SOCIAL DOMAIN

A MOTIVATION FOR ENERGY BASED POVERTY INDICATORS

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Abstract: A common method employed in tracking the success of poverty alleviation in ensuring sustainable development is through the use of a set of lead indicators which provide tangible measures of evaluating fluctuations in both poverty and environmental quality. A requirement of such lead indicators is that they be diverse in their approach, as indicators from different disciplines have their strengths and weaknesses. A motivation is made here for broadening the scope of such research through the inclusion of a set of energy based poverty indicators in the area of poverty assessment. Such energy poverty indicators provide an invaluable extra dimension in the assessment in that they relate to all three sustainability spheres: economic, social and environmental.

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Introduction

According to Kemmler and Spreng (2005), human activities are closely linked to energy use, and hence an energy dimension to poverty exists. According to The International Energy Agency (IEA) (2004), energy is a prerequisite to economic, social, and environmental development, and Saghir (2005) states that no country has managed to substantially reduce poverty without greatly increasing the use of energy. It is thus suggested that energy poverty is a useful factor with which to judge overall human welfare.

Although energy is not deemed as being a basic need, energy provision is a necessity in alleviating poverty, including for the provision of basics such as food, clean water, health, *etcetera* (WEC, 1999). Energy poverty, being a subdivision of poverty itself, hence has very subjective implications. It has been defined according to three distinct approaches: economics-based approaches, engineering-based approaches, and access-based approaches (Pachauri, 2004). The first two approaches are based on expenditure on and consumption of, and the later on access to, energy. Therefore, no unanimous definition of energy poverty exists. However, a working definition can essentially be generated in a similar way as for poverty in general, through the use of a poverty line; this poverty line being related directly to one of the three approaches mentioned above. For example, if levels of household energy consumption lie below a predetermined level, then these households may be classified as energy-impoverished. The same method can be employed using expenditure or access-based approaches.

The IEA highlights that with prosperity comes demand not only for more, but also for better quality, energy. The agency states that energy services enable basic human needs, such as food and shelter, to be met and also contribute to social development by improving both education and public health (IEA, 2004: 329). It asserts that the absolute amount of energy used per capita and the share of modern energy services (especially electricity) are key contributors to human development during the early stages. Saghir (2005) posits that the strong link between energy and poverty can be found in the facets of income, health, education, gender, and the environment. In the case of the last, he refers specifically to the way in which less efficient traditional sources of energy damage the direct environment of those who use them for fuel.

According to the IEA, the United Nations (UN) poverty-reduction target of halving the number of people living on less than 1 USD a day by 2015 is unlikely to be achieved unless access to electricity can be provided to another half-a-billion people (IEA, 2004). The agency declares that developing countries need to improve the availability and affordability of commercial energy to rural communities in particular in order to alleviate energy poverty and human underdevelopment. Suaréz (1995) puts forward that 'energy is a fundamental and strategic tool to attain a minimum quality of life', highlighting the importance of energy in poverty alleviation.

Energy, poverty and the environment

According to Kemmler and Spreng (2005), most important issues of sustainability relate to the production and use of energy. If one considers that coal emissions to produce electricity, and exhaust emissions from the powering of vehicles and other engines, create the greatest threats in terms of air pollution, it is not hard to see how closely energy production and environmental externalities are related. Not only do emissions contribute on a large scale to air pollution, but the extraction of resources such as oil and coal from the ground in itself contributes to the level of global pollution. According to Apollo PAC (2008), almost 30 thousand Americans die every year due to pollution from energy production, and energy used to run vehicles, heat homes and offices and power factories is responsible for 80 percent of global carbon dioxide emissions. Roper and Nagle (2006) declare that growth of nonrenewable energy consumption by humans cannot continue indefinitely without raising the temperature at the Earth's surface above some safe limit for the existence of humans.

Environment Canada (2008) simply states that the more energy is consumed, the more pollutants are released in the process. According to the organisation, every step in the energy lifecycle, including production, distribution and consumption, releases, or has the potential to release, a wide variety and significant amounts of pollutants, bar most renewable energy sources (Environment Canada, 2008). The organisation points out that fugitive processes are another concerning source of pollution. Fugitive processes involve the release of pollutants in a way that they cannot be used, an externality which occurs throughout the energy lifecycle (Environment Canada, 2008). This links closely to the second law of thermodynamics which poses, amongst others, that energy (specifically heat) cannot be converted completely into useful work (Winnipeg University, 1999). In the process of transferring energy from one form to another, some of it is transferred to alternative forms that are not useful for the purpose of the initial conversion. This is known as entropy (Winnipeg University, 1999). Hence, throughout the energy cycle, particularly in terms of traditional sources, energy is lost to the useful process, and therefore additional externalities occur that are not associated with any corresponding gain in utility or social welfare.

What is important to note at this stage is that not all sources of energy have lifecycles that are equally damaging to the environment. As indicated by Saghir (2005), traditional sources of energy are generally associated with high levels of pollution, and lower levels of efficiency as a result of fugitive processes. Modern sources of energy on the other hand generate significantly lower levels of pollution, and renewable sources close to none. Therefore, in the relationship between energy and the environment, it is imperative to understand the provision of modern sources of energy to the poor can assist not only in the aim of alleviating poverty, but can also help to alleviate the burden on the environment.

Energy is closely linked to human activities. Indeed, the occurrence of many human activities is reliant on the existence of sufficient energy. Furthermore, human development cannot continue past a certain point without the presence of sufficient quantities of, and adequate quality, energy. Therefore poverty, and hence the alleviation thereof, is directly linked to energy sources and services.

Similarly, exploitation of, and externalities which affect, the environment are often a result of human processes that produce, distribute and consume the energy required not only for increased development, but to sustain current standards of living. As such, energy, in terms of production, distribution and consumption, is a significant variable not only in the depletion of the quantity of natural resources, but also in the depletion of the quality of the environment as a whole. However, in terms of pollution, modern sources of energy are far superior to traditional biomass sources on a per unit basis and hence the replacement of traditional energy sources with the provision of contemporary energy supplies can result in a positive effect on the environment.

What can thus be derived is that, because the energy lifecycle affects the spheres of the economy, the environment, and society concurrently through the aforementioned mechanisms, it proves to be a yardstick with which the relationship between them can be monitored. Energy is a significant variable in all three dimensions and can therefore be used to assist in the evaluation of poverty and sustainability relations. Furthermore, provision of modern energy can be seen to yield positive results in terms of both poverty alleviation and sustainable use of environmental resources.

Energy based poverty indicators

Environmental poverty indicators alone are simply not sufficient to fully encompass the diverse characteristics of the relationships between poverty and environmental resource usage. Such tools need to be supplemented by others which are better in different fields, thus hedging the position, and broadening the scope, of the researcher. As identified, there is a significant energy dimension to poverty and to human activities in general. Similarly, there is a strong relationship between energy and resource use and to environmental quality in general.

Furthermore, the applicability of economic indicators to assess poverty is also limited, particularly so because wealth does not constitute wellbeing, but more dimensions to well-being exist (Kemmler and Spreng, 2005). According to Kemmler and Spreng (2005), an energy-based indicator set can cover most relevant sustainability issues, contrasting with economic or environmental models, 'where not all sustainability spheres can be described accurately'.

The energy system therefore presents itself as a good candidate for providing a manageable set of interlinked lead indicators to track the relationship between poverty alleviation and resource sustainability, and acts as a supplement to those indicators which borrow from other spheres. The United Nations Development Programme (UNDP) has developed five indices of human development, which are updated annually, used to assess the quality of life of a country's population (IEA, 2004). These include amongst others the Human Development Index (HDI), which is applied to all countries, and a Human Poverty Index, HPI-1, which is used specifically for measuring poverty in developing countries (Sirgy, 2001).

According to Sirgy (2001), HDI is the foundation of the other indices and is composed of three components: longevity (life expectancy and mortality rates), knowledge (literacy and enrolment rates), and standard of living (measured according to economic wellbeing, such as per capita income). Suaréz (1995) states that the HDI is calculated on the basis of a simple average of life expectancy, educational level, and per capita gross domestic product. HDI measures performance on an increasing scale between 0 and 1. Sirgy (2001) mentions that HPI measures deprivation along the same dimensions with some variations, with the added dimension of employment (long-term employment rate).

None of the UN indices explicitly takes energy use into account (IEA, 2004). However, since there is an energy dimension to poverty, the proposal to use energy-based poverty indicators as a supplement to standard economic measures, in measuring the relationship between poverty and the environment, is based on the premise that energy use is a significant variable in both poverty and resource fluctuations.

The transition from energy indicators to energy based poverty indicators

The theoretical literature on energy based poverty indicators is, unfortunately, limited; attributable largely to the fact that the concept is still in its relative infancy. According to Kemmler and Spreng (2005), the use of energy indicators has previously been limited to environmental and economic issues. However, the International Atomic Energy Agency (IAEA) (2005) presents a core set of energy indicators which constitute the Energy Indicators for Sustainable Development (EISD), which does include a few indicators in the social dimension. In addition, the World Bank (2008) put forward a summary of proposed welfare energy indicators as early as April 2000.

Nevertheless, when one considers that the most important issues of sustainability relate to the production and use of energy, it becomes increasingly palpable that the use of energy indicators should be extended to the sphere of social development. In addition, it is possible to calculate future energy flows, demand and distribution with common energy-economic models (Kemmler and Spreng, 2005), providing an extra dimension to energy indicators which enhance their aptitude for inferences of current trends on the future. Kemmler and Spreng (2005) note that the choice of energy indicator to be used within a strong set of lead indicators is important as different indicators will fair worse in measuring social dimensions than others, due to the implied method of measurement according to physical units.

The IEA identifies three key indicators of energy use in developing countries: per capita energy consumption, the share of modern energy services in total energy use, and the share of the population with access to electricity in their homes (IEA, 2004). Kemmler and Spreng (2005) suggest that this list is in fact inexhaustible. The IAEA (2005) core set of energy indicators, for example, contains 30 energy indicators applicable to sustainable development, including the three mentioned above. What is important to note is that only 4 of these fall under the social dimension category, whilst the rest are distributed between economic and environmental categories, illustrating how this class has indeed been overlooked.

As a close relationship between human activities and energy use exists, it is suggested that this subsequently implies a link between poverty and energy use. The IEA (2004) affirms this link between poverty and energy use, by uncovering a strong link between per capita energy consumption and countries' HDI values, especially for non-OECD countries. This link between per capita energy use and human development is even stronger when considering commercial energy alone. Suaréz (1995) presents another comprehensive analysis of the energy consumption-HDI relationship. He shows how HDI values improve significantly as energy consumption rises above zero until a certain level of consumption equivalent to approximately 1000 kilograms of oil per capita is reached.

Evidence thus supports the concept of extending the use of energy indicators in economic and environmental modeling to the social sphere, despite the fact that limitations exist in the process of measuring social dimensions. Although some pioneering efforts have been made to approach the use of energy indicators from the social dimension, the subject of the next section, much ground must still be covered for its application to become widespread.

Studies which identify energy poverty indicators

From the limited literature available on energy based poverty indicators, it is apparent that they can be categorized according to various themes. The IAEA (2005) divides them according to accessibility, affordability and quality. The EISD core set includes one other category under the title "Health" that tracks safety levels of different energy sources. The World Bank (2008) groups the indicators they propose under three different headings: Basic needs, Monetary and Non-monetary. Examples of energy-poverty indicators from the above sources include: Share of household income spent on fuel and electricity, Average total cost per effective unit of energy, and Exposure rates to indoor air pollutants.

Pachauri *et al* (2004) describe energy poverty according to not only the quantity of energy used, but also the access to different sources of energy; access being defined as a household's ability to consume a certain fuel (Kemmler and Spreng, 2005). They develop a poverty indicator which utilizes an energy access-consumption matrix in measuring poverty, separating households into three different access categories and according to a scale of useful energy usage, in Watts per capita. In response to this, Kemmler and Spreng (2005) assess the explanatory power of energy-poverty indicators in general, according to three different conventional poverty dimension measures: primary, useful, and access-adjusted useful energy. They find that the access-adjusted useful energy measure has a stronger correlation than useful energy, which in turn has a stronger correlation than primary energy. They note that access-adjusted energy correlates as well with the compared poverty measures as expenditure, a common measure employed in poverty indicators, does. Kemmler and Spreng (2005) furthermore reveal that access-adjusted energy deciles have similar characteristics to those of expenditure for a number of variables. These findings suggest that access-adjusted useful energy is a practical base for the development of a poverty indicator, whereas primary and useful energy measures are of less assistance.

It is, however, important to note that the appropriateness of energy-poverty indicators was only tested for a limited number of poverty dimensions, and the researchers mention that energy measures are subject to similar limitations as income- or expenditure-based indicators. A general limitation is that like the other indicators, a single energy-based indicator cannot grasp the multidimensionality of poverty, other limitations include: the implied method of measuring social aspects with physical units, obtaining opportunity cost information and transferring it into tangible data, obtaining household energy consumption data, *etcetera* (Kemmler and Spreng, 2005). The various poverty dimensions included in the research overlap to a large extent and as such, those classified as "poor" in the research are indeed a very heterogeneous group (Kemmler and Spreng, 2005). Nonetheless, the analysis highlights the importance of considering both quantity and type of energy used by a household in constructing an energy-poverty indicator.

Do energy indicators qualify as good indicators of poverty

According to Kanjee and Dobie (2003: 31) 'an indicator quantifies and simplifies phenomena and helps understand complex realities'. Prennushi *et al.* (2001) present a number of necessary components in formulating a good indicator. First, the indicator should be a direct and unambiguous measure of progress. Next, its relevancy should be established such that it measures factors which reflect the objectives of the project for which it is employed. The indicator should vary across areas, groups and over time, being sensitive to changes in policies, programs and institutions, so that its explanatory power remains unchanged. It should also be transparent and impervious to manipulation of the results. Finally, the indicator should be cost-effective to track.

It is prudent to ascertain the efficiency of energy poverty indicators in terms of the above requirements. First, energy poverty indicators provide an objective measure of human quality of life, using physical units that measure clearly the level of energy use, and ambiguity is therefore restricted. Second, in terms of the relevance of energy-poverty indicators, this paper has sought to clarify that such tools are significant in the poverty evaluation process. However, the level of applicability of the indicator to the research depends on which indicator the researcher uses and in which context it is used. Third, measures of energy are constant regardless of variations in other variables, implying that the accuracy of energy poverty indicators is unchanging over time and as such these tools remain applicable across sample populations in a constant format. Fourth, they enable the researcher to track progress using constant appraisal techniques over time which are invulnerable to changes in policies or review procedures. In addition to this, the associated objectivity of the indicators limits the amount by which it is possible to manipulate the results. Finally, the cost-effectiveness of energy-poverty indicators should not vary much from that of other indicators, as the method of obtaining data is very similar. The transferring of information into useful data, however, may be time consuming. Nevertheless, from a generic perspective, energy poverty indicators comply with all the requirements of a "good" indicator and can therefore be placed on a par with other conventional indicators. Nevertheless, the onus remains on the researcher to ensure that the lead indicators used in any research constitute the optimal set in that particular context.

Conclusion

Depending on the type of policy that is implemented to accomplish poverty alleviation, poverty alleviation itself can indeed play a crucial role in achieving growth and development that is more environmentally sustainable. If the process of achieving goals for sustainable development involves an environmental approach, as is suggested in this document, it may ultimately result in a more manageable use of natural resources, which can subsequently lead to long term sustainability.

The method of tracking the success of poverty alleviation in ensuring sustainable development is through the use of a set of lead indicators which provide tangible measures of evaluating fluctuations in both poverty and environmental quality. Such a set of lead indicators is required to be diverse in its approach, as different indicators from different dimensions have varying strengths and weaknesses. As such, an opportunity has been identified to broaden the scope of such research through the inclusion of energy-poverty indicators, which have not previously been extensively employed in the assessment of poverty. The role of energy poverty indicators in the assessment of the poverty-sustainable resource use context is thus to enhance the explanatory power of the set of lead indicators employed to track fluctuations in measurable data. Energy-poverty indicators provide an extra dimension in that they relate to all three sustainability spheres, and provide a tool with which not only to accurately trace historical data, but also to make inferences onto the future.

Despite the fact that they are exposed to similar restrictions as income- or expenditure-based indicators, such as the difficulty in measuring social aspects through the implied use of physical units, energy-based poverty indicators can hence play a significant role in monitoring poverty. As such, energy based indicators can be used to more accurately assess the relationship between sustainable development and poverty alleviation in conjunction with those indicators already in use.

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