Mapping global impact data for solar cooking: A case study

Pia Otte (PhD Political Science)
Norwegian University of Science and Technology
Pia.otte@svt.ntnu.no, pia.otte@bygdeforskning.no

Abstract

Many different types of solar cookers have been implemented to improve people's cooking situation around the world. However, we lack information related to the continuous use of these cookers. In this paper I present a first attempt of mapping existing institutional solar cookers around the world and their levels of use. I introduce a new reporting format that I applied in my study and that assesses levels of success. However, the data gathering tool applied in this study in form of an open access spread sheet was not very successful. The results show that there is a need for such a data gathering tool and suggests the development of a virtual platform that enables solar cooking organizations to collect and share their experiences around the world.

1. Introduction

Many different types of solar cookers have been implemented to improve people's cooking situation around the world. However, we lack information related to the continuous use of these cookers. In the past various problems have been stated in the literature related to the price, access, maintenance, and the local production of solar cookers (Carmody and Sarkar, 1997, Ahmad, 2001). In addition, solar cookers have been described as culturally disruptive because they present a new way to prepare food (Tucker, 1999). In a previously published paper I have provided an overview of the complexity of the factors that influence the adoption of solar cookers (Otte, 2013).

In order to increase the success of solar cookers we need to pay more attention to the social aspects that determine the adoption of these cooking devices. In this paper, I present a first attempt of mapping existing institutional solar cookers around the world and their levels of use. The paper presents a part of my PhD thesis where I investigate the determining factors that lead to the successful adoption of institutional solar cookers (Otte, 2014). In this article, I will introduce a new reporting format that I applied in my study and that assesses levels of success. The results will show that there is a need for such a data gathering tool and suggests the development of a virtual platform that enables solar cooking organizations to collect and share their experiences.

The paper is structured as follows: Section 2, starts by providing an overview of different types of solar cookers. Based on this overview I will define the term institutional solar cooking applied in this paper. Furthermore, section 3 will show my attempt of tracking institutional solar cookers and the obstacles I faced during this process. Based on the limited success of my data gathering approach section 4 will introduce the idea of a virtual platform for improving levels of knowledge on the success of solar cooking projects.

2. Types of solar cookers

In general we can divide solar cookers between domestic (household) and institutional solar cookers. Furthermore, we can identify solar cookers with heat storage that make it possible to cook during evening hours or rainy days and solar cookers without heat storage. In addition, we can divide solar cookers into direct and indirect systems. Direct systems convert the sun rays directly to heat energy while indirect systems use a heat transfer fluid to transfer the heat from the collector to the cooking unit as for example oil. A modified and simplified overview based on Muthusivagami et al. (2010) is presented in Figure 1.

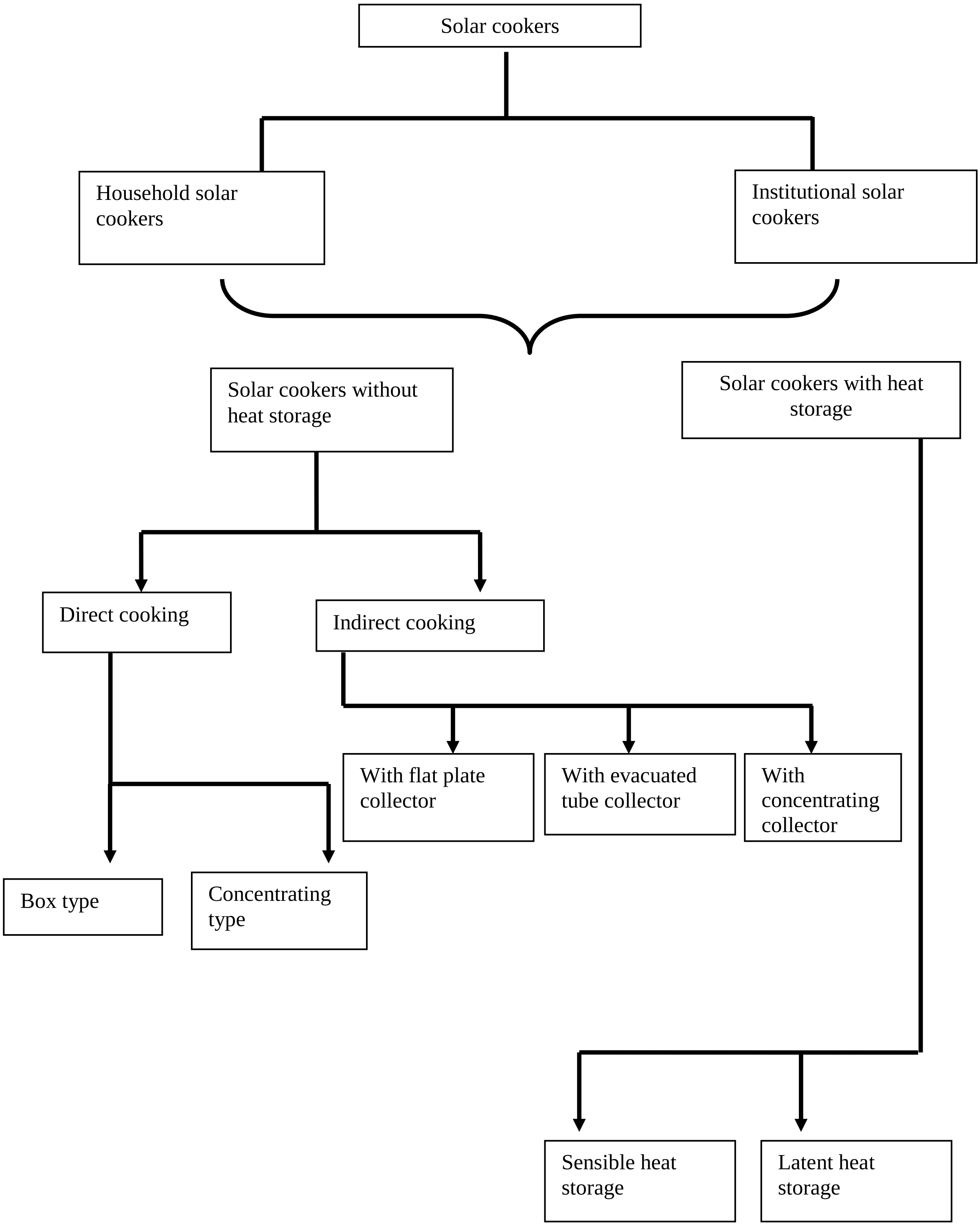

Figure 1 Overview of of solar cookers
Source: Author's replication/modification from Muthusivagami et al. (2010:692)

Doing a (google) online search it is very easy to find different types of domestic solar cookers. However, it is much more difficult to obtain the same overview of institutional solar cookers. Doing an online search and typing "institutional solar cookers" in the search engine leaves us mainly with images of domestic solar cookers.

Within my PhD thesis where I investigated the determining factors that lead to the successful adoption of solar cookers at an institutional level, a first step was to document all existing institutional solar cookers from which I could later choose one technology. In my study I define institutional solar cookers as those systems that cook food for more than 20 people per day. Institutional solar cooking captures cooking with a single system for a larger amount of people (SCI, 2014). Institutions can also make use of several domestic solar cookers for cooking but this does not capture institutional solar cooking as such. This study focuses entirely on those systems that are able to cook food for more than 20 people. This threshold was set since the most efficient domestic type of solar cooker (SK 14) can cook for up to 20 people per day (EG Solar, 2014).

3. *Mapping of institutional solar cookers*

By doing a more specified online search I was able to trace five different types of institutional solar cookers: 1.) Scheffler reflectors, 2.) the Villager Sun Oven, 3.) the Sunfire, the 4.) Chari Solar Trough and 5.) Helios Solar Array. In addition to these existing types of solar cookers, the NUFU Solar Project at NTNU in cooperation with different universities in Africa has worked on developing different prototypes of institutional solar cookers with heat storage. Several concepts have been successfully tested but no prototype has been implemented in a larger field study so far[1].

For my study it was very valuable to choose a particular type of solar cooker in the early beginning, which could be compared across different settings. By choosing one technology, I can control for technical differences between the different types of solar cookers that might have an impact on the continuous use.

However, it turned out to be very difficult to find more detailed information on the different types of solar cookers related to their implementation and continuous use. I decided to contact the developers and promoters of different institutional solar cookers to find out more about the distribution and continuous use of these cookers. Originally I had planned to create a profile of each implemented solar cooker by measuring several parameters: (1) local production, (2) existence of heat storage, (3) type of system, (4) type of solar cooker within the system, (5) size of the solar cooker, (6) country of implementation, (7) continuous use, (8) type of institution using the solar cooker (e.g. school, hospital, others), and (9) type of application (is the solar cooker only used for cooking or other purposes such as for example sterilization, cooling, laundry?). Based on the information obtained from these parameters, I planned to choose the comparative solar cooker for this study.

However, my contacts had difficulties to provide me with more detailed information related to the use and number of implemented systems. I realized that it would not be possible to track down each single solar cooker that was implemented and that I should develop a database that consists of more aggregate data on the five solar cookers. Thus, I developed a database that listed the five types of institutional solar cookers according to eight parameters: (1) Cases (2) the country of use, (3) the type of system and (4) the type within each system, (5) the size of the system, (6) the existence of storage, (7) the degree of local production and (8) continuous use.

With this way of data collection I no longer tried to track down each single solar cooker that had been implemented but focused on the total number of a particular type of solar cooker implemented in a country. However, by using this aggregate data I lose some information. For example with focus on parameter (8) "continuous use" it will be problematic to state whether the systems are in use or not if several solar cookers were implemented in the same place but show differences in the levels of success. Nevertheless, since the available information was so limited I chose this approach as a kind of compromise. In the following, I will describe each of these parameters more detailed and their coding for the spread sheet:

(1) Cases

The category captures the number of implemented systems in each country.

(2) Country of use [country]

This category captures the country where the solar cooking system was implemented. (To a certain degree) I was able to retrieve information related to the countries of implementation for each solar cooker (online search). Based on this information I coded the countries as presented in Table 1.

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[1] A link to the NUFU Solar Project can be found here: http://www.ntnu.no/ept/nufusolar.

Table 1 Abbreviations and list of countries of use

AF	Afghanistan	GH	Ghana	PA	Pakistan
AN	Angola	GU	Guatemala	PE	Peru
AR	Argentina	HA	Haiti	PN	Panama
BA	Bangladesh	HO	Honduras	SA	South Africa
BF	Burkina Faso	IN	India	SI	Sri Lanka
BO	Bolivia	KE	Kenya	SL	Sierra Leone
BR	Brazil	LE	Lebanon	SM	Soma
BW	Botswana	MA	Madagascar	SO	Somalia
CA	Cameroon	ME	Mexico	SP	Spain
CH	China	MO	Mozambique	SU	Sudan
CI	Chile	ML	Mali	SW	Swaziland
CU	Cuba	MW	Malawi	TA	Tanzania
DR	Dominican Republic	NA	Namibia	TH	Thailand
EG	Egypt	NC	Nicaragua	TI	Tibet
ES	El Salvador	NE	Nepal	TU	Turkey
ET	Etiopia	NG	Niger	UG	Uganda
GA	Gambia	NI	Nigeria	US	United States of America
GE	Germany	NK	North Korea	ZI	Zimbabwe

(3) The type of system [system]

The type of system captures whether the solar cooker is a direct or indirect system. As mentioned earlier, direct systems convert the sun rays directly to heat energy while indirect systems use heat transfer fluid to transfer the heat from the collector to the cooking unit, abbreviated as “direct” or “indirect” in the excel document.

(4) The type within each system [type]

This category refers to the division of different solar cookers within direct and indirect types. For direct types we can differ between box cookers and concentrating types. This was coded as followed:

1 box cooker
2 concentrating type

For indirect types we have three alternatives:

1 with flat plate collector
2 with evacuated tube collector
3 with concentrating collector

(5) The size of the system [size]

The category "size of the system" captures the amount of people the system can cook for. The definition of institutional solar cookers is very broad (> 20 people) and thus this parameter provides us with some more detailed information on the cooking size. This category was not pre-coded. It was planned to divide the size into three categories S (small) M (medium) L (large) based on the answers received by the promoters.

(6) The existence of storage [storage]

This category captures whether the solar cooking system includes heat storage and was simply coded as "yes" and "no".

(7) The degree of local production [LP]

This category captures whether the solar cooking system is locally produced or not. The category was coded as "yes" and "no".

(8) Continuous use [in use]

This parameter probably presents the most important one for this study and captures whether the solar cooking system is still in use or not and was coded as "yes" and "no" category in the excel document.

The information I received on each of the eight categories is based on online sources or e-mail interviews with the promoters and inventors of the different types of solar cookers. However, as I mentioned earlier the data on the internet was incomplete and not all organizations responded to my e-mails. Therefore, I uploaded the database on the internet to make it accessible to the public. By uploading the incomplete database I provided organizations working with solar cooking with the opportunity to add their information to the list. Thus, solar cooking promoters got the chance to not only include additional information to the five cookers but they could also inform about additional types of institutional solar cookers, which I did not address in my preliminary list.

I uploaded the database in 2012. In addition, I uploaded a codebook that explained the abbreviations used and a short letter, which informed readers about the purpose of my study. All three documents were uploaded in the form of a Google Docs document. A link to these documents was made available on Solar Cookers International[2] and Solar Brücke[3]. Table 2 presents an overview of the database after my online search and e-mail interviews.

Table 2 Mapping of institutional solar cookers[4]

Name	Cases	Country	System	Type	Size	Storage	LP	In Use
Villager Sun Oven		AF	direct	1		no	no	
		AN	direct	1		no	no	
		AR	direct	1		no	no	
		BF	direct	1		no	no	
		BO	direct	1		no	no	
		DR	direct	1		no	no	
		ET	direct	1		no	no	
		GH	direct	1		no	no	
		GU	direct	1		no	no	
		HA	direct	1		no	no	
		HO	direct	1		no	no	
		IN	direct	1		no	no	
		KE	direct	1		no	no	
		NA	direct	1		no	no	
		NE	direct	1		no	no	

[2] The link to Solar Cookers International can be found here http://solarcooking.wikia.com/wiki/Villager_Sun_Oven#External_links (Accessed 29.06.2014)

[3] The link to Solar Brücke can be found here: http://www.solare-bruecke.org/ (Accessed 29.06.2014)

[4] The references for this table are presented in the 'reference list for table 2'.

Name	Cases	Country	System	Type	Size	Storage	LP	In Use
		NI	direct	1		no	no	
		NK	direct	1		no	no	
		PN	direct	1		no	no	
		SA	direct	1		no	no	
		SI	direct	1		no	no	
		SM	direct	1		no	no	
		SW	direct	1		no	no	
		TA	direct	1		no	no	
		TH	direct	1		no	no	
		TU	direct	1		no	no	
		UG	direct	1		no	no	
		ZA	direct	1		no	no	
		ZI	direct	1		no	no	
Scheffler reflectors	21	AF	direct	2	8,10,12		yes	
	5	AR	direct	2	8,10,12		yes	
	6	BA	direct	2	8,10,12		yes	
	3	BO	direct	2	8,10,12		yes	
	9	BW	direct	2	8,10,12		yes	
	20	BF	direct	2	8,10,12		yes	
	2	ET	direct	2	8,10,12		yes	
	2	EG	direct	2	8,10,12		yes	
	1	ES	direct	2	8,10,12		yes	
	1	GA	direct	2	8,10,12		yes	
	8	GE	direct	2	8,10,12		yes	
	2	CA	direct	2	8,10,12		yes	
	30	KE	direct	2	8,10,12		yes	
	1	CU	direct	2	8,10,12		yes	
	10	ME	direct	2	8,10,12		yes	
	2	NA	direct	2	8,10,12		yes	
	6	NE	direct	2	8,10,12		yes	
	100	NK	direct	2	8,10,12		yes	
	10	PE	direct	2	8,10,12		yes	
	1	SL	direct	2	8,10,12		yes	
	1	SA	direct	2	8,10,12		yes	
	1	SP	direct	2	8,10,12		yes	
	20	SU	direct	2	8,10,12		yes	
	1	TI	direct	2	8,10,12		yes	
	700	IN	direct	2	8,10,12		yes	
	1	LE	direct	2	16		yes	
	1	ME	direct	2	16		yes	
	400	IN	direct	2	16		yes	
	2	IN	direct	2	50		yes	
	1	IN	direct	2	60		yes	
Sunfire (Schwarzer)	200	IN	indirect	1		yes & no	yes	
	1	BR	indirect	1		yes	yes	Yes
	1	SA	indirect	1			yes	
		ML	indirect	1			yes	
	5	AR	indirect	1		yes	yes	Yes
		CL	indirect	1				
		MW	indirect	1				
	1	NC	indirect	1		yes	yes	yes
	1	GE	indirect	1		yes	yes	yes
Chari Solar Trough		IN	indirect	3				
Helios solar Array		ME	direct	2				
		US	direct	2				

Table 2 shows that the information on the different types of solar cookers is very limited. We can also see that the Scheffler reflectors present the type of solar cooker that is best documented. The information is based on a list of all implemented Scheffler reflectors worldwide by Hoedt (2009). It was difficult to gain a similar overview of the other types, since it was not possible to find a similar list for the other types of solar cookers. This is illustrated by the many blank rows in the table.

We can also see that particularly the column "in use" lacks information. This justifies the need for future studies that investigate levels of use of solar cookers. In some cases it was possible to receive information related to the countries of implementation but it was not possible to find out how many of these implemented cookers in each country are still in use.

4. Conclusion - How to map global data on solar cooking more successfully?

The aim of this paper was to illustrate step by step a tracking process that I applied in my PhD study for choosing a type of solar cooker for my comparative research. We could see that the data gathering tool applied here in form of an open access excel document was not very successful. However, the document also proves the point that there is a need for such a data gathering tool.

One way to increase levels of knowledge could be the development of an open source virtual platform where solar cooking groups can upload and collect their information about their projects. This platform could be a tool of quality control that serves as a database for future projects/research investigating the social aspects of solar cooking. This platform would also help to increase communication between different solar organizations to learn from each other and to avoid repeating the same mistakes. Solar Cookers International (SCI) provides on its website country specific information on solar cooking, which inform about solar cooking activities in different countries (SCInet Wiki). This presents a starting point from which we could go on and add quantitative and qualitative data on the actual number, places of implementation and use of solar cookers. This platform would take place on different levels starting from a local level that captures different solar cooking projects in a particular country. The information about these projects would be collected at a country level and then uploaded on a virtual global platform on solar cooking as presented in Figure 2.

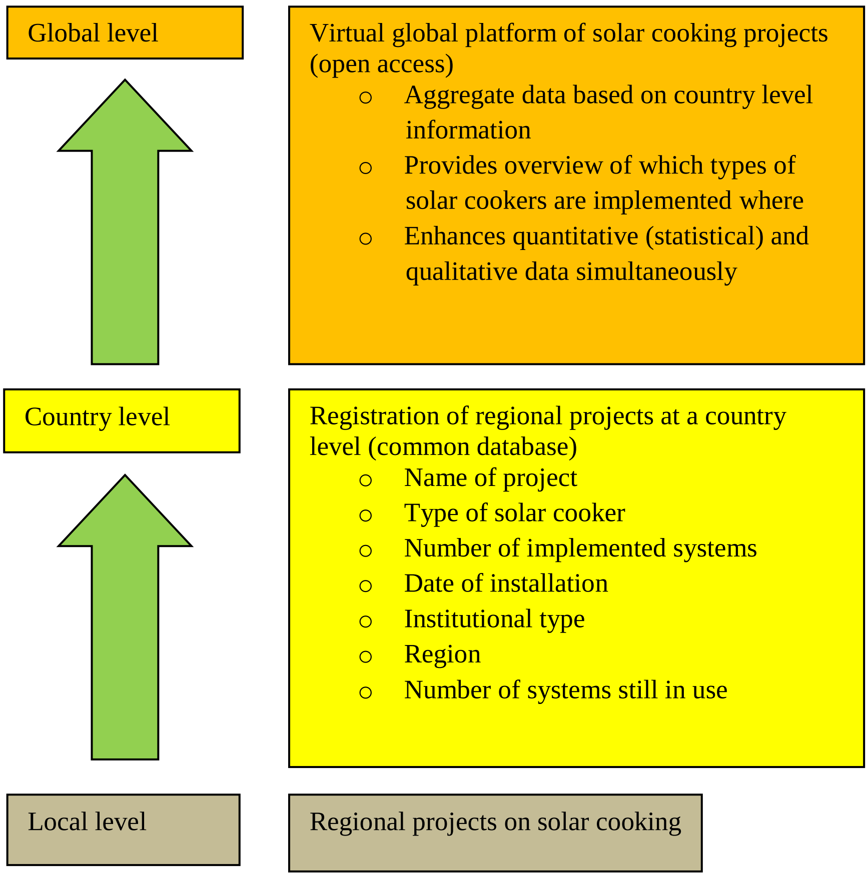

Figure 2 Model for a virtual platform for solar cooking

Each solar cooking project could register in this data base. The basis for registration could be a template similar to the one I presented in this article. This template could be uploaded on a public server where solar cooking organizations could upload and update their data. This virtual platform would make it possible for solar cooking groups - which are normally divided in space and time - to learn from each other.

However, this platform is not without challenges. My described mapping process on solar cooking showed that it is often very difficult for solar cooking organizations to keep track of the continuous use of the systems. These projects often take place in remote areas, which are difficult to access. However, by providing a first data base that provides an overview of the number of implemented systems, it would make it easier for researchers/practitioners in general to locate the project sites. Furthermore, the presented model is not without limitations. There are still questions to answer such as: Who will be in charge of such a platform? And how do we ensure a fluid communication, particularly in places with limited access to the internet?

Nevertheless, this article presents a first step into this direction and aims to encourage practitioners to elaborate further on this idea. Despite these limitations, such a platform would certainly increase communication and project coordination between different solar cooking groups. Furthermore, it would provide a chance for solar cooking groups who cannot afford the attendance of solar energy conferences due to economic barriers, but who surely play a huge part on the ground to share their experiences. In addition, it enhances access to information and provides information on quantity as well as the quality of implemented solar cookers because in the end we can only really make a difference if these cooking technologies are taken into use in the long-term.

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