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Innovation diffusion: Dissemination circuits of improved cookstoves in Maroua, Far North Region of Cameroon

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Abstract— *Household cooking with solid fuels in traditional cookstoves is detrimental to health, the environment and socio-economic development. Hence, a range of Improved Cookstoves (ICSs) technological innovation is available. Current diligence to ICS focuses on the ''triple benefits'' they provide-improved health and time savings for households, preservation of forests and associated ecosystem services, and reducing emissions that contribute to global climate change. In spite of the purported advantages of such technologies, little is known about successful approaches to their dissemination in Maroua. More so, scientific publications on the ICS dissemination circuits are scant. This study grants in-depth analyses of dissemination circuits of ICS technology in Maroua. The study employed a qualitative case study research design. Qualitative data was collected for a period of nine months through reconnaissance surveys, field visits/observation, photographs taking and in-depth interviews. Collected data was presented and analysed using qualitative statistical techniques including figure, percentage, graph and a plate. It was found that ICSs was first introduced in the town by some French organisations in a bid to reduce the consumption of fuelwood and the pressure it exerts on the already degraded forest, and the actors involved in the dissemination of the ICSs include the government, NGOs and CIGs, and private individuals (friends and relatives). The dissemination circuits employed by these actors include sensitization and free donations, the mass media, and interpersonal and interactive channels. Of these, the latter is the most popular and practicable (36%). This study champions that the dissemination circuits currently employed are deficient for the area (the mass media for instance records only a trivial 4% of circuits used), and so the use of traditional three stone fire place is still topping the list of different types of cookstoves commonly used. It provides suggestions which if implemented, will promote successful large scale dissemination and adoption of ICSs technology, intensify dissemination circuits and stimulate ICS market transformation in the area.*

Keywords— Improved cookstoves, dissemination, technological innovation, Maroua, Cameroon

I. INTRODUCTION

Cooking is a basic need of every household and an important human activity. Cooking requires a regular supply of energy. The major household fuel use, particularly the poor, in developing or low income countries is for cooking (World Energy Outlook, 2006). Yet, access to clean energy for cooking is limited, and there is a staggering reliance on unprocessed biomass and traditional (dung, agricultural residues, charcoal and fuelwood) methods of cooking (World Energy Outlook, 2006; Bruce *et al*., 2000 cited in Okuthe and Akotsi, 2014), which are associated with significant costs to human health. For the millions of households in developing countries relying on traditional biomass (Table 1), cooking is more than just a daily activity. It is associated with long hours spent collecting biomass (Rai and McDonald, 2009). The situation is more severe in Sub-Saharan Africa (SSA) where Cameroon is found, where the proportion of the population relying on biomass is highest. Seventy six percent of SSAs population makes use of biomass fuels as their primary source of energy, and the most prevalent household energy source used for cooking and heating is fuel wood in the form of firewood and charcoal (Tidze *et al*., 2016).

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Table.1: People relying on traditional (unprocessed) biomass (in millions)

Region	2004	2015	2030
Sub-saharan Africa	575	627	720
North Africa	04	05	05
India	740	777	780
China	480	453	394
Indonesia	156	171	180
Rest of Asia	489	521	561
Brazil	23	26	27
Rest of Latin America	60	60	58
TOTAL	**2 528**	**2 640**	**2 727**

Source: Modified from World Energy Outlook (2006)

These conventional cooking methods lead to environmental damages such as forest/land degradation, air pollution, black carbon emissions, and other emissions from burning of the fuels which contribute to global warming. The gender and social impacts are also skewed, as women and children are primarily affected given their proximity to cooking fires and there is decreased opportunity for children due to the time spent collecting fuel. About 1.3 million people (mostly women and children) die prematurely every year because of exposure to indoor air pollution from biomass. Valuable time and effort is devoted to fuel collection instead of education or income generation (Global Standard Improve Cookstove Activities Guidebook, 2016; World Energy Outlook, 2006).

Consequently, Switching to other alternative clean energy sources such as Improved Cookstoves (ICSs) could positively impact health, livelihoods and the environment. ICSs can reduce or eliminate, depending on the fuel used, the harmful respiratory and other health effects of indoor air pollution caused by traditional fuels. This could improve the quality of life for women and children, and for their entire families and communities. By eliminating the need to forage for fuelwood or biomass, trees and other vegetation are spared, preventing the release of greenhouse gases (WIPO GREEN, 2014). ICSs saves from 10-50% of biomass consumption for the same cooking service provided, and can reduce indoor air pollution by up to one-half (World Energy Outlook, 2006). Recognizing the myriads of benefits that ICS offers, the United Nations Millennium Project recommended halving the number of households using traditional biomass for cooking by 2015, involving 1.3 billion people switching to alternative fuels (such as ICSs).

Therefore, the many energy-related health, environmental, economic and livelihood problems could be addressed and sustainable patterns of economic growth achieved through the development and diffusion of technological innovation. Technology plays a vital role in the economic development of a country. It is essential to realize sustainable development goals (Balanchandra *et al.*, 2007). ICSs burn biomass more cleanly and efficiently, and could thus help mitigate problems related to solid biomass use by households (Shrimali *et al.*, 2011). Promoters of ICS technologies argue that the use of these technologies offers several benefits such as improved health, fuel saving, reduction in green house gases emissions, among others (Tebugulwa, 2015). As Hendrickson and Whatley (2011) notes, ICS technology has been promoted as the most cost-effective method to reduce particulate matter emissions and improve household health conditions. Since ICSs improves cooking efficiency compared with traditional cook stoves, ICSs can reduce the amount of fuel required and fuel gathering/cooking time, all of which have the potential to improve health and increase household income. These efficiencies can also benefit the local environment and global climate because of reduction in fuelwood harvesting and particulate emissions (Okuthe and Akotsi, 2014). Consequently, several ICSs programmes have since been introduced in Africa (including Cameroon and Maroua), Asia and Latin America aimed to disseminate ICSs to households. Since the 1980s, hundreds of millions of ICSs have been distributed worldwide, with varying degrees of success. China's Ministry of Agriculture estimated that, in 1998, 185 million out of 236 million rural households in China had improved biomass or coal stoves (Sinton *et al.*, 2004 cited in World Energy Outlook, 2006). In India also, an estimated 34 million stoves have been distributed while in Africa, 5 million are in use (REN21, 2005 cited in Ibid). In Kenya during the 2000s, several programmes aiming at testing and disseminating energy saving technologies were implemented. One of these technologies was ICSs, which was intended to increase the efficiency of using energy from biomass sources (Okuthe and Akotsi, 2014).

This is similarly an on-going process in Maroua, situated in the Far North Region of Cameroon where over 125, 000 ICSs innovation (a new material technology-cooking stoves-which previously did not exist in the region but its now been adopted by the inhabitants or culture) have been developed and is being disseminated or diffused (transmitted or spread in the Maroua community and the

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circuits employed in the process by the actors involved) since 2008. In this sudano-sahelian climatic zone of Cameroon, the majority of both the urban population and the totality of the rural people depend exclusively on wood for heat energy (Hamed, 1990 cited in Njiti and Kemcha, 2002). Here, approximately 70-80% of households in both rural and urban areas use wood fuel as their main source of energy for cooking and heating (Njong and Tabi, 2011 cited in Tidze *et al*., 2016; Nlom and Karimov 2015). They use firewood as their main energy source for cooking, estimated at between 0.7-1.6kg/person/day and about 27,000-39,000tons/year (Association Française des volontaires du progress (AFVP), 1989 and Assan, 1991, all cited in Njiti and Kemcha, 2002). Wood, charcoal and kerosene are the energy sources commonly being utilized in Maroua (Tidze *et al.*, 2016). This is because they are relatively cheaper, accessible and available and can be easily retailed (as from 100FCFA and 150FCFA in many places) in the quarters, compared with other energy sources which cannot be retailed in little quantities such as domestic gas (currently 3,250FCFA or $5.92 for a bottle of 6kg and 6,500 or $11.85 to 7, 000FCFA or $ 12.76 for a bottle of 12kg). Some of these common energy sources like fuelwood have become scarce. Some of the major areas supplying fuelwood into Maroua such as Madjina, Songonye, Ngambarou, Moulvougaye and Kingeriwa have been witnessing reduction of their forest areas. In these areas, the forest has been drastically reduced from 31.1% to 22.4% between 2004 and 2014 (Tidze *et al.*, 2016). More so, the community of fuelwood users in the town and environs is wide and varies from households to other petty traders ranging from the local beer "bil-bil" brewers, roasted meat (soya) and fish sellers, blacksmiths, roadside restaurant (puff-puff and beans), fish/potatoes fryers, those who roast maize and plum, etc) who increasingly depend solely on energy from fuelwood on a daily basis as their primary energy source (Ibid).

Given the current attention towards ICSs uptake, their dissemination circuit in Maroua has not been given the attention it deserves, creating a knowledge gap. This knowledge gap has hampered the large scale successful dissemination and consequent adoption of the stoves by the inhabitants. This study therefore delves into the dissemination circuits of ICSs in Maroua and provides suggestions to development actors, policy makers and socio-economic planners for their successful wide scale dissemination and adoption. It also adds to existing knowledge on ICSs technological innovation dissemination circuits. The aim is to intensify dissemination strategies of these clean and improved energy and more environmentally friendly cookstoves that are currently being disseminated in the region.

II. MOTIVATION/JUSTIFICATION FOR THE STUDY

This study which was conducted in Maroua in the Far North Region of Cameroon was motivated by diverse reasons. Firstly, Maroua exhibits extensive potentials to benefit from ICSs technological innovation, situated in the arid Sudano-Sahelian zone of SSA (Sub-Saharan Africa) where fuelwood has become scarce. SSA (where Maroua s found) has one of the highest levels of solid-fuel depend-ence globally (Table 1). In Maroua in particular, 70-80% of households rely and use solid biomass as the main household energy source (particularly fuelwood) which comes from the forest. With a high rate of deforestation currently recorded in the area, fuelwood has now become scarce to get.

Also, efforts are currently on-going to disseminate ICSs in the area, but with trivial success even with the government's free donation/acquisition strategy.

More so, the area has only few remaining trees because fuelwood has already been harvested for urban and rural consumption. Since the area is arid, trees grow back very slowly.

Furthermore, the town hosts a large and ever growing population, which soared from 17, 000 inhabitants in 1950 to over 600, 000 inhabitants in 2016 (Central Bureau for Census and Population Studies [BUCREP], 2010 and Maroua Urban Council [CUM], 2016). This implies increase in firewood collection due to the volume required to support the needs of the ever increasing population leading to deforestation. With a large scale dissemination and adoption of ICSs in this area, this situation could be salvaged.

Finally, there is the persistence of a technological gap in Maroua town and its environs, notably between Maroua urban (core) and its environs or peripheral areas supplying fuelwood into the town (within the radius of 50km from the core), necessitating the need of technological transfer of the technological innovation (ICSs) from the core areas to the periphery or environs. All these reasons are the motivating factors justifying this study.

III. RESEARCH METHODOLOGY

For this study, a qualitative case study research design was used. The research followed Gerring's (2004) definition of a case study research, one in which the researcher chooses a single unit and studies it in detail to generalise the findings of the study. Its advantage is that it immerses the researcher into the topic by giving him/her the opportunity to experience first-hand what he/she is about to study. It also gives room for the study to carry out a much more detailed analysis of the phenomenon it seeks to uncover and so it remains an important methodology in social science research considering the fact that it is expensive to study every single unit of analysis in a study like this one.

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Nevertheless, case study research uses data gathered from a single case to generalise its results which can be misleading because it fails to take into consideration the unique nature of different units amongst which one is chosen for the study (Ibid). In this study, I chose, and carried out an in-depth analysis of the dissemination of ICS in Maroua, situated in the Far North Region of Cameroon.

3.1 Study area

Maroua is located between Latitude10° and 11°N of the Equator and Longitude 13° and 15°E of the Greenwich Meridian (Google Earth) (Fig. 1). The Maroua Municipality covers a surface area of 127km^2. Maroua is the administrative headquarters of the Far North Region of Cameroon, situated in the Diamaré Division, and is one of the six Divisions that make up the Far North Region. Maroua has a population of 600,000 inhabitance distributed within 3 council areas: Maroua I, Maroua II and Maroua III. The town's population is cosmopolitan, with a bourgeoning rate of growth of 3.5% (Watang Zieba, 2014). In 1950, the population of the town was 17, 000 inhabitants. It increased to 271, 000 in 2001 and to 400, 000 in 2015 (Wanie, 2016). It is currently estimated at 600, 000 inhabitants (CUM, 2016). Innovation is quickly disseminated amongst such a large urban population, with a population density of about 101.6 inhabitants /km^2. It has a multitude of ethnic groups such as the Arabs, Hausas, Shulvas, the Guiziga, Kanouri, Kirdi, Kotoko, Mundang, Mofou, Mafa, the Musgoum and the Peuhls who are mostly located in the Diamare. Other ethnic groups from within the country are also present, like the Sawas, Ewondos, Tikars, etc together with foreigners dominated by Chadians. These ethnic groups are distributed all over Maroua town and are living in major quarters (Fig. 1). Maroua also host about 76, 500 refugees at Minawao refugee camp from Northern Nigeria fleeing the nefarious activities of the dreaded terrorist sect Boko Haram (Wanie and Tamasang, 2018). Fulfulde is the common language spoken, though French and English are the two official languages of the country as a whole. As far as vegetation is concern, Maroua is situated in the sudano-sahelian agro-ecological zone, which is one of the most affected by deforestation, land degradation and decertification. Savannah makes up the region's primary vegetation. Most of the area is thus covered in thin grasses punctuated by thorny shrubs such as baobab, Faidherbia, and Karita. However, human activities such as burning of fields, chopping down trees, and overgrazing of cattle have exacerbated the problem of desertification in the Far North Region as a whole. In response, the Cameroonian government, with aid from various non-governmental organisations, launched the Operation Green Sahel (*Sahel Vert*). The project aims to reverse the effects of desertification by reintroducing trees to the region.

3.2 Data collection

Primary and secondary methods were used in the collection of data. The secondary methods consisted of published and grey or unpublished sources across multiple disciplines through relevant results identified from libraries and through google search (textbooks, e-books, journals, dissertations, conference presentations and reports and other institutional sources).

The simple qualitative research method constituted the main primary method used. Qualitative data for this study were obtained following a period of 9 months (September-May 2017) conducted in 20 quarters within Maroua (Fig. 1). During this period, relevant data was collected and subsequently analysed. Data collection through the descriptive research design was via reconnaissance surveys, field visits/observation, photographs and in-depth interviews with a government ministry-MINEPDED (Ministry of Environment, Nature Protection and Sustainable Development) via its regional and divisional delegates in Maroua, NGOs and heads of households. To gain an informed understanding of participant views on dissemination of ICS, data collection through in-depth interviews/focused group discussions on different occasions during the 6 months period was mainly through seminars organised by HEIFER International, and within the participant's home. Trained data collectors or field assistance interviewed participants in their local, native language (Fulfulde). Interviews ranged from ten to thirty minutes in length, similar to studies by Rhodes *et al*., (2014).

3.3 Data analysis

Collected data was analysed using descriptive statistical tools including tables, percentages, graphs, and a plate.

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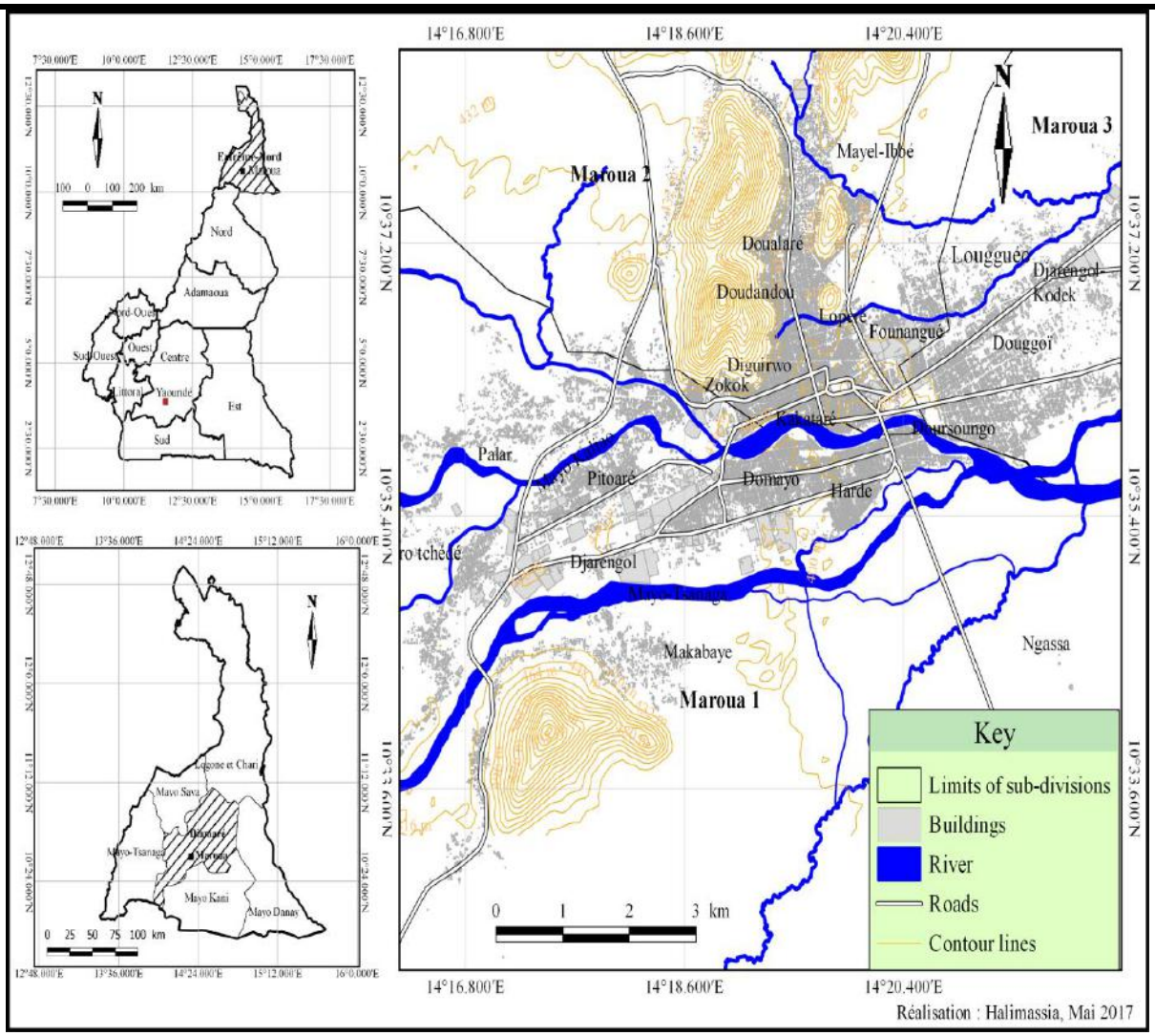

Fig. 1: Location of the study area

Source: Adapted from Maroua Urban Council **(**2007**)**, and realised by Halimassia **(**2017**)**

IV. RESULTS, INTERPRETATION AND DISCUSSION

The results are presented under origin, actors involved and dissemination circuits of ICSs in Maroua.

4.1 Origin of ICSs in Maroua

ICSs was first introduced in Maroua by some French organisations known as '*l'Association Française des Volontaires du Progrès* (AFVP), *l'Association Bois de Feu* (ABF), and *Commission des Communautés Européennes (CCE) et du Comité Français Contre la Faim* (CFCF)'. These organizations came up with a pilot programme which was to ensure the diffusion of ICSs that will respect the realities of the Far North region (drought prone) and eventually reduce the consumption of fuelwood and the pressure it exerts on the forest. This project did not last long as the organizations ran out of finances. Despite the lack of finances, the diffusion of ICS continued in the early years of 2000 with "*Programme National de Reboisement*" (PNR). PNR had as objective the diffusion of ICS to zones that are endangered by desertification phenomenon. In 2008, the Ministry of Environment and protection of Nature re-launched the "*Operation Sahel Vert*", ensuring a sustainable cutting of wood in addition to using ICS. Since then, the regional delegation of MINEPDED has been disseminating ICSs to households in Maroua and the Far North Region of Cameroon as a means of combating deforestation. Between 2008 and 2016, over 125, 000 ICSs have been successfully distributed as shown in Table 2.

Table.2: Number of ICSs distributed in Maroua (2008-2016)

S/N	Year	Number of ICS disseminated
1	2008	21,300
2	2009	13,076
3	2010	15,384
4	2011	18,227
5	2012	18,496

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6	2013	11,500
7	2014	5000
8	2015	15,500
9	2016	9,360
Total		**125,843**

Source: Far North Regional Delegation of MINEPDED (April, 2017)

4.2 Actors involved with ICSs dissemination in Maroua

Diffusion is associated with how to transmit or spread or disseminate new knowledge and technology to target groups. The dissemination of ICSs in Maroua is carried out by several development actors, including government institutions (Far North Regional and Departmental Delegations of MINEPDED), NGOs (HEIFER International, SNV, SAILD), CIGs and private individuals (friends and relatives).

4.3 Dissemination circuits of ICSs in Maroua

The dissemination process employed by the development actors occurs through a variety of communication circuits such as mass media, interpersonal and interactive channels. The interpersonal channel is the most popular and practicable as observed from field results (36%). This confirms Roger's (2003) theory of diffusion of innovation which states that diffusion is the process by which an innovation is communicated through certain channels, mostly interpersonal skills over time among the members of a social system. Detailed result of the dissemination channels of ICS in Maroua town is presented in Fig. 2.

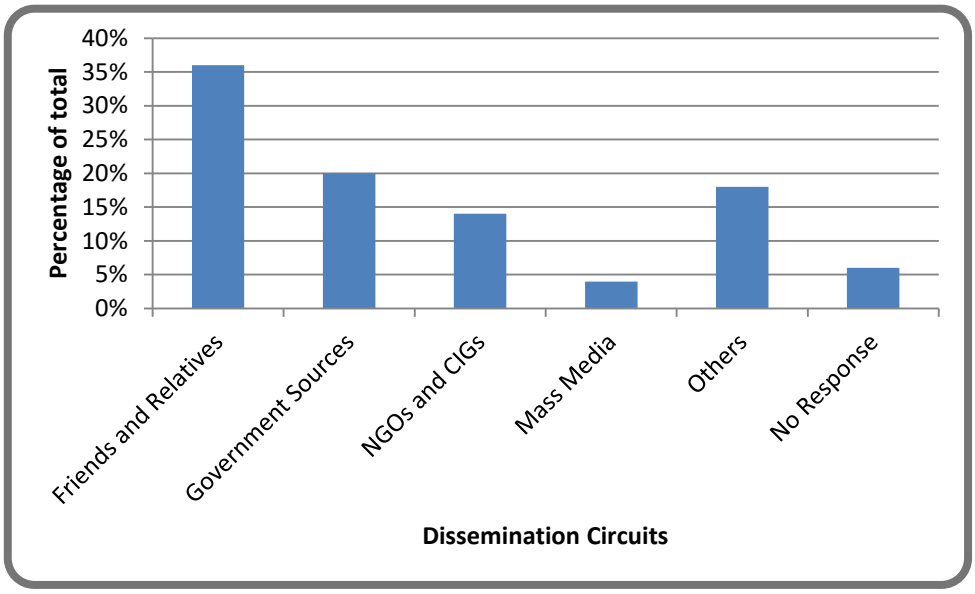

Fig. 2: Dissemination circuits of ICSs in Maroua. Source: Field Work (2015-2016).

4.3.1 Sensitization and free donations by the Government (MINEPDED)

The dissemination strategies employed by the government via MINEPDED are massive sensitization campaigns via the mass media, posters and door to door, emphasizing the disadvantages (social, economic and environmental) of the massive use of fuelwood and the advantages linked to the use of ICS. MINEPDED has launched campaigns such as the Operation Sahel Vert and «*champagne de sensibilisation sur les foyers ameliores*» in which free distribution of improved cook stoves (foyer ameliores de type Centrafricain) was carried out in Maroua and its environs. The dissemination varies from quarter to quarter after a pre-selection of households and CIGs has been done. The operation started in 2008 with 21, 300 ICS distributed, 1,076 in 2009, 15, 384 in 2010 and 18, 227 in 2011 giving a sum total of 67, 987 stoves distributed for the first phase of the *Operation Sahel Vert* (Table 2). The second phase started in 2012, with 57, 856 stoves disseminated between 2012 and 2016, and the process is still on-going.

The distribution of ICSs is done as shown in Figure 3.

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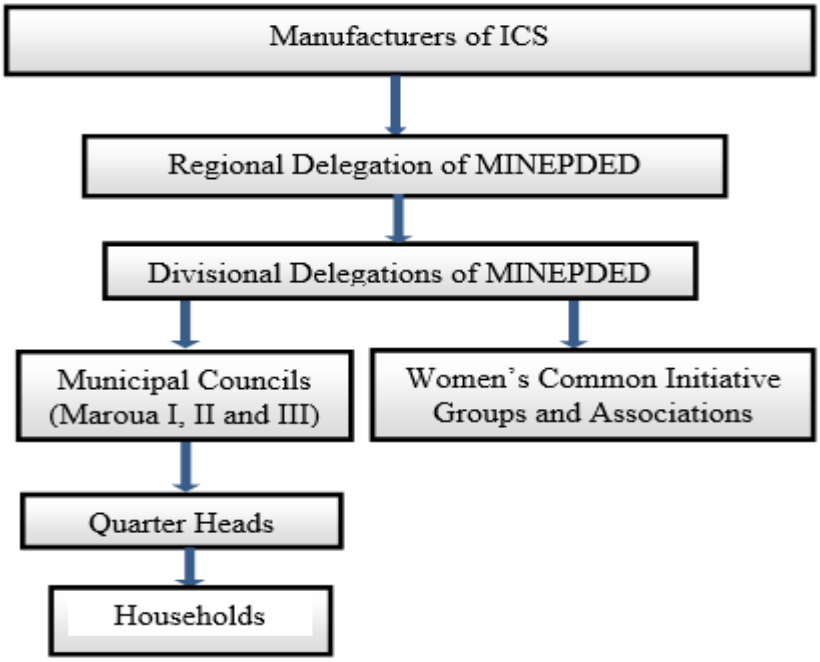

Fig.3: Dissemination circuits of ICSs technology in Maroua. Source: Culled from Tidze et al., (2016), Far North Regional and Departmental Delegations of MINEPDED for the Diamaré Division (2016) and field enquiry (December-April, 2017)

Following Figure 3, the distribution circuits of ICSs in Maroua town and its environs employed by MINEPDED goes from the manufacturers to the regional delegation of environment, which then channels to the departmental delegation. The departmental delegation then dispatches the stoves to the urban councils, common initiative groups, chiefs and quarter heads and households. Again, from the councils, the stoves go to quarter heads who then distribute the stoves to women and households. This strategy is a laudable one as it provides employment to some special interest groups in the community (women and some physically handicapped persons). On the other hand, it creates room for bribery and corruption as some of the ICS do not always reach the desired population.

Besides sensitisation, the government also carries out dissemination of ICS via free donations. A critical examination of the government's free donation of ICSs dissemination strategy reveals that free donation is not *sine qua non* of their large scale adoption and use. The responses from users who acquired the stoves via free donation reveals the following five problems associated with large scale adoption and use of the stoves (Fig. 4).

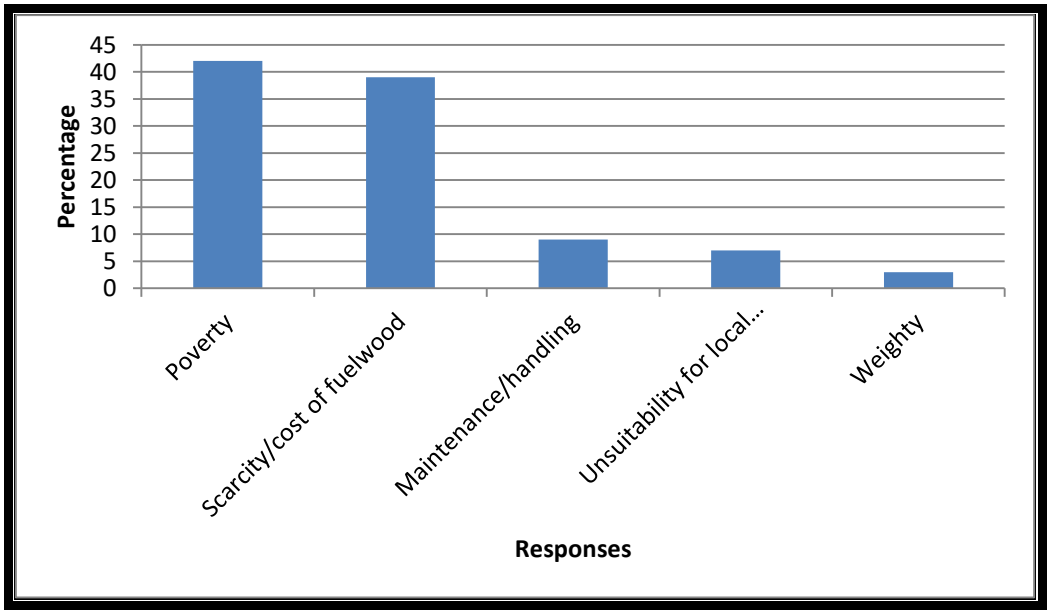

Fig. 4: Analysis of responses of problems of low adoption of ICSs despite government's free donation strategy in Maroua. Source: Field enquiry (April-May, 2017)

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From Figure 4, we realise that the majority (42%) of beneficiaries complained of poverty, impeding their continuous use the stoves despite haven received it as a free donation from the government. They have low household incomes not high enough for them to access fuelwood for the stoves continually, due to unemployment and lack of a formal training. Other 39% blamed scarcity of fuelwood as a result of unsustainable harvesting, while a meager 3% complained the stoves are weighty when filled with soil/clay in the intended location rendering it difficult to transport. The above result ties with previous studies by Lewis and Pattanayak (2011) cited in Jeuland and Pattanayak (2012) who observed that high use of improve stoves cannot be assumed even when stoves are highly subsidized or given free of charge. For example, just 45% of households in 26 villages in Peru used more efficient wood-burning stoves that were provided free of charge (Adrianzén, 2010 cited in Ibid). Other key reasons beneficiaries advanced for not using ICS despite free donation according to Jeuland and Pattanayak (2012) are problems with stove quality, the lack of expected gains in fuel efficiency, and the difficulty or changes in cooking methods that are required for successful use.

4.3.2 Interactive and interpersonal communication strategy by Friends and relatives, NGOs and CIGs

While government institutions are targeting mostly the urban milieu, NGOs such as HEIFER International and SAILD are operating in both urban and rural milieu. HEIFER International regroups women, children and men of different CIGs spiced by animation workshops (songs, images in an interactive manner between the animator and the participants). The scene portrays to the participants the consequences of deforestation and abusive cutting of trees. This paves the way for controlled cooking test (the traditional or staple meal of the people-millet or corn fufu and/or moringa, mboko okra soup prepared with meat using different pot sizes) in order to compare the possible different types of cooking stoves used in the area (the improved three stone fire place that HEIFER is encouraging, the traditional three stone fireplace, the metallic stove, the centrafricain stove, and the ceramic stove).

In addition to animation and controlled cooking test, training workshops on the construction of this improved three stone fire place are also organized by HEIFER, regrouping common initiative groups. Local and available material such as stones, cow/donkey/horse dung, ant hilled or clay like soil and water are needed for the operation in which the final product gets ready after six to seven days. HEIFER seeks to employ acceptability of its technology as they see to it that the stove is compatible with the user's needs which range from cultural needs such as specific cooking methods of traditional cuisine, taste preferences, culinary utensils, cooking location, and the art of cooking itself to individual priorities such as convenience and attractiveness of the stove. This is because for a technology (ICSs in this study) to be adopted by users, these socio-cultural needs must be taken into consideration. Traditional cooking practices with the three stone firewood stove are widely used, as they satisfy the culinary needs of households. Such fuels however have a multitude of social, health and environmental consequences attached to their production and use. It is therefore of utmost importance that society moves towards the use of more sustainable energy alternatives. Respondents attach themselves to the traditional three stone fire place for cultural reasons (76.4%). This goes to illustrate the fact that cultural practices especially cuisine and the act of cooking itself influences the choice of fuel and type of stove used by households in the region. Plate 1 illustrates the interactive and interpersonal communication strategy used in the dissemination of ICSs in Maroua and its environs.

Plate 1: Different women's groups being schooled on what ICSs are, and their social, economic and environmental advantages. This is usually followed by a practical session of improved three stone fireplace constructions and question and answer sessions after sensitization with the aid of chats. This exercise is carried out by technicians from CeTAmb in collaboration with HEIFER International.

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V. RECOMMENDATIONS AND CONCLUSION

A close examination of the dissemination circuits of ICSs in Maroua reveals that despite all efforts employed by the government, NGOs and private individuals, the uptake or adoption of ICSs by households is still very slow mainly due to poverty. Opinions of the sampled inhabitants hold that many more households are willing to adopt the innovation. This far, the use of traditional three stone fire place is still topping the list of different types of cookstoves commonly used in Maroua because the dissemination strategies employed for ICSs dissemination are not sufficient, given the enormity of problems they face. This study recommends further studies to understand the socio-cultural determinants of the adoption of ICSs and fuel choice or household energy sources, trends, practices and preferences in the area. Such considerations ultimately give insight into whether a specific technology (in this study ICSs) will be appropriate for the local needs of the intended beneficiaries, and cultural understanding of local cooking traditions. Furthermore, knowledge of such determinants will ensure for the design of ICSs which has a higher chance of user adoption and long-term sustainable use, which is important because if the health and environmental problems associated with traditional biomass consumption are to be curbed, then it is vital for proposed technologies to match and fulfill consumer culinary needs and preferences. It is further recommended that the sensitization and "practice process" of the ICSs be expanded by other actors different from the government (MINEPDED), so that they become more popular, because as people become more familiar with an innovation, they are more likely to adopt it. More so, alternative financing approach, such as carbon financing which is successful in India, should be adopted which will develop new market segments amongst unprivileged groups such as the lower income and poor populations who dominate the area ensuring large scale dissemination of the stoves. Subsidization of dissemination NGOs and even private individuals via international funding and specialized expertise from successful companies in the business notably from China, which is a success model, will enhance the dissemination process. There should equally be adequate awareness campaigns amongst the population because as of now, awareness raising and consumer education stands as a barrier to dissemination efforts. This will convince people on the benefits of the stove for them to adopt and use. Regarding the problem of limited use despite government's free donation/acquisition strategy, investment in ICSs such that private benefits greatly exceeds the costs is paramount, similar to Hutton *et al*., (2007) cited in Jeuland and Pattanayak (2012). Intensively planned/coordinated door-to-door sensitization from one quarter to another, such that the beneficiaries understand the health and other benefits from ICSs technology is equally a motivating factor (Alder, 2010). It is also primordial that beneficiaries seek alternative raw materials to fuelwood that will enable high use. The World Bank (2011) for instance, has proposed some game changers for the rapid spread of ICSs technology including small credit operations to beneficiaries and new financing mechanism from both public and private sources, all linked to climate change mitigation.

In conclusion, there is a need for an upfront, comprehensive research agenda to accompany large-scale initiatives promoting ICSs dissemination in the area. This should increase the range of perspectives, involving all major stakeholders including beneficiaries, civil society, government and the private sector. Within this research agenda, there is a clear need for quantitative assessments of effectiveness to be complemented by carefully devised and conducted qualitative and quantitative studies. These should focus on assessing factors that determine adoption and sustained use, and where appropriate, exclusive use including various dimensions of equity such as gender, socio-economic status and urban-rural location previously stipulated by Debbi *et al*., (2014).

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