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Assessing the extent and intensity of energy poverty using Multidimensional Energy Poverty Index: Empirical evidence from households in India☆

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ABSTRACT

In this paper, we have made a comprehensive assessment of the extent and various socio-economic implications of energy poverty in India. Amartya Sens's capability approach to development underpins the analysis of household-level data taken from the India Human Development Survey-II (IHDS-II), 2011-12 using the Multidimensional Energy Poverty Index (MEPI). The overall results show that energy poverty is widespread in India and the existence of energy poverty also coincides with the other forms of deprivations such as income poverty and social backwardness. For example, Dalits (Lower Caste) and Adivasis (Tribal) are found to be extremely energy poor compared to the other social groups in India. The results also reveal that it is the responsibility of women to manage the domestic chores such as collection of firewood and making of dung cake in traditional Indian households. Inefficient use of such biomass fuels is found to cause health hazards.

1. Introduction and background

The concept of energy poverty has received enormous attention not only in the literature but also in public policy, as energy in general (and cleaner energy in particular) is necessary to achieve systemic welfare of society (Birol, 2007). The declaration of the year 2012 as the "International Year for Sustainable Energy for All" by the United Nations (UN) General Assembly is a testimony to the overriding importance of energy accessibility and affordability in the promotion of socio-economic welfare. This is on account of the realization that welfare of society is closely intertwined with the use of modern technology and energy services. For instance, the use of LPG for cooking instead of biomass such as firewood or dung cake, protects women from health hazards like chronic respiratory problems; and access to electricity at home creates a conducive learning environment for children, and better healthcare environment at hospitals. (See, for example, Roberts et al. (2015) and Savacool (2012)).

The literature shows that there is no universally acceptable definition of energy poverty or fuel poverty.[1] However, the existing tradition is to capture domestic energy deprivation in developed countries with the concept of fuel poverty and that of developing countries with energy poverty. Accordingly, lack of heating fuel in developed countries and lack of access to electricity in developing countries symbolize the domestic energy deprivation with similar consequences for the socio-economic well-being of the society.

In this study, therefore, we adopt the definition of energy poverty by Day et al. (2016), who conceptualized energy poverty as a "situation of inability to realize the essential capabilities as a result of insufficient access to affordable, reliable and safe energy services, and taking into account the alternative means of realizing these capabilities in a reasonable manner". Energy poverty is thus perceived in a rather comprehensive multidimensional way along the line of Amartya Sen's capability approach to development. This is in sharp contrast to reducing energy poverty to some monetary metrics, such as, the quantity of energy consumed or expenditure incurred on energy resources. Likewise, the multidimensional nature of energy poverty is reiterated by Pereira et al. (2011), arguing that it extends beyond income and can be measured with a greater degree of accuracy with a multidimensional framework.

In this era of climate change with the unusual climatic conditions such as global warming, persistent drought, and unprecedented snowfall, energy poverty should be paid at least as much attention given to the other traditional, fundamental challenges faced by the world such as income poverty. This is in spite of the fact that the distinction between energy poverty and income poverty is blurring. Unlike the challenges like income poverty, any attempt to address energy poverty

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[1] See, for example, Pachuri et al. (2004), Pachauri and Spreng (2011), Wang et al. (2015) and Day et al. (2016) for various definitions and approaches to the measurement of energy poverty.

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through the expansion of the access and consumption of the energy resources such as fossil fuels would cause an increase in carbon emission. Therefore, use of energy without paying adequate attention to the efficiency of the use would warrant an associated flip side, environmental degradation and the resultant threat to the sustainable development. For instance, countries like the USA and Saudi Arabia with higher per-capita energy consumption also top the list of countries with higher per-capita CO_2 emission (see González-Eguino (2015), for relevant statistics). Urge-Vorsatz and Herrero (2012), for example, have documented the implicit trade-off between climate change mitigation and energy poverty alleviation and have suggested that the only option to align these two conflicting goals is to ensure high standards of efficiency. Malla (2012) has found empirical evidence of increasing carbon emission as a result of an increase in the use of fossil fuels in Nepal (Also see Kaygusuz (2011) and Chakravarty and Tavoni (2013)). This simultaneous tradeoff between tackling energy poverty and maintaining environmental sustainability will be more pressing in the case of developing countries like India, since India cannot adequately meet the energy challenges in the foreseeable future simply with the renewable energy resources.

The attempt to deal with energy poverty will be relatively more demanding than dealing with the income poverty through affirmative state actions such as taxation, social security schemes, and other public expenditure programs. This is because of, among other things, the lack of methodological and conceptual consensus regarding what constitutes energy poverty, implying that differentiated treatment of the issue should be adopted depending on the context involved (Barnes et al., 2011). For example, Kandkher et al. (2012) and Wang et al. (2015) have shown that the income non-poor need not necessarily be the energy non-poor especially in the rural areas in India, and therefore, energy poverty calls for a different remediation approach (Also see Spagnoletti and O'Callaghan (2013)). This is relevant in countries like India with varying cultural, geographical, and climatic conditions compared to the relatively small countries with similar cultural, geographical, and climatic features.

Further, eradication of energy poverty is a highly complex issue, (see, for example, Walker and Day (2012)), so it requires planned programs and strategies involving the development of huge infrastructure with a large amount of resources. Therefore, tackling energy poverty is different from dealing with the income poverty using traditional fiscal means.[2] For example, according to the India Energy Outlook (2015), a special report released by the International Energy Agency (IEA), India requires $2.8 trillion to develop its energy infrastructure to ensure better energy access by 2040.

In light of the above-cited factors, one can discern that the problem of energy poverty with associated complexities and nuances, can only be tackled with carefully calibrated measures and policies for which a proper understanding and assessment of the energy poverty situation is inevitable (Nussabaumer et al., 2012). A comprehensive assessment of energy poverty in India will also be useful to deal with its socio-economic consequences (González-Eguino, 2015). Therefore, in this paper, we undertake a comprehensive assessment of India's energy poverty scenario using the household data obtained from the India Human Development Survey-II (IHDS-II), 2011-12.

According to the India Energy Outlook (2015), India uses only about 6% of the world's primary energy resources, despite the fact that India accounts for 18% of world population. Specifically, portraying the enormity of the problem of energy poverty in India, the report indicates about 240 million people in India still do not have access to electricity and about 840 million people use firewood as the primary cooking fuel in traditional stoves, which cause indoor pollution and consequent health problems. These statistics justify the relevance of this study based on India; the findings of this study can guide the policy makers to adopt appropriate strategies to address the issue of energy poverty. Also, this study contributes to the literature as it is the first research attempt to evaluate India's energy poverty situation using the Multidimensional Energy Poverty Index (MEPI) based on Amartya Sen's capability approach to development as an underlying theoretical framework.

The empirical results obtained using the MEPI show that energy poverty is widespread in India and the existence of energy poverty also coincides with other forms of deprivations such as income poverty and social backwardness. For example, Dalits and Adivasis are found to be extremely energy poor compared to the other social groups in India. Results, which are similar to the findings of similar studies around the globe also reveal that in traditional Indian households, women are explicitly tasked with the management of domestic chores like the collection of firewood and making of dung cake, and the inefficient use of such biomass fuels is found to cause health hazards.

2. Theoretical underpinnings of the study: energy poverty and capability approach

Each and every individual on the face of the planet yearns for a contented life. However, what constitutes a contented life remains elusive, as it may vary from individual to individual and situation to situation. Therefore, what is pragmatic is to fix the bottom line as to what is necessary regarding goods and services to lead a dignified and contented life in society. It is here, the access and the affordability to modern, clean energy resources such as electricity and LPG emerge as the essential elements for a contended life. For example, access to modern cooking fuel will provide the leeway to girls to go to school because collecting firewood is treated as the responsibility of women and girls in the traditional Indian households. Thus, the relationship between energy use and well-being is at the core of the debate in the field of energy poverty. In other words, the lack of access and affordability of modern, clean energy resources and technology is to be treated as one of the forms of deprivations in the society (Day et al., 2016). Moreover, the issue of access to modern energy resources like electricity is more pressing, as it is impossible to address them from a household's point of view without the collective social endeavor, such as the intervention of the state.

As the idea of energy poverty is multidimensional, so are its consequences (Roberts et al., 2015). Cooking with biofuel causes indoor pollution and ill-health of women. The lack of electricity and proper lighting will affect the prospects of better education for children and it also affects the health of the people in both summer and winter as electricity provides cooling or heating services. Access to electricity will encourage the use of modern technologies and thereby improve productivity. As the prices of energy resources rise, households are forced even to reduce the consumption of essentials such as food and clothing to make up for the loss of purchasing power (Papada and Kaliampakos, 2016). In short, energy resources have a key multi-dimensional role in the promotion of the overall socio-economic welfare of the society. The overarching importance of energy resources in the promotion of social welfare implies that the idea of energy poverty should be conceptualized in a comprehensive manner without reducing it into certain simple metrics such as the amount of money spent on energy resources or quantity of a particular energy resource used. The 'capability approach' proposed by Amartya Sen is particularly useful for understanding what constitutes energy poverty and how to tackle the problem.

The effort to look at the access to energy resources through the lens of capability approach is justified by the findings of previous studies such as Kandkher et al. (2012) and Wang et al. (2015) who have established that freedom from income poverty need not necessarily imply freedom from energy poverty. Their finding also corroborates Sens's suspicion about the effectiveness of focusing on a particular

[2] Also see Boardman (2010) and Hills (2011) for a detailed discussion how fuel (energy poverty) is distinct from income poverty