Energy and Inclusive Growth of Karnataka: Analysis and Policy Implications

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Abstract: *Energy is a crucial factor in the process of development. Availability and access to energy are pre-requisites for the functioning of any system, sector and region which invariably demands for energy security. The present study has made an attempt to analyze, the energy inclusiveness in the process of growth of Karnataka. Census survey data have been used for the study and disparity techniques have been largely used for analysis. Possible pre-testing procedures have been followed to ensure the data validity. Arguments have been made only on the basis of tested results. It has been found from the study that there is significant difference between urban and rural regions in access to energy sources. There is a correlation between development and access to energy sources. It has been found from the impact analysis that regional factors and income have positive impact on use of modern clean energy sources. Therefore, there is a need of integrated energy strategy for inclusive growth of Karnataka. Otherwise, some regions, some districts, some sections of the people will be left-out in development process due to lack of access to energy.*

Key Words: *Cooking, Energy Availability, Inclusive Growth, Clean Energy and Renewable Energy.*

Introduction

Indian plans and development process assumed that growth of the economy will percolate into the marginal sections of the people and groups. But, the assumption of plans has failed to reach the marginal sections of the

economy. The government of India, as remedial measures, has introduced specific programmes for the development of marginal sections of the economy particularly, during the fifth Five Year Plan. These specific programmes have considerably helped some sections of the people to improve their livelihood. However, large sections of the people have been left out of the development process. Accordingly, the government of India in its 11th and 12th plan periods, has introduced inclusive growth strategy to include hitherto excluded people and sections. As a matter of fact, inclusive growth policy will be incomplete without energy component in its inclusive strategy (GOI, 2007). Therefore, energy is must for inclusive growth as well as development process. Energy is a crucial factor in the process of development. It has been found from the studies that there is a significant positive relationship between energy and development. Availability and access to energy are pre-requisites for the functioning of any system, sector, and region which invariably demands for energy security (Premakumara, 2012). At the same time, availability of clean energy is necessary and sufficient condition for sustainable development (Hancock and Vivoda, 2014). Accordingly, in the present paper, an attempt has been made to analyze the availability and use of different energy sources for cooking purposes. The study will examine the status of use of energy for cooking both at urban and rural areas of Karnataka. The study will also analyze the disparities between urban and rural areas in use of energy sources for cooking. Based on the analysis, the present study will also evaluate eco-efficiency of energy use for cooking.

Review of Literature

There are two sets of distinct arguments related to energy and development. The first set of argument is that energy has significant impact on production. Energy will result in the development (Masih, 1996 and Asafu-Adjaye, 2000). It implies that, without energy, the other inputs like labour and capital may not be used productively in production process. However, contribution of energy to the development varies, based on the availability and efficient use of energy. Accordingly, energy has been considered as a factor in the production process and development. The other argument is that, energy is not at all a factor of production, since the value of energy in total production is very negligible. Therefore, energy may not play a significant role in development process (Cheng, 1995 and Yu E. J., 1992). However, the widely accepted argument is

that energy is a crucial factor in production process. As a matter of fact, energy is essential for economic development, and eco-efficient and clean energy is critical for sustainable development. Adequate and reliable and affordable energy are the pre-requisites for development (Premakumara, 2012). The other important dimension argues that there has been significant association between energy efficiency and development (Sascha and Andreas, 2015; Sreenivas, 2014).

Most of the early literatures on causation of economic growth on energy consumption have confirmed the causation by using uni-directional Granger-causality Tests (Yu E., 1984; Kraft J. K., 1978; Lin, 2003; Soytas, 2003; Mozumdar, 2007). During late 90's economists like Nachane and others have employed Engel-Granger Models to estimate the causation of electricity and energy on economic growth (Nachane, 1988; Masih, 1996; Asafu-Adjaye, 2000; Thoma, 2004; Hansen, 2002; Yoo, 2005). Meanwhile, the co-integration techniques were also used to estimate long-run relationship between energy consumption and economic growth. Jumbe and Huang have proved bi-directional relationship between energy consumption and economic growth (Jumbe, 2004; Huang 2008). Estimation of multi-dimensional relationship has also proved the role of energy in overall economic development (Tamizan, 2009; Shahbaz, 2012). Recently, Sadorsky has proved the influence of financial development on energy consumption (Sadorsky, 2010). Very recently, ARDL bounds test was used to prove the causation of energy demand on export (Shahbaz, 2013). There is a need of stable energy security in a country to have sustainable balanced economic development. Since the concept of energy security and inclusive energy policy are more complex, multidimensional, and contextual, the most of the previous studies have tried to define the concept of energy security (Bohi and Toman, 1996; Baldwin, 1997). The recent studies have tried to estimate and forecast the energy security (Kamonphorn & Hironobu, 2014; Ito, Zhidong, and Komiyama, 2005). A few studies have also tried to develop the dimensions and indicators to measure the energy security (Lixia and Youngho, 2014). However, there are no unique studies which analyze the inclusiveness of energy in the development process specifically. To be more specific, there are no intensified studies to examine use of energy for cooking, particularly in Karnataka by using Census data. Hence, there is valid justification and rationale for the present study.

Methodology

The present study has used cross sectional secondary data collected from Census 2011. The data collected at district level for all households, for use of energy for cooking. Firewood, crop residuals, LPG, and kerosene have been considered for analysis of use of energy for cooking. Radar is used for presentation of district level data in order to understand the availability and use of particular energy source for lighting and cooking. Dummy variable regression model is used for difference analysis to estimate the impact of region on use of energy sources. All necessary steps have followed for data process and normality tests have conducted for variables and parameters.

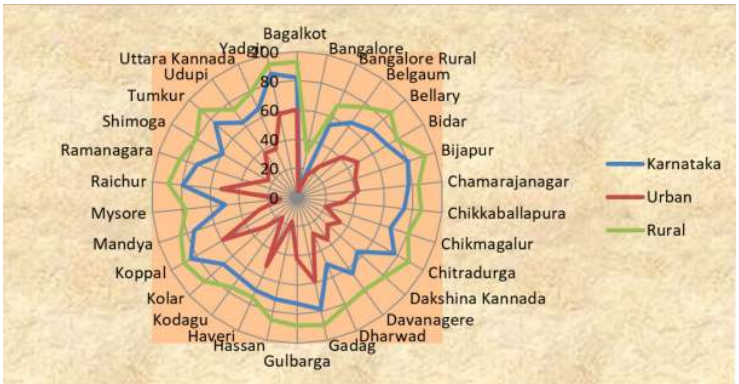
Analysis of Use of Energy for Cooking in Karnataka

Cooking is one of the most essential basic needs of households. Households use different energy sources for cooking purpose. In this part of analysis, an attempt has been made to evaluate the energy use and its eco-efficiency in cooking activity. Most of the households use electricity, firewood, crop residuals, cow dung, LPG, Solar, kerosene, bio-gas and many other sources of energy for cooking. Electricity, LPG, biogas, and solar are the modern as well as eco-efficient forms of energy sources being used for cooking. On the other hand, firewood, crop residuals, kerosene are treated as traditional and non-eco-efficient forms of energy sources being used for cooking. However, in the present study, firewood, crop residuals, LPG, and kerosene have been considered for analysis. With this background, in the present analysis, an attempt has been made to estimate the energy availability and accessibility to urban and rural households in Karnataka. An attempt has also been made to estimate the difference between urban and rural energy availability for cooking in Karnataka.

The Use of Firewood for Cooking in Karnataka

In the following section, an attempt has been made to present the relative status of use of firewood in rural and urban Karnataka. The blue line presents district wise use of firewood in Karnataka, red line shows firewood use in urban Karnataka and green line depicts firewood use in rural Karnataka.

Figure 1: Use of Firewood for Cooking in Karnataka



Source: Census 2011

It has been found from the above graph that in Karnataka, the lowest use of firewood was found in Bangalore district. In rural Karnataka, the highest firewood using households are found in Yadgir, Bagalkot, Bellary, Bijapur, Chamarajanagar, Chikkaballapura, Chitradurga, Gadag, Gulbarga, Hassan, Kolar, Koppal, Mandya, Raichur, Ramanagar, and Tumkur districts. In urban Karnataka, the highest firewood using households are found in Yadgir, Bagalkot, Koppal and Gadag districts. Therefore, there has been a wide range of disparities in use of firewood for cooking in Karnataka. It is also clear from the above graph that, firewood is a major source of energy for cooking in Karnataka. Accordingly, the growth process of Karnataka, has failed to reduce the dependency on firewood, which is the most eco-inefficient form of energy source.

With this background, an attempt has also been made to estimate the difference between urban and rural Karnataka in use of firewood for cooking with the help of dummy variable regression model.

FC= á + â D1 + e

Where;

FC = Firewood for Cooking

á = Intercept (Value of benchmark, in the present context it is the value for rural)

â = Difference between bench mark and D1

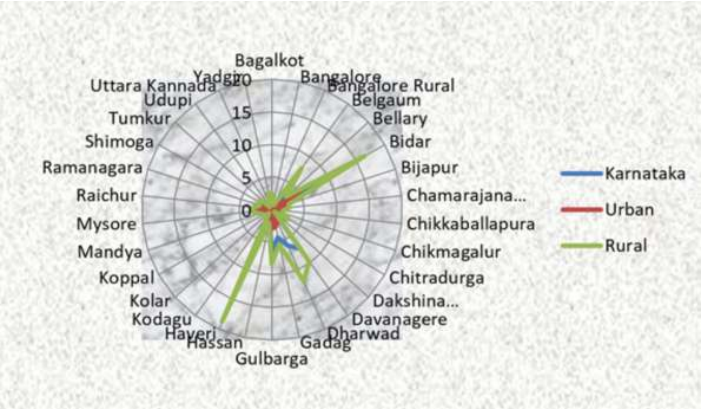
D1 = Dummy for urban (1 for dummy and 0 for otherwise)
FC = 81.60 - 46.987 D1
(t): (33.788) (-13.757)
Sig: 0.000 0.000
R^2 = 0.761, F = 189.261, Sig: 0.000

It has been found from the results of dummy variable regression model that, the average firewood use for cooking in rural Karnataka is 81.60 per cent. This is acceptable. The difference between urban and rural is -46.987 per cent. This is negative and acceptable. Therefore, there is a significant difference between urban and rural Karnataka in use of firewood for cooking.The use of firewood for cooking is significantly low in urban Karnataka. Though the firewood is a renewable energy source, it is not an eco-efficient energy form. Therefore, dependency on firewood has to be reduced particularly, in rural Karnataka with specific measures.

The Use of Crop Residuals for Cooking in Karnataka

In the following section, an attempt has been made to present the relative status of use of crop residuals in rural and urban Karnataka. The blue line presents district wise use of crop residuals in Karnataka, red line shows crop residuals use in urban Karnataka and green line depicts crop residuals use in rural Karnataka.

Figure 2: Use of Crop Residuals for Cooking in Karnataka



Source: Census 2011

It has been found from the Figure 2 that, in Karnataka, the highest crop waste use was found in Bidar district. In urban Karnataka, the highest solar using households are found in Bidar district. On the other hand, the lowest found in Bangalore district. In rural Karnataka, highest solar using households are found in Haveri, Bidar, Dharwad and Davanagere districts. Therefore, there has been a wide range of disparities in the use of crop waste for cooking in Karnataka. It is also identified from the Figure 2 that, crop waste is not a major source of energy for cooking. Accordingly, though, the crop waste is not a major source, still rural Karnataka has been depending on crop waste, which is the most eco-inefficient form of energy source.

With this background, an attempt has also been made to estimate the difference between urban and rural Karnataka in use of fire wood for cooking with the help of dummy variable regression model.

$CC = á + â\ D1 + e$

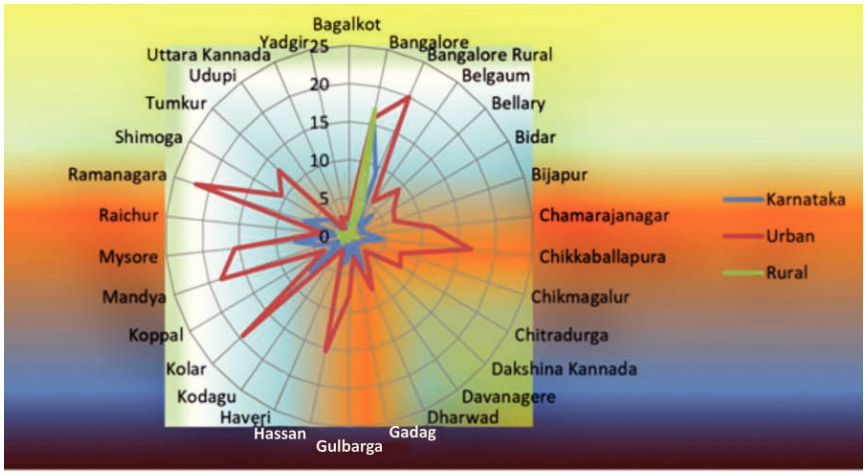
Where;
CC = Crop Waste for Cooking
á = Intercept (Value of benchmark, in the present context it is the value for rural)
â = Difference between bench mark and D1
D1 = Dummy for urban (1 for dummy and 0 for otherwise)
CC = 4.050 - 2.670 D1
(t): (6.561) (-3.059)
Sig: 0.000 0.003
R^2 = 0.139, F = 9.355, Sig: 0.003

It has been found from the results of dummy variable regression model that, the average firewood use for cooking in rural Karnataka is 4.050 per cent and it is acceptable. The difference between urban and rural is -2.67 per cent and it is negative and acceptable. Therefore, there is a significant difference between urban and rural Karnataka in use of firewood for cooking. The use of firewood for cooking is significantly low in urban Karnataka. Accordingly, there is need of addressing this issue in order to improve the eco-efficiency of energy use.

Status of Use of Kerosene for Cooking in Karnataka:

In the following section, an attempt has been made to present the relative status of use of kerosene in rural and urban Karnataka. The blue line presents district wise use of kerosene in Karnataka, red line shows kerosene use in urban Karnataka and green line depicts kerosene use in rural Karnataka.

Figure 3: Use of Kerosene for Cooking in Karnataka



Source: Census 2011

It has been found from Figure 3 that, in Karnataka the highest Kerosene use has been found in Bangalore district. In urban Karnataka, the highest Kerosene using households are found in Bangalore rural, Ramanagara and Kolar district and lowest found in Uttara Kannada district. In rural Karnataka, highest solar using households are found in Bangalore district. Therefore, there has been a wide range of disparities in use of Kerosene for cooking in Karnataka. It is also identified from the above graph that, Kerosene is also a major source of energy for cooking. Accordingly, the growth process of Karnataka has to be considered in order to decrease the dependency on kerosene, which is also the most eco-inefficient form of energy source.

With this background, an attempt has also been made to estimate the difference between urban and rural Karnataka in use of kerosene for cooking with the help of dummy variable regression model.

KC= á + â D1 + e

Where;

KC = Kerosene for Cooking

á = Intercept (Value of benchmark, in the present context it is the value for rural)

â = Difference between bench mark and D1

D1 = Dummy for urban (1 for dummy and 0 for otherwise)

KC = 1.233 + 7.710 D1

(t): (1.363) (6.023)

Sig: 0.178 0.000

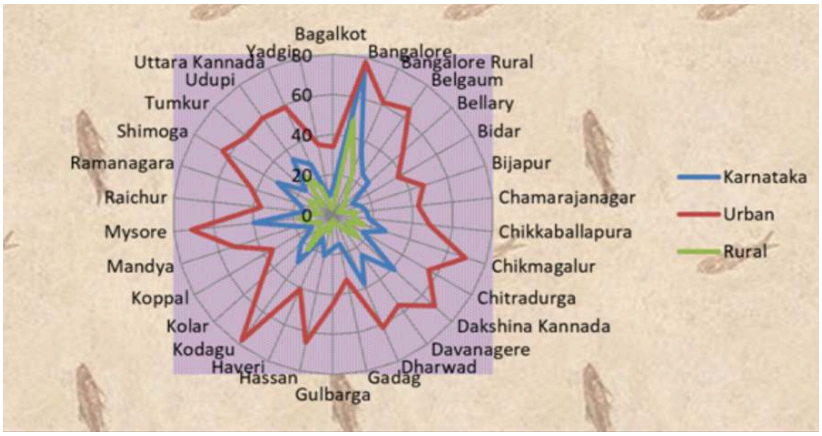
R^2 = 0.385, F = 36.280, Sig: 0.000

It has been found from the results of dummy variable regression model that, the average kerosene use for cooking in rural Karnataka is 1.233 per cent which is not acceptable; means that, there is no guarantee of use of kerosene for cooking in rural area. The difference between urban and rural is 7.71 percent and it is positive and acceptable. Therefore, there is a significant difference between urban and rural Karnataka in use of kerosene for cooking. The use of kerosene for cooking is significantly high in urban Karnataka. Accordingly, a large number of households still use kerosene as a major energy source for cooking particularly, in urban Karnataka. Hence, in urban Karnataka, it is necessary to address this issue.

Status of Use of LPG for Cooking in Karnataka

In the following section an attempt has been made to present relative status of use of LPG in rural and urban Karnataka. The blue line presents district wise use of LPG in Karnataka, red line shows LPG use in urban Karnataka and green line depicts LPG use in rural Karnataka.

Figure 4: Use of LPG for Cooking in Karnataka



Source: Census 2011

It has been found from Figure 4 that, in Karnataka the highest LPG users are found in Bangalore district. In urban Karnataka, the highest LPG using households are found in Bangalore, Mysore, Kodagu and Chikkamagalore districts. In rural Karnataka, the highest LPG using households are found in Bangalore districts. Therefore, there has been a wide range of disparities in use of LPG for cooking in Karnataka. It is also identified from the above figure that, LPG is a major source of energy for cooking in urban Karnataka. But, it is not so in rural areas. Accordingly, the growth process of Karnataka has failed to promote LPG for cooking in rural areas.

With this background, an attempt has been also made to estimate the difference between urban and rural Karnataka in use of LPG for cooking with the help of dummy variable regression model.

LPGC = á + â D1 + e

Where;

LPGC = LPG for Cooking

á = Intercept (Value of benchmark, in the present context it is the value for rural)

â = Difference between bench mark and D1

D1 = Dummy for urban (1 for dummy and 0 for otherwise)

LPGC = 11.587 + 41.557D1

(t): (5.564) (14.111)

Sig: 0.000 0.000

R^2 = 0.771, F = 199.107, Sig: 0.000

It has been found from the results of dummy variable regression model that the average LPG use for cooking in rural Karnataka is 11.587 percent, which is acceptable. The difference between urban and rural is 41.557 percent, which is positive and also acceptable. Therefore, there is a significant difference between urban and rural Karnataka, in use of LPG for cooking. The use of LPG for cooking is significantly low in rural Karnataka. Accordingly, there is a need to promote LPG in rural areas for cooking, which is eco-efficient.

Conclusion

The present study analyzed the use of energy sources for cooking in both rural and urban areas of Karnataka. Firewood is the major source for cooking in rural areas. LPG is the major source for cooking in urban areas. However, there is a wide range of disparities in the availability and use of firewood in rural areas. There is also a wide range of disparities in the availability and use of LPG in urban areas among the districts. A large number of households are still using kerosene as an alternative for LPG in urban area and alternative for firewood in rural areas. Therefore, in Karnataka, relatively, the use of energy for cooking is not eco-efficient in rural areas compared to urban areas. India is a signatory for Kyoto and Doha agreements on Carbon to reduce it by 18 percent. The present status of, use of energy in Karnataka for cooking will not up-hold the Kyoto and Doha agreements, because of its energy eco-inefficiency. Therefore, there is dire need for government intervention to restrict the use of firewood in rural areas and to promote LPG or biogas for cooking in rural areas. The government intervention is also needed to restrict the use kerosene in urban areas and also to promote solar and LPG for cooking in urban areas. As a matter of fact, to materialize these strategies, the energy programmes need to be integrated with housing programmes and others. As per the estimations, the installation cost of solar in total cost of house construction is less than 4 percent and increasing return to scale operates as the size of solar panel increases. Therefore, the government may make mandatory of installation of solar with the construction of houses with necessary subsidy schemes and strategies.

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