***Measuring Energy Poverty In Mozambique: Is Energy Poverty A Purely Rural Phenomenon?***

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## Overview

Poverty is an alarming problem faced by many developing countries such as Mozambique. It can plague a country in different forms, such as food poverty, storage of natural resources, storage of agricultural products, lack of shelter and clothing, among others, as pointed out by Sher et al., (2014). Although most empirical literature on poverty relates it to production and income, it is globally and politically recognized from the United Nations Sustainable Development Goals -SDGs that access to affordable, reliable, sustainable and modern energy is fundamental to achieve many of today´s global development challenges such as poverty, inequalities, climate changes, food security, health, unemployment, (IEA 2017).

According to Nussbaumer et al., (2013), although in industrialized countries modern energy services[[1]](#footnote-1) are taken for granted, they remain unavailable to a range of the world population in developing countries where the provision of basic needs such as food, lighting, use of appliances, water, sanitation, essential health care, education and communication is challenging. Energy has an important role for human development, allows the improvement of education, health, poverty reduction, employment, gender equality, transport, communication, production, and commerce.

To emphasize the multidimensional nature of energy poverty, the objective of this study is to measure the level of energy poverty in Mozambique by updating and refining the calculation of the Multidimensional Energy Poverty Index (MEPI) and the impact of the different dimensions of energy poverty at national, provincial and regional levels using Mozambican demographic and health surveys data for households. Mozambique was chosen as a representative country of the developing Sub-Saharan region that has had traditionally low levels of access to energy even though considered a country with abundance of resources.

## Methods

For analysis and measurement of energy poverty in Mozambique, this study uses the MEPI proposed by Nussbaumer et al. (2012) and created by Oxford Poverty & Human Development Initiative (OPHI) with the association of United Nations Development Program - UNDP (Sher et al.2014). The MEPI considers the set of energy deprivation that may influence an individual lifestyle. It is based on five dimensions that represent basic energy service needs with 5 indicators: modern cooking fuels, indoor pollution, electricity access, household appliances ownership, entertainment/education appliances ownership and telecommunication means. With this metric, an individual or a household is considered energy poor if the combination of the deprivation that he/she/it faces exceeds a pre-defined threshold$ k=0.33$. The threshold is arbitrary defined according to the definition and measurement/approach used for energy poverty analysis, (Wang et al. 2015; Sher et al. 2014; Pachauri et al. 2018; Ramirez-Díaz et al. 2019).

If $c\_{i(k)}$ is a vector of deprivations counts of a household $i$, and $q$ the number of energy poor households, i.e. the number of households whose combination of the deprivation that it faces exceeds $k$, then

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| --- | --- |
| $$q=\sum\_{i=1}^{n}c\_{i}\left(k\right) if c\_{i}\left(k\right)>0.33$$ | Eq. 1 |

The metric allows computing a headcount ratio ($H=q/n$) which is the fraction of people known as energy poor and the average of the intensity of deprivations of the energy poor ($A=\sum\_{i=1}^{n}\frac{c\_{i}(k)}{q}$), i.e. the percentage of the dimensions in which energy poor people are deprived. The MEPI is given by the product between the headcount ratio and intensity of energy poverty ($MEPI=H×A$).

For the purpose of the current study, the analyses were developed based on the latest data collected in 2015 from the Demographic and Health Surveys – DHS, with a total sample of 7000 households, calculated using probabilistic sampling theory, where the number of survived households in each province was determined taking into account the notion of representativeness of the sample and the effect of the number of inhabitants, i.e. the sample for each province is share of its inhabitants, (DHS Sampling guide 2012).

## Results

Using Mozambican DHS survey data for household Record phase 7, version 1 for the year 2015 (year of the most recent DHS survey) the MEPI at national and provincial levels was calculated. Setting the multidimensional energy cut-off $k$ to $0.3$, the different regions are ranked according to the degree of energy poverty they face. A region is considered as suffering from acute energy poverty if $MEPI>0.9$ or moderate energy poverty if $MEPI<0.6$. [[2]](#footnote-2)

A MEPI of 0.65 shows that in 6 years the country has improved by about 20% compared to the results obtained from the earlier assessment (2009), resulting from the efforts to enhance electrification rates and expansion of telecommunications networks. Despite this improvement, the results show that 84% (fraction of the households known as energy poor or head count ratio -H) of Mozambican households is still living below the poverty line, compared with 98% of the earlier assessment (2009), which may be showing that the upgrading on energy poverty is linked to greater level of inequalities among population.

Results show that Mozambique is no longer suffering from acute energy poverty, having improved the energy poverty index from 0.9 in 2009 to 0.65 in 2015. This improvement is not uniform across the country. At the provincial level, the poorest province is Zambézia, followed by Nampula and Cabo Delgado, with MEPI scores of 0.79, 0.77 and 0.76, respectively, and intensity of energy poverty scores of 0.83, 0.84 and 0.79, respectively. Zambézia province is the one that suffers from higher deprivations for all indicators.

The level of inequalities mentioned above is also accompanied by 0.78 of deprivations (Intensity of energy poverty - A), i.e., the 84% of Mozambican households living below the energy poverty line are still strongly deprived of basic energy services, measured by the different indicators that characterize the MEPI.

## Conclusions

More than 70% of Mozambican households lack access to electricity. The electricity consumption of the other 30% is for lighting rather than productive uses. Almost 90% of households, both in rural and urban areas, use traditional biomass (wood and charcoal) as cooking fuel. The use of modern cooking fuels such as electricity and natural gas is still incipient and, when existing, restricted to urban areas. Although energy poor households live mostly in rural areas, 34% of urban households are energy poor, which suggest that energy poverty in the country is also an urban phenomenon and is not only lack of access but also lack of capacity to afford energy services that are necessary to fulfill basic needs.

Therefore, the improvement in MEPI is accompanied by greater inequalities that pose challenges to the country in the sense that ensuring universal access to electricity with lighting-based consumption is not an enough condition to generate social development and reduce inequalities. Since energy consumption based on lighting services does not create wealth for poverty alleviation it is necessary to ensure the availability of energy for productive uses (e.g. encouraging the inclusion of local renewable energy production with food production process and smart-grid installation based on local renewable inputs for irrigation, geoprocessing and agribusiness) that could generate income that in turn would promote economic and social development and reduce the inequalities. Furthermore, these findings portrait a diverse landscape of energy poverty across Mozambique provinces thus suggesting that public policies ought to be defined at the provincial level and not only via one umbrella policy to address energy poverty across the country.

Recognizing that access to modern, reliable, affordable, safe and sustainable energy is not an end in itself, adopting an integrated multisectoral strategy (e.g. development of public infrastructures, access to financial markets) might be a way of capitalizing the effects of energy access to human development. Therefore, regarding methodologic issues for the metric used here, the study concludes that there is a need to include a new variable related to productive uses of energy (e.g. the electrification of agriculture might be a good indicator to measure productive uses of energy in the construction of an index for energy poverty) that can capture the use of energy to generate income and poverty alleviation. Furthermore, it would be interesting to introduce a measure of energy affordability in energy poverty metrics.

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1. Such as transportation, warm/cold room, light, cooking, communication, entertainment, education. [↑](#footnote-ref-1)
2. All graphical representation of the results will be included in the final version of the paper and at the presentation. [↑](#footnote-ref-2)