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Original article

Cooking in refugee camps and informal settlements: A review of available technologies and impacts on the socio-economic and environmental perspective

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ABSTRACT

In the world, the number of forcibly displaced people is arising. These people have several needs, especially in terms of food security. The humanitarian response usually focuses on food availability and access, while food processing is often neglected. In this framework, cooking technologies play an essential role. Many scientific studies and international reports address the issue of clean cooking technologies dissemination in developing countries. Less information is instead available in the literature for the specific case of humanitarian contexts, such as refugee and Internally Displaced Persons (IDP) camps, or informal humanitarian settlements. Unsustainable and inefficient cooking technologies or practices can have direct impact on food preparation, and indirect effects on local biomass resources overexploitation, health of local people, and social conflicts between hosted and hosting communities. This study aims at presenting a systematic review of both scientific and grey literature on cooking technologies and related practices, including a selection of experiences from the implementation of cooking devices in humanitarian projects and programmes. The Authors conclude that the attention to the problem is arising, but still very few information is available, in terms of scientific research.

Introduction

Natural disasters, population growth, social conflicts, political or structural crises often are a cause of forced migrations, which can lead to humanitarian emergencies. The number of forcibly displaced people in the World at the beginning of 2015 was more than 55 million, the highest in the last decades. The United Nations High Commission for Refugees (UNHCR) reports that about 15 million are refugees, while about 34 million are internally displaced persons (IDPs). Moreover, about 2 million are considered as asylum-seekers. Numbers have been particularly increasing for the last 4 years [1]. Such people have several needs and one of the most relevant for preserving a decent standard of living is food security. Humanitarian actors usually try to address them focusing on food availability and access, while food utilization – a fundamental pillar of food security – is often neglected [2]. The lack in technologies for appropriate and safe food utilization leads to malnutrition and weak health, enhances causes of mortality, and creates a status of permanent emergency.

Humanitarian emergency response deals, in first place, with food safety and security, but most of the food provided by humanitarian agencies has to be cooked before eating. The way food is prepared has an important impact on nutrition: in the case of Niger, for example, the distributed food had to be prepared with boiled water (and this happened 3 or 4 times a day). Since traditional cooking generally requires a great quantity of fuels, and takes time, it was found that rations were consumed dry (limiting the nutritional value) or prepared using non-boiled water (raising the risk of infections) in the vast majority of cases [2].

In this framework, sustainable energy technologies can play a key role to provide efficient, reliable and equitable access to basic services, such as cooking and food preservation. Furthermore, the issue of access to cooking energy in humanitarian contexts is also at the core of other challenges, such as protection, relations between hosts and displaced people, environmental damage, over-exploitation of natural resources, etc. [3]. As a matter of facts, in many cases, women and children must cover long distances to find firewood and have to carry heavy loads back to the camps. This puts them at risk for physical and sexual attack, physical injuries, and other problems. Women and children are also exposed to health risks, especially asthma, pneumonia, or other respiratory infections due to the smoke produced by inefficient cooking

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Acronyms

CO	Carbon monoxide
CO_2	Carbon dioxide
DALY	Disability Adjusted Life Year
DME	Dimethyl ether
DRC	Democratic Republic of Congo
EA	Environmental Audit
EIA	Environmental Impact Assessments
FAO	Food and Agriculture Organization
FNC	Forest National Corporation
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
GBV	Gender Based Violence
IAP	Indoor Air Pollution
ICS	Improved Cooking Stove
IDP	Internally Displaced Person
IEA	International Energy Agency
LPG	Liquefied Petroleum Gas
NGO	Non-Governmental Organization
PM	Particulate Matter
SAFE	Safe Access to Fuel and Energy
TLUD	Top-Lit Up-Draft
UNHCR	United Nations High Commissioner for Refugees
USAID	United States Agency for International Development
UXO	Unexploded Ordnance
WHO	World Health Organization

systems [4–6]. In addition to this, refugees often sell or exchange a portion of their food rations in order to procure the firewood needed to cook the remaining food. Moreover, in situations where firewood is the main resource, such as in sub-Saharan Africa, the competition for the access to fuel is a trigger for tensions between refugees and host communities. The collection of firewood by refugees can cause deforestation or degradation of green areas, which can have a permanent impact on the local environment [5,7].

At the international level, the Safe Access to Fuel and Energy (SAFE) initiative is trying to draw the attention on the issue of energy in the case of crisis-affected populations, in particular refugees and IDPs [8]. On the other hand, the level of attention of academic and scientific research in the field is still weak, despite several gaps are evident, in particular regarding rigorous and independent impact assessments of programmes [9].

Aim and structure of the work

In the light of all the factors concurring to the situation previously depicted, this study aims at presenting the results from a systematic review of available scientific and grey literature on cooking technologies and related practices in humanitarian contexts. The analysis includes a selection of experiences and findings from the implementation of improved technologies in humanitarian projects and programmes developed up to now.

The work is organized in two main parts: in the first one, we present a review of the main typologies of Improved Cooking Stoves (ICSs) and other cooking technologies, with a specific focus on humanitarian contexts. In the second part, we carry out a review of scientific and grey documentation on the experiences and impacts from different humanitarian projects focusing on the specific issue of cooking; we identified four main areas of study and research, namely: (i) *Environmental impact*; (ii) *Health*; (iii) *Safety*; (iv) *Education, livelihood, and social issues*. We searched for peer-reviewed papers by Science Direct editorial platform and Scopus database, and reports within the grey-literature produced by international organizations and institutions within the Union of International Associations – IGO Search engine [10] and PubMed, using the following key-words and combinations: Improved Cook Stoves, biomass fuel, biomass stove, solar cooker, fireless cooker, firewood, internally displaced, refugee, humanitarian. Among all the papers matching our key-words, a selection has been carried out, based on the following rules:

i. reference context of the documents must be related to humanitarian settings: refugee camps, IDPs camps, informal settings.
ii. documents must deal with experiences related to the use of ICSs and biomass cooking technologies within the above-mentioned context. Works that merely cite or touch upon campaigns of stove dissemination, without providing any detail on the technology and/or mention to the impact on people, have been discarded.
iii. publications date must be in the years ranging 1995–2016.

Cooking stoves taxonomy and their utilization in humanitarian contexts

According to the World Energy Outlook 2015, 2.7 billion people in the world rely on such stoves, and in particular on traditional ones [11]. In fact, in developing and emergency contexts, such traditional biomass cooking stoves are generally used for water and space heating, lighting, smoking and cooking food.

In general terms M. P. Kshirsagar and V.R. Kalamkar define a "Biomass cookstove" as "a physical structure that contains air-fuel combustion for heat release, and subsequently, directs the heat of combustion towards a cooking target (pot/pan/griddle)" ([12], p. 582).

Traditional cooking stoves

A univocal definition of traditional cooking stoves does not exist, since the term refers to devices, which differ according to the specific context. Usually, the term identifies very cheap or no cost models of stove, whose use is well established within people's traditional habits. In most cases, they are characterized by very low efficiency and high Carbon monoxide (CO) and Particulate Matter (PM) emissions. The literature commonly identifies four models of traditional stoves: *three-stone fire stoves*, *mud stoves, metal stoves* and *fired clay* (*viz.* ceramic) *stoves*. The former, often named "open-fire stoves", are simple and zero cost fires built directly on the ground where three stones work as the pot support. The main drawbacks of such devices are the large amount of radiative thermal losses toward the environment, the huge amount of PM produced during the combustion, and the exposure to open burning flames. On the other side, the fact the flames surround directly the pot makes them sometimes more efficient than other cooking devices [13,14].

Mud stoves are structures made of sun-dried mud dried by heat from the fire with a hole for placing the pot on the top and three sides that enclose the fire (Fig. 1left side). They are semi-permanent stoves and they are usually built on site, with no-cost or at least very low. They are supposed to be more efficient than three-stone fire stoves since the enclosed fire caused a reduction

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