Electrical Energy Consumption In Agri-Food Establishments In West Cameroon

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Abstract

In the West Cameroon region, agri-food establishments: bakeries, fishmongers and restaurants contribute to three quarters (3/4) of employment in the towns, turnover and added value of regional businesses. These are also the sectors that consume the most electrical energy; between them, these establishments account for more than 50% of the electrical energy consumption in the entire Western region of the country. For six months, we conducted the study in (5the) major towns of West Cameroon chosen at random (Mifi, Menoua, Bamboutos, Nde and Haut-Nkam). Field observations of recurrent power cuts and surveys of local policy makers were also conducted on the supply of electricity, which remains problematic throughout the country. Our results show that the average electricity consumption per establishment is particularly high in bakeries, at around 1441.67 KWh, compared to 1295.45 KWh for fishmongers and 371.21 KWh for restaurants. Electricity is mainly used as a driving force for thermodynamic purposes (cold rooms, deep-freezing and air-conditioning of engines in bakeries, etc.). On the other hand, it should be noted that this sector of activity faces enormous difficulties, including the inadequacy of electrical energy in terms of supply, access and quality. The electricity supplied by The Energy of Cameroon (Eneo) is still very inadequate given the high demand. It is precarious and characterised by untimely power cuts. In fact, the average power cut in the cities studied is 24 days and 20 minutes, for a period of six months. We have come to the effective conclusion that recurrent power cuts are the result of a poor electricity supply and have a significant impact on the agri-food activity, due to their dependence on this source of energy. All these problems in West Cameroon indicate that energy demand will have to increase considerably in the coming years due to population growth (+7.8%) and socio-economic development. Therefore, we believe that policy makers should turn to renewable energies which are natural energy sources such as solar and wind power. In addition, local elected officials should think about building more mini hydroelectric dams in villages to reinforce urban areas with electrical energy.

Keywords: Consumption, Electrical energy, Agro-food Company, West Cameroon

Introduction

Agri-food establishments are among the largest consumers of energy in Cameroonian cities. Thus, Cameroon, like other sub-Saharan African countries, faces a serious problem of access to basic energy services. Access to electricity has become essential to everyday life and is a key component of business competitiveness. It is therefore obvious that no economic development is conceivable without electrical energy that is available and accessible in quantity and quality. However, despite the many efforts made by politicians, the electricity deficit, estimated at 320 GWh in 2001 (Nkue and Njomo, 2009), is currently around 50 GWh. This deficit, marked by frequent and sometimes prolonged power cuts, disrupts economic life and growth. This situation weakens the level of establishment and productivity of small and medium-sized enterprises in the production, processing and marketing of basic products in the country, particularly in West Cameroon where we conducted our study.

The electricity sector in Cameroon is a sector in constant evolution. The demand for electricity is growing year after year. Today, despite the joint efforts of the public authorities and those responsible for the production and distribution of electricity in Cameroon, the demand for electricity is far from being completely satisfied. The West Cameroon region is currently facing an unprecedented energy crisis, suffering from insufficient and unreliable electricity resources. Productivity, competitiveness of agribusinesses, but also economic activity as a whole and growth are paying a heavy price. Electricity is a basic necessity whose access in Cameroon is recognised as a right. It has become indispensable to everyday life and is an essential component of Cameroon's development (Adolphe Moukengue Imano; 2015). The agri-food industry occupies an important place in the economy of Cameroon in general and West Cameroon in particular. However, the expected growth of the agri-food industry is likely to be hampered by difficulties in accessing quality energy at a competitive price.

Our objective is to show that the deficit in electrical energy has a negative impact on the productivity of agri-food establishments in West Cameroon. As a hypothesis: The deficit in electrical energy has a negative impact on the productivity of agri-food establishments in West Cameroon. In other words, the degradation

of the quality of electricity supply and the poor results of the company in charge of the production, transport and distribution of electrical energy in a context of economic moroseness. Load shedding has a negative impact on the performance of agri-food establishments.

Research Methodology

In order to carry out our research and to obtain reliable data, we opted for the hypothetic-deductive method, which is a popular approach in the social sciences because of its effectiveness. It consists of making hypotheses after observation and in-depth research on a particular phenomenon and then verifying these hypotheses in the field using survey techniques, in order to draw conclusions. We proceeded by consulting existing data through exploratory readings and exploratory investigation. We then carried out the actual fieldwork phase. The data collected is processed using computer tools, word processing and statistical processing software.

Location of the study area: The Western Region is one of the 10 regions of Cameroon. It is located between latitude 5°30'0 N and longitude 10°40'0 E. It borders five Cameroonian regions, and consists of 8 departments covering an area of 13,892 km^2. Its population was estimated in 2005 at 1,720,047 inhabitants with a density of 124 inhabitants/km^2, making it one of the most densely populated regions in the country. Its equatorial Cameroonian climate has two main seasons, a dry season and a rainy season. Temperatures range from 11°C to 30°C, with an average temperature of 22°C.

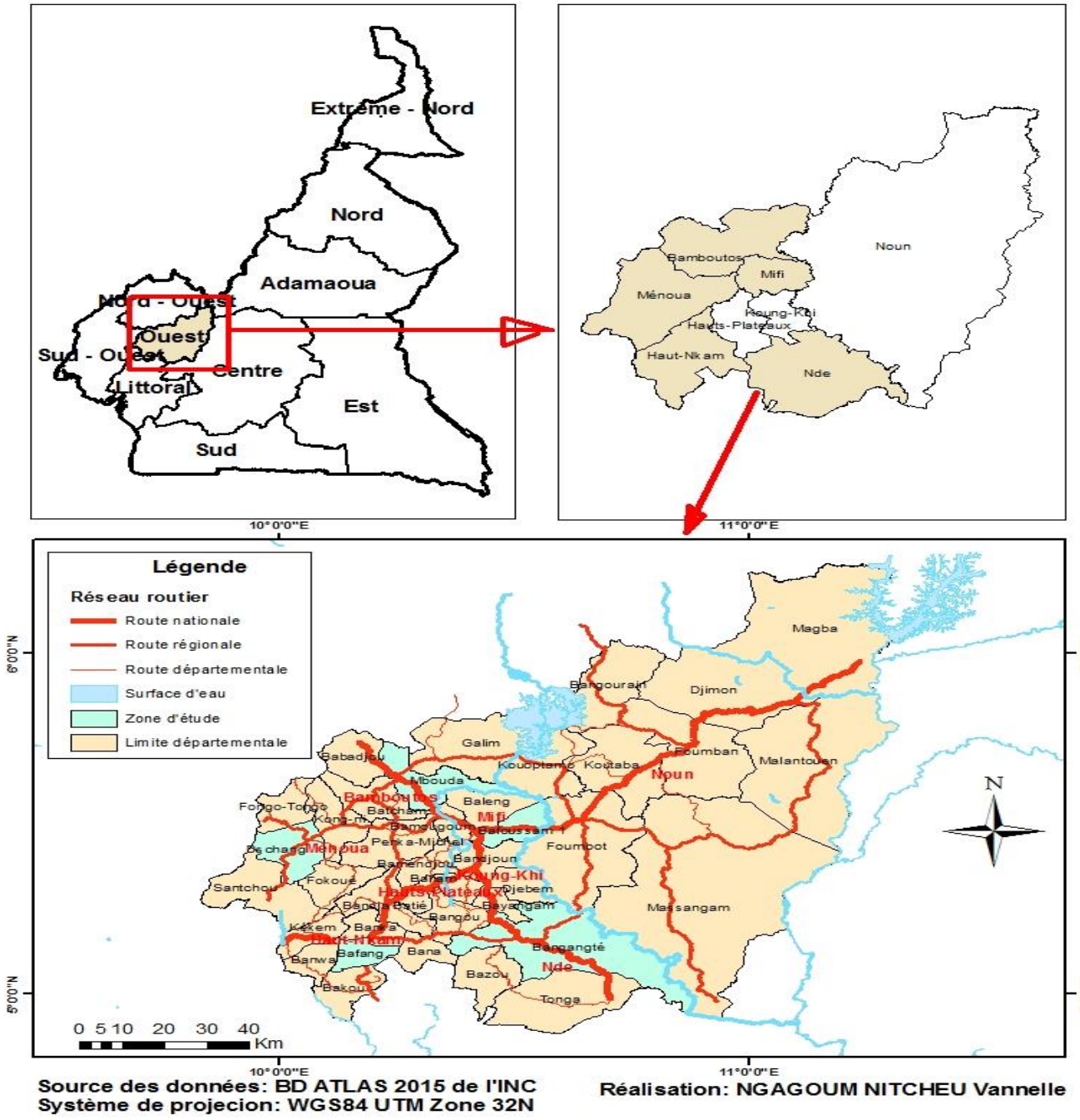


Figure 1 Location of the study area

In relation to the collection of qualitative data, we have used several ways and means to gather the information necessary for the completion of our work. The first is documentary research. This is the existing data, which is essential for our study. This research allowed us to consult general and methodological books, journals, articles, theses, dissertations, etc., that deal with the subject of electricity consumption in agri-food establishments. We found some of these documents in various libraries and archives of public and parapublic services, in particular the library of CERETH (Research Center in the Wester Highland), that of the Faculty of Arts and Humanities and internet sources. The observations enabled us to gather information on the times of electricity cuts in the West Cameroon region, to get to know these establishments, their daily habits and their problems thanks to the observation of the course of their activities and their mode of operation during load shedding. Thus, we developed an observation grid that enabled us to list the different appliances used in the target agri-food establishments and the times of power cuts. It enabled us to formulate our various working hypotheses.
Our sampling method is objective, representative of the population and corresponds to our study criteria, which include a diverse population. Due to financial and time constraints, and in order to reach the target establishments, we established selection criteria, namely: modernity, type of activities carried out and speciality. Thus, the 85 establishments chosen are representative of the entire study population. Our target population consists exclusively of bakeries, restaurants and fish shops in the Western region.

The questionnaires are submitted in five departmental capitals of the West Cameroon region, namely: Bafoussam, Dschang, Mbouda, Bangangté and Bafang. It consists of collecting specific technical information from agri-food establishments and surveying their knowledge, interest and opinion regarding electricity consumption and renewable energy. This information was collected during the period from 1er December 2020 to 31 May 2021. The advantage of this method is that it allowed us to collect a large amount of information from a number of establishments at a low cost and with reliability.

The spatial distribution of these different survey locations was done in such a way as to interview different individuals for better representativeness and relevance of the data collected.

Results and Discussions

The electric power sector in Cameroon has undergone many changes since 1929, with the various changes in its electric power production and distribution companies. Indeed, the electricity distribution monopoly has changed four times in the last seventy years, from Cameroon electric power (1948) to ENEO-Cameroon (2014). Since 1929, four power plants have been set up, including Edéa (276 MW), Song loulou (384 MW), Lagdo (72 MW) and Memve'ele (211MW). The electric power distribution company has undergone changes, namely: from ENELCAM to SONEL following reunification; from SONEL to AES-SONEL following the privatisation of electric power with the objective of increasing service with particular emphasis on rural areas; and finally from AES-SONEL to ENEO following the Cameroonian state's desire to improve the electricity sector and open it up to competition. The main players in the sector are: 1° Energy of Cameroon S.A. (ENEO-CAMEROON S.A.): manages the production of up to 1000 MW and the distribution of electricity in Cameroon. 2°The Electricity Sector Regulatory Agency (ARSEL): ensures the regulation, control and monitoring of the activities of operators in the electricity sector. 3°The National Company for the Transport of Electrical Energy (SONATREL): responsible for managing the transport of electrical energy and the transport network on behalf of the State.

Electricity consumption in agri-food establishments

The consumption of electrical energy in agri-food establishments varies from 500kwh to over 3000kwh as shown in the following figure.

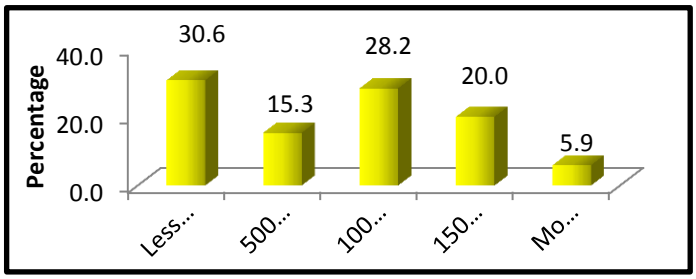


Figure 2: Monthly consumption of kWh

As shown in the figure above, 30.6 agri-food establishments consume less than 500 kWh per month, 15.3% consume 500-1000 kWh; 28.2% consume 1000-1500 kWh; 20% consume 1500-3000 kWh and 5.9% consume more than 3000 kWh per month. This consumption varies according to the opening period of the establishment, the number of appliances and their installation power.

In reality, this consumption varies from one establishment to another. Indeed, the average electricity consumption per establishment is particularly high in bakeries with an average of 1441.67 KWh compared to 1295.45 KWh for fishmongers and 371.21 KWh for restaurants as shown in the figure below.

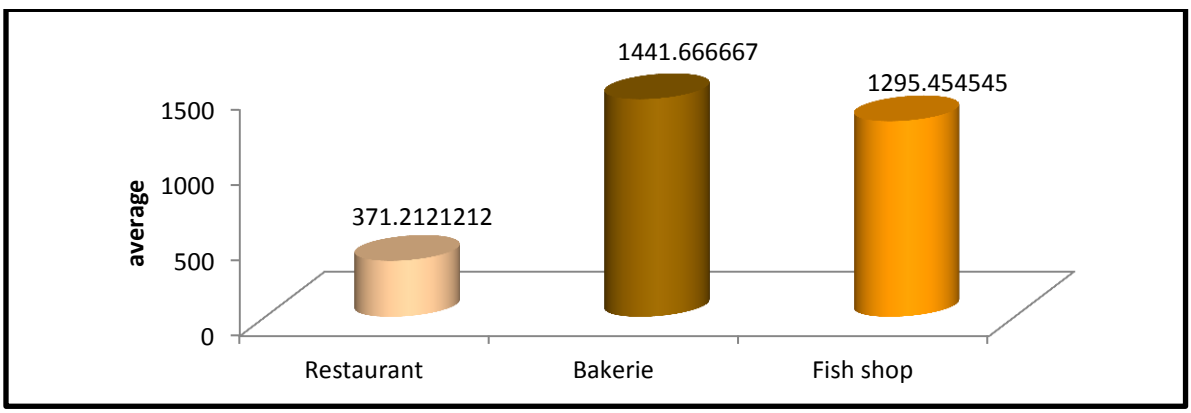


Figure 3: Average electricity consumption by type of establishment

The study conducted by Christophe CHOIMET on the analysis of energy consumption in the bakery sector in France in 2014 showed that electric bread ovens used in bakeries are responsible for half of the total electricity bill. This is because this equipment requires a lot of electrical energy to operate. The average consumption of bread ovens used in bakeries is 74300KWH per year.

Power cuts in the West

Electricity is used above all as a propelling force for thermodynamic use (cold rooms, deep-freezing and air-conditioning of engines in bakeries, etc.). Furthermore, it should be noted that this sector of activity encounters enormous difficulties, including the inadequacy of electrical energy in terms of supply, access and quality. It is precarious and characterised by untimely power cuts. Indeed, the average outage time in the cities studied was around 24 days 20 minutes during the study period (6 months). The West Cameroon region suffers from a deficit in electricity, marked by frequent load shedding and untimely power cuts

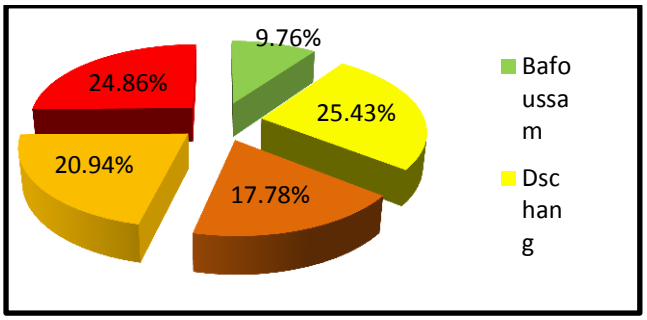


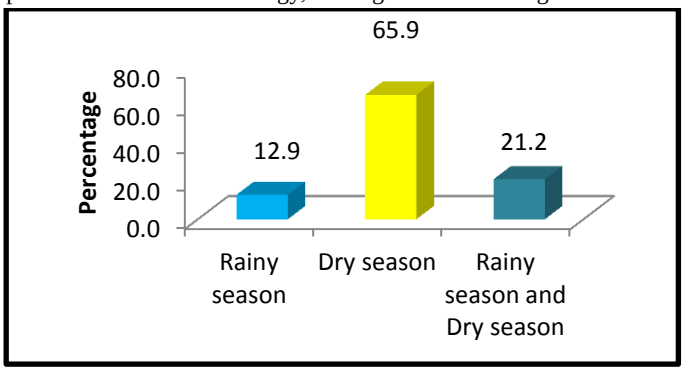
Figure 4: Overall proportion of power cuts in West Cameroon.

It can be seen from this figure that Dschang records 25.43% of power cuts (...unit of assessment), followed by Bafang with an average of 24.86% and Bangangté with 20.94%. On the other hand, Mbouda and Bafoussam, with 17.78% and 9.76% respectively, have the lowest load shedding rates.

In relation to the load shedding factor, energy distribution and consumption are impacted by load shedding, which is characterised by the absence of energy, although it is part of the energy distribution process, as it solves the equation energy produced equals energy consumed, as the energy produced cannot be stored. Load shedding is therefore a last resort measure to avoid grid[1] collapse. It is an organised, controlled and momentary cut in the power supply to certain areas of the territory, the aim being to reduce the load and maintain the electrical balance on the network. However, we can have load shedding even when the electricity network is well balanced and energy demand equals supply. The purpose of load shedding is not only to balance the grid, as some factors can lead to load shedding.

Indeed, the electricity supplied by The Energy of Cameroon (Enéo) remains very insufficient compared to the high demand. Indeed, less than 5% of the electricity potential is exploited for the production of electricity in Cameroon. In concrete terms, while supply is only growing at a rate of 3% per year, demand for electricity is growing at around 7.5% per year (Ministry of Water and Energy, 2015).

Irregular hydrology: Since the production of electrical energy is dependent on the flow of rivers, variations in this flow have made it possible to observe that during the dry seasons, load shedding is much more abundant (65.9%) than in the rainy season (12.9%). In the dry season, the flow of rivers is low, which results in limited production of electrical energy, leading to load shedding.

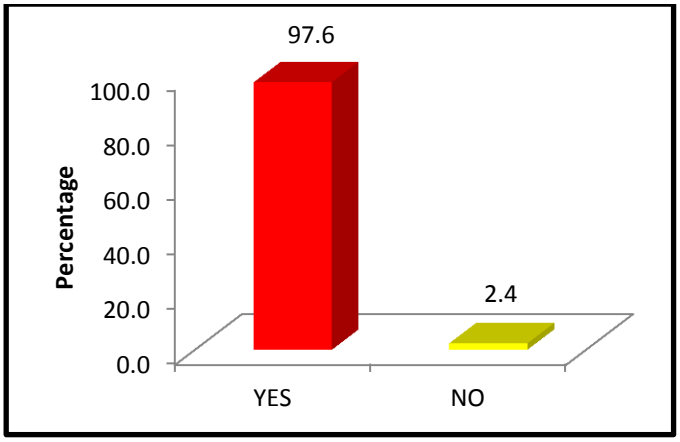


Source: Field survey, 2021

Figure 5: Season of frequent power cuts

Aggressive weather conditions: Rainfall accompanied by strong winds causes poles or trees to fall, resulting in power cuts.

Highly disturbed distribution networks: The diagram below shows that 97.6% of food processing establishments experience frequent voltage drops, compared to 2.4% that do not. This situation results from the fact that some users who should be classified as HTA subscribers (special customers) with their own power transformers, are instead connected to the low voltage network (BTA subscribers), and cause considerable disruption to the power supply, resulting in poor voltage quality.



Source: Field survey, 2021

Figure 6: Decline in tension in agri-food establishments

In the case of our study, the poor voltage quality is due to: overloading of distribution transformers and power fraud and pirate connections by users.

Maintenance of the electricity system: ENEO-Cameroon reactivates the old system of energy rationing in a context where energy-intensive industrial units are coming on stream, thus worsening the situation. In fact, in recent months, we have seen a return of load shedding in most of Cameroon's cities. Officially, the concessionaire of the public electricity service, ENEO-Cameroon, explains that this situation is due to reinforcement work on the network.

Deterioration of transmission and distribution networks: The quality of electricity service in Cameroon is subject to several disturbances, voltage drops and surges, regular interruptions and

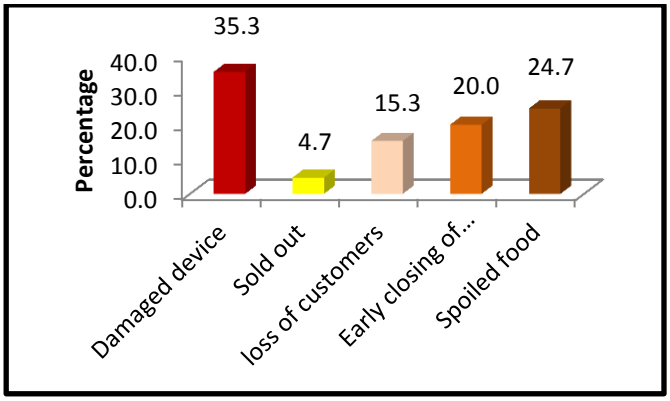
frequency variations, as well as recurrent fires in electrical circuits. This is due to the recurrent falling of old poles. In addition to the energy production deficit and technical problems on the distribution network, Eneo also lists bush fires among the causes of energy load shedding. Since January 2021, the concessionary company for electricity distribution in Cameroon has counted "around 200 poles" that have collapsed due to this human activity, according to an information note published on 15 March on the subject of "bush fires and their impact on electricity service".

During a press conference held on 1 April 2021 in Yaounde, the Minister of Water and Energy, against all odds, accused Eneo and Sonatrel, actors in charge of the distribution and transport of electricity respectively, of being the main culprits of the inconveniences suffered by the population. "[1]Since the beginning of March 2021, the population and economic operators have been facing recurrent inconveniences linked to the disruption of the public electricity service.

In relation to the economic situation, Eneo Cameroon explains the increase in electricity cuts by the cash flow tensions and the scarcity of wooden [2] poles. The General Manager, Mr. Eric Mansuy, declares that: "several reasons are at the origin of this situation for which we express our regrets to our customers. Firstly, there is the deteriorated financial situation of the company. The electricity sector in general is experiencing an acute liquidity crisis. For Eneo, this is a serious cash flow crisis, due to huge unpaid bills, which prevents us from honouring all our commitments to our suppliers. The most visible consequence is the difficulties encountered in the daily supply of fuel to our thermal power plants, leading to sporadic load shedding, which is harmful to our customers and, more generally, to the country's economy. According to Mr. Eric Mansuy, in addition to the cash flow tensions, there is a scarcity of wooden poles, particularly those used for repairs. This is due to the precarious security situation in the North-West, the region where Eneo gets all its raw material. As a result, the production of poles has dropped by more than 90%. "Eneo has approached the authorities through the Ministry of Forestry, which has agreed in principle to the sustainable exploitation of certain eucalyptus reserves in the West," the CEO nevertheless tries to reassure.

The impact of power cuts in agri-food establishments

Reliable access to electricity is the foundation of any modern economy. However, unreliable electricity supply undermines the performance of agri-food establishments. As evidenced by persistent blackouts, unreliable electricity supply has a significant impact on these establishments.



Source: Field survey, 2021

Figure 7: Consequences of power cuts in agri-food establishments

Impacts on equipment in agri-food establishments

Untimely and repetitive power cuts do not allow agri-food establishments to function properly. These difficulties constitute a major handicap whose consequences are heavily felt on the equipment of agri-food establishments. The series of power cuts damages electronic equipment. On average, 35.3% of equipment in agri-food establishments is destroyed as a result of such incidents. This is because electronic equipment is not designed to withstand excessive voltage fluctuations. If the power supply is interrupted or if there is a power failure in the electrical network, some equipment breaks down. In fact, the managers of food processing establishments are victims of the premature ageing and frequent malfunctioning of their electrical appliances and equipment. It can be seen that maintenance companies and workshops in these cities are increasingly called upon to maintain equipment such as freezers, refrigerators, computers and other electronic devices (see photo).

Source : Cliche NGAGOUM NITCHEU Vannelle (2021)

Photo 2 : Damaged equipment

Tainted food in the food industry

A power failure immediately shuts down food storage equipment such as freezers and refrigerators, causing considerable damage. Thus, when equipment stops working, it is possible to lose some or all of the food stored in it. The food can no longer be consumed without danger to health. The stoppage of the equipment causes the proliferation of bacteria. The food does not spoil immediately after the cuts; it depends on the length of the cuts. When the power cuts last for days, this causes a great deal of inconvenience to the

managers of food processing establishments, who record an average of 24.7% of spoiled food as a result of power cuts.

Source : Photo NGAGOUM NITCHEU Vannelle, 2021

Photo 3: Spoiled food

A study by Foster and Steinbuks (2009) shows that in sub-Saharan Africa, a chronic power outage over a period of 15 to 60 days causes an 8% loss in unsold sales. These losses will be greater for establishments unable to adapt to power outages by acquiring generators.

Impact on the economy of the structure

Power outages have a serious impact on the workflow of agri-food establishments, their performance and the additional costs in terms of unforeseen expenses.

Stoppage of activities, stock shortages and loss of customers: Load shedding brings activities to a halt, which prevents work from being carried out serenely, and activities are slowed down. Thus, 20% of agri-food establishments declare that they have closed their establishments early because of electricity cuts. Electricity interruptions lead to a halt in production, and 4.7% of losses due to stock-outs are recorded.

Source : Photo NGAGOUM NITCHEU Vannelle, 2021

Photo 4: Out of stock

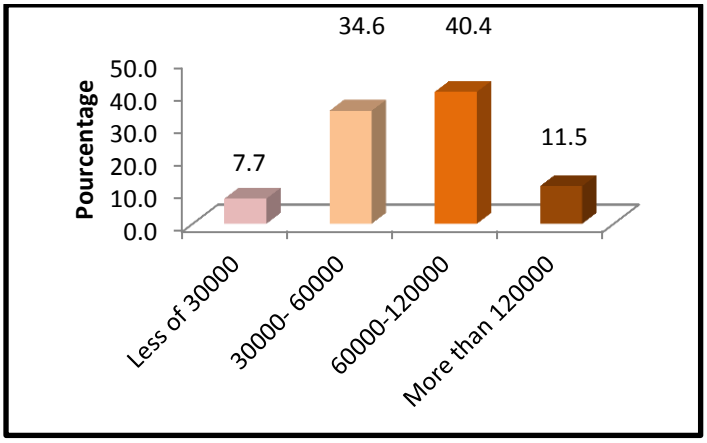
These shortages also lead to a slowdown in production. A study conducted by Vicky Ngo Mandengon stock management in commercial enterprises showed that the risks of stock-outs include

- Dissatisfaction of clients who may lose confidence in the structure;
- Loss of turnover, as customers may decide to choose another product or structure;
- Delayed execution of tasks and therefore a delay in delivery, which leads to a poor image of the institution.

The quality of food in fish shops after days of power cuts is poor, which explains why 15.3% of shops have lost customers due to power cuts, which can lead to the bankruptcy of some shops. Once food is spoiled, it has to be thrown away. Customer dissatisfaction with products is caused by product failure. A customer who is dissatisfied with the product he/she buys is a lost customer. This leads to the deterioration of the customer-structure relationship.

Reduced performance and additional costs: Power cuts lead to a slowdown in activities in agri-food establishments, notably loss of orders, production shortfalls, and delays in the execution of certain orders. The loss of earnings due to power cuts is estimated at hundreds of thousands of CFA francs. For establishments that do not have a generator, power cuts prevent them from working serenely; activities slow down, especially when these cuts last for days.

The extra cost: The difficulties caused by disruptions in the supply of electricity also impact on company finances. An establishment that has a back-up generator is protected from losses due to load shedding and unnecessary salary payments. All its employees continue to work and thus justify the payment of salaries. When load shedding losses become maximum, unavoidable, they become a drag on performance, a generator is needed. Electricity shortages have therefore led managers of food processing plants to invest in generators. The monthly cost of fuel for their operation can amount to hundreds of thousands of CFA francs,



Source: Field survey, 2021

Figure 8: Monthly cost of diesel and petrol consumed by generators

As can be seen, untimely power cuts lead to additional costs in terms of petrol and/or diesel consumption. Thus we find that 7.7% of agri-food establishments using generators spend around 30,000 FCFA on fuel, 34.6% spend 30,000-6,000 FCFA, 40.4% spend 60,000-12,000 FCFA and 11.5% spend more than 120,000 FCFA. Indeed, a study by Reinikkaand Svenssonin 2002 shows that chronic cuts in public electricity supply lead large Ugandan firms to purchase generators. The majority of these firms (compared to 16% of SMEs) make this investment, which represents 25% of their total investment in the year studied. There is therefore "less capital allocated to production" and other activities.

Social impacts

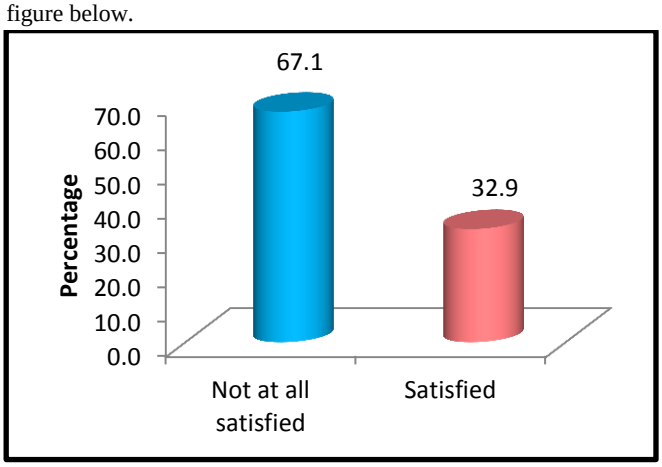
Power cuts have multiple social impacts, including staff reductions, unemployment and loss of social ties.

In relation to the reduction in staff, frequent power cuts have repercussions not only on the establishment but also on the lives of its employees. For example, an institution may have to dip into the salaries of its employees to pay for the petrol needed to run the generator, resulting in delayed payments or salary arrears. An institution that does not have a generator gives salaries to employees who are idle during breakdowns. Consequently, it incurs a cost which in the long run will lead it to dismiss or send some of its employees on technical leave.

Unemployment is an economic, political and social scourge that affects all socio-professional categories (employees, workers and managers). It can lead to a loss of purchasing power and household debt, and even to eviction from housing for non-payment. An unemployed person can no longer meet basic social needs such as nutrition, housing, security and health, let alone those of his or her family. Unemployment can also lead to the proliferation of serious crime, the dislocation of households and the disruption of the family fabric, the use of children in resale activities exposing them to violence, exploitation, abuse and child neglect.

The loss of social ties: As the company is the main place where employees socialise, the loss of a job is accompanied by the loss of the network and professional ties that enable socialising. The devaluation of the status of the unemployed has a profound effect on the individual's self-image and self-esteem. Despite the free time available, the unemployed person does not feel worthy of taking advantage of it to experiment with new activities that would allow him or her to create new social links. The shame he feels leads him to isolate himself from his family and friends. By withdrawing into himself, the unemployed person disrupts the balance of his family life. In 1987, Serge Paugam (1993) pointed out that 43.5% of men who had been unemployed for two years had experienced a marital break-up, compared to 18.9% of those who were in work. For all these reasons, long-term unemployment appears to be one of the main causes of social exclusion.

Hydropower is nowadays less and less satisfactory as shown in the figure below.



Source: Field survey, 2021

Figure 2 : Satisfaction with the quality of electricity supplyS

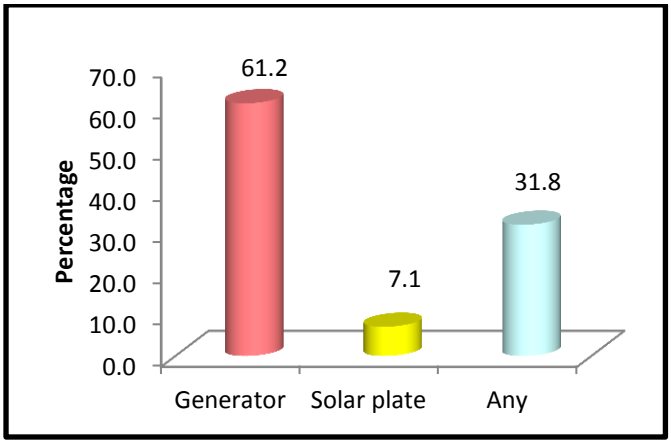
Indeed, 83.529% of the establishments surveyed said they were not satisfied with the quality of energy supply, compared with 16.471% who said they were satisfied. This is mainly because of the impact that load shedding has on their activities. There are therefore more advantages to investing in other renewable energies.

Adaptation strategies and renewable energy

West Cameroon, like other regions of Cameroon, is facing serious problems of access to electricity. This deficit, marked by frequent and sometimes prolonged power cuts, disorganises economic and social life. Yet West Cameroon is considerably rich in renewable energy resources: the sun in almost all parts of the region, the wind on the hillsides and mountain tops, biomass and thermal energy. Faced with power cuts, agri-food establishments are developing multiple strategies to safeguard and perpetuate the functioning of their structure.

Power outages and switching to alternative energy sources

Agri-food establishments use other sources of energy to run their operations. The figure below shows the main ones. It can be seen that 61.2% of establishments use generators, 7.1% use solar panels and 31.8% have no other source of energy in the event of a power cut.



Source: Field survey, 2021

Figure 9: Other energy sources used in agri-food establishments

Use of generators in the food industry

In order to compensate for power cuts, agri-food establishments are rushing to use generators to avoid stopping their activities. Establishments that do not have any other source of energy face multiple financial difficulties. An establishment that has one is protected from losses due to load shedding and from wages paid out unnecessarily.

Source : photo NGAGOUM NITCHEU Vannelle, 2021

Photo 5 : Generator

Strategies and renewable energy as a public policy alternative

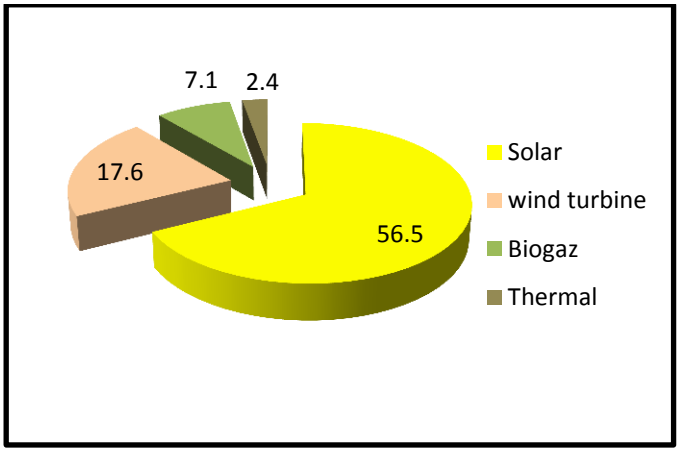
Energy in general is of prime importance for the development of a country. It is in fact the indispensable lung of the global economy. Like many other countries with insufficient resources, Cameroon, in order to meet its growing demand for electricity, is looking for innovative solutions in terms of costs and guarantees in order to ensure the sustainable development of its energy sector. Renewable energies will certainly contribute to this, given the awareness of the negative environmental impacts of current systems and the existence of a significant potential. Renewable energies are at the heart of economic development issues. Indeed, Cameroon has immense, abundant and varied renewable energy resources, harmoniously distributed throughout the country. If this potential is rationally exploited, its impact will be very significant and will constitute a real opportunity for the country's local and global development.

The electricity sector and the 'renewable energy' alternative

Renewable energy is an inexhaustible source of energy**.** Available at will, these sources are diverse and varied, ranging from solar to wind to geothermal**.** Thanks to these low-pollution energies**,** we can envisage a prolific energy production system that is more respectful of nature. Renewable energy sources are attracting attention in both developed and developing countries. These types of energy offer developing countries (DCs) in particular the possibility of increasing their energy supply autonomously at national and local level.

A particular feature of renewable energy is the ability to generate from local resources to meet local energy needs. The modularity of power levels gives them a particular advantage in applications such as decentralised rural electrification.

Renewable energy is energy that is naturally regenerated within a human lifetime.



Source: Field survey, 2021

Figure 10: Other types of renewable energy

According to the survey shown in the figure above, 67.6% of users have heard of solar energy; 21.1% of users have heard of wind energy; 8.5% of users have heard of biogas and 2.8% of users have heard of thermal energy.

Solar energy is widely available and is developing rapidly. Users are more open and willing to use solar energy, followed by wind energy and biogas, while thermal energy remains very little known.

Solar energy: Solar radiation is a primary source of renewable energy. Studies, the results of which were included in the National Energy Plan (PEN), published in 1990, indicated that Cameroon, due to its geographical position, has an average insolation of 4.9 KWh/m²/d, i.e. 4 KWh/m²/d for the southern part of the country and 5.8 KWh/m²/d for the northern part. The solar energy received in Cameroon is estimated at 89.25 TWh/year and can be exploited in two forms, thermal and photovoltaic (the theoretical national average of electrical production is estimated at 2327.5 TWh, i.e. about 20 times the hydroelectric potential, which is around 19.7 TWh).

Source: photo TAKOUKAM Arsène, 2021

Photo 6: Solar panel

For several years, Cameroon's solar potential has remained unexploited. However, over the last decade, some companies and NGOs in the field have distinguished themselves by installing several small solar fields in rural areas, sometimes under the diligence of mobile phone operators. The same is true for some hospitals and localities not served by the public grid. Cameroon plans to build solar power plants in 1000 localities in the country.

Table 1Solar power plants built in the western region as part of the Huawei project

N°	Name of the site	Power	Department	Borough
1	Makoutam-Plateau	54KW	Menoua	Fokoue
2	Makpa I	97.2KW	Bamboutos	Galim
3	Batoula-Bamenghui	54KW	Noun	Malantouen
4	Njigbachouh	54KW	Noun	Messangam
5	Mbakop	54KW	Noun	Malantouen
6	Mayoh(Njitoukwet)	81KW	Noun	Massangam
7	BelekwetChieftaincy	26.1KW	Noun	Massangam
8	Bamboo 2	54KW	Noun	Malantouen
9	Mankang-Mayong	54KW	HAUT-NKAM	Baku
10	Mangourain (Nkouombi)	54KW	NDE	Bazou
11	Njinga-Ndoutain	97.2KW	NDE	Bazou
12	Baboutcheu-Ngaleu	21.6KW	NDE	Bazou
13	Tsah-Bamendou	54KW	NDE	Bazou
14	Bamela	32.4KW	NDE	Bazou
15	Feuguimbou (Nfenguembou)	183.6KW	NDE	Bazou
16	Fotemo	54KW	NDE	Bazou
17	Fondjomekwet	81KW	NDE	Bazou
19	Nzalla	50KW	Menoua	Fokoue
20	Menfoung	50KW	Bamboutos	Galim
21	Makpa	50KW	Noun	Malantouen
22	Mantchoutbi	100KW	Noun	Messangam
23	Makoup	80KW	Noun	Malantouen
24	Machatoum	100KW	Noun	Massangam
25	Mankouombi	100KW	Noun	Massangam
26	Njissain	30KW	Noun	Malantouen
27	Bekambe	80KW	UpperNkam	Baku
28	Bagnoun	80KW	Nde	Bazou

Source: West Cameroon Regional Water and Energy Delegation, (2021)

Wind energy: The movement of air masses caused by temperature differences between them gives rise to wind, the energy of which can be harnessed: this is wind energy. It can be used to drive hydraulic pumps, for example, or to generate electricity hrough wind turbines. With wind speeds that hardly reach 5m/sec over the entire territory, the potential for electricity production in Cameroon is rather low (SIE-Cameroon, 2011).

The Bamboutos in the Western region is a favorable area for the development of wind energy (MINEE, national energy Plan, sector diagnosis: the new energy and renewable, 1990). An update of the data through studies of the wind potential carried out by a Spanish company (ECOVALEN Energy) from 2009 to 2010, has shown, for example, that it is possible to build a 40 MW windfarm in the Bamboutos Mountains (MINEE, Cameroon energy situation, 2015).

Source: photo NGAGOUM NITCHEU Vannelle, 2021

Photo7: Wind turbine installation

Table 2Some wind energy infrastructure in Cameroon

Location	Installed capacity (kW)	Commissioning
West/Bambutos	0,6	2005
Northwest/Bui	1	2009
West/Menoua	1,8	2012
Northwest/Bui	1	2010
Northwest/Bui	5	2015
Total	9,4	

Source : MINEE Report, 2015

Biogas

Biogas is a gas composed mainly of methane (CH4) obtained from fermentation (or anaerobic digestion), the process of degradation of organic substances with the help of so-called anaerobic micro-organisms. This fermentation, also known as mechanization, occurs naturally (in marshes for example) or spontaneously (in landfills containing organic waste). But it canals sob induced artificially in digesters to treat sewage sludge, industrial or agricultural organic waste, etc. The potential for biogas production in Cameroon is, as in many countries, almost unlimited, as the raw material use dismayingly lives tock manure and other organic household waste.

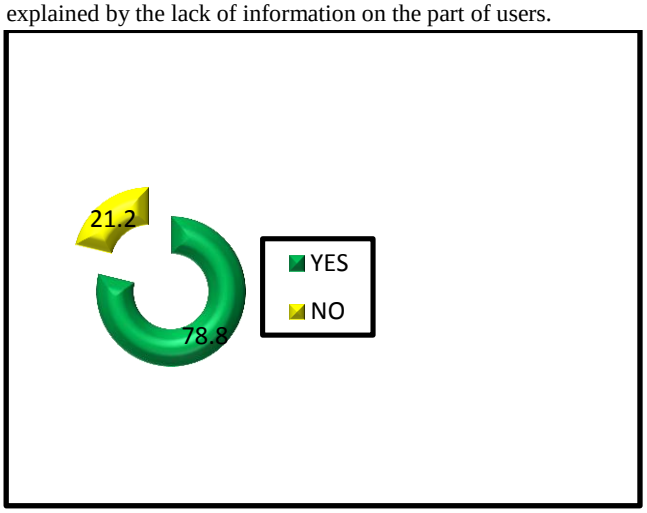
Geothermal energy

Geothermal energy comes from the increase in temperature (geothermal gradient) in the earth's inner layers which can generate temperatures in excess of 150° Celsius. This temperature brings the water in the aquifers to the boil, and the steam produced is captured by drilling from the surface to power turbo-alternators for electricity production. Cameroon has some exploitable potential in this sector. The National Energy Plan identifies three major areas in Cameroon for the exploitation of geothermal energy: The Ngaoundéré area with the Laopanga, Katip Foulbé, Voludé and Bazaosprings; the Mount Cameroon area and the Manengouba area with Lake Monou.

The obstacles to the development of renewable energy and the advantages of its use

Barriers to the development of renewable energy

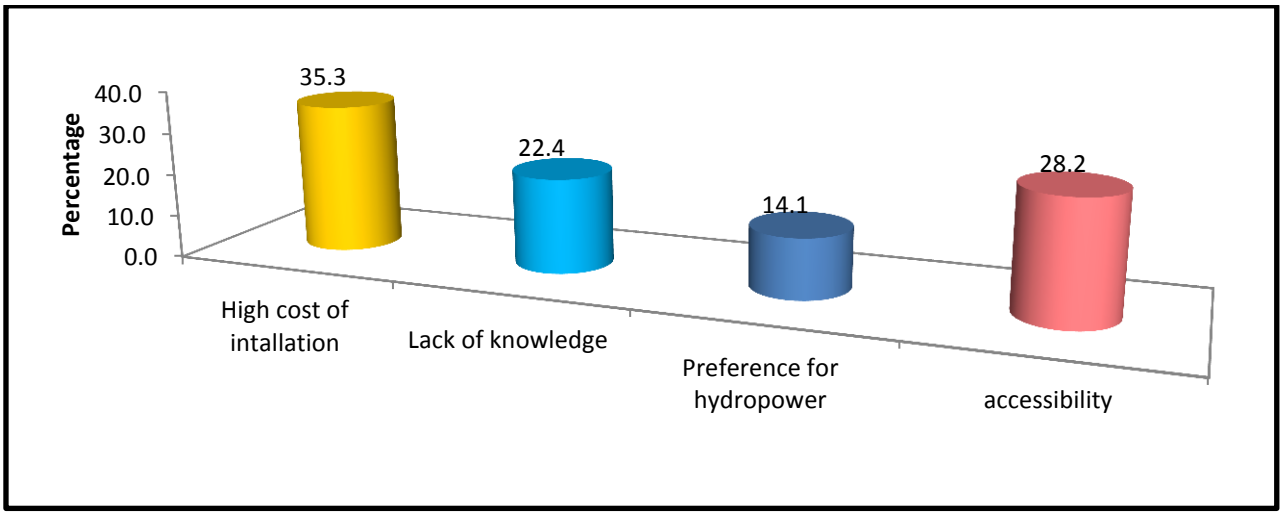
The development of renewable energy in Cameroon faces several obstacles. The first is the lack of knowledge of these energy sources. In our study, we found that 78.8% of agri-food establishments have some know ledge of renewable energy and 21.2% do not know about renewable energy. This situation can be explained by the lack of information on the part of users.



Source: Field survey, 2021

Figure 11: Knowledge of renewable energy

We note a lack of interest even among those who are informed about these energy sources. Thus, of the 78.8% of agri-food establishments that are aware of renewable energy, only 7.0588% use it. The figure below presents some of the reasons for this state of affairs that we have collected.



Source: Field survey, 2021

Figure 12: Reasons for not using renewable energy in agri-food establishments

There are several barriers to the deployment of renewable energy:

- High installation costs 35.3% ;
- Lack of knowledge 22, 4% ;
- Preference for hydroelectricity 14.1% ;
- Accessibility 28.2%.

Benefits of using renewable energy

The advantages of renewable energy are numerous, as it is generally clean, safe and, most importantly, available in unlimited quantities. Our survey revealed that 7.0588% of the target agri-food establishments use solar equipment. The managers of these facilities enjoy energy independence. It should also be noted that investment in renewable energy is a win-win situation in the long run.

- Solar systems are easy to install and require very little maintenance;
- Little waste ;
- Safety: by using them in majority, climatic, economic, environmental and social stability would be achieved, especially by developing large thermal power plants. Safety is one of the main advantages, as there are very low risks of accidents.
- With the installation, the structure benefits from energy autonomy, which all evirates the problem of power cuts and consequently all the related prejudices that we have previously noted.

Similarly, when a structure is stable in terms of power generation and human resource management, it will contribute more effectively to the development of the national economy and the individual as a link in the chain.

Conclusion

In the end, this study enabled us to understand that power cuts lead to lower productivity in agri-food establishments. In order to improve the quality of energy supply, the electricity distribution company has undergone changes: We changed from ENELCAM to ENEO following the Cameroon in government's desire to improve the electricity sector and open it up to competition. The different actors involved have different and complementary roles, and their combined actions contribute to improving the quality and quantity of electricity supplies. In reality, despite these joint efforts, we note that despite it's a bund a hydroelectric potential, the Cameroonian energy system is experiencing a greater balance between supply and demand. This is particularly the case in the Western region that we studied. This region has a rich hydroelectric potential that remain sun tapped, and its development could considerably reduce the rate of untimely power cuts.

In addition, we have noted that' several parameters influence electricity consumption in agri-food establishments, in particular the number and type of appliances in use, and their operating time. However, activities are disrupted in agri-food establishments because of recurrent load shedding. In fact, the Western region has recorded and average of 24 days 20 minutes of power cuts over a period of 6 months. This situation is due, among other things, to a low supply compared to the demand for electricity, to the irregularity of supplies linked to the low water period, to the disruption of the distribution network, to maintenance work on the electricity system imposed by the ageing of production equipment, to fraud, but also to low investment in the electricity sector. The frequent power cuts caused considerable losses in the establishments studied, with material, economic, human and social damage.

To overcome these difficulties, several strategies are being developed by these agri-businesses to cope with power cuts. The most common are the use of generators and solar equipment. However, solar energy is not widely used due to its difficult accessibility, lack of knowledge and the high cost of purchasing the installation. Given that hydropower alone is no longer sufficient to meet the energy needs of establishments, and in view of the inconvenience caused by this traditional source, it is becoming essential for agri-food establishments to turn to renewable energy. Investing in other energy sources has more advantages in terms of the independence and energy autonomy hey offer to agri-food establishments. Therefore, the policy must turn to renewable energies which are natural energy sources such as solar energy, wind energy...Also, local elected officials must think of multiplying the construction of mini hydroelectric dams in the villages to reinforce the urban areas in electric energy.

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