

# TchadSolaire Project Evaluation

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*Touloum Refugee Camp, Chad  
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*by*

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## Summary

The NGO, Tchad Solaire began working in refugee camps in Eastern Chad in 2005. The principal reason for their intervention was to minimise the demand for wood for cooking. To this end, UNHCR supplied households with fuel efficient cookers (Save80), while Tchad Solaire provided solar cookers (Cookits).

This report is an evaluation of the work of Tchad Solaire in the Touloum refugee camp (one of the three camps where Tchad Solaire operates). The survey was requested by Tchad Solaire and was carried out by a team of six, who had no previous experience working in Chad. We conducted a survey of 233 households (about 5% of those in the camp) and also had discussions with UNHCR, CARE and ADESK officials, the Tchad Solaire staff, and refugees employed by Tchad Solaire in the camp.

We were particularly impressed that most households now use a mixed strategy for their cooking. It involves a combination of the Save80, the “banco” mud stove and solar cookers. We saw relatively little use of the traditional, but inefficient 3-stone fire. With this change in cooking practices we discovered that the wood supplied by UNHCR is now broadly sufficient and households rarely need to search for more. We were impressed with the calibre, dedication and achievements of the Tchad Solaire staff.

We found this to be an appropriate time for such an evaluation for two main reasons. The first is that the three camps have now largely been equipped with solar cookers. Hence Tchad Solaire has options on how to continue its works in these camps, and also on whether

to broaden its work to surrounding villages, to additional camps, and possibly to the wider community in Chad. Second, Tchad Solaire was founded to cope with an emergency situation, which no longer exists.

We support the strategy of Tchad Solaire to have introduced the Cookit, given the emergency fuel shortages existing when it started its work. We strongly suggest that urgent efforts be made to improve the durability of the Cookit and that a durable replacement be sought for the plastic bag. We also strongly suggest that Tchad Solaire refine and test the design of the retained heat baskets they are distributing in the camps. We saw few grey water-kitchen gardens in use and have suggested that Tchad Solaire re-evaluate its efforts in this area.

We made a range of further suggestions related to training and the management style of the Tchad Solaire staff. We have suggested that it is an appropriate time for the Tchad Solaire staff to investigate other types of solar cookers, particularly the box cooker, which can be made with materials available in the camps. This could be useful eventually within and outside of the camps. It would also transfer a solar cooking technology to the women, which they could take back with them to Sudan.

## The context

### Tchad

The sub-Saharan nation of Chad currently hosts almost a quarter of a million Sudanese refugees in UNHCR-supported camps located in an arid region near the border with Sudan. After more than six years, these camps have evolved into sprawling, albeit unsustainable thatched roofed, mud walled villages housing tens of thousands of refugees who depend on UNHCR for food, water, fuel and medical care.

### Touloum refugee camp

This camp of approximately 20,000 refugees is divided into ten zones, which are further divided into blocks. When the camp was established in 2004, the refugees' traditional three stone fire method of cooking involved balancing a pot on large stones and slowly pushing the burning end of a log under the pot. The three-stone fire is a highly inefficient method of cooking, which results in significant wasted heat and generates high levels of smoke due to incomplete combustion. In Touloum camp, which this survey examines, the widespread introduction and acceptance by the refugees of Save 80 stoves and banco mud stoves along with solar cookers over the past several years has significantly reduced the amount of firewood consumed. It was not possible to determine the quantity of wood saved by any specific device since they were all introduced over the same period of time. The use of these cooking devices has virtually ended the weekly trips women made to search for firewood outside of camp. Despite the dramatic reduction in fuel consumption, the amount of firewood that must still be provided on a monthly basis (5 kilos per person for families with a Save-80 and 7-8 kilos per person for families without a Save-80) to the residents of Touloum and other camps is costing UNHCR millions of dollars each year. It is also contributing to the depletion of forest cover in Chad and in neighbouring countries. UNHCR continues to search for ways to reduce fuel consumption including more efficient and durable solar cookers.

### Tchad Solaire

In 2004 Derk Rijks, a volunteer with KoZon, a Dutch organization that promotes solar cooking, demonstrated this technology to a group of women in N'Djamena, Chad. In 2005, with UNHCR's approval Rijks conducted solar cooker workshops at the Iridimi refugee camp in Eastern Chad using the Cookit, a panel solar cooker made of cardboard and aluminum foil. The Cookit, the least expensive and most portable of all solar cookers, was developed by Solar Cookers International of Sacramento, California. In 2005, Rijks founded the NGO Tchad Solaire and recruited Marie Rose Neloum, a Chadian, who had been trained in the use of the Cookit, to serve as its President. Once private funding was obtained and local staff hired, Tchad Solaire began constructing workshops, importing materials and hiring refugee women to make, distribute and offer training in the use of solar cookers in Iridimi, Touloum and Oure Cassoni refugee camps. More than 40,000 solar cookers have been produced and distributed in these camps by Tchad Solaire over the past four years. Tchad Solaire is also overseeing four additional projects in one or more of the three camps where it operates. These include: retained heat baskets, grey water recycling for small gardens, soap manufacture, and the local production of the Save 75 fuel efficient stove, which refugee women obtain in exchange for two woven mats.

## Touloum evaluation

In mid-2009 Rijks suggested an evaluation of the work of Tchad Solaire in the Touloum refugee camp. A previous evaluation of the solar cooker project in Iridimi had taken place in October 2007. The evaluation team consisted of six people, from five countries, with complementary experience. Information about the team is in Appendix 1. None of the team had direct connections with the Tchad Solaire NGO. Funding for the evaluation was provided by Tchad Solaire, which covered all of the team's expenses (air fares, accommodation and food). Evaluation team members participated on a voluntary basis and received no compensation for their work.

The team travelled to Ndjamena from Paris on Sunday 25<sup>th</sup> October<sup>1</sup>. Once internal travel documents were obtained and the UNHCR Chad director had been briefed on the team's activities, they travelled to Abeche, where they briefed the UNHCR Technical Advisor for refugee operations in Eastern Chad. Arrival in Iriba, which would be the team's base for the next two weeks, was on Wednesday 28<sup>th</sup> October. The team's first trip to Touloum Camp in a MINURCAT-escorted convoy (which travelled about 17km to and from Touloum six days per week) was on Thursday 29<sup>th</sup> October. The team spent most of the next two weeks in Touloum camp interviewing refugee families, Tchad Solaire staff and local officials. The team departed for Ndjamena on Thursday 12<sup>th</sup> November and for Paris and beyond, on the evening of Friday 13<sup>th</sup> November.

This was the first visit to Chad and to a refugee camp for all members of the team. We were expecting to see rows and rows of tents and were surprised to see a settled albeit sprawling village with spacious mud walled compounds and multiple huts some with elaborate thatched roofs inside each compound.

## Objectives

The primary objective of this evaluation is to improve the effectiveness of the interventions by Tchad Solaire in the Touloum refugee camp, in Eastern Chad. A second objective is to enable Tchad Solaire to operate more effectively in the future in similar camps and surrounding villages, should they decide to do so. This evaluation also comments on the wider operations and management structure of Tchad Solaire. This evaluation was requested by Tchad Solaire and was funded by their donors. This report is written for Tchad Solaire.

## Activities

The main activity in this evaluation was a survey of households in the camp. All 10 zones of the camp were included and a total of 233 families (about 5% of the population) were interviewed. The review team designed the questionnaire and chose which zone to visit on each day<sup>2</sup>. The results are summarised in the next section of this report. An English translation of the questionnaire along with a detailed description of the survey questions are in Appendix 2.

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<sup>1</sup> Five of the team arrived on October 25. One team member, our statistician, was delayed by one week, due to visa problems.

<sup>2</sup> This choice had sometimes to be modified, because food distribution, by UNHCR, was also one a zone-by-zone basis. It was useful to avoid the zone where distribution was planned to maximise the chance that families were present. The team members randomly selected family compounds to visit and marked the entrance to each one visited with a yellow ribbon to avoid duplicate visits by other team members.

Tchad Solaire has fourteen members of staff. The evaluation team conducted extensive interviews with all staff members except Ali Moussa who was based in Ndjamena. The findings from our meetings with all staff are summarised in the next section of this report. The questions posed to Marie Rose Neloum (President), Gilhoube Patallet (Treasurer) and Derk Rijks (technical advisor and founder of Tchad Solaire) and the other Chadian members of staff are in Appendix 3.

There are currently four full-time and several part time refugee women in the Touloum camp who assemble the cookers and two in each zone who provide follow-up support. These individuals were also interviewed. The questions they were asked are in Appendix 4.

The team met as a group with the Iriba-based directors of CARE and ADESK. In Touloum camp the team met once with the president of the refugees and twice with the president of the female refugees.

The main part of this report reflects the views of the six members of the review team. We agreed fully on the recommendations and hence the report provides our joint views. All but one member of the team provided an additional short personal statement in Appendix 1.

Provisional recommendations were presented verbally to the Tchad Solaire team, and also to a representative of UNHCR, prior to the departure of the team from Iriba. During these presentations we found it useful to draw some parallels with other studies. These parallels are provided in Appendix 5.

One of our recommendations is that Tchad Solaire should evaluate other types of solar cookers, in addition to the Cookit, for possible future deployment. One such type is the “box cooker”, which has been used by a member of the review team (Patrick Fourier) in a project in Bolivia. Further information on this type of cooker is provided in Appendix 6.

## The Findings

### The survey results

The team surveyed 233 female heads of households who were asked which type of cooking device they used to prepare their meals. The survey obtained data on the type of food prepared and the device used for over 1200 meals. The women were also asked about the durability of the Cookit, and for their views on the advantages and problems associated with the use of the solar cooker. The team also obtained the number of times the women left camp to search for wood before and after receiving their stoves and solar cookers. The results are summarised here and described in more detail in Appendix 2.

There were deficiencies in both the design and the execution of this survey. They are also described in Appendix 2 for two reasons. The first is that this description may help future surveys to avoid these problems. The second is that we believe the results are defensible, even with these deficiencies, but readers need this information, so they can draw their own conclusions.

### *Methods used for cooking*

Table 1 shows the number of dishes prepared using each type of cooker. In contrast to two years ago, less than 10% are prepared using inefficient three stone fires. The homemade mud “banco” stove was used the most, for about one dish in three, followed by the Save80, fuel-efficient stove. The solar cooker was used for about one dish in four.

Boule was the dish prepared the most, followed by okra sauce, which was often eaten with it. These were rarely prepared using the solar cooker. Some women believed that these dishes could not be prepared with a solar cooker. The Tchad Solaire team disputed this as did some women we met who were able to cook these dishes with solar cookers, pointing the way to the need for more training and follow-up.



The survey team was served a solar cooked lunch (including boule, meat, beans, okra sauce, rice and macaroni) every day we were in the camp. More training was a common request

heard from the women surveyed (as well as the Chadian staff of Tchad Solaire), even though it was not specifically a question in the survey.

**TABLE 1: METHOD OF COOKING DIFFERENT FOODS**

Product	Banco	Save80	Solar	3 stones	Save75	Overall
<b>Boule</b>	177	148	57	49	2	433
<b>Okra sauce</b>	122	66	18	24	1	231
<b>Tea</b>	56	56	63	14	1	190
<b>Lentils</b>	25	26	56	9	0	116
<b>Rice, mil, etc</b>	28	29	48	4	1	110
<b>Dried beans</b>	18	9	39	0	0	66
<b>Other</b>	42	31	22	4	1	100
<b>Overall</b>	<b>468</b>	<b>365</b>	<b>303</b>	<b>104</b>	<b>6</b>	<b>1246</b>

Table 2 shows the meals that were cooked using different methods. This table shows the current limitation of the solar cookers. They are used almost exclusively for cooking lunch. For the lunch, over half the dishes were claimed to be prepared with the solar cooker.

Logically the solar cooker cannot be used for breakfast, because there is no prior sun. They could be used for dinner, but only when families have a functioning retained heat basket, or other form of insulated container, to keep the food hot. This is one of the current projects of Tchad Solaire, to which we return in the section on recommendations.

**TABLE 2: MEALS COOKED WITH DIFFERENT METHODS**

Meal	Banco	Save80	Solar	3 stones	Save75	Overall
<b>Breakfast</b>	217	147	0	49	2	415
<b>Lunch</b>	89	77	279	19	1	465
<b>Dinner</b>	159	134	7	34	2	336
<b>Any time</b>	3	7	17	3	1	31
<b>Overall</b>	<b>468</b>	<b>365</b>	<b>303</b>	<b>105</b>	<b>6</b>	<b>1247</b>

Tables 1 and 2 are concerned with the dishes cooked using each method, rather than with the proportion of families that use the different methods. This is shown in Table 3. This shows that most families used their solar cooker at least once in the day. Some used it just for their tea, which is an important use, and delicious when made with the solar cooker. Team members were served many cups of scalding hot solar cooked tea during their visits to the refugees' family compounds. The brewing of tea is also a use that is highly appropriate, because keeping tea ready for visitors would otherwise consume considerable quantities of wood. In table 2, the "any-time" category was almost exclusively for tea, with the one exception being a family that prepared food to sell.

Omitting those families who used their solar cooker just for preparing tea, there were four out of five who used their solar cooker for preparing at least one of their lunchtime foods. Three out of four families used their banco at least once. This was the same percentage as used the Save80. One person in six still used a three stone fire.

**TABLE 3: NUMBER AND PERCENTAGE OF FAMILIES COOKING WITH DIFFERENT METHODS**

	Solar	Solar (no tea)	Banco	Save80	3 stones	Save75
Number	177	158	146	144	30	2
Percent	91%	81%	75%	74%	15%	1%

The percentages in table 3 do not add to 100%, because most families used more than one method of cooking in the day. Indeed only 6 families (3%) stated they used a single method of cooking, while 40% used two methods and nearly 60% used three or more methods.

This table shows what method the families said they used. We also observed what was actually used since our visits were all in the morning, during the time when the solar cooker would be working. The data above perhaps over-estimate slightly the popularity of the solar cooking, partly because the families knew that was the particular interest. They also may slightly underestimate the use of the traditional three stone fire method. For example, just occasionally when three stone fires were not mentioned as a method of cooking, we found they were still warm! However we believe the summaries in tables 1 to 3 are indicative of the true use.

### *Use of the Cookits*

We asked how many Cookits each family had. Households are issued two Cookits following their initial training. A large household may be given three. There is considerable movement in and out of the camp, and special training courses are arranged for new arrivals. In this survey, only one household did not have a Cookit. Twelve families (5%) had only one Cookit. Four out of five families (77.5%) had two and the largest was one household, where three wives cooked together and had a total of 7 Cookits. The average was 2.3 Cookits per household, making a total of just over 10,000 Cookits in the camp, if 4500 households are assumed.

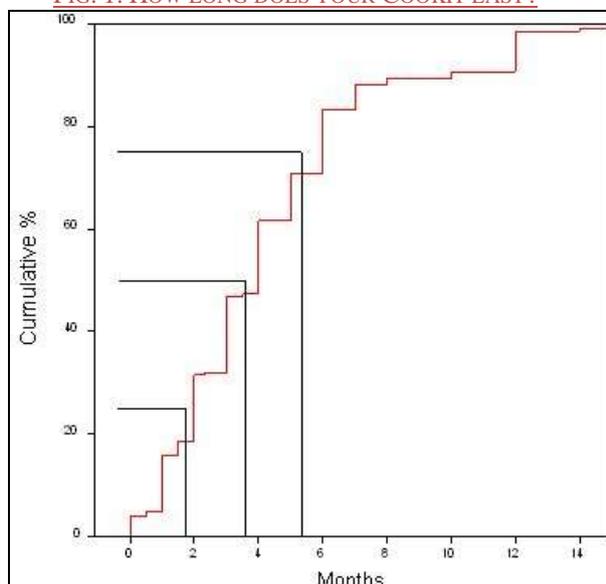
We also asked how frequently households used their Cookit. Four out of five (81%) said they used it every day, while 11% claimed to use it 6 days out of seven. There are two caveats here. The first is that “every day” is only those days when solar cooking is possible, and this is each day at the time of year (November) of the survey. The second is that the training course emphasised that the cooking should be done each day, and the review team felt that some responses repeated what had been taught.

Occasionally the solar cooker was not being used on the day of the survey, even though the response was 7 days out of 7. This led to some creative explanations including, “the person trained in solar cooking is a teacher, and is using it now, but at the school”.

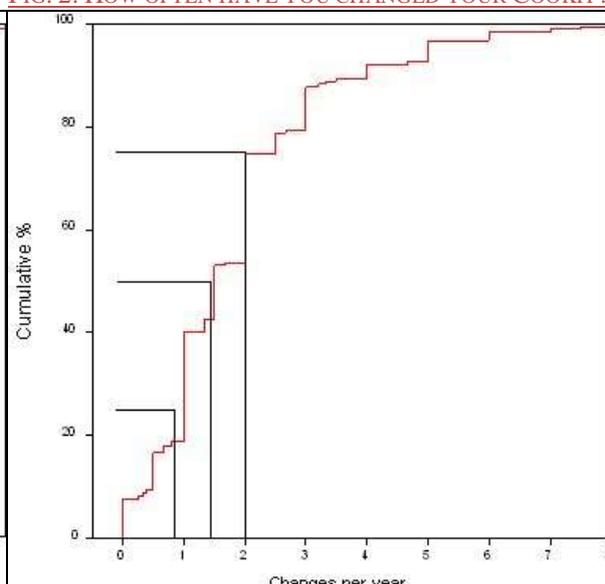
### *Durability of the Cookits*

The durability of the Cookits is an important issue. We approached this topic in four ways, two of which were within the survey. One question was “How long does your Cookit last?” and a second was “How many times have you changed your Cookit for a new one?”

**FIG. 1: HOW LONG DOES YOUR COOKIT LAST?**



**FIG. 2: HOW OFTEN HAVE YOU CHANGED YOUR COOKIT?**



These responses are inconsistent with each other. The median that households state that their Cookit lasts is just under four months.

In contrast, Fig. 2 is from the statement of how many times households changed a Cookit, divided by the time since they started. This gives a median of about 1.5 changes per year and a mean of just under 2. So, on average, each family changes a Cookit twice a year. They have roughly two Cookits, so a Cookit is changed, on average, about once a year.

We believe Fig. 2 is closer to the truth, because it is consistent with our other two methods of estimating the durability of the Cookit, which involved interviewing Tchad Solaire staff. We stress that it is the “rate of replacement” that has been measured. It does not relate to the usage of the Cookits. To assess durability in relation to usage would require different data, possibly from a daily “diary” in a sample of households, that records usage and replacement.

Most households have two or more Cookits, but many use only one of them on any given day. Cookits are likely to last longer if they are used only occasionally unless they are improperly stored and destroyed by water or termites. With the data collected in this survey we are unable to determine the durability of a Cookit if used on a daily basis. The four artisans, who make the Cookits, manufacture 35 per day, for 6 days per week, so about 200 per week, or 10,000 per year. There are an estimated 10,000 Cookits in the camp and this corresponds well with Fig. 2, that replacement is about one per year. It is probably a little less than that, because there is a large stock of Cookits, from this manufacture.

Tchad Solaire employs two refugee staff in each zone. They are responsible for arranging the replacement of the Cookits. We asked them how many they replace each week. This varied by zone, but was roughly 15 per zone per week. There are 10 zones, giving a replacement

rate of about 150 Cookits per week for the camp, or 7500 per year. This is again, reasonably consistent with the data on the manufacture, and with Fig. 2.

We return to the issue of the durability of the Cookits in our recommendations. We strongly believe that Cookits can be provided that are considerably more durable than those produced currently. Whichever of Figure 1 or Figure 2 readers choose to believe (and we have explained why we are more inclined towards Figure 2), what is more important is that the households have as long-lasting a product as possible.

In using the Cookit, the pot is put within a heat-resistant plastic bag. This is replaced when needed. We asked how long the bags last. The replies are shown in Fig. 3. The box plots show the shortest and longest times stated by households in each zone. The line in the middle of the box is the median time.

**FIG. 3. LENGTH OF TIME BETWEEN REPLACING THE PLASTIC BAGS**

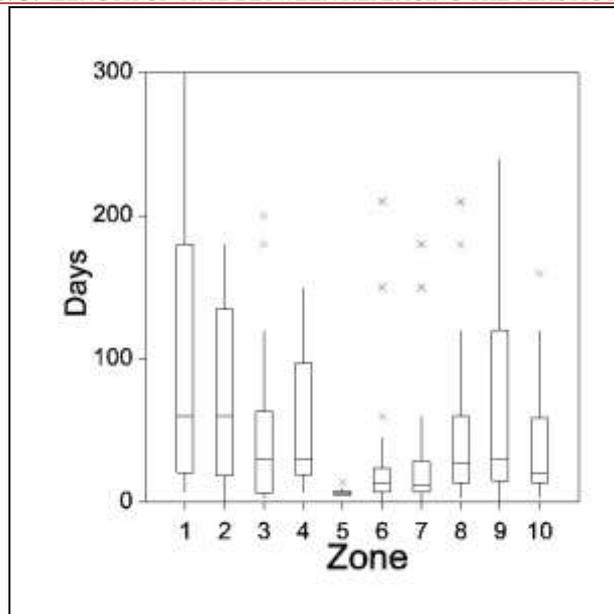


Fig. 3 shows a huge variation in the stated times with the shortest being very few days, and the longest being over a year. The duration of a heat resistant plastic bag used for solar cooking on a daily basis in other countries is approximately one month. The plastic bags are replaced by the refugee staff working in each zone, and the results show large zone-to-zone differences. In particular they show an apparent difference between zone 5 and the others.

This is not a crucial issue for the cookers, however it illustrates the sort of information that is difficult to collect from a survey, but easy to gather if routine records are collected. In discussions with the staff working in each zone, the team learned that most can write, or can find people to write for them. In the future it would be sensible for Tchad Solaire to collect more data on a routine basis.

### ***Advantages and disadvantages***

We asked what the women considered to be the positive points in their use of a solar cooker. A few had no point to make or said simply that it “was all good”. Three quarters of the women gave more specific points. They provided roughly two points per family, as follows:

- 23 (15%) said it cooked their local food easily

- About a third, included a reason to do with health or safety, i.e. 30 said there was no smoke, and a further 25 said there was no fire, or that people didn't get burned, while 7 said they had fewer illnesses.
- Nine respondents specifically mentioned their children, typically "It is good for the children", or "the children can eat", while one response was "It is easy to use when one is ill, or busy, or with a baby".
- Half the people who responded (90) gave economy of wood, or other fuel or water (less is needed to cook meat and vegetables) as a positive point.
- Eleven people mentioned that they considered the taste to be better. Six specifically mentioned that it was good for making their tea.
- One in three (61) mentioned that they valued the free time, or that they could do other things while the food was cooking.
- Finally, two respondents mentioned that their husband now also did some cooking!

When asked about negative points, about one third had no point to make. Those who expressed problems also gave an average of about two points per respondent.

- The most common was that the cooking was not possible when there was no sun, or there was too much dust. This was from about half of those who gave a reason. It would have been more, but we often asked the question as "In addition to the days when there is no sun, what problems do you have with your use of the cooker."
- Sixty respondents complained about the lack of durability of the cooker, either that "it breaks often" or more specifically that water destroys the aluminium or the cardboard, or that it is eaten by termites.
- About 20% (27 respondents) said that their food was not cooked enough when there was insufficient sun.
- About 15% (16 respondents) said the cooker was not suitable for a large family, or that their pot was too small.
- Five people claimed it did not cook their boule well, while a few others had a particular food, e.g. the sauce, they claimed was not well cooked.
- Five people complained that the cooking took too much time.
- Four people felt that wind was a problem, while two felt that having to move the cooker to point towards the sun was a disadvantage.
- Finally, to our surprise, no one felt that the use of the plastic bag was a problem!

We observed that women who complained about the solar cookers not cooking their food well enough (see above) were generally the same ones whose cookers has not been turned to face the sun. This indicates a need for more training, and some respondents indeed expressed a wish to have further training.

### *Searching for wood*

The need for female members of households to venture outside the camp for wood was the original issue that led to the commissioning of Tchad Solaire, and the provision of the Save80 fuel-efficient stove. We asked households how often per week they went in search of wood, both before the provision of fuel efficient stoves, and now. The results are in Fig. 4 and Fig. 5.

FIG. 4 TIMES LEFT CAMP FOR WOOD BEFORE

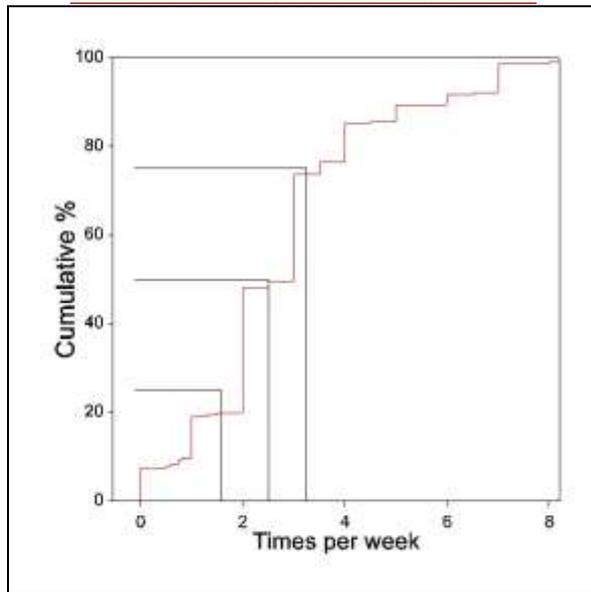
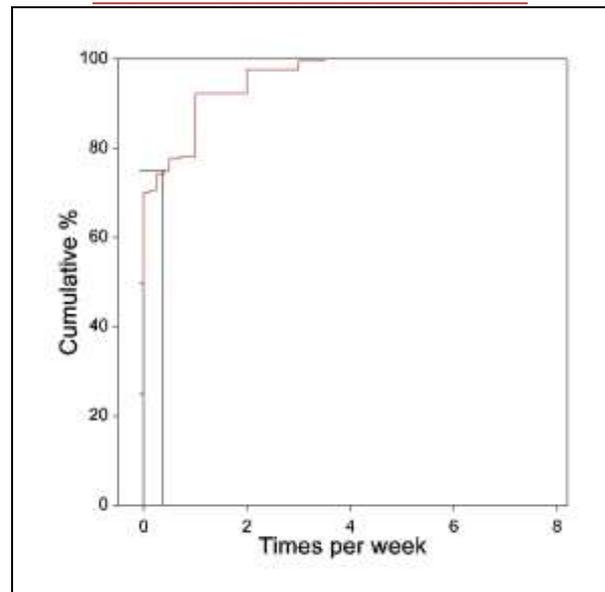


FIG. 5 TIMES LEFT CAMP FOR WOOD NOW



The differences are dramatic. Before the introduction of the Save80 and solar cookers almost every family had to leave the camp to gather wood. The median was twice per week, Fig. 4. Some looked for wood on a daily basis. Less than 10% of households did not search for wood and most of those households explained that it was because they had been threatened. Now, 70% of the households do not search for wood, Fig. 5. Very few search more than twice per week.

#### ***Insulated heat retention basket***

Tchad Solaire has introduced the gufa (insulated heat retention basket) and the potage hammam (grey water recycling for kitchen gardens). The survey asked if families had either device. Only 6 families (3% of those asked) had an insulated basket. This is consistent with the information from Tchad Solaire that 140 were distributed in the camp. Just under half the families had a basket without insulation. Many women showed us large woven baskets with TS painted on in large black but without insulation. Tchad Solaire explained that the women would be notified when to bring their baskets to the Tchad Solaire workshop to have a blanket sewn in for insulation. The refugee women hired to sew insulating blankets into the baskets at the workshop are completing approximately five baskets per week. The team had a number of questions about the insulating capacity of the current design. These are discussed under technical recommendations.

#### ***Kitchen gardens-grey water recycling***

When asked about the kitchen garden, 30% said they did not have one. 20% said they did, with the remainder saying they used to have one, but not now. Most who had given up volunteered that this was because of the shortage of water. The other reasons were the lack of seeds, or that their basin was broken, and had not been replaced.

The team saw a few grey water systems (plastic sheeting, tubes and buckets) in use but the majority had fallen into disrepair. We saw a limited number of gardens inside family compounds, which some families said they watered with water from the wadi since they preferred not to use wash water on plants they would later eat. Many claimed to have given up their gardens because of the drought.

## Discussions with staff

Tchad Solaire's local staff is primarily based in Iriba with several staff members in Bahai to supervise operations at Oure Cassoni camps and another in Ndjamena to handle shipping and logistics. We had individual discussions with five of the staff, and in other cases, we met with staff in pairs. We always had two members of the survey team present, usually with one person asking the questions, and the other taking notes. All discussions were in French.

### *Chadian Staff*

Our discussions with Tchad Solaire staff revealed a dedicated team, justly proud of their accomplishments and fully committed to continuing their work. There was a general agreement among all Chadian staff that more trainers were needed to reinforce the solar cooking skills learned by the refugees.

The evaluation team found that while senior staff were aware of UNHCR's significant contribution to Tchad Solaire's budget, none were able to articulate the details of the organization's full operating budget, accounting methods, income from other donors or international supply chain. None of them had direct contact with Tchad Solaire's major donors, suppliers or the members of that organization's international board of directors. All major logistic, management, supply and technical decisions for the organization are made by Tchad Solaire founder and technical advisor Derk Rijks.

Frustration with the inaction of the refugee women working for Tchad Solaire in the ten zones of Touloum was a common theme among the Chadian staff. This was usually expressed in a relatively simplistic way that was likely related to the refugees' lack of formal education. This is similar to the way a teacher might be frustrated at pupils who have "refused" to learn materials. We return to this point in our recommendations, because we feel the solution rests more with the trainers than with the trainees.

Most Chadian staffers are keen to expand their work more generally in Chad. They were quite modest about their remarkably successful introduction of solar cooking into three large refugee camps, however few of them had any knowledge of options for solar cooking other than the Cookit.

Specific responsibilities of the various Chadian staff members—with the exception of the president, treasurer and the Bahai-based director of Tchad Solaire activities in Oure Cassoni—appear to be somewhat nebulous. "Everyone does everything," was a common refrain.

When asked to articulate the 2009 goals of the organization, several responses were given including: reduce wood consumption in the camps by 25%; distribute retained heat baskets to 5477 households in Iridimi and Touloum; equip willing families with grey water systems and exchange two vanneries (placemats) for one locally-made Save 75 rocket stove.

All staff has received training in the use and manufacture of the Cookit. One staff member has taken a short UNHCR budget course, but no other training has been provided. Staff members stated that they had neither written position descriptions nor clearly defined job responsibilities.

All expressed a desire for a more durable Cookit. Although they felt that ideally the materials should come from Chad, they agreed that it would be better to import high quality materials from overseas if that would result in a longer-lasting Cookit. Several staffers expressed concerns that the solar cooker and other Tchad Solaire-sponsored projects in Iridimi are losing momentum due to lack of supervision. They were concerned that there is

nothing in writing regarding Tchad Solaire's training programs. Some of them had seen the parabolic solar cookers that were introduced in Iridimi camp and rejected by the refugees several years ago. None of the staff had ever seen a solar box cooker.

### *SAV refugee staff*

The Sudanese refugee staff employed by Tchad Solaire in Touloum camp are assigned two to a zone as SAVs (service after sale representatives) or to work in the atelier making the Cookits, sewing the bags and sewing blankets into the heat retention baskets. The evaluation team conducted group interviews with the workshop artisans who make the Cookits and the SAVs in the zones.

The SAVs described their primary responsibilities as setting up and cooking food, making tea with their Cookits every day at the central office in each zone, and taking damaged Cookits and plastic bags to the workshop to exchange them for new ones. During our interviews they estimated that they exchanged 10-15 Cookits and 20-40 plastic bags per week. The evaluation team was shown a written position description for the SAVs in French and Arabic. It is less a position description than a detailed outline of how to use, clean and properly store the Cookit; how to examine a Cookit to determine if it needs repair or replacement; and what repairs can be done by the artisans at the workshop.

The Chadian staff claimed that the Sudanese refugee women do not respect and will not listen to the Sudanese SAVs in the zones and that Chadian trainers in the zones would be more effective. Although there is no written description of the SAVs' responsibility as trainers or their requirements to make house calls in this document, the SAVs are expected by Tchad Solaire to visit family compounds in their zones to ensure women are using the Cookit properly. Few of the SAVs possessed a retained heat basket, which is not surprising since this is a new project in Touloum. The SAVs described their biggest concern as their inability to respond to demands by women in their zones for more cooking pots. The SAVs do not keep regular data on which family compounds they have visited. Several said they wanted to be paid more for their work. A significant increase in coordination between the Chadian staff and the SAVs in the zones is needed.

### *Artisans*

The artisans who make the Cookits take turns doing different tasks, switching jobs each week. When the SAVs bring damaged Cookits to the workshop, it is the artisans who decide whether to repair or replace them. They told our team that if used with care a Cookit can last five months. They observed that many of the refugee women do not take proper care of their Cookits. They said that the plastic bags used every day last one week. When asked what could be done to improve the Cookit, they said it would be good if the foil and cardboard could be coated with plastic so they would not be damaged by water.

## Recommendations

### Background

Tchad Solaire is firmly established in the three refugee camps, with virtually every family equipped with two or more solar cookers. Since they are considering expanding into more camps, this was an appropriate juncture to seek the objective observations and recommendations of a team of neutral but knowledgeable observers. Tchad Solaire have introduced tens of thousands of desert-dwelling refugees to a new method of cooking that allows them to tap in their most abundant and free source of energy—the sun. We commend them on their success which we witnessed first hand as we randomly visited family compounds throughout the ten zones of Touloum camp and saw solar cookers in use everywhere.

The Cookit solar cooker was designed as a lightweight, inexpensive device for use primarily in emergency situations where mobility and easy storage are key requirements. It is also the least expensive solar cooker and can be appropriate for very poor communities that have continuous access to heat resistant plastic bags. This is consistent with the work of Tchad Solaire when it started and we therefore consider the introduction of this type of cooker to have been appropriate.

The situation is now different. Touloum is a settled community. The vast majority of female residents no longer leave camp to search for wood. This is therefore an appropriate time for Tchad Solaire and those who provide support to them, to assess how their work on solar cooking might evolve in the future.

Our detailed recommendations, given below, relate primarily to the Touloum camp, because this was where the survey was conducted. We recognize that Tchad Solaire may expand in the following ways:

- It has currently equipped three refugee camps, which will require continued “servicing” for their use of solar cooking to continue and hopefully expand.
- Tchad Solaire may also be asked to provide solar cookers to surrounding villages, which are impacted by the presence of the camps and receive some support from UNHCR.
- It may also be asked to provide solar cookers to other refugee camps.
- It could provide solar cookers to other communities in Chad, which are unrelated to the situation of the refugees. This was suggested by many of the Tchad Solaire staff. Such a move would have the twin benefits of broadening the work of Tchad Solaire, while providing the type of experience that they would need were they to become involved in recommending appropriate support for the refugees when they return home.

### Technology recommendations

#### *More durable Cookits*

Previous reviews of Tchad Solaire’s work have recommended that a more durable Cookit be investigated. We concur with these reviews and recommend that research on a more durable version of the Cookit be a high priority for Tchad Solaire in 2010.

We examined the cardboard and foil currently being used by Tchad Solaire to construct Cookits for distribution in the camps. Comments from the women interviewed indicate that moisture from the hot cooking pots along with spilled sauce or hot water causes the aluminum to quickly separate from the cardboard and tear, rendering the Cookits unusable.

More durable Cookits are manufactured in the U.S. and Kenya, and there are many packaging manufacturers in the U.S., Europe (and perhaps in Africa) who produce Mylar-coated, plasticized cardboard, that could be used to construct a water resistant Cookit which would be more durable than the current model.

In the short term, more durable foil and cardboard (including pre-fused materials) should be obtained for the Cookit as soon as possible. Local manufacturers in Ndjamená should be considered as possible suppliers if they can produce high quality materials. If not available locally, overseas sources of plasticized, Mylar-coated, waterproof cardboard should be explored.

Local manufacture is the ideal since in addition to providing host-country employment it gives ownership to the affected population and strengthens the local economy. The worthy goal of local construction must also be balanced, however, with the need to provide a high quality, durable product.

Field tests should be conducted by TS at different levels with a large (e.g. 100) sample of Cookits from various sources including SCI Kenya, SCI U.S. and the Cookit used by Steve Harrigan in Darfur to evaluate their durability and acceptability as compared with the currently manufactured Cookit.

The Cookit is a solar cooker technology appropriate for emergency and disaster situations. Hence we also suggest that it is also now appropriate for Tchad Solaire to explore more durable solar cookers (box, parabolic). We describe this in greater detail below.

### ***A Replacement for the Heat Resistant Plastic Bags***

A durable replacement for the plastic bag should be researched, tested and (if possible) deployed as soon as possible. We were privileged to participate in a large celebration of solar cooking at the camp. Hundreds of people were fed and the food was delicious.



However, the sight of several hundred women repeatedly snapping their plastic bags to shake out the moisture after removing their steaming pots of food from the Cookits was a stark

reminder that with limited rations, these women do not have enough water to wash their bags after each use. Removing a very hot cooking pot from a steamy plastic bag while keeping both from touching the Cookit or the ground is a challenge to the refugee women who work on dirt/sand floors.

They must keep the bags elevated while they are damp or the dust will turn to mud and make cleaning even more difficult. During our visits to family compounds we saw many plastic bags in use that were so dirty, the pot was barely visible inside. This dramatically reduces the temperature in the pot and increases the time need to cook the food.

One member of the team brought a plastic dome (normally used as a winter greenhouse for small plants) and cooked a pot of rice with it to demonstrate a more durable alternative to the plastic bag. The dome was much easier to manipulate than the plastic bag once the food was cooked. A pot placed on an aluminum plate inside the dome reached the same temperature as it would inside a plastic bag (250 F-121 C). The plastic dome became cloudy where it touched the hot pot after one hour. Other more heat resistant plastic domes should be explored.



### ***An effective heat retention basket (Gufa)***

The provision of an effective means of keeping solar cooked food hot for evening consumption is a key priority of Tchad Solaire. We found that almost no families use solar cooking for anything but the midday meal. A well insulated heat retention basket will allow refugees to solar cook a second meal and keep it hot until evening.



The survey team examined the heat retention baskets currently being lined with blankets at the workshop. Team members with extensive knowledge of retained heat cooking technology informed Tchad Solaire that the baskets as currently constructed did not contain sufficient insulation to keep food safely hot for 3-4 hours.

Team members stuffed one of the baskets with shredded pieces of discarded cardboard solar cookers to demonstrate the level of insulation required for effective heat retention. Testing and temperature measurements to determine the correct type and quantity of insulation should be carried out at Tchad Solaire's Iribia office before more of these baskets are distributed in the camp.

When an improved gufa is introduced TS should specify the objectives of this introduction precisely (e.g. at least 30% of families use it for at least four evening meals per week), and collect data to be able to evaluate the success of the introduction. We would like to see this type of objective for all TS activities. Gufa distribution should be accompanied with intensive training and follow up to ensure that the women understand their proper use.

The refugee women are open to new technologies for cooking. Tchad Solaire risks losing their trust if it introduces on a large scale additional technologies, which do not function properly. This is a considerable risk with the gufa at present, hence our recommendation above for an investigation and testing phase.

### *Kitchen Gardens-Grey Water Recycling*

We can fully understand why Tchad Solaire should want to add activities that permit the refugee families to have some fresh food that they grow themselves.

However, we found minimal use of the grey water systems in the compounds we visited. This is a complex issue and we are concerned on two points. The first is that Tchad Solaire is a small NGO and it is "spreading itself very thinly". There is a risk that continuing this work could divert its resources away from its core business of solar cooking.

The second point is that Tchad Solaire does not have a marginal advantage over other organisations in this area. Had this initiative progressed smoothly it would have been a triumph. But given the complexity in Touloum, we recommend that Tchad Solaire focus its personnel and resources on solar and retained heat cooking technology. Other NGOs with more knowledge and experience in grey water recycling, and on the particular seed varieties that are appropriate for this environment, would be more appropriate for managing such a project.

### *Other types of solar cookers*

Our team urges Tchad Solaire to begin experimenting with and documenting the effectiveness of other types of solar cookers (box, panel and parabolic) at their Iriba office, which is inside a spacious walled compound. Some of the disadvantages of the Cookit, noted in the survey, would, at least partially, be resolved by other types of solar cookers.

The typical walled compounds we observed in Touloum could provide shelter from the wind for parabolic solar cookers and more than adequate space for a two-pot solar box cooker. We recommended that Tchad Solaire consider experimenting with versions of a mud walled solar

box cooker currently used in Gaza. A sheet of glass, Plexiglas or even a heat resistant plastic bag can be used in a metal, bamboo or wooden frame with this type of cooker. With proper training, this type of solar cooker could be built by the refugees in the camps and rebuilt when they return to Sudan. We saw the metal workers in the zone six souk hammering used salad oil cans into doors, windows, knives, bowls and other implements. They could also produce the metal lining and the window frames needed for demonstration solar cookers.



Gaza solar box cooker made with mud.

We suggest that the future of solar cooking in Tchad will be improved with experimentation by Tchad Solaire on different types of solar cookers. The Tchad Solaire team should develop detailed information in the first instance, with the refugee households (and other potential users in Chad) becoming involved once documented time and temperature results are available for effective solar cooker options.

The second step would be to test solar cooker models in pilot projects with daily measurements carried out by Tchad Solaire staff members in the different zones. The involvement of the refugee families in developing these options is highly relevant to the continued possibilities for solar cooking once families return to Sudan. Further information on box cookers is provided in Appendix 6.

### ***The Save-75 Fuel Efficient Stove***

The Save 75 is an effective, locally produced technology. It may be of use in the future work of Tchad Solaire, outside the camps, where no other fuel-efficient stove has been produced. We question the utility of its further introduction in a location where most families have already received a Save 80, which they use regularly. This can cause confusion. For example we saw women using the pot from the Save 80 on their Save 75, which is not efficient.

Tchad Solaire may choose to continue introducing the Save75 to groups that do not have the benefit of the Save80. If so, we suggest that the construction could benefit from a scheme of testing, possible improvements (wood support, pot skirt, stability of the chimney stability), and introduction on a pilot scale, to ensure the best possible product.<sup>3</sup>

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<sup>3</sup> Although we urge Tchad Solaire to focus their attention on improving the solar and retained heat cooking technologies they have introduced into the camps, we recommend the following two studies if they decide to continue with the promotion of the Save 75: 1. Liana, 2008, Firewood Saving Stoves ([http://www.liana-ry.org/Liana\\_docs/Firewood-saving\\_stoves\\_review\\_by\\_Liana.pdf](http://www.liana-ry.org/Liana_docs/Firewood-saving_stoves_review_by_Liana.pdf)); 2. USAID, 2009, Fuel Efficient Stoves in IDP Settings, (<http://www.bioenergylists.org/files/PDACM099.pdf>)



Save 75 Fuel-efficient stove

## Systematic structured learning<sup>4</sup>

Tchad Solaire was founded in response to an emergency fuel shortage. Through the combined efforts of primarily the UNHCR (Save80) and the Tchad Solaire (Cookit), the emergency phase is now over.

Tchad Solaire is managing the largest example of solar cooking in the world, but solar cooking is still a new technology. If Tchad Solaire can build on its successes, then the use of solar cooking could expand still further, both within the camps, and more generally.

We contrast the continued use of the Save80, with that of the Cookit. With the Save80, the refugees are still cooking in roughly their old way, but much more efficiently. We have the impression that the use of the Save80 will continue without much further intervention from UNHCR. In contrast, those families using the Cookit are doing some of their cooking in a radically new way. The number of refugees who have embraced this new way of cooking is extremely impressive, but it may also be fragile.

We use two examples to illustrate the need for an increased focus on data collection and evaluation, in addition to more training and follow-up. One issue in the survey was the durability of the existing solar cookers. This is much better answered using routine records than from a retrospective survey. The systematic recording of when each family was issued their cooker and when it was replaced would be a simple way of estimating the durability.

Numbering and dating each Cookit with permanent ink on the day it is issued would also facilitate this record keeping. A survey could then relate this replacement rate to the amount of solar cooking done by the households. This sort of data is rarely recorded in emergency situations. Tchad Solaire does not have such data at Touloum, though it is available at Iridimi, through the dedication of one of the staff members.

Hence we recommend that Tchad Solaire become more systematic in its collection and use of routine and other data.

Tchad Solaire should also be systematic in its evaluation of alternative solar cooking technologies<sup>5</sup>. For example, the introduction of the insulated heat retention baskets needs

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<sup>4</sup> We acknowledge the contribution of Ric Coe (previously head of research support for ICRAF/ILRI, based in Nairobi) for the phrase “systematic structured learning” or SST.

<sup>5</sup> This type of research is needed, partly because solar cooking is in its infancy. We are conscious that some organisations do not support “research”, because they draw a distinction between “research” and “development”. If so, then we suggest the term “systematic structured learning or SST” be adopted. Hence innovations such as the insulated basket would be evaluated systematically, both to support the innovation in Touloum, and also to permit others to see whether it might be useful elsewhere. Of course SST **is** research, i.e. we are discovering something new – and it is directly to help development!

careful evaluation to maximize its chance of “success”. Tchad Solaire could also usefully define what it means by “success”, so it can measure whether it achieves its goals. Success for the insulated basket might be defined as “at least 30% of households use it for at least 4 evening meals per week”.

One reason that this more systematic approach is needed is because we feel that many refugee families will be receptive to further innovations (like the insulated basket), that Tchad Solaire might suggest. This implies a responsibility for Tchad Solaire to maximize the possibility that such innovations prove acceptable in practice.

Another priority for the possible introduction of solar cookers by Tchad Solaire is the local population in villages near the camps. These are mainly small “hamlets” which have been highly stressed by the massive influx of refugees. We did not visit these villages, but were told that they are provided with support by UNHCR, similar to that provided for the refugees. These villages could be treated like an additional zone if advance data collection were possible. If Tchad Solaire does expand into the villages, or into further camps, it should take the opportunity to collect data on cooking habits and fuel consumption before providing the cookers, as well as afterwards.

## **Management recommendations**

We are impressed with the accomplishments of the Tchad Solaire Staff. We believe they have reached the point where their position descriptions should be written, their functions clearly delineated and authority delegated to specifically appointed members. Local senior staff should be full participants in and fully informed about the planning, ordering of supplies, budgeting and logistics for all Tchad Solaire projects.

Thus, for the future success of Tchad Solaire, the evaluation team recommends that senior staff be given greater decision making authority where appropriate and that more information be shared with all relevant members of the team. Participation in planning based on more complete knowledge of the supply chain and the funding mechanisms will result in a stronger more resilient organization.

The two refugee women employed by Tchad Solaire in each zone are the eyes and ears of Tchad Solaire in the camp. They could be valuable collectors of data and effective disseminators of technology with more training and more systematic guidance. They should have clear, written position descriptions, objectives, better supervision and a method to measure their specific accomplishments on a regular basis.

These women were observed to be keeping spotty or no records on their distribution of Cookits and plastic bags and on their follow-up visits to homes in their zones. They appeared to receive only minimal monitoring and follow-up training from the Tchad Solaire staff. The number of Chadian trainers should be increased in order to effectively expand the training to supervise the work of these women.

Finally, Chad Solaire should examine the implications of continuing to diversify its range of projects versus concentrating on technologies directly connected to cooking. Given the growing need for solar cookers to reduce fuel consumption it might be more prudent to consolidate Tchad Solaire’s focus on the promotion and improvement of this technology and the complementary retained heat cooker technology.

## Training recommendations

The refugee women should learn to construct their own Cookits and how to repair them as part of their initial training program. This is done in similar courses in Kenya and Bolivia, as described in Appendix 5. This will give them a more personal stake in the care and maintenance of their solar cookers. Training for those who already have solar cookers could include a requirement to bring their damaged Cookits to the workshop to work with the Tchad Solaire staff in the repair or replacement of their Cookits.

We also suggest that all solar cooker training should be reinforced with follow-up training at least once a year.

We commend the work of Tchad Solaire in placing two SAV (Service après vent) representatives in each zone to support the sustainability of solar cooking in the camps. The SAVs should receive formal and continuous instruction in how to train the women in their zone in the use, construction and repair of solar cookers.

We also recommend that Tchad Solaire consider a series of short training courses for its own staff. The continued success of solar cooking in Touloum could be enhanced by a more participatory approach being adopted by Tchad Solaire. This could also facilitate the transfer of ownership of the solar cookers from Tchad Solaire to the refugee families themselves.

Adopting a more participatory approach fits well with the philosophy of Tchad Solaire, as it already encourages close involvement and responsibility being taken by the refugee staff. We would therefore expect that the Tchad Solaire staff would easily add the results from a training course in this area.

We further recommend training for Tchad Solaire staff in how to train others using adult learning methods<sup>6</sup>.

Senior staff might also benefit from additional courses in management and accounting, so they can progressively assume more responsibility in the running of Tchad Solaire.

The input of the refugees should be sought at the start of each project so that cultural issues/objections can be addressed and projects adjusted for maximum impact (e.g. the concerns of some women about using washing water for the grey water recycling system).

Tchad Solaire should explore partnerships with the camp schools to introduce the scientific and health aspects of solar cooker technology to refugee children.

All projects should be documented in writing to provide the most effective template for others to use when introducing solar cookers and other energy saving devices into new camps.

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<sup>6</sup> There are many books and other resources on this area. A simple and popular example is the book called "Telling Ain't Training", by Stolovitch and Keeps (2002). It claims to explain a) Why training fails, b) What makes training successful, and c) How you and your learners can achieve astonishing results.

## Recommendations – summary

We congratulate both Tchad Solaire, and those who provided them with the funds for their operations. A small, but dedicated team has made a remarkable contribution in Touloum and, we believe, in the other camps. This success will provide an excellent springboard for their future work.

There is no longer the same emergency situation that led to Tchad Solaire's initial work. Hence, reflection, by Tchad Solaire, both on its methods of conducting future operations, and on improvements in the products it supplies, will facilitate further adoption of solar cooking technology, both within these camps and possibly more widely.

Our specific recommendations are summarized as follows:

### Technology

1. Locate, test and deploy more durable, water resistant materials to make the Cookit.
2. Locate, test and deploy a more durable alternative for the plastic bag.
3. Adding a heat retention basket is important. But the insulation for the current baskets should be tested and temperature maintenance verified before more are distributed.
4. Grey water recycling systems/kitchen gardens in Touloum is complex. Management by an organization that specializes in this area would allow Tchad Solaire to focus its efforts on efficient cooking technologies.
5. Explore other solar cookers for introduction into the camps and the general population.
6. Discontinue distribution of the Save-75 in those camps where households use the Save 80.

### Collecting and evaluating data

1. Use refugee staff to collect routine data on solar cooker use and replacement.
2. Keep precise records about when each Cookit is issued and when it is returned.
3. Set clear goals for future distribution of alternative cooking technologies and systematically collect the data needed to measure the achievement of these goals.
4. When introducing solar cookers into nearby villages, collect baseline data before the women start using the solar cookers.

### Management

1. Give senior Tchad Solaire staff greater decision-making authority.
2. Ensure that senior Tchad Solaire staff has full knowledge of budgets, supply chains, and donors.
3. Provide written position descriptions and a clear delineation of responsibilities to all Tchad Solaire staff.
4. Provide Tchad Solaire's refugee representatives in each zone with more monitoring and guidance in the execution of their duties including record keeping.
5. Explore the implications for Tchad Solaire of further diversification vs. specializing in the promotion of efficient cooking technologies.

### Training

1. Train refugee women to make and repair their own Cookits.
2. Train the refugee representatives in the zones how to be effective trainers.
3. Train Chad staff in participatory management techniques and how to train others using adult learning methods.
4. Seek the input of the refugee women when designing training programs.
5. Consider partnerships with the camp schools to introduce solar cooking to the children.
6. For future reference document all training programs in writing.

## Appendix 1: Personal information

### Anna Dembele

**Anna Dembele** is qualified in agricultural and rural engineering. She has worked extensively as an instructor for the Association of Women Engineers in Mali where she was responsible for training women in the techniques of manufacturing and demonstrating the use of solar cookers. She is currently working for the Office de la Haute Vallée du Niger (a branch of the Malian Ministry of Agriculture) where she is responsible for community development programs. She has also been involved in a number of other women's training programs, a participatory rural development program and baseline surveys for FODESA.

### Karyn Ellis

I commend Tchad Solaire for undertaking such a momentous endeavor, and believe that the solar cooking project can be an invaluable service to refugees on a long-term basis, with a few adjustments in training and manufacture. If the women trained on solar cooking are also instructed on how to build a simple solar cooker out of local materials (like the Save 75), then it will become a cooking technology that they can embrace as their own, rather than worry about who will fix the technology once they are away from the refugee camps.

The basic materials used to make a solar panel cooker need to be of the highest quality available to maintain the longest life possible for the cooker and ensure a favorable experience for the family's cook. If a cooker breaks too easily or lasts only a short time, confidence in the technology will wane and people will look to other technologies which prove more durable. Because the Cookit is such a simple device to build out of only a few, relatively inexpensive materials (cardboard, aluminum foil & binding tape), it would behoove TS to invest in the best and most durable materials available to keep in stock at the refugee camps and possibly transport to other areas in need.

**Karyn Ellis** is the Director of International Program Development for Solar Cookers International (SCI) in California. Karyn works to collaborate and partner with fellow NGOs and indigenous government ministries to implement solar cooking, water pasteurization and safe water projects in developing countries. She has a Masters of Science in International Development Technology from Humboldt State University, and a Bachelor of Arts in Sociology with a French minor from San Francisco State University. Karyn has served under a USAID contract at the State Department in Washington DC from 2005-2007; as a volunteer for Crisis Corps in Namibia, Southern Africa from 2004-2005; and Peace Corps in Burkina Faso, West Africa from 1997-1999.

Solar Cookers International: [www.solarcookers.org](http://www.solarcookers.org)

The Solar Cooking Archive: [www.solarcooking.org](http://www.solarcooking.org)

### Patrick Fourier

In Africa, successful, far-reaching projects promoting and distributing solar cooking equipment as an alternative to biomass are rare. These projects are complex and require continuous and sustained input since the acceptance of this new method of cooking also involves significant behavioral changes.

As a member of the team involved in the three-week evaluation of the Tchad Solaire (TS) project I was privileged to witness the use of Cookit (panel style) solar cookers on a daily basis by thousands of Sudanese women in the Touloum camp. The highlight of this mission was most certainly the simultaneous preparation of thousands of solar cooked lunches by refugee women for a celebration on the 7<sup>th</sup> November 2009.

The Tchad Solaire team have been continually involved in the Sudanese refugee camps in northeastern Chad for the past 5 years. They have built themselves a solid reputation for their contribution in reducing the search for firewood around the camps and consequently the incidence of violence against women and children. Currently three camps, containing nearly 70,000 people, benefit from Tchad Solaire's activities.

An emergency situation prevailed during the first few years of the project and this has been a driving force behind Tchad Solaire's activities until now. The situation is now becoming more stable. Tchad Solaire should reformulate its objectives to better address the issues of local development faced by the population. Therefore if TS wishes to continue promoting solar cooking in this region of Africa and expand its actions to encompass the Chadian citizens in the surrounding villages they should consider revising their initial approach to take some of the recommendations made by the evaluation team into account.

An important alteration that will help with this evolution is to ensure that the cookers are no longer given for free. The refugees should participate in making or purchasing them. The development of a more sustainable solar cooker model such as the thermal solar box cookers outlined in Appendix 6, will also contribute to greater sustainability. Other modifications that will strengthen Tchad Solaire's program are: capacity building for the Chadian team, the testing of new designs before their mass application and finally, establishing systematic monitoring of data to accurately assess the impact of the program.

Patrick Fourier worked in the high-tech industry for 25 years (Matra, Philips, Daimler, Harris and Atmel) in various managerial, engineering and training posts. He then joined Bolivia Inti Sud Soleil (BISS) in 2007. BISS is an NGO which is successfully distributing solar cooking technology in Latin America, with the intention of maximizing the impact of this organisation amongst African populations. Using the expertise acquired at BISS, Patrick supports hundreds of organisations as they introduce solar and other alternative energy strategies to the African continent. As a member of the Working Group on Desertification and Climate & Development, his practical experience and field knowledge provide valuable insight and targeted actions against the effects of climate change.

Bolivia Inti Sud Soleil : [www.boliviainti-sudsoleil.org](http://www.boliviainti-sudsoleil.org)

## Jetty Kentie

One of the things that struck me most as a member of the evaluation team of Tchad Solaire Touloum 2009 was the devoted team spirit of each member of TS and their president Mme Marie Rose Neloum. Each member seemed ready and able to step in where needed. [This is a precious and rare thing that should be preserved.

Derk Rijks stands at the origin of all this. He is the founding father of solar cooking in the refugee camps and of Tchad Solaire, but he may have to reduce and eventually end his direct supervision of the activities of Tchad Solaire. His TS offspring has grown up, but it still needs extra help to stand on its own feet and consolidate its position in the camps and the neighboring villages. I believe Tchad Solaire should give high priority to training its staff and improving the quality of the solar cookers and the heat retention baskets. Other activities such as the grey water gardens and other new income-generating activities, as tempting and attractive as they may be, do not earn the first priority in my opinion.

**Jetty Kentie** worked for twenty years at the Training Department of the International Agricultural Centre, Wageningen in the Netherlands, where international, agronomical courses were organized in the broad area of

sustainable development in the agriculture, food, rural development and natural resources management sectors. The courses were meant for postgraduate students from developing countries, including many Africans. In the past few years, she has travelled to Mali and Burkina Faso to work on solar cooking projects.

## Patricia McArdle

Over the past two years, in every one of my public lectures and demonstrations on solar cooker technology in Washington DC and overseas, I have mentioned Tchad Solaire's remarkable work in Iridimi, Touloum and Oure Cassoni refugee camps. I consider it a great privilege to have been able to spend almost two weeks in Touloum refugee camp meeting with the women who make and use the solar cookers and working with the Tchad Solaire team that has made this all possible. The glistening silver clamshell Cookits we saw pointed at the sun in every zone of the camp attest to the remarkable technology transfer that Tchad Solaire has accomplished in a very short period of time.

I fully concur with the observations, conclusions and recommendations in this report. It is my sincere hope that Tchad Solaire will endure and prosper with more management responsibility transferred to the local staff and a greater emphasis on training, documentation and data collection. My greatest concern in the short term is the urgency of finding more durable materials for the Cookit and a long-lasting replacement for the plastic bag.

I am pleased that Tchad Solaire has introduced retained heat cooker technology which can double the cooking capacity of a solar cooker by allowing the evening meal to be cooked in the afternoon and kept piping hot until after dark. I urge Tchad Solaire to accept our recommendation to produce better-insulated baskets and document their heat retention capacity before distributing more in the camps.

Finally I urge the Tchad Solaire team to learn about other solar cooking alternatives including the box cooker described in Appendix 6, which can also be used as a retained heat cooker. Since the durability of wood is an issue, I urge Tchad Solaire to study the mud box cookers used in Gaza, the SOS Sport solar oven made of recycled soda bottles, and the metal solar box cooker designs included in the 2009 report by the graduate engineering students of U.C. Berkeley Professor Ashok Gadgil (whose students also developed the Darfur Stove). Metal solar box cookers are currently made and sold in India.

Most refugee women I spoke with said they would only use a solar cooker in Sudan if Tchad Solaire came with them to provide new Cookits and plastic bags when theirs wear out. A durable, locally made solar box cooker that the refugee women can reproduce when they return to Sudan is a worthy and attainable goal.

**Patricia McArdle** is a retired American diplomat who currently serves on the board of Solar Cookers International and is President of the Board of Directors of Solar Household Energy, Inc. She first became involved with the promotion of solar cookers during a one-year tour of duty representing the U.S. government in northern Afghanistan. She lives in Arlington, Virginia and frequently lectures on and demonstrates solar/integrated cooking in Washington D.C. and overseas.

## Roger Stern

I was impressed with the mix of methods most families use for their cooking and with the potential this gives for combining further improvements in their lifestyle, with even more economies in the use of wood.

I found the technical arguments advanced by the team for the recommendations to be convincing. These included more durable materials for the Cookit, and possible expansion of Tchad Solaire's activities more broadly than the surroundings of the refugee camps. This

would also to provide the skills so Tchad Solaire can give broader guidance to families on options for continued solar cooking on their return to the Sudan.

Given we are no longer in such an emergency situation I would like Tchad Solaire to become more systematic in its collection and use of routine data, of some longitudinal data and of data before interventions are made as well as afterwards. For new activities, including the important “gufa”, I would like more research, both at a technical level, and through pilot studies that are in collaboration with refugee families. A greater understanding of participatory approaches, by Tchad Solaire staff will help in their activities and promote better ownership of the technologies by the refugee families.

Roger Stern is a statistician in the Statistical Services Centre, University of Reading ([www.reading.ac.uk/ssc](http://www.reading.ac.uk/ssc)). He was previously a lecturer in statistics in the same University. He spent seven years, from 1990 to 1997, based in Niger, West Africa as the statistician for ICRISAT<sup>7</sup> and previously worked in Sri Lanka and Nigeria. Much of his current work is in Africa and is concerned with improved methods of teaching statistics as well as the provision of statistical support for research activities, particularly related to agriculture.

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<sup>7</sup> ICRISAT – International Crops Research Institute for the Semi-Arid Tropics.

## Appendix 2. The Survey

The final version of the questionnaire is given below. The team recognises that after several revisions it still contained various problems. Despite the flaws, it served its purpose, both in learning about the views of the households and in providing the review team with the necessary background to underpin their recommendations.

### Questions for Female Heads of Household used in the evaluation of Tchad Solaire's project in Touloum (25 October – 13 November 2009)

**Objective:** To determine how energy for cooking and heating water is used in the camp. The responses were anonymous and were intended to help improve living conditions in the camp.

Zone

date/hour

Initials of evaluator

**1.1) What meals do you prepare every day?**

**1.2) For how many people?**

**1.3) With what type of cooking equipment?**

Number of people	Solar Cooker	Save 80	Save 75	mud stove	Three Stone fire	Heat retent. basket	other
a boule (corn meal)							
b Tea							
c Lentils							
d Okra Sauce Dried							
e Okra sauce fresh							
f Dried beans							
g flour gruel							
h rice, sorgum, grains							
I other							

Meal codes p=breakfast, L=lunch, d=dinner,

**2.1) How many solar cookers do you have?**

**2.2) How many times a week do you use them?**

**3) If you don't have a solar cooker, why?**

**4.1) How long is it before you replace or repair your solar cooker?**

**4.2) What do you do when your solar cooker is damaged?**

**4.3) What are the reasons you have to repair or replace your solar cooker)? (open response: cardboard, aluminum, etc.)**

**4.4) How long must you wait for the replacement (or repair) of your solar cooker?**

- 5) How many times have you replaced (or repaired) your solar cooker?
- 6) How long does the plastic bag last? (open response: in months or weeks)?
- 7.1) What are the advantages of a solar cooker?
- 7.2) What do you do while your food is cooking in the sun?
- 7.3) What are the disadvantages of the solar cooker?
- 8) Do you have a retained heat basket and what is it for? (open response: for keeping food hot or finishing the cooking of food)?
- 9) How many times a week must you leave camp to search for wood?  
 Before you received a solar cooker and a fuel efficient stove?  
 After you received a solar cooker and a fuel efficient stove?
- 10.1) Do you have a grey water recycling system for your kitchen garden?
- 10.2) If yes what produce do you grow in your garden?
- 10.3) What do you do with the produce you grow?
- 11) What did you learn during your training with Tchad Solaire?  
 Positive points Negative points
- 12) When you return to your home in Sudan what will you use to cook your food? (open response: with which equipment?)  
 solar cooker Save 75 or Save 80 mud stove 3-stone fire hay basket other
- Other remarks**

This is an English translation of the form as given, except the space for comments, between questions, was reduced.

Some points that readers may feel compromised the results, or that we suggest could be improved in a further similar study, are as follows. Our views are in hindsight. The administration of the questionnaires was also not helped by the fact (because of visa problems) that the statistician was only able to join the team after most of the data had been collected.

**Many languages were involved.** The Tchad Solaire staff acted as translators. This, in itself, gave potential for bias, though we do not consider it to have been an issue in practice. The translators were given the questions in French. They translated them into Arabic, which was spoken by most of the refugees. However, sometimes that was further translated into Zaghawa, then the replies were translated back, and the responses were then written – sometimes in English, because four of the team were Anglophone. This provided a natural example of a typical “whispers game” with plenty of opportunities for misunderstanding.

**Observational information could have been recorded.** We were never refused admission, and were also always permitted to see all the resources the household used for cooking.

There was nowhere on the form to record this information. It could have provided a good basis for simple questions on the usage of each resource, and not just the solar cooker.

**Question 1 on the different foods could have been more consistently recorded.** In particular, some of the team asked about breakfast (etc) in general use, whereas others asked about today.

Making a question specific, i.e. about a particular day, makes it easier to answer.

**Questions on the durability of the cooker are complicated.** Memory questions, such as “4.1 How long before you replace your cooker?” are very difficult to answer. In this case it is even more complicated because households have more than one cooker, and have usually replaced them a few times. Even questions that appear simpler, such as “5.1 How many times have you replaced your cooker?” are actually complicated by the fact that households have 2 or more cookers.

This sort of information is much better obtained from routine records than this sort of one-off survey. They can give the date of issue and the date of return or repair. In the emergency situation, at the start of the work, the keeping of routine records is often not a high priority. We asked what records were available. They were in an excellent state for Iridimi, but not for Touloum. In the future more attention should be placed on the keeping and use of routine records.

The same applies to the question on replacing the plastic bags. This is done through the refugee staff working in each zone, and it should be easy to keep and use relevant records.

**Is the replacement rate enough?** In this survey the responses have indicated how often the cookers are replaced. This, as mentioned above, could better be obtained through routine records. However, the replacement rate is only at the current amount of usage of the cookers. Termites apart, the cookers will last a long time if they are hardly used. Understanding durability of the cookers in relation to their use could be done through longitudinal data recording. This might be by children, for (say) 100 households, and could possibly be linked to schoolwork.

**Questions on advantages and disadvantages are difficult.** For the cookers, these are questions 7.1 and 7.3. We sometimes felt that respondents were trying to remember what they had been taught. It is sometimes simpler to ask “For you, what is the best thing about the solar cooker?” then “Are there any other good things?” If they have not listed cooking any food better, or worse, there could then be a follow-up question on that aspect.

It would also be a fairer questionnaire if those questions were asked about all the methods of cooking that the household used, with solar cooking not being the first.

**Searching for wood.** Question 9 asks how many times per week someone has to go in search of wood, both before receiving the Save80 and their solar cooker, and also now. If new camps are to be added, it would be better to do two separate surveys, one before, to get the baseline, and then a second after, as we have done. Then no memory is involved. The ideal, when there is an intervention, such as solar cooking, is to do “before and after surveys”, both in camps with the intervention, and in others without.

**What will you take home?** Question 11 asked what the refugees would take with them, when they were able to return to the Sudan. The basic question was pointless; all said they would take their possessions home!

Of more interest was the observation, volunteered by some, that there was plenty of wood at home, so they could then return to using their old 3-stones method of cooking. Others

recognised, or were asked, about the issue of replacements if they wished to continue to use the solar cooker. They usually said they assumed that Tchad Solaire would return with them!

### **Appendix 3. Questions for Tchad Solaire staff**

**Question 1:** What are your responsibilities and what degree of freedom/independence do you have?

**Question 2:** What are your annual objectives? Do you have a written position description?

**Question 3:** What challenges do you encounter in your work?

**Question 4:** Did you receive any training when you joined Tchad Solaire?

**Question 5:** How do you train the refugee women who work in each zone? How is their supervision managed?

**Question 6:** Does Tchad Solaire operate the same in the other camps as in Touloum?

**Question 7:** What is your view of the sustainability of solar cooking?

**Question 8:** Should Tchad Solaire specialize (in solar and retained heat cooking) or continue to manage all five of its projects? (solar cooking, retained heat cooking, grey water recycling kitchen gardens, Save 75 fuel efficient stoves, soap making)?

**Question 9:** Should materials (for the solar cookers) be imported or obtained locally?

**Question 10:** Would it be better to import a fully constructed solar cooker and employ more trainers instead of artisans?

**Question 11:** Do you have ideas about other types of solar cookers?

**Question 12:** What is your vision for the coming years?

**Question 13:** Would you like to add anything else?

## **Appendix 4. Questions for Touloum staff**

### **Questions for the artisans (who manufacture the Cookits)**

- Question 1. What are your responsibilities?**
- Question 2. What difficulties do you encounter in your work?**
- Question 3. What tasks have you carried out during your most recent workday?**
- Question 4. What tasks have you carried out during your most recent workweek?**
- Question 5. How do you organize your work with your fellow workers?**
- Question 6. In the past week how many solar cookers have you repaired?**
- Question 7. Do you have any suggestions to improve your effectiveness?**
- Question 8. Does someone in your household solar cook while you are working at the atelier and how many times a week do they solar cook?**
- Question 9. What is your opinion of the durability of the Cookit?**
- Question 10. Do you have any suggestions for improving the Cookit?**

### **Questions for the SAV (Service Après Vent) refugee women, two of whom work in each zone for Tchad Solaire**

- Question 1. What are your responsibilities?**
- Question 2. What difficulties do you encounter in your work?**
- Question 3. What tasks have you carried out during your most recent workday?**
- Question 4. What tasks have you carried out during your most recent workweek?**
- Question 5. How do you organize your work with your fellow workers?**
- Question 6. In the past week how many solar cookers have you repaired?**
- Question 7. In the past week how many solar cookers have you replaced?**
- Question 8. What did you prepare for lunch today and with which cooking device?**
- Question 9. Do you have a gufa (retained heat cooking basket) and do you know how to use it?**
- Question 10. What problems do the women in your zone have regarding the use of the solar cookers?**
- Question 11. Do you have any suggestions for improving the use of the solar cookers?**
- Question 12. What do men in your zone think about the solar cookers?**

## Appendix 5 Parallels

When outlining our provisional recommendations to the staff of Tchad Solaire at the end of the evaluation, we found it useful to give examples of similar situations elsewhere. These are given here.

### *The Cookit*

Solar Cookers International (SCI), created the Cookit solar cooker 15 years ago (1994) with the intention of providing a low-cost, effective solar cooker to people living in rural areas of developing countries. The Cookit is the most inexpensive solar cooker in the world, built commercially in the U.S. & Kenya for less than \$10. SCI intentionally left the design and dimensions of the Cookit unpatented and available on the Solar Cooking Wiki website (<http://solarcooking.wikia.com/wiki/Cookit>) so that anyone can replicate this simple technology.

Over the past 15 years, SCI has learned many lessons, one being that if the materials will not withstand the elements of the African climate for at least a year, the technology will not be taken seriously and consequently not used. Comparative costs between different grades of cardboard and aluminum foil are minimal, especially when considering cost-benefit ratios in the long run, and hence they found that care should be taken to use the best quality possible.

### *Solar Cooking International's Training Approach*

SCI's East Africa Offices, located in 5 regions throughout Kenya, focuses on the advantages of the Cookit's simplicity by training women both to solar cook local foods and to make solar cookers out of locally obtained materials. SCI believes that training women how to make their own solar cookers is essential to the sustainability of solar cooking projects. It empowers women to claim the technology as their own.

SCI has found that women who become adept at making, as well as using their solar cookers, often find themselves with additional time on their hands which can be used to generate income. They are encouraged to create small businesses by organizing trainings of their own and identifying sources for obtaining local materials for manufacture.

### *SCI's promotion of integrated cooking*

SCI has "showrooms" in its offices in California and Kenya, which include many different types of solar cookers, as well as other types of fuel-efficient methods of cooking (rocket stoves and retained heat cookers/hay baskets). The inclusion of other types of cooking devices emphasizes solar cooking's involvement in an improved strategy for cooking, referred to as Integrated Cooking. Integrated cooking is the use of solar cookers when the sun is out, fuel-efficient stoves at night or during inclement weather, and hay baskets to continue cooking food that's been brought to a boil and/or keep food hot for many hours. This combined method of cooking uses the least amount of fuel-wood necessary to cook food and heat water. Studies have shown that the practice of integrated cooking can save up to 80% of biomass normally used to cook.

## *Training with solar box cookers in Bolivia*



Bolivia Inti Sud Soleil manages local teams of five or six people responsible for the coordination, technical supervision, organization of courses, training, monitoring and management of the solar cooker projects. The approach of Bolivia Inti Sud Soleil ensures that the beneficiaries actively participate in every stage of the project.

Participants register voluntarily for a weeklong training session. During the course, the women learn to make their own solar box cookers. For many women this is the first time they have used tools, such as hammers. Trainees also learn to prepare traditional dishes using their solar cooker.

In addition to their week's work, beneficiaries make a financial contribution of 30% of the total price of the cooker.

Bolivia Inti Sud Soleil monitors the participants for a period of 4 months after their training. After that the solar cooker becomes the property of the recipient, on the condition that they continue to use it.

### ***Participatory approaches***

Twenty years ago in agricultural research, new varieties were produced, often in on-station trials. Some were not accepted by the farmers, and researchers could be heard complaining that this showed their lack of education, etc, i.e. it was the farmer's "fault". Now, innovations are often researched in a more participatory way, which helps to ensure that they meet the real needs of farmers.

In our discussions with the Tchad Solaire staff we sometimes heard that the lack of greater adoption of solar cooking by the refugees, and the limited effectiveness of the staff working in each zone, might be the refugees "fault". Instead we suggest that capacity-building in participatory methods for the Tchad Solaire staff, might provide other options.

## Appendix 6. Solar box cookers



### SWOT analysis of the use of Solar Box Cookers with a Heat Retention function in Toulom (Chad)

STRENGTHS	WEAKNESSES
<p>Unlimited energy source</p> <p>Zero biomass consumption</p> <p>No fire danger</p> <p>Smoke free</p> <p>No need to collect firewood</p> <p>Cooking requires little supervision</p> <p>Low maintenance</p> <p>Sufficient sun exposure within the compounds</p> <p>Lifespan of 15 years (the first BISS cookers are still in use after 10 years in the Andes)</p> <p>If the sun goes behind a cloud, food in the insulated box continues cooking for a short time. The box can also be stuffed with insulation when cooking is finished to keep food hot for several more hours.</p> <p>The refugee women are already aware of solar cooking</p> <p>Cooking times are faster than with a Cookit</p> <p>Easily repaired (e.g. Changing the glass or plastic cover)</p> <p>According to the data available it would be possible to use them 11 months out of the year in North East Chad</p>	<p>Cost approx 50-70€ (price of materials and labour)</p> <p>Local availability of materials (wood, glass or plastic, aluminium foil or sheeting, isolating material)</p> <p>Glass is breakable (if used)</p> <p>Relatively heavy for a woman on her own</p> <p>Needs to be directed at the sun every 30 mins</p> <p>Amount of food prepared only sufficient for 10 people (basic model)</p> <p><b>Minimum size 60 x 60 cm</b> and needs protection from theft and bad weather (narrow doors, small houses etc could be problematic)</p> <p>Not resistant to <b>termites</b> or rain</p>
OPPORTUNITIES	THREATS
<p>Complete transfer of all technology</p> <p>Creation of income generating activities (carpenters, trainers, after sales service)</p> <p>Complete energy autonomy for the families</p> <p>Replacement of wooden panel by woven mats or mud walls.</p> <p>Technology appropriate for dissemination throughout the whole of Chad</p>	<p>Dependent on external financing</p>



# Solar Box Cooker

*This sheet gives the basic information about this equipment. If you would like to use this tool as part of a development program please contact BISS for more information*

## DESCRIPTION

### Cheap, readily available materials

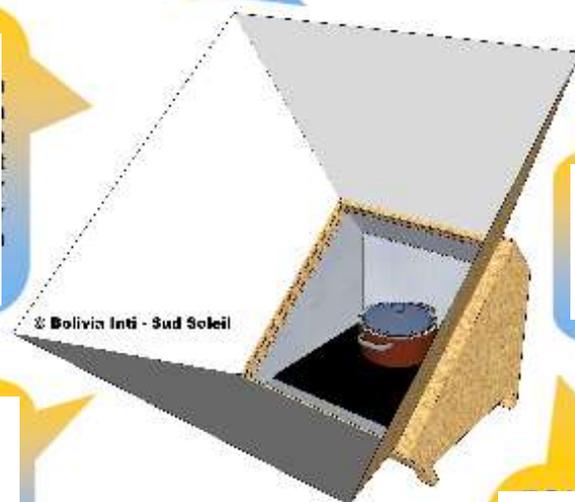
- Wood (eg. Pine)
- Plywood
- Clear glass as transparent as possible (3mm thick)
- Aluminum sheeting
- Wool or other water resistant isolating material
- Ironmongery (nails, screws etc)
- Black plate

## MANUFACTURE

- Preparation (cutting) of the elements is time consuming
- Once in kit form the cooker is quick and easy to assemble (1 day maximum)
- No particular skill is necessary

## USE

- Possibility of combined cooking methods using parabolic or fuel-efficient stoves at the start of cooking and heat retention or panel style solar cookers to finish cooking.



## PRECAUTIONS

- If made from wood, the cooker needs to be protected from inclement weather and insects

## TYPE OF COOKING

- The solar cooker is suitable for the preparation of all types of dishes except for fried food

## MECHANISM

- Light goes through the glass. It is absorbed by the black base plate and the cooking pot where it is transformed into heat (greenhouse effect). The infrared radiation that is emitted does not escape through the glass and the isolated casing retains the heat that is generated
- **Requires direct sunlight**

## PERFORMANCE

- 90-110°C in clear skies (without additional reflectors)
- 100-150°C with additional reflectors (cardboard or plywood with reflective surface)
- 1L of water boils in 1 hour (100% energy saving)
- A chicken cooks in 1½-2 hours (twice as long as a conventional oven)