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# An Assessment of the Energy Poverty and Gender Nexus towards Clean Energy Adoption in Rural South Africa

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**Abstract:** South Africa has about 2.5 million households without electricity access, most of which are located in rural areas and urban informal settlements. The nexus of energy poverty and gender is at play in the affected communities, as women and girls are culturally stereotyped with the task of collecting unclean fuels (e.g., firewood) and using these for their households' energy demands. Therefore, this study prioritized rural women and girls as respondents in the provinces most affected by gendered energy poverty (GEP) in the country. The study was carried out in selected rural unelectrified areas of Limpopo, Mpumalanga, and KwaZulu-Natal provinces using structured interviews. The study revealed that GEP in the rural areas has exposed women and girls living there to security concerns, health hazards, premature death, domestic fire accidents, time poverty, income poverty, illiteracy, drudgery in households and farm tasks, etc., at different levels of severity. It also showed the effects of perceptions, age, income, and culture on the choice of energy use among the respondents. Mitigation strategies against GEP in rural South African communities through clean energy adoption are also proposed in this paper.

**Keywords:** energy poverty; energy poverty and gender nexus; firewood; gendered energy poverty (GEP); indoor air pollution; rural South Africa; women and girls



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## 1. Introduction

The United Nations Sustainable Development Goal (SDG) 7 stated that access to reliable, sustainable, and affordable clean energy for all is important for national development [1]. However, there are about 1.1 billion people globally that are living without access to electricity and about 2.8 billion people using unclean fuels for cooking, the majority of which are in rural Sub-Saharan Africa (SSA) [2]. Access to affordable and clean energy is necessary for the elimination of energy poverty in the region.

The global energy demand is expected to be five times higher than its present figures because of increased technological and industrial advancements, increased electrical gadgets, and a world population forecasted to be over 9.7 billion by 2050 [3]. However, the energy sector cannot continue to increase its capacity of unclean energy plants in order to meet the growing demand; otherwise, the global temperature would increase by two degrees Celsius [4], which would result in harsh climate change, desertification, flooding, extinction of certain plants and animals, etc. Hence, there is a need to promote the use of sustainable, clean, and safe energy sources to meet the ever-growing electricity demand in the world, thereby curbing energy poverty. In fact, 2020 was reported to be 1.02 °C warmer than the baseline of 1951–1980, according to Goddard Institute for Space Studies (GISS) of the National Aeronautics and Space Administration (NASA) [5]. Therefore, energy poverty should be mitigated globally, but through renewable, clean, safe, affordable, and sustainable energy sources.

Energy poverty refers to a lack of access to sustainable and affordable clean energy services. Energy poverty in SSA affects females mostly, because women and girls are commonly stereotyped with the task of providing and using unclean energy for their

households. Consequently, they are involved in the daily collection and use of firewood (also called traditional biomass), paraffin (also called kerosene), coal, animal dung, and other unclean energy sources for their households' energy demands. Therefore, the energy poverty and gender nexus, also referred to as gendered energy poverty (GEP), describes the effects of energy poverty on women and girls because of their traditional responsibility of providing and using unclean energy fuels for their households [6–10].

Household air pollution, also known as indoor air pollution, is due to the incomplete combustion of unclean energy fuels within houses, and it is reported to account for about 4 million deaths yearly [10]. Furthermore, the exposure and inhalation of harmful gases from unclean cooking fuels is responsible for about 0.4–0.6 million deaths in children below the age of five in SSA and in South and Pacific Asia [11]. The premature deaths of these children below five years old is because they are often with their mothers while cooking in the kitchen, thus inhaling the fumes from the incomplete combustion of unclean cooking fuels.

Statistics South Africa [12] presented the latest General Household Survey (GHS), which showed that 84.7% and 80.4% of households in the country have electricity access from mains and use clean cooking facilities, respectively, and they are mostly found in urban areas. The type of energy used for lighting and cooking varies according to the type of housing, race, income level, and the gender of the family head [12]. In South Africa, common unclean energy sources used for lighting are paraffin and candles, and for cooking are firewood, paraffin, coal, and animal dung. Female-headed households, which represent about 37.9% of households in South Africa, are reported to be more affected by energy and income poverty than male-headed households [12,13]. This is also similar to experiences in other countries, as represented in [8,14]; hence the need for more gender-inclusive energy policies. In the future, most of the world's population should have access to clean energy by 2030, including rural dwellers. The majority of future electrification would come from renewable energy sources (RES)—powered by microgrids.

The objectives of this research are to study the challenges of GEP in rural South Africa and to make recommendations for solutions that would contribute to national mitigation plans, which would aid in the timely eradication of GEP in the country. This would offer an improvement in the quality of life in rural South Africa, not only for women and girls, but for all of the residents. This has a unique approach to studying the energy poverty and gender nexus in rural South Africa by conducting research on the people that experience it the most in rural Limpopo, Mpumalanga, and KwaZulu-Natal. The respondents are only female, as they are the target of the nexus research. The contributions of the work include extensively showing the relationship between energy poverty and multidimensional gendered poverties in health, time, literacy, economy, etc., that are experienced by the women and girls of rural South Africa, in a manner that has not been previously presented in the literature. Ten respondents from the qualitative interviews from the sample space were selected to reflect their personal experiences on the use of firewood as an energy source for cooking. The survey results present very useful information for any entity (public or private) that may want to mitigate the energy poverty and gender nexus in rural South Africa. The choice of rural areas from three different provinces was made to enhance the development of a solution model that could have a wider scope of acceptance and implementation at both interprovincial and national levels. In addition, as far as the author is aware, no previous work has covered the subject of the energy poverty and gender nexus in South Africa as conducted and presented in this work.

The rest of this paper is structured as follows: The energy poverty and gender nexus is presented in Section 2, the research methodology is presented in Section 3, and the results and discussions follow in Section 4. The recommendations from the research findings and the conclusion are presented in Sections 5 and 6 of this paper, respectively.

## 2. Literature Review on the Nexus of Energy Poverty and Gender

### 2.1. Nexus of Energy Poverty and Gender

Globally, energy poverty is felt differently across genders, incomes, traditions and cultures, and perceptions, as well as the availability of natural energy resources. However, it has been well mitigated, because the gender perspective has not been given the attention it requires. In 2003, women accounted for 70% of the 1.3 billion poor people in the world, and this is because gender plays an important role in accessing resources (e.g., energy) and decision making in households [15]. The authors further mentioned that the rural women had to devise strategies to cope with their energy poverty. Such strategies include a reduction in their cooking times and meals, eating cold foods and leftovers, changes in diet, the use of less fuel-intensive food processing and cooking methods, and buying other types of cooking fuels such as kerosene/paraffin. The work in [16] advocated for a shift in the measure of fuel poverty for households in England from an expenditure-based 10% indicator to a low income high cost (LIHC) indicator that measures a household's fuel poverty depending on its efficient use of energy. The non-uniformity in the energy efficiency of different fuel types needs to be considered in further adaptations of the proposed indicator [17,18]. The authors in [7] also emphasized the need to mitigate the nexus of energy poverty and gender (NEPG) as a key to achieving the United Nations Millennium Development Goals 3, 7, and 8 in developing countries. The technique of applied theatre, as a nexus and system analysis tool, was used to study some of the women in clean energy development in the Navajo nation [19] long with lessons to solve their energy-related social issues.

A study reported in [9] showed that women and girls in Mendakwe village, Cameroon, were at greater risk of energy poverty than men and boys. In 2016, 70% of households in SSA depend on solid fuels (especially firewood, charcoal, and coal) for their households' energy needs [20]. In Botswana, 4%, 44%, 89%, and 87% of rural women make use of firewood for producing jam, manufacturing local brews, cooking, and heating, respectively [21]. In addition, women carry heavy logs of firewood on their heads, shoulders, and backs over long distances daily in order to meet the energy demands of their households. Women walk an average of 5 km every day to collect close to 20 kg firewood for use in their households' and still return to cook with them in open fires, whose fumes are constantly inhaled by women and children [22]. It is even more severe in the Sahel region, where rural women travel between 15 and 20 km daily to fetch firewood for their households [22]. Deforestation and climate change in Africa have increased the challenges for women and girls fetching firewood, as they have to travel longer distances on foot to fetch firewood for their families. Gendered energy poverty is insignificant in North Africa because of its high rate of electricity access or near-universal electricity access [20,23].

The challenge of energy poverty in rural and informal communities in South Africa affects women (57%) more than men (43%) [12]. However, access to universal clean energy is an enabler of socioeconomic development in the country.

### 2.2. Overview of Energy Poverty and Gender in South Africa

Electrical energy is essential to effectively and safely carry out many household, commercial, industrial, and productive tasks. Nevertheless, it is expedient as it comes from clean and sustainable sources, which would contribute to economic development and the elimination of energy poverty. However, because of unequal access to clean energy in South African, the affected households burn unclean fuels in simple stoves and open fires. In addition, more men than women have access and receive a higher income [12,24]. The 2.5 million households in South Africa that lack access to electricity are found in unelectrified rural areas and urban informal settlements [6,12].

According to Statistics South Africa, about 19.6% of the residents in the country use unclean cooking facilities, while the rest use clean cooking facilities [12]. The provincial use of unclean cooking facilities in South Africa is 35.8%, 22.9%, 21.5%, 20.5%, 18.9%, 18.2%, 7.9%, 7.8%, and 6.6% for Limpopo, Mpumalanga, Gauteng, KwaZulu-Natal, Eastern Cape,

North West, Western Cape, Free State, and Northern Cape provinces respectively, in order of decreasing use [12].

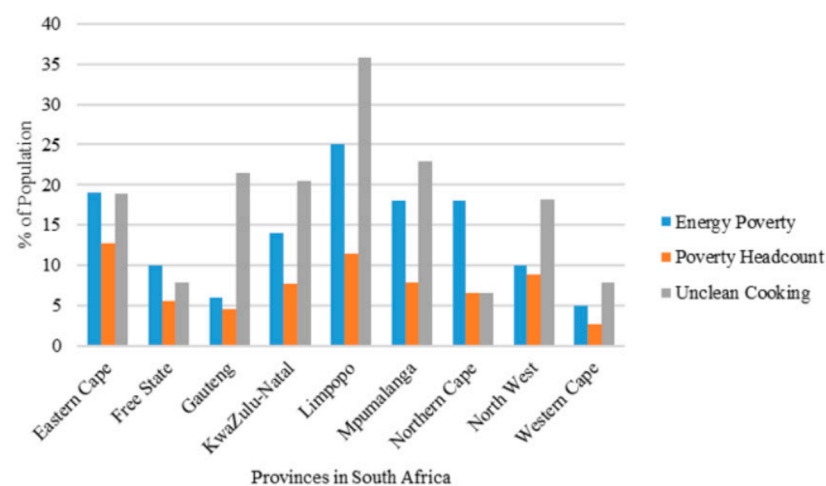
Unclean cooking facilities used in South Africa include firewood (7.7%), coal (0.4%), and paraffin (3.6%), while clean cooking energy sources being used are gas (3.6%), electricity (76.8%), and solar energy (0.1%). The remaining 7.8% accounts for other sources such as animal dung, agricultural residues, etc. In most cases, more than one energy source is used for cooking, depending on the availability and affordability at the time of use. Some residents use solar cooking stoves, but this only accounts for 0.1% of the energy mix for cooking in the country.

Rural households and informal settlements without electricity access are often challenged with the effects of indoor air pollution (IAP) and with the resulting risks to human health and the environment. The burning of firewood in human dwellings leads to the emissions of greenhouse gases (GHGs) into the atmosphere, including carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO), nitrogen oxides, sulphur hexafluoride, volatile organic compounds (VOCs), etc. These GHGs are harmful to human health, and also negatively impact the global climate [21,25].

The particulate matter (PM<sub>10</sub>) released from the IAP in rural dwellings is 300–3000 µg/m<sup>3</sup> for a period of 24 h [26]. However, GHG emissions during cooking in open fires may go up to about 10,000 µg/m<sup>3</sup>, which is significantly higher than the air quality standards of 75 µg/m<sup>3</sup>, 50 µg/m<sup>3</sup>, and 40 µg/m<sup>3</sup>, for PM<sub>10</sub> in South Africa, the United States of America, and the European Union, respectively [10,27,28]. The newly proposed PM<sub>10</sub> standards of 75 µg/m<sup>3</sup> and 40 µg/m<sup>3</sup> in South Africa aim to replace the previous air quality standards of 120 µg/m<sup>3</sup> and 50 µg/m<sup>3</sup> for daily and annual limits, respectively [28]. GHG emissions and small particulate matter from IAP cause inflammation in human lungs and airways, thereby reducing the capacity of the blood to carry oxygen, and causing impairment in the immune system of affected persons. Evidence of relationship between IAP and certain health challenges (e.g., laryngeal cancers, cataract, tuberculosis, nasopharyngeal, and low birth weight for newly born babies) have been established in the literature [21,25]. Hence, there is a need to find sustainable solution(s) to energy and poverty in the country.

Women and girls are also traditionally tasked with the collection of firewood for their families, thereby putting their lives and the lives of the children with them at risk because of different accompanying hazards, including physical hazards, health hazards, and even premature death, among others [8,12–14,22,29,30].

The statistics on energy poverty, poverty headcount, and unclean cooking in South Africa are presented in Figure 1, with data obtained from [12,13] on a provincial basis. Limpopo province has the highest population in energy poverty and use of unclean energy sources, and the second highest in poverty headcount. Females in Limpopo province are the greatest hit by energy poverty-induced gender poverty in the country.



**Figure 1.** Provincial statistics on energy poverty, poverty headcount, and use of unclean fuel for cooking.

The report in [31] by the Human Sciences Research Council (HSRC) further showed that females in Limpopo province suffer more from poverty incidence, severity, and intensity than their male counterparts. This implies that Limpopo in South Africa is the province with the highest occurrence of the nexus of energy poverty and gender in the country. Hence, was the province chosen for the highest number of respondents in this study.

Furthermore, baseline studies carried out by Statistics South Africa are presented in Table 1 using data from [32]. The table shows that Limpopo has the lowest average annual household income of R79,152 obtained from work, capital, pensions, social insurance, family allowances, individuals, imputed rent on owned dwellings, and other sources. However, the Western Cape has the highest average annual household income of R222,959. This further shows the inequality that exists between the provinces in the nation.

**Table 1.** Average annual household income by province.

Provinces	Average Annual Household Income
Eastern Cape	R90,156
Free State	R98,529
Gauteng	R193,771
KwaZulu-Natal	R101,088
Limpopo	R79,152
Mpumalanga	R107,561
Northern Cape	R103,912
North West	R86,926
Western Cape	R222,959

R—rand (South African currency).

The other provinces with energy poverty and gender nexus challenges among their rural dwellers considered in this study are Mpumalanga and KwaZulu-Natal.

### 2.3. Rural and Urban Dimensions of Energy Poverty and Gender Nexus in South Africa

The nexus of energy poverty and gender in South Africa has rural and urban dimensions. The rural dimension is mostly influenced by a lack of access to clean and affordable electricity. In rural South Africa, about one-third of residents lack access to grid electricity, and thus use unclean and unsafe sources of energy in their households. This task is traditionally carried out by women in the family. The urban dimension is mostly influenced by where the household lives and the type of dwelling they live in. Approximately 20% of households in Gauteng and the North-West province live in informal settlements (e.g., shacks), with the former having the highest record in the country. However, the metros in the country have the highest record of informal settlements. This is one of the factors that contributes to the energy poverty and gender nexus in urban areas. About 6.5% of the urban population in South Africa are without access to electricity, with the highest amount being located in Gauteng, which is the economic hub of the country; however, the urban population accounts for about 66.4% of the total population in the country [12]. Increased rural–urban migration is also a contributor to the increasing number of informal settlements in urban cities like Johannesburg.

In both urban and rural scenarios, NEPG occurs in South Africa because of certain factors. Firstly, the fetching and use of unclean energy sources by women and girls in order to meet the energy needs of their households due to a lack of access to grid electricity. Secondly, the lack of affordability of clean energy sources for some households, despite connection to grid electricity, therefore resorting in the use of unclean energy sources for lighting, cooking, and heating. For instance, about 10% of electrified households in the country still use firewood for cooking [12,33]. In 2012, the national survey carried out and reported in [33] showed that 43% of South African households were energy poor, because they spent, on average, 14% of their monthly income on energy needs. Thirdly, the preference of some households to rather use firewood freely obtained from nature than to

pay for electricity. Although the government has tried to introduce some policies in order to address these challenges, they have not yet been satisfactory.

In order to help poor households to afford the use of electricity, the government began the implementation of Free Basic Electricity (FBE) in 2003, whereby each indigent household is given free 50 kWh electricity monthly in order to meet their basic energy needs [34]. However, when FBE could not reach all of the indigent households, the government went further to introduce another policy called the Free Basic Alternative Energy (FBAE) in 2007 [35]. The FBAE policy gives indigent households without electricity access the equivalent of R56.29 in alternative fuels, such as paraffin and liquefied petroleum gas (LPG), or whatever is deemed fit by the municipal government where they reside. Furthermore, the government of South Africa introduced the Inclining Block Tariff (IBT) in 2010, with the intent to make indigent and low-income households pay less for electricity and promote energy efficiency among medium- and high-income households [36]. Despite the FBE, FBAE, and IBT interventions by the government, there are still energy-poor households in the country, as the programs did not reach all of the intended recipients in the country, especially the urban poor population and unelectrified rural population.

There are some studies in the literature about energy poverty in South Africa [11,30,37–39]. These studies highlighted some of the challenges related to energy poverty from different perspectives. However, this study carried out a more robust analysis by conducting inter-provincial structured interviews with the target group only in order to establish a more robust solution for the country regarding the mitigation of the energy poverty and gender nexus. This is an approach not taken in previous literature. In addition, using women and girls only as respondents was not done in any of the previous literature, but was done in this work in order to know how well the target gender are affected by energy poverty so that the proposed solutions could be more effective. Hence the unique approach adopted for this research.

### 3. Research Methodology

This research employed quantitative and qualitative research methodologies to understand the respondents' subjective perspectives on the topic of interest [40,41]. This study was intended to reveal their perspectives and opinions on the subject, so as to generate qualitative results that could lead to good recommendations for the appropriate mitigation of GEP in rural unelectrified areas of South Africa. In order to achieve this efficiently, structured interviews using predetermined questions were developed for all of the respondents, with opportunities given to each person to express her opinions. The interviewees comprised female (women and girls) only, as the focus of the work is on gendered energy poverty. This is not because there are no males (men and boys) in the chosen municipalities, but because the study is focused on the effects of GEP, which would be better reported by the affected gender (women and girls) than by men and boys. This research applied purposive and quota (in part) sampling methods in order to obtain subjective realities from the study. The authors in [19,42] also advocated for women's participation in properly understanding the nexus of energy poverty and gender and for proffering solutions.

The sample space was chosen from the three provinces in the country with the highest use of unclean energy sources for cooking—Limpopo, Mpumalanga, and KwaZulu-Natal. However, more interviews were conducted in the Limpopo province because it has the highest percentage of residents affected by gendered energy poverty in the country, according to the data obtained from [12,13]. In KwaZulu-Natal, the interviews were conducted in the unelectrified areas of eMngwena and eMhlabung. In Limpopo, interviews were conducted in unelectrified areas of Ga-Mashishimale in the Mopani District Municipality, Mashite, and Ga-Mphahlele in the Capricorn District Municipality. Furthermore, eMakhazeni in the Emakhazeni local municipality was chosen within the Nkangala District Municipality in Mpumalanga. All of these communities are made up of majorly black African people. The choice of provinces for this research was not aimed at sidelining any province, but was made because these three provinces account for 68% of the poor and

unclean cooking energy population of South Africa [12,13]. Hence, the results from them can give a good idea about what is happening in the other six provinces in the country.

Because of the COVID-19 pandemic in the country, and the restrictions placed by the government in order to limit the spread of the virus (such as reduced human-to-human contact), the conventional survey method of sharing questionnaires could not be adopted in this research. Therefore, the questions were designed in Google form and were filled in according to the responses of the residents. The form contained two parts. In Part A, which was for the quantitative analysis, options were provided for the respondents to choose their answers from. In Part B, which was for the qualitative analysis, the respondents were given the liberty to respond in their own words with short answers, without options given. Hence, they could freely express their answers, which would be written down by the interviewers. The demography of all of the respondents is presented in Table 2. Structured interviews were conducted with 1366 women and girls without access to electricity and using unclean energy sources for lighting, cooking, and heating in the communities mentioned above.

**Table 2.** Demographics of the respondents.

Gender	Province	Age (Years)	Number of People	%
Female	Limpopo	0–17	107	7.8
		18–30	328	24.0
		31–50	349	25.5
		51 and above	189	13.8
	KwaZulu-Natal	0–17	38	2.8
		18–30	64	4.7
		31–50	66	4.8
		51 and above	24	1.8
	Mpumalanga	0–17	28	2.0
		18–30	76	5.6
		31–50	59	4.3
		51 and above	38	2.8
TOTAL			1366	≈100

Table 2 shows the age group of the respondents considered across the chosen provinces. The results of the survey can be considered to be reliable because of the spread of adult respondents, that is, from 18 years and above. The Google form was filled out by the interviewers on behalf of those who did not have a smart phone, as was the case with most of the respondents. Non-ownership of a smart phone can also affect the level of access to e-news, e-learning, e-banking, etc.

#### 4. Results and Discussion

The results presented in this section cover all of the survey results for Parts A and B of the questionnaire from the three provinces visited for this study.

##### 4.1. Results from Survey Questions—Part A

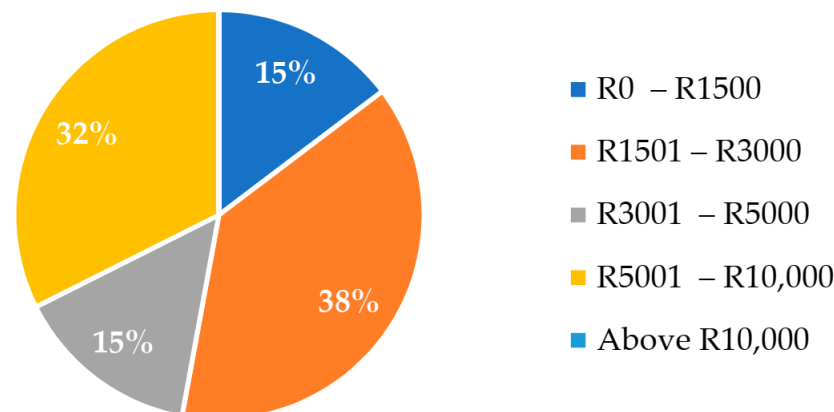
The female residents of these rural unelectrified areas spanned across all age groups, as shown in Table 2. Most of the children and youths were living with their grandparents, while some were living with their middle-age parents. The survey was conducted over six weeks, where four weeks were spent in Limpopo, and a week each was at KwaZulu-Natal and Mpumalanga.

The average household size was five people per household, with 65% being male-headed, and 35% female-headed households. There were only 6% households headed by persons under the age of 18 years old, while 94% were headed by persons older than 18 years old. Hence, household energy decisions can be considered reliable, as guidance from an adult would be available.

The dwelling types comprised 63% formal/brick houses, 28% traditional/hut, and 9% informal dwelling/shack. Hence, electrical wiring could be installed in most houses when they have electricity access. The government is committed to building houses for those without formal dwellings in rural and urban areas of the country [6].

The employment statistics showed that 29% of respondents were self-employed, 24% were civil or public servants, 24% were students, and 15% were farmers, while the remaining 9% did jobs occasionally. The respondents were also majorly dependent on grants, salaries, and pensions, while a few were dependent on farming and personal businesses. This shows that the burden of clean energy would be on the few earning monthly payments. Their level of income was also a great determinant to their choice of energy, as previously also mentioned by [15].

In addition, the majority (i.e., 68%) of households earned below R5000 monthly, as shown in Figure 2. However, none of the respondents had a household monthly income greater than R10,000. Therefore, according to [32], the majority of the respondents were in the poorest/first quintile of income (R7029 or less per month). This further shows that most of them were living in income poverty, which could be related to their energy poverty and may affect their choice for clean energy.



**Figure 2.** Levels of household monthly income.

The distribution of the level of the highest educational qualification obtained by the respondents is presented in Table 3, showing that about 83% had at least a primary school education. This was advantageous to us during the survey, as most of them could comprehend the questions being asked and they answered correctly either in English or their native language. In addition, this would contribute to their reception, adaptation, and use of clean energy when given the opportunity.

**Table 3.** Highest educational qualification obtained by respondents.

Highest Educational Qualification Obtained	% of Respondents
Tertiary	18.2%
Secondary	42.4%
Primary	21.8%
None	17.6%

The use of different sources of energy for lighting, cooking, water heating, and space heating by the respondents is presented in Table 4, and shows that most people used more than one source of energy for each type of energy demand. This is the reason the total number of respondents for each energy use is more than the total number of respondents (1366 respondents). It can also be seen from Table 4 that firewood and paraffin were the most used unclean energy sources used by the unelectrified population. However, firewood was the highest unclean energy source used for cooking, water heating, and space heating



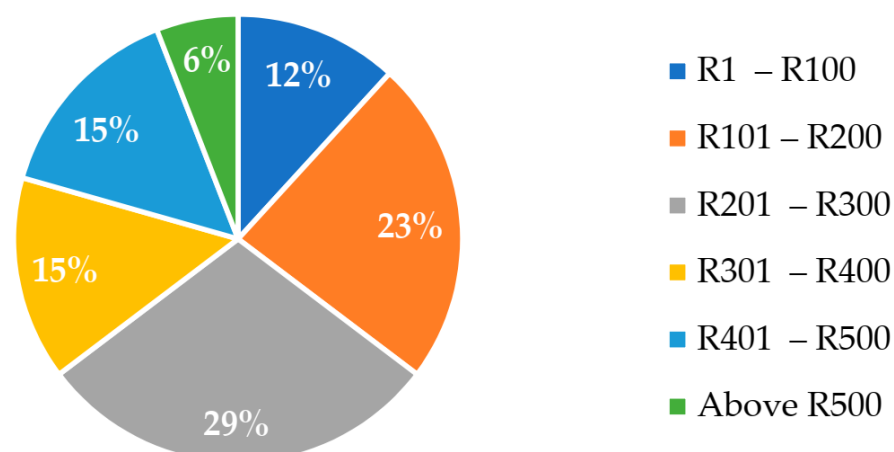
by the respondents. A reason for its wide use in these communities is because it is freely available from nature.

**Table 4.** Energy use for lighting, cooking, water heating, and space heating.

Energy Source	Number of Respondents Using Energy Source			
	Lighting	Water Heating	Cooking	Space Heating
Animal dung	-	80	120	94
Batteries	120	-	-	-
Candles	884	402	-	482
Coal	-	240	200	254
Firewood	74	964	1044	924
Paraffin	482	362	1020	444
Solar energy	21	-	-	-

Lighting energy need was mostly met with paraffin; the water heating energy need was mostly met with firewood; the cooking energy need was mostly met with firewood, followed closely by paraffin; and their space heating energy need was mostly met with firewood as well. However, solar energy was sparingly used for lighting by the respondents, most of whom were among the Limpopo respondents. The use of solar lamps for lighting needs to be encouraged much more among unelectrified rural dwellers to improve the quality of their energy mix and to deter them from using unclean energy sources for lighting and their associated consequences. It would also offer its users longer hours for business, studying, family time, etc.

The alternative energy sources being used are either bought with money or are freely obtained from nature and neighbors. The households' monthly average energy expenditure is presented in Figure 3. These results show that most of the respondents spent less than R300 monthly on energy expenditure for purchased fuels, and their average energy expenditure was R265 for the sample space. It should be noted that this result does not include the cost of free fuels used by the respondents, which could have an effect of the results presented in Figure 3, were they to pay for them. This is very important to note, and can be an indicator of the amount they may be willing to pay for electricity bills when given access.

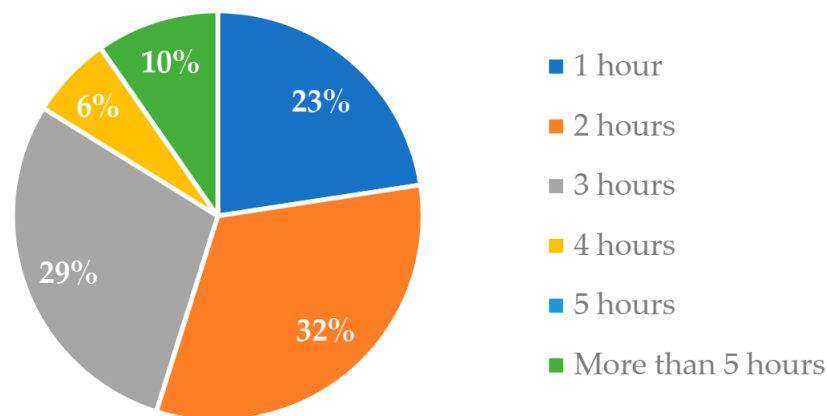


**Figure 3.** Household monthly average energy expenditure.

Furthermore, the respondents showed 98% willingness to switch from unclean sources of energy to clean energy use through electricity access. However, 95% indicated willingness to switch to renewable energy as the source of energy for electricity access. This is a promising development for the government or independent power producer, who may want to bring electricity access to these communities. As they did not have electricity

access as at the time of conducting this survey, the only government energy intervention policy that they could benefit from was the Free Basic Alternative Energy (FBAE), but it was only being accessed by 6% of the respondents for the purchase of paraffin. In fact, most of them were not even aware of the FBAE government policy at all; hence the need for more awareness of the FBAE policy in rural areas. As paraffin is among the sources of many shack fires in South Africa, the government should allow people to use FBAE money to purchase clean energy sources like solar lamps, solar cooking stoves, and solar heaters.

Figure 4 shows that the majority (61.3%) of people spent 2–3 hours daily going to the bush/mountain to fetch firewood for household energy use. This productive time spent fetching firewood could be used for other productive activities that could increase their income and lead to better living standards.



**Figure 4.** Time spent fetching firewood daily by the respondents.

It was also discovered that the time taken by each person to fetch firewood depended on her proximity to the source of firewood, the quantity of firewood needed, and what energy demand the firewood would be used to meet. Good wood for cooking is not abundant in the bushes and mountains any longer as in the past due to deforestation, and hence it takes a longer time to get them. In addition, skills are required to fetch good and safe wood for household energy use. There is the fear of extinction of these good woods as they are not consciously replanted after felling. If electricity access is not extended to them on time, the challenges they faced from fetching and using firewood would definitely increase.

The challenges faced by the residents of these communities using firewood, paraffin, and candles as energy sources are presented in Tables 5–7, respectively. The results presented in Table 8 represent the challenges they face due to lack of access to electricity. These challenges are arranged in the tables in the order of decreasing severity to the respondents. The values presented in Tables 5–8 do not add up to 100% because the respondents were affected by more than one challenge for each type of unclean energy being used.

The results presented in Tables 5–7 show that respondents are mostly challenged by the use of firewood, followed by candles, and then paraffin. More penetration of solar lamps, cooking stoves, and heaters would reduce these challenges and the levels of severity on the residents. Electricity access is a major solution that would eliminate the challenges of energy poverty, as long as its affordability is also addressed.

The perceptions of the respondents were also obtained regarding the effects that universal electricity access can have on their lives and livelihoods. About 85% responded that electricity access would improve their standard of living and economic activities. In addition, 82% responded that it would improve the quality of health services received in the communities, the academic performances of the learners, and the quality of life of the residents.

**Table 5.** Challenges of using firewood as a source of energy.

Challenges	% of Respondents
Handling the wood requires caution to avoid injury	72.7%
It is very challenging to use wet wood during raining season	69.7%
Time taken to fetch firewood from the forest or farm	61.5%
Danger involved in fetching firewood from the forest	57.6%
Lots of firewood is required	54.5%
It takes longer time to finish cooking	51.5%
Time wasted in fetching wood	48.3%
Cost of firewood	42.4%
Lungs and eyes infections and diseases	39.4%
Wood burning can get messy	36.4%
Risk of household fire	35.2%
Fear of deforestation	33.3%
Limited time to go to school	30.3%
Limited time to participate in societal activities	24.2%
Indoor air pollution	21.2%

**Table 6.** Challenges of using paraffin as a source of energy.

Challenges	% of Respondents
Risk of household fire	45.5%
Paraffin is expensive to buy	38.3%
Non-availability of paraffin whenever needed	33.3%
Needs constant refilling	24.2%
Indoor air pollution	22.3%
Adverse health issues (e.g., respiratory issues, eye problems, and lungs diseases)	21.2%
Poor lighting	15.2%

**Table 7.** Challenges of using candles as a source of energy.

Challenges	% of Respondents
Risk of household fire	67.6%
Poor lighting	58.8%
Needs constant replacement	50%
The cost of buying candles	47.1%
Indoor air pollution	32.4%
Adverse health issues (e.g., respiratory issues, eye problems, and lungs diseases)	29.4%

**Table 8.** Challenges of lack of access to electricity.

Challenges	% of Respondents
Poor lighting	66.7%
Unclean and unsafe cooking methods	65.9%
Insecurity	62.8%
Difficulty in charging mobile phones	63.6%
Limited time to study for students	57.6%
Time wastage	55.5%
Difficulty in using the alternative unclean energy sources	50.5%
Lack of access to timely and correct media information	48.5%
High demand on human power to do work that machines could do faster and easier at home, farm and work	45.5%
Difficulty to use electronic gadgets	42.4%
High level of emigration of youths	33.7%
Health issues (e.g., respiratory issues and eye problems)	27.3%
Low socio-economic activities	24.2%
Limited time for trading activities	21.2%

The summary of the consequences of gendered energy poverty on the lives of the respondents is presented in Table 9, in the order of decreasing severity. Likewise, the values do not add up to 100%, because the respondents are challenged by more than one factor. These results show that they view security as the greatest challenge they are subjected to because of a lack of electricity access, while societal and political limitations are their least challenges. The impact of energy poverty on their level of literacy also influences their employability and access to good and quality jobs, which would also determine their income levels. Hence, energy poverty is a challenge that has many interconnected consequences or challenges. Earlier work by [43] showed that an increase in rural electrification in South Africa led to a 9% increase in female employment and income.

**Table 9.** Consequences of gendered energy poverty on the respondents.

Challenges	% of Respondents
Security issues	69.8%
Income poverty	67.6%
Sexual assault	62.9%
Illiteracy	55.9%
Time poverty	50%
Physical hazards	38.2%
Adverse health effects	32.4%
Untimely deaths	23.5%
Ageing	23.4%
Drudgery in household tasks	20.6%
Drudgery in farm tasks	16.7%
Societal and political limitations	14.7%
Other	2.9%

#### 4.2. Results from Survey Questions—Part B

The results for Part B of the questionnaire are presented in this section. However, because of the constraints regarding the space and length of this article, only ten responses were selected per question and are presented in this section. The responses are presented as provided by the respondents in order to preserve the quality and originality of the findings, except for some grammatical corrections, where necessary.

##### **Question 1 (Q1).** *How do you feel using firewood for cooking?*

*Responses:*

- i. I don't feel good at all. It's annoying.
- ii. I don't like it because it requires a lot of things. My kids have to either fetch wood in the bush or buy when we have money.
- iii. I think it is really bad because nowadays the kids prefer to buy firewood for use at their homes, but we can't afford to buy most times so my kids are negatively affected by this.
- iv. I really enjoy using firewood for cooking. It's a culture that we will never stop practicing.
- v. It was not nice at first, but I got used to it. As a child I used to feel like it's a lot of work because I had to fetch the firewood we would use for cooking in the house. Now, I am used to it and I feel like it's actually faster than using electric stoves.
- vi. I hate using firewood for cooking, but sometimes we don't have any choice especially since there is no electricity.
- vii. Firewood nowadays is expensive so cooking using firewood is too costly for my family since we are not working.
- viii. My girls are a bit affected because they are sometimes forced not to bath before going to school due to time required for the water (used to bath) to boil. This is not good especially for girls who maybe in their menstrual periods on those days.

- ix. Not really happy because it requires a lot of energy to go fetch the firewood and to cook thereafter. It's really not a good idea if you have other choices because firewood on its' own is not just the best way to go about cooking.
- x. It is not easy for girls carrying firewood while having menstrual period pains.

These responses reveal that most of the respondents are not pleased with the use of firewood, except for a negligible amount (four elderly women) who said that they have gotten used to it and so do not see anything bad about the use of firewood for cooking because it is their culture. However, they did not enjoy the use of firewood when they were younger. This implies that age also has an effect on people's perceptions of unclean fuel. The incorrect perception of cooking with firewood as part of culture by the few old women could also be addressed through an awareness campaign on clean energy. It is important that they experience clean and safe means of cooking and to see if their judgement would be different.

**Question 4 (Q4).** *What risks do you face during fetching and using firewood as an energy source?*

*Responses:*

- i. It is very risky to life and I get hurt in the mountains sometimes.
- ii. It's dangerous and unsafe. There are some snakes and other dangerous animals in the mountains.
- iii. Going in the bush is not safe especially when we don't know what or who else is in the bush with us.
- iv. It's dangerous in the bushes. Some trees are dangerous since they have thorns, while others are dangerous because of some fluids that come out of them when you cut them and we don't know.
- v. We encounter dangerous animals like snakes in the bush. Also, some thieves and rapists attack us on the way to and from the bush.
- vi. We are exposed to wild animals in the mountains. Also, climbing mountains is not easy at all most especially, when we are returning home carrying firewood.
- vii. There are animals that can kill human beings when fetching the firewood in the bushes. We also hurt ourselves when cutting the firewood. Also, when cooking with firewood we get burns on our skins by the fire or hot firewood.
- viii. Fetching firewood outside is 100% not safe, so my kids are at risk of being kidnapped and mugged.
- ix. My kids are very playful and we all know how dangerous the bush is in terms of wild animals and other things that might be a threat to them while playing on the way to and from the bush to fetch firewood.
- x. Nowadays crime has risen at a very huge rate so going into the bush especially with girl-children is very risky. Also, when it is my kids' turn to cook, they get too playful to a point that they play around the fire, and also with the fire which leads to serious fire accidents and injuries on their bodies at times. My girls are also at risk since I sometimes force them to go outside and fetch firewood alone while I am busy with other chores at home. They sometimes don't even bath, and that can attract other diseases into their bodies.

These responses show that all of the respondents face at least one type of risk associated with fetching and using firewood, including health risks, fire risks, rape, kidnapping, premature death, and physical hazards. Therefore, eliminating a highly risky energy source will make people's lives safer. This has also been supported by the works in [8–11]. Unclean energy needs to be replaced with clean energy sources to spare more women and girls from the associated effects of fetching and using firewood as an energy source.

**Question 5 (Q5).** *What are the effects of fetching and using firewood on the girl-child education?*

*Responses:*

- i. My kids have less time to study or do their school work.
- ii. When most of the kids are at the school, mine are in the bush looking for firewood.

- iii. My girls are usually forced not to go to school when they are in their menstrual periods simply because they are too slow to get the fire started in order to boil the water that they will use to bath.
- iv. It requires so much time to fetch and use firewood, hence it negatively affects my kids because some teachers are rude at their school, and won't even have pity on them to at least revise the content covered when my girls were absent at school.
- v. Also, cooking with firewood takes time and my kids eat late, which is not good for kids that are going to school. We all know that learning on an empty stomach is not as effective as learning on a full one.
- vi. My kids do not have enough time to revise their school work due to needed time to fetch firewood from the bush.
- vii. Since we don't have electricity, the children can't study at night even when they are preparing for tests and exams. I believe that this affects their performances at school.
- viii. In fact I'm afraid that my children may not be able stand with their mates in the future because they don't go to school on days that they return very late from the bush.
- ix. It affects their performances at school because they are sometimes late to school due to the distance of our house from the mountains where they fetch firewood.
- x. Reading around firewood fire is very risky for the girls because they sometimes doze off near the fire, which is very risky for them. There is also the risk of loose pages of their notes and textbooks flying inside the fire. We sometimes pay fine to the school on the textbooks because they are borrowed to the learners by the school. In fact, one of them had a portion of her hair burnt with candle fire while studying when they were quite younger because they were careless around the fire.

According to the respondents, the education of girl-children is also affected by fetching and using firewood. This includes lateness to school because of the long time it takes to fetch firewood and make the firewood fire, inability to catch up with school work due to lateness to school, and insufficient time for studying after school. Furthermore, a lack of access to electricity limits their access to remote or distance education through the internet or radio. Some use battery-powered radios in order to listen to news, radio classes during COVID-19, and to enjoy some entertainment. If this energy poverty continues, the literacy gap between men and women would continue to widen as well. Hence, there is a need to mitigate gendered energy poverty in rural South Africa.

**Question 6 (Q6).** *How is the use of firewood affecting your health?*

*Responses:*

- i. The fume could harm someone, and cause tuberculosis. My kids sometimes also get injured while in the bush.
- ii. It's very dangerous to the eyes during cutting of trees. It also affects the sight of women and girls during cooking.
- iii. Some trees can be poisonous to us and we don't know until they are being used.
- iv. Some trees are not safe for cooking due to the fluids they contain and causes some fever when they are used.
- v. I don't know of any health effects of using firewood because I am used to it.
- vi. There is no negative effect of using firewood on our health unless when we use the trees whose smoke causes headache. Since I have been using firewood for years, I know the trees and I don't fetch the harmful trees from the bush. Therefore, I don't get sick from using firewood.
- vii. In terms of health, the firewood affects me negatively because the smoke does not always go through the chimney, and the smoke causes air pollution that can affect the lungs. This air pollution leads to lungs cancer, eye irritations, and difficulty in breathing at times.

- viii. The flames from burning firewood affect our health. Also, small particles of the wood can enter our eyes when cutting the wood into smaller pieces and cause eye defects such as cataracts. The kids are mostly affected by these because they are not always careful with the trees and they don't know much about firewood.
- ix. The fumes from burning firewood can cause tuberculosis from constant inhalation. So they die prematurely because the clinic is also far from the village.
- x. I sometimes cut myself while cutting the trees, but as time went on I started learning how to cut them in a safe manner although I still cut my hands sometimes.

The responses show that most of the respondents are aware of the health challenges (e.g., tuberculosis, lungs cancer, breathing difficulties, and premature death) associated with the use of firewood as an energy source, while a few of the respondents are not aware of any health challenge associated with the use of firewood, as mentioned earlier in [10,11]. However, these minority have some health challenges, which they are not sure are related to the use of firewood. So, it may not be sufficient to accept their claims of no negative effects of firewood on their health.

**Question 7 (Q7).** *How is the use of firewood affecting your time use?*

*Responses:*

- i. Wet woods take a lot of time to burn during cooking. Also, it takes a lot of time to fetch and prepare firewood for cooking.
- ii. Three hours in a day spent to fetch firewood is a lot of time, and we usually come back late from fetching wood.
- iii. My kids sometimes play in the bush, and therefore makes us to take more time than needed in fetching the firewood home.
- iv. I would say that it does takes much of our time, but if you get up very early to fetch firewood it won't affect any of your other plans for the day.
- v. Using firewood for cooking saves times and is usually faster than using electricity for cooking once you know how to make quick fire. It only takes more time when fetching the firewood, but we longer do that as we do buy from the shops.
- vi. Firewood cooks faster, but fetching them can be energy and time consuming.
- vii. Cooking with firewood needs one to start early because it's a very slow process.
- viii. My kids are either arriving late or not fully focused at school whenever they start boiling water too late. I was told by the teacher that they even doze during class, which is not good at all as this might cause my kids to even fail in their schools.
- ix. It is time consuming because most of the firewood we use don't catch fire quick so we are sometimes forced to arrive at work and school late.
- x. Cooking with firewood takes time and it makes my kids eat late, which is not good for kids that are going to school.

The challenge of time use is also experienced by the residents of these communities because of their lack of access to electricity. Fetching and cooking with firewood takes a lot of time from its users, but the time taken varies from household to household. The time spent fetching and using firewood depends on a number of factors, including their proximity to the location of the firewood, an individual's skill at identifying good firewood in the bush/mountain, an individual's skill at making a fire quickly, affordability of the purchase of firewood from the shops and hawkers, and distance from the shops. However, it is clear that the productive time of women and girls is being competed for by the use of firewood as an energy source. This productive time could instead be used to improve their socioeconomic lifestyles, educational activities, family time, recreation, etc., as also advocated for by [11,14,15].

The responses of the respondents regarding their source of firewood are presented in Table 10, and shows that the residents obtain firewood for cooking from the bushes, mountains, and/or local purchases. The source of firewood depends majorly on their proximity to the bush or mountain, and the availability of financial resources to purchase firewood for the household. Although purchasing firewood exempts them from the evils

attached to fetching it from the bush or mountain, it still exposes them to the evils associated with the use of firewood. They are also mostly financially-constrained when buying firewood, even when they would like to do so. However, the woes attached to both the collection and use of firewood need to be addressed without further delay.

**Table 10.** Source of Firewood for Household Use.

Source of Firewood for Household Use	% of Respondents
Mountains and bushes only	60%
Buy only	20%
Mountains and bushes + Buy	20%

When asked about their perceived effects of firewood on the environment, their responses included air pollution, deforestation, threat to the preservation of animal life, soil erosion, global warming, and environmental uncleanness. As environmental preservation is essential for sustainability, it is important that all of the factors putting it at risk are addressed in the country.

The survey carried out and reported in this work is found, in some cases, to fill some of the gaps and concerns identified in some existing literature [8,13,21,22,37,38,43–48]. An imminent solution is expected from all stakeholders in order to end gendered energy poverty in rural South Africa, and the world at large, in a timely manner.

## 5. Recommendations for the Mitigation of the Energy Poverty and Gender Nexus in Rural South Africa

Offering sustainable solutions towards the mitigation of the energy poverty and gender nexus in the country is highly imperative. The recommendations presented in this section are based on the findings from this work.

Firstly, increased awareness on the risks associated with the use of firewood should be given priority by the government at all levels—national, provincial, and local municipal levels. This is necessary because some of the respondents have limited knowledge of the risks associated with the use of firewood. Some elderly respondents have greatly adapted their lives to the use of unclean fuel, and do not think that electricity could be better. Such awareness generation should include radio jingles and bill boards in native languages. In addition, community meetings can be used as avenues to increase awareness on the effects of the use of unclean energy sources, as well as the advantages of clean energy. Furthermore, concerning the low awareness of the respondents regarding the government's energy policies, there more policy enforcement officers from the Department of Energy (DoE), South Africa, should be deployed to the rural areas so as to engage more closely with them, and to assist with the necessary documentation required for them to benefit from the current and future energy-incentivized policies. It is also recommended that the officers sent to these unelectrified areas speak the local dialects for ease of communication and understanding the information being passed across.

Secondly, as soon as electricity access gets to the people, it is essential that it is made affordable to the residents, so that they will use the electricity for their basic energy demands of lighting, cooking, and heating. Supplying electricity is one thing, but making it affordable for them to pay electricity bills is another very important thing in order to ensure the usage of electricity when they are connected. As the majority of residents presently spend less than R300 on their current monthly energy expenditure (on firewood, paraffin, coal, etc.), it is essential that with clean energy use, their monthly energy expenditure is still kept affordable with respect to the household income.

Thirdly, household energy decisions and responsibilities are culturally gendered in Africa, and so the fetching of firewood and cooking is majorly allocated to the women and girls in the family. This is the reason all of the respondents in this study were only women and girls. Therefore, there is a need for energy responsibilities and decisions in South African homes to embrace gender equality. For instance, if men and boys join women and



girls in going to fetch firewood pending their electrification, there will be reduced risks for the rape and kidnapping of women and girls. This would also lead to keeping more girls in school.

Fourthly, there is a need for an increased presence of security operatives and surveillance in the rural areas in order to protect women and girls against kidnapping and rape on the way to and from the bush or mountains when fetching firewood.

Fifthly, the government needs to promote more gender-friendly energy policies, which should include gender-sensitive energy planning strategies for low-income and rural women in order to alleviate their energy-related gender poverty. The uniqueness of the energy needs of men and women, and how clean and modern energy technologies can sustainably impact them equitably, affordably, and profitably, should be considered by the government. This study has shown that the experiences of rural women and girls to energy poverty are similar, at least across the three provinces considered in this study. There is a need for the government to coordinate its energy policies at every level in order to have a desired national result of universal electricity access. Representatives of residents and civil societies in unelectrified areas and informal settlements should be considered to sit with government officials at all levels in order to find enduring and workable solutions to the challenge of energy poverty and gender in rural and urban settlements in the country. The work in [19] also shows the capability of women to drive clean energy.

Sixthly, the government should speedily embrace universal electricity access through distributed energy generation using renewable energy sources, such as solar and wind, as appropriate for each community. Some of these communities are located amidst mountains, which would be very expensive for grid extension. Hence, renewable energy-powered generation should be encouraged for these off-grid rural unelectrified areas. Therefore, distributed standalone or off-grid renewable energy-powered microgrids are recommended for these rural unelectrified areas, which can be implemented faster by independent power producers (IPPs) and local municipalities. There is ongoing legislature aimed to open up more space to independent power producers and municipal power generation in the country [49]. In the 2020 budget, a total of R16.4 billion was allocated to support the Integrated National Electrification Program (INEP), from which 560,000 new connections to the power grid were expected over the medium-term expenditure framework (MTEF) period, and 15,000 households are to be provided with non-grid connections per year [50]. This electrification program is to be executed by the municipalities and Eskom. However, there have always been backlogs from past budgets that were not realized. The 2021 budget for INEP was reduced to R3.6 billion due to the effects of the COVID-19 pandemic on the economy [50]. This implies that after economic recovery, the government of South Africa would have to do more in order to achieve the 2030 universal electricity access plan. Many years ago, the grid connection of microgrids was a no-go area in the country's power industry, and no one was allowed to be off-grid, but as the energy demand continued to rise beyond the capacity of the ailing power infrastructure, it became necessary for the Department of Mineral Resources and Energy to review its laws and policies governing microgrids both in standalone and grid-connected modes [51,52]. In fact, the power utility in the country, Eskom, has informed the populace to expect load shedding to continue for the next five years, meaning that the energy crisis in the country is not going to end in 2021 [52]. The President of South Africa, Cyril Ramaphosa, said during the State of the Nation Address (SONA) in 2020 that the government has made amendments to the laws governing the operation of IPPs in the country [53]. The new changes include regulations on new generation capacities, license for own-use distributed generation, and procurement of power from IPPs. The IPPs are now allowed to generate beyond 1 MW capacity, and their contribution to the national grid is expected to grow to 6800 MW by 2024 [53,54]. The IPPs greatly welcome the new developments and policies in the energy sector. Hence, it is envisaged that some unelectrified areas in the country would be served in the future by IPPs using renewable energy sources, instead of everyone waiting for the national utility provider to extend the grid to them. Thereby contributing significantly to the mitigation of

gendered energy poverty in the country through access to clean energy. As the government continues to advance in its goal towards universal electricity access, more policies are expected to be enacted that would encourage increased electricity access in the country, clean cooking facilities, affordable electricity bills, distributed generation and storage, feed-in tariffs, clean energy incentives, etc.

Seventhly, the challenge of energy affordability needs to be addressed. In South Africa, any household spending more 10% of its monthly income on energy expenditure is said to experience household energy poverty [28,33,55]. Therefore, based on their current average energy expenditure of R265 monthly, which does not include the cost of free firewood obtained from the bushes and mountains, it is recommended that the government should increase the amount of energy allocated under the FBE program from 50 kWh to 100 kWh, as the electricity tariff increased by at least double its value between the creation of FBE and now [34,56]. In addition, the amount allocated to households under the FBAE program to assist the residents with the affordability of clean energy should increase from R56.29 to an amount that supports energy affordability (less than 10% of monthly income) in accordance with Equation (1), as long as the calculation yields a positive result:

$$\text{Proposed FBAE} = \text{Monthly energy expenditure} - 10\% \text{ of household monthly income} \quad (1)$$

This can be done in a similar way that tax returns are done in agreement between the DoE, South Africa, and the South African Revenue Service (SARS). The implementation of the proposed FBAE in Equation (1) would further encourage rural residents to use electricity for household and commercial needs whenever access is granted to them. In addition, if (1) is implemented, it would contribute to solving some of the concerns of the government of South Africa at different levels by solving energy poverty and its accompanying effects. Furthermore, the FBAE fund should be discouraged from being used to purchase unclean fuel (e.g., paraffin, candles, firewood, etc.), but rather clean energy sources such as LPG, solar energy, and wind energy. As paraffin is among the sources of many shack fires in South Africa, the government should allow people to use the FBAE money to purchase clean energy sources like solar lamps, solar cooking stoves, and solar heaters. These policy amendments can be implemented by the local municipality authorities with approval from the DoE of South Africa for the rural residents. The use of energy-efficient appliances should also be encouraged, as this could contribute to the reduction of their electricity bills as well. However, certain intervention measures could be introduced by the government in agreement with certain indigenous manufacturers to sell their energy efficient appliances at reduced rates to their rural customers.

This work proposed strategies that are gender-inclusive solutions in the mitigation of the NEPG. It has also become more eminent than before to actively involve women in solving women's energy poverty issues, as also advocated in some literature [7,15,19,30,42]. This work contributes significantly to a nationwide survey and mitigation studies on the energy poverty and gender nexus in rural South Africa.

## 6. Conclusions

This work aims at studying the effects of energy poverty on women and girls in rural unelectrified areas of South Africa, with an all-female sample space chosen from three predominant provinces where gendered energy poverty is mostly experienced in the country. This is to encourage the stance that gendered energy poverty is better solved with gender-inclusiveness. This work showed that the respondents predominantly used candles for lighting, and firewood for cooking, water heating, and space heating. The unclean energy sources comprising their energy mix are paraffin, batteries, coal, and animal dung, while solar lamps were the only component of clean energy in their energy mix, but they were only used by 0.02% of the respondents for lighting.

The results further showed that, in decreasing order of severity, NEPG inflicted them with insecurity, income poverty, sexual assaults, illiteracy, time poverty, physical hazards,

adverse health effects, untimely death, ageing, drudgery in household tasks, drudgery in farm tasks, and societal and political limitations.

Women and girls suffer from energy poverty because energy is an essential need of humans, which is sought out through any available and affordable means, and they are traditionally stereotyped with the task of providing energy for their families. Hence, this paper proposed policy amendments that would embrace the accessibility and affordability of clean energy by poor rural households in the country, such as the proposed adjusted FBAE and FBE policies for clean energy sources. These solutions have not been previously presented for mitigation of the NEPG in South Africa.

Furthermore, the following additional solutions have been proposed to mitigate gendered energy poverty in rural South Africa: decentralized energy generation using off-grid microgrids (public or privately owned), increased socioeconomic awareness on the merits of clean energy and the demerits of unclean energy, gender-friendly energy planning and policies, intra-household gender equality on energy responsibilities, affordable energy tariffs, and income-based energy incentives.

The results presented in this paper have shown some novel mitigation strategies against the NEPG in rural unelectrified areas of South Africa. Therefore, with an anticipated future of universal access to clean, modern, and affordable electricity in South Africa, the energy poverty and gender nexus would be a thing of the past in rural South Africa, and by extension, other countries in Sub-Saharan Africa.

With additional funding, this work could be expanded to all of the provinces in the country in order to have a national view of the experiences of women living in other rural unelectrified areas of the country.

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