Energy Technologies for Food Utilization for Displaced People: from identification to evaluation

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Abstract: the increasing number of displaced people in the World not only requires rapid humanitarian actions, but also attention to host communities and a holistic and long-term vision. Energy has not been really considered a relevant topic in people displacement, yet, resulting in negative impacts on several aspects, including food utilization, thus food security. New solutions are required, as well as sensitization, training, and support to humanitarian actors. The "Sustainable Energy Technologies for Food Utilization (SET4food)" project developed tools to support identification and introduction of appropriate solutions, tested innovations in some of the currently most important crises, and promoted the enhancement of humanitarian response capacity. Although a very limited monitoring period and data still under analysis, field activities gave interesting and promising indications regarding the overall impact of improved access to energy for displaced people, and opened new scenarios. Evaluation of such experiences is essential to bring solid evidences of the importance of energy in people displacement, and foster the implementation of integrated energy programs. Finally, learning from an extensive literature review and field experience, knowledge was transferred to several humanitarian actors with dedicated training and dissemination activities, and practical recommendations were developed to meet the most common challenges.

Keywords: technologies, energy, food security, food cooking, food preservation.

Full Paper

Introduction

By end-2014, the number of forcibly displaced people in the World was 59.5 million, the highest after the II World War. UNHCR (2015) reports that they are 19.5 million refugees, 38.2 internally displaced persons (IDPs) and 1.8 asylum-seekers, and they have been progressively increased in number for the last 4 years, with an estimation of 13.9 newly displaced in 2014. Such people have several needs, especially in terms of food security. Humanitarian actors usually try to address them focusing on food availability and access, while food utilization is often neglected (Haver K., Harmer A., Taylor G., 2013). The utilization of food, including the access to drinking water, is one of the four pillars of food security, and affects food properties in terms of nutritional intake, especially micronutrients, and healthiness (European Commission, 2009). Appropriate technologies for cooking, food preservation, and water purification are required, but all of them entail the access to fuel or other energy sources. Indeed, access to energy for displaced people is very important from different perspectives, but it is often problematic, and entails five key challenges: "protection, relations between hosts and displaced people, environmental problems, household energy-related natural resource restrictions and livelihood-related challenges" (Lyytinen 2009, pag. 1). The importance of energy for development was pointed out by the Sustainable Energy for All (SE4All) Initiative, while Safe Access to Fuel and Energy (SAFE) focused the attention on crisis-affected populations, in particular refugees and IDPs (SAFE, 2015). Indeed, if people living in camps, and similarly in informal settlements, are provided with energy services, they may access to a wide range of opportunities to change their condition, and conduct a more productive and active life (Bellanca, 2014). Unfortunately, several gaps are still present in humanitarian response for providing displaced people with an adequate access to energy, and studies are few, mainly related to stoves and generally without an independent impact assessment (Gunning, 2014). Very few displaced people have access to modern forms of energy: generally their practices are unsustainable, with average household costs of at least 200 USD per year (family of five) and disproportionate CO_2 emission compared to quantity and quality of energy finally utilized (Lahn & Grafham, 2015). Therefore, the gap in giving the right importance to energy access – in particular in linking relief, rehabilitation and development – is clear.

The SET4Food project

In this framework COOPI – Cooperazione Internazionale, Politecnico di Milano and Fondazione Politecnico di Milano implemented the "Sustainable Energy Technologies for Food Utilization (SET4food)" project, co-funded by the European Commission's Humanitarian Aid and Civil Protection department (ECHO). It aimed at enhancing the response capacity of humanitarian actors through the identification and implementation of appropriate energy solutions for food utilization for displaced people, in both camps and informal settlements. Starting from an extensive literature review, support tools for humanitarian actors were produced, that is a Decision Support System (DSS) for the identification of a ranking of potentially appropriate energy solutions, and guidelines regarding technologies potentially available (Barbieri et al., 2015). Innovative solutions were implemented in pilot projects in Central African Republic (CAR), Haiti, Lebanon and Somalia. These solutions tested the DSS logical scheme, and got field indications about potentialities of new technologies and approaches to provide displaced people with an enhanced access to energy. Such indications were not only related to food utilization, but also to other potential changes in people life. Finally, several training activities and dissemination events took place in different continents, in order to sensitize humanitarian workers, public officers, academic staff and the private sector regarding the topic, and provide them with some practical tools. An e-learning course was also developed in English, French and Spanish, in order to reach a larger audience worldwide. The importance of monitoring field activities was twofold: from one side the attention was focused on the solutions proposed, how they worked and the impact for people life; on the other side, feedback from humanitarian operators and local stakeholders, including representatives of local communities, was considered an added value to understand replicability and scalability of innovative solutions. Then, all the indications were taken into consideration to revise and improve the tools developed. Therefore, inputs from the field did not only allow improving both guidelines and the DSS, but also contributed to training and dissemination activities, including production of new literature for the sector. Two more chapters were included in the guidelines: one regarding technological innovation in practice, and the other dedicated to recommendations coming from field experience and testing. Finally, additional indications to the SET4food tools were provided by stakeholders involved in dissemination and training activities (Figure 1).

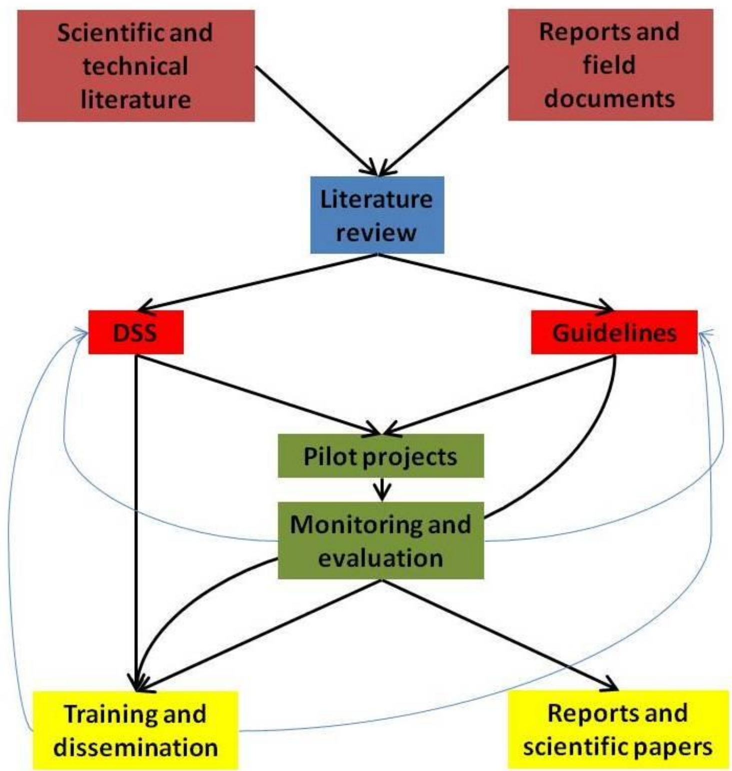

Figure 1 - Theoretical structure of the flow of knowledge of the SET4food project.

Identification of innovative energy solutions for food utilization

The proposed solutions considered a broad definition of innovation in humanitarian contexts, including "adaptation and improvement" of "products, processes or wider business models" (Betts and Bloom 2014, pag. 5), and were defined with the technical support of Politecnico di Milano (Polimi). By considering local needs, conditions and constraints, the team of Polimi proposed both the technologies and their application scheme, including adaptation to local contexts. The same framework is proposed to SET4food tools users, who can replicate the same pathway in the place where they operate (Figure 2). The solutions proposed in the pilot projects are described in Table 1.

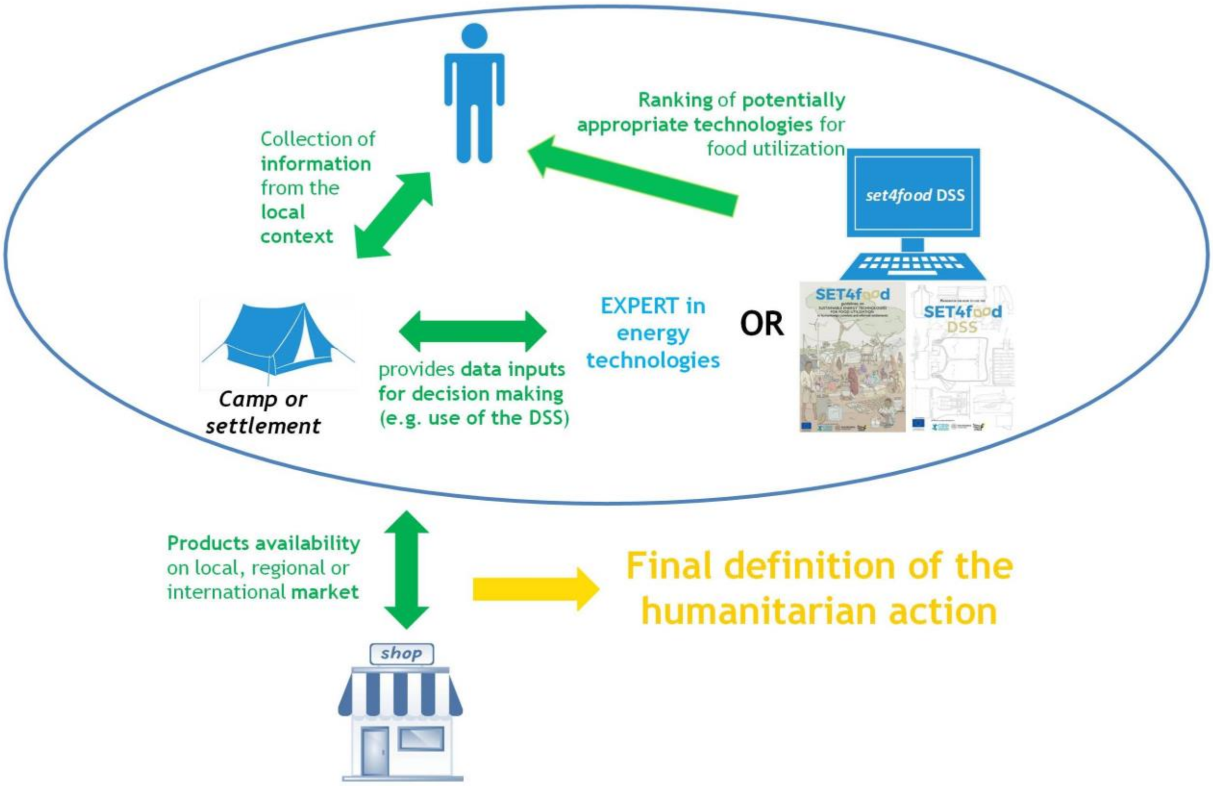

Figure 2 – Assessment and design framework proposed by SET4food.

Data collection and monitoring

Data collection was designed in order to monitor operation of the proposed solutions, and get indications about their potential impact. Indicators, or their proxy, were differently defined according to considered solutions and local conditions. Also frequency and method of data collection varied from case to case (refer to Table 2 for the main indicators). Indicators tried to investigate the impact on health, economy, and life-style of users, and the environment, while all the pilot actions are evaluated in terms of effectiveness, efficiency and success. Unfortunately, due to the very short duration of the project, findings could only give general indications about implemented solutions. The monitoring period was limited to just some months due to intrinsic constraints of the project structure. On the other hand, the structure and technology selection procedure alone represented an outcome of the project, to be replicated in future on an extended and more appropriate time scale.

Practically speaking, the majority of indicators was monitored collecting data simply by filling forms, or complying registries. However, some monitoring devices were procured and installed in order to measure specific parameters with a certain frequency. They were data-loggers coupled with sensors, with the possibility to regularly download data and vary sampling conditions. For example, thermocouples were installed on the external body of improved cookstoves in CAR and Somalia. The objective was to track the cooking practices of targeted families by using the temperature of the devices over time as a proxy indicator of their utilization. In such a way, it was possible to get quantitative and precise data about the number of times a certain family cooks and for how long. Another sensor tracked the status (i.e. open/close) of a certain shutter. Applied on a refrigerator or freezer door, it could give reliable data of the number of times displaced people opened the device, and for how long. These observations gave indications about people behaviour, and if explanations and advices about the use of the technologies were followed. The temperature inside a freezer was monitored as well, in order to verify the correct functioning of the device and detect any failure or malfunction that could affect food preservation. A hanging weight scale was procured to regularly measure the firewood daily collected and burned by a family. Additionally, electrical systems were provided with data-loggers to monitor generated and consumed energy, batteries status and other parameters of interest.

Data were regularly monitored, and partially analysed during the course of the pilot projects, in order to make corrections or changes in the installed systems.

Table 1 – Innovative solutions implemented in SET4food pilot projects.

Country and people	Municipality and type of settlement	Households covered	Technologies
Lebanon Syrian refugees	Kfarsaroun (informal settlement)	13	13 moveable standalone photovoltaic systems in DC for indoor and outdoor lighting and to power 13 small thermoelectric fridges (20-25 litres each)
			12 potskirts for gas burners
			13 water purification systems with UV lamps integrated (Steripens)
	Deddeh (informal settlement)	103	One hybrid solar/wind system providing energy to 7 multi-compartment refrigerators equipped with eutectic plates
	Kfarsaroun (informal settlement)	16	16 vacuum sealer hand-pumps with 30 bags each
			7 micro-gasifiers (ELSA cookstoves)
	Btouratij (informal settlement)	9	9 micro-gasifiers (ELSA cookstoves)
Somalia IDPs	Mogadishu (camp)	315 (out of 900 in the camp)	3 standalone photovoltaic systems in DC for indoor and outdoor lighting and to power 3 solar fridges used in sharing mode (25 families each)
			99 improved cookstoves (1 locally-made and 2 commercial models): • 90 (30 per model) in sharing mode (2 families each) • 9 (3 per model) for demonstrative purposes
			60 water purification systems for household water treatment and safe storage (LifeStraw – Family 2.0; Tulip – Siphon)
Central African Republic Congolese refugees	Zemio (camp)	230 (out of 1251 in the camp)	2 standalone photovoltaic systems (different PV technologies) in AC for indoor and outdoor lighting and to power 4 standard refrigerators and 1 freezer used in sharing mode (totally 100 families)
			4 locally-made root cellars (using cold bricks produced by freezers)
			1 improved smoking device (adapted charcoal improved cookstove)
			1 improved locally-made solar dryier
			100 improved cookstoves (1 locally-made and 1 commercial models) working with biomass (including firewood)
			30 solar lanterns (D.Light S2)
Haiti IDPs	Port-au-Prince, St. Etienne 1 and 2 (camps)	24 (out of 202 in the camp)	3 standalone photovoltaic systems in DC to power 6 locally-made fridges (500 liters capacity) used in sharing mode (4 families each) – SPARK model
	Port-au-Prince, Villambetta (informal settlement)	222	222 water purification systems for household water treatment and safe storage (LifeStraw – Family 2.0; LifeSaver – Jerrycan; Tulip – Table Top; Grifaid – Family Aquafilter; Sawyer – Point-One-Filter)

Table 2 – Main indicators introduced for monitoring solutions operation and impact.

Issue	Indicator	Proxy	Method	Final result
COOKING	Access to cooked food	N.A.	Register/survey	# of meals cooked per day increased of #%
	Fuel cons reduction	N.A.	Register/survey	Fuel consumption reduced by #%
		Time to collect fuel	Register/survey	Time to collect fuel reduced by #%
	Use of device	Temperature in the stove	Data logger	The device is used # times a month
	Use of device	N.A.	Register/survey	The device is used # times a month
PRESERVATION	Use of device	N.A.	Register/survey	The device is used # times a month
		# of openings of refrigerators door	Data logger	The device is used # times a month
	Device operation	Inside temperature	Data logger	Temperature data series
		Power consumption	Data logger	Power data series
WATER PURIFICATION	Access to safe water	Quantity of water consumed	Register/survey	Water consumed increased by #%
		Use of water treatment	Register/survey	Frequency of use of treatment technologies
		Water expenditure for treatment	Register/survey	Water expenditure changed of #%
POWER SUPPLY	Electricity cost	N.A.	Register/survey	Cost per month
	Produced energy	N.A.	Data logger	kWh
	Supplied energy	N.A.	Data logger	kWh
	Supplied power	N.A.	Data logger	kW
GENERAL	Access to food	N.A.	Register/survey	# of meals per day increased of #%
	Access to energy	Meeting energy needs	Register/survey	Access to energy increased of #%
	Nutrition	Dietary diversity (household)	Register/survey	Household dietary diversity score (HDDS) increased of #%
		Dietary diversity (women)	Register/survey	Women's dietary diversity score (WDDS) increased of #%
	Perception	N.A.	Register/survey	Perception is changed of #%

Preliminary results analysis

The SET4food project was concluded at end-2015, but data are still under processing and analysis. However, it is already evident that basic access to energy represents a key element in displaced people life, and that the nexus with energy in this context clearly exceeds the sole food utilization and food security dimensions. For example, some preliminary findings can be already pointed out:

- Improved cookstoves (ICSs) were distributed to Congolese refugees living in a camp in a rural and very remote area of CAR. ICSs were of two models, one locally-made in the capital city, and the other produced by a well-known international brand, and imported. Both were very welcome by all the beneficiaries. They could immediately appreciate the benefits in terms of fuel savings, against a benchmark of exclusive use of three-stone fire, situation shared by both host and hosted communities (i.e. baseline before pilot project implementation). On average ICS were used more than twice a day by each household, confirming a shift from three-stone fire. Such results stimulated local entrepreneurship, and some private actors evaluated to start a local business;

- In an informal settlement in Haiti, IDPs received five different models of water filters, with different characteristics, but all equipped with systems for safe storage of treated water. The users not only experienced a reduction in terms of cost of drinking water procurement and time for water fetching, but also shared the filters with relatives and neighbours, strengthening social bonds.

- In an informal settlement in Kfarsaroun, Lebanon, an integrated approach to food utilization was proposed, with technologies supporting cooking, food preservation, water purification and lighting. The feedback from some Syrian refugees was better than expected, entailing an improvement in household economy, food saving, time saving, children health, night breastfeeding practices, and, in general, life-style and opportunities. People highly appreciated the use of pot-skirts specifically designed for gas-stoves. This device was a simple metal ring insulated with rock wool and installed between gas-stove and pot. It aimed at increasing thermal efficiency of a gas-stove during cooking activities, thus reducing the amount of LPG consumed. Furthermore, this pot-skirt allowed outdoor cooking – a common practice in that settlement – by protecting the flame from the effect of wind. Data confirmed an average use of 6 times per week, that means that all the households utilized the pot-skirt on a daily basis. Unfortunately, quantitatively data about LPG consumption were not reliable due to many logistic reasons. On the other hand, users declared that gas cylinders could last longer. With regard to access to safe water, the same community received portable water purification devices (i.e. UV lamps to neutralize biological contamination). These devices were appreciated, and used almost daily (6 times per week on average). The same households also received a small thermoelectric refrigerator, powered by a simple solar photovoltaic system, which at the same time provided energy for lighting the household. Performances of the fridges were monitored with specific devices, by tracking their internal temperature and openings/closings. Data confirmed both good operation and correct use of the fridges, which maintained internal temperatures in the range of 8 – 13.5 °C. The devices were opened 1 – 4 times per day by each family. Field surveys reported that the fridges were mainly used to preserve food leftovers, vegetables, fruits, bread, yogurt and water. On average, each food item spent 1 – 3 days in the fridge before consumption.

Despite these positive preliminary results, it is worth mentioning that the improvement of refugees' conditions in Lebanon – as well as in any other humanitarian context – is not an easy task. For this reason, not all the technologies proved to be appropriate, despite good initial assessments carried out in all the contexts. For example, the dissemination of an adapted prototype of the ELSA micro-gasifier (Bluecomb, 2015) did not have success in another community of Syrian refugees: people did not appreciate it because it was not easy-to-use, it was too small for big pots (and a locally-made support structure was required also for small pots), quite difficult to light properly, considered dangerous for children, and could work only in batch (i.e. impossible to refuel during cooking). Households of the same community received also a vacuum sealer and some bags. Also in this case, data suggested that people did not completely understand how to really benefit from it. Indeed, only one-fourth (23%) of them regularly used it, with peaks of two-third (67%), but also days with no households using it at all. Probably people perceived vacuum sealer as a "poor" and useless technology, since fresh food like meat and vegetables could not be preserved with it.

Conclusions and recommendations

All the indications collected stressed the importance of a holistic approach to basic access to energy for displaced people, and suggested that energy could be a key element linking humanitarian aid and development. Moreover, host countries could benefit from this approach to energy access, not only in order to reduce the load on public services or mitigating potential conflicts, but also to identify opportunities for integration and mutual development for both host and hosted communities. Indeed, the average duration of displacement is already 17 years (Lahn & Grafham, 2015), still raising, thus host countries should start evaluating new ways of dealing with refugees. Moreover, displaced people already contribute to local economy. For example, Syrian refugees in Lebanon pay a rent, and offer low-cost manpower, especially useful for the construction sector. On the other hand, their number is so high, that neither public services nor local communities are ready for a process of integration. An inclusive intervention, aiming at both bring humanitarian assistance to displaced people and support host communities, especially poor and vulnerable people, could really change the host community perception of refugees and IDPs. An enhanced access to energy is a mandatory condition to allow displaced people to achieve some opportunities, and struggle to have a role in the host community. In particular, renewable energy sources look among the most promising solutions, especially in rural and remote areas far from the national grid.

On the other hand, the appropriateness of a technology strictly depends on local conditions and requirements. The assessment of the context is very important, and should be able to depict all the relevant information and properly analyse them. For example, in Lebanon the micro-gasifer model proposed did not fail only due to its technological characteristics, but also because of a bad perception shared by beneficiaries regarding the practice of cooking with firewood: those people decided to cook with firewood only because it was the only option, motivated by economical reasons. Although in a difficult situation, they did not want to improve the use of a fuel they disliked, preferring to move to LPG as soon as possible. Even if they accepted to test a micro-gasifier and were prepared to do it, finally they did not, and asked again for LPG, even if this option was clearly economically unsustainable. From this example, it is quite evident that the factors affecting success or failure of a certain humanitarian intervention are plenty, various and almost impossible to be fully predicted. The simple technological factor (i.e. efficiency and characteristics of a certain technology), in particular, plays an important but limited role. Top-down projects – even if using the best technologies – are often inappropriate, and humanitarian actors are more and more moving towards a new way of project formulation, based on a holistic and multidisciplinary approach.

Projects such as SET4food can also establish new opportunities for all and provide humanitarian actors with some clear and significant case studies. As a matter of facts, there is a clear gap of knowledge in this particular field. Lack of scientific evidences from a large number of cases and about the nexus between energy and other sectors (e.g. health, education and protection) in humanitarian contexts is still evident. Humanitarian actors and academia should join their efforts to immediately develop and propose effective solutions, with short-term benefits, but also looking at long-lasting impacts. Thus, the linkage with development should be somehow embedded in most of interventions. In order to achieve such an ambitious goal, several humanitarian actors should be sensitized to the importance of energy, and accustomed to test and introduce innovations, instead of only standard solutions.

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