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Use of Photovoltaic Systems in Rural Congo: Comparative Challenges Revealed

—A Look at the ABATA Region in Tshopo Province (DRC)

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Abstract

Energy issues remain a critical concern in the Democratic Republic of Congo (DRC), particularly in rural areas, where access to electricity is still limited due to weak public policies in this area. In Tshopo Province, specifically in the ABATA Grouping, observations indicate relatively low adoption of photovoltaic systems and a preference for them over other energy systems due to cost, ease of energy supply, and associated benefits.

Subject Areas

Sociology

Keywords

Photovoltaic System, Rural Environment, Energy, Socio-Economic

1. Introduction

Lack of access to energy services is one of the key factors hindering economic and social development, slowing poverty reduction, and impeding growth. Access to energy services is insufficient in many African states, and particularly in sub-Saharan countries, which generally rely on biomass as an energy source; energy insecurity is widespread [1].

In the context of a public lighting project in villages in Benin, Quentin Cavillier M. [2] found that photovoltaic systems generally present a problem of adequate management and sustainability, beyond their undeniable socio-economic benefits. Following this observation, [3] suggests that the African continent can particularly rely on solar energy, given the abundant sunshine and wind power in certain areas, to meet a significant portion of its energy needs. The hydroelectric potential

is currently estimated at only 5%.

Electricity is considered a luxury or the preserve of urban and industrial centers, and is therefore not currently provided equitably to all social strata [4]. As some studies demonstrate, 80% of the Congolese population lives in rural areas with only 1% having access to electricity [5].

The ABATA group, one of the peripheral regions located in Tshopo Province in the Democratic Republic of Congo (DRC) and attached to the city of Kisangani, is not exempt from this situation. However, this group constitutes a socio-economic and tourist center of attraction due to the agricultural activities carried out there, which continuously and directly supply the city, thus requiring an energy supply for socio-economic activities. For this reason, this research attempts to address concerns about the level of use of photovoltaic systems in the ABATA group compared to other energy sources, coupled with the reasons that might justify its adoption, and the impact of this adoption on the development of the area.

2. Methodological Framework

This research was conducted in the Democratic Republic of Congo, in the Tshopo Province, specifically in the ABATA group located in the BAMANGA-BENGAMISA sector. The data collection area extended from kilometer marker 18 to kilometer marker 120 on the KISANGANI-BUTA road.

To carry out this study, the functional method, based on the model theorized by Robert King Merton, was used.

Indeed, the use of photovoltaic systems is considered both an alternative and an observed consequence of the lack of electricity in the ABATA group, contributing to the region's energy needs. Clearly, this system plays an important role in providing electricity to households, powering appliances, charging mobile phone batteries, and providing energy coverage for both celebratory and celebratory events in the community. However, due to theft, lack of sunlight, insufficient financial resources for equipment purchase, and a lack of qualified installation expertise—all considered malfunctions—the system's expected functions are no longer being performed.

This method was supported by interview, documentary, and detached observation techniques, which enabled data collection through a stratified random sampling plan consisting of 50 statistical units, under the conditions of the probabilistic method.

3. Presentation, Interpretation and Discussion of Results

3.1. Data Collected in Relation to the Level of Use of Solar Panels Compared to Other Energy Sources

Level of energy source utilization in the ABATA group

Figure 1 shows that four energy sources are used in the ABATA community. Solar panels appear to be used sparingly (8%) compared to batteries, which are used extensively (44%), but their use is very limited and their cost is relatively high

compared to that of solar panels. Generators and batteries, estimated at 36% and 12% respectively, are also gaining popularity at the expense of photovoltaic systems. However, according to information gathered in the field, batteries are recharged either by generators, by mains electricity, or by solar panels.

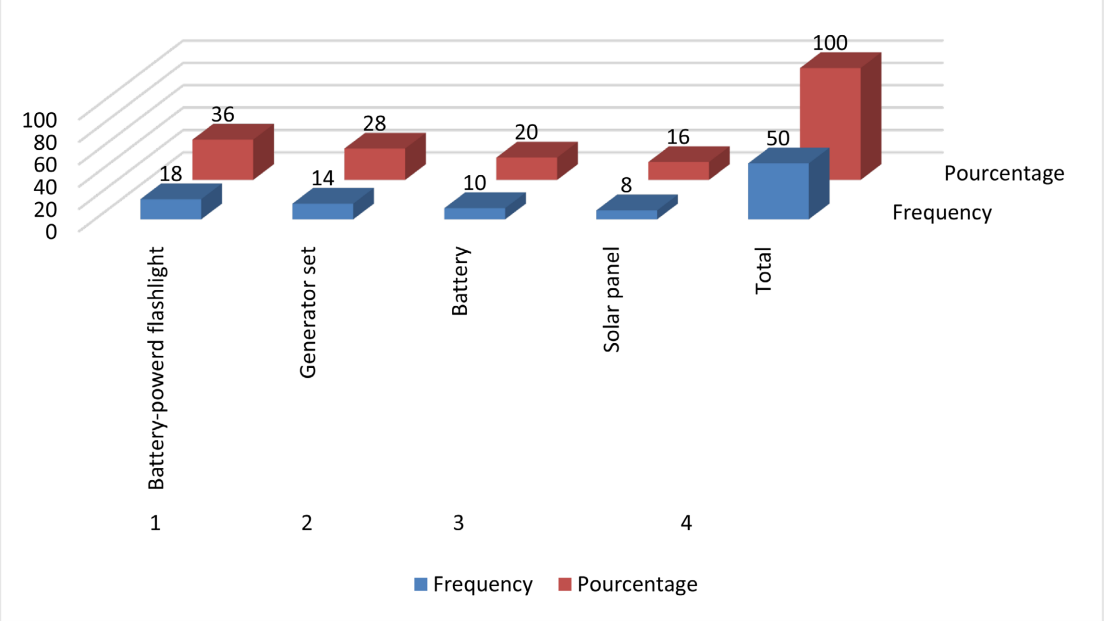


Figure 1. Level of solar panel (photovoltaic system) use compared to other energy sources.

These results demonstrate that the use of photovoltaic systems remains quite low and that no measures are being taken to promote their use.

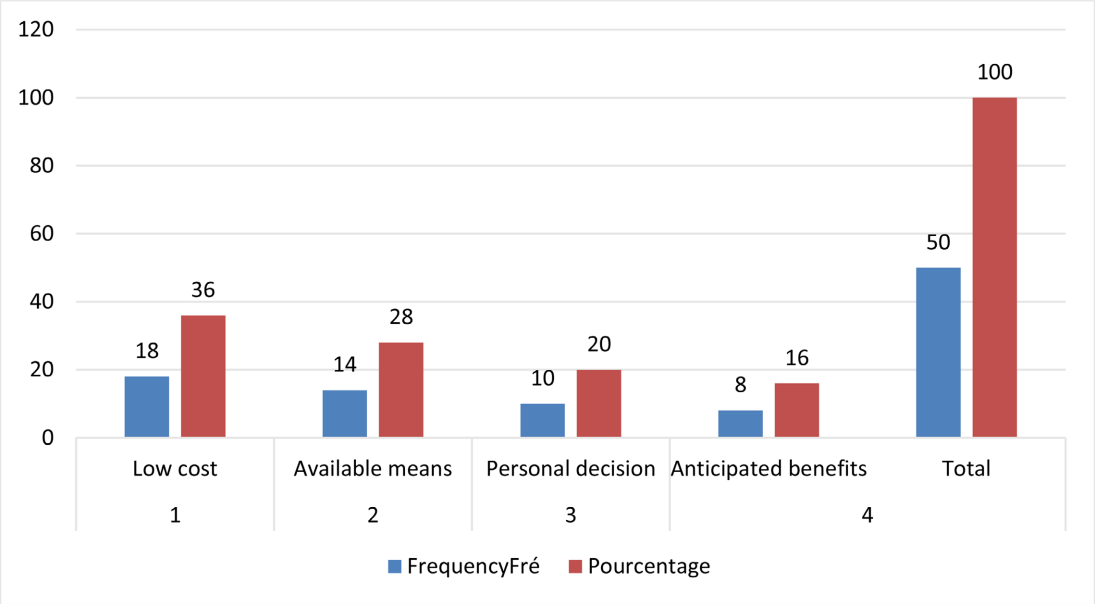
It is clear that of the four types of energy sources identified in the field, only two types—generators and solar panels—are capable of providing significant benefits compared to the others. Batteries are generally used only for applications with very limited impact. In order to amplify socio-economic and even cultural activities and consolidate development efforts in the area, it is more than essential to primarily use those that provide great services at lower costs.

Reasons for using energy sources

The results in **Figure 2** indicate that respondents cited four reasons for choosing this energy source: lower cost (36%), availability (28%), personal preference (20%), and anticipated benefits (16%). However, a more thorough analysis suggests that the primary reason given for using photovoltaic systems is less compelling, as they are perceived as not sufficiently advantageous compared to other adopted systems. While the cost of supplying photovoltaic systems may be relatively higher than some others, their advantages are significant and outweigh the investment.

Difficulties encountered in accessing the energy sources used

Regarding the drawbacks and difficulties in accessing and/or using the energy sources under study, the information gathered from the survey participants revealed the following:



Legend: Batteries; 2: Generator; 3: Battery; 4: Solar panel.

Figure 2. Reasons for using the energy sources used.

- Batteries degrade rapidly, causing the torch springs to rust and damage them quickly. This is costly;
- Solar panels only function optimally during periods of drought due to the increased sunlight. Their supply cost is high, and their installation and even maintenance require training and instruction;
- Without electricity or generators, batteries are not usable. All the energy sources they rely on incur regular and transactional costs. Furthermore, they degrade rapidly;
- Finally, generators are generally prone to equipment degradation and malfunctions. Repairs require significant financial investment and the necessary technical expertise.

Operating time of energy sources used

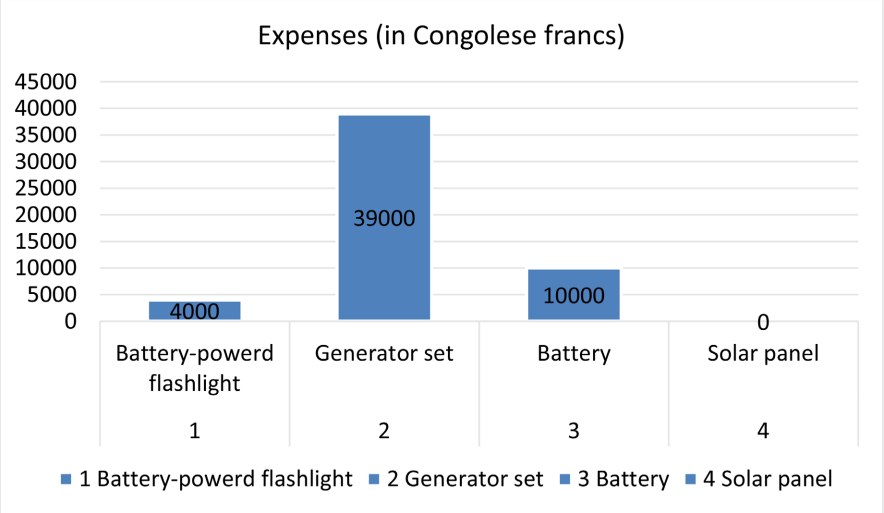
Table 1. Minimum operating time of the energy sources used.

Code	Minimum duration	Energy source				F	Fr
		Stack	Group	Battery	Sign		
1	1 day	3	14	1	3	21	42
2	2 to 3 days	9	0	2	2	13	26
3	1 week	6	0	4	3	13	26
4	2 weeks	0	0	3	0	3	6
TOTAL		18	14	10	8	50	100

Table 1 clearly shows that only batteries and generators are recognized as energy sources capable of lasting for approximately two weeks. Admittedly, their

percentage is small. This indicates a problem with raising awareness of the scope and merits of photovoltaic systems within the ABATA group, hindering their effective adoption.

Estimate of monthly expenses incurred



Legend: Fc: Congolese francs.

Figure 3. Advice on monthly expenses incurred for energy sources used.

Figure 3 clearly shows that generators are the most expensive energy source used in the region (39,000 FC monthly), followed by batteries and cells, whose costs are estimated at 10,000 FC and 4,000 FC per month, respectively. Solar panels, on the other hand, are used without any monthly expenses, except for those incurred for their supply or potential costs in case of a breakdown.

Level of knowledge about solar panels among respondents

Table 2. Opinions on solar panel knowledge.

CODE	Respondents' point of view	Fo	Fr (%)
1	Yes	18	36
2	No	32	64
Total		50	100

Table 2 shows that 64% of the respondents have no knowledge of photovoltaic systems. This lack of knowledge shapes the level of adoption of this new energy source, which is particularly popular in regions without access to electricity.

Opinions on the advantages of the energy sources used

The information provided in Figure 4 above indicates that solar panels remain the most advantageous, despite not being widely used. Batteries follow in terms of percentage, followed by the other two sources, namely generators and batteries.

Based on the information provided by the respondents, the advantages of photovoltaic systems include free sunlight, the considerable number of devices that

can be charged (phones, batteries, radios, flashlights, etc.), and the conversion of solar energy into electrical energy. For batteries, prices are relatively affordable and they are readily available throughout the region, both during the rainy season and the dry season. The durability of the batteries has been noted, while the reliable output and warranty of the generators have also been highlighted.

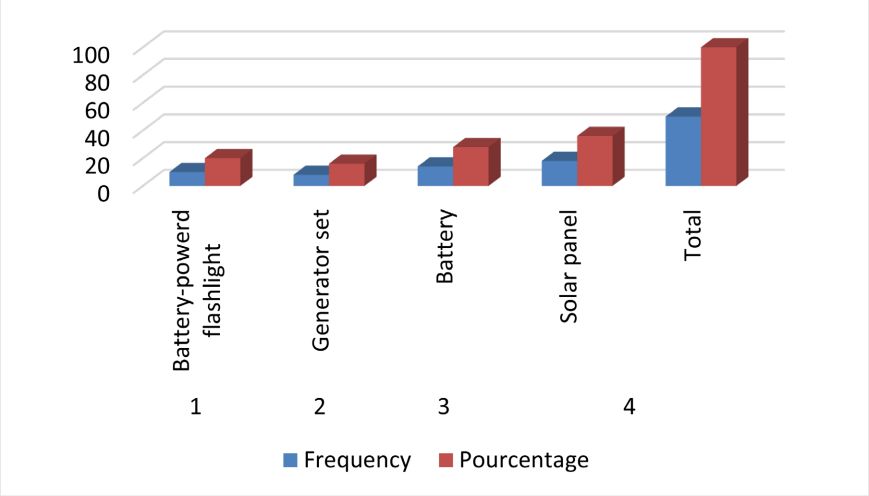


Figure 4. Opinions on the most advantageous energy source compared to other sources.

3.2. Opinions on the Contribution of the Photovoltaic System to the Socio-Economic Life of the Community (Impact)

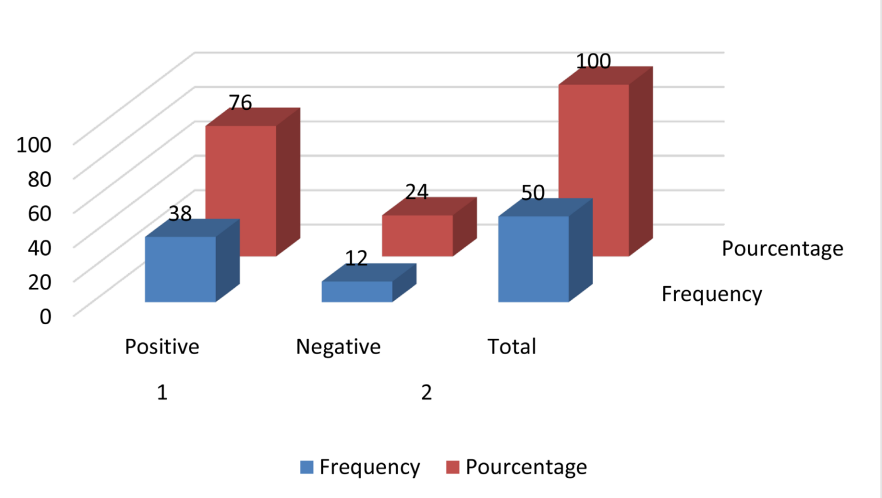


Figure 5. Impact of solar panels.

Figure 5 shows that 76% of respondents have a positive opinion on the contribution of this energy source to the socio-economic life of the community, compared to 24% who have the opposite opinion. It should be understood that these opinions are based on the limited or inconsistent information available to the local population, without any formal awareness campaigns. Although the photovoltaic system is not yet widely used in the study area, its positive impact on the socio-

economic life of the community is recognized.

4. Discussion and Conclusion

Regarding the use of energy sources, Figure 1 shows that the study area makes limited use of photovoltaic systems, consistent with the observations made by Victor Bwire [6] in the village of Kibae, Kenya. This is likely due to the limited resources and income of the population.

The results of the investigations reveal several constraints associated with the use of other energy sources, besides the one under examination. These include rapid battery depletion, torch damage caused by springs, the need for battery and torch replacement, frequent recharging, and fuel costs [7]. These constraints are considered more significant than those of solar panels, particularly during cloudy days and at night. Youba Sokona made similar observations regarding kerosene lamps and LEDs in Kenya. Adopting this system would facilitate the rational use of income in the study area.

As Likwandjandja Jean-Denis [8] states, "it seems important to note that the organizational characteristics of rural households are not to be found in theories of the rational nature of money, but more likely in the analysis of how actors assess, weigh, and justify their uses of money, their conformity to the nature of their intimate relationships, the boundaries they establish between the market world and the family, their social relationships, and even their perception of development." Likwandjandja Jean-Denis observes that rural households use their income according to their basic or priority needs, and do so collectively, but their savings capacity remains low. In light of this study, for these households to meet their basic needs, they would be better served by developing a local policy to reduce expenditures, particularly regarding the use of energy sources.

Considering the advantages noted by the subjects surveyed for the photovoltaic system, it is reasonable to consider that its impact is positive on the socio-economic activities of the community.

Conflicts of Interest

The authors declare no conflicts of interest.

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