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# RURAL ENERGY SOURCE INDEX: COMPUTED FROM NSSO 66th ROUND

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## ABSTRACT

Human beings face a host of risk to their health caused by residuals necessarily generated during consumption and production process. Air emission is not exempted. Air pollution can be classified into two types namely indoor and outdoor. There are many causes for outdoor air pollution such as emission from industry, auto mobiles and so on, whereas household sector generates indoor air pollution due to burning of unprocessed bio fuel in traditional stoves. The people who may be exposed to indoor air pollutants for the longest period of time are often those most prone to get disease. Such groups include the young children, the elderly, and the chronically ill, especially those suffering from respiratory or cardiovascular disease. According to 2011 census, 85 percent of Indian households still rely on bio-fuels such as wood, dung cake and crop residuals for cooking and heating purposes. It was recorded 93 percent in the 2001 census. This paper is addresses the socio-economic aspects of households with use of high and low risk materials vary with per capita consumption expenditure (MPCE), social group and occupation. In order to realize the socio-economic aspects with respect of rural energy, NSSO 66th round data were analyzed. It concludes that economically, socially weaker section and people living below poverty line have still relay on high risk as principle sources of cooking and lighting. This is root causes of respiratory and cardiovascular diseases.

**Keywords:** High Risk Material, Low Risk Material, Indoor Air Pollution, Occupation, Social Group

  

ISSN: 2455-8834

Volume:01, Issue:04

## INTRODUCTION

It is a general myth that the production sector is generating more quantum air pollution during its operating process. However, the households sector is also a parallel to industrial sector to create emission. The Households cooking material is matter of concern, since an energy source for lighting and cooking is essential to welfare of rural poor. The people using clean fuels are one of the Millennium Development Goals (MDG) to comprehensively achieved sustainable environment. The conventional fuels remain cooking and heating sources as a result harming to environment and health of rural poor. For instance, The WHO (2002) sated that the world's 4th largest killer and it is causing 2.5 million premature deaths per caused by indoor emission. To reduce the indoor air pollution, clean fuel should adopt through improved stoves or better ventilation in the cooking area. The uses of firewood have been many negative effects, both social and environmental. Mostly women and children collect the firewood and this can take several hours per day leaving this group with less time for education, employment and recreation. The use of firewood and other forms of biomass as a cooking fuel is also directly related to exposures of the hazardous particles from the smoke that these fuels produce when burned (Gautam 2009). There have been several State initiatives that have attempted to mitigate the harmful effects of solid fuel usage. These include subsidies for clean fuel alternatives of solid fuel such as LPG, kerosene and biogas plants. The effectiveness of these clean fuel options has been limited as these alternatives are largely unavailable in most rural regions. Households in these regions are compelled to use solid fuels due to income and supply constraints (The Hindu, 17 April 2012). The household sector is one of the major consumers of energy in India. It accounts for about 50 percent of the total national energy budget. According to Census 2011 about 75 percent of the total populations live in villages. People in rural areas need energy for lighting, cooking and making warm water. Since the study is also concerned with rural households, the demand of the people who are in the study area is also mainly for lighting and cooking.

## MATERIAL AND METHODS

The construction of Energy Source Index is based on NSSO 66th round survey conducted at all India level during July 2009 to June 2010 and it was published 2012. Two types of index have been developed namely Positive Index and Negative Index. The low risk of non polluted cooking materials such as, kerosene and LPG are taking into consideration for calculating positive index. The polluted material such as coal, fuel wood and dung cake are considering for calculate negative index. There is no methodology available in the previous literature is considering to prepare for Energy Source index. Therefore, this method has been formulating long and healthy

  

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life to lead to prepare life Energy Source index. This dimension of index can be derivative human development index (HDI) method.

This secondary data sources were used analyse the various selected indicators of health risk factors from major states of India. This paper mainly focuses on the economic and social dimensions of these risk factors. Throughout the analysis is going to look at comparison between materials used by households in different states with Marginal Consumer Per capita Expenditure, occupation and social group of NSSO sample households, across the zone. This NSSO studies 17 states which have been sub divided into two zones namely, southern and other than southern state. A Sothern state includes Andhra Pradesh, Karnataka, Kerala and Tamil Nadu and other than southern state such as Arunachal Pradesh ,Assam ,Bihar, Chhattisgarh, Gujarat, Haryana, Jharkhand, Himachal Pradesh, Jharkhand, Madhya Pradesh, Odisha, Punjab, Rajasthan, Uttar Pradesh and West Bengal. In addition, the assumption made in the methodology is that both positive and negative indicators, representing the characteristics of cooking material are used. The formula is given below to calculate positive index.

$$\text{Positive index} = \frac{(\text{Actual Value} - \text{Minimum Value})}{(\text{Maximum Value} - \text{Minimum Value})}$$

$$\text{Negative index} = \frac{(\text{Maximum Value} - \text{Actual Value})}{(\text{Maximum Value} - \text{Minimum Value})}$$

This index is calculated for seven variables, minimum and maximum values were become fixed across the sates. However, since the maximum values are chosen such that they are higher than (or) equal to the actual value of 17 major states in India, Similarly the minimum values are chosen such that they are lower than (or) equal to the actual value.

**ANALYSIS AND DISCUSSION**

The focus of the effort is to analyse the high risk (solid fuel) and low risk materials (liquid fuel) of the select households towards cooking energy, to investigate the relationship between materials used by different social variable such as occupation, social group and marginal per capita consumption expenditure. In this backdrop, a few hypotheses were set tested. The results of the study are presented before.

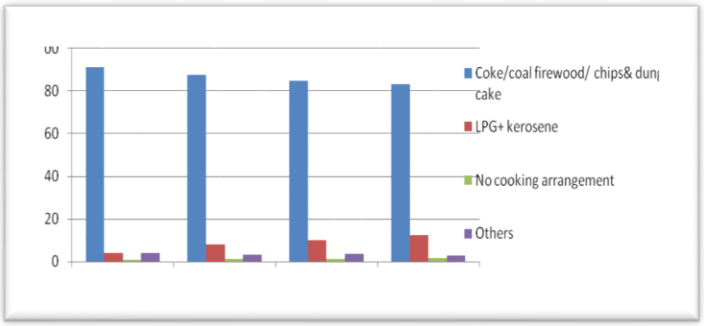
ISSN: 2455-8834

Volume:01, Issue:04

**Table 1: Percentage distribution of households by primary source of (high risk and low risk materials) energy for cooking from 1993-94 to 2009-10 (all India)**

| Years | High risk materials (Coal, Firewood chips, Dung cake) | Low Risk Materials (LPG, Gobar gas kerosene) | No cooking arrangement | Others |
|---|---|---|---|---|
| 1993-1994 | 91.1 | 3.9 | 0.7 | 4.1 |
| 1999-2000 | 87.6 | 8.1 | 1.1 | 3.1 |
| 2004-2005 | 84.9 | 9.9 | 1.3 | 3.8 |
| 2009-2010 | 83.4 | 12.3 | 1.6 | 2.7 |
| | **r** -0.99 P = 0.008 | | | |

Source: Data computed from NSSO 66th round, 2012.




Mostly Indian households have conventionally being used the solid fuel such as firewood, dung cake, unprocessed agriculture residuals as cooking and heating materials. There exist divergent viewpoints in this realm. All spin-off effects would naturally be borne by the households. This view may give an impression that there is health problem born by women folk and dependents. Some would argue that household sector have little knowledge and affordability to access low risk materials as a results there is greater loss of opportunity cost. It is, in this context necessary to identify cooking energy resources which pollute indoor harming the lives of women folk and dependents of women. 83.4 percent of households continued use the solid fuel in 2009-10 and it was 91 percent in 1993-94. Around 8 percent of households have dropped to use solid fuel. The part of household having no cooking arrangement shows a steady to increase from 0.7percent in 1993-94 to 1.6percent in 2009-10 (table1). The NSSO survey data helped raising the question whether or not high risk material has replaced by low risk materials statistical significant as

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Volume:01, Issue:04

cooking energy. A hypothetical situation is emerged. The correlation technique was adopted. The r value is –0.99 with p value is 0.008. It was confirmed that the inverse association between high risk and low risk materials. The low risk material has replaced the high risk metatarsal an over period of time. Nevertheless 83 percent of households have relay on high risk materials for cooking and heating at present.

**Table 2: Occupation wise distribution of 1000 hh's using high and low risk cooking materials**

| Type of Occupation | High risk materials | Low Risk Materials | Others | No cooking arrangement |
|---|---|---|---|---|
| Farm labourer | 936 | 34 | 29 | 2 |
| Self-employed Farm | 875 | 101 | 24 | 1 |
| Non-Farm labourer | 855 | 117 | 23 | 4 |
| Self-employed Non-Farm | 768 | 198 | 29 | 5 |
| Non-Farm others | 541 | 325 | 11 | 123 |

Source: Data computed from NSSO data 66$^{th}$ round (2012)

The vulnerable people are facing many disease that result from usage of high risk materials such as unprocessed agricultural residuals, cow dunk, coal and chips. In addition to that the occupational diseases were a major cause of morbidity and mortality. The occupation is one of the social characters of the households and it is build the economic wealth of households. In some areas, adequate cooking space with proper ventilation has reduced indoor air dust. However, due to inadequate of ventilation in the majority rural houses, the incidence of diseases such lung cancer, respiratory problems, asthma and cardio vascular causally attributable to these majority of vulnerable people like cooking women, dependents; children and elders and is still very high. In many rural houses, exposure to a variety of irritative, sensitizing agents is still a major challenge. For high risk materials such as cow dung cake, crop residuals, firewood use before the introduction of low risk materials but still high risk materials is dominant one. However tendency changed slowly and the households had started to use low risk for cooking and heating. This is may be positive sign. For incidence, 936 households out of 1000 households have been used high risk materials for cooking and heating purposes by farm labourer followed by 875 out of 1000 households have been used by self employed, 855 out of 1000 households of non-farm labourer, 768 out of 1000 households of self employed under nonfarm and 541 out 1000 households of non-farm other, respectively (table 2). The rural

  

ISSN: 2455-8834

Volume:01, Issue:04

people are reluctant to use low risk materials like Liquid Petroleum Gas due to no cost effective and lack of awareness (Nigel Bru et.al 2006). Given the fact that conventional sources of high risk materials and modern sources of low risk materials are practice in vogue in the village, the current demand of the residents is for low risk materials supply through Public Distribution System. However, they have depending largely on conventional sources for cooking purposes. It should be reduced. The vulnerable group switchover use from high risk materials to low risk materials resulted better health of the poor.

**Table 3: Distribution of 1000 rural HHs using high risk and low risk materials by social group for cooking and heating purposes**

| Social Group | High risk materials | Low Risk Materials | Others | No cooking arrangement |
|---|---|---|---|---|
| ST | 903 | 47 | 9 | 40 |
| SC | 894 | 71 | 27 | 7 |
| OBC | 841 | 136 | 21 | 12 |
| Others | 738 | 207 | 34 | 21 |

Source: Data computed from NSSO data 66$^{th}$ round (2012)

The patterns of rural energy sources such as high risk and low risk materials have been used by different social groups (Table 3), it is quite clear picture that 930 households per 1000 households of Scheduled Tribes (STs) followed by 894 out of 1000 households among the Scheduled Castes (SCs), and 841 out of 1000 households from Other Backward Classes (OBCs in rural areas are more dependent on high risk materials as traditional cooking fuel than other social groups who increasingly use modern liquid fuels as low risk materials. There is inverse relationship between social group orders and conventional materials used. A high risk material has low cooking efficiency, and its use has negative effects on health due to the proximate smoke that is generated. The average percentage of dependency on high risk materials is between from 90.3 and 89 per cent across the aforementioned deprived groups, compared to close to 73 per cent for all ‘other’ groups in rural areas. However the data shows that the dependency on low risk material has only increased over time in rural areas amongst the social groups.

  

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Volume:01, Issue:04

**Table 4: MPCE wise distribution of energy sources used by per 1000 Rural Hhs for Cooking**

| State classification | BPL | | APL | | BPL | APL |
|---|---|---|---|---|---|---|
| | HRM | LRM | HRM | LRM | Other Material | |
| Sothern State (include AP, TN, Karnataka, | 905 | 80 | 684 | 282 | 100 | 1 |
| Other than South (except south) | 928 | 37 | 819 | 141 | 29 | 19 |

Source: Data computed from NSSO data 66th round (2012). BPL: Below Poverty Line, APL: Above Poverty Line. HRM: High Risk Materials and LRM: Low Risk Materials

Poverty is one of the crucial socio economic formidable problems, which India is facing today. Poverty is defined in a number of ways by different people. There are three approaches for discussing the poverty line, Mohan Guruswamy et.al (2006) stated that poverty can be measured by nutrition intake, per capita income and per capita expenditure on food. They define poverty as households in rural India who spend less than Rs 368 per capita expenditure on food can be said to fall below poverty line.

In this analysis, consumption of high risk and low risk material differences with respect to poverty rates among the population is examined in this table 4. The poverty level has measured with the help of monthly Per Capita Consumption Expenditure (MPCE). The MPCE has used to measure the poverty level. It is comparison between south and other than south state's of India, the extent to which level of people are at a standstill using high risk and low risk material for households energy. People living in southern states are some extent better rather than other states with respect to consumption of high risk and low risk materials. For instant, 928 per 1000 households among below poverty line in south are using high risk materials as a result the high social cost to the poor than rich due to indoor air pollution followed by 905/1000 households in southern state, 80/1000 households are using low risk materials in the south followed 37/1000 households except south, respectively. Among 1000 households under the category of above poverty line, 648 households are consuming high risk energy source in south whereas 819/1000 households are consuming high risk materials rather other states. The Low risk source is mainly used by maximum 287/1000 households in south followed by 141/1000 households except south states, respectively. The south is better than other states and households under living APL is improved with respect use of low risk materials as cooking energy.

  

ISSN: 2455-8834

Volume:01, Issue:04

**Table 5: Index of Indoor Cocking Energy**

| Major State | Negative Index | | Positive Index | | Women's Education India | | MPCE Rural | |
|---|---|---|---|---|---|---|---|---|
| | Value | Rank | Value | Rank | Value | Rank | Value | Rank |
| Andhra Pradesh | 0.6 | 4 | 0.54 | 5 | 0.18 | 13 | 0.4007 | 4 |
| Assam | 0.3 | 9 | 0.37 | 7 | 0.37 | 8 | 0.0999 | 13 |
| Bihar | **0.18** | **13** | **0.03** | **15** | **0.02** | **16** | **0.0765** | **14** |
| Chhattisgarh | **0** | **17** | **0** | **17** | **0.20** | **11** | **0.0005** | **16** |
| Gujarat | 0.24 | 11 | 0.31 | 8 | 0.46 | 6 | 0.3561 | 6 |
| Haryana | 0.57 | 5 | 0.63 | 4 | 0.36 | 9 | 0.6147 | 3 |
| Jharkhand | 0.41 | 8 | **0** | **16** | **0.09** | **15** | **0.0108** | **15** |
| Karnataka | 0.28 | 10 | 0.3 | 9 | 0.39 | 7 | 0.3187 | 9 |
| Kerala | **0.75** | **2** | **0.75** | **3** | **1.00** | **1** | **1.0000** | **1** |
| Madhya Pradesh | **0.04** | **15** | **0.09** | **12** | **0.19** | **12** | **0.1010** | **12** |
| Maharashtra | 0.5 | 7 | 0.5 | 6 | 0.58 | 2 | 0.3396 | 7 |
| Odisha | **0.2** | **12** | **0.04** | **14** | **0.30** | **10** | **0.0000** | **17** |
| Punjab | **1** | **1** | **1** | **1** | **0.48** | **4** | **0.7340** | **2** |
| Rajasthan | **0.03** | **16** | **0.1** | **11** | **0.00** | **17** | 0.3389 | 8 |
| Tamil Nadu | **0.74** | **3** | **0.79** | **2** | **0.54** | **3** | **0.3833** | **5** |
| Uttar Pradesh | 0.16 | 14 | 0.1 | 10 | 0.17 | 14 | 0.1022 | 11 |
| West Bengal | 0.51 | 6 | 0.08 | 13 | 0.47 | 5 | 0.1613 | 10 |

Source: Source: Data computed from NSSO data 66th round (2012).

This is an initiating effort in constructing rural Cooking Energy Index (CEI), the NSSO 66th round data were utilized for constructing CEI for all major states in rural India to explore the relationship between high risk and low risk cooking materials. The CEI is potentially useful for policy makers to understand the health risk owing to usage of rural cooking materials. Minimum and maximum values are set in order to convert the indicators into indices between 0 and 1. The minimum value in both positive and negative indices has proved that lower the index value higher the usage of high risk and lower usage of low risk material and health impact thereof. The smoke from domestic sector resulted increases the health risk of the rural poor. Table 5 reveals state wise ranking of rural cooking energy source Index. The ranking is prepared for low risk materials like LPG, Gober gas and kerosene as positive indicators and negative score for dunk Cake, Coal, Firewood chips. The mean values of low risk material index and high risk index gave rural Cooking Energy Index. It is observed that Punjab state got 1st rank and CEI value was 1. This is witnessed the highest user of low risk material for cooking and heating

  

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Volume:01, Issue:04

followed by Tamil Nadu (2nd rank) with CEI means 0.79 and Kerala (3rd rank) by CEI mean 0.75 out of 17 major states, respectively. Comparing all the 17 states, the both Jharkhand and Chhattisgarh have shared lowest of rank value of 16.5 and the index value have got 0. The households in these states have had access the high risk cooking materials. The mean value of high risk materials lead to negative index, obviously Punjab has turned 1st rank with respect to using less proportion of high risk materials such as Cake, Coal and Firewood chips. The Punjab CEI value was 1 followed by Kerala CEI value 0.75 and Tamil Nadu CEI value 0.74, respectively. States like Kerala, Maharashtra, Tamilnadu Punjab and registering first five rank which can be attributed to high literacy rate and high MPCE on the other hand, Rajasthan, Bihar, Jharkhand, Uttar Pradesh and Chhattisgarh states ranked 17, 16 15, 14 and 13 out 17 rank displayed low literacy and MPCE. Hence, the upshot is literacy rate and growth rate have a strong bearing on CEI status too.

## CONCLUSION

Notwithstanding the difficulties involved in drawing conclusion, this analysis brings forth the following concluding remarks. Firstly, there is inverse relationship between high risk and low risk materials used by rural people over the period of time. The considerable percentage of conventional fuel used by people living below poverty line are varies between the south and other than south. Despite socially weaker section still relay on high risk materials. In addition, the rural CEI was developed for selective 17 major states in India. This CEI includes high and low risk materials used by the households. The CEI shows relationship the socio-economic variables and high risk materials and health impact thereof. The CEI is fairly a new phenomenon. Preparation of index assumes importance in this context. Each state within the county instance differences in cooking energy practices such as high risk and low risk materials. Level of women literacy rates and MPCE are a few factors exerting influence on rural cooking energy sources in practices. Regarding this index of India confirmed States like Kerala, Maharashtra, Tamilnadu and Punjab registering first five ranks which can be attributed to high literacy rate and high MPCE on the other hand, Rajasthan, Bihar, Jharkhand, Uttar Pradesh and Chhattisgarh stayed at the bottom. The low risk material contributes to better CEI which in turn improves welfare of the rural poor.

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ISSN: 2455-8834

Volume:01, Issue:04

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