Report of Field Assessment and Focus Group Discussion of

Distributed Institutional Improved Cooking Stoves

(Florian Schumacher, Monika Broehl)

28/09/2013

Contents

Table of Figures

Acronyms

AEPC	Alternative Energy Promotion Centre
CFUG	Community Forest User Group
ESAP	Energy Sector Assistance Programme
IAP	Indoor Air Pollution
ICS	Improved Cooking Stoves
IICS	Institutional Improved Cooking Stoves
FECOFUN	Federation of Community Forestry User's, Nepal
FGD	Focus Group Discussion
NEEP	Nepal Energy Efficiency Programme
REDP	Rural Energy Development Programme
RRESC	Regional Renewable Energy Service Center
STPP	Support to Peace Process Project

1. Background

In Nepal, biomass is still the most important fuel for cooking and heating purposes. According to the World Health Organization (2013b), 81 % of the citizens of rural areas are using wood as main cooking fuel in 2006.[1] In addition, 9 % of the rural population is mainly cooking with dung and 2 % with crop waste (ibid.). This adds up to a number of 92 % of the rural population that mainly uses solid biomass fuels for cooking purposes (ibid.).[2] Bearing in mind that just 17 % of Nepal's population lives in urban areas, highlights the impact of this cooking behavior (World Health Organization, 2013c, p. 162).

The current use of biomass is inefficient and leads to a high level of Indoor Air Pollution (IAP. This does not only apply for the domestic cooking, but also inter alia for canteens, schools, restaurants, hotels, cantonments and police barracks, where bigger stoves are used. According to World Health Organization (2013a) figures, the number of DALYs[3] per 100.000 capita attributable to IAP is 846. The same indicator for children under five is even more than five times higher (4916, ibid.). The inefficient use of biomass further contributes to forest degradation and black carbon emissions. An average yearly rate of forest conversion into shrub land of 5.57 is estimated (Acharya, Dangi & Acharya, 2011, p. 34). This has vast implications on the society, such as a higher number of natural disasters and a decline in the biodiversity as well as the number of forest products and services (ibid.). Additionally, dwindling forest resources affect the market price of wood.

Women are mainly responsible for the household production systems. Women and small children are exposed to smoke for several hours every day and are the groups mainly affected by indoor air pollution (Practical Action, 2013). Hence, they suffer more severely from health problems related to the use of biomass, as depicted in figure 1.

Health Problems	Men	Women
Eye problems	35	73.0
Lung disease	21	41.0
Asthma	-	13.5
Uterus Prolapsed	-	49.5

Figure 1: Selected Health problems related to use of biomass (Mahat, 2004, p. 547)

[1] In contrast in urban areas just 36 % of the population used wood as main cooking fuel (World Health Organization, 2013b).

[2] Under consideration of urban population in total 83 % (ibid.).

[3] "Disability -Adjusted Life Years (or DALYs) are a summary measure of population health that combine (i) the years of life lost as a result of premature death and (ii) the years lived with a disease. Death and DALY rates are calculated by dividing the number of deaths, resp. DALYs, by the total population (or indicated if not, e.g. if a specific population group such as children under 5 years, is used)." (World Health Organization, 2013a)

Generally also the larger dimensioned stoves are inefficient and have, on average a higher savings potential than the small stoves. To make use of these potentials institutional improved cooking stoves (IICS) are being promoted and disseminated. However, within the national ICS promotion program the promotion of IICS has had a lower priority in comparison to improved cooking stoves (ICS) for domestic use. During the last 10 years two different kinds of mud IICS have been promoted through AEPC, ESAP and REDP. Nonetheless, the current situation is marked by a lack of reliable data on field performance, actual fuel saving, perceived IAP reduction, customer satisfaction and economic aspects. So far neither potential fuel nor cost savings through IICS can be quantified nor user satisfaction and possible economic and marketing feasibility of IICS.

The Nepal Energy Efficiency Programme (NEEP), implemented in 2009 within a bilateral development cooperation agreement between the Federal Republic of Germany and Nepal, targets a more efficient use of energy for domestic and productive purposes. As part of the operational plan of NEEP component 2b, it has been agreed upon the enhancement of the IICS dissemination strategy of AEPC. In general, APEC started comparatively late with disseminating IICS and efforts remained on piloting level. In total, only 50 IICS have been disseminated by AEPC in the five Terai districts[4] of Mid- and Far Western development regions, since 2010/11. In addition, 65 IICS were installed in Surkhet through cooperate effort of STPP[5] and NEEP.

To gain a better insight into the situation and the options how to achieve the program objective, a field assessment of IICS as well as focus group discussions (FGD) with IICS users on were conducted.

The field assessment covered 28 interviews with users of IICS, which were carried out on-site by GIZ Development Advisor Mr. Rolf Striffler and GIZ intern Mr. Florian Schumacher and supported by AEPC and STPP regional staff. The studied districts were Dang, Kapilvastu, Rupandehi and Surkhet. Additional interviews have been conducted at Malekhu Bazaar (Dhading District). It was aimed to gain an initial insight into the current situation and to gather indicative data on the field performance, usability, and robustness of the disseminated IICS. Furthermore, initial information on economic aspects, user satisfaction, and the local fuel situation shall be acquired. In this report the collected information shall be presented and analyzed. At a later stage, this information shall be the basis to draw conclusions, for recommendations and suggestions utilized for a possible enhancement of the current IICS dissemination strategy of AEPC.

Two FGD were conducted by Mr. Saroj Dahal, STPP Programme Officer with the support of Mr. Adarsha Shresta, STPP Liaison Officer and Ms. Sharmila Khatiwada, FECOFUN Regional Coordinator

[4] Bardia, Banke, Dang, Kailali, Kanchanpur
[5] Support to Peace Process Project (GIZ)

Far West and Ms. Monika Broehl, GIZ Development Advisor. The FGD targeted a participation of 50% users and 50% commanders' gaining information on customer satisfaction, economic factors, and general information about the IICS used in the former PLA Division 6 in Surkhet that were distributed in the earlier mentioned cooperation between STPP and NEEP.

2. Methodology

Structured interviews have been chosen as research approach for the assessment. These interviews were based on an interview guide (Annex 1: Interview guidelines) consisting of four general categories of interest, ten subcategories and keywords related to these categories. The interviews were conducted in the districts of Dang, Kapilvastu, Rupandehi and Surkhet. Supplementary, there were interviews made on the way to Surkhet in Dhading. This choice was taken on grounds of the activity of the implementing partner AEPC in Dang, Kapilvastu and Rupandehi and the dissemination of stoves in Surkhet trough joint action of STPP and NEEP.

The interviews were taken with current as well as former IICS users. Each interview took between 20 to 60 minutes, depending on the interviewee and the language knowledge of the field staff. All interviews were just recorded in writing, due to loud exterior noises in the most cases.
By dint of visual inspections and market observations additional impressions were collected.

The analysis is based on both, qualitative and quantitative elements. Thus, it will be partly based on hard numerical facts as well as on a subjective examination of answers and observations.

To supplement the structured interviews two FGD were held at a later stage in Rajhena-3, Madanchowk, Banke and in Birendranager, Surkhet with users and commanders from the former cantonments. For the ease of conducting these discussions guidelines were prepared, covering the following topics: owner and IICS; use of IICS; maintenance and robustness; fuel; performance (comparison to previous stove); reactions and feedbacks (different levels); willingness and impact of stove (Annex 2: Guidelines for FGD)

3. Findings

In total 28 cases were studied (N=28) and two FDG, one with 10 and the other one with 16 participants, were held to draw inferences from the studied units to a larger class of similar units.

3.1. General Information

3.1.1. Structured interviews

The stoves which were inspected were on average 8.75 months in use. This indicates a relatively short period since their construction. Outliers were a stove at a police barrack with 47 months in use and two that were recently built, just 14 days before the interview, at a hotel and another police barrack. Regarding the positioning of the stoves no trend could be identified. 53 % of the stoves were placed outside, whereas 43 % inside and 4 % was partly placed outside partly inside. In addition not all stoves, which were placed outside, where protected from rain.

The uses of the stoves were versatile: 13 stoves were used for commercial purposes such as hotels, restaurants or alcohol producers; seven institutional users like police barracks, cantonments and three were privately used for the purpose of livestock feed production. These users most commonly had a traditional mud stove (61 %, 17 in total) before the acquisition of an IICS. 18 % or 5 in total had IICS before (predominantly in Malekhu where the old IICS had to be dismantled due to the road expansion). The visited IICS were dominated by two kinds of designs: First, the one or two pothole mud inbuilt IICS, with iron reinforcement, no pothole rings but an iron fire gate, a chimney of 1.5 meter length and made out of mud and bricks and secondly, the “rocket stove” model, with reinforcement, an iron fire gate and a grate (see figure 2). Remarkable in this context, were the stoves in Malekhu where all assessed stoves (five) had a metallic chimney with damper and a length of at least two meters. One stove, assessed in Dang, even had a metallic fire door. All stoves were made out of bricks, mud, dung, straw, fiber (sisal or goat hair), sugar and salt. For reinforcement, iron and for the fire gates and grates flat iron bars were used. As already stated, most of the chimneys were made out of mud and bricks, but in Malekhu iron pipes served as chimneys. Furthermore, 12 out of 19 mud inbuilt IICS were two pothole stoves.[6]

Figure 2: "Rocket stove", used for fodder production

[6] six one pothole and two three pothole stoves

3.1.2. Focus Group Discussions

The IICS used in the cantonments were constructed on mud basis, and some parts such as the fire gate and pothole rings were made of iron. The IICS were installed inside the different cantonments kitchens and in general the IICS were used for 1 ½ years in the cantonments. It has been mentioned that up to now still some IICS are in use with Nepalese soldiers.

For a better understanding it has been explained that in one satellite cantonment and division head quarter, 500 to 900 combatants were staying (Annex 3: Cantonments system).

In one company three kitchens were available. One IICS was planned to be used for 50 to 100 people, but with time the IICS were insufficient to feed the number of people necessary and therefore one IICS was only used for a group of 50 to 60 people.

The division office requested GIZ to install IICS to ease their work, but the number of IICS provided was not sufficient and therefore it was compulsory to continue cooking on traditional stoves as previously. The previously used stoves were three stones supporting to hold the pot over a fire hole in the ground.

3.2. Aspects of usage

3.2.1. Structured interviews

An important aspect concerning the usage of the IICS is the daily hours of operation. The mean of the estimated hours by the interviewees is 7. The outliers have to be taken into regard, with a daily use of 16 or even 17 hours or less than 1 hour, due to the use just for parties or really big groups. This gives already an indication that the usage is really different. Also the type of usage differs as

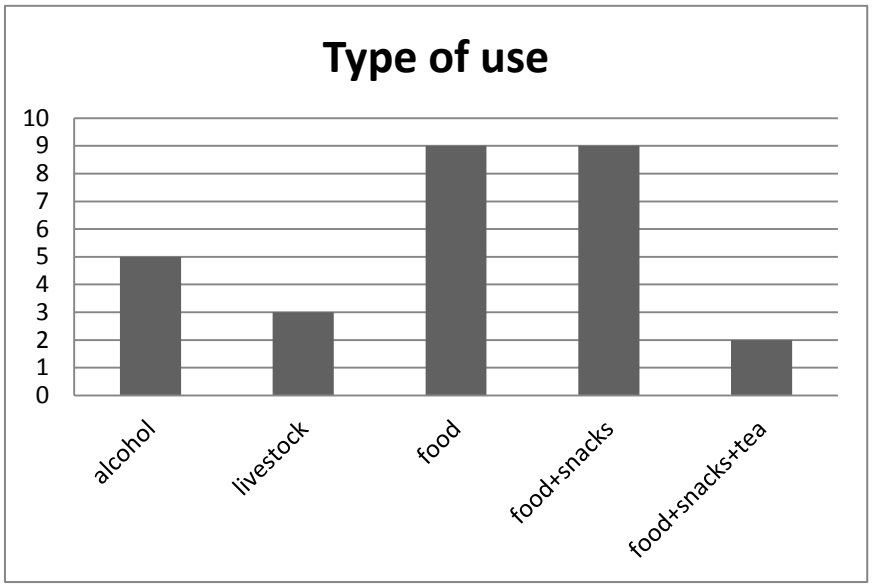

Figure 4: Type of use for stove

observable in figure 4: Although the majority utilized the stove for the cooking of food, snacks and some even for tea, five stoves were used for the production of local alcohol (rakshi) and three for the cooking of fodder. In 90 % of the cases, where the stove was used for food preparation (in total 20 stoves) the user had an additional stove for either the preparation of tea, snacks, small servings and generally as back-up to be more flexible. All extra LPG stoves served this purpose (in total 36). Furthermore, three interviewees were in possession of a tandoori stove and four of traditional stoves.

Figure 3: IICS used for Rakshi production with big pots

Positively to mention is that nearly all interviewed persons judged the availability of the construction

and reinforcement materials for the stoves as easy. Just one answered that the metal for his stove had to be ordered and was therefore not immediately available. The same high level of availableness applies to trained stove masters. For all respondents was or is a stove master easy available or they were not able to answer this question. Important to know in this context is the fact that – apart from Surkhet – in all other districts the RRESCs have just become active on the dissemination of IICS. Therefore, they trained also stove masters on IICS.

Besides, the users mainly resorted to the standard design provided by the stove master and did not wish any individual modifications. Just five stoves had individual modifications. These were pothole bars to enable the use of smaller pots, a minimized height of the "rocket stove", contrary an increased height and lastly the removal of the iron fire gate to increase the size of it. The meaningfulness of especially the last two activities is disputable. Similarly to the number of modifications, is the number of needed after-sales-service through a stove master quite low. Just six of the interviewed made use of it, which might be also related to the short length of use of the assessed IICS. Repairs were necessary at the outlet (three times), at the fire gate (two times) and one stove needed the exchange of the pothole ring. Likewise, the number of self-repairs is low, probably because of the same reasons. Three out of four respondents which self-repaired their stove did some smearing at the pothole to ensure its stability. It is worthy to mention that there is no correlation between the age and the necessary repairs. Furthermore, it was stated by the interviewees that they did not have to pay for minor repairs and got instructions how to maintain the stove from the promoter. The information was spread either through a booklet or just by

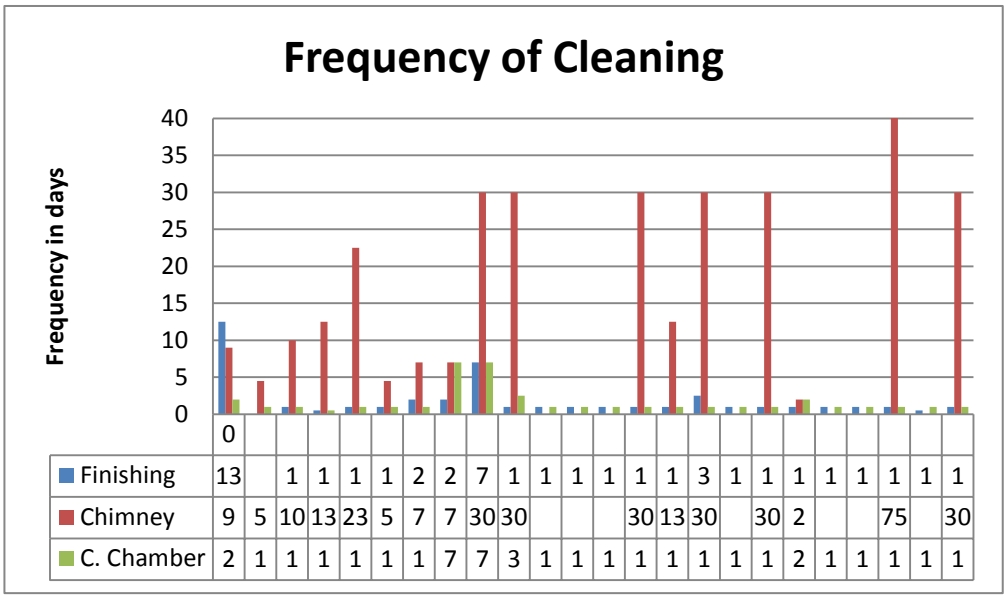

Figure 5: Frequency of Cleaning

communicating the important points.

When looking at the cleaning activities conducted by the users, it is detectable that this is quite an important topic for them (cp. figure 5). One cleaning action is the finishing, from the most people executed on a daily basis (mode=1). The frequency of the chimney cleaning is already more scattered and influenced by the outlier of just cleaning the chimney every 75 days. The mode is 30. Lastly, the superior number of users cleans the combustion chamber daily (mode=1). The data gaps in the figure are linked to the "rocket stoves" or to the fact that the stove was just in use for a short time and hence, the chimney was not cleaned yet.

All users fueled their stoves with wood. Just two farmers also burned agricultural residues beside wood. For the majority the fuel wood is easily available (22 times mentioned), for five moderate and for one hard. The last answer was reasoned by the absence of a community forest in the immediate vicinity. The user complained also about the high price of wood, which rose over the two past years and declared that especially in the winter time there is rarely a cost advantage in comparison to LPG. As already mentioned, two farmers used wood and agricultural residues side by side as their fuel. Eleven respondents just utilized fuel wood and 15 respondents as well as LPG. Nevertheless, nobody was restricted in his/her fuel choice, because everywhere all kinds of fuels were available.[7]

Concerning the fuel consumption, considerable differences between the users were detected: On average 822.44 kg of fuel wood and 3.03 LPG cylinders are used per month. The analysis of the correlation between the use and the consumption revealed the following: Correlation between the number of meals per day and the wood consumption is low with r=0.32. This means that with a higher number of meals per day, the amount of fuel wood increases. Alike, there is a correlation measurable between the number of snacks per day and the use of LPG cylinders per month. Here moderate linear correlation exists (r=0.48). The correlation between the hours of use per day and the used wood per month is very low (r=0.07). This might relate to the very different user patterns of the interviewees. All in all, it is hard to derive more precise findings, because many factors are influencing the fuel consumption (e.g. the using pattern, wood quality) and for some respondents it was hard to estimate how much fuel they use on average.
Concerning the wood quality, 21 assessed their fuel wood as good and dry, just five said that the quality is moderate. Albeit users assessed the quality as good, there were huge differences in the storing. For instance, the visitied army and police sites have proper shelters for the wood or stored it

[7] That means for cooking LPG, fuel wood and kerosene. The prices for kerosene and LPG are everywhere fixed and hence have just a small range (LPG NPR 1470 to 1550, kerosene NPR 100 per liter).

inside, whereas many others stored the wood outside just covered provisional with a piece of tarpaulin.

3.2.2. Focus Group Discussions

The IICS in the cantonments were used four times per day; the main dishes, rice and daal were cooked twice a day additionally to snacks in morning and afternoon. The IICS was generally used for four to six hours per day. The responsibility of cooking changed on a daily basis, and it was routine for everyone to be involved in the kitchen work.

During the 1 ½ years that the stoves were used in general no technical problems occurred, except that once in a while bricks broke due to the big size of pots, which then was repaired by them. Regular maintenance such as coating the IICS with mud, cleaning it daily after the last meal and cleaning the chimney once a week was carried out by the respective user/cook.

Wood was used to fire the IICS. The fire wood was generally provided by the surrounding community forests. Usually Sajh - a species available in that area - was used as fire wood.

Before the introduction of the IICS the traditional fireplace was placed on the ground. The FGD participants recollected several incidents when clothes caught fire and causing burn injuries due to the cook stand above the fire place. With the installation of IICS the height was raised up to one meter, which was much more comfortably to use and safer. The users stated that through the use of IICS the felt improved well-being and had less coughing. Furthermore the black stains in the kitchen and on the utensils were reduced giving the kitchen a cleaner appearance.

3.3. Customer satisfaction

3.3.1. Structured Interviews

One important aspect contributing to the customer satisfaction is the performance of the IICS. It was asked how much change on the three different parameters speed, smoke reduction and fuel consumption they perceive in comparison with their previously used stove. If the previous stove was also an IICS, then it was asked for the comparison with the stove which was used before that. Analyzing the numbers regarding the improvement in terms of the speed of the stove, the mean of the answers is 26.65 %. Astonishing is that seven declared that the IICS is not faster than their previous stove (0 = mode). Three of them were using a self-build traditional stove with combustion chamber and potholes, but no chimney, two a simple traditional mud stove, one a three stone stove and one a stove which was just build out of bricks. For one interviewee the difference was not in matters of speed, rather in the endurance of the heating. Two others stated that it is still not comparable with LPG, because it takes some time until the fire has an adequate heat but when this certain heat is reached, the speed is very good.

In the case of smoke reduction there is a more united picture: The respondents perceive on average 75.52 % less smoke than with their previous traditional stove (in comparison: mode = 75). For some it was hard to estimate, because in contrast to the IICS the previous stove was placed outside or they could not quantify the reduction. There was one outlier, with a value of just 35 % reduction. This might be connected to the absence of an adequate outlet at the stove.

As last indicator of performance, the perceived savings in the fuel consumption were queried: 40.9 % is the estimated saving of fuel on average. Also here, two respondents answered that there is no difference in the consumption. Nonetheless, this is a quite good value and the most interviewees stated that they have even a 50 % fuel saving. When comparing the answers of 0 % speed improvement with the relative answer to the fuel consumption, you can detect that although there are no fuel savings on grounds of speed, the mean of fuel consumption of the seven respondents is 26 %. In general, there is a moderate correlation between the speed improvement and the fuel savings in comparison to the previously used stove of ($r=0.52$). This casts the statement of respondents which said that there is no discrepancy in terms of speed into doubts.

The performance was also one of the major points which lead to a positive overall feedback: 23 respondents answered that they are satisfied with their stove; just three replied that they are not satisfied. The reasons for the dissatisfaction are very diverse and do not seem to be a general hindrance for the IICS dissemination: One interviewed person complained about the high price of wood (in this case NPR 9.5 p. kg) and because of that, the person was using LPG (15 cylinders p. m.).

Another reason for dissatisfaction was caused through the height of the stove. The stove was used for local alcohol production, wherefore high and voluminous pots are necessary. This heightening was an individual modification made by the stove master and was obviously not well communicated with the user. Now the user has problems to handle the stove and the alcohol production process easily. Lastly, one stove was malfunctioning as a result of deficiencies in the constructed stove. Thus, the speed of the stove is very dissatisfactory for the user and it produces a lot of smoke. As a consequence, she preferred to use the traditional stove for the production of the livestock fodder. That these points do not lead to a general resistance towards IICS shows the question regarding the willingness to pay for a replacement or repairs: Even though they were not happy with their stove, they are willing to pay.[8]

When turning to the positive points, the performance is one decisive factor for the satisfaction, as already described. The users were satisfied, by virtue of the smoke reduction and the speed. Now they can cook faster and due to mostly two potholes also continuously. Moreover, the IICS brought for the alcohol producers additional production opportunities. Due to the speed, some were now able to make more production processes per day and thus, produce more alcohol. Furthermore, 27 out of 28 said that the stove is easy to handle and some stated that the IICS is safer than the traditional stove. One respondent even replaced his traditional stove with an IICS, after his positive experiences with the IICS, which he purchased a few weeks before.

It seems that the happiness with the IICS affects also the attitude from the neighbors of the users. Nine persons answered that there are positive reactions from their neighbors and that they also want to build such stove. Also the customers of restaurants or hotels give positive feedback and are interested in IICS as mentioned by nine respondents.

Beside the satisfaction with the stove, there were also suggestions for improvement and changes in the design: Most frequently mentioned was the desire for a bigger stove with three potholes. Another answer regarded a reduction of the distance between the individual grates of the fire grate at the “rocket stove” to avoid the fall down of charcoal.

There were also some quality problems with the stoves: Especially at the so-called “rocket stoves” there were cracks detectable, also at stoves which were just in use for a few weeks. At some stoves there were also problems with the outlet or chimney. For example in one case fire came out of the chimney and in another the user complained about too much smoke, because of a not properly working outlet. Especially the former mentioned issue depicts a threat in the Terai, reasoned by the traditional thatched roofs. Lastly, some stoves which were in use for a longer time had some repairs

[8] This finding might be relativized, due to sociocultural aspects of the Nepalese society.

necessary. For example, the fire gate was far too big (cp. figure 7) or the pothole was damaged (cp. figure 6).

Figure 7: IICS in police barrack with damaged pothole

Figure 6: IICS used at cantonment with big fire gate

3.3.2. Focus Group Discussions

Previously, around 60.000 NPR were spent for one brigade in a month on fuel wood. With the installation of IICS the amount spend for firewood was reduced to 35.000 to 40.000 NPR per month. Up to that time also big logs were used to make it easier and to be able to cook fast, which totally changed after the installation of IICS. With the use of IICS only small pieces of firewood were used, which saved a lot of firewood and made the work easier than before.

It has been reported that the IICS made the kitchen “smoke-free”, as more than 90 % smoke passed out via the chimney. The IICS brought 40 % - 50 % of time saving to the kitchen work load. The IICS needed some time to heat-up, but when it was warm it was two times faster in cooking than the previously used traditional type of stove.

The users reported that for the installation of the IICS it would have been even more useful if the wind direction had been checked out carefully beforehand. Furthermore in Surkhet the chimney height was too short due the narrowness and small size of the kitchen, which caused that smoke, did not pass out completely. Moreover the IICS were too small, as they should have been used for more than 50 people and they were only designed for 20-30 people, hence the pots were too big, which

caused that bricks sometimes broke. Therefore a common feedback is that future IICS should be designed according to the needs of the users. However it was also mentioned that as it is designed for large quantities, it was not convenient when it was needed to prepare smaller quantities of food.

3.4. Economic factors

3.4.1. Structured Interviews

For the dissemination of IICS are their costs an important factor: There was a huge range of costs. On the one hand caused by a 100 % subsidy by STPP or the Community Forest User Group (CFUG) or on the other hand, the fact that the user was already in possession of the materials and just the wages had to be paid. What can also be interpreted from the costs is that they are very diverse, although the design and the material are similar.[9] The median of the given replies is NPR 1250 per stove. Some of the interviewees could not answer these questions, because they were not in the position of purchasing a stove. All, who had the power to decide, responded that they would be willing to buy the IICS again even at prices above 5,000 NPR.

This might also be linked to the fact that the interviewees have to pay on average NPR 8.73 p. kg of fire wood and that the IICS enables huge money savings. Estimated on a year, it can add up to average savings of NPR 38 995.52.[10] This can be a crucial factor, particularly in times of rising wood prices. Another influencing factor could be the recently announced launch of the color-coded LPG cylinder system (ekantipur.com, 2013). Thereby, the cost advantage of fire wood could rise for commercial users and then there would be an additional incentive to purchase a more efficient, faster and cleaner stove.

3.4.2. Focus Group Discussions

Regarding the economic impacts of the IICS none of iron parts of the IICS were needed to be replaced and the some bricks that were necessary to be exchanged were replaced by themselves, as they received training from a partner NGO (BNA) of STPP for that.

The use of IICS in the cantonments brought financial savings of 25% in Banke and up to 40% in Surkhet.

[9] E.g. difference between inbuilt mud IICS, iron reinforcement, 2 pothole with ring, mud chimney 1 meter (NPR 3500) and inbuilt mud IICS, iron reinforcement + fire gate, 2 pothole with ring, mud chimney 1 meter (NPR 10 000)

[10] The change of cooking behavior, due to for example a reduced use of LPG, cannot be incorporated in this calculation. Therefore, the actual savings might be even higher. In addition, the extension of the production and the supplementary creation of value can also not be taken into consideration.

In Surkhet two commanders are running nowadays hotels and are willing to install IICS, if the shape and size of the stove would be made according to their needs. The other participants mentioned that using an (I)ICS would be around the same cost for the amount of firewood they use in a month as for a gas cylinder and therefore they prefer to use LPG instead of (I)ICS. At the same time they referred it to the remote areas, where people can get sufficient firewood for free.

4. Conclusion and Discussion

In this report, the results of the field assessment of distributed institutional improved cooking stoves were presented as well as the outcome of two FGD held in Mid-West. IICS can be named as a “hot topic” in the context of Nepal. As outlined, the use of biomass is in particular in the rural areas still very common and has especially a negative impact on the health of the users and on the environmental situation. The IICS, inter alia used in restaurants, hotels, canteens, cantonments and barracks, have high savings potentials, due to the dimension and the intensity of use. Moreover, the IICS dissemination is highly lagging behind the dissemination of ICS and there is a data gap on the field performance, actual fuel saving, perceived IAP reduction, customer satisfaction and economic aspects. Therefore, no reliable conclusions are possible on the strategic proceeding on the field of IICS.

As part of Component 2b “Energy Efficiency in Households” of the Nepal Energy Efficiency Programme (NEEP) it came to the agreement with AEPC to foster the dissemination of IICS. This analysis shall also serve as basis for the considerations about the future strategy on the enhancement of IICS dissemination.

From the field assessment it could be found out that most of the stoves of the interviewees were for a relatively short time in use (on average 8.75 months). The purpose of use of the stoves was varying from commercial users like hotels, restaurants or alcohol producers, institutional like police barracks and cantonments to privately used ones. The majority did cook before with a traditional mud stove. The design of the stoves was predominantly either a two pothole inbuilt IICS or a “rocket stove”. The construction and reinforcement materials were in all cases the same, apart from the iron chimneys.

The usage of the stove was diverse, which could be exemplified by different length of the hours of use and the purpose of utilization. This varied from the production of alcohol or fodder to the preparation of solely food, food and snacks or even food, snacks and tea. For the great majority of respondents it was simple to get the construction and reinforcement materials and all said that a stove master is easily available. Also, most of the interviewees did not desire any individual adjustments for their stove but rather chose the standard design provided by the stove master. Due to the short utilization time answers concerning necessary stove repairs or after sales services were heterogeneous. Maintenance in terms of cleaning activities was assessed as important. Most of the people did stove finishing and the cleaning of the combustion chamber daily, whereas the chimney was cleaned about every 30 days.

All users are using firewood for the fueling of their IICS and two respondents were burning crop residues in addition. 22 answered that the wood is easy available, just for six respondents this does not apply. The users which cooked beside the wood also with LPG did this mainly for frying, small servings or tea.

The fuel consumption was also very different and on average one user burned 822.44 kg of wood and additionally 3.03 LPG cylinders per month. Correlations could be detected between the meals per day and the wood consumption (r=0.32), the number of snacks and the consumption of LPG cylinders (r=0.48) and nearly no correlation is between the hours of use per day and the wood consumption (r=0.07). This especially verifies the answers that the LPG is primarily used for snacks and shows that more hours of use do not mean a higher wood consumption in general. It might relate to different user patterns and some users like restaurants and hotels might put the stove on "stand by", as expressed by one respondent, in order to have it faster ready when guests are coming.

Concerning the performance of the IICS in comparison to the previously used stove, differences could be ascertained between the parameters speed improvement, smoke reduction and fuel savings. On average 26.65 % observed an improvement in cooking speed. Seven answered that there is no difference in the speed. 75.52 % stated a reduction in smoke. Wood fuel savings through the IICS were pegged at 40.9 % of wood. General speaking, there was a correlation between the speed improvement and the fuel savings.
The generally good assessment of the performance of the IICS led also to a high level of satisfaction (about 90%). It seems that this opinion was shared with the neighbors of the users, since nine interviewees declared that their neighbors also want to have an IICS.

Some problems with the stove could be observed: Many "rocket stove" models showed cracks, irrespective of the age of the stove. Further defects were related to the chimney or outlet and at older stoves damaged fire gates and potholes were observed. All these mentioned issues result in a less efficient performance of the stove.

Costs for purchasing an IICS had a great variation. For the exactly same model there was a span of NPR 6500. Regardless the costs, an IICS can enable huge savings. The indicated wood price was NPR 8.73, which led to average annual savings of NPR 38 995.52.

Several issues or rather areas of improvement can be named: First, the speed and heat of the IICS is still not sufficient for the majority of users, wherefore they rely on LPG for frying and tea cooking. Second, the communication with the stove masters could be improved to avoid that stoves are build

which are too high or which are too small[11]. Another suggestion related to stove masters would be to ensure a better customer support, in particular for the institutional users. Especially in cantonments and barracks the stoves were not in a good condition. There was no contact with the stove master after the construction. A better after sales service could probably ensure that the stove is in a good condition and thus more efficiently operating. Fourth, it is crucial for the IICS dissemination that the quality deficiencies with the "rocket stove" models are rectified. A negative opinion could hamper the willingness to purchase such a stove.

A further observation concerns the enhancement of IICS dissemination: Many respondents told us that their neighbors are interested in the acquisition of an IICS. In other areas, where IICS were not that common yet, the user build the stove after she heard from their daughter about the existence of IICS, subsequent to a visit of a demonstration site. Then she convinced her mother to purchase such a stove. Therefore, it might be beneficial to have demonstration events/sites. There people who are interested in IICS could make contact to stove masters and promoters and people who do not know about IICS yet could see learn about them and their advantages. There is also a need to teach and re-teach users on the proper utilization of IICS. In many places people used really thick and long pieces of wood, which is inefficient and causes damages at the fire gates of the stoves. An additional observation was that users tried to speed up the burning of their IICS through the utilization of plastic.[12]

Unfortunately, it was not possible to deduce conclusive statements on the respondents willingness to pay and and/or a maximum amount of money for an investment in an IICS. Neither are inferences about the robustness of the stoves possible, because replacements were conducted only due to a road expansion and the age of the stoves was also relatively low. Potential savings through the use of the IICS could only be calculated generally. Lastly, it was not possible to determine which stove model was more efficient and which respondent used the stove in a more efficient way, due to the differentiating user patterns and aspects of usage.

For a follow-up study, it would be interesting to assess the effect of the initiated dual cylinder system on the purchase and usage of IICS. Beyond that, in a follow-up it would be valuable to see, how well maintained the assessed stoves are in for example one year and which problems occurred in the meantime. Perhaps, the users would also have more suggestions for improvement as a result of more experiences with the IICS. What's more, to ensure a higher validity of the findings, the stoves should not be picked by the RRESC. Rather, they should be selected randomized that no conscious choice of the best working IICS is possible. Before conducting a follow-up, there should

[11] in terms of the number of potholes

[12] In one case the RRESC employee even recommended the interviewee the use of plastic as fire accelerant.

also be a precise agreement on the definition of IICS. The miscellaneous understandings led to needless travelling, because at a few sites the stove was used by an institution but had the size of a normal household ICS.

From the FGD it can be concluded that IICS are generally perceived to be very reliable and suitable for cooking in large quantities and it was very convenient in the cantonments. The IICS were found very useful and easy for their daily life during cantonment days. The only hindrances felt while using the stoves, were not because of technical weaknesses but because of the number of the people in the platoon that was higher than the stoves capacity.

5. Annexes

Annex 1: Interview Guidelines

Category	Main Topic	Keywords
1. General information	**1.1. Owner and IICS**	– IICS in use or reasons for abandonment
		– Placement
		– User
		– Previously used stove
		– Type/ model
		– Design (chimney, rocket)
		– Materials (construction, reinforcement)
		– Size (volume, potholes)
		– Kitchen ventilation
2. Aspects of usage	**2.1. Operation**	– Operating hours
		– What food
		– How many meals / volume
		– Other stoves / for what
	2.2. Maintenance	– Availability of construction or reinforcement materials
		– Individual modifications
		– Trained stove masters / after sale service
		– Self-repair
		– Cleaning
	2.3. Fuel	– Fuel availability
		– What kind of fuel used
		– Which fuels available
		– Fuel consumption
		– Quality of fuel / e. g. moisture contents
3. Customer satisfaction	**3.1. Performance**	– Speed
		– Reduction of smoke
		– Fuel consumption
	3.2. Handling	– IICS adjusted to needs
		– Ease-of-use
	3.3. Reactions and feedbacks	– Members in family or business
		– Neighbors
		– Customers
		– Overall satisfaction / Suggestions for improvement
4. Economic factors	**4.1. Willingness**	– Willingness to pay (replacement, repairs),
		– Contribution to cost
		– Costs for different fuels
	4.2. Life span	– Life span of previous stove, if replaced
	4.3. Impact of stove	– Savings

Annex 2: Guidelines for FGD

Owner and IICS

Explanation of settings:

- How many people to serve?
- What kind of IICS?
- Previously used stove?

Use of IICS

- Used for what? What kind of meals?
- How often used in a day, how many meals?
- Always the same cook or more than one?

Maintenance and robustness:

- How long was the stove in use?
- Problems/broken parts at the stove, if so, what kind and how were they repaired, by themselves or stove master?
- Quality difference to previous stove in long-lasting?

Fuel

- What kind of fuel?
- How much did it cost?
- Quality of available fuel?

Performance (comparison to previous stove)

- Fuel consumption
- Smoke
- Speed
- General handling

Reactions and feedbacks (different levels)

- Recommendation of IICS?
- Ideas for improvement?

Willingness

- Willingness to pay (replace, repair)?
- Investment costs?

Impact of stove

- Savings
- Wellbeing especially of cooks, did it make the work easier?

6. Literature

Acharya, K. P., Dangi, R. B., & Acharya, M. (2011). Understanding forest degradation in Nepal. *Unasylva*, *62*(238), 31–38.

ekantipur.com. (2013, June 16). Colour-coded LPG cylinders launched | Business. Retrieved June 18, 2013, from http://www.ekantipur.com/2013/06/16/business/colour-coded-lpg-cylinders-launched/373352.html

Mahat, I. (2006). Gender and Rural Energy Technologies: Empowerment Perspective—A Case Study of Nepal. *Canadian Journal of Development Studies/Revue canadienne d'études du développement*, *27*(4), 531–550.

Practical Action. (2013, June 11). Smoke - indoor air pollution. Retrieved June 11, 2013, from http://practicalaction.org/smoke-indoor-air-pollution

World Health Organization. (2013a, June 6). Burden of disease: Burden of disease by country. *World Health Organization*. Retrieved June 6, 2013, from http://apps.who.int/gho/data/node.main.140?lang=en

World Health Organization. (2013b, June 6). Exposure : Solid cooking fuels (raw data) by country. *World Health Organization*. Retrieved June 6, 2013, from http://apps.who.int/gho/data/node.main.136?lang=en

World Health Organization (2013c). *World health statistics 2013.*