



BIOGAS SECTOR STATE IN SENEGAL: A CASE STUDY OF KAFFRINE REGION

TINE PC^{1*}, NIANG CI¹, TRAORE VB^{2,3}

¹SAHARA Laboratory, Inst. of Envi. Sciences, Cheikh Anta DIOP University, Dakar,
Senegal

²Hydraulics Laboratory and Fluid Mechanics, Cheikh Anta DIOP University, Dakar, Senegal

³Geoinformation Laboratory, Polytechnic High School, Cheikh Anta DIOP University, Dakar,
Senegal

*Corresponding Author: E Mail: philoarticle@gmail.com

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ABSTRACT

In this article, it is a question of making a complete diagnosis on biogas and its use in the region of Kaffrine. Note beforehand that this study is not intended to highlight the positive points; but it rather focuses on the difficulties encountered by operators, possibly identifying the main causes. Our approach is essentially structured according to three phases: (i) the documentation phase which leads us to consult general works, scientific publications, theses, etc. on the theme: this made it possible to better orient the work and delimit the field action; (ii) the data collection phase which led us to draw up interview sheets, so stakeholders, partners and services concerned were approached and questioned: this enabled a better understanding of the biogas environment and the different interactions around him ; and (iii) the analysis phase which consisted in a content analysis of the data collected in the field: this made it possible to make a complete and rigorous inventory of the situation of biogas in relation to households in general . At the end of this study, we note that, given the information available, difficulties and disappointment are the watchwords of most households in the area.

Keywords: Biogas, Energy, Biomass, Environment, Well-being, Households

1. INTRODUCTION

Since the industrial revolution, the world's populations have depended on fossil fuels, notably oil, gas and coal. According to (OECD, 1999), this dependence will

remain sustained and energy needs will be multiplied by a factor of between 1.5 and 3 by 2050, and between 2 and 5 by 2100. Indeed, fossil fuels retain a dominant

position in meeting global energy demand. This domination is felt both on the climate and on the environment. According to (IEA, 2013), the use of fossil fuels in the energy sector is responsible for 2/3 of greenhouse gas emissions worldwide. Still according to the latter, CO₂ emissions will increase by 20% by 2035. The harmful effects of these fuels on the environment such as greenhouse gas emissions, global warming, deforestation among others have caused the search for new forms of energy (Cheneval et al., 2011), supposed to be less expensive and respectful of the environment (Riedacker, 2003). In sub-Saharan Africa, for example, energy consumption is very low compared to the rest of the world; in addition, almost 39% of the total energy consumed in this part of the world is imported (ADB, 2006). Despite this dependence on imports, a problem of accessibility to energy still arises in many households, both in urban and rural areas (Dia et al., 2009). This situation of energy deficit is a major handicap to the economic and social development of a country in general and of a region in particular (Kauffmann, 2005). (Atouk, 2013) agrees by saying that the energy deficit is an obstacle to the development of households in Africa and especially in rural areas. Energy availability and accessibility play a key role in all human activities; they are a

powerful engine of socio-economic growth, particularly in the health, agriculture and industrial sectors (Chevalier et al., 2009). Biomass, particularly woody (wood), is widely used to fill the energy deficit of households in rural Africa (Meierding, 2011). However, it is clear that the combustion of firewood has harmful effects on the health of populations, particularly that of women and children, on economic development and on local ecology (Koning et al., 1985). In short, the lack of access to so-called modern energies really affects the quality of life of individuals. Thus, collective awareness of the environmental, social and economic problems linked to the energy deficit has led to numerous research and political works on forms of energy which are less expensive and concerned with the survival of the environment (Depret et al, 2009). According to (Bauqui, 1999), these forms of energy are expected to meet the needs of more than seven billion humans in the future. Biogas, described as renewable energy, is one of those forms of energy seen as the main alternatives to energy problems. It is produced from organic, food and agricultural waste; its use corresponds to the sustainability criteria in the sense that it takes all of these parameters into account. This fuel is environmentally friendly and can be used for several purposes: heat,

electricity, natural gas and fuel (Sigo, 2014). In the context of climate change, the use of biogas is more beneficial than fossil fuels in terms of environmental pollution in terms of carbon emissions. Indeed fossil fuels have higher carbon content than gas methane (Kajib et al., 2015). In addition to being a clean fuel for cooking, heating and power generation, the residues produced by anaerobic digestion are used as excellent fertilizers for soil fertility (Preston, 2005). Because of the many advantages it provides, global biogas production is currently growing by 7.6% per year and in the future this production will be seen to increase. In China, for example, there has been a rapid increase in the use of biogas in rural areas. Biogas had become one of the most important programs in promoting the well-being of populations. Already in 2007, there would be 26.5 million biogas plants, with a total capacity of 10.5 billion m³ produced. Family biogas digesters have been found across the country (Mae-Wan Ho, 2010). The importance attached to this sector is such that Germany has, to date, an annual energy potential equivalent to 30 million tones of oil equivalent. Biogas branch turnover is expected to increase to 7.5 billion euro in 2020 and 85,000 jobs will be generated (Weiland, 2013; Semence, 2009; Sigo, 2014). Africa is not to be outdone either, 27 African countries

launched in May 2007, the initiative "Biogas for a better life" whose objective is to associate governments, private sector, civil society and international partners of the development to equip 2 million homes with digesters by 2020 (Nes and Nhete, 2007). In addition, some African countries have launched the production of biogas with methanizers as support. To this end, efficient methods have been developed to produce biogas. In Rwanda, for example, the septic tanks in prisons have been used. In order to avoid a health threat, human waste is converted into biogas, which in turn is used to power kitchen ovens; many biogas systems have been built in central prisons across the country (Lohri et al., 2014). This system has contributed to improving the living conditions of prisoners, allowing more cleanliness in the prison and its surroundings and above all the stopping of cooking with wood. In Burkina Faso, a biogas power plant installed, is supplied with waste from several industrial structures such as slaughterhouses, beverage manufacturing plants, waste collectors and independent breeders (Zafianou, 2013). According to estimates, the energy produced should participate in supplying the network of the Burkinabe National Electricity Company with initially covering 4,100 households in addition to the creation of 22 permanent

jobs (**Jeune-Afrique, 2015**). Senegal, too, is not to be outdone, because the country's ambition is to guarantee broad and reliable access to cheap energy. This is why biogas has become an alternative for public policies and for the rural world (**ESDPL, 2012**). It should be noted that the use of biogas is not new in the country, indeed almost 50% of the energy used by the management company of slaughterhouses in Senegal (MCSS) would come from the processing of sound waste biogas slaughterhouse (**Ndiaye, 2013**). The company has set up an anaerobic digestion unit to self-produce energy for its consumption; thus, each year, 800 MWh of electricity and 1,700 MWh of heat are produced and immediately reused by the slaughterhouse to power the company's industrial system (**Ndiaye, 2013**). This consumption of clean energy has enabled the company to secure its electricity supply, minimize environmental pollution, lower energy costs and bills, and therefore be more competitive. For the same concern, the national domestic biogas program (NBP-SN) initiated by the Government of Senegal in 2009, has installed biodigesters in certain localities of the country and provides for the construction of 10,000 other units across the country, on the 2015-2019 period in order to provide a clean fuel source for cooking and lighting (**Mendy,**

2015). It is also added that biogas in its quality of bioenergy, preserves the health of women in rural areas by avoiding their exposure to smoke and relieving them of their exhausting chores of collecting wood, dung of cow etc. In addition, the digestate used as a fertilizer system in crops reduces the use of chemical fertilizers as well as the risks of food poisoning and public health problems (**Ba et al., 2016**). Ultimately, the energy program for domestic use as advocated by the NBP-SN aims to impact on the health and well-being of households. Thus, the use of the biodigester proves to be an essential element for the well-being of populations in the sense that it participates not only in the fight against pollution-related diseases such as respiratory diseases and cancers, but also it considerably reduces energy expenditure in families and helps protect the ecological environment (**Diop et al., 2015; Beline et al., 2013; FAO, 2014**). However, despite the spread of biodigester across the territory, many of them have broken down and / or do not fulfill the assigned functions: socio-sanitary, economic, energy production, production of biological fertilizer, protection ecological etc within households (**Niang, 2016**). Regarding the Kaffrine area, out of 65 biodigesters delivered, only 03 are in operation (**NBP-SN, 2016**). This is what largely explains the use of wood by the

rural population for their energy needs. The choice of the Kaffrine region is not accidental; it meets a practical criterion: this region was one of the pioneers in the installation of the first biodigesters in Senegal. According to (FSSP/loumakaf, 2016), 3/4 of these machines installed in this area have broken down and no longer work. This observation prompted us to visit the region to highlight the current situation of biodigesters and understand the real reasons for this dysfunction.

2. METHOD

2. 1. Study area

Kaffrine was erected in the region following administrative reforms in 2008. It is located between

14 °07 north latitude and 15 ° 32 west longitude, and covers an area of 11,181 km², or 5.6% of the national territory. The Kaffrine region is bounded in the North by the Diourbel and Louga regions, in the East by the Tambacounda region, in the South by the Republic of The Gambia, in the West by the Kaolack region (**Figure 1**) (NASD, 2015). Its population is estimated at around 609,631 inhabitants, of which 49.8% men and 50.2% women, in 2015, with a density of 54.5 inhabitants / km² compared to 70.8 inhabitants / km², at the national level . The department of Kaffrine has the highest population density, followed by Kounghoul, then Birkelane and Malem Hodar. The

population under 15 represents 48.8% while those under 25 constitute 66.7% (NASD, 2018). From an ethnic point of view, the region is mainly made up of Wolof, followed by far, Pulaar and Serere and then Bambara, etc. From the point of administrative organization, the region is subdivided into four (4) departments, nine (9) boroughs five municipalities (5) and twenty-eight (28) rural communities (NASD, 2018). Regarding urbanization, the low proportion of city dwellers makes the region one of the least urbanized in the country, i.e. 15.1% of urbanization rate mainly concentrated in the departments of **Kaffrine and Kounghoul (KRC, 2014)**. Malem Hodar is the most rural department in the region. The region's economy is based mainly on agriculture (mobilizing 75% of the population), animal husbandry, logging, trade, crafts, women's entrepreneurship and land transport. However, according to the latter, Kaffrine is one of the poorest regions of Senegal with a very high poverty rate (63.8%) compared to the national level (46.7%). Kaffrine is also one of the regions least equipped with quality basic social services (250/500) (EMC, 2015). The health sector is marked by a low geographic access rate (45%). In 2013, the region had 1 doctor per 55,000 inhabitants, while the WHO standard is 1 doctor per 10,000 inhabitants (NASD,

2015). As regards the climate, the region is of the Sudano-Sahelian type with a rainy season generally going from June to October and a dry season covering the period from November to May; the maximum rainfall is in the months of August to September (EMC, 2014). In the region, annual rainfall amounts are currently between 400 and 860 mm in places. As far as winds are concerned, the region is characterized by: (i) the continental or harmattan trade wind, a warm and dry east wind which generally blows from February to May and (ii) the monsoon, south-west wind, hot and humid whose arrival announces the start of the rainy season (May-June). As for temperatures, they are generally high and range between 26 and 39 ° C with an average of 29 ° C. The average duration of sunshine is 11 hours. The lowest temperatures are recorded between December and January and the highest between March and May (EMC, 2009). From a topographic point of view, the region has a relief consisting of a plateau as a whole and has a slight slope from north to south. On the soil level, we find in the region three types of soils: (i) tropical ferruginous soils (with variants) exploited for the cultivation of groundnuts and millet. They are sandy to sandy clay with good agricultural skills; (ii) the hydromorphic

soils characterizing the shallows and the rivers are somewhat dispersed in the region with a generally clay texture. They are called "deck" with variants "deck-dior"; (iii) halomorphic soils, characteristic of salty or tannic environments, are found mainly in the departments of Birkelane and Kaffrine (KRC, 2013). From a vegetation point of view, there is a shrub savannah to the north, characterized by an ecosystem gathering forest species typical of the Sahelian zone; and a savannah with trees to the south, which has a more varied floristic composition (NASD, 2018). In addition, the Kaffrine region has 11 classified forests and two silvopastoral reserves with an area of 241,850 hectares. However, the current state of forest resources is deteriorating as a result of the combined effect of natural (drought, wind and water erosion, salinization of water and soil, etc.) and anthropogenic (land clearing, bush fires, etc.) factors (EMC, 2009). From a hydrographic point of view, the network is characterized by two main watercourses, which are: (i) the northern extension of the saloum, a perennial salt watercourse which extends over part of the department of Birkelane; (ii) the Baobolong, a defluent from the Gambia River, which dries up in its downstream part in the middle of the dry season. Mild in the rainy season, the waters become brackish to salty in the dry season

(NASD, 2015). Regarding energy needs, especially domestic, a good part of the population uses firewood and charcoal. In fact, according to this latter, nine out of ten households in the region use wood compared to five out of ten for the national level. At the same time, only 5.7% of households use coal as fuel, while the national average is 14.8%. It is to fight against these practices which are sources of deforestation that the state is embarking on logic of diversification and substitution of fuels through an alternative solution consisting in developing and disseminating bio-digesters throughout the territory regional as well as energy production, from biomass among others (NASD, 2018). It is in these particular contexts that this study takes place. Our job is to extract the information necessary for a more in-depth reflection on the issue that can lead to very effective decision-making tools.

2. 2. Biogas production process

Biogas is a source of energy that comes from the decomposition of organic matter in the absence of oxygen. Rather, it is described as the transformation of organic substances into a combustible gas called biogas and a solid residue, more or less depleted in organic matter. Biogas is formed from a variety of anaerobic microorganisms. Microbes feed on

carbohydrates and fats, and produce methane and carbon dioxide by fermentation called methanization. It is a mechanism for decomposing perishable materials by fermentation bacteria to generate renewable energy. Indeed, the process of decomposition of organic matter and the formation of biogas is subdivided into four stages: (i) hydrolysis corresponding to the moment when complex organic matter is disintegrated into simple molecules, lipids are transformed into fatty acids, proteins in amino acids, nucleic acids in nitrogen bases and polysaccharides in monosaccharides; (ii) acidogenesis corresponding to the time of fermentation of the oligomers into volatile fatty acids, this is a relatively short step and gives fermented products; (iii) acetogenesis with which products transformed by acetogenic bacteria are obtained, that is to say fermenters into carbon dioxide and hydrogen; and (iv) methanogens corresponding to the moment when the products resulting from acetogenesis are converted into methane by the methanogens; the whole thus leading to the formation of biogas and also of digestate shown diagrammatically in Fig. 2. The device enabling this production is called a biodigester schematized in Fig. 3.

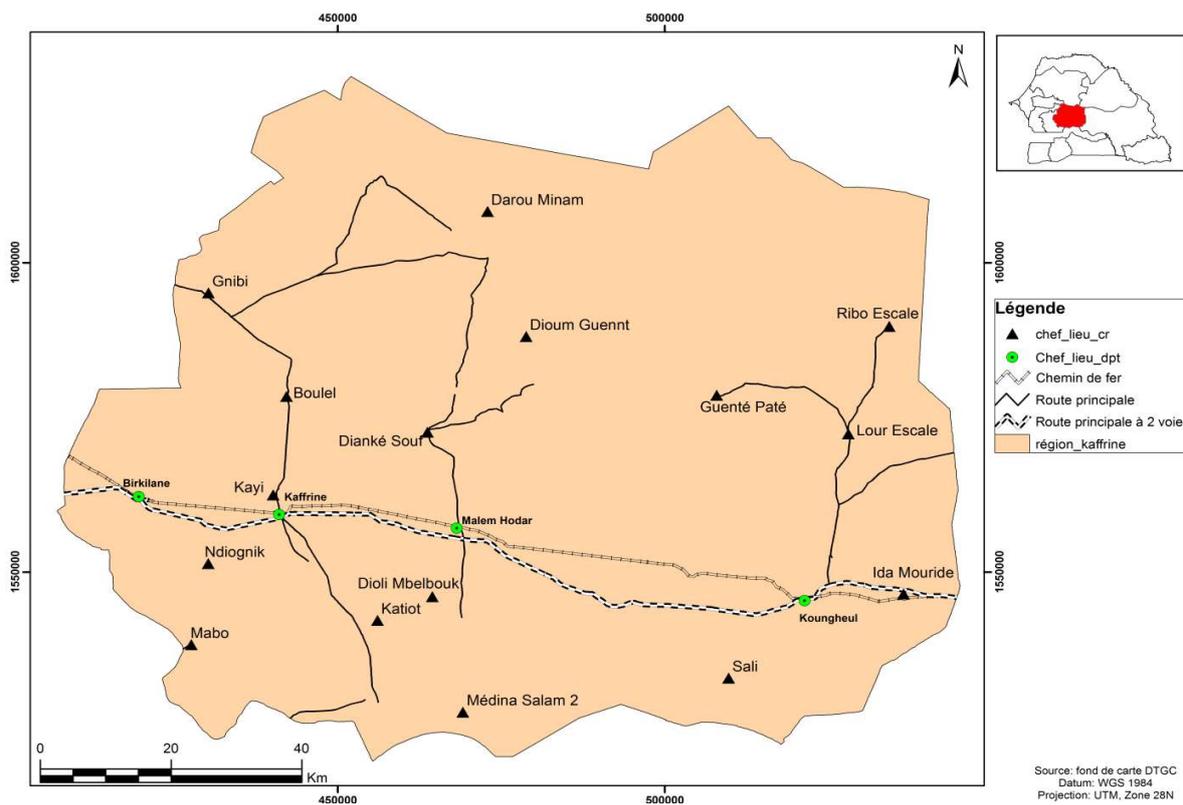


Figure 1: Location of Kaffrine region

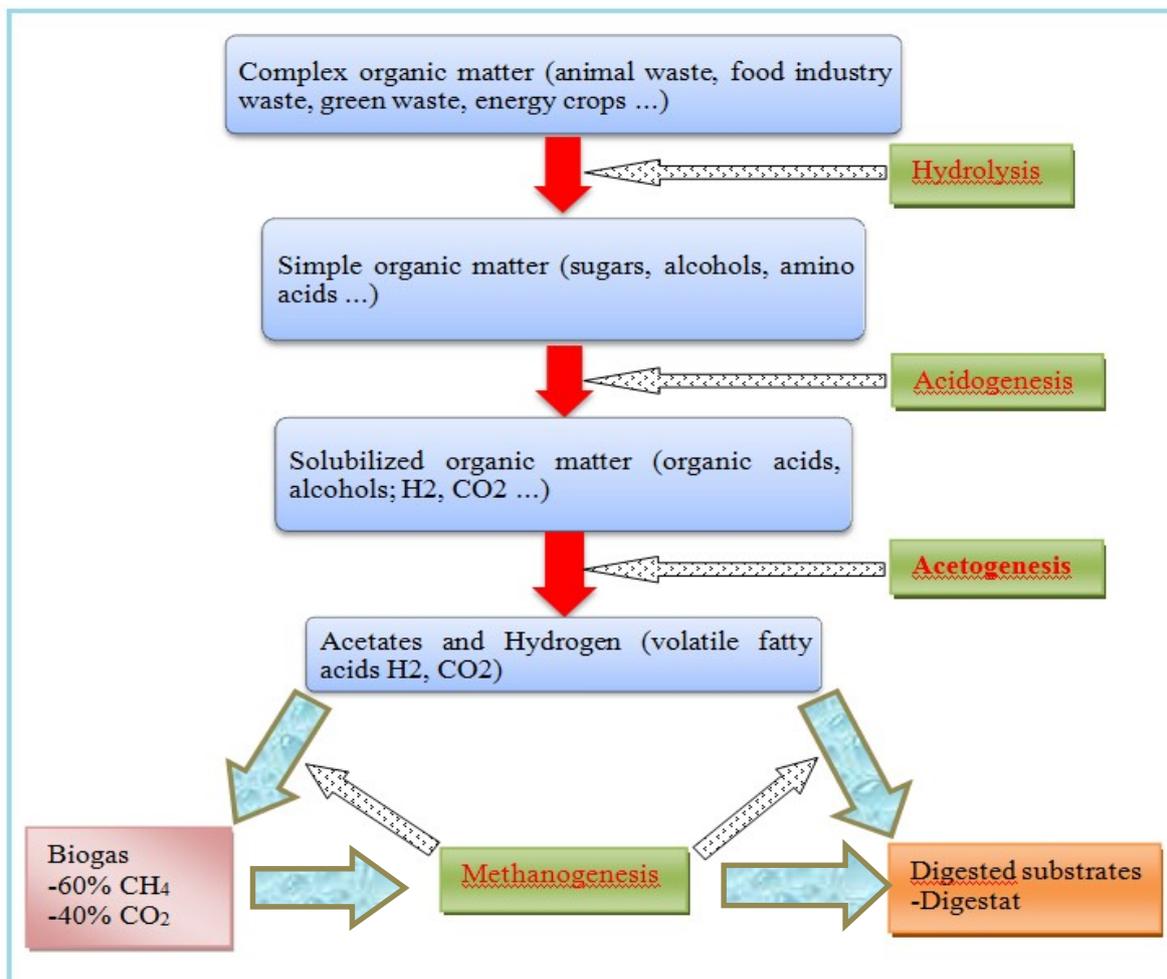


Figure 2: Principle of biogas manufacturing (adapted of Kibogo, 2013)

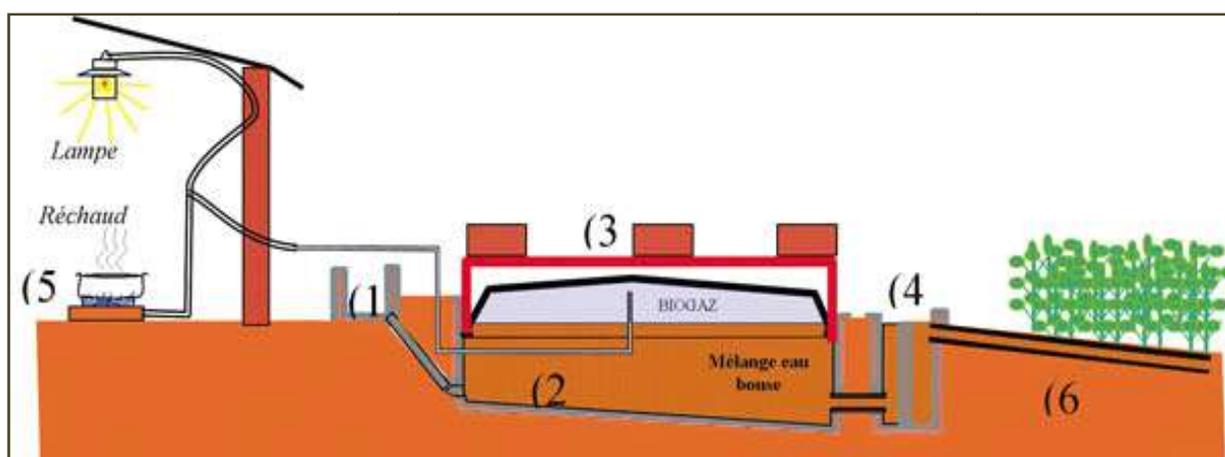


Figure 3: Simplified section of a biogas digester (Wikipedia)

1: dung receiver; 2: dung mixture; 3: biogas; 4: digestate receptor; 5: lamp and stove; 6: organic garden

2. 3. Work elaboration

The methodological approach that is adopted in the development of this work, is essentially structured according to three main phases: a documentation phase, a data collection phase and an analysis phase. The documentation phase consisted of a general review of scientific production on biogas to better orient the work, identify the concepts but also their limits of application. To this end, the most suitable general works, scientific publications, theses, dissertations and reports have been consulted. This made it possible to make a first reading, to appreciate the different contours given to the concept of biogas and to develop an operating framework to inform our work. The data collection phase consisted of a quantitative and a qualitative study. Before doing the actual fieldwork, we previously conducted an ethnographic study allowing a better understanding of the biogas environment and the different interactions around it. It appears that the qualitative

analysis was particularly more suited to this theme. Qualitative analysis rather has a subjective approach insofar as it leads directly to the interpretation, reformulation and the theorization of the phenomenon experienced or observed rather than measurement (Mucchiel Alex, 2012). (Mucchiel, 2012) agrees by saying that such a procedure is a discursive and signifying process of reformulation, explanation or theorization of a testimony, an experience or a phenomenon. So to conduct this study, we presented a specific arrangement of data collection and analysis techniques, suitable for solving the problem posed: it is observation, taking photos, interviews (formal and informal), focus groups and group discussions. For the analysis of the information collected, we used content analysis, a method par excellence based on the explanation of the text, which would be the most suitable for qualitatively analyzing this information (Boudon et al., 1982).

2.4. Fieldwork

This is the active stage of the study. It corresponds to a descent on the ground with a view to putting into practice the techniques and options previously challenged. It should normally result in the collection of the information sought. This study is taking place in the Kaffrine region, which is one of the regions selected by the authorities to promote the use of biogas. During the field process, all the actors having any link with biogas were interviewed: the NBP-SN partners, the decentralized state services (health, environment, livestock, water and forests). Thus all the persons likely to provide us with information were questioned. What is important to remember, however, is that the recruitment of the study population was mainly done taking into account the dissemination of the said region. We performed simple random sampling. In addition to being simple and commonly used, this process allows each member of a population to have the chance of being included in the sample. To do this, auxiliary data such as the databases provided by NBP-SN on the holders of the biodigester in the locality were used before selecting the persons to be surveyed. However, the remoteness and isolation of certain villages in the Kaffrine region may justify the remoteness of the locations of biodigesters in the region. Also it must be said that with

the conditions to be fulfilled by families for obtaining these tools, there are not many biodigesters in the same village; in most cases there are at most two. Given the difficulty of meeting and visiting biodigesters during field surveys, the principle of data saturation was applied, which allowed us to stop the surveys for lack of new information. This is how we interviewed families with biodigesters. The exploratory survey took place in November 2016 as for the survey itself, it was carried out in January 2017 which allowed us to collect important information.

3. RESULTS AND DISCUSSION

It is important to clarify that this study was not intended to highlight the positive points. Rather, the analysis focuses on the difficulties encountered, possibly identifying the main causes. The study demonstrated the value of analyzing and capitalizing on the hazards encountered by families: in fact, 89% families holding biodigesters declare having encountered multiform difficulties and 95% of the women interviewed declare having had enormous disappointment and have resumed their old habits (search for wood, a return from transhumance, purchase of energy).

✓ technical and operational difficulties

National NBP policy was lacking in training local biodigester technicians to

respond to a possible tool failure. There was therefore not sufficient and qualified staff to monitor biodigesters. In addition, the spare parts required in the event of a breakdown and compatible with biodigester technology are almost non-existent on the local market. According to the holders, certain parts necessary for the functioning of the biodigester, must be imported from the outside. Also add that the number of masons has been insufficient and therefore does not fully meet the demand for construction contractors in biodigesters in some localities in the region.

✓ **difficulties related to the effective non-involvement of partners (state services, IP, EIG and associations)**

In order to anticipate problems and provide appropriate responses, the NBP-SN must work with its partners in a forward-looking and constructive approach. The partners are too often neglected when they are essential allies for the smooth running of the project. These partners have several prerogatives including facilitating and publicizing or simply developing the program. According to (Niang, 2017), this has still not been the case since discomfort has been raised between implementation partners (IP), construction company, and state services. If all the actors of the project are involved in an optimal way, surely the NBP-SN would

be more likely to succeed in certain localities.

✓ **difficulties linked to the shortage of NBP staff and the inaccessibility of certain areas**

Biodigesters are scattered very far from each other. The inaccessibility of certain areas is already a big problem. Added to this is the shortage of NBP-SN implementing agents throughout the national territory in general, undermining certain program activities (delay in setting up and repairing biodigester). This situation led the NBP to sign a partnership with implementation partners (IP) who already have their personal specifications to honor and privilege their activities. This is not without consequences for the NBP since it delays the execution of the defined objectives. Faced with this situation of lack of technicians on the job, people no longer know who to contact in the event of a breakdown or a request for the installation of a biodigester. To deal with this kind of situation, it would be necessary for the NBP-SN to set up local committees (supervision, monitoring and advice) to manage the biodigester.

✓ **difficulties in stopping the project**

At the end of the pilot phase in December 2013, the State of Senegal decided to evaluate the results obtained during the commissioning of the biodigesters built. It is 2014 which is thus considered to be a

year of transition, evaluation, feasibility of a new program and search for new partners in view of the possible continuation of the project. It was in this context that a slowdown in the activities of the NBP was observed, not to say stopped.

✓ **difficulties linked to the inadequacy of social realities and an under-involvement of the population in the program**

In general, several reasons are often cited to justify the failure of development projects. For (Kessy, 1998), the failures of rural development policies are correlated with the failure of “top-down” development policies and strategies. These frequently stated projects are designed and implemented without the involvement of the beneficiaries. Often, project designers think in the place of their beneficiaries. To this end, the lack of participation and involvement of the beneficiary populations in the design and management of projects are unfavorable factors for the sustainability of the achievements. This conception is shared by (Ouédraogo, 1992), who evokes several causes of project failure. He first notes the aid programs which are characterized by the fact that donors and implementing agencies rush to bring what he has called "a turnkey project" consisting of rigid interventions designed from the outside and unsuited to local socio-economic conditions and the real needs of

the populations and, moreover, to cultural realities. In addition, it also notes the setting up of executive agencies having their decision-making centers outside the intervention environment; which delays the sharing of knowledge and information and provides an ineffective framework encouraged by opinions which are not relevant because of the ignorance that we have about the people and the ignorance of the field or environment etc. This is why the non-involvement of the populations encourages them to organize themselves only for the sole purpose of benefiting from the financing of projects without great conviction and which is in most cases conditioned by a coercive approach to government policies.

✓ **difficulties linked to the inadequacy of cooking to cultural realities**

✚ **Population's reluctance to change habits**

Generally speaking, the force of habit, resistance to change and technological innovation remains the major obstacle to the effective establishment of gas. This necessarily leads to a new type of behavior and the adoption of a new mentality among users who find it difficult to believe in it more generally, the change seems to be perceived by the individual as a loss of meaning for the subject who has lived in a sustainable world organizational and asked

to adopt other practices, norms and behaviors from another social world. One reason for the limitation of the penetration of gas is also due to the fear which is more or less justified linked to the risks of explosions, of fire in the minds of households, which make them require information campaigns and training with populations.

✦ **construction of a hard kitchen**

In rural areas, housing is mainly built in mud and the roofs are mainly made of straw or thatch (NASD, 2014). This is why the construction of a hard kitchen is in some cases an obstacle to obtaining a biodigester. In the Senegalese tradition it is very rare to find hard food; the few that can be there have their roofs made up of tree trunks and straw. To avoid fires due to the fact that methane is a very explosive gas, the NBP refuses that its elements are present in hard kitchens. These resources are generally available and are taken free of charge from the local forest formations, while the construction of the hard kitchen requires unusual expenditure within households. Hard cooking is seen by some households as a luxury. In (Niang, 2017), R.S declares on this subject "I don't find it logical to have a hard kitchen, when my bedroom is in straw".

✦ **insufficient gas and cooking time**

During this study, several households in the sites visited complained a lot about the

insufficient gas for cooking, which forced them to use biomass to reduce the deficit. This insufficiency is largely due to the size of families in Senegal in general and in rural areas in particular (polygamy, relationship), which makes it difficult to facilitate the cooking of women. To this must be added the socially designed cooking time (cooking that lasts and flexible) and practiced (sitting, standing, squatting cooking) should not and cannot in any way be correlated with so-called "modern" cooking. According to (Women cooks, 2017), the idea that gas cooks rice less well and gives it a taste not always appreciated and above all, adopted for bland reasons, is strongly rooted in cooks according to whom "a good tiéboudiene must be cooked with charcoal ". It is this ideology that makes households use wood for cooking, especially in rural areas (Figure 4).

✦ **non-mastery of the biodigester technology by the beneficiaries**

Transferring skills requires enough time and tact. Unfortunately, the feeling most shared among the beneficiaries of the biodigester is the haste in the execution and monitoring of the project. User training time is largely insufficient to allow a better understanding of the tool. Even if efforts are made for simulations in the field to strengthen the understanding of the participants, they are very rare. We then witness a favoritism of

the conditions for implementing activities to the detriment of the capacity of the communities to assume their responsibilities. Neglecting to capitalize on knowledge very often constitutes the cause of under-optimization of development projects.

✓ **safety and hygiene difficulties**

Safety is a fundamental element to take into account when installing the biodigester. According to NBP agents, the risk of a biogas explosion is minimal, but if it does, it becomes spectacular. The design of the facilities is very important, in that it

conditions the safety of maintenance work. Also the open pits (not covered) intended for the recovery of the digestate can cause in our eyes, not only safety problems but also hygiene with the proliferation of insects, flies and the emanation of odor (**Figure 5**). Although biological waste management (for example anaerobic digestion of waste) represents an alternative solution to the incineration of solid waste in the open air, the fact remains that the safety and well-being of populations and their fundamentals to worry about.



Figure 4: Back to the wood



Figure 5: Pit with uncovered digestate

✓ **Difficulties linked to the particularly heavy work of the biodigester**

First, some populations reported having experienced too much pain in installing their biodigesters. Indeed, the construction of the pits requires a lot of physical effort and manpower available if one does not have what to pay (southern zone). Then the large amount of dung required during the first filling, also requires a lot of physical effort. Indeed, the households of Kaffrine mentioned this difficulty experienced during the first filling of the biodigester. This is due to the heaviness of the dung which must imperatively remain wet and is often picked up quite far from the concessions. N.W, a local resident, said: "My family complains during the filling because it is very difficult. Nobody is helping me today so I did it on my own. Some people's biodigesters don't work because people don't put the effort into making it work; they are lazy to get the job done. Anyone who tells you that the biodigester has no job, you have to, the job is really difficult. «These cumulative constraints added to the repetitive technical breakdowns favored the total stopping of the functioning of the biodigesters in the area.

4. CONCLUSION AND RECOMMENDATION

This article was written as part of a doctoral thesis in environmental science on the

effects of the use of biogas energy in Senegalese families: multi-site case study of the regions of St-Louis, Louga, Fatick, Kaolack, Kaffrine, Kolda and Ziguinchor, herself is included in a study submitted by NBP-SN to the Dakar Institute of Environmental Sciences whose general objective was to make a global study and complements the constraints relating to the acceptability of the bio-digester by certain Senegalese households. This article also aims to shed light on the state of the biogas sector in the Kaffrine region. To achieve this objective, we have adopted a methodological approach divided into three components: a component relating to the delimitation and orientation of work, a qualitative component consisting of conducting interviews with populations and specialized structures in search of information and finally a section related to the content analysis of field data. At the end of the study, convincing and revealing results were highlighted. Globally, many difficulties arise which are technical, operational, administrative, socio-cultural and environmental, among others. However, it is not only for us to flaunt the difficulties but also to give the authorities a basis for reflection and solid arguments in the reformulation of their policy for starting up projects relating to the biogas sector. With ambitious political will, the findings of this study should serve as an aid to

decision-making. We believe that some recommendations are necessary to overcome certain difficulties encountered: (i) the NBP must first win the battle linked to technical and operational difficulties, it will be a question of seeking qualified and sufficient personnel so that they can help beneficiaries with perfect mastery of the tool; (ii) the NBP must work with all of its partners and involve them constructively in the implementation of the project; (iii) the administrative and request for support

procedures must be shorter and less complex; (iv) the NBP must take into account socio-cultural and environmental realities of the environments in which biodigesters are established. However, we would like to point out that, like all scientific work, there are shortcomings. This work is only based on the qualitative approach we think that it would be even more relevant in the future to combine the quantitative method and why not spatial in order to better map the problems.

NOTATION

ADB	African Development Bank
EIG	Economic Interest Group
EMC	Ecological Monitoring Center
ESDPL	Energy Sector Development Policy Letter
FAO	Food and Agricultural Organization
FSSP/loumakaf	Food Security Support Project in the Louga, Matam and Kaffrine Regions
IEA	International Energy Agency
IP	Implementation Partner
KLSRI	Kaolack Livestock Service Regional Inspection
KRC	Kaffrine Regional Council
MCSS	management company of slaughterhouses in Senegal
NASD	National Agency for Statistics and Demography
NBP-KRA	National Biogas Program - Kaolack Regional Antenna
NBP-SN	National Biogas Program-Sénégal
OECD	Organisation for Economic Co-operation and Development
RDI	Rural Development Institute
WHO	World Health Organization

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