Opportunities to Stimulate Local Economies through Sustainable Innovations for Home Comfort

Gender-sensitive feasibility study for rural areas in Issyk Kul and Naryn

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Summary

This study was conducted to investigate the opportunities for upscaling sustainable local-made technologies for more comfort and better hygiene conditions in rural areas. The results are relevant for decision and policy makers, local administration and stakeholders.

The population of the Kyrgyz Republic remains largely rural with 64 % of its population residing in rural areas. Rural inhabitants face many problems in daily life: energy poverty (lack of heating, light and fuel), low drinking water quality, low nutritional status, and lack of safe sanitation. The project *Home Comfort*, which gained support from the EU, has created a local capacity for improved rural living standards through sustainable energy and sanitation innovations. It contributed to MDG 1 and 3 and was implemented in Issyk Kul and Naryn oblasts of Kyrgyzstan during 2011-2013.

For this study, a survey with questions about the current situation and the demand for innovative technologies was conducted among 407 rural residents in Issyk Kul and Naryn oblast. Additionally, interviews have been held with householders and project managers, and guest books at demonstration centres were reviewed.

The innovations included:

• Energy efficient stoves (EES), which allow people to save on wood and coal

• Solar water heaters (SWH) for hot water by solar energy

• Urine diverting dry toilets (UDDT) for comfortable and safe sanitation and production of fertilizers.

The technologies have been successfully adapted and implemented, and they are appreciated by the villagers, especially by women.

The EES and SWH have good economic pay-offs compared to the traditional ways of heating or bathing. In fact, the savings they generate are respectively € 800 and € 1400 over a period of 10 years. A UDDT is cheaper than a VIP latrine after 4 years, and it increases the comfort of householders.

The results show that villagers, who often face challenges in their daily routines, are ready to take risks to improve their comfort and security. This is confirmed by the self-financed replications of energy efficient stoves during the project *Home Comfort*.

About 60% of the respondents (24% women) indicated to be willing to take a microcredit for one of the technologies. 6 to 11% of the respondents are willing to invest the full cost of the technologies, and 23 to 30% half of it. Yet, some barriers have been identified since some people are not able to invest the full amount of an innovation. SWH need to be adapted better to local circumstances and awareness must be increased concerning the benefits of UDDT. Indeed, increased availability of microcredit with low interest rates, enabling political frameworks and additional capacity building are needed to overcome these barriers.

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Abbreviations

EES	Energy Efficient Stove
MDG	Millennium Development Goal
O&M	Operation and maintenance
SWH	Solar Water Heater
UDDT	Urine Diverting Dry Toilet
VIP	Ventilated Improved Pit Latrine
WECF	Women in Europe for a Common Future
WHO	World Health Organization

1. Introduction

Kyrgyzstan is a mountainous country with a dominant agricultural sector. The deterioration of public infrastructures that occurred following the collapse of the Soviet Union has resulted in poor living standards and the aggravation of the social situation. 37% of the rural population lives below the poverty line, compared to 23% in urban areas[1]. This disparity between urban and rural settings is expected to grow according to UNDP[2]. In a context of slow growth in income per capita and limited access to financial resources, Kyrgyzstan struggles to increase expenditures on key social and physical infrastructures that could significantly increase the quality of life of its 5.5 million citizens, 64% of which live in rural areas.

Villagers heavily rely on agriculture for their livelihood. Agriculture in Kyrgyzstan is a significant sector of the economy, as it comprises 20% of the total GDP and occupies 48% of the total labour force[3]. The typical rural household normally owns a piece of land that is mainly used for subsistence farming. The Kyrgyz agricultural sector is characterized by a low productivity that can be explained by the lack of knowledge on appropriate technologies, the use of cow-dung as combustible instead of fertilizer and high prices for agricultural inputs, especially for imported products like fertilizers, seeds, fuel and agricultural machinery. In fact, chemical fertilizers have become unaffordable for many rural families[4]. Recent results from Chui oblast (similar situation than Issyk Kul and Naryn villages) showed that 59% of households earned a monthly income of between €50 and €150. The main sources of income can be seen in figure 1.

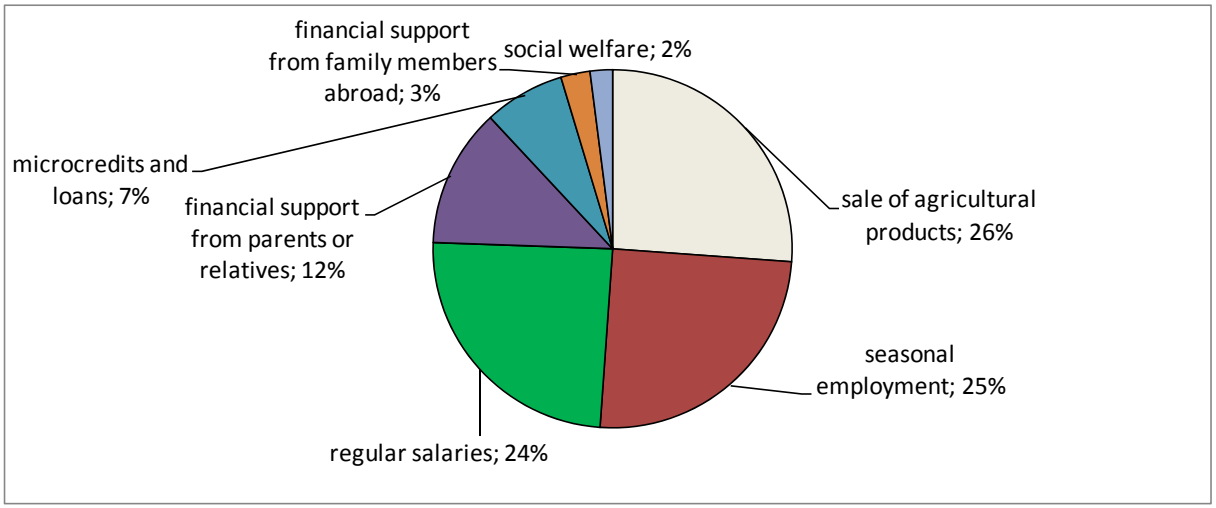


Figure 1: main sources of income in Kyrgyz rural areas[5]

[1] The Kyrgyz Republic: poverty profile and overview of living conditions. World Bank 2011. http://siteresources.worldbank.org/INTKYRGYZ/Resources/KG_Poverty_Profile_062811a.pdf
[2] „The level of poverty will continue to grow" The Gazette of Central Asia, 24 December 2012
[3] CIA World Fact Book
[4] http://www.swiss-cooperation.admin.ch/centralasia/en/Home/Activities_in_Kyrgyzstan/COMPLETED_PROJECTS/Agriculture
[5] Report by ALGA 2012

The rural lifestyle of Kyrgyzstan features standards of living that are far from the ones enjoyed by urban dwellers. For instance, lack of heating, lighting, fuel and safe sanitation, low drinking water quality, and malnutrition are all problems that are commonly encountered in rural communities. Consequently villagers are confronted to health issues that are closely related to their limited access to safe drinking water, inadequate sanitation facilities and poor hygiene practices. As an evidence of the extent of these water-related issues, diarrhoeal diseases are the main drivers of child mortality, causing 35 deaths per 100,000 children under five. This places Kyrgyzstan to the bottom of the ranking with regards to this statistic across the pan-European Region, surpassed only by Tajikistan that shows similar rates[6].

Drinking water supply in Kyrgyz villages relies mostly on artesian underground sources, which account for 80% of total water consumption for drinking and domestic needs. More than 40% of the centralized water supply systems of the country is deteriorated completely and should be replaced. In addition, more than a half of small towns and regional centres do not have centralized sanitation systems or water treatment facilities, and centralized sanitation is inexistent in rural areas[7]. Currently pit latrines and untreated wastewater run off characterise the most common sanitation systems of rural areas, which causes many hygienic and sanitary problems. However, safe and sustainable sanitation as well as adequate hygiene practices are still not affordable for many villagers.

Kyrgyzstan, which produces more than 90% of its electricity from hydropower, is facing an imminent energy crisis since 2008. Old equipment, shortages of financial resources, corruption and low water levels already have led to rolling blackouts throughout the country. These circumstances put villagers in vulnerable situations where they bear the brunt of the energy crisis. A common use of electricity in villages is water heating for tea or washing up. Traditionally, solid fuel is used in order to heat houses for it is cheaper than electric heating. Thus the main sources for house heating in villages are wood, coal and manure.

The project *Home Comfort* has been creating local capacities for improved rural living standards via sustainable energy and sanitation in Issyk Kul and Naryn oblasts in Kyrgyzstan. The project was supported by the EU and implemented by Women of Europe for Common Future (WECF), Kyrgyz Alliance for Water and Sanitation (KAWS), CAMP Ala-Too (CAMP) and Rural women's association "Alga" during 2011-2013. This publication presents the results of the feasibility study.

2. Methodology

This feasibility study is based on a field survey among 407 villagers (161 women and 246 men) from 9 villages in Issyk Kul and Naryn oblast, who were asked at the start of the project.

[6] Atlas on Water and Health http://www.waterandhealth.eu/

[7] Review of Key Reforms in Urban Water Supply and Sanitation Sector of the Kyrgyz Republic, Mosvodokanal 2004

The questionnaire comprised questions on the following topics:

- the current situation in households regarding energy, sanitation and personal hygiene
- the demand and willingness to invest in the innovative technologies (EES, SWH and UDDT).

The questionnaire included open and closed-ended questions. The villagers filled in the questionnaire on their own and were free to respond as they see fit, without being limited by some predetermined parameters. Some respondents preferred to answer anonymously. The interviewers were present and were sometimes asked for clarification, as some respondents spent more time on specific questions, or had additional interrogations.

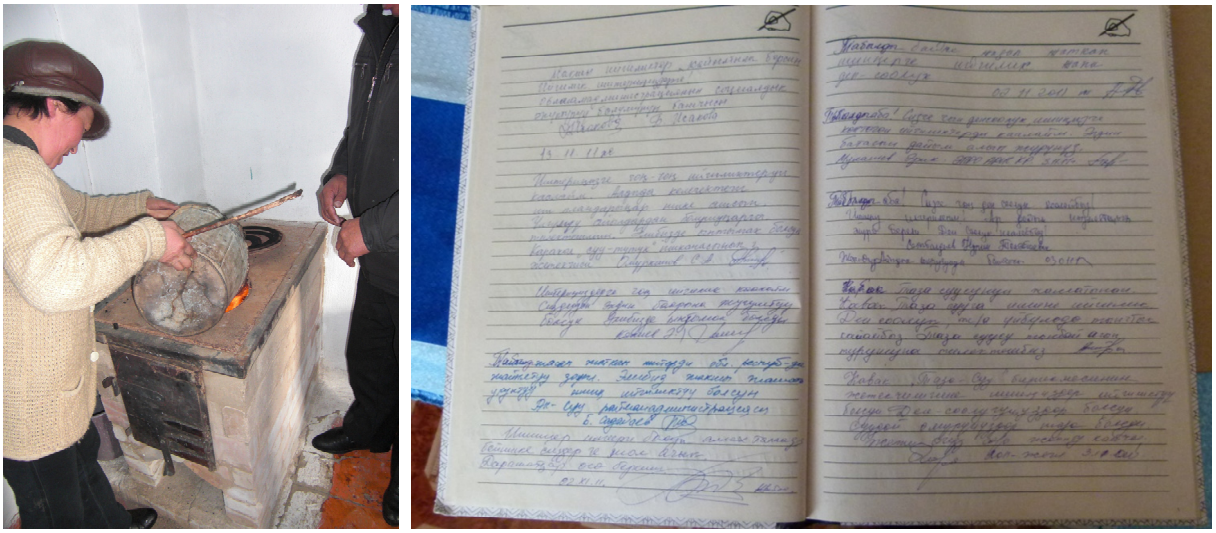
The sample of respondents for the questionnaire was chosen in a practical manner. It was decided to get a cross-section of the communities, which means that males and females from different social and age groups were surveyed. Interviewers walked down the streets and asked every tenth person to fill the questionnaire.

Additional sources of information were used, which included informal interviews, monitoring the results of objects constructed in the context of the project, and reviewing guest books at 8 demonstration centres in the project area. Data for the cost-benefit assessment were gathered from project managers, a couple of villagers and prices in local markets. Also results of previous projects in the area were used.

The data were analysed in Microsoft Excel spreadsheets. Gender disaggregated tables have been developed for each question. Out of the total number of men and women, percentages have been calculated and presented in graphs.

Guest books in Demonstration Centres

Demonstration centres were created in eight target villages where the project was implemented. In guest books, visitors were invited to write their names, contact details including telephone number or address, their opinion about the showcased technologies, and requests for their construction.



EES for demonstration in Chyrak post office / guestbook filled in by interested visitors

3. Current Situation in the Villages

3.1 Household conditions and gender aspects

69% of the respondents haven't got running water inside the house. In general, women are in charge of the water provision (72% of the respondents). In some families, responsibilities are shared with men, and in many cases, with children. Usually, the whole family is involved in fetching water for the household; in 84% of families, children have responsibilities to bring or collect water along with adults. The time spent to collect water varies from 15 minutes to 1 hour per day in the project villages. Water duties include carrying water and managing water storage. The practices vary a lot; buckets, pails, tanks or metal flasks are normally used.

The majority of respondents explained that men and women have equal responsibilities regarding agriculture. But in the households, women's labour burden was recognized by both men and women to be more intensive than men´s. Rural women are estimated to be two times busier with household-activities in comparison to men. Because of their household duties, rural women suffer more from the lack of adequate infrastructure (energy, running water, sanitation and hygiene). The time-consuming and intensive efforts required to meet basic needs reduces the potential for further income earnings, which aggravates the precarious situation of households.

The limited availability of water exacerbates the poor conditions for personal and domestic hygiene, which again increases the burden of family members, especially for women and children. Sanitary conditions were evaluated by majority of respondents as poor to moderate.

The majority of respondents (64%) are not satisfied with their living conditions. Such evaluation closely relates to the limited sanitation and hygienic conditions observed in rural Kyrgyzstan.

3.2 Energy

Rural women stressed that housekeeping during cold seasons is more time-consuming than in warm seasons. Additional activities include: kindle stove to heat house, cook and boil water for household needs.

Respondents preferred to use wood as fuel for the stove, as it is cheap and affordable. Coal is the second preferred type of fuel; it is accessible but expensive. Kyzyak (dried cow manure) is affordable everywhere in the villages, however it is not effective enough to heat the house. Kyzyak is normally only used for cooking. Gas and electricity are mainly used for cooking at home, starting from October till May. All villagers use combined types of fuel during winter as they usually save resources to insure availability throughout the entire season. Another way to save on fuel is to limit heating space at home. Traditionally, villages consist of houses with four or more rooms (more than 48 m^2). During cold days villagers usually heat one or two rooms (27 to 35 m^2) of the house. 96% of respondents (men and women) pointed out at the lack of resources in families as the main reason for heating limitations during cold seasons.

For heating and other needs, during cold months, an average rural family needs annually 2 to 5 tons of coal, which cost about €100-325, or 0.5 to 7 cubes of wood for the average cost of €15-115, or 1 to 5 freight cars of manure for the approximate cost €15-60. Most households don't have permanent foreseeable sources of income because job opportunities are often scarce in rural areas, see also figure 1. Thus, it means that, during winter, households spend up to 50% of their income on heating. In order to alleviate such burden, villagers try to collect fuel in advance by purchasing and storing fuel whenever they have the financial capacity.

Rural families have to limit warm water consumption to up to 20 l per household (maximum water consumption of household is 50 l per day see figure 3), while daily consumption of warm water per person in Bishkek is 102 litres[8].

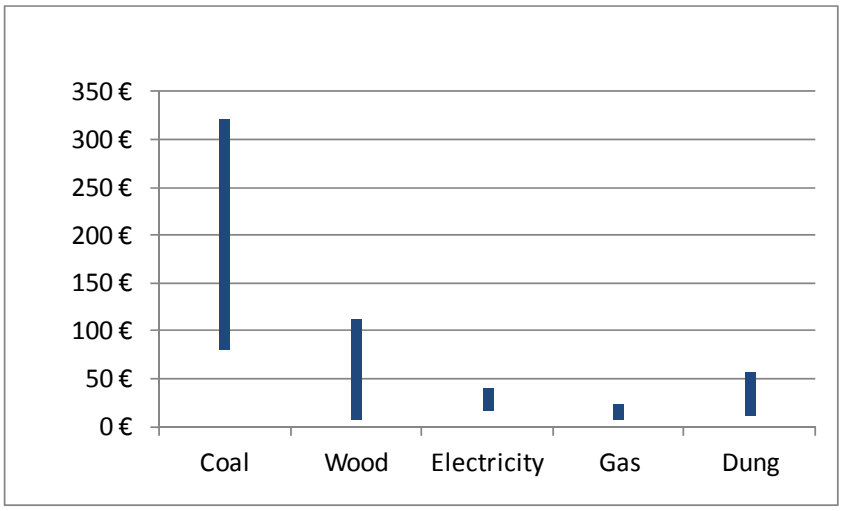


Figure 2: Annual costs for energy per household

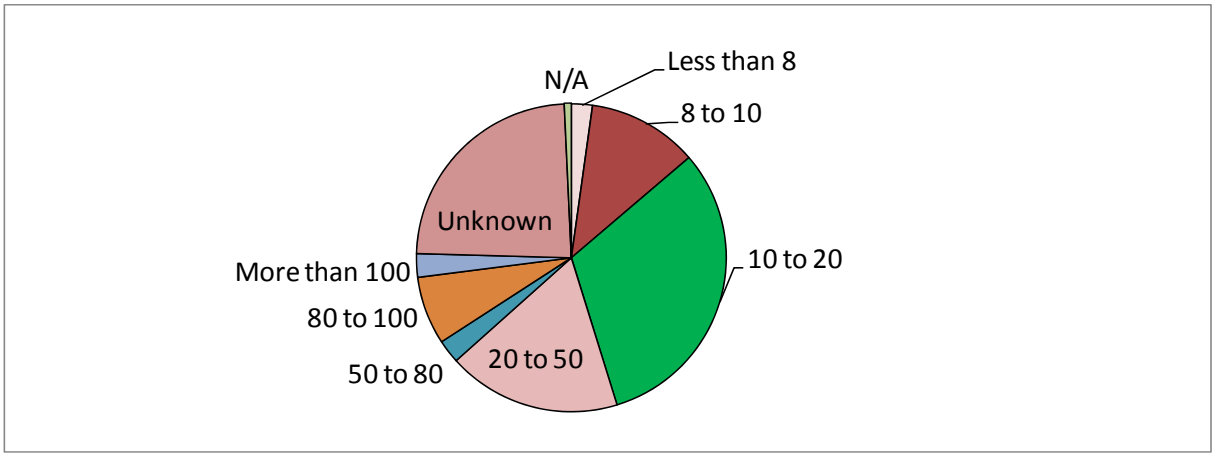


Figure 3: Quantity of warm water in l per day consumed by the respondents

[8] Water and Sewerage Utilities in the Kyrgyz Republic – Performance Indicators. Kyrgyzzhilkommunsouz

3.3 Sanitation and hygiene

98% of the respondents have a traditional pit latrine at home. Most of the toilets are located far from the house (see figure 4). Pit latrines are constructed from poor quality materials by men and are not emptied when they are full but rather relocated. Some families and schools have a ventilated improved pit latrine, which is equipped with a ventilation pipe in order to avoid bad smell and vector related diseases. It is emptied from time to time (e.g. every 3rd year) and usually not relocated.

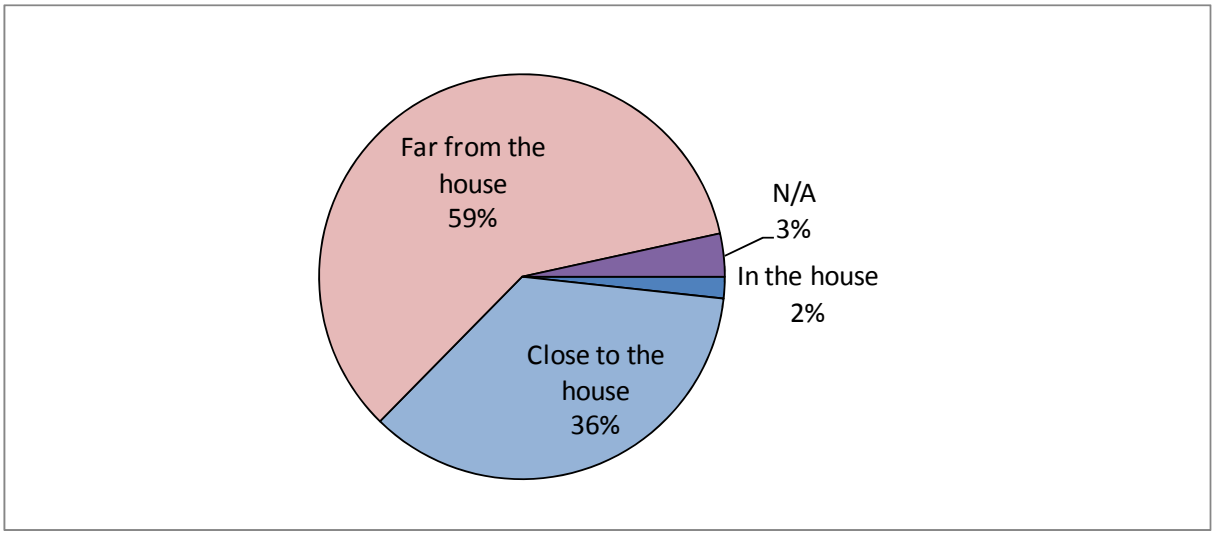


Figure 4: Distance of the toilet to the house

The toilets are difficult to use at night and during winter because of the absence of light and cold temperatures. This brings about complications, especially for women, who often report that they suffer from associated health problems such as urinary tract infections. Small children use potties in the house. Elder children (more than 6 years old) use the pit latrine, which poses a health risk on them. Stories have been reported of children who fell inside the pit. Most people have an aversion to pit latrines because of the smell and poor hygienic conditions. Latrines are cleaned regularly, once a week during summer time and once every two weeks to a month during wintertime, and the task is usually accomplished by women or girls.

Access to bath varies per season. Most people take a 'banya' 4 to 10 times a month. 30 to 40% of the respondents also take a shower 4 to 10 times a month, especially in the summer. In the summer, people sometimes use simple shower facilities with water tanks of 10 to 15 l. Informal interviews revealed that men and children make more use of this kind of facility. Women use these showers less due to warm water limitations. Also women (52%) indicated as a reason the lack of privacy of garden showers. Heating the water on open fire is usually men's responsibility.

Hygienic Conditions in the Villages

Hygiene and cleanliness is a cultural norm for villagers in Kyrgyzstan. Nevertheless, many Kyrgyz people have to live in conditions with poor water and sanitation infrastructure. Hand washing facilities outside latrines were hardly ever observed. During focus group discussions, it was revealed that many villagers do not consider hand washing with soap. Weather conditions also influence hygiene behaviour. For example, children just skip hand washing when they experience discomfort caused by cold weather. School children said: "***we don't use the school toilets because they are so dirty and smelly***."

Most rural women who participated in the research have certain psychological and health discomforts during menstruation days as they lack privacy and sanitation facilities. This issue of menstrual hygiene management is a taboo, and women have to find how to deal with this issue by themselves.

It is believed that bathing or showering is a personal choice, however, in practice, it is socially and culturally determined. Children are expected to be clean and to have clean hands, heads and faces at schools or kindergartens. In rural areas of Kyrgyzstan, bathing and showering is a matter of access to resources. Water resources may be limited so villagers would prefer to use it for drinking, cooking, and agriculture, rather than for bathing or showering. Heating of water also adds to the already burdensome household chores of women and men. Frequency of showering varies from weekly to monthly. Most villagers have summer type showers, while in the cold season, banya or showering in washbowls at homes is practiced. Showering in the summer is not a big deal, but bathing in winter is a question of fuel and water.

4. Innovative Technologies for Home Comfort

4.1 Energy efficient stoves (EES)

Energy efficient stove in construction / in operation / Family in Taldy Su

Energy efficient stoves burn fuel more efficiently and produce less smoke than conventional ovens because of a better combustion efficiency. Different types of stoves have been installed, from simple ones for cooking only to the ones for heating where hot air is guided through a space inside an interior wall of the house. Most ovens are used for both heating and cooking. Through the installation of such stoves, a family will not only reduce household fuel consumption, but also may improve family's health. The energy efficient stoves can heat a house with any kind of fuels, such as coal, dried dung and wood. The cost incurred to install a stove for cooking was in 2011 ca. €150, and €207 for a stove for cooking and heating (detailed price division in Annex 1).

Business Opportunity: Energy Efficient Stove (EES)

Maratbek Orozakunov, a farmer from Chyrak village, participated in the training on EES construction and became a qualified constructor (master). He built 20 EES in Chyrak and neighbouring villages. He never advertises for himself, so villagers find him by the word of mouth. The construction of a standard EES takes just 3-4 days. According to him, the stove has a very high efficiency: "***average consumption of fuel during winter by a traditional stove is 3-4 tons of coal, EES consumption is just 1-1.5 tons. EES is ecologically friendly in comparison with traditional stoves. The volume of ash is 40-50% less. EES is comfortable to use. Cleaning is necessary just once in three years***."

4.2 Solar water heaters (SWH)


Solar water heater for a school / at the resource centre in combination with a UDDT in Chyrak

Warm water for washing, cleaning and laundry is an important factor for comfort and hygiene in daily life. Sun is everywhere on earth and shines for everybody. It can also be a source of energy for the households. Kyrgyzstan has an annual average insolation of 4.1 KWH/m^2/day[9]. Solar water heaters, also called solar collectors, use the energy from the sun for water heating and work without electricity supply. They provide hot water for showers, kitchen use, washing clothes and depending on the size, heating the house. Households using solar collectors have no extra fuel consumption for warm water heating and save money, which they would otherwise have spent on fuel. Solar collectors are especially applicable for regions with high solar radiation and cold winters. They can be used everywhere, but their benefits will be appreciated even more by households in rural mountainous areas having insecure energy supply in harsh winter-times. The price to install a standard SWH with a 200 l tank was €293 in 2011 (detailed price division in Annex 1).

4.3 Ecosan or Urine diverting dry toilets (UDDT)

The urine diverting dry toilet (UDDT) or ecosan toilet is an innovative technology, which can be implemented inside the house or attached to the house. The ecosan toilet does not need water for flushing, it does not smell, nor does it attract flies. Urine diverting toilets do not mix urine and faeces by using a separating toilet seat. Urine is collected and stored in a reservoir. Faeces, which are collected underneath the toilet, must be directly covered by dry materials such as sawdust, soil, ashes, or a mixture of those. The toilet products, urine and faecal compost, can be used as organic fertilisers. Urine is an excellent liquid fertiliser containing nitrogen, phosphorus, potassium and many

[9] http://www.gaisma.com/en/location/karakol.html, assessed 7 May 2013

micronutrients. The fertilised plant will grow faster, develop more leaves and produce higher yields. Faecal compost is an excellent soil conditioner and fertiliser. The safe application of urine and faecal compost requires some basic hygienic agricultural considerations, according to WHO guidelines[10]. The UDDT technology has been introduced in Kyrgyzstan by WECF six years ago and is already known in the project area. Masters and mobile groups have been established in former projects. The price for a standard UDDT is €428 (detailed price division in Annex 1). After the construction of an ecosan toilet, adequate operation and maintenance of the facility, including the safe use of the toilet products, is very important for long-term sustainability.

Ecosan (UDDT) toilets outdoor and indoor

Workshop about ecosan toilets and the safe use of urine in agriculture

In June 2012, the workshop took place in the demonstration centre in Toguz-Bulak and comprised, among others, the safe use of urine. The agronomic expert Kenje Seitkazieva introduced the topic: "***urine is really yellow gold***" because it is a nitrogen rich liquid fertiliser. She explained the experiments that she had carried out with 9 households on dedicated plots, 6 in Taldy Su and 3 in Toguz-Bulak. Carrots, garlic, cucumbers and potatoes were grown on two different plots, one with the application of urine and another one without. The results in terms of 11 criteria were carefully documented and the results can be summarised as follows: the overall quality of the fertilised plants was higher, the plants were stronger and looked healthier. One family explicitly found that, "***the cucumber fertilised with urine is more robust when the temperature is fluctuating from day to night like it is the case in the Issyk Kul region***". A woman from Bokonbaeva reported her very good results by fertilising the whole garden with urine from the ecosan toilet, which yields around 500 l of urine per year: "***I have the most and biggest cherries on the trees of Bokonbaeva***." The amount of urine to be used depends on the crop. For example, trees need less urine per squared meter than potatoes. As a rule of thumb, 1-2 l urine can fertilise one squared meter per harvest. The application of urine in the garden was demonstrated by the head of health care centre of Toguz-Bulak, Ainyra Alymbaeva. She always applies urine in her garden, and the participants were impressed by her wonderful garden.

[10] WHO guidelines for the safe use of wastewater, excreta and greywater 2006
http://www.wecf.eu/download/2008/who_guidelines_vol4_summary_russ.pdf

5. Assessment of Costs and Benefits of the Technologies

In this chapter, the financial costs and benefits of the technologies (UDDT, EES and SWH) at the household level are analysed and compared to the traditional technologies, which consist of pit latrines or VIPs for sanitation, conventional stoves for heating and cooking, public or private banya for warm water body washing.

5.1 Quantitative assessment

The quantitative assessment uses a time period of 10 years with an annual discount rate of 10%. Soft indicators like health, comfort and time saved are not included in the analysis because figures are very subjective, but they are nevertheless considered in section 5.2. The calculations are based on the assumption that the household have to replace their toilet, stove or bathing facility or that a new house is being constructed.

The calculation of the costs for the different technologies is included in annex 1.

The UDDT has an initial investment cost of €427. A UDDT has an estimated maintenance cost of €26 starting in the second year. Every year, the UDDT produces fertilizers equivalent to about €40. In contrast when people construct a VIP latrine of the same quality they pay €293, yet the VIP needs to be emptied every 3 years for €80. A simple pit latrine costs €60 (including labour) and it needs to be relocated every 3 years.

Initial investment costs of a UDDT are relatively high in comparison to a simple pit latrine because of better material quality. The big advantage of the UDDT is that it can be integrated into the house, which reduces the real cost of its implementation as opposed to other detached alternatives.

In the graph, it can be seen that a UDDT is cheaper than a VIP latrine after 4 years. Because the pit latrine has to be replaced, the cash saved on relocation by using UDDT accumulates over the years, while the fertilizer (urine and faecal compost) adds to its financial benefit.

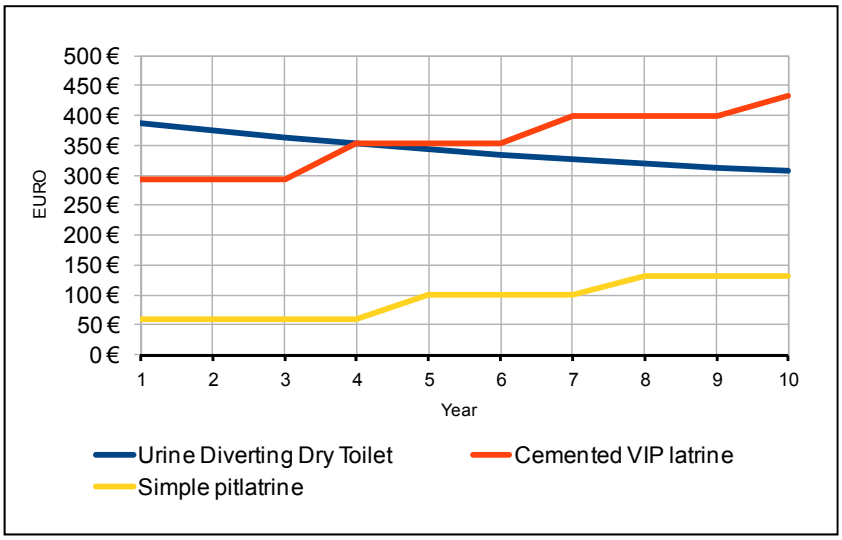


Figure 5: Cumulative and discounted costs of the sanitation technologies

The EES has an investment costs of €207 in case of a standard stove for heating and cooking and €150 for a simple stove only for cooking. A conventional stove costs €256. The EES uses 40% less inputs in the form of coal, wood and kyzyak to operate. According to the survey, people spend an average of €300 on these combustibles using traditional stoves, resulting in an annual saving of €120. In our model, we assume that after 5 years, the EES needs to be repaired for €80.

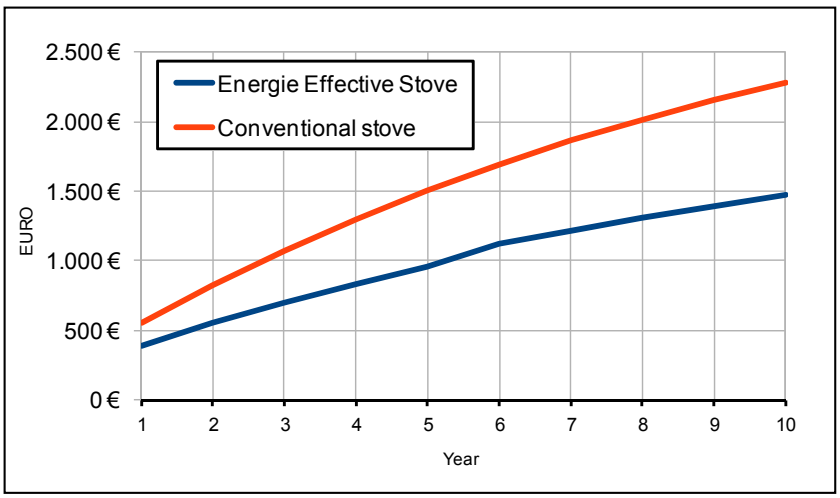


Figure 6: Cumulative and discounted costs of the stove technologies

The SWH has an investment costs of €293. After 5 years, the SWH needs maintenance for an estimated cost of €77. Additionally, €177 is needed to build a shower. The SWH saves €36 in fuels and electricity costs from water heating (calculated according to the insolation in Kyrgyzstan, the efficiency of solar collector and local energy prices). The construction of a new banya cost €565, and after 5 years, maintenance at the cost of €40 is needed. The cost for running the banya is

approximately €150 per year assuming that the householders use the banya every week. Some people choose to go to a public banya where they pay approximately €250 per year.

You can see in the figure that a banya is far more expensive than a shower. Over a period of 10 years using the latter instead of the former can allow households to save up to €1400. A solar water heater saves €273 over 10 years compared to an electrical boiler, which cuts the costs of personal hygiene by half.

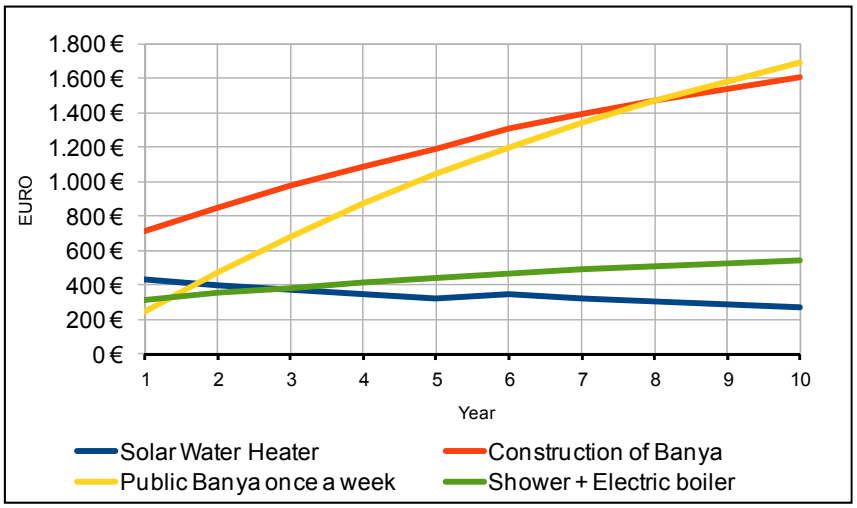


Figure 7: Cumulative and discounted costs of warm water solutions

5.2 Qualitative assessment

The soft indicators in terms of health benefits and improved living conditions brought about by these innovative technologies are difficult to quantify. Nevertheless they play a crucial role for householders when it comes to deciding whether to invest or not. The technologies improve the living conditions in a way that rural families can enjoy a level of comfort similar to the one of their urban counterparts. In the table below, the benefits and disadvantages of the technologies are summarised. The soft indicators for the EES and SWH are very evident. All family members benefit from the comfort of an EES and a SWH for washing up and private hygiene, yet women derive even more benefit from the SWH for the reasons aforementioned in section 4.3.

For the UDDT, there are relevant health benefits that are not necessarily self-evident. Due to the improved sanitation conditions, which require proper hygiene behaviour as well, the rate of water borne diseases decreases, especially for diarrhoea and helminth infections among children. Therefore, this results in better nutrition and school performance. In addition, women and girls especially report to appreciate the comfort of the UDDT.

Table 1: Qualitative Benefits and Disadvantages

	Benefits	Disadvantages
EES	More comfort; Time-saving; Energy-saving; More rooms can be heated; Improved health, better air quality in the house; There are options to integrate house heating; It stays warm for a long time;	Must be built by a master to ensure the quality
UDDT	Increased comfort and hygiene: no bad smell clean, can be built inside; Improved health and nutrition; Relatively simple explanations; can be built and repaired with locally available materials; No water source required; UDDT does not require water; Multiple designs possible (sitting/ squatting, wet/dry cleaning); Can be used by children.	Adequate training is needed; Maintenance required (cleaning, emptying urine tank at least 4 times a year and the faecal chamber every second year).
SWH	Availability of hot water; Time-saving; Basic principles easy to understand; Flexible placement opportunities.	Must be built by a master to ensure the quality Lower efficiency in the winter; Problems with freezing prevention; Risk of construction mistakes.

6. Scaling up Opportunities

6.1 Project results

Scaling up means expanding and replicating the project results for the EES, SWH and UDDT. All three technologies have been adapted and proven to be realistically implemented in the villages. Upscaling is now the overall objective. Henceforth, villagers must be able to purchase or construct the innovative technologies themselves with local support but without being dependent on any external donor support. In this chapter, different opportunities, barriers to upscaling and necessary framework are discussed.

In the next figure, the project's results are shown, which includes information on the number of objects built and the different financing options used: project money (demonstration objects), co-funding, microcredit or self-financing.

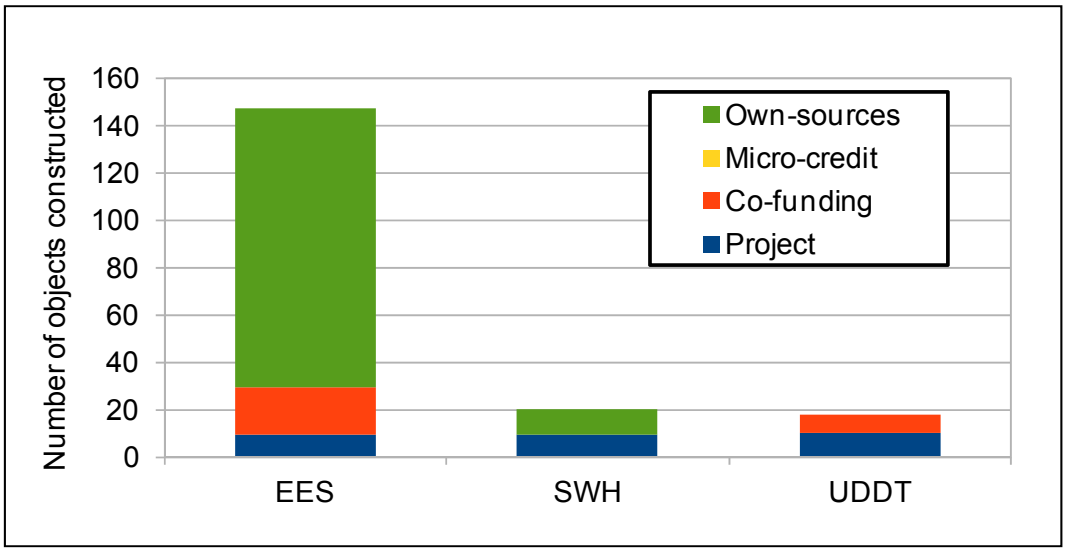


Figure 8: Number of technologies constructed during project duration of 2 years

The EES, SWH and UDDT were constructed at all of the 9 demonstration centres with project funding. The EES was the technology that was the most frequently replicated through villagers' own initiative (118 times). The trained masters were engaged by households to implement the EES. These replications took place without any project involvement. Villagers made their request to the trained masters and paid them. The SWH has been replicated 11 times in the same fashion, but the technology faced some technical problems in the beginning of the project. Eight UDDT were constructed with co-funding from the project.

Building Local Capacities and Setting up Small Business in the Villages

During project realisation, there were practical trainings on EES or SWH construction. Participants got practical knowledge on technologies, in order to earn money through contracts for building and installing the technology. Trainings on construction of EES and SWH as well as workshop on O&M of UDDT were conducted. As a result of the trainings, 20 EES and 15 SWH constructors now contribute to the implementation of the new facilities. Also 17 people became trainer-consultants after trainings. Constructors and trainer-consultants work at the demonstration centres in 8 villages. Villagers have open access to the centres at any time, and trainer-consultants or constructors give initial consultations for interested people on energy efficient stoves and solar water heaters. For UDDT, mobile groups for construction have been established earlier and they are responsible to provide the services to consult and construct a UDDT for households.

6.2 Interest at demonstration centres

During the last two years, 1100 villagers visited the demonstration centres (617 women out of the total amount of visitors). 79% of the visitors indicated that they would like to have at least one of the three models in their household.

General level of interest of women is higher in comparison to the one of men. Women often wrote comments in the guestbook like: “it is so important to know and have opportunity to have technologies that can make life so much easier for women”. Men have interest, not only as users or beneficiaries of these technologies, but also to know construction techniques.

6.3 Willingness to invest in the innovative technologies

Villagers were asked how much of their own money they would invest into the technologies. 6 to 11% of the respondents are willing to invest full of the costs of the technologies and 23 to 30% half of the costs. The highest willingness to invest is found for SWH. For EES and UDDT, there was a slightly lower willingness to self-finance the product. Differences between men and women are especially found for UDDT. 7% more men are willing to invest half of the costs of a UDDT.

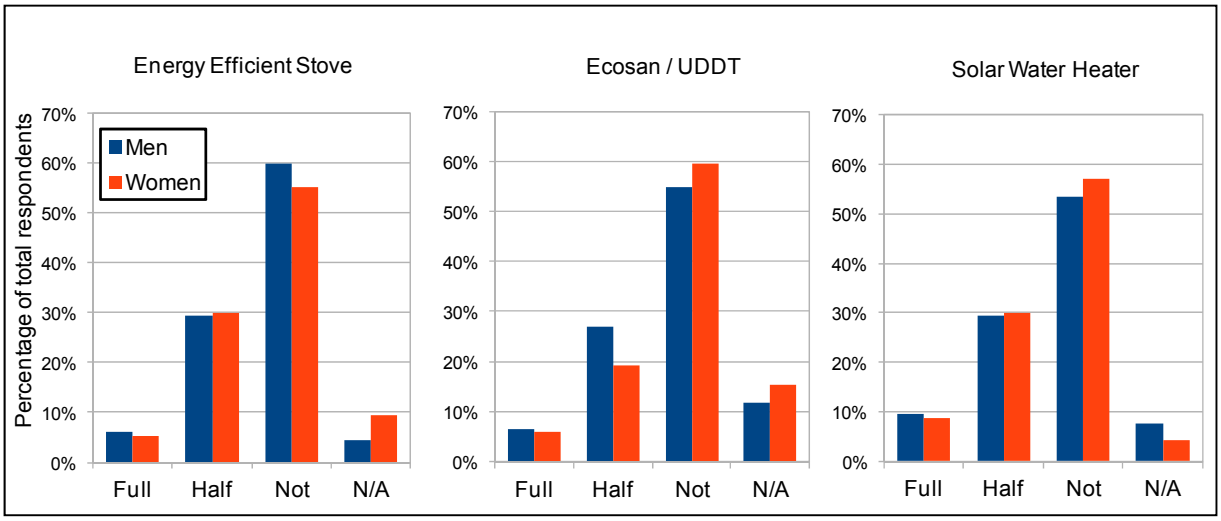


Figure 9: Willingness to invest in the technologies

6.4 Willingness to take a microcredit for the technologies

There are many micro finance institutions in Kyrgyzstan, however they operate with high interest rates (over 30%), which may apply only to a short-term commercial investment, but not for long-term non-commercial infrastructure investments. Villagers indicated that these rates are too high for them.

Villagers of the project area recognised the importance of investments in improved rural living standards through sustainable energy and sanitation. However, even though they obtained necessary knowledge and information, the respondents reported that they faced the problem of lack of financial resources. In the survey, we asked villagers about their willingness to take a low-interest (5%) microcredit. About 60% of the respondents (24% women) indicated that they would take a microcredit for one of the technologies. Most demand was expressed for EES and SWH (both around 30%) among the respondents who are interested to take a microcredit. UDDT showed less interest (14%). The interest of EES was slightly more among men, for SWH about the same and for UDDT more among women.

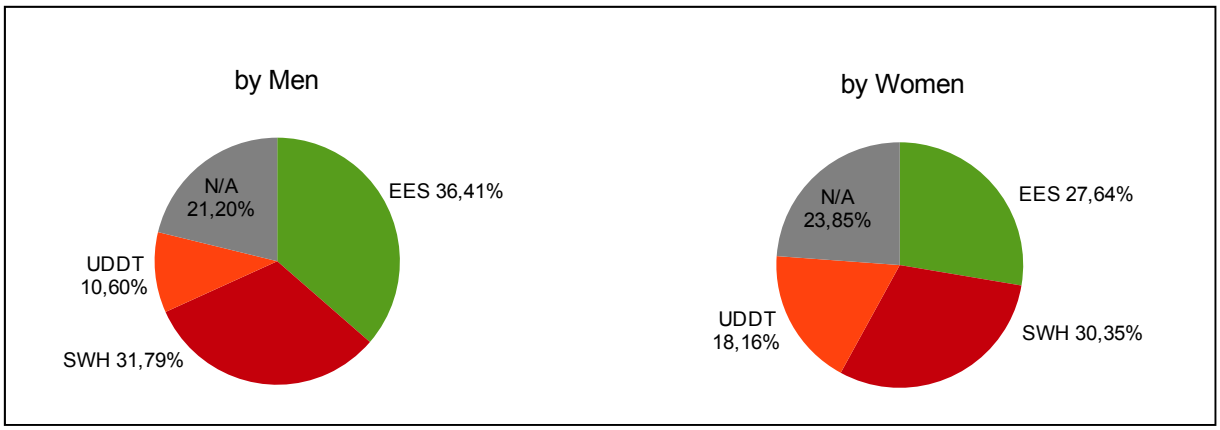


Figure 10: Willingness to take microcredit

6.5 Barriers for upscaling

In this paragraph, we discuss possible barriers for upscaling. We seek for answers on the question: Why villagers do not replicate easily the technologies although they are demonstrated in their village where they can see and test them?

Behavioural intention is believed to be the best predictor of behaviour in most social psychological theories. Intention is the cognitive representation of a person's readiness to perform a given behaviour. Behaviour in turn, is seen as a function of one's attitude towards a particular act (the degree to which performance of the behaviour is positively or negatively valued), one's norms (i.e.

the perceived social pressure to engage or not to engage in a behaviour) and one's perceived limitations (people's perceptions of their ability to perform a given behaviour)[11].

People in rural areas often do not know about innovative technologies. They stick to their tradition and are not aware that other technologies exist. In general, it can be said that people have an indifferent attitude towards innovations. They are neither 'nonbelievers' who will not take any initiatives by themselves and oppose all efforts, nor 'believers' who support innovations and are ready to invest. Instead, most people stick to their tradition or wait for external interventions. The willingness to take a microcredit or invest in the technologies showed that 20 to 30% of the rural populations have a positive attitude towards these innovations. Regular consultations and trainings conducted in the frame of the project proved that knowledge and access to information plays an important role in changing this attitude.

Cultural norms are likely to influence the decision making regarding new home comfort technologies. For example 20% of the people are willing to use urine for agriculture, thus for 80% of the people, the use of urine might be a barrier to accept a UDDT. However, these norms can change over time. After implementation of the UDDT and successful demonstration of the use of urine, some people have changed their mind during the project time.

The use of banya for personal hygiene is another cultural norm. People might perceive a shower as inadequate for personal hygiene because they are not used to it, which forms a barrier to accept a SWH.

Villagers reported financial limitations to buy the technologies. However, the fact that 118 EES have been replicated through people's own resources shows that people are able to invest in new convincing technologies. This became also clear from the survey where about 23-30% indicated to be ready to invest half of the price of an UDDT, SWH or EES. The EES and SWH have a good economic pay-off, yet this benefit is especially visible for EES where people spend less money for their fuels in the winter. A shower and toilet are more likely to result in an increase of comfort instead of financial benefit. The benefits for a UDDT are predominantly related to the soft indicators, which makes them less concrete than monetary benefits, contributing to the lower rate of adoption of the technology. However, the number of replications in the home comfort project shows that this is a slow process.

Technologies like UDDT and SWH involve changes in behaviour related to hygiene and social norms, while an EES does not feature this type of psychological barriers, as heating a house is not necessarily related to private life. Moreover there is no difference with regards to the operation of a conventional stove versus an EES. Therefore people are likely to perceive investments in EES as less risky as they are already accustomed to its principles and consequences.

Other limitations were perceived in technical and constructional aspects of SWH. This technology needs more support and adaptations to local circumstances as well as more skilled maintenance. This contrasts with EES, which has already been well adapted to Kyrgyz villages by CAMP. The construction of UDDT is well known, however proper O&M still needs to be developed and additional awareness and support must be provided.

[11] Ajzen, I. (2005). Attitudes, personality, and behavior (2nd. Edition). Milton-Keynes, England: Open University Press / McGraw- Hill

7. Conclusions

The three technologies EES, SWH and UDDT are suitable technologies to improve the living conditions in the villages in Issyk Kul and Naryn oblasts, as they are much appreciated by the villagers, and more specifically by women, whose empowerment is a crucial component of development. The decision to buy an innovative technology for householders is perceived as a risk. For people living in poverty, the costs of the technologies are relatively high, and the investment often represents several months of income for the family. This study however proved that villagers who are challenged by current problems in their daily routine are ready to take risks to improve their comfort and security. This is confirmed by many self-financed replications of the EES during the project.

The **energy efficient stoves** have a good economic pay-off, are robust and people can directly observe their benefits by seeing the amount of fuels they save. These aspects are probably the reasons of high rates of replications. About 30% of the people in rural areas are ready to invest half of the costs in this technology and are likely to take a low-interest micro credit for energy efficient stoves.

Solar water heaters have good potential in the rural areas of Kyrgyzstan given the economic benefit and improvement of comfort. However, the model has known some major technical difficulties and people have an awaiting attitude. Nevertheless still 30% people are interested to take a low-interest microcredit for this technology.

About 14% of the rural inhabitants are willing to take a microcredit for **urine diverting dry toilets**. 23% are willing to invest half of the costs in this technology. The economical pay-off of the UDDT compared to a traditional pit latrine is limited, which indicates that people are willing to invest in comfort and hygiene improvement. The UDDT has a barrier concerning the use of urine in agriculture. A significant behavioural change as well as operation and maintenance, cleaning and management of toilet products are needed to insure its success. That is why this technology requires more time to be implemented compared to the other technologies.

Upscaling the innovative energy and sanitation technologies can play an important role in developing a new perspective with regards to gender roles. These three new facilities can contribute to improve health, create opportunities to save resource and increase level of income in families. Traditionally, women take care of family and housekeeping. Thus, in many cases, women would be responsible for the effective functioning of UDDT, solar water heaters or energy effective stoves. This new role of women can potentially increase women's position in families, as they will get opportunities to control resources within the household. Men can benefit from new employment opportunities related to the implementation and construction of the products. In this view, the technologies can stimulate local economies in Kyrgyz rural areas.

8. Recommendations

- Adequate sanitation, warm water and energy belong to the basic infrastructure for a healthy economy. In order to bridge the divide between rural and urban areas and make the rural life more attractive, adapted sanitation and energy solutions such as EES, SWH and UDDT are feasible and needed.
- Political will and support is needed in order to upscale the technologies. Safe and sustainable energy and sanitation are national benefits. Given the enormous costs in public health every euro investment in sanitation can have a cost benefit ratio of €4.80 on national level[12]. The energy efficient technologies are measures for climate change mitigation.
- Capacity development is crucial for upscaling the new technologies. Owners of constructed technologies pointed out that they understood benefits after one year of exploitation. Additional awareness raising, trainings and consultations at the beginning stage should be considered.
- The quality of the technology is crucial for further replications. Existing capacities and knowledge of local communities, including community based organization such as Community Drinking Water Users' Union, Water Users Association, Self Help Groups should be used as they have some trust and credibility in the communities and able to embed and secure the knowledge and know-how. Warranties on constructed objects are likely to facilitate the replication. Local business can play a role in this.
- Small-scale entrepreneurship is a key for long term and sustainable upscaling of the technologies. Continuous capacity development is useful to improve and sustain the technologies.
- Currently, people are ready to invest in the technologies however they cannot pay the full cost on their own. Sanitation and energy solutions should be supported in terms of financial incentives, which would be facilitated by an appropriate policy framework.
- Self-help groups and microcredit can be useful financial instruments in rural area in order to upscale the technologies. Part of the villagers would like to take a microcredit at low interest rate, but the existing microcredit institutions have too high interest rates. Attracting external or donor resources might be needed for this purpose.
- Social financial mechanisms for non-commercial infrastructure or social housing in rural areas are needed. There are many financial institutions in the country. Local authorities and stakeholders can grant additional financial resources to the villagers who want to invest in energy-efficiency measures to overcome financial barriers.
- Local authorities should consider providing low-interest microcredit as the technologies implemented have considerable benefits in the long run, economically as well as ecologically.
- At the national level, programmes for improving living conditions in rural areas should be prioritised and receive technical and financial support, together with more educational programmes for technical students.

[12] WHO 2012: Global costs and benefits of drinking water supply and sanitation interventions to reach the MDG target and universal coverage http://www.who.int/water_sanitation_health/publications/2012/globalcosts.pdf

ANNEX 1

Construction cost of EES for cooking (construction cost from 2011)

№	Materials	Total cost KGSom	Exchange rate	Total cost €o
1	Bricks	2000	62,20	32,15
2	Metal for doors + labour	2000	62,20	32,15
3	Labour	3500	62,20	56,27
4	Other materials	1000	62,20	16,08
5	Transportation	800	62,20	12,86
	Total cost	**9 300,00**		**149,52**

Construction cost of standard EES for cooking and heating (construction cost from 2011)

№	Materials	Total cost KGSom	Exchange rate	Total cost €o
1	Bricks	2 400,00	62,20	38,59
2	Fire resistant bricks	2 000,00	62,20	32,15
3	Metal for doors + labour	1 200,00	62,20	19,29
4	Cast iron stove	1 500,00	62,20	24,12
5	Labour	4 000,00	62,20	64,31
6	Others materials	1 000,00	62,20	16,08
7	Transportation	800,00	62,20	12,86
	Total cost	**12 900,00**		**207,40**

Construction cost of SWH (construction in 2011)

№	Materials	Total cost KGSom	Exchange rate	Total cost €o
1	Plywood, wood materials	4 000,00	62,20	64,31
2	Steel for tank	4 000,00	62,20	64,31
3	Heat insulation materials	2 200,00	62,20	35,37
4	Glass	500,00	62,20	8,04
5	Metal pipes	1 500,00	62,20	24,12
6	Metal elbow	200,00	62,20	3,22
7	Cooper pipes	0,00	62,20	0,00
8	Transportation	800,00	62,20	12,86
9	Labour	5 000,00	62,20	80,39
	Total cost	**18 200,00**		**292,60**

Construction cost of UDDT (construction in 2011)

№	Materials	Total cost KGSom	Exchange rate	Total cost €o
1	Construction materials for the foundation	5 000,00	62,20	80,39
2	Construction materials for walls	5 000,00	62,20	80,39
3	Construction materials for the roof covering	2 200,00	62,20	35,37
4	Sanitary engineering (pipes etc.)	4 000,00	62,20	64,31
5	Toilet seat	1 000,00	62,20	16,08
6	Construction materials for finishing the building (ceramic tiles, paint, plastering, whitewashing)	1 500,00	62,20	24,12
7	Electrical wires	200,00	62,20	3,22
8	Plastic tank	900,00	62,20	14,47
9	Transportation	800,00	62,20	12,86
10	Labour cost	6 000,00	62,20	96,46
	Total cost	**26 600,00**		**427,65**

Construction cost of VIP (walls from burned bricks, construction in 2011)

№	Materials	Total cost KGSom	Exchange rate	Total cost €o
1	Construction materials for the foundation	4 000,00	62,20	64,31
2	Construction materials for walls	4 000,00	62,20	64,31
3	Construction materials for the roof covering	2 200,00	62,20	35,37
4	Sanitary engineering (pipes etc.)	500,00	62,20	8,04
5	Toilet seat	0,00	62,20	0,00
6	Construction materials for finishing the building (ceramic tiles, paint, plastering, whitewashing)	1 500,00	62,20	24,12
7	Electrical wires	200,00	62,20	3,22
8	Plastic tank	0,00	62,20	0,00
9	Transportation	800,00	62,20	12,86
10	Labour cost	5 000,00	62,20	80,39
	Total cost	**18 200,00**		**292,60**

ANNEX 2

Calculation: urine replacing chemical nitrogen and phosphorus fertiliser

N-Fertiliser “Cilitre” => 26 KGS / kg with 36% nitrogen => 72 KGS/kg nitrogen

P-Fertiliser “Superphosfaat” => 36 KGS /kg with 20% phosphorus => 180 KGS/kg phosphorus

1 person produces 4 kg nitrogen + 1.2 kg phosphorus

It is estimated that 80% of the urine can be collected in the UDDT

8 € x 6 people per household = 40€

This study was conducted to investigate the opportunities for upscaling sustainable local-made technologies for more comfort and better hygiene conditions in rural areas. The results are relevant for decision and policy makers, local administration and stakeholders.

The EuropeAid funded project "Home Comforts" has demonstrated solutions how to find affordable and sustainable ways towards improved living conditions in rural areas of Kyrgyzstan. "It is so important to bridge the divide between rural and urban areas in Kyrgyzstan", says Anara Choitonbaeva, chairman of the Kyrgyz Alliance for Water and Sanitation (KAWS), "thus applying adapted and sustainable technologies for rural areas." She coordinates the activities taking place in nine villages in Issyk-Kul and Naryn oblast. "Especially women and girls are suffering from insufficient infrastructure in the villages", adds Aijamal Bakashova, gender expert of ALGA, who is one of the authors of this study.

The selected adapted technologies cover three aspects essential for an improved living standard: comfortable heating, warm water and safe sanitation in the house. Energy efficient stoves, solar water heaters and ECOSAN toilets have been installed in each of the nine villages for demonstration. They are located in public places, mostly in the Community Drinking Water Users Unions (CDWUU) so that the villagers can see and touch the new technologies, e.g. in the village Chyrak, the energy efficient stove was installed in the post office and in Toguz Balak in the village ambulatory.

"After successful demonstration, one challenge for sustainable implementation and up-scaling the environmental infrastructure technologies are the lacking financing options for the villagers", explains Claudia Wendland, the overall project coordinator at WECF. This study gives information about the technologies, how they were implemented and accepted, assesses their costs and benefits and discusses what are the potentials for further upscaling.

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