed, but it is assumed that they would last for the next 30 to 50 years. Gas is widely available only in urban and peri-urban areas, where the current pricing policy of charging households a (subsidised) monthly flat rate, irrespective of the amount of gas consumed, encourages waste and discriminates against rural households without connections [Asaduzzaman 2009]. Even though a large proportion of the population does not have access to gas supplies, demand already exceeds production capacities and continues to rise. Therefore, energy officials admit that the country could face a gas supply crisis as soon as 2011. Half of gas produced is used for power generation, followed by fertiliser production, household cooking, and other industrial and commercial uses [Economist Intelligence Unit 2008].

Discovered reserves of coal are another potential resource for electricity generation. According to Bangladesh's 2004 National Energy Policy, total coal reserves amount to 2,527 million tonnes contained in four fields. However, the quality and the quantity of usable coal has yet to be clearly determined. Bangladesh's only operating coalmine at Barapukuria, has so far delivered less than 3 million tonnes. Scientific criticism on ongoing and planned coal projects with regard to the negative social, environmental and economic consequences of coal extraction has been formulated [Moody 2008].

With regard to renewable energy sources other than biomass, Bangladesh has potential to use solar energy and biogas, while the potential for hydro and wind power is



limited. The average solar radiation is 3.85 kWh/m<sup>2</sup>/day, which is quite good for photovoltaic (PV) applications. Solar PV is used widely throughout the country and has the potential to form part of a broader rural electrification programme [Asaduzzaman 2009]. In agriculture-based rural Bangladesh, there is potential for biogas production from livestock wastes and other sources. Biogas programmes have been developed and piloted over the past 30 years, and a large-scale plant production appears economically and financially feasible. [Asaduzzaman 2009]

The scope of hydropower generation is very limited in Bangladesh as the majority of land is made up of plains, with the exception of some hilly regions in the northeast and southeast parts of the country [Asaduzzaman 2009]. According to Asaduzzaman et al [2009], the potential of using wind power for electricity generation is likely to be limited to coastal areas and islands with strong wind regimes.

### **2.2.3 Energy supply in Bangladesh**

The quality of Bangladesh's infrastructure is poor. Electricity supply is erratic, leaving many firms reliant on their own generators, while natural disasters such as flooding periodically destroy large parts of the country's infrastructure.

Electricity generation per head is among the lowest in the world, at about 168 kWh per year in 2006/07. As 60% of households do not have electricity supply, there is a huge unmet demand for energy and a lack of reliable sources of electricity. The shortage in generating capacity necessitates extensive load-shedding (planned power cuts), especially in the summer [Economist Intelligence Unit 2008].

Electricity generation grew at about 7% p. a. during the last fifteen years compared with an average annual GDP growth rate of about 5.5% [Power Cell 2007].

Approximately 40% of the overall population is connected to the electricity grid network; in rural areas, 70% of the people remain without connection to the grid [Hossain 2006] [Asaduzzaman 2009]. An additional 600,000 rural customers, equivalent to 3% of Bangladesh's almost 17 million rural households, are gaining access to the national grid each year [Asaduzzaman 2009]. Electricity is mainly used for lighting, radio and television. Those who do not have electricity use kerosene lamps, which account for 70% of lighting energy in rural Bangladesh [Asaduzzaman 2009]. These lamps provide poor lighting, limit the working hours of rural people at night and seriously restrict opportunities for studying at night.

### **2.2.4 Energy policy**

For the last 20 years there have been several reforms in Bangladeshi energy policy. In 1995 the Bangladesh National Energy Policy (NEP) primarily promoted commercial use of energy to push economic growth. Since the NEP was adapted in 2004 and

a new draft was published, fair energy prices were set as another target. The protection of natural resources, renewable energy and energy efficiency were emphasised as key topics. In 2008, the Power Division of the Ministry of Energy and Mineral Resources passed the Renewable Energy Policy of Bangladesh. This policy aims to tap the potential of renewable energy. Amongst others it includes the extension of solar energy and the efficient use of biomass. Based on these and other energy carriers, the entire population should be supplied with electricity by 2020. Furthermore the power sector is supposed to become financially viable and the efficiency of the sector is to be increased [MoPEMR 2008a]. To reach this goal Bangladesh has a Power System Master Plan for the 2005-2020 time period. This Master Plan envisages a doubling of generating capacity by 2010 to meet the increase in electricity demand.

However, according to a study from Ahmad [2001] “the energy sector, including exploration and generation, is considered as one of the areas that is most prone to corrupt practices in Bangladesh.” So far, progress on reforms has been slow, owing to a lack of political will, opposition from trade unions and obstruction by vested interests [Economist Intelligence Unit 2008].

## 3 Programme and Interventions

### 3.1 Sustainable Energy for Development Programme

As part of the focal area of German-Bangladesh bilateral development cooperation, the Sustainable Energy for Development Programme (SED) is being implemented basically addressing two components: promoting renewable energy and increasing energy efficiency. The Bangladesh government partner of the joint programme is the Ministry of Power, Energy and Mineral Resources (MoPEMR).

To further develop the results of the preceding project<sup>4</sup>, SED was set up in 2007 with a duration of three years and eight months. The budget of this first phase amounted to almost 5 million Euros. In addition to financial support from the Federal Ministry of Economic Cooperation and Development (BMZ), SED received several million Euros for the dissemination of renewable energies under the German-Dutch Cooperation Agreement “Energising Development” (EnDev) through GTZ.

Overall, SED aims to support Bangladesh in promoting poverty-reducing economic growth (Pro-Poor Growth) especially in grid-distant regions, and to improve the competitiveness of the business sector. While the first phase of the programme focuses on activities towards intermediary actors and ultimate beneficiaries, the programme is expected to contribute to developing a base to improve the livelihoods of poorer segments of the population in the long run. The programme is expected to assure that poor, and in particular women, are actually the primary beneficiaries by orienting its activities to this target group.

The programme is designed to follow a multi-level approach, to support government institutions to develop a favourable policy framework for renewable energy and energy efficiency and to promote service organisations in the energy sector in these two areas. Furthermore SED strengthens existing initiatives of associations and private organisations by introducing and disseminating renewable energy and energy efficiency measures in households, social and public institutions and in companies.

GTZ is implementing the SED programme in collaboration with the Bangladeshi partner, the Power Division of the MOPEMR. GTZ serves de facto as the implementer, in addition to its role as service provider, the financial support for capacity building and the financial aid provided. The “German contribution” in this area is considered to play a pioneering role in promoting renewable energies for the energy sector among the development actors active in Bangladesh. The study analyses the programme

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<sup>4</sup> The preceding technical cooperation project ran from 2004 to 2006: Promotion of the Use of Renewable Energies (PURE)

interventions that promote the dissemination of solar home systems and improved cook stoves.

### 3.2 Solar Home System interventions

The development a self-sustaining market for Solar Home Systems (SHS) is SED's aim in promoting the dissemination of this technology to households, businesses and social institutions. The SHS market is expected to provide access to electricity for people in remote and rural areas, who are not usually connected to the national grid, replacing kerosene lighting and battery-supported electricity supply.

Solar Home Systems are small photovoltaic systems that transform solar energy into electricity, providing a decentralised power supply to individual users. Units normally consist of a photovoltaic panel (40 Wp to 130 Wp), a battery, a charge controller, and some lighting devices. In addition to lighting, SHS supply power for small electrical appliances such as radios, cassette players, mobile chargers and black and white TVs.



**Figure 1 – Solar Home System units and panels, Source: SLE-Team**

The dissemination scheme is implemented through the government-owned Infrastructure Development Company Limited (IDCOL)<sup>5</sup>. IDCOL is responsible for the overall management and cooperates with 16 partner organisations that disseminate SHS on a commercial basis. The partner organisations take care of marketing, sales as well as the installation and maintenance of systems. The users buy the SHS units directly from the partners, mostly in conjunction with a hire purchase arrangement.<sup>6</sup>

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<sup>5</sup> The scheme implemented under the responsibility of IDCOL is defined as the Rural Electrification and Renewable Energy Development Project (REREDP).

<sup>6</sup> SHS of peak capacities between 40 and 130 Watts are currently sold at a subsidised price of between 220 and 680 Euros.

The scheme under IDCOL is financed by GTZ along with support by other development actors and donors. Apart from this financial support, SED successfully implemented a pilot project with four organisations to introduce around 800 10 Wp to 21 Wp Small Solar Home Systems (SSHS) in 2007. As a result of the pilot project, SSHS are now included in the distribution scheme through IDCOL.

### 3.3 Improved Cook Stove interventions

The establishment of a self-sustaining, nationwide market for improved cook stoves (ICS) is SED's overall aim in promoting the dissemination of this technology to households, businesses and social institutions. The intention of this intervention is for improved stoves to replace traditional clay stoves.



**Figure 2 – Traditional stove and ICS in Bangladesh, Source: SLE-Team**

Traditional stoves in Bangladesh create a lot of smoke and heat, which cause health problems and lead to the inefficient burning of fuels. Improved cook stoves combine the feature of a chimney to vent the smoke and are designed to burn biomass fuel more efficiently. Through this improved design, many negative effects experienced by cooks with traditional stoves can be avoided and biomass fuel can be saved. The technology has been developed in the context of Bangladesh by the Bangladesh Council of Science and Industrial Research (BCSIR).<sup>7</sup> SED adapted the original stoves and integrated them into their approach to establish a self-sustaining market for ICS in Bangladesh. As the existence of improved cook stoves is still unknown to most Bangladeshis, SED's strategy aims to reach a critical mass of households to demonstrate the health and financial benefits to others. The demand for ICS is supposed to increase once people are aware of the technology's advantages [GTZ 2008].

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<sup>7</sup> Annex 9.1 provides an overview of the history of improved cook stoves in Bangladesh.

To this end, the SED programme is currently working with 165 partner organisations and small companies. These partner organisations are marketing the stoves and provide a link between the customers and stove builders. They are also expected to provide an after-sales services. The respective stove builders are responsible for the construction of the improved stoves.

The contribution of SED mainly comprises the financing of training for stove builders, financial support for the distribution and marketing of ICS, as well as facilitating experience exchanges among partner organisations. Throughout the cooperation, partner organisations are required to conduct technical monitoring of the built ICS to ensure their high quality.

In addition to promoting the distribution of ICS through a market-based approach on a commercial basis, some partner organisations are being supported to target especially vulnerable groups such as holders of the Bangladeshi Vulnerable Group Development (VGD)<sup>8</sup> card and extremely poor households. Poor people are provided with access to improved stoves for significantly less than the usual amount of around 600 to 1,000 Taka, or are given them free of charge.

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<sup>8</sup> VGD (Vulnerable Group Development): governmental programme to support extremely poor people with food staples and basic services in order to promote their self-reliance.

## 4 Analytical Framework and Methods

### 4.1 Impact assessment

In line with GTZ terminology, this study defines impacts as changes which can be attributed causally or plausibly to a development intervention. These changes are commonly measured by means of comparison with a baseline or control group. In the present study, subjective changes were taken as a basis. Impacts may be intended or unintended, expected or unexpected, positive or negative [GTZ 2008]. This study differentiates between the seven levels of a result chain ranging from “inputs” to “highly aggregated benefits” as presented in Table 1.

Level		Example
Inputs		Resources such as material, equipment, staff and funds.
Activities		Advisory services, training, or funding.
Results	Output	Qualified institutions/organisations or supporting measures are in place and have sufficient financial resources.
	Use of Output	More efficient processes and improved services of institutions/organisations or the use of funds.
	Outcome / direct benefit	Improved access to electricity for rural households. This corresponds to the project or programme objective.
	<b>Attribution gap</b>	
	Impact / indirect benefit	Increased household income or reduced workload for women.
	Highly aggregated impact	Contribution to achieving the MDGs.

**Table 1 – Levels of a result chain. Source: Adopted from GTZ [2008]**

From output to outcome levels, changes can be causally and plausibly attributed to a development intervention. By formulating objectives at this level, a programme takes responsibility for achieving these results. However, changes and effects at the impact level are also influenced by other factors that may not relate to a specific programme and its interventions. Thus, changes at this level are considered indirect benefits and are to a significant extent beyond the direct influence of a programme (“attribution gap”). Therefore, it cannot assume responsibility for reaching these impacts. When assessing impacts, the plausibility of the relationship between outputs, use of outputs and outcomes (direct benefits) has to be demonstrated [EnDev 2007].

It is assumed that ICS-related impacts and outcomes observed by this study are largely due to SED’s activities, as the GTZ-supported programme is the single actor. In the case of SHS, effects along the impact chain can only be attributed to the overall SHS dissemination scheme to which GTZ contributes through SED as one of several development actors (compare Chapter 5.1).

In the present study, the focus lies on assessing impacts that can be attributed to the use of the technologies for domestic and commercial users. Checking the total number of SHS or ICS that have been distributed and are in use was beyond the scope of

the impact assessment. Also, special attention was given to job creation and income generating effects for users as well as for intermediaries.

At household level, the team interviewed both men and women using SHS and ICS in order to assess gender-related impacts. Correspondingly, male and female stove builders and SHS technicians were interviewed. Whenever relevant, data were assessed and analysed disaggregated by sex.

According to the terminology mentioned above, result chains have been elaborated for both SHS and ICS interventions (see Annex 9.2).

## 4.2 Poverty

### 4.2.1 Understanding of poverty

When assessing the poverty orientation of the programme interventions, the study follows the multidimensional understanding of poverty developed by OECD/DAC [OECD 2001]. This is in line with the definitions of poverty adopted in the Bangladeshi Poverty Reduction Strategy Paper [GoB 2005] and the 2015 Programme of Action [BMZ 2001] of the German Government. The concept reflects the interlinkages between the various dimensions of poverty (see Figure 3).

The **economic dimension** encompasses the ability to earn an income, to consume and to have assets, which is key to food security, material well-being and social status. The **human dimension** includes aspects of health, education, nutrition, clean water and shelter. The **political dimension** includes human rights, a voice and some influence over public policies and political priorities. The **socio-cultural dimension** is concerned with the ability to participate as a valued member of a community. The **protective dimension** refers to the capacity of people to withstand economic and external shocks (resilience). **Gender equality** and **environmental sustainability** are crosscutting issues that relate to each of the dimensions of poverty.



Figure 3 – The dimensions of poverty.  
Graph created by the authors based on OECD [2001]



## 4.2.2 Poverty orientation

The poverty orientation of a development programme is understood to be composed of the following two aspects:

- the extent to which poor people are reached (**pro-poor orientation**) and
- **poverty reducing impacts** of the interventions [GTZ 2007a].

### Pro-poor orientation

The pro-poor orientation is determined by the extent to which poor people are reached by the intervention. The BMZ distinguishes two basic forms of pro-poor orientation: *direct* and *comprehensive* poverty reduction. Projects that reduce poverty immediately work *directly* with a target group that mostly consists of poor segments of the population. A project is considered to make a *direct* contribution if the proportion of poor people within the target group constitutes at least 50%, or is at least equivalent to the proportion of poor people within the population in the respective region. Otherwise it is not considered to be directly pro-poor oriented. *Comprehensive* poverty reduction is achieved by addressing poverty at the macro or sector level. In order to assess the pro-poor orientation of SED's project activities, information about the poverty status of the beneficiaries of the project as well as their social surrounding has been captured. To measure the poverty of the target group and compare it to national poverty levels, the study adopts the official income-based method. According to this method, the monthly per capita income is the sole indicator to determine poverty [BBS 2007] [World Bank 2008] (compare chapter 2.1).

The share of poor people among the beneficiaries is then compared with the national and regional distribution of poverty as outlined in the 2005 Household Income and Expenditure Survey [BBS 2007]. The respective income thresholds that define the upper and the lower poverty lines were inflation-adjusted based on 2005 values.<sup>9</sup>

### Impacts on poverty

Assessing the poverty reducing impacts of a programme means analysing whether the programme's outcomes, results and impacts help to mitigate the scope of poverty, help prevent poverty, or help to alleviate the impacts of poverty.

To get a more detailed insight into the characteristics of poverty affecting the beneficiaries, the study used the "Multidimensional Approach to Measure Poverty in Rural Bangladesh" [Bhuiya et al. 2007]. The tool elaborated in this approach enables pov-

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<sup>9</sup> In this study, the national upper poverty line is equivalent to a monthly per capita income of approximately 970 Taka, the national lower poverty line equals 860 Taka.

erty to be assessed in its multidimensionality through a range of items selected on the basis of a country-specific package of basic needs. The tool, as it was applied for this study, is composed of questions of basic need with regards to food, clothing, shelter, health, education, and social involvement<sup>10</sup>. The tool generates a poverty parameter on a scale from 6 to 18 points for every respondent, where 6 means not poor and 18 extremely poor in all dimensions.

The results of this poverty appraisal provide a useful basis to assess the question; whether and how the impacts of the intervention can reduce poverty.

### 4.3 Sustainability of the dissemination structure

The study analysed SED's strategy to determine if activities will lead to a continuous distribution of ICS and SHS technologies via a self-sustaining market. To assess this matter, the definition for sustainability developed by OECD/DAC is applied: "Sustainability is concerned with measuring whether the benefits of an activity are likely to continue after donor funding has been withdrawn" [OECD-DAC 1991]. The question that this study addresses is therefore whether the market introduction is likely to be durable, i.e. whether a viable dissemination structure for ICS and SHS will persist after SED interventions have ceased.

HERA and EnDev provided indicators that were used to analyse aspects of interest for sustainability.<sup>11</sup>

Aspects that were considered important for assessing of the sustainability of the distribution structure were as follows:

- incentives provided by SED and other institutions in the distribution structure
- the monitoring of partner organisations;
- the actual usage of the technology distributed and the consumer acceptance;
- adequate communication and feedback between customers and providers (including marketing activities);
- the needs of (potential) clients compared to the benefits of the technology;
- profitability and dependencies of the partner organisations on SED support with regard to financial, technical and institutional capacities;
- capacity and motivation of the necessary personnel as well as their satisfaction in the job;
- demand and other relevant aspects of the market.

<sup>10</sup> To keep surveys and questionnaires short and simple, the tool was reduced to the most relevant question from each of the six dimensions of poverty, as suggested by Bhuiya et al [2007].

<sup>11</sup> Some of these indicators had been designed to assess the sustainability after major development assistance has been completed. Given the fact that efforts to establish a self-sustaining market are still ongoing, these indicators were not applied.

At a higher level, the overall context in which the project is implemented were considered. Both threats and opportunities to sustainability loom behind national policies and institutional developments in Bangladesh as well as behind multilateral agreements regarding carbon emissions.

The relationship between SED and the implementing partner organisations, as well as rapports between partner organisations and their staff and clients, were analysed to make suggestions on how to increase the likelihood of a self-sustaining market distribution in the future. Based on the analysis, conclusions about the sustainability of the dissemination structure were drawn.

In the conclusions drawn, the study points out plausible connections between the current dissemination structure and necessities for a self-sustaining market. Entry-points to enforce the sustainable development of markets for ICS and SHS were determined and recommendations were developed.

## **4.4 Sampling and procedure**

The research concept is based on a mixture of methods for the collection and analysis of information. To find out about the impacts of the technologies and to collect information on the dissemination structure, qualitative methods such as focus group discussions, workshops, open conversations, key informant interviews and semi-structured interviews were applied. In order to generate data for statistical analyses, surveys were conducted at household level and with micro and small enterprises (MSE). Since a comprehensive, baseline study for the context of the SED programme was lacking, the survey of impacts focused on the changes that beneficiaries observed over time.

### **4.4.1 Procedure**

Based on SED documents, on former studies about the impacts of SHS and ICS, and on a set of indicators provided by EnDev [2009], the study team developed result chains for the SHS and ICS activities. Preliminary questionnaires and interview guidelines were then developed and discussed with SED staff. They encompass clusters of questions related to different impact categories, maintenance and user satisfaction as well as to information on the poverty level of users.<sup>12</sup>

Interviewees were asked about concrete data (e.g. energy expenditure before and after the acquisition of a SHS) as well as their personal perceptions about various kinds of changes. Furthermore, interviews including questions on similar topics were

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<sup>12</sup> Sample guidelines and questionnaires are available on request from the SLE.

conducted with non-users in order to get insights into their livelihood systems and the need for acquiring respective technology.

For the field phase, a total of 11 local researchers were contracted to support the study team by conducting surveys, facilitating group discussions and translating for the German research team. Pre-tests in Tangail (ICS) and Gazipur (SHS) were held, and the results were then only included in the qualitative analysis. Open interviews were usually conducted in mixed teams of Bangladeshi and German researchers and - whenever possible - in absence of staff from the partner organisations.

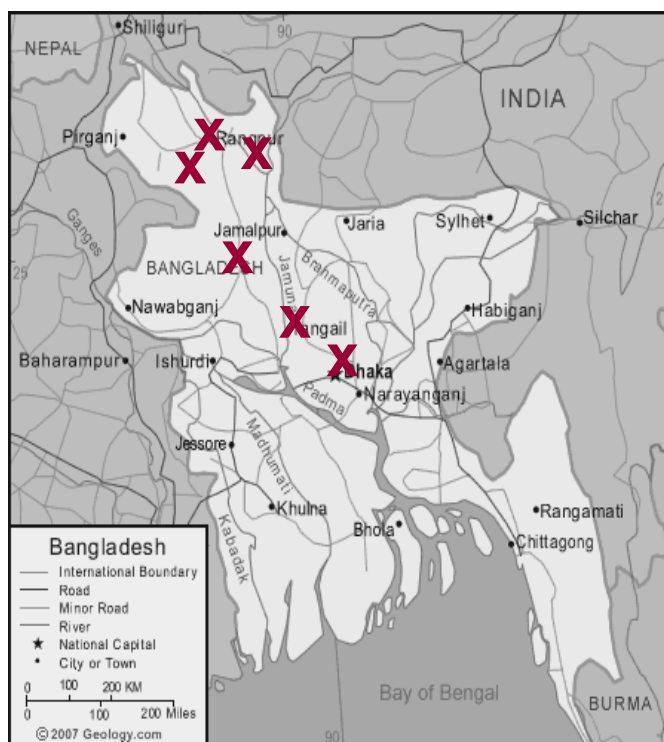
#### 4.4.2 Sampling

The study took place in the Dhaka and Rajshahi division.<sup>13</sup> Partner organisations included in the study were expected to cooperate with SED for at least 18 months in ICS distribution and at least three years in SHS distribution, respectively. For SHS partners, it was relevant that they also sold 10-20 Wp SSHS. For both technologies, the team interviewed large and small partner organisations.

The specific research sites for ICS and SHS were selected by the study team in cooperation with the partner organisations. Users were supposed to possess the respective technologies for at least one year in the case of ICS and at least 18 months in the case of SHS.

While a mixture of urban and rural research sites were chosen for ICS, a focus on rural sites was made for SHS field research, since grid electricity was usually available both in urban and peri-urban areas.

In addition, the ICS team took special samples in particularly poor villages in the surroundings of Dinajpur, Shagata (Rajshahi division) and Dhanbari



**Figure 4 – Research sites for SHS and ICS. Map adapted from [Geology.com 2007]**

<sup>13</sup> There are 83 of a total of 165 ICS partners and 5 of a total of 16 SHS partner organisations working in Dhaka and Rajshahi divisions. 14,031 and 51,817 ICS have been distributed in Rajshahi and Dhaka Divisions [according to SED, 14.09.2009], whereas 48,123 and 73,798 SHS have been distributed respectively [IDCOL 2009].

(Dhaka division). Non-user interviews were taken in the same villages as the user interviews, as well as in neighbouring villages and urban areas where the respective technology was not available.

Respondents were supposed to adequately represent the beneficiaries of the respective technology. For SHS, the aim was to interview a sufficient number of women and men in user households. Since the prime beneficiaries of ICS were assumed to be the cooks, the ICS team proceeded by requesting to interview the main cook in the household, who were women in most cases. At the selected research sites, the research teams used convenient sampling in order to identify interviewees wherever possible.<sup>14</sup>

### **Description of SHS and ICS samples**<sup>15</sup>

*SHS*: Three SHS partner organisations were included in the study. These were the two largest players in the sector, with a 63% and 15% share of all SHS sold under the IDCOL scheme, which SED contributes to (see Chapter 5.1). A smaller representative was also included, which sold less than 1% of the SHS distributed under IDCOL [IDCOL 2009]. During the field research, the SHS team conducted 10 interviews with solar branch managers and interviewed a total of 18 technicians and field assistants. Further key informants were interviewed as listed in Annex 9.3.

At user level, 16 open interviews were conducted with SHS-owning households and 2 with MSE. For statistical analysis, 172 standardised interviews with SHS users were conducted, of which 136 were held with households and 36 with micro and small enterprises. In addition, 41 interviews with non-users form part of the quantitative survey. Of these, nine non-users were asked additional open questions. The majority of respondents were male (75%).

*ICS*: Eight ICS partner organisations were analysed by this study, including three medium-sized partners, four smaller ones, and SED's biggest partner in ICS dissemination.<sup>16</sup> Three of the eight partner organisations selected in cooperation with SED had only been working in ICS distribution for approximately one year.

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<sup>14</sup> Partner organisations are required to document all installed ICS and SHS in lists. In the case of SHS, convenient sampling was done by starting with the name of a location indicated in the lists, provided by the partner organisations, and then asking the interviewees or other villagers to identify further SHS users for interviews. In the case of ICS, the information in the lists provided by SED was frequently insufficient for the study team and the partner organisations to locate ICS cf. 4.4.3.

<sup>15</sup> Annex 8.3 gives a detailed overview of the data collection for both technologies in the different research areas, including the exact number and type of interviews conducted per partner organisation.

<sup>16</sup> While the biggest partner has distributed 29,302 ICS country-wide, medium-sized partners had distributed 1,000 – 2,000 ICS at the time of the study, and small ones less than 800 ICS.

The ICS results described in chapter 6 are based on a sample of 290 standardised<sup>17</sup> and 133 open (qualitative) interviews. More than 90% of interviewed users were female, with an average age of between 31 and 40 years old. Rural households constituted 80% of the sample. Besides households, MSE and social institutions, health centres and independent actors involved in distributing ICS were interviewed. The vast majority of stoves (85%) included in this study were less than one year old.

#### **4.4.3 Methodological limitations and lessons from the research process**

While the team had originally intended to only select interviewees who had possessed an ICS for at least one year or an SHS for at least 18 months, this criterion had to be discarded. Thus, 90% of the households interviewed for this study had obtained their ICS less than 12 months ago. In the case of SHS, more than half of the SHS units had been installed over one year ago.

Due to the fact that – contrary to expectations – the distribution of SSHS had only recently started, finding research sites with several SSHS was difficult. As a consequence, the sample comprises only a few SSHS-users. Nonetheless the share of SSHS in the sample was higher than the 3% average of all distributed SHS. The study team considers the impacts assessed for the technologies to be reliable. However, no statements can be made on how long these impacts are likely to last due to the recent installation.

The sample from all customers drawn for this study is not random for either of the assessed technologies. The results are thus not valid to make statistically representative statements. In the case of SHS, convenient sampling starting from a central location meant that no remote areas were included and a higher than average share of SHS users found were MSE. In the case of ICS, randomised sampling was not possible because the information given in the lists provided by SED – on which the sample was to be based – was insufficient to locate improved cook stoves in most cases. As a first step, the research team tried to trace households independently of the partner organisations. It frequently occurred that the expected user had never possessed an ICS (see the box below). In the case of Partner C, many of the users had destroyed the ICS because the installation had not been completed. Except for Partner G, none of the organisations were able to locate a sufficient sample of ICS with the limited information available from the lists. Thus, guides of the partner or-

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<sup>17</sup> Additionally 21 standardised interviews were conducted during the pre-test. These interviews were not included in the statistical analyses.

organisations were asked to locate any households with ICS, regardless of whether these were on the reported lists or not.

**The case of Partner D – Example of the Alal Char and Char Salapac research sites**

The study team went to Char Salapac and Alal Char – two islands in the Jamuna River - to conduct interviews with ICS users from Partner D. The team was provided with the report containing a list of all domestic ICS reported to SED by the partner organisation. Out of a total of 306 documented, domestic ICS, the report lists 56 domestic ICS installed in Char Salapac and 28 domestic ICS installed in Alal Char.

Throughout an entire day of research the team was not able to find a single ICS either on Char Salapac or Alal Char. The research team located two households, which were provided with ICS under a government initiative more than three years ago. Floods had destroyed the ICS within some months. Moreover, the team located 33 people who identified their names on the list and who confirmed to the team that they had never bought or possessed an ICS. Furthermore, the team located a number of people who were identified from the list and who verbally confirmed that they had never bought or possessed an ICS.

In Alal Char, a meeting of the partner organisation was held one week prior to the team's visit informing the Char inhabitants about the ICS. In interviews people explained to the study team that the distribution of ICS was refused by the Alal Char community, because they considered the technology unsuitable for the circumstances on the islands. Regular flooding would quickly destroy the ICS. One woman explained that this year she already had to move her house four times because of flooding. An ICS would not be useful under these circumstances. Though the partner organisation is well known on the river islands for different services (rebuilding houses, distributing seed) nobody knew about anyone owning an ICS distributed by Partner D.

One result that can be drawn from the research process is that a significant number of users reported to SED do not possess an ICS. This correlates with the preliminary findings of another independent study currently conducted by the Nielsen Company. From a sample of 20 partner organisations, this study reports that only half of the reported ICS were found and many were out of use. On the other hand, financial auditing reports of the partners suggest that all ICS from the lists were built and in regular use at the end of the contract period.

Interviewees frequently had difficulties to quantify their income, expenditures, fuel consumption or money and time savings. Hence, all statements regarding numbers have to be treated very carefully and indicate a range rather than exact data.

As shown throughout the sampling chapter, there are certain biases and limitations in regard to the results. The result chapters have to be read keeping the following conclusions from the research process in mind:

For ICS:

- Due to the influence of the partner organisations in the selection of households, it has to be assumed that a bias exists in the sample.
- The information about the households provided in the lists were in many cases insufficient to locate the households either independently or with the support of the partner organisations.
- It has to be concluded that a share of the households reported as ICS owners in the lists of the partner organisations do not have an ICS.
- No statement can be made about how long the impacts of the ICS technology will last.

For SHS:

- Remote households in the villages are underrepresented in the sample due to the procedure.
- Statements about how long the impacts of SHS will last can only be made to a limited extent.
- Due to the procedure for selecting interviewees, the number of MSE in the sample exceeds the regular share of MSE among SHS users.
- The non-user interviews were conducted especially with poor households to gain an insight into their perspective on the SHS. This sample is not representative for households without SHS.



## 5 Results of Solar Home System Assessment

To assess whether a self-sustaining market for SHS will develop, the dissemination scheme implemented under IDCOL has been analysed. Financial contributions from GTZ to IDCOL, as well as other SED activities like training and initiatives outside the IDCOL structure, are taken into account. Then, the extent to which the poorest segments of society are currently benefiting from SHS interventions has been analysed. The actual impacts of SHS on the beneficiaries are analysed in detail under chapter 5.3 (impacts).

### 5.1 Dissemination structure and context

In Bangladesh, the creation of a self-sustaining market for solar systems is supported by a market introduction and barrier removal programme that is implemented through the government-owned Infrastructure Development Company Limited (IDCOL)<sup>18</sup>.

Since its beginnings in 2003, the IDCOL programme has successfully supported the dissemination of a total of 344,000 SHS (50 Wp average capacity) until June 2009 [IDCOL 2009]. The SHS that were distributed under the IDCOL scheme represent the vast majority of SHS in use in Bangladesh.

#### 5.1.1 Description of the dissemination approach

IDCOL is responsible for the overall management and has contracted 16 partner organisations to distribute SHS.<sup>19</sup> The partner organisations take care of marketing, sales as well as installation and maintenance of the systems. The users buy the SHS directly from the partners, mostly in conjunction with hire purchase arrangements.

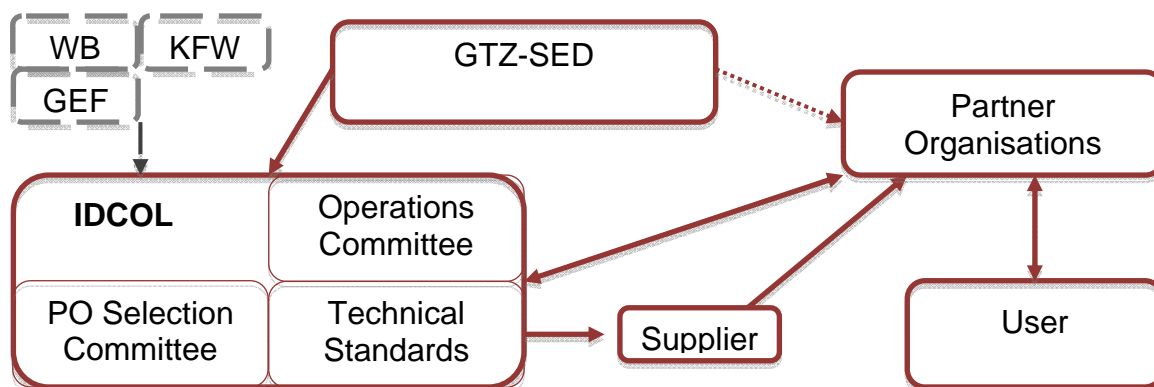
To lower the existing market barriers, IDCOL provides a buy-down grant (Grant A) to partner organisations to lower the price of every SHS, a grant for the institutional development of the partner organisations (Grant B), and a revolving fund to cover the financing gap of the partner organisations, which is created by purchasing SHS and reselling them on instalment-based sales contracts to users. In addition, IDCOL provides support for marketing activities, capacity building for the partner organisations, and puts into place quality ensuring measures.

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<sup>18</sup> The scheme implemented under the responsibility of IDCOL is defined as the Rural Electrification and Renewable Energy Development Project (REREDP).

<sup>19</sup> Grameen Shakti, BRAC Foundation, COAST Trust, TMSS, SRIZONY Bangladesh, CMES, IDF, Shubashati, UBOMUS, DORP, BRIDGE, PMUK, Hilful Fuzul, RSF, PDBF and Mukti. At the time of writing, five more organisations have applied for participation.

Currently, the SHS dissemination scheme is basket-funded by multilateral development partners (WB, GEF) that provide the refinancing funds, and bilateral partners (GTZ and the German Development Bank, KfW), which provide Grants A and B as well as management support for IDCOL.<sup>20</sup>



**Figure 5 – SHS dissemination structure, financing structure and activities of SED.**  
Figure devised by the authors

Concerning the refinancing, IDCOL provides soft loans to the partner organisations that have a seven to ten year maturity with a one to two-year grace period. To compensate the competitive advantages, IDCOL has recently started charge different interest rates for the refinancing loans to the partner organisations (8% for larger and 6 to 7% for smaller organisations). Since 2005, GTZ has supported the dissemination of SHS through the SED programme with three consecutive grant contracts with IDCOL amounting to up to €8.5 Million Euros (see Table 2 below).

<b>GTZ Contracts with IDCOL</b>			
<b>Timeframe</b>	<b>Purpose</b>	<b>Amount</b>	<b>Source</b>
2005 -2007	SHS Grants	Up to 2.2 million Euros for 34,000 systems	EnDev1
2007 –2009	SSHS Grants	Up to 1.2 million Euros for 24,500 systems	EnDev1
2009	SHS Grants	5 million Euros for 104,000 systems	EnDev1
<b>SED Contracts directly with PO</b>			
2005 - 2006	SSHS-Pilot Project	800 systems	BMZ

**Table 2 – Financial contributions by GTZ and SED in the SHS Sector,**  
devised by the authors, based on information provided by SED

<sup>20</sup> In the first phase, grants and funds were entirely financed by the World Bank and the Global Environment Facility.

In addition to the management fee for IDCOL, GTZ currently provides grants amounting to 34 Euros for regular systems and 38 Euros for SSHS for every system sold (see Table 3 for details). The actual grants reduce the price of SHS by some 5-15% for larger and smaller systems, respectively. In line with the former practice, a policy to constantly reduce Grant A and B was adopted, using the specifications of the KfW agreement (which with €16.5 million is considerably higher than GTZ support) as a reference.<sup>21</sup> Up until the end of 2009, GTZ contributions account for approximately 90,000 systems, representing around 25% of the systems distributed under IDCOL.

	Amount in Euro per unit sold				
	SHS				SSHS
Provided by GTZ		100,001-200,000			All
Provided by KfW	First 100,000		200,001-300,000	Beyond 300,000	-
Grant A – Buy-down grant	30	30	25	20	30
Grant B – PO institutional development	8 - 4	4	3	2	8
IDCOL Management fee	7	7	7	7	13
<b>Total support</b>	<b>45 - 41</b>	<b>41</b>	<b>35</b>	<b>29</b>	<b>51</b>

**Table 3 – Composition of grants and fees provided by GTZ and KfW, devised by the authors based on information provided by SED**

In addition to the regular-sized 40-130 Wp SHS, SED has tested the acceptance of 10-21 Wp SSHS in direct cooperation with four selected partner organisations. This pilot project, which started in 2006, distributed some 800 SSHS. As a result of the pilot project, GTZ now provides grant support for SSHS through IDCOL, and 20 and 21 Wp SSHS were included in the portfolio of the partner organisations.<sup>22</sup> To set an incentive to sell more SSHS, a higher grant is provided for SSHS as opposed to SHS.

Additionally, SED activities encompass capacity building for partner organisations to facilitate SHS distribution. Until September 2009, approximately 850 people were trained. Most of them are staff of partner organisations and are currently working in management and technical positions in the solar sector.

<sup>21</sup> At the beginning, the World Bank supported each of the first 20,000 systems with \$90 (\$70 Grant A and \$20 Grant B) through IDCOL. This amount has been reduced to \$50 per SHS.

<sup>22</sup> 10 and 16 Wp SSHS are currently not supported, as usable batteries with an adequate warranty period are not available on the market.

### **Management, monitoring and quality assurance**

IDCOL assumes the major responsibility for monitoring in the structure. IDCOL monitors the performance of the partner organisation with regards to sales activities and the efficiency of credit collection. Partner organisations provide detailed reports about every system that has been installed 10 to 12 times per year.

At present, IDCOL physically inspects about 50% of the SHS within 21 working days. If the result of the inspection is satisfactory, grants and refinancing for the reported systems are released.<sup>23</sup> Additionally, IDCOL frequently conducts financial audits of the partner organisations. Up to now, impact monitoring by IDCOL has not taken place, but recently an independent consultancy was contracted for an impact study.

For its current monitoring of the dissemination scheme, SED relies on the monitoring activities of IDCOL and the respective reports. As SED considers the monitoring activities to be sufficient and reliable, it does not carry out regular control of these reports nor does it monitor the performance of partner organisations at the user level.<sup>24</sup> However, auditing has been conducted for a sample of the first 50,000 SHS and a second auditing contract was finalised. In general, all the monitoring activities at user level focus on successfully installed SHS (output-level), and none of the stakeholders involved conduct systematic monitoring of the impact of the activities.

Several measures to ensure high quality at different levels of operation are set up by IDCOL. Obligatory monthly management meetings with all partner organisations are held to exchange information and to advocate mutual learning. IDCOL also establishes technical specifications for solar equipment to create a benchmark of high quality in the SHS market. The technical standard committee deals with respective difficulties. Nonetheless, key informants identified maintaining the high quality of the SHS as one of the major challenges for the future. For example, they complained about a decrease in the quality of the technical components like PV-panels.

IDCOL has established a small call centre that users can turn to for information, technical solutions or complaints. Even though IDCOL is encouraging the partners to distribute stickers with the respective phone number to all their clients, only 7% of the study's sample knew about this number. Some partner organisations offer one-day user training to convey knowledge about the usage and maintenance of SHS, which are financially covered by IDCOL. Nonetheless, not all the partner organisations have the capacity to offer them on a regular basis. Thus, only one third of the respondents stated that a household member had attended such user training.

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<sup>23</sup> The work of the technical inspectors is monitored by phone calls to randomly sampled users.

<sup>24</sup> The KfW for its part has contracted an independent international consultancy (PSE AG from Germany), that is monitoring the distribution of the SHS in Bangladesh.

### 5.1.2 Context of technology dissemination

When assessing the dissemination structure of SHS the context should be taken into account. Some of the findings regarding the market situation, demand and supply, the acceptance of the technology and user satisfaction, the longevity of the technology as well as other aspects are presented in the following paragraphs.

#### Market situation, current demand and supply

Generally, it can be stated that due to insufficient electricity supply (compare Chapter 2.2.2), there is a continuous high demand in rural areas for affordable and long-lasting SHS. In addition to this, there is also a high demand for a supply of higher electric capacity in order to operate bigger equipment like pumps, fridges etc.<sup>25</sup> Demand for SHS has also been detected in areas with access to the national electricity grid to backup grid-electricity during power cuts, which occur frequently. Partner organisations are planning to expand their business in areas connected to grid to raise sales numbers even though the SHS sold in these areas are not subsidised by IDCOL. The monthly sales numbers (17,000 SHS in 9/2009) have constantly increased and are expected to rise further. Due to the market development and the increasing sales numbers, the price of the SHS for the users has been reduced.<sup>26</sup>

The price of SHS units and the financing models to buy them are both important factors that influence demand. However, Grant A does not show the high demand creating effect that was expected. 75% of the users confirmed that they would have bought the very same system if it had been 3000 Taka more expensive.<sup>27</sup> The direct subsidies to the users were considered crucial for the purchase of SHS only by the remaining 25% of the interviewees, who on average were less well off than the rest.<sup>28</sup>

The provision of paying in instalments is very popular, as 97% make use of it. However, among the users, 27% have faced problems at some point in paying the instalment rates.

Even though all partner organisations have some kind of marketing activities, around 70% of the users obtained initial information about the SHS from other users like

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<sup>25</sup> With respect to this, a recent initiative of IDCOL is a project to build up small local solar grids, where the electricity is generated by a 1 MW solar park. It is planned that central (market) places are supplied with electricity for direct use in business activities.

<sup>26</sup> While users had to pay a total price of about 30,000 Taka for a 50 Wp system in 2003, the prices now range from 27,800 to 28,500 Taka. The yearly inflation ranged between 7% to 9% over the last years. The price for a 20/21 Wp SSHS ranges from 12,700 to 14,500 Taka.

<sup>27</sup> This amount is equivalent to Grant A, which was provided to subsidise the price for the user. The average exchange rate in August 2009 was 100 Taka = 1.019 Euro [GTZ 2009a].

<sup>28</sup> The average household income of those who would not have bought the SHS for the higher price was 20% lower than the average income of those who would have bought the system regardless.

neighbours, friends or relatives, and only around 20% by staff from partner organisations. As part of the dissemination approach, the partner organisations are encouraged to expand their sales structures with the aim that a potential customer should be able to choose between two or more partners when buying a SHS. This has been achieved in almost half of the cases, as 40% of interviewed users stated that they had this possibility at the time of purchase. Accordingly, 60% of the interviewed users still faced one supplier with a local monopoly. The extension of the sales structure is part of the institutional development supported by Grant B,<sup>29</sup> How and to which extent Grant B is used is subject to the partner organisations' management decisions.

However, stakeholders and key informants stated that competition among different partner organisations is in place. With regard to price and interest rates, bigger partner organisations profit from economies of scale. The prices for comparable systems differ among the organisations. The offered interest rate for the hire purchase varies from 8% to 15% per annum. At present, organisations do not have many possibilities to compete among each other by offering SHS of different technical quality, as technical standards are set by IDCOL.

Service capacities of partner organisations vary significantly. The ratio of numbers of SHS sold to service staff differs between 100-300 to 1 in the sample of this study. According to key informants, a ratio of 60-70 to 1 would be necessary to ensure good service. Free maintenance and after-sales services are standard practice during the repayment time of the hire purchase<sup>30</sup>. Afterwards some partners keep offering maintenance and after-sales services free of charge while others charge for it.

Some partner organisations are expanding their activities, up-streaming the value chain, like assembling and producing different components<sup>31</sup>. Furthermore, some partners have expanded their portfolio at their own expense.<sup>32</sup>

As SHS devices or components are presently not accessible to users beyond the IDCOL scheme, customers largely depend on IDCOL's partners. Only some of the

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<sup>29</sup> At the time of writing, an estimated total number of 1,600 local offices existed, with an increasing trend. Other forms of institutional development observed in the study were recruiting new employees, capacity building and training for employees, improvement of management, starting research and development activities, undertaking regional market studies, mutual learning.

<sup>30</sup> As a consequence, some users obtained their SHS on a hire purchase basis in order to benefit from after sales services, even though they could have bought the system at once.

<sup>31</sup> Originally, partner organisations focused on sales and after sales management and purchased all components from one trader. Now, some have established contacts to the suppliers of components like panels from outside Bangladesh. They now assemble parts of the SHS in specialised centres.

<sup>32</sup> For example, one partner organisation sells large SHS with higher capacity in urban areas, and equips posts and transmitters of their associated telecom company with solar panels. Another partner is introducing lanterns with LEDs that are charged with a small solar panel. The third partner organisation is developing a 5 Wp solar lighting system that is not yet on the market.

wholesalers offer much bigger solar systems to users independently. The biggest battery producer and trader in Bangladesh plans to establish decentralised service centres in the areas where SHS are distributed to allow the users to deal directly with them.

The lack of alternative supply also applies to services and maintenance. SHS are mostly sold to households and business entities in remote and rural areas where technical knowledge about SHS is rare. Here users depend on the partner organisations when seeking repair and replacement of broken parts and appliances.

### **Acceptance of the technology and satisfaction of beneficiaries**

The benefits provided by SHS seem to match the users' needs, as more than two thirds of the users interviewed express their satisfaction with the systems. More than 90% said that they would recommend SHS to relatives and friends, while 7% of the users were unsatisfied. The suggestions on how to improve the system most frequently were related to increasing the panel- and battery capacities to run more electrical devices with SHS.

Furthermore, the SHS technology is accepted and demanded by the rural population, as 80% of the interviewed non-users state that they would like to buy a SHS and two thirds would even prefer electricity from SHS over grid connection. Solar systems are considered to be related to an improvement in social status by 45% of the users and 56% of non-users who are willing to buy a SHS.

User satisfaction with the services provided by the partner organisation is lower than the satisfaction with the SHS itself. Only 65% of the users are satisfied or very satisfied with the service, 12% expressed their dissatisfaction. According to the user, service could be improved by a more reliable service, quicker response to problems, and better skilled staff dealing with the user.

The research team experienced many cases in which the users were unaware of basic terms and conditions, exact warranty periods and future costs related to the SHS and the contract with the partner organisation. During the instalment period, users with sufficient educational background or social status are able to claim after-sales services, if necessary by threatening not to pay their instalment rates. However, this power fades as soon as the instalment rates are fully paid.

Users and staff of partner organisations stated that the technical knowledge of field workers is often insufficient to deal with the technical problems at the installation site. Field workers – who are usually responsible for the installation of SHS, collection of instalments, provision of maintenance, and other services – mainly get training on the job by the technicians of the partner organisations.

The majority of technical staff and field assistants interviewed in this study expressed satisfaction with their job; some see good long-term working perspectives in the SHS

sector. While currently none of them is working freelance, some explained that they would be very interested to offer their services independently or open their own shop selling SHS appliances. In contrast, some field assistants were very unsatisfied with their salary and said that they would quit as soon as there was an opportunity.

### **Longevity of the technology**

IDCOL considers the longevity of the technology as crucial for a long-lasting success. As a consequence producers are required to give 20 years warranty on the panel, five on the batteries and three years on the charge controller. The battery is the second most expensive component of the SHS amounting to approximately 30% of the sales price, and the part most prone to lose its efficiency over the years. The share of users that had to replace the battery increases with the age of the SHS. 38% of the users who own a SHS that is older than three years old had to replace the batteries, submitting a warranty claim.

A recycling system for batteries is in the process of being established. Partner organisations are legally obliged to deliver defective batteries back to the manufacturers, who are able to recycle them. The largest battery provider, for instance, has contracts to pay the partner organisations for old batteries and collect them. While all partner organisations are encouraged to provide the user with financial incentives, some of them are already paying customers between 1,000 and 1,500 Taka for each defective battery they turn in.

### **Future developments**

Stakeholders and IDCOL are at present discussing measures to mitigate losses of SHS in Bangladesh due to heavy weather. In the past years, over 30,000 SHS have been destroyed by cyclones like Cidr (November 2007). IDCOL is considering a co-operation with insurance companies or the creation of a fund to rebuild destroyed systems in order to deal with this problem.

In the future, the SHS market could take advantage of the Clean Development Mechanism (CDM) (see page 52). One partner organisation and IDCOL have submitted two separate proposals for obtaining certified emission reductions (CER) for the use of SHS (reduced use of lighting fuels).<sup>33</sup>

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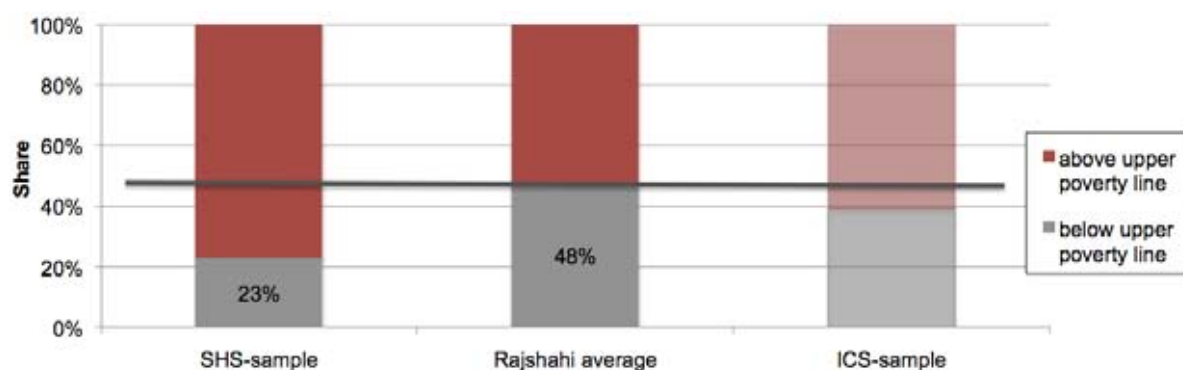
<sup>33</sup> The credited reduction in emission will be around 250 kg CO<sub>2</sub>-equivalents per SHS per year accounting for approximately \$2.25 per year at present.



## 5.2 Poverty orientation

Due to the relatively high financial investments that users have to make when purchasing a system, the SHS are per se not apt for reaching the poor. The basic approach to develop a market for SHS is not based on the attempt to provide solar energy to poor segments of the population, but to all potential customers. However, it is expected that in the long run, the establishment of a market will reduce the costs of SHS for users, so that lower income groups will be able to benefit from solar electricity to a higher extent. Key informants, staff of the partner organisations and the local Bangladeshi researchers classified the typical users as members of the middle-class.<sup>34</sup>

Nonetheless, the study findings suggest that there is a considerable number of poorer people among those who decide to buy a SHS. Applying the regional poverty line, 23% of the SHS users in the sample can be classified as being poor. Still, on average the sample is better off than the rest of the population as the SHS-owning households show higher per capita incomes (2,400 Taka per month on average<sup>35</sup>) than the national average of 1,485 Taka. Furthermore, the sample drawn for this study is significantly less affected by poverty than the rest of the population in the Rajshahi division. Here 48% live below the upper poverty line and 31% below the lower poverty line, compared to 23% of the SHS users in the sample who are living below the upper poverty line and 16% below the lower poverty line. Hence, the intervention cannot be considered to be directly pro-poor oriented following the criteria of BMZ, as less than 50% of the interviewed beneficiaries are poor and the poverty distribution is above average.



**Figure 6 - Share of people living below the upper poverty line in the SHS sample and the research region. Graph created by the authors based on calculations from authors data and from the 2005 HIES, Bangladesh**

<sup>34</sup> Staff from partner organisations and key stakeholders highlighted this fact in interviews and at the kick-off workshop (July 30, 2009 in Dhaka), as well as in the interviews conducted during the study.

<sup>35</sup> Median=1,700 Taka, SD=2,043.

Applying the multidimensional poverty tool to the SHS users in the sample, the average poverty score is 8 with score ranges between 6 and 14 points<sup>36</sup>. 14% of the households surveyed have 6 points (well-off), and a cumulative 56% of the households surveyed have 6 or 7 points, meaning they have no characteristics of poverty or minor characteristics in one dimension. However, 28% of the households in the survey are absolutely poor in one or more dimensions, the most frequent dimension of absolute poverty being social exclusion: 21% of the respondents were not socially active at all. Absolute poverty in health and lack of assets ranks second and third, respectively. Thus, around 7% of respondents reported frequent illnesses among the household members, and in 4% of the households, the majority of household members had less than three sets of clothing. Absolute poverty in the other dimensions was very rare.

The non-user survey suggests that the fact that the share of poor people among the users is lower than in the regional average is related to the price of the SHS, as poor households are generally interested in acquiring SHS. More than 80% of respondents in the non-user survey saw the potential benefits of SHS for their everyday life and reported that they would buy a SHS but that they simply could not afford it.

### **Observed approaches to reach poorer people**

During the research, the study team has identified some approaches and ideas on how to make SHS more procurable for poorer segments of the population.

*SSHS*: In order to enhance the pro-poor orientation of the SHS intervention, SED has promoted 800 10 to 21 Wp SSHS in a pilot phase from 2005 to 2006 via four partner organisations. Prices of SSHS are lower<sup>37</sup>, as the provided power is only sufficient to run a few LED and tube lights, or very small electrical appliances for a short duration.<sup>38</sup> After the pilot project, SED is now granting the distribution of SSHS under IDCOL with the aim of selling 24,500 systems by December 2009. Interviews with staff from partner organisations and the survey revealed that SSHS are mainly demanded by MSE. SED is currently planning to start a new pilot project in cooperation with DFID to test and introduce a new generation of SSHS with 5 Wp per household. The estimated costs of the 5-Watt systems are around 30 Euros. A distribution of 100,000 systems is being discussed with DFID should people be satisfied with them.

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<sup>36</sup> A score of 14 signifies absolute poverty in several dimensions; the maximum score would be 18, signifying absolute poverty in all six dimensions.

<sup>37</sup> The price for a 10 Wp SSHS is one third of the price of an average 50 Wp SHS.

<sup>38</sup> Some of the systems are also used to charge a mobile; and 20 WP systems can be used to operate pocket black and white TVs for some hours.

*Sharing:* Sharing an SHS can halve the necessary investments, allowing poorer households and MSE-owners to benefit from solar systems. Sharing was found to be more popular amongst MSE. 36% of commercial users in the sample share power from their SHS. However, users have to be located within close vicinity as efficiency of the system decreases sharply at distances of more than 6 metres from the battery.

*Payment:* A microfinance utility offered by one partner offers a smaller down-payment (10% instead of 15-20%) and a longer period of instalment rates (up to 4 years) to users. This reduces the threshold of the initial investment, as well as the monthly financial burdens. Staff from the partner organisation stated that the microfinance utility is rarely demanded, but if so it is mostly used by enterprises. None of the microfinance utility users were found in the study.

*Further grants:* Another observed approach to reach more poor people was a further granting of SHS by third parties, in this case by a governmental institution. The local governmental official took over the initial down-payment, and abolished the threshold of the high initial investments. Some of the users of these further subsidised SHS are among the poorest users of the sample. But not all of them were satisfied with the SHS, as they are now facing serious problems with the payment of instalment rates and the danger of accumulating debts (see box Chapter 5.3).

## 5.3 Impacts of Solar Home Systems

### Domestic SHS

When asked which was the most significant improvement in their home since obtaining a SHS, 60% of domestic users stated “lighting”, and 19% mentioned “study conditions”. Watching TV and fuel-saving are the 3<sup>rd</sup> and 4<sup>th</sup> most important improvements according to interviewees (see Figure 7).

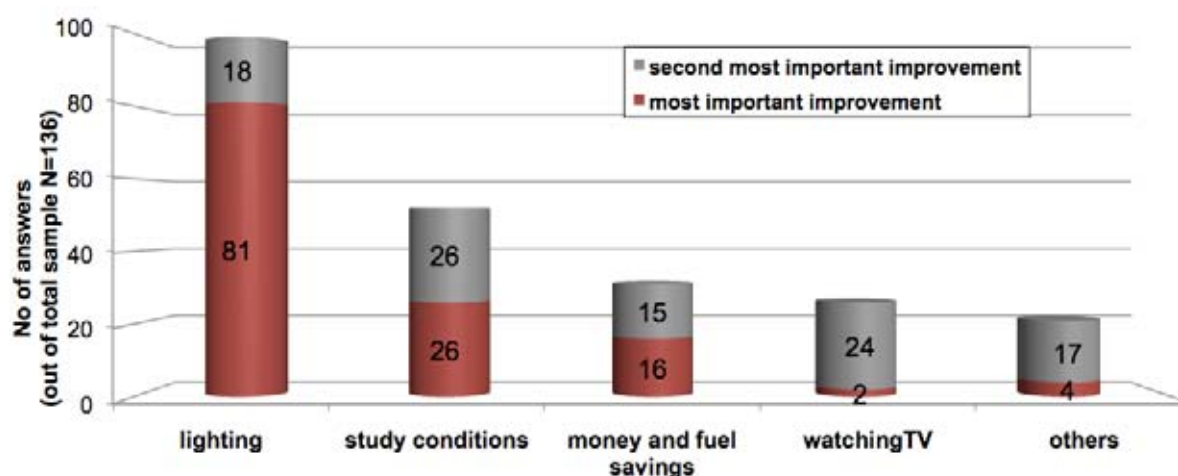


Figure 7 – The most important improvements of the SHS to households.  
Graph created by the authors based on calculations from own data

### *Improvement of study conditions for children*

For the majority of users, the SHS lights replaced the traditionally used kerosene lamps that implied a wide range of discomforts as well as a potential fire hazard in the homes. Moreover, burning of kerosene implies health threats due to air pollution and toxic fumes, another reason why the cleaner alternative of electric lighting is highly appreciated. While more than half of the SHS users in the household sample find the air quality improved, 44% find no change.

A great number of interviewees stated the improvement of study conditions for their children in the evenings as a main reason to buy the SHS and as one of its major benefits. Statistical analysis reveals that on average, primary school boys read 1.7 and girls 1.9 hours per day with electric light, and boys/girls at secondary school age read 3 and 2.5 hours respectively with electric light. While electric light does enhance the reading comfort and the conditions for pupils to do their homework, it is difficult to judge the role this plays in achieving more highly aggregated impacts, e.g. an improvement in the educational status. In a group discussion in one of the research sites, teachers pointed out that the performance of pupils who could now study over electric light had not improved in comparison to former times. However, the improvement of study conditions through electric light is a significant impact on the human dimension of poverty.

### *Health*

Asked about their perception of SHS-related changes in their health status, 55% of respondents in the household sample found no change and 44% asserted an improvement of the family's health condition since the acquisition of the SHS. The use of SHS had both a direct and an indirect impact on the health situation. Direct impacts are related to less smoke or cleaner living conditions. As for indirect impacts on the health situation, better access to health-relevant information through TV or radio was considered to be a benefit, even though there are other more relevant sources of health information.

### *Access to information*

The use of SHS also has an impact on access to information in general, particularly through TV in cases where people did not have a TV before. 62% of the households found that their access to relevant information has improved due to the SHS. In the statistical sample, the average number of times people watch the news per week rose slightly from four times before the installation of the SHS to five times afterwards. While radios are hardly ever used in combination with SHS, some interviewees indicated that they use news services via their mobile phones. Others appreciated that they could now read the newspaper in the evenings under electric light.

The improvements in access to information described here can have poverty-reducing impacts on the political as well as the human dimensions of poverty. However, since poorer customers may not be able to afford the additional investment for TV, almost all information-related impacts are likely to only materialise for those SHS owners who – in financial terms – are relatively well-off.

**Case study: The Madrasa teacher**

Mr. Mohammed Tazlimur Vutto (name changed) is a Madrasah teacher in his 30s living on a small island in Northern Bangladesh, where he also has some agricultural land. Since his wife left him, he is living alone. At night, he cooks his own food and gives lessons in Arabic to some of his students from the Madrasah. He has a small 20 Wp Solar Home System with which he can operate two lights and a very small black and white TV, as well as charging his cell phone. “It is very important to have the solar home system for giving classes”, he says. “I felt I needed it for teaching, and now I can also watch the news and at night I can cook and I am free from darkness.” Having the TV, he feels better informed and his friends go to his house more often because of the electric light and TV. Before he bought the SHS, he used a kerosene lamp and sometimes a small battery to run a light bulb. The SHS has made a huge difference for him, as he can leave one light on all night and it allows him to earn some additional money through tuition. He intends to save this money and invest it in land. If grid electricity was available in his home town, he would have opted for that because “then I could watch TV for more time and we could use a motor for irrigation which we cannot use with the SHS.” However, when his savings allow him, Mr. Vutto also wants to change his SHS into a bigger one with which he can run more lights, a fan and perhaps a CD player.

*Communication*

While only few users name mobile charging as an important benefit of the SHS, more than 60% of the interviewees indicate that their possibilities of communicating have improved due to the SHS. Three quarters of the households already had a mobile phone before buying the SHS. The main benefit reported is therefore having it regularly charged, without having to rely on shops that charge cell phones. Women with family members working abroad particularly appreciated the increased accessibility via phone.

*Social activity*

The majority of users responded that their social activities had not changed since the acquisition of the SHS. In those cases where respondents did assert a change in social activity, the trend was rather a decrease than an increase, as respondents stay at home more than before to watch TV, or use mobile phones instead of visiting people. For children, a decrease in social activity was mostly caused by longer studying times. On the other hand, watching TV at home with friends was the main reason for an increase in social activity for both adults and children.

### *Perception of safety*

Around 40% of the respondents that commented on their perception of safety find their safety improved since the acquisition of the SHS, while 60% do not. Different reasons were revealed why people feel safer due to electric light in and outside their house: they expect that thieves will refrain from breaking into a lit home, and they feel less insecure going out to the yard at night to receive a guest, or to use the bathroom, which is often located outside at some distance from the house.

#### **Case study: Reduced danger from snakes**

Mrs. Johanara and her husband Nazrul Haque (names changed) live together with three of their five sons, one daughter-in-law and three grandchildren in a small village beside a river in Kachua, in the northern part of Bangladesh.

Mrs. Johanara lost her eyesight eight years ago, and has stayed at home since then. Her husband, a former fighter in the liberation war, is a farmer and earns about 3,000 Taka per month. He takes care of his wife and of the household. Over a year ago, they bought a 40 Wp Solar Home System .

Both appreciate the benefits of the SHS. They were very unhappy with the kerosene lamps they used before as the lamps were frequently blown out by the strong wind from the river. The family had quite high expenditures for kerosene in the past. Because of the snakes in the region, they always left one lantern lit at night. Now, with the electric light, they feel much safer, as they can see the snakes better at night. However, because of the costs for medical treatment for his wife, Mr. Haque was not able to pay the instalment rates for 3 months. The payment of the instalments was postponed.

### *Workload and working comfort*

For the great majority of people in SHS-households, the SHS does not have an impact on their overall workload, but on their working comfort. Only 5% of respondents said that their workload had decreased due to the use of the SHS, while 10% explained that it had increased. Interviewees generally explained that due to the lighting in the evening, they now had more time to do the same work. Particularly women, who do the main household work, perceived this as a very positive change.

The overall result of the survey is that SHS in private households are hardly used for income generating activities (in less than 3% of all cases).

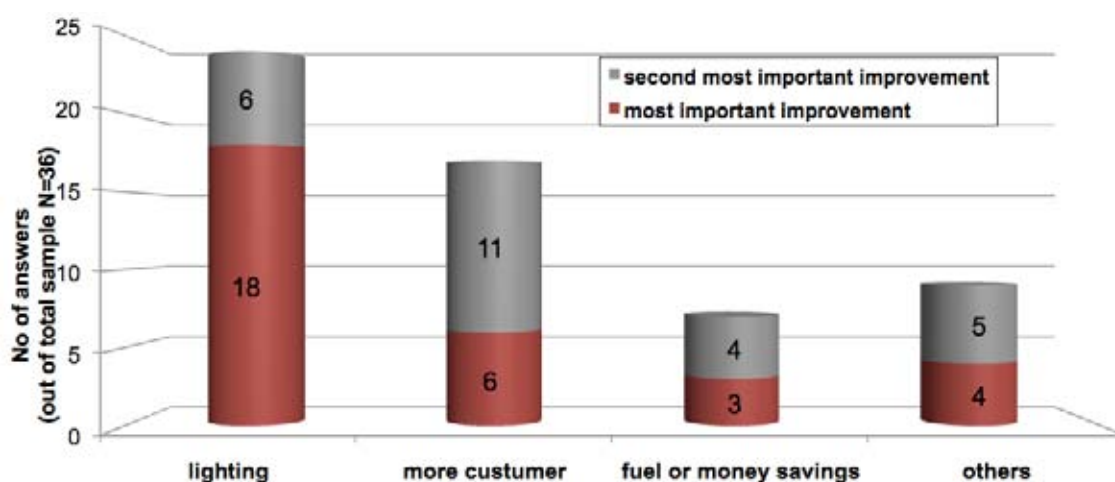
### *Money-saving*

While SHS are usually not bought with the expectation of saving money in the short term, most users expect money savings in the long run. Indeed, the survey reveals that once the system is paid off, most users are actually able to save money in comparison to their former energy expenditure (most importantly, expenditure for lighting fuel). In very few cases (4%), the instalment rates paid by households are lower than its average monthly kerosene spending was, so these users save money immediately after the initial down-payment.

Respondents in most households explained that they used or intended to use the saved money for all kinds of daily expenditures. Some intended to invest the money or deposit it as savings. However, it is not clear how many users are aware of the high expenditures they are likely to face soon after the five-year warranty period of the batteries has expired (see chapter 5.1). In most cases, these replacement costs would probably lower or even neutralise the savings in energy expenditure.

### Commercial SHS

For commercial SHS users, the most important impacts are increased profit due to longer opening hours and savings in energy expenditure (see Figure 8).



**Figure 8 – The most important improvements of the SHS to MSE.**  
Graph created by the authors based on calculations from own data

#### *Income-generating effects of SHS*

More than half of the interviewed shop-owners – typically in teashops, grocery stores and small restaurants – explained that their profits rose through the SHS. Besides lighting, TV is an important factor in attracting customers in over half of the cases. Furthermore, over three quarters of the commercial users of SHS stated that they have extended their daily working hours in their business since using the SHS, by an average of two hours.

The SHS considered in this study generally do not have enough capacity to be used for electrical appliances that could be used in production, such as heating lamps in poultry farms, irrigation pumps for agriculture, or mobile phone charging on a larger scale. Around 10% of the MSE in the sample were also connected to the grid, but considered the SHS to be very important as backup, since power-cuts usually occur precisely in the evening hours when they need lighting for their business activities.

#### *Money-saving*

Savings in energy expenditures are more pronounced for MSE than for households and occur after a shorter period. For seven out of 36 assessed MSE, current energy

savings already exceeded the instalment rates, with savings ranging between 650 and 3950 Taka per month. All MSE owners in the sample shared the perception that they could save on energy expenditure thanks to the SHS in the long run.

#### *Investments and job creation*

Three quarters of interviewees stated that they were planning to invest the increased profit into their business. Furthermore, the additional money is used for private savings, family support and education, and investments in property. Business expansion resulted in the creation of a new job in only three out of 36 cases.

As in the case of household users, it is not clear whether MSE owners are aware of the likely future costs for replacing the SHS battery.

It can be resumed from the insights gained on increased income, money-saving and investments that poverty-reducing impacts from solar systems in MSE occur mainly for the owners of MSE and their families. Although there is a low ratio of job creation, some of the jobs created could be suitable for poor people, as work in restaurants for instance is considered to be unskilled labour.

#### *Information and safety*

An informational benefit that is particularly relevant for business people is access to information on prices and market developments through mobile phone and TV. This is something that people who do not own a SHS can also benefit from (see below). While improved safety was less relevant for MSE than for households, some shop owners did also appreciate the electric light as protection against robberies.

### **Impacts on SHS technicians and field assistants**

The expansion of the SHS sector results in the creation of permanent jobs for management staff, diploma technicians as well as for assistant field staff and some trainers. The necessary qualifications – engineering diplomas for technicians and higher secondary school certificates for field assistants - as well as cultural expectations limit job creation mainly to less poor and male workers. While jobs requiring field visits are not considered acceptable for women in Bangladesh, women with engineering degrees do work in the technology centres of the largest partner organisation, where they assemble SHS appliances and give user training. The female technicians who were interviewed characterised the working environment of these technology centres, which also offer accommodation, as very good. Assembling SHS appliances at home also offers additional income, creating opportunities for women working for this partner.

The job creation results in financial and status-related impacts for people working in the sector and for their families. While the technician's salary ranges between 7,000 and 9,000 Taka per month, field assistants earn around 2500 Taka per month which



is approximately equivalent to the national minimum salary. Besides using the money for daily expenditure, they usually support their family with parts of the income they now earn. Some also reported that they had a savings account or were planning to invest in a house or other assets.

Interviewees furthermore reported that they “felt safer in society” now, that their families were proud of them and that they enjoyed being able to receive training and interact with more educated people than before. Consequently, job creation in the solar sector has poverty-reducing impacts in the economic, social and human dimensions, which in some instances are also relevant for the issue of gender equality.

### **Impacts beyond the users in villages with SHS**

Non-users did not readily report many positive impacts of SHS-use in their villages. Asked more specifically, however, more than 50% of the people without a solar system in SHS villages feel that they can benefit in some way from the fact that other people have a SHS, e.g. through improved access to TV and information from TV-owners, charging mobile phones in SHS-using households or in shops, and a feeling of improved safety due to lighting in public areas. Mainly, the male population benefits directly from TV in public places as women do not usually go to teashops or market places to watch TV. Sharing the benefits of SHS appliances in private homes is determined by social stratification, as the poorest are usually not invited to the homes of the well-off households. In areas where grid connection is not available, village people and MSE owners have the perception that solar electricity mainly boosts the economic activities of shops and restaurants.

### **Unintended impacts**

In the entire sample, around one fourth of SHS users were facing problems paying their instalment rates. Partner organisations also reported sporadic cases in which they had taken back SHS from users who were not able to pay. The obligation to pay instalment rates over a long period poses a risk for poorer users in particular, since the rates bind money that cannot be used to cope with unexpected shocks.

The case study presented in the box below illustrates the potential negative effects that may occur when households buy or are convinced to buy an SHS which is beyond what they can afford. However, the risk of becoming indebted is generally mitigated by the possibility of giving back the SHS to the partner organisation in case of insolvency, thereby being released from payment obligations<sup>39</sup>.

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<sup>39</sup> Partner organisations have different regulations for returning SHS or exchanging them for a different capacity. Usage period is taken into account and typically results in a 75% price return after 1 year, 50% after 2 years, etc.

**Case Study: Increase of household expenditure**

Uddin Islam (name changed) lives on Shridev Chor island, a remote place in the North-Western area of Pirgacha/Rangpur. He earns the income for his family as a day labourer in the trade sector. The household income of 3,000 Taka per month is not enough to ensure nutrition for all the seven household members. During the last year, it was quite a common occurrence for some of his household members to go without three meals a day due to food shortages. The 50 year old man is heading one of the poorest households the study team talked to, showing characteristics of extreme poverty in four out of six dimensions.

Together with 24 other families, Uddin Islam was selected by a campaign of the national government's local representative (TNO/Thana Nirbahi Officer) to benefit from the distribution of SHS. Even though the TNO made the initial down-payment, he was sceptical from the outset. But he was not asked and had no other choice than to take the SHS.

For the past four months, he now has a 40 Wp solar panel on his rooftop and a battery in the house, with sufficient capacity to run a TV and charge mobiles. But both are expensive and the family neither possesses a TV nor a mobile phone. Even though he uses the lights in the evenings, he considers the SHS as unnecessary. Mr. Islam is struggling hard to pay the monthly instalment rates that the employee from the partner organisation is collecting every month. The 600 Taka is a lot of money for the household, compared to the 50 Taka they spent before on kerosene. They urgently need the money for other purposes. When asked if he would recommend the SHS to his relatives and friends, Mr. Islam said "No".

Finally, negative impacts on the environment pose a serious risk: the dumping of old batteries could potentially neutralise all positive environmental impacts, if not worse [Mulder 2008]. While a recycling system is currently being established, key informants reported that a substantial number of defective SHS batteries are just sold or thrown away. In both cases, the battery acid and other toxic substances are released into the environment without proper treatment. Since battery leakage was also reported as a maintenance problem by one partner organisation, health problems resulting from battery acid may also pose a risk for current SHS users.

## 5.4 Conclusions and recommendations

To round up the results obtained in the study, the following conclusions and recommendations first address the question of sustainability of the dissemination structure as outlined in chapter 5.1. Then, conclusions on the aspect of poverty orientation are drawn from the findings, and suggestions are made on how to improve benefits for the poorest segments of society. Finally, conclusions from the impact assessment are described in order to elaborate recommendations on how to enhance positive impacts and mitigate negative impacts.

### 5.4.1 Enhancing the sustainability of the dissemination structure

The overall set-up of SHS dissemination in Bangladesh can be considered a role model for approaches in other countries. The combination of a sales approach with payment in instalments leads to a high and increasing number of SHS sold in Bang-

ladesh. The involvement of organisations that distribute the systems in a profitable manner is creating a dynamic solar sector in Bangladesh that can provide sustainable business opportunities. The dissemination scheme is on the right path to reducing existing barriers to establish an SHS market. Independently from the provided grant support, market creation has led and is still leading to decreasing prices, considerably increasing the number of potential customers. A further market penetration is likely to entail an ongoing extension of the sales structure, as well as institutional development of the partner organisations. The incentives in the dissemination structure are generally set out in a way that encourages all stakeholders to establish sustainable and long lasting structures and economic relations.

As the market is not yet completely established, the market power of the majority of users and potential customers towards the partner organisations is still relatively low. This lack of power is mitigated to some extent by the quality-assuring measures taken by IDCOL. In addition to this, the strong role of IDCOL enables stakeholders to learn and improve. The success of the dissemination scheme still depends on the management and monitoring activities of IDCOL, as well as the incentives set and the financial support provided by international development partners. The study concludes that the IDCOL programme has taken the necessary measures to establish a self-sustaining market and is dealing with crucial issues related to sustainable market development in a proactive, efficient and comprehensive manner. Further support of the IDCOL programme is highly recommended until the market is fully established.

### **Phasing out subsidies**

Under the current design of the distribution structure, IDCOL is not generating profits from the distribution of solar systems as such to cover its management costs. IDCOL's ability to operate therefore currently depends on the management fee paid by GTZ and KfW. As the distribution of SHS is a capital-intensive business, partner organisations at present highly depend on soft loans for refinancing the SHS. It can be assumed that without these loans, under the current sales model of hire purchase contracts even the bigger partner organisations would face problems running a profitable business without raising their prices. The long-term success of an established market for SHS in Bangladesh will therefore largely depend on an ongoing provision of soft loans to partner organisations for refinancing SHS.

However, according to key informants from larger organisations, larger partners would be able to operate without Grant A and B from now on, since they are benefiting from economies of scale and can use various approaches for reducing the SHS base price, e.g. by assembling SHS components themselves. In addition to the financial aspect, Grants A and B and the soft loans have an additional quality-assuring function as they oblige partner organisations to comply with IDCOL regulations and monitoring. As Grant A influenced the purchase decision of only 25% of customers in

the sample, it is considered to be the least important component in the financing structure. Yet its benefit is facilitating access to SHS for comparatively less affluent households.

Subsidising SHS distribution should continue until the market is completely established. However, the study recommends the reconsideration of the weighting of the different grants. The foreseen phasing out of Grant A should lead to smarter subsidising, targeting resources to those cases where the grant is decisive for the purchase. As the demand-creating effect of Grant A is present among less affluent user groups, granting lower capacity SHS (including SSHS) should continue, while Grant A could be ceased immediately for larger capacity SHS.

The amount and the phasing out of Grant B should be reconsidered, reflecting the relevance of further sales structure extension and other institutional developments of the partner organisations. In order to further contribute to the institutional development of a variety of market participants, including those who face disadvantages in economies of scale, a larger financial support for smaller partner organisations could be considered.

IDCOL should retain its strong position in the distribution structure until a self-sustaining market is established, and the management fee for IDCOL should be maintained until that time.

### **Enhancing user satisfaction and local capacity for quality services**

The general management capacities of the partner organisations seem to be relatively high, allowing them to deal with and react to changes in the business environment. Yet it seems that the partner organisations do not place adequate emphasis on user satisfaction and issues like after sales service, but focus mainly on sales numbers as an indicator of good performance. Since the field assistants meet users on a monthly basis, the preconditions for a management towards user satisfaction are actually very good. Nonetheless, the transmission of relevant information from users to management staff is not always assured.

In the present study, a lack of capacity, know-how and sometimes motivation in regional offices to provide adequate information and services was observed. While staff in leading technical positions have good technical knowledge, field assistants frequently lack technical knowledge to deal adequately with occurring maintenance problems. As service is the least profitable part of the organisations' business activities, it is also prone to receive little attention. Technical maintenance in remote areas is costly and time-consuming, and partner organisations face no incentives to provide services after the SHS is paid off. In many areas, competition between partner organisations is not yet established to a degree that allows customers to choose be-

tween different providers and claim quality services. Neither is marketing done to an extent that all potential customers are aware of the different offers available in an area in which several providers are already established. Furthermore, many users are poorly informed about the terms and conditions of their SHS contract as well as about proper usage and maintenance. While this is partly due to staff shortages – some partner organisations currently do not have the capacity to offer user training on a regular basis – the research also revealed that particularly poorer and less educated customers frequently do not get quality services.

As part of its capacity building activities, SED should support the abilities of the partner organisations to manage their activities towards user satisfaction, in order to ensure a sustainable demand for SHS in the long run. The overall ratio of service staff to customers needs to be increased. In view of the low qualification of field assistants, capacity building for them especially should be improved, or the selection criteria changed for people with higher qualifications.

More local technology centres for assembling SHS should be established, leading to a decentralisation of SHS supply, additional job opportunities for women, and increased local capacity to offer user training. SED could support this financially as well as with training (business start-up, technical training, and training of trainers for user training). Furthermore, SED should continue to support local information and marketing campaigns in order to ensure competition and maximise the market power of the customers.

Since there are no local service providers outside the partner organisation structure and hardly any SHS components and appliances available in the free market, users are currently very dependent on the partner organisations' support. Initiatives as by the largest battery provider to establish its own service centres, as well as the complaints hotline introduced by IDCOL, are adequate measures to decrease users' dependency on the partner organisations and to strengthen their market power. Key informants pointed out that the only solution to ensure quality services was to build on local knowledge, enhance local capacity and diversify service and supply options.

SED should consider providing start-up support for local technicians interested in opening their own shops with SHS appliances, and offering freelance services. Apart from the financial support through Grant B, SED should wherever possible support partner organisations' and other providers' initiatives to decentralise their structures. Such support could consist, for example, in a public-private partnership with battery providers to establish local service, sales and recycling points for SHS batteries.

## Monitoring

Currently, monitoring of the programme is only conducted by IDCOL, focusing mainly on the quantity and technical aspects of distributed SHS. A systematic monitoring of the results of the intervention is not implemented by any of the stakeholders involved. There are neither guidelines for partner organisations on how to make use of Grant B, nor a systematic monitoring of their institutional development.

SED should introduce independent result-orientated monitoring with a special focus on impacts of the project interventions. The monitoring should also encompass partner organisations' use of Grant B and should be established in collaboration with KfW. Furthermore, a system on how to monitor success (beyond the number of SHS sold) should be developed with the partner organisations. Their abilities to monitor their own institutional development as well as the quality and results of their work should be strengthened through additional capacity building. The monitoring system should also include measures to establish a systematic exchange between users and the partner organisations' management, enabling the latter to better govern their activities towards user satisfaction. In line with this, the reports that IDCOL demands from the partner organisations should be amended with information concerning results, e.g. use of the SHS. IDCOL should monitor that the complaints number is being attached to newly installed SHS and ensure that users know about the complaints centre.

## Ensuring that the benefits of SHS distribution will last

SHS distribution is only sustainable if long-term viability and usage of the solar systems can be ensured. The breakdown of batteries as the second-most expensive part of the system is a critical juncture, since it is expected after 6 or 7 years of usage, long before the 20-year guarantee on the solar panels ends. Shortly after the end of the warranty date, users will thus have to make an investment which is higher than the initial down-payment for buying a SHS. Five years after the beginning of the distribution, it was too early for the present study to survey how many people will replace batteries with their own money after the end of the warranty period. However, considering the users' expectation to save money after paying off the SHS, it can be assumed that at least some users would rather stop using the SHS than paying one-third of the original system's price at once to buy a new battery. Additional hire chase schemes could mitigate that threat and have already been discussed in IDCOL management meetings.

Partner organisations should try to integrate battery replacement into the current SHS financing schemes. They could offer customers to pay for new batteries in instalment rates, or to include the financing of a second battery into the initial contract

(with an extended payment period). SED could support such schemes by providing a revolving fund for refinancing the hire purchase for batteries, for example.

In addition to the core activities of the solar programme, other developments, initiatives and actors within and beyond the scope of IDCOL are important for a successful market introduction. Despite the guarantees given by producers, key stakeholders asserted a decrease in quality of SHS appliances and pointed out that a testing centre for SHS items and appliances should be established.<sup>40</sup> A measure to reduce the overall price of the solar systems and boost local economic production, would be to assemble the solar panels in Bangladesh instead of importing them. Finally, as insurance companies show little interest in offering solar panel insurances against weather damage, a fund or other measures would probably be needed to finance these.

SED should consider supporting the establishment of insurance for solar panels. Such support could consist in the creation of a recovery fund, as well as adequate lobbying activities. In addition, SED should think about ways to foster testing capacities, either by way of a central test centre in Dhaka or through enhancement of the testing capacities of partner organisations. Furthermore, SED could also consider ways of backing the initiatives for local SHS panel assembly.

#### **5.4.2 Working towards poverty orientation**

Applying GTZ's criteria, the current programme cannot be considered to be directly pro-poor oriented. Although an established market for SHS reduces costs, it also cannot be assumed that the poorest households would automatically benefit from an established and self-sustaining market in the future. The technology itself shows limitations for the use of poor households. Apart from relatively high initial investments for the SHS itself, users need to dispose of additional appliances to benefit from all its advantages. Furthermore, a certain solvency is needed to be able to afford continuous instalments. As instalment rates in the offered payment schemes usually far exceed poor households' current energy expenses, economic savings in the long run may not justify the high investment in a SHS.

SED and other stakeholders have taken promising measures to make SHS accessible for less affluent segments of the population. The past and ongoing promotion of

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<sup>40</sup> While IDCOL sets the technical standards and approves SHS items, it does not have the capacity to test them.

SSHS by SED has introduced cheaper systems. While 10 and 16 Wp systems are currently not available on the market, the support of the 20/21 Wp system can be considered a success in terms of quickly growing sales numbers since the beginning of 2009. The incentives for partner organisations to make special efforts to sell SSHS (higher Grant B) appear to be set in the right way. The current intent of some partner organisations to develop and market even smaller 5 Wp SHS and the plan to add solar lanterns to their portfolios are very positive. On the one hand, these are much cheaper than standard SHS and can be afforded by poorer households. On the other hand, it should be kept in mind that the poverty reducing potential of low capacity solar systems and devices is mostly limited to those impacts which are related to electric light.

As SSHS are more suitable for reaching poorer people, it is recommended that SED continue its support to further integrate them into the market, and prolong it after the expiry of the current contract with IDCOL in December 2009. Through consulting, financial support for pilot projects and the provision of grants, SED should also encourage attempts by partner organisations to make even smaller SHS marketable.

It is not only the total price, but also the type of financing model that limits the access of poorer people to SHS. Comparing SHS prices with the median monthly incomes of SHS-using households, it can be assumed that only a very small share of the customers interviewed would have been able to afford the SHS by a one-time payment. The micro-finance utility with a lower down-payment and longer repayment period (currently offered only by the biggest partner) has the potential of attracting low-income customers, as the initial payment constitutes a high threshold for them.

The instalment model should be maintained, and partner organisations should consider introducing a broader range of payment options with lower down-payments and longer instalment periods. SED should support partner organisations in the development of financing models that meet the needs of poorer households. Such models could include flexible rates and different payment patterns, such as weekly or seasonal payment. All partners should be encouraged to apply respective models to lower the hurdles for the poorest potential users. Since such models result in a greater finance gap for partner organisations, it would have to be assessed if offering such models is financially viable for them. Otherwise SED could consider creating a special fund for micro-finance utility models and similar pro-poor payment options.

SHS-sharing shows some technical limitations as the maximum distance between the battery and appliances cannot be more than six metres away and the owner has



limited control over the energy used by others. Nonetheless, sharing is a way to make SHS affordable for poorer people and offers a lot of potential.

The possibility and potential of SHS-sharing should be promoted by the marketing activities of the partner organisations.

Poor people do not benefit much from job creation by solar technology. While jobs that can be created by commercial SHS use are jobs which poor people could fulfil (e.g. assistant jobs in a restaurant), such job creation is not taking place on a large scale. Jobs in the solar business are mainly for more highly educated people; only field assistants sometimes show a background of poverty. However, the approaches of some partner organisations to link their solar business activities to vocational training for disadvantaged people are good attempts to create jobs for poorer people.

SED should encourage and assist partner organisations to establish local technology and training centres. A further measure to support sustainable pro-poor job creation would be to develop (on the job) training concepts for poorer people, ensuring the high quality of their work.

#### 5.4.3 Enhancing positive and mitigating negative impacts

With the exception of economic impacts related to expanded business activities, the study was able to confirm most expected impacts. In major relevant areas like communication and information, study conditions and health, the electricity from SHS creates favourable conditions for improvement, but for more highly aggregated impacts, the influence of other factors is decisive. Thus, for instance, a family's commitment to education has a higher influence on the studying hours of its school children than the source of light. Contrary to expectations of HERA and EnDev, the study found almost no new business activities or direct use of the electricity for income generation. Even though the use of electric lights leads to an extension of working hours and a rise of profit in rural MSE, hardly any job creation was observed. This is due to the limitations of using SHS for income relevant activities.

In order to create income generating impacts, it is therefore recommended to promote solar systems with a higher capacity, which are suited to running appliances like irrigation pumps. In addition to the development of individual solutions, a suitable measure could be the support of attempts by IDCOL to build solar mini grids in remote areas.

SHS do not always have positive impacts on the users' financial situation. While immediate money-saving only occurs in MSE or households with above-average energy expenditure, the obligatory monthly instalment may limit the household's ability

to react to economic shocks or, in some cases, to afford necessary daily consumption.

To prevent the possible negative impacts on daily needs expenditure due to instalment rates, the solvency of the user has to be considered when selling SHS. SED has to be aware of the financial conditions of the target group when developing special approaches to reach poorer people with micro-credit instalment schemes.

SHS are not the only source of electricity in rural Bangladesh. Almost half of the SHS owners had employed electrical appliances like radio and TV before, mainly through the use of storage batteries. As the extension of the national grid in rural areas is ongoing, some SHS clients were connected to the grid a short time after buying the SHS. Although the IDCOL programme only grants SHS in non-electrified areas, IDCOL and the partner organisations are currently not taking national plans for grid extension into account for selecting special areas of operation for SHS promotion.

From a development perspective, the distribution of SHS to remote areas where grid connection is highly unlikely should be a priority in the coming years.

Stakeholders are aware of the potential negative environmental impacts of SHS distribution, mainly through inappropriate treatment and disposal of defective batteries. Nevertheless, some batteries are thrown away or sold by users. As a retraction and recycling system for the batteries is just being established, at the time of writing it was still uncertain whether the incentives in the system are strong enough to ensure that all batteries will be returned to the recycling system after usage in the future. Additional incentives could be integrated into the suggested hire purchase models (see above) for replacement batteries, e.g. by discounting a certain sum for the old battery, and making delivery of the used battery a precondition for buying a new one.

SED should support the development of the retraction and recycling system, encouraging all partner organisations to inform their customers about the hazards of inappropriate battery treatment, and to repay them for returning defect batteries. In line with this, SED could support the partner organisations in raising awareness about recycling, or target Grant B to the development of a functioning retraction system. Incentives for recycling should form part of all hire purchase models offered to replace batteries. The effectiveness of the incentives for battery recycling has to be monitored and, if necessary, adapted to ensure that all batteries are returned.

## 6 Results of Improved Cook Stove Assessment

To assess if a self-sustaining market for ICS will develop, the dissemination scheme implemented by SED is described in its context and analysed with regards to sustainability. Then, it is analysed to what extent the poorest segments of society are currently benefiting from ICS interventions. The first two chapters on ICS dissemination and poverty orientation enable the actual impacts of the technology disseminated through SED to be interpreted and understood. These are analysed in detail in chapter 6.3.

### 6.1 Dissemination structure and context

The dissemination of ICS under SED only started in 2007. Experiences of how to implement a stove project of such scale were limited. Different approaches have been tried so far and the successive learning process of SED led to the present cooperation with partner organisations, described in the following paragraphs.

#### 6.1.1 Description of the dissemination approach

SED's present approach mainly comprises financial support to partner organisations to encourage the dissemination of ICS. However, it also includes aspects of training, technical support and marketing. The partner organisations are the intermediary link between users and stove builders. ICS are used in households (domestic ICS), by MSE and social institutions such as schools and community centres (institutional ICS).



Figure 9 – Stakeholders involved in ICS dissemination. Figure created by the authors

Customers normally obtain an ICS through the partner organisations, which either employ or contract stove builders to build the ICS. Stove builders install the ICS and

the customer pays either directly to the stove builder, to a supervisor or to the partner organisation. Some partner organisations offer payment in instalments. Figure 9 gives an overview of the dissemination structure of SED's ICS activities. It includes external actors, namely SZ Consultancy, bundling emission reductions from ICS to be traded with Climate Care.

SED covers the costs of stove builder and supervisor training, financially supports the marketing activities of partner organisations and the development of chimney manufacturing facilities. In addition, partners receive a grant for their institutional development (typically 100 Taka). Formerly, the partners also received a revolving fund as start-up support, which is phased out over two consecutive contracts and has to be used for continuation of ICS dissemination. Since May 2009, this revolving fund is no longer disbursed to new partners, but partners now receive financial incentives for their stove builders for each ICS (compare Table 4).

Over time, the terms and conditions of the financial agreements between SED and the partner organisations have been frequently adapted. The agreements, which are generally prepared by SED and then countersigned by the partner organisations, usually cover a time span of half a year. For this time span SED sets a target of a certain number of ICS (typically 300), which the partner organisation has to distribute. SED requires that 95% of the distributed stoves must be of sufficient quality and that 75% of the stoves must be in regular use.

Financial contributions	1 <sup>st</sup> contract	2 <sup>nd</sup> contract	3 <sup>rd</sup> contract
For training of stove builders	113,000 Taka	113,000 Taka	113,000 Taka
For marketing activities	30,000 Taka	30,000 Taka	30,000 Taka
Chimney manufacturing facility	20,000 Taka/facility (50% of costs for manufacturing plant)		
Institutional development grant	100 <sup>41</sup> Tk/domestic ICS 500 Tk/institutional ICS	100 Tk/domestic ICS 500 Tk/institutional ICS	100 Tk/domestic ICS 500 Tk/institutional ICS
Revolving fund (until May 2009)	240 Taka/domestic ICS 1600 Tk/institutional ICS	120 Taka/domestic ICS 800 Tk/institutional ICS	None None
Incentive for stove builders (starting May 2009)	250 Taka/domestic ICS and 500 Taka/institutional ICS) (The incentive for stove builders is supposed to be paid until the partner organisations receive money from the CDM)		

**Table 4 – Overview of SED's financial support for partner organisations, created by the authors based on information provided by SED.**

SED pays the partner organisations according to written invoices and technical reports submitted by the partners, which are verified by an authorised auditor.

<sup>41</sup> This sum can be raised to 200 Taka/domestic ICS to compensate partners that have special approaches to targeting poor households or indigenous people.

Complementary to the financial agreements with the partners, SED organises network meetings with partner organisations every three months. With regard to capacity building at the level of partner organisations, SED does not provide training for management, marketing or specific distribution strategies for ICS, as partners are expected to have adequate skills and capacities when starting cooperation with SED. In order to facilitate the distribution of ICS, partner organisations have to rely on stove builders. Therefore, SED funds the training of 25 stove builders for each partner organisation early in the contract phase.<sup>42</sup> The training is organised by the partner organisations and trainers are usually coordinated by SED.<sup>43</sup> The training of stove builders focuses on technical aspects of ICS like the design, materials used and the construction process. Initial attempts also included marketing or business skills in order to assist stove builders to start proper businesses. Since SED did not consider these latter aspects successful they no longer form part of present training. Additionally, more extensive training is offered to stove builders who are intended to work as supervisors.

The process of identifying and selecting potential stove builders varies amongst the partner organisations. Training is announced through different media (e.g. local newspapers etc.), yet only few of the assessed partner organisations have clear criteria for the selection of participants for the stove builder training.

Most of the stove builders are working on a commission basis<sup>44</sup> and get paid relative to the number of ICS they build. Maintenance services are usually not paid. Only one partner organisation pays the stove builders a fixed salary.

Stove builders mainly install the ICS, and in some cases they are also involved in marketing activities. Furthermore, all assessed partner organisations considered the responsibility for after-sales services to belong to the stove builders.

### **Management, monitoring and quality assurance**

SED currently works with 165 partner organisations. NGOs and enterprises who want to cooperate with SED have to build 100 ICS before they can become an SED partner organisation. Other formal selection criteria for partner organisations are not documented and the selection is based on the judgment of the SED staff.

The current monitoring of the ICS intervention consists of reporting by partner organisations on the implementation of their contracts, which are verified by an external

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<sup>42</sup> Contributions to the partner organisation equate to approximately 110,000 Taka for the training of 25 stove builders.

<sup>43</sup> SED works with eight trainers, of which only one partner organisation offers training on its own.

<sup>44</sup> Though many of the partner organisations claim that the stove builders are employed on a fixed basis, in most of the cases the stove builders get paid per ICS built.

auditor. Partner organisations submit a work plan after signing the contract, deliver progress reports, a technical final report<sup>45</sup> and a financial statement at the end of the contract period. Then, a financial auditing is conducted for each contract, including a physical inspection of a random sample of the stoves. The final payment is then disbursed and may be adjusted according to the results of the audit.

Recently, a first one-time impact monitoring was commissioned by SED. Nielsen Company – an independent consultancy – has the task of assessing the existence, impacts, and usage patterns of the ICS in households. So far this is the only assessment that includes older stoves from earlier contracts.

One of the partner organisations assessed by the present study carries out its own user surveys. However, none of the other partner organisations appeared to have established systematic monitoring approaches of their own activities. Except for the information given in the final reports, no additional information about their activities was available.

### **6.1.2 Context of ICS dissemination**

The ICS dissemination structure, as it has been developed so far, is embedded in a context that was analysed with respect to the market situation, user satisfaction and other criteria. Some of the findings regarding the context are presented in the following paragraphs.

#### **Market situation, current demand and supply**

*Profitability.* In spite of the SED's support, currently little<sup>46</sup> or no profit is generated by the partner organisations through the distribution of ICS. Though many of the partner organisations have other activities, initially all partner organisations finance ICS distribution and the salaries of stove builders through SED's support, and to a smaller extent through the profit generated from ICS sales.

*Competition.* One of SED's objectives is to establish a minimum of two competing ICS suppliers within the reach of each user. Since most of the interviewed ICS users only knew of one partner organisation distributing ICS, it can be assumed that potential clients cannot yet choose between different suppliers, i.e. partner organisations, to benefit from competing offers. At the same time, prices for the same ICS model

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<sup>45</sup> For each ICS distributed through the partner organisation, the technical final reports encompass a list with the name and signature of the user and, in more recent cases, the name of the husband or another relative, as well as information about the village and the greater administrative unions (upazila, zila). At the time of the study the format of the lists was being adapted to also include the household phone number.

<sup>46</sup> The maximum profit per domestic ICS was 250 Taka in the case of one partner organisation.

vary significantly between partner organisations, with the overall observed price range for different-sized stoves for domestic use varying between the extremes of 300 Taka and 3,000 Taka. The typical domestic stove, however, costs between 800 and 1200 Taka<sup>47</sup>. As SED's financial contributions cover a substantial share of its cost, they most likely lower the price of the ICS (compare Table 4).

*Demand.* During the field research, street vendors of prefabricated (non-improved) stoves were observed in urban areas. One of these vendors explained that his business is going well and that he is expecting to sell more stoves in the future. This can be seen as a sign that there is a market and some willingness to pay for stoves. Still, the prefabricated stoves without chimneys are cheaper than the regular ICS and may be more affordable for poor households. On the other hand, some better-off households without an ICS showed interest in obtaining a gas stove.

Demand can be created by addressing the needs of potential clients. Out of 47 households without ICS that were interviewed for the study, more than two thirds claimed that they had health problems related to the use of their traditional stove. The most common problems among non-user cooks are smoke and heat in the kitchen, gathering the cooking fuel and lighting the fire. Hence, the needs in the kitchens of non-users seem to be addressed by the advantages of the ICS (compare with chapter 6.3).

Marketing has been established as a part of the regular business of partner organisations to raise awareness about the advantages of ICS. Mostly better-off households are targeted, which are likely to be able to afford the ICS at the regular price.

### **Acceptance of the technology and satisfaction of beneficiaries**

#### *ICS usage*

Almost 80% of respondents in this study use their ICS for all cooked meals and more than 90% claimed that the ICS has changed the appearance of their kitchen positively. This indicates that the ICS technology is accepted once it is obtained.

Most of the ICS users included in the household survey (89%) are satisfied with the technology of ICS. Yet a high dissatisfaction level (77%) was detected with the services of the partner organisations. While more than 90% of users state that they do not receive any maintenance service, 40% of those who receive maintenance are not satisfied with it. In more than 10% of those households that possess the ICS for less than one year, the ICS did not work properly at the time of the interview. It has to be

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<sup>47</sup> These prices do not consider the additional initiatives targeting poor households with subsidised ICS.

assumed that impacts of the technology, as well as the users' satisfaction with it, are likely to be compromised by the lack of quality control and after-sales services.

Only 39% of the households have been provided with a manual that they considered helpful. Most of the households (57%) were only instructed by the stove builder on how to use the ICS, although the training of stove builders does not include aspects of maintenance. These circumstances, combined with high variation in the users' maintenance behaviour (the cleaning frequency of the chimney varies from every day to never) indicate that the knowledge about the use and maintenance of ICS is low.

### *Job satisfaction*

Through the distribution of ICS, jobs are mainly created for stove builders who carry out the installation. A frequent complaint of active and ex-stove builders was the irregular, commission-based work and the lack of sufficient opportunities to build ICS. Some ex-stove builders specifically expressed their wish for a fixed job. The main factor of stove builders' dissatisfaction is the low income they earn<sup>48</sup>. This, together with unreliable payments by the partner organisations, turned out to be the prime reason why the ex-stove builders had quit the job.

Finally, the reputation of building stoves is not prestigious for men<sup>49</sup> since it is traditionally a woman's task. The work with mud and clay is considered as "dirty work".

## **Future Developments - ICS in the Clean Development Mechanism**

The Clean Development Mechanism (CDM) is a market-based mechanism of the Kyoto Protocol under the United Nations Framework Convention on Climate Change. It enables emission-reduction (or emission removal) projects in developing countries to earn certified emission reduction (CER) credits, each equivalent to one tonne of CO<sub>2</sub>. These CERs can be traded and sold, and used by industrialised countries to meet a part of their emission reduction targets under the Kyoto Protocol. [UNFCCC 2009]

The current dissemination structure is mainly characterised by financial contributions from SED to its partner organisations, which are reduced or phased out over three consecutive contracts. In the future, however, substantial funding could be generated through the international climate policy framework. The Clean Development Mechanism provides the opportunity to obtain money for greenhouse gas emission

reductions through the Clean Development Mechanism (see Box). Climate Care, SZ Consultancy Limited (in the following referred to as SZ), and Grameen Shakti have

<sup>48</sup> The average income of stove builders interviewed in this study varies from 1,000 Taka to 4,500 Taka per month (with two exceptions of supervisors who earned up to 7,500 Taka).

<sup>49</sup> Some stove builders have been called names like "chula bhai" (oven brother) or "chula maker" in a disrespectful way.



submitted a methodology proposal to UNFCCC to implement ICS in the CDM. In this constellation, Climate Care works as a reseller of certified emission reductions (CER). SZ is a private company<sup>50</sup> that wants to bundle the emission reductions of most SED partner organisations and sell them to Climate Care. Grameen Shakti is the major ICS distributor amongst the SED partner organisations and wants to sell the emission reductions of their ICS directly to Climate Care.

The CDM methodology foresees payments for each ICS that is used with firewood, functioning and in use. SZ and Grameen Shakti report the ICS to be counted into the CDM and will earn money according to the number of ICS they report, after GHG savings are validated<sup>51</sup>. In order to obtain a share of the CDM money, the partner organisations have to assure the installation, maintenance and use of ICS. The development of an external control mechanism by UNFCCC was still underway at the time of the study.

## 6.2 Poverty orientation

The primary goal of SED interventions in the ICS sector is to create a viable and self-sustaining market. This means that the poorest of the poor are not considered to be the main target group or to make up a particularly large share of beneficiaries. Rather, the declared target group of ICS interventions is the entire Bangladeshi population. As 40% of the population of Bangladesh live below the *upper poverty line*<sup>52</sup>, SED trusts that once stove dissemination is well established, it will automatically reach a certain share of poor people.

According to the criteria of BMZ and HERA, who put a strong emphasis on the inclusion of the poorest in development interventions, projects have to meet certain criteria to be considered poverty-oriented. A project's target group has to consist of more than 50% poor people, or has to be at least equivalent to the proportion of poor people within the population in the respective region, in order to be considered directly pro-poor oriented. In the particularly poverty-affected research region of the Rajshahi division, the proportion of people living in poverty is as high as 48%.

For the present beneficiaries of ICS dissemination, the survey revealed that less than 40% of the interviewed households in the sample had a per capita income below the upper poverty line. Taking statistical variance into account, this share is significantly lower than the regional average would suggest. Consequently, on the basis of the

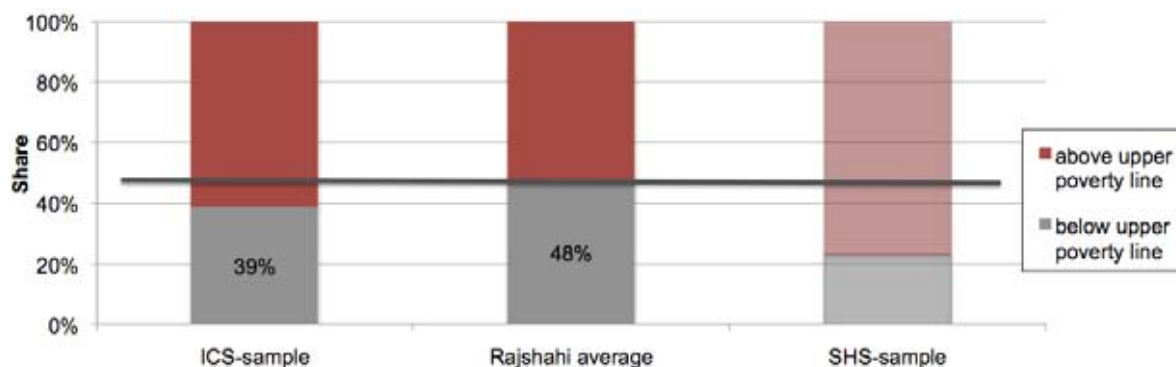
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<sup>50</sup> SZ Consultancy Limited is co-owned by the current ICS project coordinator of the SED.

<sup>51</sup> SZ consultancy sells the CER to Climate Care and will keep a share of the money for each ICS and passes 70% - 80% of the revenues to the organisations responsible for the ICS.

<sup>52</sup> Equivalent to approximately 1,090 Taka.

present sample, the analysed interventions that distribute ICS through a market-based approach, cannot be considered pro-poor oriented. (compare Figure 10)



**Figure 10 – Share of people living below the upper poverty line in the ICS sample and the research region. Graph created by the authors based on calculations from authors’ data and from the 2005 HIES, Bangladesh**

One third of the surveyed households live below the *lower* poverty line<sup>53</sup>. The average monthly per capita income of the households in the sample is higher than in the regional average of the Rajshahi division, with a considerable income difference between urban and rural households<sup>54</sup>.

Applying the multidimensional tool to measure poverty, it was found that the basic needs of most people in the sample were largely met<sup>55</sup>. When comparing the prevalence of extreme poverty in the six dimensions covered by the tool, the most prevalent deficit was a lack of clothing. The second most prevalent deficit was the health dimension: 10% reported that household members were ill “quite frequently” (once or more a month). Additionally, 57% answered “now and then” (three or more times a year). In comparison, households seemed to be well-off in the social dimension with more than half of the households claiming to be socially “very active”.

As most of the poor households collect fuel (compare chapter 6.3), there seem to be no monetary incentives for poor households to invest in an ICS. Additionally, some basic requirements have to be fulfilled to benefit from the technology, such as owning a piece of land and shelter in which to install the ICS. Especially in the case of the so-called hard-core poor this pre-requirement is hardly ever fulfilled.

<sup>53</sup> Equivalent to approximately 900 Taka.

<sup>54</sup> Urban households dispose of an average monthly per capita income of over 2,000 Taka (median=1,991 Taka, SD=2,024) while rural households only dispose of approximately 1,991 Taka (median=1,100 Taka, SD=2,024).

<sup>55</sup> The tool sets a scale from 6 (basic needs are satisfied) to 18 points (basic needs not at all satisfied). The average score of the surveyed households is 8 points. All households were on a scale of between 6 to 16 points.

### Observed approaches to reach the poor

An ICS costs an average of 970 Taka. This is almost as much as an average monthly income of the lowest income group in the sample. But in addition to the overall price, the model of payment can also be relevant for pro-poor orientation. None of the respondents from the overall sample took a micro loan or borrowed money from relatives to pay for the stove. However, paying in instalment rates was more popular in the two lower income groups of the sample<sup>56</sup>. More than half of the households in these two income groups paid the ICS in instalment rates, whereas only one third of the highest income group chose this option. This suggests that poor people can benefit from paying in instalments and that they are not likely to have enough savings to pay at once.

Three partners were found to target poorer segments of society and implement special approaches that go beyond the market-based distribution. Partner A offers stoves for 20 to 50 Taka to landless people living in state-owned shelters. This approach is additionally supported by SED with 450 Taka per stove.<sup>57</sup>

Independent of additional financial support, partner G sells ICS for 500 Taka. The payment is offered in three instalments during a two month period. Partner Organisation G subsidises these stoves from their own surplus resources from other projects. These two approaches appear to reach poor people, since the median income of the households reached by partner A is below the lower, and for partner G below the upper poverty line.

The third partner organisation with poverty focus, Partner C, closely cooperates with local government to provide VGD-cardholders<sup>58</sup> with ICS for a low price of around 100 Taka. For this initiative, additional financial support was provided from SED. The close cooperation of local government, which is responsible for providing aid to VGD card holders, with a related local organisation did not seem to be adequate to assure the successful implementation of this initiative (see the box below).

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<sup>56</sup> Three income groups were formed using a two step cluster. Low income group: N=125, mean =940 Taka, SD=424; middle income group: N=47, mean=2,860, SD=680; high income group: N=31; mean=5,840; SD=1,662. Households that benefited from additional subsidies from SED to reach poor households were excluded when forming these income groups.

<sup>57</sup> This support is outside the regular financial support depicted in Table 4.

<sup>58</sup> VGD (Vulnerable Group Development): governmental programme to support extremely poor people with food staples and basic services in order to promote their self-reliance.

**The campaign of Partner C to reach the poorest**

In an attempt to reach poor households, SED previously provided additional financial support for a tentative project providing ICS to 700 VGD-cardholders at a lower price of 100 Taka. This initiative was implemented jointly by Partner C and the local government structure (UP Committee). Also, after SED support had ceased, the organisation and local government continued the campaign to distribute ICS to VGD-cardholders.

Unfortunately, this approach does not seem to be successful, as the vast majority - 19 out of 22 - of the interviewed VGD-Card holders reported that they were forced by the local government to buy ICS for varying prices between 100 and 500 Taka under the VGD-scheme (out of 19 households interviewed, 9 fell into the support period of SED). Users reported that they had been blackmailed, that otherwise they would not continue to benefit from the food aid provided under the VGD programme. At the time of research, only four out of the 22 visited households possessed a working stove. Eight of these poor households had never received the ICS at all even though they had had to pay for it. A further two households only got an incomplete ICS as essential parts like the chimney or grill were not provided, and the members of one household had to build the stove by themselves. In the rest of the households an ICS was installed, but due to poor quality and lack of maintenance they were not working anymore.

### 6.3 Impacts of Improved Cook Stoves

The study concentrated on impacts concerning health, fuel and money savings as well as changes in workload and time expenditure. In light of the limitations outlined under chapter 4.4.3, the impacts described in the following passages should be generalised with due caution. For a considerable share of stoves reported by the partner organisations, potential impacts may not materialise or only occur during a limited time period. Still, the dissemination of ICS in the respective regions can be plausibly linked to SED's activities.

#### Health

From open interviews with households in Bangladesh, it was apparent that heavy smoke and the heat radiating from traditional stoves constitute the main problems women face in their kitchens and threaten their wellbeing. Especially for the rainy season, when dry biomass fuel is hard to come by, women report difficulties starting their fires and have to put up with a heavy concentration of smoke and soot that is generated from the cooking process. Eye irritations, coughing and respiratory problems, headaches and dizziness are commonly described ailments.

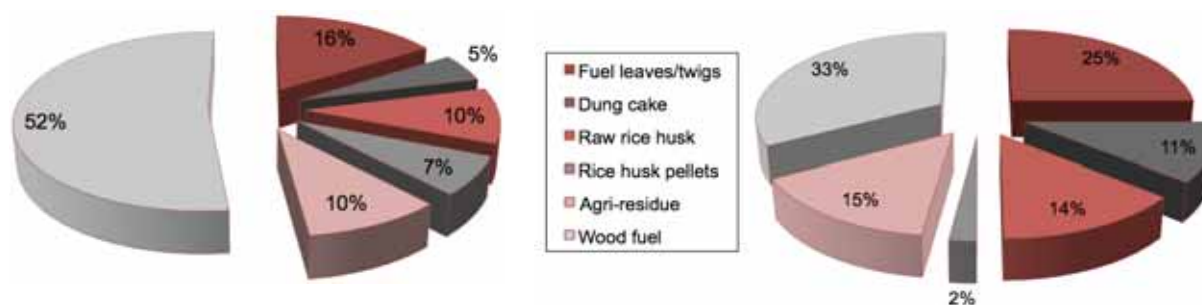
The study asked ICS users – women in over 90% of cases - whether there is less or more smoke in the kitchen than with the traditional stove. Among all households surveyed, 95% of users report significantly less smoke. This is mentioned as a major advantage of improved cook stoves by 75% of respondents. Almost 40% of users see the decreased heat in the kitchen as a major improvement with the new stoves.

As a direct consequence of the experienced smoke reduction, 87% of users report that they feel healthier than before. With 97% of respondents, almost all users mention positive impacts on their eyes followed by less coughing and respiratory diseases. As pointed out in the previous chapter, health was one of the poverty dimensions with the largest shortcomings among beneficiaries. At the same time, the positive health impacts of ICS turned out to be of great importance for women and the most obvious improvement of the new technology.

Finally, while 6% of respondents report less accidents related to cooking, more than 90% generally agree that the ICS is the safer alternative to traditional stoves.

### Fuel-saving

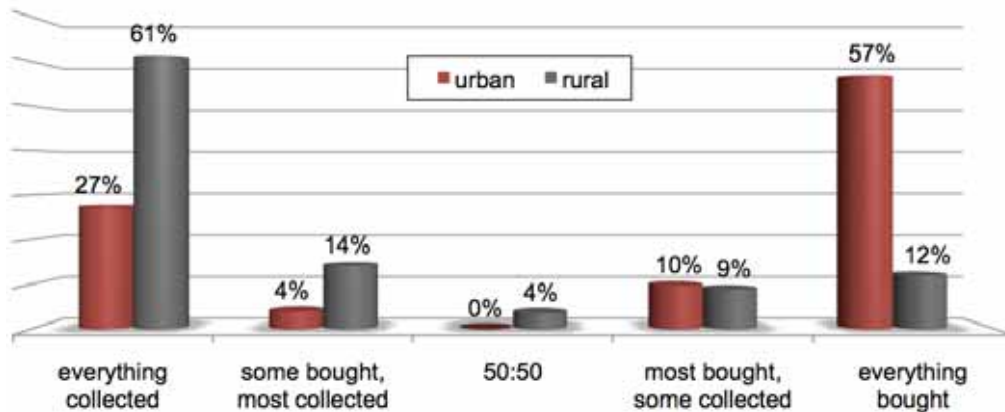
According to SED, standardised kitchen tests showed an average fuel-saving of 50%, a figure that is routinely used in the promotion of ICS. However, while standardised tests enable the exact documentation and measurement of fuel consumption, ordinary households are less aware of how much fuel they actually use. Households typically use a large variety of fuels for cooking, as Figure 11 illustrates.



**Figure 11 – Types of fuel in urban areas (left; N=53) and rural areas (right; N = 227). Graph created by the authors based on calculations from own data**

Means of obtaining the fuels also vary, as Figure 12 shows. Most of the fuel is bought in cities, whilst the surveyed rural families typically collect most of their fuel.

Only 60% of the respondents were able to approximately quantify the change in fuel consumption with the ICS. Women often collect fuel continuously alongside other (agricultural) work and without regard for standardised measures of weight or volume. Households who buy fuel, on the other hand, often do so in large amounts once or twice a year and are therefore unaware of smaller changes in consumption. Finally, some households reported that they pay workers to collect fuel.



**Figure 12 – Means of obtaining fuel in urban and rural areas.**  
Graph created by the authors based on calculations from own data

As a consequence, data from the survey shows a wide range of changes in fuel consumption due to ICS. In the sample, there are households who report to use twice the amount of fuel with the ICS compared to traditional stoves, as well as households that save up to 70% of fuel. Two thirds of those who can quantify savings (N=177) report between 14 and 53% less fuel consumption. This equals an average savings rate of 33%. It can be concluded from this sample, therefore, that the high rates achieved in standardised kitchen tests overestimate real savings achieved with ICS in households. Finally, there was no apparent relationship between the type of fuel used and the respective savings rates. 86% of respondents use the same fuel as before.

The observed fuel-saving is likely to have a positive impact on the crosscutting issue of the environment of poverty dimensions, as the pressure on biomass decreases.

### Time-saving

Cooking plays a major role in women's daily workload: four to six hours each day are spent in the kitchen to prepare three meals a day, typically including rice, fish or meat, curry and *dal* (pulses). All items are cooked by simmering, requiring constant fuel input and the continuous attention of the cook [Hassan 2001].

Interviewees were asked whether they can save time with their ICS. A total of 82% report general time saving since they have been using the ICS. Out of those, 70% can quantify the amount of time saved at an average of 7 hours per week.

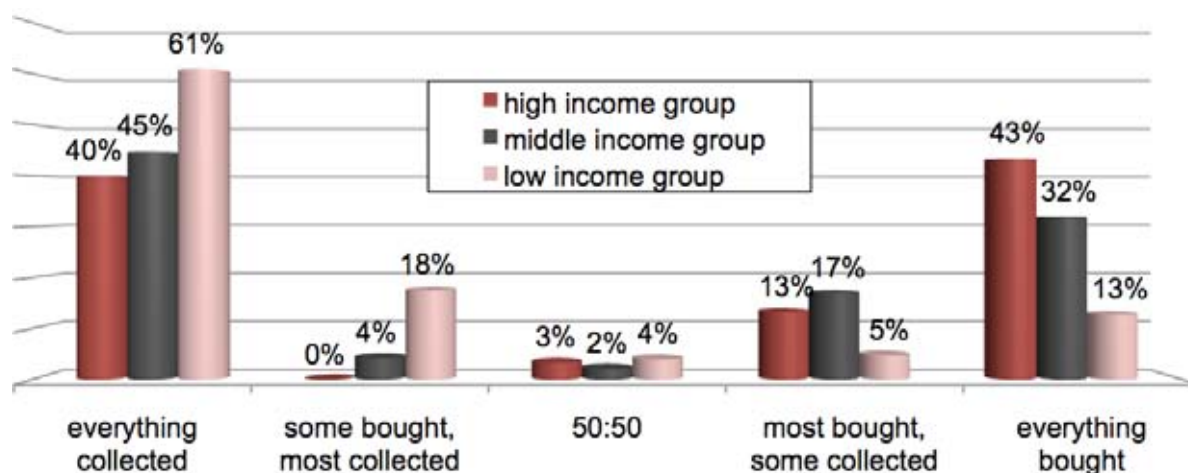
When asked for the reason for the time saving, 95% of respondents state that cooking is faster with the ICS. The time gained due to easier cleaning of the kitchen and pots was identified as a major time saver by 31% of users. The time saved through reduced fuel collection seems to be less important, as only 10% of users identified it as a major source of time-saving. Less than half of those who collect some share of their fuel were able to quantify the time necessary to do so. Among those, the aver-

age time needed was around four hours per week. So while a difference in fuel collection time is likely because of fuel-saving, it was not considered to be a major advantage for most of the households interviewed.

When asked what the saved time is generally used for, it was found that women use most of the seven hours saved per week for other household work, with the remaining priorities being leisure and farm work. With regards to potentially poverty-reducing aspects of time saving, it was found that only 3% of the women use the saved time to gain additional income and for education, respectively. However, an additional 4% report that they can now earn their income with more ease. With respect to the crosscutting issue of gender, no impacts on gender equality resulting from the use of ICS were apparent from the study.

### Money saving

In addition to the chance to use saved time for income generation, saving money through ICS is another potentially important impact of improved stoves. One third of respondents state that they can save money due to the ICS. Hence, the economic poverty of users is directly addressed through the monetary savings facilitated. In line with their tendency to buy fuel, urban users reported money savings more frequently, in almost half of the cases. The percentage of those who can save money is lowest for the poorest income group, which can be explained by the fact that poorer households tend to collect a larger share of their fuel (see Figure 13).



**Figure 13 – Means of obtaining fuel for the observed income groups.**  
Graph created by the authors based on calculations from own data

The question of what the saved money is used for is most frequently answered with “daily household expenses”, as can be expected due to the fungibility of money-saving. Within this category, expenses for food typically take the largest share, in line with national figures reported in the 2005 HIES [2007]. Finer differences between

income groups occurred though, as the wealthiest income group also invests additional money in education and savings.

## **Economic impacts of ICS**

### *MSE and social institutions*

The impacts observed on the household level are also typically evident for commercial users, as shown in 17 qualitative assessments with MSE and social institutions.

As commercial stoves are used more intensely and for the preparation of many meals each day, both the potential benefits of ICS and the problems experienced with traditional stoves multiply. Cooks – in MSE, a majority of them male – frequently suffer under the heavy smoke and heat in their workplace, while pots and tin roofs are damaged by excessive soot build up.

As the restaurants, tea stalls, hotels and social institutions surveyed in this study prepare large amounts of food every day, the potential for

fuel and money saving is large. One restaurant owner using a traditional stove reported fuel expenses as high as 8% of sales. Others complained that almost half of their profits are eaten up by fuel expenses. Accordingly, money-saving was found to be substantial among MSE using ICS. As in the case of private users, the saved money is typically used for family purposes rather than being reinvested in the business.

### *Stove builders and chimney manufacturers*

So far, 10,000 stove builders were trained by the partner organisations with the support of SED. SED estimates that 10% of the trained stove builders continue their work after the training – this matches the impression gained by the study team throughout the field research.

While selection processes for the training to become a stove builder differ substantially between partner organisations, interviews and discussions showed that new jobs have been created for formerly unemployed and/or low-skilled people. To analyse the changes that occurred for the people who have been trained as stove builders, 51 individuals were interviewed or asked for their opinions in group discussions.

### **Stories from the field – institutions using ICS in northern Bangladesh**

“During our field research, it was not only the boys in the orphanage that gave us valuable information on the improved cook stoves. We also visited a health training centre and hostel, where young women are prepared to work for mother and child health all over Bangladesh. As future medical experts, they pointed out that it is always the women who work in the kitchen. The improved cook stoves with chimneys can create a healthier working environment for women. It is not only the mothers, but also small children who are helped by the new stoves as children often help in the kitchen. Finally, mothers can save time due to faster cooking and dedicate it to their children.”

*Local Researcher (Aug. 2009)*



The most obvious impact for the 39 working stove builders interviewed proved to be income generation. Typically, stove builders receive 250 to 350 Taka per stove built, with a common target being ten stoves per builder per month. Except for the case of one partner organisation, all stove builders interviewed were employed on a commission basis, with the income of those working regularly reaching up to 2,500 to 3,500 Taka per month. However, most stove builders worked on a very irregular basis, parallel to other work and/or education. The use of saved money was in line with the answers given by other stakeholders and the spending priorities identified in the 2005 HIES [BBS 2007], namely household expenditures and family.

#### **Case Study: The chimney manufactory**

Mr. Muhammad (name changed) rents the production site for his chimney manufactory from a local primary school. He has invested in machines to produce chimneys for a range of organisations distributing ICS. Mr. Muhammad procures all the inputs for chimney production (mainly cement) from the local market. He employs two technicians and six day laborers, who earn around 160 and 130 Taka per day, at a daily working time from 11 am to 4 pm. On a busy day, he can produce up to 40 chimneys, or 1200 per month. He sells most of them to organisations that distribute ICS with the support of SED and private stove builders. By selling the domestic chimneys for 150 to 160 Taka and the commercial chimneys for 200 to 220 Taka, Mr. Muhammad can make a profit of 20 to 40 Taka per chimney, which he invests in his own NGO and to support his family.

In addition to income generation for stove builders, exemplary assessments also showed a large potential for income generation for chimney manufactories. Supplying partner organisations and individual stove builders with materials such as chimneys, caps and grills, their businesses directly benefit from increasing ICS distribution.

### **Environmental impacts**

In addition to the environmental benefits of biomass-saving, as mentioned earlier, studies such as the kitchen performance tests performed by Climate Care have repeatedly shown that more efficient fuel burning in improved stoves leads to reductions in CO<sub>2</sub> and other greenhouse gases (GHG).<sup>59</sup> As stated in chapter 6.1, it is expected that the emission reductions of the project will be certified through the CDM.<sup>60</sup>

The preliminary results of the study by Nielsen [Nielsen 2009] suggest that only a fraction of the stoves reported actually exist and are in regular use.<sup>61</sup> This is in accordance with the impression that the study team got in the field. At the same time, SZ

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<sup>59</sup> See Project Design Document available at the [www.unfccc.org](http://www.unfccc.org) [September 2009]

<sup>60</sup> At the estimated saving rate of 50%, GHG-saving is assumed to equate to one tonne per year for domestic stoves and 16 tonnes of GHG per year for commercial stoves.

<sup>61</sup> It was found that 51% of the stoves reported by partner organisations really exist and that only 61% of these existing ICS are in use.

currently reports that approximately 90% of the stoves exist and are in regular use. The independent auditor contracted by SED regularly confirms that stoves are built as reported and are functioning properly at the end of the half-year contract phase.

As the study cannot confirm any of these numbers, discrepancies are apparent. In light of these discrepancies, it has to be assumed that the verifying entity in the CDM scheme will face considerable challenges to scrutinise actual GHG-saving on the user level. A monitoring scheme is currently being developed by UNFCCC. An over-estimation of emission reductions<sup>62</sup> would lead to a net increase of GHG emissions and unjustified awarding of CDM credits. Therefore, globally aggregated climate impacts of ICS dissemination in Bangladesh could be negative. If the CDM works properly, the GHG balance of the ICS project will be neutral.

## **6.4 Conclusions and recommendations**

To interpret the results obtained in the study in a meaningful context, the following recommendations will first address questions of sustainability for the dissemination structure, as outlined in chapter 6.1. Suggested entry points to improve sustainability are SED's current incentive scheme, aspects of monitoring and general strategy. The aspects of user acceptance of ICS and future demand will conclude the assessment of sustainability, while the final paragraph on CDM deals with an important external factor influencing ICS dissemination. Also, aspects of poverty orientation are addressed and suggestions are made on how benefits for the poorest segments of society could be improved.

### **6.4.1 Enhancing the sustainability of the dissemination structure**

SED sees itself to be in an early phase of an ongoing learning process. Nevertheless, SED has rapidly expanded its network of partners, extending its reach at a very high pace. Taking past shortcomings into account, the setup of the ICS dissemination structure has been constantly adapted. Financial incentives have been adapted, training activities restructured and different groups of beneficiaries prioritised<sup>63</sup>.

However, it appeared during the study that the rapid expansion of ICS activities did not leave much room for reflection along the way. The increasing scale of the project can potentially entail errors or omissions that could have severe consequences on

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<sup>62</sup> Due to overestimation of fuel saving rates or because too many ICS are included in the CDM.

<sup>63</sup> For example, the training of stove builders originally only targeted women and earlier on, participants were paid to participate. The present approach targets young men in particular and foresees no allowances for training participants.

the success of the ICS technology in Bangladesh. Understanding how the changes implemented by SED actually affect beneficiaries seem to be limited.

Impressive numbers of ICS are reported, and auditing and reports by SZ consultancy confirm that most of the constructed stoves exist. The results of this research, however, and the preliminary results of the study by the Nielsen Company contradict these findings.

The contradictions between different reports should be cleared up and a monitoring scheme should be developed. Furthermore, the efficiency of the current network of 165 partner organisations and their performance should be evaluated, past failures and successes reflected and strengths and weaknesses of a market-based dissemination analysed. On this basis, decisions on far-reaching strategic consequences and the future of ICS interventions in Bangladesh should be taken. Therefore, the study recommends an evaluation of current activities and an intensive exchange of experiences between HERA, EnDev and SED.

### **Financial incentives under current agreements**

SED's support to the partner organisations is based on the fulfilment of short-term agreements. During a period of time (usually six months) a significant number of stoves have to be built. Under the current scheme, only ICS that have been built under the respective contract are inspected. Partner organisations then sign a consecutive agreement that again encourages the installation of a certain additional number of ICS.

It is therefore concluded that incentives encourage a quick installation of many stoves. No incentives are in place to keep track of older stoves and assure their proper functioning. This is considered to be the reason why a severe lack of maintenance services was observed during the research. In the long run, this undermines the development of a self-sustaining market and a long-lasting usage of the stoves.

The incentives set by SED should encourage maintenance services and assure that the lifetime of the ICS is prolonged. This is especially important since partner organisations have to be able to maintain their stoves in order to benefit from potential CDM funds (see following paragraphs). One way to address this could be to interlink the consecutive contracts. This means that, for example, the grant for institutional development, the revolving fund and/or the stove builder incentive could be conditioned to enable the partner organisations to offer proper maintenance services or to provide a guarantee to the users for a set time period.

The fulfilment of this requirement could be checked with the audit of the second, third and later contracts. The audit of the later contract could also cover a check on the existence and functioning of older stoves. If a predetermined share of the old stoves is still in place and functioning after the time span of the next one or two contracts,

the revolving fund would not have to be paid back. If fewer stoves exist, a relative amount of money would be deducted from the payment of the actual contract.

While incentives set by SED remunerate the partner organisations for distributing a high number of ICS, the same short-term incentives are currently passed on to stove builders. The newly introduced incentives for stove builders by SED only focus on ICS installation. Consequently, the partner organisations encourage their staff to build as many stoves as possible through (often insufficient) commission-based salaries. This adds to the disregard of other services (e.g. maintenance), which are the responsibility of the stove builders.

To ensure a high quality of the stove builders' work, they should not only be paid in relation to stoves built but also receive a basic payment for after-sales-services.

Furthermore, it should be ensured that the full support provided by SED, targeted at the stove builders, really reaches them and that they receive a salary that is high enough to remain in their job. Therefore, auditing should pay special attention to the proper usage of incentives for stove builders.

In addition to the question of whether incentives are set to be short or long-term, their scale is another important factor for successful ICS dissemination. A share of the financial support is directly linked to the costs accrued for the partner organisation for each ICS installed. The revolving fund – as part of the support that is paid for each installed ICS – is phased out.

The newly introduced stove builder incentive, however, significantly increases SED's contribution and covers a large part of the costs for the ICS. At the same time, the profit margin in the ICS distribution is very small, increasing the overall significance of SED's contributions.

To prevent partner organisations from depending financially on SED, the scale of SED's contributions to partner organisations should be critically reflected. Encouraging the foundation of new organisations that rely entirely on support from SED, and whose only field of activities is ICS distribution is not recommended. Instead, established organisations with a wider field of activities and financial sources should be reverted to.

Finally, while partners clearly benefit from SED's financial support, technical support is considered important by this study. Currently, the elaboration of partnership agreements, training programmes for stove builders, marketing, and many other important tasks are fulfilled by SED. This practice may undermine the long-term capacity development of partner organisations.

SED should focus on advisory and technical support for its partners, besides its current focus of mainly financial assistance. Partners should be guided to become self-reliant ICS suppliers, through active support and learning at all stages of the distribution.

### **Monitoring for usage**

Reliable information on the use of inputs is a basic requirement to manage the project and monitor impacts. Moreover, the question of whether ICS are distributed and how long are they used is important to judge the impacts of SED's activities. As we mentioned earlier, SED has to rely on a number of inconsistent reports on installation, existence and usage of improved stoves in this regard. Currently, no systematic monitoring of results or impacts of the ICS on beneficiaries has been implemented.

Due to this lack of information, it is difficult for SED to detect the insufficient performance of partner organisations. Consequently, SED may not be able to apply necessary sanctions on the lack of performance. Several observations made during the research give a clear indication that some of the partners that have been surveyed are not performing well or even fail to perform in implementing their contracts with SED.

This influences the development of a self-sustaining market in a negative way as it can lead to the support of partner organisations that may not perform well and that may be unfit to sustain their business in a market environment without financial support. Also, shortcomings in terms of longevity of the distributed stoves and the services provided by partner organisations cannot be addressed by stakeholders with the necessary priority.

Establishing a continuous, systematic and independent monitoring and evaluation system of the work of SED and the partner organisations is highly recommended. The elaboration of a monitoring system needs to ensure the orientation on SED's goals and should therefore involve all relevant stakeholders, i.e. partner organisations, SED, and EnDev/HERA.

To get a realistic understanding of the benefits of ICS interventions, SED should pay more attention to the long-term usage of ICS by households. In addition to auditing newly installed ICS, the continuous usage should be monitored and reasons for non-acceptance of the technology ought to be analysed. Also, reasons for the high rate of stove builders that do not work after their training should be analysed. Based on this analysis, it is recommended that efforts are made to design a more efficient training concept in cooperation with all partners. Feedback mechanisms between users, partner organisations, and SED should be strengthened to provide learning opportunities for partner organisations and SED.

### **Strategic management for quality**

The analysis of the currently prevailing incentives shows that SED's present strategy focuses largely on quantitative upscaling. After the SED programme successfully took off, substantial support through EnDev was meant to multiply the benefits of project activities. The conclusion that this study draws is that the simple upscaling of the successful initial phase, an increase of partner organisations and other stakeholders, without the corresponding development on the management and strategic level has not led to a more successful project.

Slower dissemination of ICS with a smaller number of partners but higher attention paid to quality and maintenance service is highly recommended, as the threat of unsatisfied users through poorly maintained stoves should not be underestimated. The experiences and lessons learned from previous and ongoing assessments and from HERA's promotion of stove dissemination for over 25 years should be taken as a basis for realigning stove dissemination in Bangladesh.

If cooperation with a high number of partners and external stakeholders is nevertheless found to be a viable strategy for SED in the future, the necessary in-depth and systematic coordination will require larger capacities (i.e. more staff) and clear responsibilities within the SED team. However, in light of the preliminary results of independent monitoring by Nielsen (2009) and the impressions from the partner organisations assessed in this study, a thorough evaluation of the current partnerships is recommended.

In addition to reducing the sheer number of partner organisations, their capacity and qualification to contribute to SED's long term goals is considered a key factor for success. Currently, SED does not formally evaluate the capacities and strategies that partners can or will apply to distribute ICS.

The criteria for the selection of qualified partner organisations should be transparent and set with due regard to questions of sustainability. For example, potential partners should not depend on SED for the better part of their financing. Besides, they should be well established in the respective regions.

At present, financial agreements are prepared by SED and then signed by the partner organisations. Except for the pre-requirement to build 100 ICS, little or no action has to be taken by prospective partners before the contract starts. However, proactive planning by the partner organisations is considered important to assure an adequate dedication and realistic estimation of the tasks for ICS distribution and to prevent partner organisations from sliding into financial dependencies on SED support.

To assure an adequate procedure for ICS distribution, partner organisations should submit a proposal and their planned distribution strategy before involvement with SED. This strategy could, amongst other aspects, address the necessary capacities and required skills of stove builders and supervisors as well as, marketing activities, regions where the distribution will take place, how the materials will be obtained, and an exit strategy for phasing out SED support.

SED should then analyse if the strategy seems viable and feedback should be given to the partner organisation. Afterwards, necessary adjustments could be made and the decision whether cooperation should begin would be based on a documented plan.

### **User acceptance**

The acceptance of the ICS seems promising once it is obtained. Nevertheless, it is assumed that many problems may occur due to a lack of proper understanding and servicing of the ICS. If the long-term functioning and usage of the ICS cannot be assured through functioning after-sales structures, it has to be assumed that no self-sustaining market will develop<sup>64</sup>. The problem of the lacking after-sales services is worsened by the observation that users can seldom choose between more than one ICS supplier. This lack of competition between ICS distributors lessens the bargaining power of the users and may lead to an insufficient focus on the needs of potential ICS customers. Finally, for the every-day maintenance and minor technical problems with ICS, it is crucial that users are informed properly about the functioning of the stoves and how they should be looked after.

SED should make every effort to strengthen the bargaining power of users. Users should be provided with increased information on the range of ICS providers operating in their region. Furthermore, promotional activities supported by SED should inform users of their right to an after-sales service and of the approved quality standards of ICS that suppliers have to meet. Finally, a service line for customers or frequent visits by SED to users could increase pressure on partner organisations to meet the needs of their clients until sufficient market coverage is achieved.

### **Demand**

It can be assumed that users' knowledge of ICS and its related advantages has been improved due to marketing by SED and its partner organisations. The continuation of marketing at the same extent, however, is questionable without SED support. At the

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<sup>64</sup> The lack of after-sales services is considered the main reason why the government initiative to distribute ICS failed in the 1980s.

user level, signs of a market for stoves have been observed. In addition to the custom-made stoves distributed by SED partners, demand is likely to be addressed by cheaper, easy to access prefabricated open stoves as well as high-end gas stoves on the market. Non-users reported problems such as smoke and heat in the kitchen, which can be successfully addressed by the ICS technology.

The congruency of problems resulting from the use of traditional stoves with the advantages of the ICS is therefore considered a good basis for partner organisations to enter this market and should be used to develop demand at the user level. Also, in households that pay for fuel, the potential for savings with ICS should remain a strong selling argument.

SED should remain open to cooperate with existing actors in the field, such as suppliers of pre-fabricated stoves or cooking utensils. Rising demand and increasing accessibility of gas for cooking poses a challenge to the demand for ICS that should be met with strong marketing to households for which gas-stoves are too costly. Finally, the long-term benefits of renewable biomass fuels should be highlighted and international support for renewable energy (such as CDM, see below) should be taken advantage of.

### **Benefiting from the global system of carbon trading**

Even though SED is not involved in the CDM proposal, the work of its partner organisations will be strongly influenced by the outcome of the currently ongoing verification process. SED partners could receive as much as 300 to 400 Taka per functioning stove and year (compare Chapter 6.1). Hence, the CDM may well set new incentives and influence the development of a self-sustaining market for ICS in a positive way. The additional money could make ICS distribution more profitable and provide large incentives to improve the services offered by the partner organisation, to achieve longer-lasting operation of the stoves, as partner organisations have to make sure that the stoves are functioning and in use to repeatedly get the CDM money.

It is important to note that initially, stove users are the legal owners of carbon credits generated through ICS. However, they will be asked by the partner organisations to allow the transfer of all credits to SZ. The experiences collected on the household level in this study lead to the conclusion that it will take considerable efforts to explain the international legal framework of CDM to the average household. The risk that organisations may impose their will on uninformed households is considered to be very high. Neither SED nor SZ has any influence on the use of CDM funding by partner organisations and so far, no clear monitoring scheme was agreed upon under the CDM to check the existence and usage of stoves on the household level.

SED should use its influence over partner organisations to ensure that CDM funding is used to improve ICS after-sales services. One example would be to use the money



to offer users a guarantee and regular servicing for their stoves, which could be renewed every year that the ICS remains in use.

SED should furthermore cooperate with the parties involved in the CDM agreement (JPMorgan/Climate Care, UNFCCC). It should make all information on existence and the usage of stoves available to monitoring entities under the CDM contract. Thereby, every effort has to be made to mitigate possible negative impacts of its ICS interventions on the environment (if too much GHG is accounted for every stove) and on user satisfaction (if money is not used to their benefit).

The CDM money will be spilled out relative to the results of an independent verification of the existence, functioning and the fuel-saving of the stoves. Therefore a random sample will be drawn from all partner organisations included in the scheme. Consequently, partner organisations depend not only on the quality of their own stoves to get money from the CDM, but from the results of the verification of a sample of ICS from all the partner organisations involved. This creates an opportunity to generate a common interest for the control mechanisms amongst partner organisations.

To improve the performance of partner organisations, SED should take advantage of the circumstance that the partner organisations' benefit from the CDM directly depends on the existence and condition of ICS of other partner organisations. It should be made clear that in spite of the competition between partner organisations, cooperation and control would help to generate more money for all ICS suppliers.

The possibility to develop a peer control-scheme amongst partners should be discussed. Groups of partner organisations could be formed that control each other and make sure that stoves reported by the group really exist and work properly. This may even include common service schemes.

#### **6.4.2 Working towards poverty orientation**

The sample analysed in this study shows that users who acquire stoves via the market are less poor than both the national and regional average in Bangladesh would lead to expect. Therefore, the conclusion is made that even if a self-sustaining market for ICS developed in Bangladesh, it cannot be assumed that the poorest households would benefit from it.

However, from the positive impacts of ICS on users observed by this study, above all smoke reduction and time and money savings, it can be concluded that the use of ICS helps to reduce poverty above all in the deficit dimension of health.

Therefore, SED should put a greater focus on reaching poor people, especially by lowering the price of ICS for poor households as this seems to be the hurdle for purchasing one.

If one wants to assure that the poorest part of the population benefits from positive impacts of ICS technology, additional efforts beyond the general market distribution are indispensable. Two entry points can be identified in which continuous efforts should focus on: poor households have to be encouraged to change their cooking habits and partner organisations need to be persuaded to target the poor.

From a user perspective, switching to ICS requires the change of dominant cooking habits. With very limited funds available, poor households tend to be reluctant to invest in new technologies. According to an ongoing study by [Miller et al. 2009], “villagers consider new, expensive technologies as being more appropriate for leaders who are richer or more educated.” The price of ICS is certainly a decisive hurdle. Since poor people collect most of their fuels, financial saving may not justify the high investment in an ICS.

The comparison of non-users’ needs and positive impacts of ICS observed in this study, however, shows that health benefits can serve as a strong incentive to adapt the new technology. This is in line with Miller et al. [2009], that “people are more willing to spend extra on a stove that protects a woman’s health versus one that saves them time.”

As a consequence, marketing to poor households should focus on smoke reduction and health benefits as the most important benefits. SED should continue to invest heavily in the dissemination of knowledge about the hazards of smoke in kitchens and the health benefits that ICS can provide.

From a perspective of the partner organisations, the poor currently do not form a viable market for profit-oriented providers, as they lack the financial resources and the readiness to invest in a new technology for cooking. Marketing is geared towards affluent elites and producers are hardly willing to sell stoves below their production costs. Only three of the assessed partner organisations showed special approaches that reached the poor.

More partners should offer a certain share of their services to poor households. To this end, disbursements could be made under the condition that for instance 30% of stoves are installed in poor households. As this may be hard to scrutinise, conditions could be tied to the types of stoves installed, i.e. that 30% of stoves have to be from the most affordable category (made from clay, one or two potholes) and paid for in instalments, as these models are most likely to be used by poor households.

Stoves that are used by businesses and wealthy households are currently supported with higher absolute contributions from SED than smaller, poor-friendly models. Thus, relatively well-off households or businesses benefit disproportionately. At the same time, willingness to pay the regular or even a higher price for ICS was high among more affluent households and restaurant owners (plausibly so, considering that savings in fuel will quickly repay initial investments).

Current contributions for the most elaborate and institutional stoves should be rethought. Even at this early stage of market introduction, SED should bundle its resources to finance ICS that are attractive to poor users. Refinancing for smaller domestic stoves should be offered and approaches that reach poor households should be promoted. Special support would allow partner organisations to install ICS for minimal down payments. Households should be enabled to pay ICS over longer periods of time in affordable instalments. As SED contributions should be gradually reduced, partner organisations should be supported to adopt a method of flexible pricing, increasing profit margins for more sophisticated stoves and subsidising the most basic models for poorer customers. Finally, HERA could contribute its experience to assist in elaborating concepts to reach poor target groups.

If the poor are to be targeted specifically by SED or its partner organisations, conclusions from this study suggest that government programmes such as handouts for VGD cardholders are not the ideal channels to reach the neediest.

From the selection of partner organisations, poverty orientation should be considered and partners should be well entrenched in poor communities. In light of the accusations observed of corruption and mismanagement among one of SED's partners, it is recommended to preferably work with experienced NGOs that can credibly demonstrate the necessary dedication and knowledge to support the poorest households in their respective regions.

## 7 Final Remarks

In summarising and comparing the insights into the dissemination of the two technologies, some general conclusions are drawn here. The experiences from Bangladesh show that a market based approach, which seeks to overcome existing market barriers and applies private delivery models, is a viable strategy to quickly disseminate technologies for improved energy supply. In combination with direct or indirect subsidies, a widespread market penetration can be achieved even in a poor country. Other than in the case of SHS, the establishment of a market for ICS faces the hurdle that new technology replaces a simple device, which has been traditionally self-made by women at no charge. As a consequence, communication of the advantages of the technology to the users has to be emphasised much more than for SHS.

It is evident that measures taken to establish a self-sustaining market and attempts to enhance the poverty orientation of such an approach are sometimes contradictory. Nonetheless, poor people can be reached to a considerable extent if the specific market barriers that restrain the poor from purchasing the technologies are tackled by adequate measures. As the barriers for the poor may be of a different nature compared to the better-off, they should be analysed in detail and separately. Direct and indirect subsidies have to be assigned in a smart way, targeting those who need them. But even though poorer households are reached by the interventions, it has to be kept in mind that the scope of positive impacts decreases the poorer users are. In the case of SHS, additional technical devices (TV, mobile) are a precondition for some of the positive impacts to materialise. In the case of ICS, the monetary advantages are smaller for the poor as they usually do not pay for fuel.

On the one hand, the generation of long-lasting impacts of the technologies depends on their adaptation to the users' livelihood. On the other hand, it has become clear that after-sales services and other quality-assuring measures are also essential for both long-lasting impacts and for a successful market introduction. It is concluded that appropriate incentives and adequate monitoring are the key factors for success when disseminating a technology. Incentives have to promote the enduring commitment of stakeholders and monitoring mechanisms have to address the performance of stakeholders involved on a regular basis. In order to achieve a sustainable market development and long-lasting development impacts, it is necessary to set up control mechanisms independent of the financing development institutions and to establish feedback channels that include the relevant stakeholders and the users. Thereby another general shortcoming of the market creation can be addressed: the relatively low bargaining power of users. It is crucial to strengthen this until sufficient competition is in place.



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## 9 Annex

### 9.1 History of Improved Cook Stoves in Bangladesh

Bangladesh is one of the world's poorest and most densely populated nations (total 153.5 million, 1000 inhabitants/km<sup>2</sup>), with a vast majority of people living in poverty and unable to satisfy their basic needs. The poor especially struggle to satisfy their basic energy needs - above all energy for cooking. In Bangladesh, per capita energy consumption is the lowest in the world: The total annual per capita energy consumption of the country was estimated as 171.0 Oil Equivalents [World Resource Institute 2009]. One third of the total energy demand is covered by commercial energy such as oil, natural gas, and coal; the remaining two thirds are attributed to renewable energy. Among the renewable energy sources, biomass plays the most important role. Biomass comprises wood fuel, charcoal, twigs and leaves, but also agricultural residues such as plant residues, paddy husk and bran, biogases, jute sticks and animal dung.

About 90% of families in Bangladesh use traditional stoves for cooking and also for heating purposes. Traditional stoves in Bangladesh usually take the form of a mud-built cylinder with three raised points on which cooking utensils rest. The efficiency of these traditional stoves varies from 5-15% depending on the depth of the stove and size of the flue gas exits.

The traditional stoves often cause health hazards to the users. Significant quantities of irritants, toxins and carcinogens are released into the kitchen environment, due to incomplete combustion of biomass fuel in traditional cook stoves. Over time, these pose a major threat to the respiratory health of the users. In general, the main combustion products of wood are carbon dioxide, steam, carbon monoxide particulate and polycyclic organic matters. The World Health Organization (WHO) has estimated that each year 43,000 women and children in Bangladesh die as a direct result of exposure to indoor air pollution, while millions more suffer from respiratory diseases, tuberculosis, asthma, cardiovascular diseases, eye problems, and lung cancer [GTZ 2009b].

To reduce the scarcity of traditional biomass fuels and to mitigate the hazardous impacts of traditional stoves, a series of improved cook stoves (ICS) suited to local conditions have been developed by the Institute of Fuel Research & Development (IFRD) of the Bangladesh Council of Scientific & Industrial Research (BCSIR) in Dhaka over the last 35 years. These stoves can save 50-60% fuel compared to traditional ones and solve the problems of indoor air pollution. The improvement was made by proper dimensioning of combustion chambers to provide heat transfer to pots and by attaching a chimney to the stove that leads the smoke out of the cooking

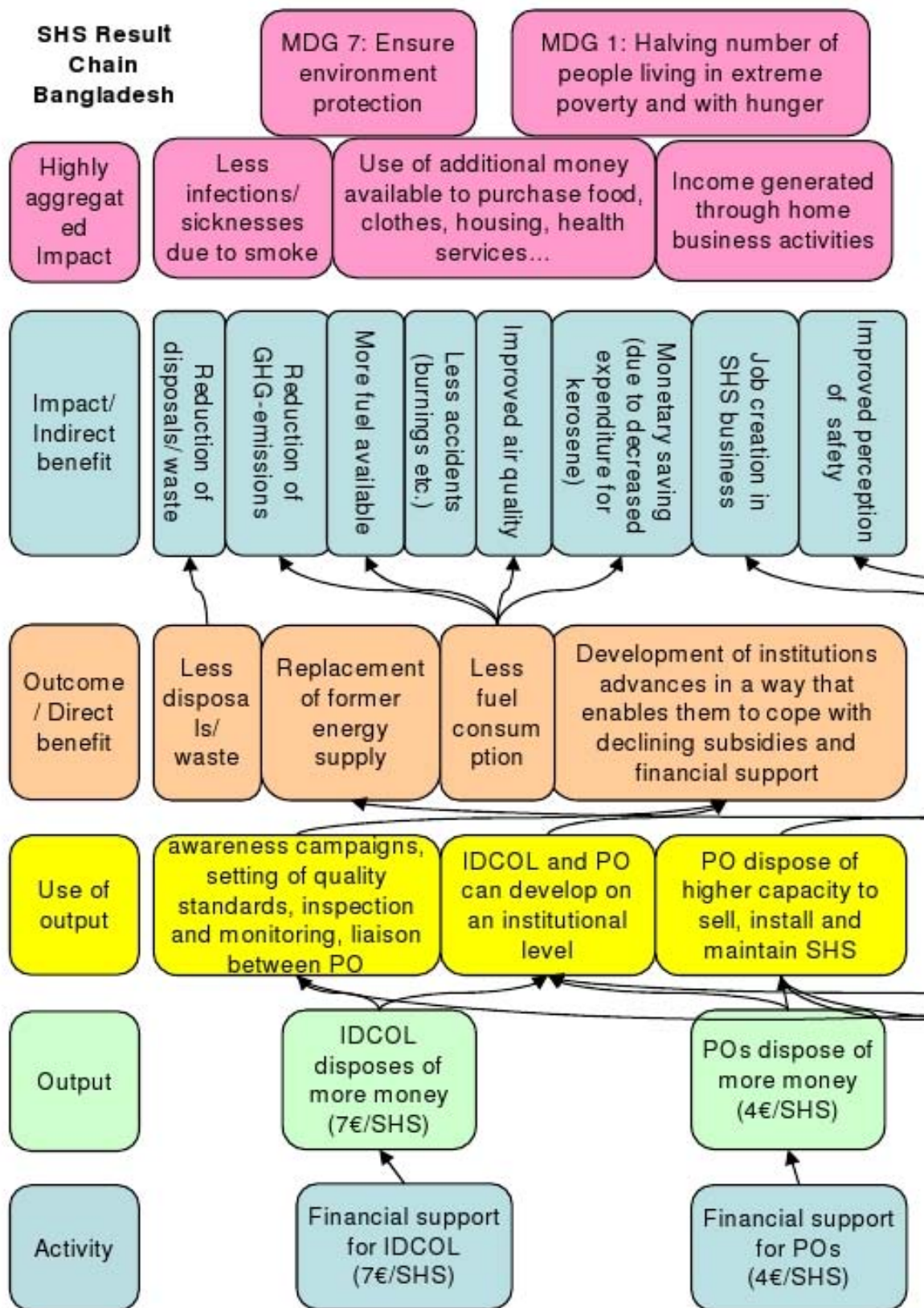
area. Since the stoves are meant for the masses, any kind of sophistication in their manufacture or operation will act as a deterrent to their widespread application. Attempts have therefore been made to develop and introduce modified versions of the traditional stove that suit the requirements of the users with respect to biomass fuel types, the shape of cooking pots and cooking habits. So far, 39 models of improved stoves have been developed from which five were chosen to popularise improved cook stoves in the country.

BCSIR has then successfully completed two pilot projects to disseminate improved stoves in the country. In the first phase from July 1994 to June 1997, about 1,000 people were trained and nearly 63,000 ICS were installed in 35 districts with a budget of 15 million Taka. In the second phase from July 1998 to December 2001, nearly 1,200 people were trained and over 115,000 ICS were installed in 29 districts with a budget of 42 million Taka. These efforts were supported by seminars on the application and dissemination of appropriate technologies in the country organised by the Ministry of Science and Information and Communication. Scientists from IFRAD conducted over 210 training courses on improved stove technology until December 2001. A large number of individuals from different governmental and non-governmental organisations in the country have been trained. Today, several international donors, such as GTZ (German Technical Cooperation), KfW (German Development Bank), and the World Bank are involved in the promotion and dissemination of improved stoves. They are supporting more than 165 local NGOs or entrepreneurs with training, materials and finance; so that, according to their numbers, more than 140,000 ICS have been distributed so far and over 9,000 people have been trained to work in the distribution and installation of improved cook stoves. For the future, it is even planned to cooperate with the global system of carbon emission trading and to be recognised as a project under the Clean Development Mechanism.

Source: Rashid Khan, A.M. Hasan (2001)



## 9.2 Result chains



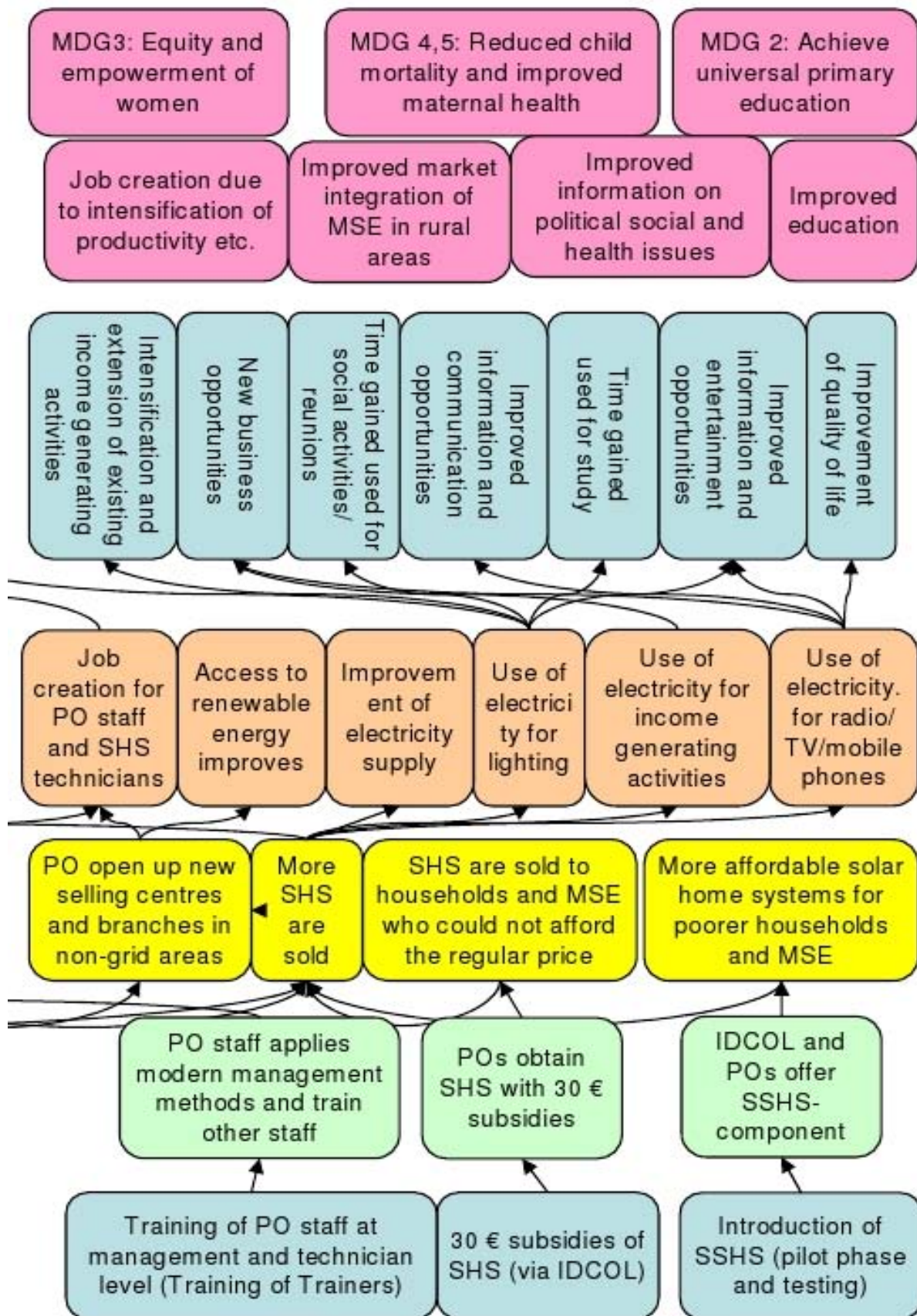
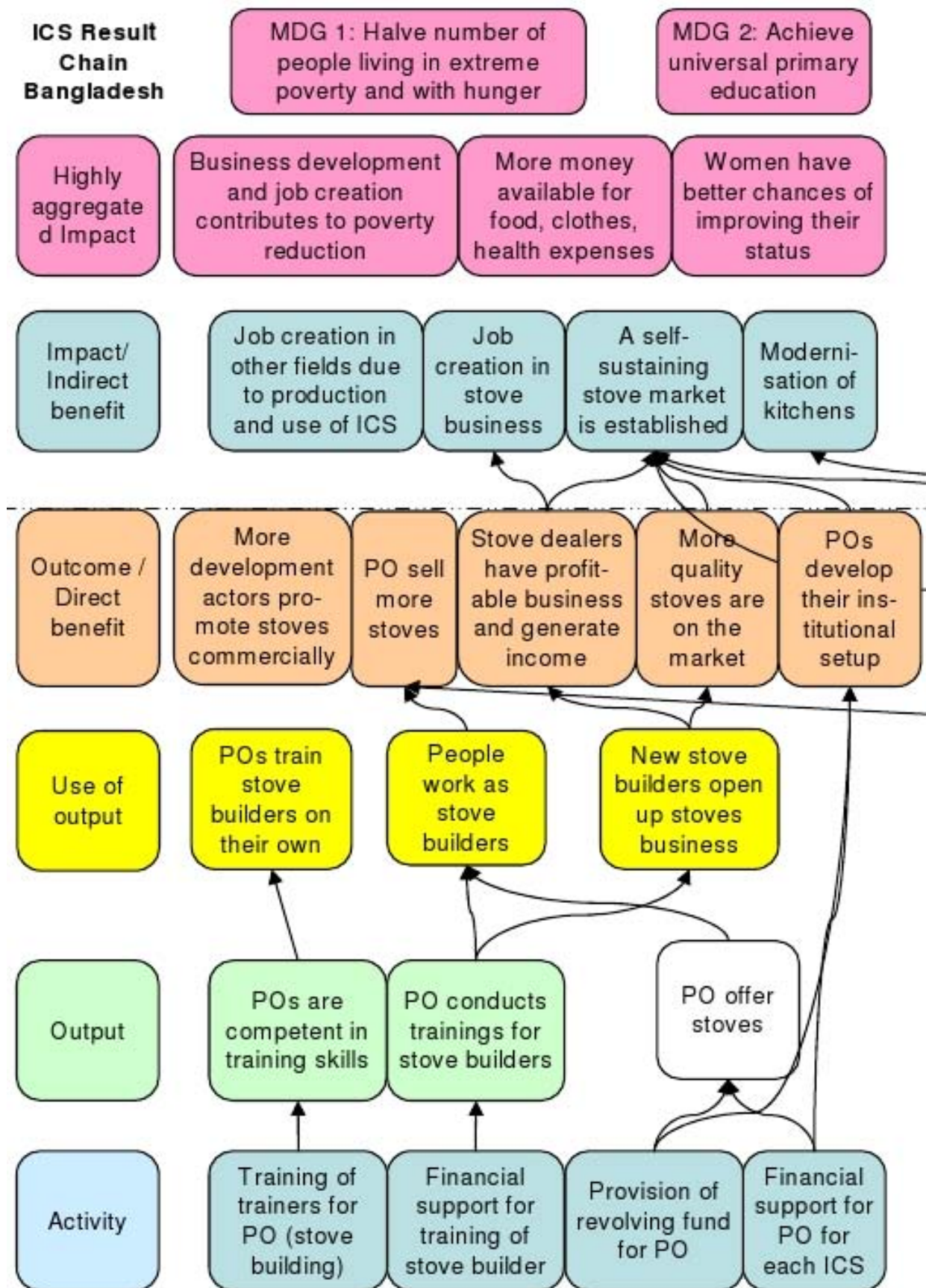


Figure 14. Result chain for the SHS-related interventions of SED. Result chains were developed by the SLE Impact Study 2009 in the context of the analysis of the Sustainable Energy for Development Programme (SED), Bangladesh.



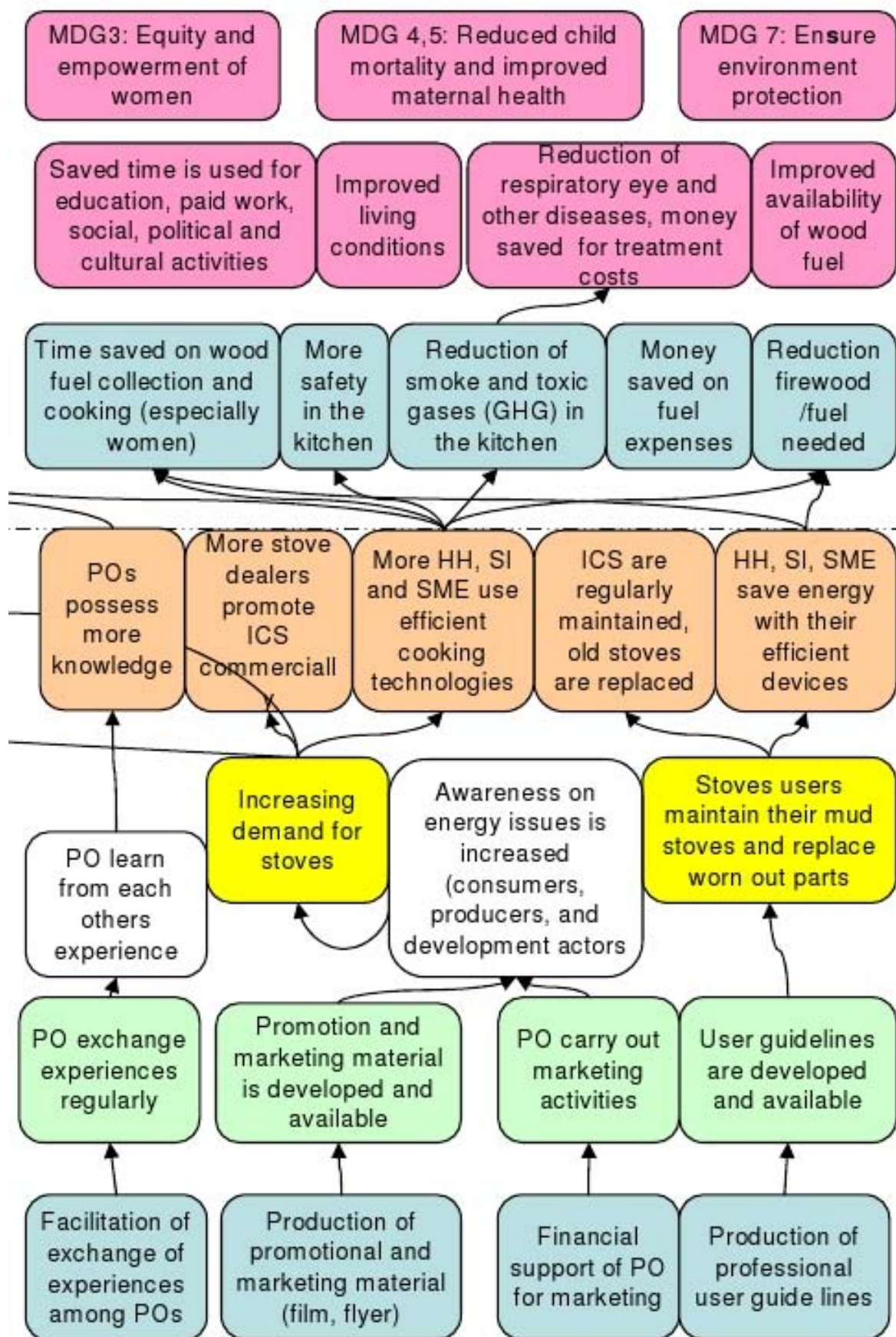


Figure 15. Result chain for the ICS-related interventions of SED. Result chains were developed by the SLE Impact Study 2009 in the context of the analysis of the Sustainable Energy for Development Programme (SED), Bangladesh.

### 9.3 Overview of interviews conducted

#### Overview for SHS key informant interviews

Date	Name	Organi- sation	Position	Location
09.08.09	Mr. Faruk Ahmed Sarker	Grameen Shakti	Regional Manager Gazipur	Grameen Shakti Lokal Branch Mawna
11.08.09	Mr. Abdul Mazed	CMES	Head of CMES Solar Programme	CMES Kayetpara/ Gazipur
11.08.09	Mr. Elias Hossain	CMES	Local Solar Manager Kayetpara / Gazipur	CMES Kayetpara/ Gazipur
12.08.09	Mr. Monirul Islam	IDCOL	General Manager	Dhaka
23.08.09	Mr. Yaquil Hossain	CMES	Regional Solar Manager Daoti Unit, Pirgacha,	CMES Daoti Unit, Pirgacha, Rangpur
18.08.09	Md. Humyun Kabir	Grameen Shakti	Branch Manager	Gangachara
18.08.09	Mr. Kamal Hossain	BRAC	Branch Manager	Gangachara
20.08.09	Mr. Robiul Islam	BRAC	Regional Manager	BRAC Training Center Rangpur
20.08.09	Mr. Delwar Hossain	Grameen Shakti	Divisional Manager Rangpur	Regional Office Rangpur
24.08.09	Mr. Nurul Alom	BRAC	Branch Manager	BRAC Branch Badorganj/ Rangpur
29.08.09	Mr. Jahangir Alam	CMES	Local Solar Manager	Dinajpur
30.08.09	Mr. Hafisur Rahman	Grameen Shakti	Regional Manager Dinajpur	Dinajpur
10.09.09	Mr. Absal Kamal, Mr. Ahsan Bhuiyan, Mr. Quamrul Haque, Mr. Fazlul Haque	Grameen Shakti	General Manager, Assistant General Manager, Deputy General Mngr, Deputy General Mngr,	Grameen Shakti Headquarters Dhaka
14.09.09	Mr. Robiul Islam, Mrs. Farzana Husain	IDCOL	General Manager, Investment Officer (Technical)	Dhaka
14.09.09	Mr. Shamzul Kibria	MoPEMR	Joint Secretary Power Division, National Programme Director SED	Dhaka
15.09.09	Mr. Tazmilur Rahman	KfW	Senior Programme Manager Energy	KfW Office Dhaka
16.09.09	Dr. Mohammad Khaleq-uz-zaman	GTZ	Senior Advisor	SED Office Dhaka
17.09.09	Mr. Rob Choudhury	BRAC	Programme Coordinator	BRAC Headquarters Dhaka
17.09.09	Mr. Sohel Ahmed, Mr. Syed Ishtiaque Ahmed	Rahimafrooz	General Manager, Programme Manager	Rahimafrooz Renewable Energy Ltd, Dhaka

**Table 5 – Overview of interviews conducted with SHS key informants**



Method	Partner Organisation				Total
	Grameen Shakti	BRAC	CMES	Other	
Standardised survey in households	45	67	23	1	136
Qualitative appraisals in households	8	4	3	1	16
Standardised surveys in MSE	16	17	2	1	36
Qualitative appraisals in MSE		2	1		3
Standardised survey and qualitative appraisal with non-user households and MSE					41
Interviews and discussions with technicians and field assistants	7	5	6		18
Interviews and discussions with village doctors and teachers					5
Total no. of assessments	76	95	35	3	255

**Table 6 – List of SHS assessments, 9 August – 4 September**

### Overview for ICS

Location	Partner organisation	Household surveyed	Qualitative assessments
Dhanbari	Jhenai Enterprise	16	13
Rangpur	SEED	37	11
Gangachara	SAP	25	10
Gobindogonj	Palli Shakti	31	8
Saghata	WDP	86	11
Shibgonj	Baso	48	7
Dinajpur	BRAND	38	8
Rangpur	Grameen Shakti	25	8
	Unknown	5	2
Rajshahi division	Households without ICS		47
	SME without ICS		5
	Health centres		3
<b>Total</b>		311	133

**Table 7 – List of ICS assessments, 9 August – 4 September**

Date	Name	Organisation	Position	Location
09. Aug 09	Mr. Shafiq Islam	Upazila Chairman, BISD	UP Chairman	Dhanbari
10. Aug 09	Mr. Ferdous Ahmed	Jhenai Enterprise	Managing Director	Dhanbari
11. Aug 09	Anonymous informant	Grameen Shakti	-	Dhanbari
17. Aug 09	Mrs. Saroti Rani Saha	SEED	Executive Director	Rangpur
19. Aug 09	Mr. Shamimuz-zaman	SAP	Executive Director	Gangachara
19. Aug 09	Mr. Najrul Islam Kha	Palli Shakti	Executive Director	Gobindogonj
22. Aug 09	Mr. Farid Ahmed	WDP	Chief Executive	Shaghata
24. Aug 09	Mr. Nazrul Islam	BASO	Executive Director	Shibgonj
29. Aug 09	Mrs. Runa Laila	BRAND	Executive Director	Dinajpur
Aug-Sep 09	Dr. M. Khaleq-uz-zaman	GTZ	Senior Advisor, SED	Dhaka
Aug-Sep 09	Mr. Otto Gomm	GTZ	Programme Coordinator, SED	Dhaka
Aug-Sep 09	Mr. D. Ahmed Taufiq	GTZ	Head of Programme Finance and Administration, SED	Dhaka
Aug-Sep 09	Mr. A. N.M. Zobayer	GTZ	Programme Officer, SED	Dhaka
09. Aug 09	Dr. Yasmin Siddiqua	The Nielsen Company Ltd.	Associate Director	Dhaka
09. Aug 09	Mr. Waliul Mutasim Matin	The Nielsen Company Ltd.	Manager	Dhaka
10. Sep 09	Mr. Animesh K. Sharker	SZ Consultancy Services Ltd.	Chief Executive Officer	Dhaka
15. Sep 09	Dr. M. S. Islam	Grameen Shakti		Dhaka
15. Sep 09	Mr. Abser Kamal	Grameen Shakti	General Manager	Dhaka
15. Sep 09	Mr A.M. Hasan Rashid Khan	Grameen Shakti	Consultant	Dhaka
14. Oct 09	Mr. M. Hamidur Rashid	Chowdhury Hossain Rashid & CO	FCA Partner	Dhaka

**Table 8 – Overview of interviews conducted with ICS key informants**

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