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Measuring Energy Poverty in Cameroon: An Alternative View of the Problem

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Abstract: ***The objective of this paper is to explore the multidimensional aspect of energy poverty in Cameroon. It is structured around a composite indicator that reflects the diverse facets of this scourge: the quality of energy resources, the availability of those resources, the amount of energy used and the quality of access to energy. Indeed, although the term energy poverty appears in official documents, reflecting various aspects of the reality of households, studies on this phenomenon are generally based on a strict indicator. In this study, we are going beyond the one-dimensional consideration of the extent of energy poverty, developing a multi-dimensional vision of the phenomenon. Energy poverty is reflected in the Cameroonian households with a lack of access to some modern energy resources because of their unavailability or low availability. The results obtained show the importance of energy poverty according to place of residence, the standard of living of households, gender of head of household, level of education, and religion. The following analysis of these characteristics should guide policy makers on priority targets of a fight against fuel poverty policy aimed at reducing social inequalities.***

Keywords: energy poverty, composite index of energy poverty, energy resource, energy service, multiple correspondence analysis

1. Introduction and Background

The Energy Action Plan for Poverty Reduction [24] defines energy poverty in Cameroon as " populations lack of access to energy services in quality and quantity, reliable, efficient energy services sustainable and continuously." Thus energy poverty results from a combination of factors such as: the quality of energy resources, the availability of those resources, the amount of energy used and the quality of access to energy. It is therefore a complex and multifaceted phenomenon. In a broader perspective, energy poverty is related with insecurity and social inequality. In Cameroon, the provision of reliable energy, efficient, sustainable and continuously now occupies an important place in public decision making. While the multidimensional nature of energy poverty has often been mentioned by some authors [5], [9], [21], the measures used in most studies to understand this phenomenon are often stringent, and include only a single appearance. This paper attempts to develop an aggregate measure of energy poverty applied to the specific case of Cameroon. Can a multidimensional measure of energy poverty help us to better understand the various aspects of the phenomenon? After providing some elements relating to the definition and delimitation of energy poverty in Cameroon, we will develop a profile of this phenomenon to identify households affected by this problem.

2. Concepts and measures of energy poverty

The increasing number of studies on energy poverty is accompanied by a wide variety of questions and defining proposals. These definitions are not unequivocal. The wide variety of cultures and living patterns hinders the adoption of a definition of a standardized indicator of the concept of energy poverty. Indeed, energy poverty as poverty takes different faces depending on the time, place, culture, etc. Thus, we distinguish the approaches of energy poverty developed in the European context, and those that were developed in the context of tropical countries.

3.1 Approaches developed in the European context

The concept of energy poverty was theorized for the first time by [7] in his book "Fuel Poverty: from cold homes to affordable warmth" that will eventually be part of the political agenda in the UK in 2001 with approval of the "UK Fuel Poverty Strategy." Document whose one aim, is to eradicate fuel poverty in the UK by 2016. According to this definition:

"A fuel poor household is one that cannot afford to keep adequately warm at reasonable cost. The most widely accepted definition of a fuel poor household is one which needs to spend more than 10% of its income on all fuel use to heat its home to an adequate standard of warmth. This is generally defined as 21ºC in the living room and 18ºC in the other occupied rooms - the temperatures recommended by the World Health Organization"

This definition, though it includes a wide range of uses of energy, is often limited in practice the need for heating and occult energy consumption for other uses. In addition, it uses a strict threshold: 10% of all income can be spent to cover the energy consumption. This threshold corresponds to the average energy expenditure of the three deciles of population with the lowest income in the UK [8].

In general, studies that have used the concept of "energy poverty", as developed in the European context, consider this as insufficient household income to meet its energy needs [1], [4], [12], [15], [19], [26], and [28] .

Thus [9] made a remark that a definition of energy poverty that is based solely on income is too limited. He considers energy poverty as a multidimensional problem, drawing a parallel with the different possible definitions or representations of socioeconomic "poverty". According to its analysis that energy poverty is a combination of three following factors: lack of access to some level of utility, the fact of not having certain primary goods and the lack of capacity ("capabilities").

2.2 Approaches developed in tropical countries

Even in tropical country, there is not a unanimous definition. Some authors have studied energy poverty by transposing these countries, definitions developed in the European context [11] and [17] by identifying energy poverty as insufficient household income to meet its energy needs. Others have rather seen the energy consumed nationally compared to other broader measures of poverty such as the Human Development Index (HDI) or the physical quality of life index (PQLI) [18].

Among the approaches developed in tropical countries, there are also those whom consider energy poverty in terms of energy actually consumed by the households to meet their needs for heating, lighting and cooking, [13], [25] cited in [1], [6], [14], [18], [20].

It is also useful to consider the term "energy poverty" as it is often used in official documents of the fight against poverty and development [10], [27] , [29]. In this context, the term energy poverty is expanded to the dependence on traditional solid fuels to meet the basic energy needs, for example, hot water, heating or cooking [30].

Thus [22] introduce new elements for discussion. They distinguish three approaches to energy poverty. The first attempts to identify a line of energy poverty based on the amount of energy used at a national aggregate level. A second approach uses engineering estimates to determine the amount of energy directly necessary to satisfy basic needs. The third approach is to define energy poverty in terms of access to energy services.

In terms of estimated energy needs from basic engineering calculations, there is talk of establishing some hypotheses about the type of energy using equipment (home, light bulbs, etc.), their sizes, the effectiveness and intensity of use. Moreover, this approach requires a normative step first defining a set of basic needs.
The third approach presents access to energy services in two main areas:

- Physical access to energy (for example, if the household is connected to a power grid)
- Participation in the energy market or the end use energy equipment market.

In this context, the fact that households use or not different types of equipment is a matter of choice. So what distinguishes a poor household from easier cleaning is the widest range of choice in terms of fuel use (more efficient, more convenient, less polluting) and equipment or appliances. It follows that energy poverty is a set of constraints that prevent households to meet their basic energy needs [1], [6], [20], [21] and [23].

By focusing on the latter approach [21] emphasize the multidimensional nature of energy poverty and the need to cover a range of different elements to the extent of this phenomenon. This concept of energy poverty rather than focusing on access to energy, is interested in quantifying the energy deprivation. This prospect is very interested in aspects related to capture the quality of energy services, reliability, and the notion of affordability.

In the absence of standardized definition, other criteria can be used as part of more local initiatives, to take into account the specificities related to climatic conditions and cultural practices. For example, as part of a territorial diagnosis of energy poverty, it becomes crucial to consider the different ways of using energy. For Cameroon, the following detailed approach allows us to understand, in various dimensions, energy poverty.

3. Methodology and Data

3.1 Understanding fuel poverty in Cameroon and authors

The methodology for measuring energy poverty in this study relates to the approach that defines this phenomenon in terms of access to energy services. This perspective of deprivation, focusing specifically on the poor [2], should provide a more direct indication of the relevant aspects of energy poverty. Energy services commonly claimed by households concern: cooking, lighting, communication and information (telephone, satellite / cable TV network), education and entertainment (radio, TV), and other energy services provided to households (refrigeration, iron, etc.)

3.2 Data

The analyzes presented in this work are based on data from the third Cameroon household survey (ECAM III, 2007). This survey was conducted at the base, in order to study the living conditions of Cameroonians households. It is therefore a good tool to study the dimensions of well-being of households, mainly those related to their energy profiles. The survey also provides information on monetary spending, education, health, possession of certain property, access to clean water, and a host of other socio-economic, demographic and infrastructure of households.

Quantifying the loss of energy services through the use of indirect indicators. These indirect indicators or proxies involve a normative judgment. It is therefore crucial to ensure that the chosen proxy is closely correlated with the service to quantify. However, the use of the proxy represents a potentially powerful way to explore new grounds in terms of quantification of energy poverty.

3.3 Identification and selection of relevant dimensions

The multidimensional nature of energy poverty should be reflected in the choice and structure of variables. We define the different dimensions of the new metric of energy poverty around domestic services commonly required to capture the different elements discussed below.

Cooking is one of the fundamental requirements. The energy, as heat is needed to prepare meals. We take elements of energy poverty associated with cooking including the type of fuel used, keeping the concept of convenience in mind. Taking into account the limitations of data availability, we do not consider the type of home. Nevertheless, we believe that for every service requested by households, the indicators should reflect as much fuel as equipment.

Access to electricity for the services it provides, is key to development. In particular, modern lighting offers many advantages for development. In addition, other services such as entertainment, education, and communication, for example, are subject to the access to electricity. We include indicators related to the presence of certain equipment to capture aspects of the final use that are usually excluded from access to energy metric.
Access to electricity or modern fuels is of limited use for users who do not have the financial means to pay for fuel, nor the ability to provide adequate facilities to energy service access. Therefore, we include variables related to the possession of radio or television and refrigerator. We also introduced the dimension telecommunication. Recent history has shown the critical role of the use of mobile phones and phones in particular, that require the availability of electric power, in the socio-economic development. Finally, we consider the mechanical power as an essential dimension of access to energy.

We avoid assigning relative weights to different dimensions and indicators, because of the arbitrary nature of such a process. However, there are strong reasons to believe that the variables considered in this measure of energy poverty are not of equal importance. Despite this, we emphasize the fact that a weighting structure can change the value of the metric and therefore the conclusions of the analysis. Moreover, the choices made in this study in the selection of indicators and the weighting structure are indicative and in order to demonstrate the methodology. They are adapted to the specificities of the analysis. Table 1 shows dimensions and variables used to assess energy poverty.

Table 1: Dimensions and variables used to assess energy poverty

Dimensions	indicators	Variables
Physical access to energy	Availability of resources	• gas station, oil depot / gas near the accommodation • Distance between housing and pole / electric connection point • power line presence at high or medium voltage to the vicinity of the housing
	Activities done to access resources	• At least one member of the household practice logging • Has gathered wood for the household in the last 7 days
Cooking	Resource	• Main energy source for cooking
	Cooking appliances	• Presence of the stove • Gas stove Presence • oil stove Presence • Gas bottle Presence • Contain Moulinette
Lighting	Resource	• Main source of lighting
Communication and information	Telecommunication Equipments	• fixed telephone presence • Presence of Mobile Phone • Presence fixed CT phone • Presence of the mobile CT phone • Presenceof Fax / Fax
	Telecommunication facilities	• Household has an Internet connection • Household has a wiring to the TV / satellite network
Education and entertainment	Possession of appliances	• Presence of radio station • Presence of TV • Presence of the Satellite Dish • Presence of the Computer • Presence of musical Chain • Presence of DVD / VCD Player
Motor Force	Equipments	• Vehicle Presence • Presence Motorcycle / Moped
Other domestic services	Other appliances	• Presence of Fridge • Presence of Freezer • Presence of electric iron • Presence of Air Conditioning • Presence of Fan

3.4 Aggregation of multidimensional indicator of access to energy

The method chosen to aggregate the multidimensional indicator of access to energy is the factorial method developed by [3]as part of the study of multidimensional poverty. The choice focused on this technique is mainly explained by the fact that it eliminates as much as possible arbitrariness in the calculation of a composite indicator. Normally it is to capture the energy access through an array X with n rows and p columns, that is to say, p variables measured on n individuals:

$$X = \{x_i / i \in I, j \in J\}$$

At this table, we can associate two cloud points:

- The cloud of n lines in $E=R^P$; E is called the space of individuals and denoted $N(I)$ the cloud of individuals
- The cloud of p columns in $F=R^n$; space F is called space variables and is denoted by $N(J)$ cloud variables.

At this level, we will conduct a multiple correspondence analysis (MCA) on all the available and relevant variables characterizing the access of Cameroonian households to energy services.

To do this, we adopt the following notations:

- j_k the number of modality of the variable k
- $W_{j_k}^k$ is the weighting coefficient (standard score on the first axis) of the modality j_k, with $j_k \in J_k$.
- $I_{j_k}^k$ is a variable that takes the value 1 when i adopted by the modality j_k, $(j_k \in J_k)$ et 0 if not.
- K is the number of sectional indicators

If in the table X, rows represent households and columns variables characterizing the household access to various energy services, individuals factorial coordinates on the first axis (axis of maximum inertia) are considered as composite indicators access to energy services to these households.

$$ICAE = \frac{\sum_{k=1}^{K} \sum_{j_{k=1}}^{J_k} W_{j_k}^k . I_{j_k}^k}{K} \qquad (1)$$

Where ICAE is the composite indicator of access to energy. This indicator has the advantage to classify households according to their energy welfare.

4. Results

The histogram of the singular values of this preliminary MCA allows to identify the primary factor eigenvalue λ_1 = 0.3003 which explains 19.25% of the total inertia, and the second factor eigenvalue λ_2 = 0.0998 Which explains 6.40% of the total inertia. The main plane (axis 1-axis 2) therefore gains 25.65% of the total inertia. We focus our study on the first two axes. Variables that contribute most to the formation of these axes are respectively:

- **Main energy source for cooking** with categories (*SO01- Wood bought; SO02- Wood collected / received; SO03- Cooking Gas; SO04- cooking electricity; SO05- Cooking Pétroleum; SO06- Charcoal; SO07- Sawdust / Wood Chip; SO08-Other; SO09- Do not Cook).*
- **Main source of lighting** *with categories (SO01 - Petroleum for lighting; SO02 - individual electric meter; SO03 - col electric meter(principal); SO04 - coll electric meter(without div); SO05 - col electric meter(with div); SO06 - connected without electric meter; SO07 - électro Grp; SO08 - Gas for lighting).*

These are the variables that are most considered when interpreting the main factorial design. The distinction of the first axis highlights the phenomenon of energy poverty. Table 2 presents the histogram of the first 5 singular values of the preliminary MCA.

Table 2: Histogram of the first 5 singular values

Number	Singular Values	Percent	Cumulative Percent	
1	0.3003	19.25	19.25	********
2	0.0998	6.40	25.65	*****
3	0.0646	4.14	29.79	***
4	0.0537	3.44	33.23	**
5	0.0520	3.33	36.56	*

Source: Author from ECAM III data using the software SPAD

The first factorial design (axe1-axe2) in Figure 1 below allows us to discover the variables that describe a state of energy poverty are left, and those that indicate a state of wealth are right.

Overall, the first factorial axis between two categories of households:

- Left, households that use so-called traditional energy sources as the main energy for cooking and lighting. We say of these households they are poor in energy terms.
- Right, households to meet their energy needs, use so-called modern energy. These households will qualify for the non-poor in energy terms.

Energy-poor households mainly cook their food with wood collected / received, or other traditional fuels (sugarcane bagasse, millet cotton rod or corn, palm kernel shells, peat palm nuts, Covers peanut, vegetable waste, animal waste). They combine these fuels to a set of rudimentary equipment (home three stones, the braided wire topped with a BBQ grill, an open barrel topped with a grid, auto gentes) ones made themselves in the traditional way, and at a very low cost. Their main sources of energy for lighting are either kerosene or other traditional fuels such as animal or plant waste. Kerosene for lighting, it is often associated with the hurricane lamp as main equipment.

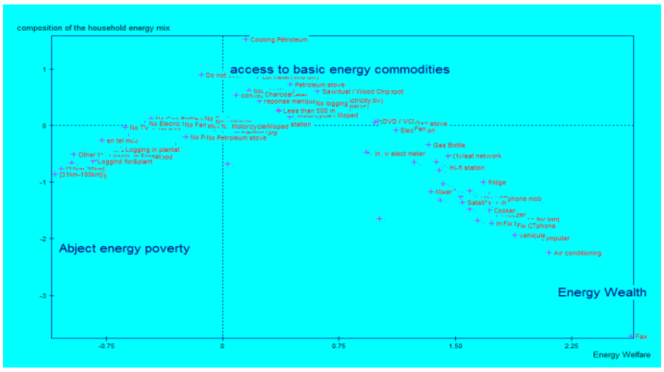

Figure 1: The main plane of the preliminary MCA
Source: Author from ECAM III data using the software SPAD

A deeper look of energy poverty shows that households are in this situation can be characterized as follows:

- At least one member of the household practice forestry (forest, field, or both at once).
- When asked whether they picked the wood for the household in the last 7 days, they said yes.
- The distance between the housing and the post service or the nearest electrical connection is often very large. In general, it is greater than 10 kilometers.
- In terms of communication and information, the poor are weak because they often lack equipment such as: telephone (fixed or mobile) CT phone (fixed or mobile), fax / fax. Similarly, they have neither an Internet connection nor a cable to TV / satellite network.
- The size Education and entertainment access to energy services also are altered because there is a lack of radio, TV set, satellite dish, computer, music system, and DVD / VCD player.

The dimensions Power and other domestic services they are also anemic. Indeed, the property such as, vehicle, motorcycle / moped, fridge / refrigerator, freezer; electric iron, air conditioner, fan, lacking in energy poor.

Non-poor households in terms of energy, use commercial energy for cooking. The use of such energy sources implies the presence of adapted equipment with energy efficient (stove, gas stove or oils, improved wood stoves). The main source of energy of these households for lighting is the electric current obtained by the electrical grid connection. Thus, the non-poor in terms of energy combine the following characteristics:

- The availability of energy. Indeed, these households often housing near a gas station, or an oil depot / gas.
- They come to meet their needs in terms of information and communication. Moreover, they are often holders of amenities such as telephone or CT phone (mobile or fixed).
- They can sometimes have an internet connection, and a cable to TV / satellite network.
- The education and entertainment dimension is reinforced to these households by the presence of equipment such as radio, television, a computer, a satellite dish, a music chain and DVD / VCD player.
- They meet their needs in the driving force of dimensions and other household appliances thanks to the presence of vehicles, freezer / fridge, roping, fan, electric iron.

The Multiple Correspondence Analysis has provided the basic elements for selecting the variables that will be used in the construction of ICAE. The main criterion used is that of the Ordinal Consistency of the Prime Axis (OCPA) factorial that is, for a given primary indicator to see its ordinal structure wellness respected by the ordinal structure coordinates (scores) of its terms of the first axis. This property is a necessary condition for ICAE orders households according to their level of energy welfare. Other second order criteria relate discrimination measures, the spread on the first axis, and the high frequency of non-responses or very low frequencies to certain terms. The final selected dimensions and variables are presented in the table 3.

Table 3: Selection of dimensions and useful variables for building ICAE

Dimensions	indicators	Variables
Physical access to energy	Availability of resources	Distance between housing and pole / electric connection point
	Activities done to access resources	At least one member of the household practice logging
Cooking	Resource	Main energy source for cooking
	Cooking appliances	Presence of the stove Gas stove Presence Gas bottle Presence
Lighting	Resource	Main source of lighting
Communication and information	Telecommunication Equipments	Presence of Mobile Phone
	Means of telecommunication	Household has a wiring to the TV / satellite network
Education and entertainment	Possession of appliances	Presence of DVD / VCD Player
Other domestic services	Other appliances	Presence of Fridge Presence of electric iron Presence of fan

The final MCA performed on 13 variables used for the construction of ICAE resulted in a considerable increase in the explanatory power of the first axis, which rose from 19.25% to 22.59%. The explanatory power of the second axis also increased from 6.40% to 7.39%. The table 4 presents Histogram of the first 5 singular values of the final MCA.

Table 4: Histogram of the first 5 singular values

Number	Singular Values	Percent	Cumulative Percent	
1	0.4518	22.59	22.59	********
2	0.1479	7.39	29.99	*****
3	0.1044	5.22	35.21	***
4	0.0905	4.53	39.74	**
5	0.0835	4.18	43.91	*

Source: Author from ECAM III data using the software SPAD

This leads to the factorial design shown below in Figure 2. From left to right, show that:

- ***Households affected by abject energy poverty***. These households use wood picked for their cooking and light oil. They have no access to electricity. This latter situation means they cannot provide for them needs in other dimensions of energy welfare, selected above (physical access to energy, communication and information, education and entertainment, other domestic services).
- ***Households with access to basic energy commodities***. They choose between purchased wood; oil and chip wood for their cooking needs. The characteristic for these households is that they have a connection to the electrical network, which seems to be the prerequisite to avoid falling into abject poverty energy. These households often housed within 500m from the nearest electrical connection post.
- ***Households with energetic wealth***. This group is mainly composed of households for their cooking use cooking gas.

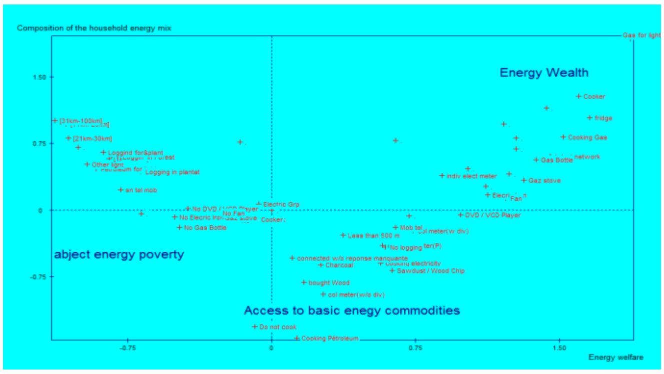

Figure 2: Map of the final principal MCA
Source: Author from ECAM III data using the software SPAD

Variables that contribute most to the inertia of the first axis are: the main source of energy for cooking, the main source of energy for lighting, the presence of a gas cylinder, the presence of iron electric board. It is these variables that synthesize the best energy welfare of Cameroonian households.

The calculation of energy poverty line is about applying the formula:

$$seuilICAE = \max C_i^P m_i^P + \min C_i^R m_i^R \qquad (2)$$

$$\max C_i^P = -0{,}2532$$

$$\min C_i^R = -0{,}2499$$

or

$$m_i^P = 0{,}433$$

$$m_i^R = 0{,}567$$

We found a -0.252 poverty line. Here, the incidence of poverty is ***H= 43.29%.*** This threshold can build the poverty measure that we use (FGT_0) and thus raise the profile of poverty.

5. Discussion

5.1 Breakdown of energy poverty based on area of residence

The impact of energy poverty is (*H = 78,591%)* in rural areas against (*H = 15,412%*) in urban areas. We stress here the difference in the types of access to energy problems between the urban households and rural households. Indeed, the urbanization and modernization process causes changes that can reduce the choices of households to meet energy needs. Thus, in the absence of sufficient and regular cash income, the urban poor are likely to suffer a greater shortage than the rural poor, or this shortage can be of different nature.

For rural households, the lack of infrastructure or their age, when existing, force them to turn to traditional sources of energy for lighting and cooking. In addition, the frequency and length of breaks and domestic energy shortages grow these households use kerosene for lighting and firewood for cooking.

Table 5 below shows the breakdown of energy poverty based on area of residence. It appears from this table that:

Table 5: Impact of energy poverty and ICAE depending on area of residence

Decomposition energy poverty in Cameroon		
	Energy poor	ICAE
Urban area	15.412412	0.56
Rural area	78.591324	-0.70

Source: Author from ECAM III data using the software SPAD

Energy poverty is particularly acute for rural households ***H= 78.59%***. Indeed, these households often lack access to modern energy resources and are condemned to use traditional solid fuels to meet their lighting and cooking needs.

Transposing that analysis to the different regions of the country as illustrated in the Figure 3 below, we can see that the regions with the highest incidence of energy poverty and ICAE weakest are those whose rural part is strongest. Thus, the rate of fuel poverty in the cities of Yaoundé (*H = 0.978%*) and Douala (*H = 1.906%*) is less pronounced. The regions where the rate is the lowest are the South (*H = 29,719%*), South West (*H = 40,467%*), Littoral (*H = 42.857%*) and West (*H = 46,676%*), followed by the regions of Adamawa (*H = 47,668%*), Eastern (*H = 49.233%*) and Central (*H = 52,135%*). It is in the North-West (*H = 58,906%*), North (*H = 65 976%*) and the Far North (*H = 69 790%*) the situation is more serious in terms of energy poverty.

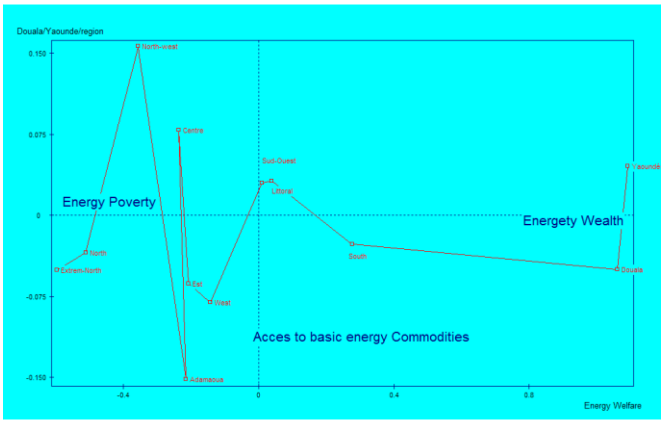

Figure 3: Energy Wellness by region
Source: Author from ECAM III data using the software SPAD

Table 6 provides the breakdown of energy poverty in Cameroon by residence areas of the head of household.

Table 6: Impact of fuel poverty and ICAE depending on the region

Decomposition energy poverty in Cameroon		
	Energy poor	ICAE
Douala	1.906578	1.06
Yaoundé	0.978474	1.09
Adamaoua	47.668392	-0.22
Centre	52.135677	-0.24
Est	49.233391	-0.21
Extrême-Nord	69.790962	-0.60
Littoral	42.857143	0.01

Nord	65.976715	-0.51
Nord-Ouest	58.906883	-0.36
Ouest	46.676971	-0.14
Sud	29.719625	0.28
Sud-Ouest	40.467937	0.04

Source: Author from ECAM III data using the software SPAD

5.2 Breakdown of energy poverty based on the level of life

The incidence rate of energy poverty is particularly high for poor households in terms of standard of living (*H = 80,710%*). Indeed, the electricity connection (between 60 000 FCFA and 150 000 FCFA), as the purchase of a bottle of cooking gas and a gas stove involve significant costs and capital expenditures. Moreover, the poor in terms of living standards have difficulties to participate in the market for modern energy resources, and to provide improved facilities of final energy consumption.

Table 7 below shows the breakdown of energy poverty based on the standard of living of the household.

Table 7: Incidence of energy poverty and ICAE according to the level of life

Decomposition energy poverty in Cameroon		
	Energy poor	ICAE
Poor	80.710464	-0.77
Not poor	32.121281	0.23

Source: Author from ECAM III data using the software SPAD

From this table, there is a strong relationship between poverty in terms of living standards and energy poverty. Indeed, 80% of the poor living standards are poor in energy terms with *ICAE=-0,77*

ICAE=-0, 77

The more detailed review of the energy access by income shows that there is negative income between income and the rate of energy poverty. Indeed, the poverty rate decreases as income increases. For example, for those who make a monthly income assessment, the rate (*H = 42,894%*) for households headed receives less than 23 500 CFA (*H = 23,185%*) for households headed perceives a income bracket [23 500-47 000 [, and continued to decline until (*H = 0.00%*) for households headed receives 752,000 CFA francs or more.

Similarly, for which an annual assessment of income, the incidence rate of energy poverty is (*H = 77,262%*) for households headed receives less than 200 000F CFA, (*H = 71,727%*) for households headed perceives income [200 000-400 000 [and continued to decline until (*H = 0.00%*) for households headed receives 5 million CFA. The Figure 4 below illustrates the energy wellness according to the assessment of the household head.

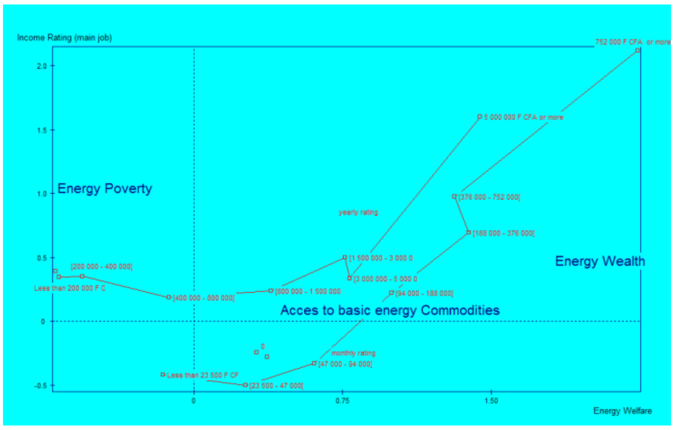

Figure 4: Wellness energy according to the assessment of the household head
Source: Author from ECAM III data using the software SPAD

5.3 Decomposition energy poverty by gender of household head

The Gender should always have a particular character in studies of energy poverty. Indeed, considering for example the case of wood energy, it is women who are responsible for the collection, transport and use of this resource. They should logically be more vulnerable to fuel poverty than men.

The results of our study indicate that households headed by women (*H = 47,517%*) are most affected by the phenomenon of energy poverty than those headed by men (*H = 41,748%*). However away from poverty rate among households headed by women and those headed by men is not very big (about 5,769 points). Explanatory elements may come from the status of household heads in the populations studied. Know the real difference between men and women suggests extending the study to individuals.

Table 8 below shows the breakdown of energy poverty by gender of household head.

Table 8: Impact of energy poverty and ICAE by gender of household head

Decomposition energy poverty in Cameroon		
	Energy poor	ICAE
Male	41.748505	0.03
Female	47.517265	-0.08

Source: Author from ECAM III data using the software SPAD

The Figure 5 below illustrates the energy wellness according to gender of the household head.

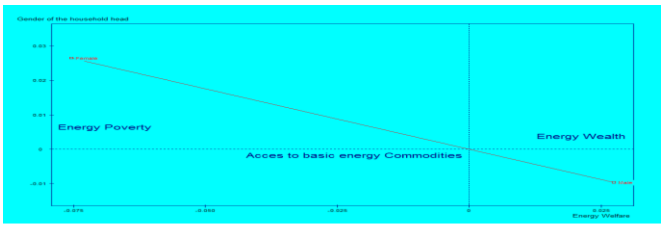

Figure 5: Energy Wellness according to gender of the household head
Source: Author from ECAM III data using the software SPAD

5.4 Decomposition of energy poverty based on the instruction level of the household head

There is a negative relation between the instruction level of head of household and the incidence rates of energy poverty. The distance between households whose head has a higher instruction level and those head is unschooled is very important. The energy poverty incidence rate is (*H = 76.108%*) pay by the chief unschooled against (*H = 2.756%*) for households whose head has a higher level of instruction. Table 9 below shows the breakdown of energy poverty based on the level of the household head.

Table 9: impact of energy poverty and ICAE according to the level of the household head

Decomposition energy poverty in Cameroon		
	Energy poor	ICAE
No schooling	76.107826	-0.69
Primary	53.005764	-0.29
Secondary Cycle 1	28.738512	0.24
Secondary Cycle 2	12.995975	0.68
Superior	2.756340	1.27

Source: Author from ECAM III data using the software SPAD

It shows that the main target are those households whose head is unschooled (***H=76,1%*** and ***ICAE=-0,69***). Households whose head has the primary level are also affected by energy poverty with a ***H=53%,*** and a ***ICAE=-0,29***.

Subsequently, as illustrated in the Figure 6, the energy wealth by level of the household head is growing from junior high school (ICAE = 0.24), secondary cycle (ICAE = 0.68) and the upper (ICAE = 1.27).

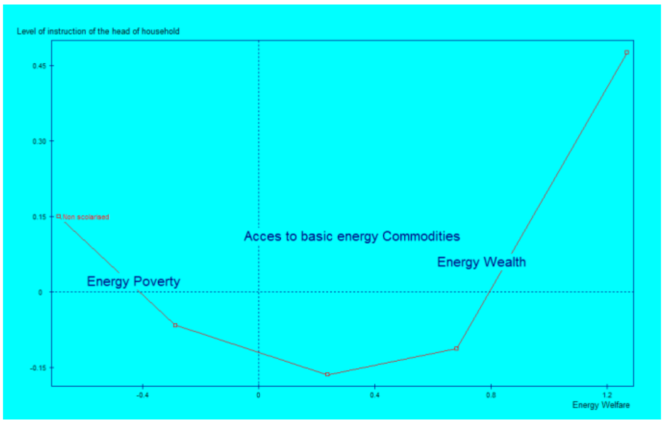

Figure 6: Wellness energy depending on the level of the household head
Source: Author from ECAM III data using the software SPAD

5.5 Breakdown of energy poverty based on the religion of the household head

The breakdown of energy poverty based on the religion of household head shows, as illustrated in the Figure 7 below, that households whose head declares belonging to the group "other religion" (*H = 19,718%*) and Catholic the (*H = 36,655%*) have an impact energy poverty below the national average. Other Christians (H = 43.103%) and Protestants (*H = 43.929%*) impact of energy poverty approximately equal to the national average. Muslims (*H = 48,931%*) and those who say they have no religion (*H = 56,735%*) impact of greater than the national average energy poverty. Energy poverty is particularly pronounced among households headed animist (*H = 81,739%*).

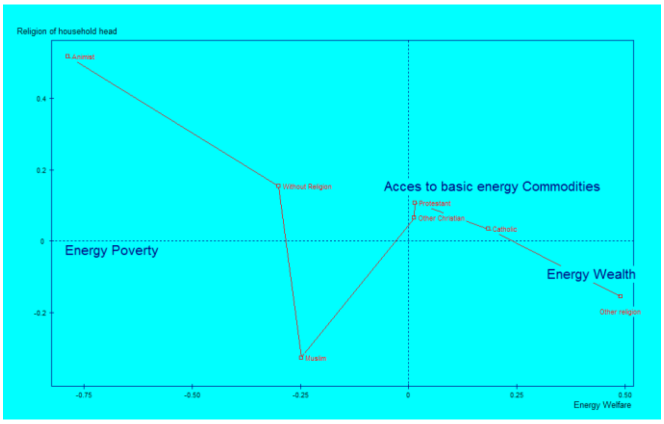

Figure 7: Energy Wellness as the religion of the head of household
Source: Author from ECAM III data using the software SPAD

Table 10 below provides the breakdown of energy poverty based on the household head's age group.

Table 10: Incidence of energy poverty and ICPE according to the religion of the household head

Decomposition energy poverty in Cameroon		
	Energy poor	ICPE
Catholic	36.655594	0.19
Protestant	43.929714	0.01
other Christian	43.103447	0.01
Muslim	48.931530	-0.25
Animist	81.739128	-0.79
other religion	19.718309	0.49
No religion	56.735752	-0.30

Source: Author from ECAM III data using the software SPAD

According to Table 10 energy poverty strongly affects animist **(*ICAE=-0, 79* and*H=81,73%*)**. And those who say they have no religion **(*ICAE=-0, 3 0* and*H=56,74%*).** This result emphasizes the importance of taking into account cultural aspects in the study of energy poverty.

6. Conclusion and Recommendations

In this article we have tried to apprehend energy poverty in Cameroon, taking into account its various facets. Indeed, considering energy poverty as "a lack of access to populations to energy services in quality and quantity, to reliable, efficient, sustainable and continuously", the problem then becomes a complex phenomenon on account of different aspects. Moreover, ECAM III, besides the fact that it was conducted for purposes other than capture energy poverty, and it dates from 2007, does not account for certain crucial aspects of energy poverty such as the amount of energy actually consumed. Nevertheless, it helps develop an alternative vision of this scourge.

Regarding this alternative vision of energy poverty, this study has highlighted the importance of the spatial dimension, but also the interests of socio-economic characteristics of households. Thus, reducing energy poverty in Cameroon requires a priority in national policies that focus on rural areas. Access to reliable energy services is low in these areas, due to the unavailability of the proper energy. The possibility of access to reliable energy services can play an important role in reducing energy poverty. Indeed, we find that households living near a gas station, a gas supply or oil or an electric pole are less affected by this scourge than those far of this type of infrastructure.

The analysis according to the standard of living of households shows that the poor are most affected by energy poverty. Indeed, the cost of access to energy may disqualify some households with insufficient income to meet their energy needs. Access to energy requires initially an initial investment that may prove too high for poor households (eg for connection to the grid, or to acquire equipment), and a second time some regularity in the payment of invoices. Therefore the policies against energy poverty should specifically target households with the lowest standard of living.

The analysis of energy poverty by gender revealed that households headed by women are more vulnerable to this problem than households headed by men. It is recognized that the wood gathering chore heating and cooking is often assigned to women, which makes contributes to disarm recent deal with the scourge of fuel poverty. However, this study does not actually aware of the differences between men and women, because the analysis is conducted at the household level. An analysis of energy poverty according to the individual characteristics should better put the difference between men and women highlighted.

The review of the fuel poverty according to the level of the household head its magnitude decreases with education. This makes it imperative when strengthen policies against poverty for households headed out of school. Energy poverty for this category of households is greater. We conclude that education can contribute to fighting the cultural aspects of energy poverty.

The analysis of energy poverty based on the religion of household head has helped to highlight some aspects of the culture and lifestyle. Thus we see that energy poverty is mainly the problem of households headed animist, without religion, or Muslim. These cultural aspects of energy poverty can still be combated through education and awareness policy aimed to show the benefits of using modern energy to meet the energy needs of households.
Understand the multidimensionality of energy poverty can be essential in the public decision making to combat this scourge. The prospect of the Energy Action Plan for Poverty Reduction [24] , shows that the state plays a central role in the provision of energy reliably and continuously. Its mission is to develop the production infrastructure, and transportation of modern energy to promote the balanced distribution of the latter in the national territory, and help reduce social inequalities.

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