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KEROSENE CONSUMPTION IN INDIA: WELFARE AND ENVIRONMENTAL ISSUES

K.S. Kavi Kumar
Brinda Viswanathan

MADRAS SCHOOL OF ECONOMICS
Gandhi Mandapam Road
Chennai 600 025
India

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K.S. Kavi Kumar
Professor, Madras School of Economics
kavi@mse.ac.in

and

Brinda Viswanathan
Associate Professor, Madras School of Economics
brinda@mse.ac.in

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MADRAS SCHOOL OF ECONOMICS
Gandhi Mandapam Road
Chennai 600 025
India

Phone: 2230 0304/2230 0307/2235 2157
Fax : 2235 4847/2235 2155
Email : info@mse.ac.in
Website: www.mse.ac.in

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Abstract

The adverse fiscal effects of fuel subsidies in developing countries like India are well documented. More recently, few studies have highlighted the fiscal, welfare and environmental effects of possible removal of subsidies on fuels in general. In the Indian context the leakages and errors of targeting, especially in case of kerosene supplied through public distribution system (PDS) have also been discussed widely in the literature. Using the National Sample Survey data for two recent rounds corresponding to the years 2009-10 and 2011-12, the present study explores the welfare and environmental implications of decline in the provision of kerosene through PDS. Focusing on kerosene used by the households for cooking purposes, the paper argues that kerosene has significant role in the household energy-mix and it helps in reducing the indoor air pollution. The study further highlights that the kerosene targeting has improved in recent years, that the subsidies have been progressive across geographical zones and sectors, and that economically and socially weaker groups of the society benefit more through implicit transfers associated with kerosene subsidies. While efforts to minimize and eliminate the diversion of kerosene to alternate markets including transport sector must continue, the phasing out of kerosene should be carried out gradually and cautiously to reduce adverse fallouts such as households moving down the energy ladder to use inferior fuels like dung and agricultural residue.

Keywords: *Fuel Subsidy; Welfare Effects; Indoor Air Pollution; Distributional Impact; India*

JEL Codes: *D6; H2; Q5; R1*

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K.S. Kavi Kumar
Brinda Viswanathan

INTRODUCTION

In India kerosene is supplied through the public distribution system (PDS) at a subsidized price. In the rural areas it is meant to supplement the households' lighting requirements, especially in areas with no electricity supply. In the urban areas, on the other hand, kerosene is meant to augment the households' cooking energy mix, especially in the areas with limited liquefied petroleum gas (LPG) penetration. Though there is no open market sale of kerosene, the fuel is accessed by the households from the market due to leakages in the PDS system (Clarke, 2014; Rao, 2012).

In addition to the leakages, there are growing concerns about diversion of kerosene to alternate markets, particularly to dilute diesel in the transport sector (Raghavan, 2016). Similar to other goods supplied through PDS, kerosene is also criticised for its poor targeting. The leakage, diversion and poor targeting are all cited as reasons for withdrawing the supply of kerosene through PDS. Kerosene subsidies are part of a bigger set of fuel subsidies which are criticised due to their large contribution to the overall fiscal burden in the country, with minimal benefit to the target groups.

Over time, the dependence on kerosene as primary fuel either for cooking or for lighting has declined in India due to significant penetration of LPG and electricity, respectively. The Economic Survey (2014-15) highlights that only a smaller fraction of poor households (46 percent) use kerosene as primary fuel for cooking needs and hence weak in targeting (GoI, 2015). Such an assessment based only on primary fuel could be misleading as kerosene has been an important supplementary fuel, especially for cooking.

While all of this is factual, we argue in this paper based on regional analysis that unless LPG penetration increases dramatically – both in rural and urban areas, decline in kerosene consumption due to drop in supply increases indoor air pollution and undermines efforts to reduce health burden. The Southern, Western and Northern states which have better penetration of LPG in urban areas do show significant decline in indoor air pollution over the past decade. Further, the urban areas of Eastern states and the rural areas of Southern states also show decline in indoor air pollution due to better functioning PDS and hence greater use of kerosene to supplement their cooking energy needs away from coke/coal and firewood, respectively. In the absence of these options, the rural areas of Eastern, Central and Northern states move towards other dirty fuels (dung and crop residue), leading to increase in indoor air pollution. Apart from the reduction of indoor air pollution, the kerosene subsidy continues to provide implicit income transfer to socially and economically weaker sections and several studies have shown that such transfers are 'progressive' (Datta, 2008; Rao, 2012; Anand *et. al.,* 2014; Basu and Basole, 2014).

The specific objectives of this paper include, (a) analyzing the role played by kerosene in the household's energy mix of cooking fuels; (b) analyzing the role of kerosene in reducing indoor air pollution; and (c) assessing the nature of implicit income transfers due to kerosene subsidy. The study uses unit record data from two National Sample Survey (NSS) rounds – 66^{th} (2009-10) and 68^{th} (2011-12) for the analysis. In particular the analysis uses consumption data reported by the households for cooking and lighting purposes. For easy comparability, the analysis is mostly carried at five broad geographic zones of India across the expenditure deciles in rural and urban areas separately. The five geographic zones considered include: North – covering the states of Jammu and Kashmir, Haryana, Punjab, Himachal Pradesh, and Delhi; Central – covering the states of Madhya Pradesh, Chattisgarh, Uttar Pradesh, and Uttaranchal; West – covering the states of Rajasthan,

Gujarat, Maharasthra, and Goa; East – covering the states of Assam, Bihar, Orissa, West Bengal, and the six North Eastern States; and South – covering the states of Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu.

The paper is structured as follows: The rest of this section presents the spatial and temporal trends in primary cooking fuel used by the rural and urban households, and provides a brief review of literature. The subsequent section discusses the approach followed in the estimation of cooking energy at the household level, and presents the spatial, temporal and decile-wise trends in the expenditure share of dung and other fuels in the household's overall consumption expenditure. The third section describes the approach adopted for estimating the particulate matter (PM) emissions resulting from the use of cooking fuels at the household level, and reports the trends in the same. This section also reports the results from the econometric strategy followed to determine the role of kerosene in explaining the variations in indoor air pollution. The fourth section analyses the trends in implicit income transfers associated with kerosene subsidy and explores progressivity of the implicit income transfers. The final section provides concluding observations.

Primary Cooking Fuel – Rural and Urban India

Due to inadequate penetration of LPG, especially in the rural regions, the rural households in India depend on various bio fuels, burning them largely in inefficient cook-stoves. The resulting indoor air pollution is considered to be one of the major health burdens in India and other South Asian countries (Ezzati, 2004; Smith *et. al.,* 2004). A number of studies have provided both macro and micro estimates of health burden due to use of bio fuels and other solid fuels such as coal etc.

Based on NSS data for the years 2004-05, 2009-10 and 2011-12, Figure 1 reports the percentage of households using various fuels as

primary cooking fuels in the rural and urban regions of India. The percentage of households using bio fuels as primary cooking fuel has only marginally declined in the rural India over the past one decade. The urban households on the other hand had increased their dependence on LPG due to better penetration of this cleaner cooking fuel. As mentioned above, kerosene has served as an important transition fuel for the urban households, who had better access to LPG compared to their rural counterparts. Overall, the spatial and temporal trends suggest that in case of rural India, (a) kerosene as primary fuel has declined in all zones, and (b) dependence on 'other fuels' has increased in the Central and the Eastern zones. The 'other fuels' largely include a combination of fuels such as dung and crop residue that are equally, if not more, polluting as firewood. In case of urban India, greater LPG penetration has led to reduction in household's dependence on firewood as well as kerosene. This pattern is clearly evident in the Northern and the Southern zones.

Since the households meet their cooking energy needs through multiple fuels, any assessment based exclusively on primary cooking fuel could be misleading. It is in this context the role of kerosene acquires significance. Non-availability of kerosene can in principle force the households to either revert to firewood or push them down the energy ladder to depend on inferior fuels such as dung and crop residue. Such transition could have significant effect on indoor air pollution, viewed especially in terms of particulate matter emissions[1]. In addition, since kerosene is supplied through public distribution system at subsidized price, non-availability of kerosene could lead to adverse welfare effects due to loss in implicit income transfers to the households.

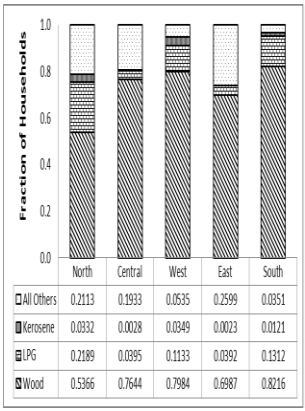
Only a handful of studies have analyzed in Indian context the role of kerosene in household's energy mix. The studies have largely

[1] This is not to suggest that kerosene is a clear cleaner alternative to bio fuels and other solid fuels. The literature is still scanty (see Nicholas *et. al.*, 2012 for a comprehensive review of literature) and hence for the purpose of this study, it is assumed that kerosene when burned in better cookstoves leads to lesser overall emissions.

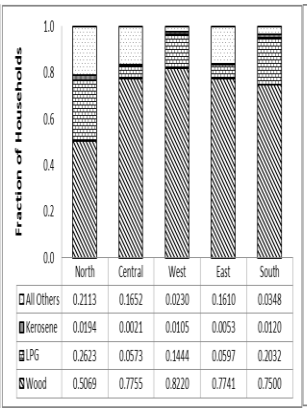
focused on the diversion of kerosene to other sectors, progressivity of kerosene usage and fiscal and welfare implications of kerosene subsidies. Recent studies including Gupta (2014) and GoI (2015) have highlighted the large scale leakages of kerosene from PDS and have thus provided the basis for a debate on withdrawal of kerosene from PDS. Clarke (2014) in a detailed study of subsidy transfers associated with kerosene highlighted that even though the subsidized kerosene is diverted to other sectors, the subsidy transfers are relatively evenly distributed across income deciles. Anand *et. al.* (2014), on the other hand looking at the fuel subsidies in general, argue that they are badly targeted with the richest 10 percent of households receiving six times higher benefits than the poorest 10 percent of households.

Rao (2012) using NSS data for the year 2004-05 argued that kerosene subsidies are regressive in rural Maharashtra whereas they are progressive among urban households. Given that the PDS targeting in general has improved over the past several years, it will be useful to assess the progressivity of kerosene subsidies in the recent years in Maharashtra as well as other parts of India. At the same time, it is also important to understand the extent to which use of kerosene would have contributed to the energy mix of the households and helped in reducing the indoor air pollution.

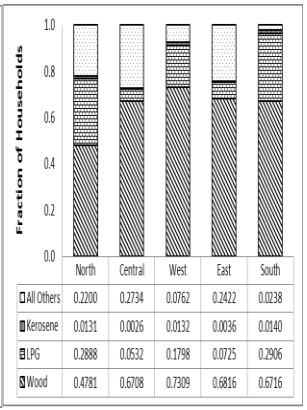
RURAL HOUSEHOLDS



2004-05

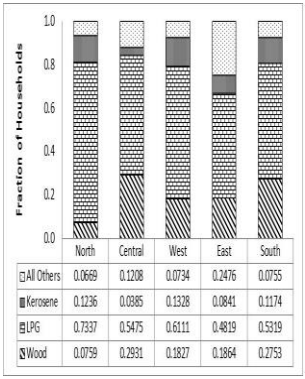


2009-10

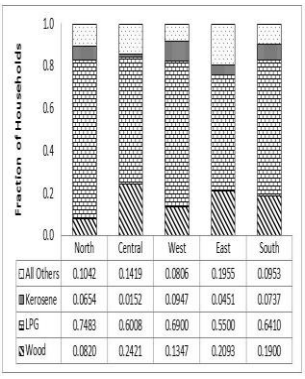


2011-12

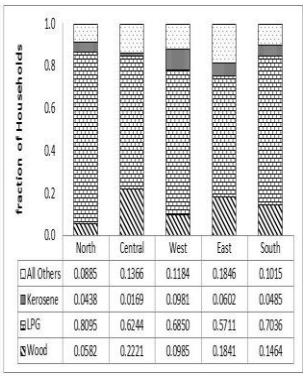
Urban Households



2004-05



2009-10



2011-12

Figure 1: Fraction of Households Using Different Fuels as Primary Cooking Fuel – Rural and Urban Zones of India

Household Cooking Energy – Shares of Different Fuels

The NSS data provides information on quantity and value of different fuels used by the households for meeting their cooking energy needs. Considering that the fuels accessed by the households have uniform quality, it is feasible to estimate the aggregate cooking energy content.

However, there are a couple of issues that need special attention. Fuels like kerosene can be used both for cooking and lighting purposes. Since the NSS data reports only the overall kerosene used by the household, it is essential to allocate kerosene between the cooking and lighting needs of the household to assess the overall cooking energy. For some fuels like dung and crop residue, the NSS data provides only value information and no quantity information as it is difficult to ascertain the same during the survey.

The following approach is used in this study to estimate the household cooking energy and the contribution of different fuels in meeting the cooking energy requirements.

(a) For allocating kerosene between cooking and lighting the information on the household's choice of primary fuels for cooking and lighting is used. In case of households reporting electricity as primary fuel for lighting, all the kerosene used is allocated for cooking purpose. In case of households reporting kerosene as primary fuel for lighting, all the kerosene used is allocated for lighting purpose. For the households reporting kerosene as primary fuel for both cooking and lighting, the kerosene used for cooking alone is obtained by subtracting from the total kerosene consumption the average consumption reported in the region, sector and state where the household resides.

(b) Using fuel-wise energy content and thermal efficiency values reported in Smith *et. al.* (2000), Mestl and Eskeland (2009), and Venkataraman *et. al.* (2010), the cooking energy at household level is estimated.

(c) For assessing the energy obtained by the households from other sources of energy for which no quantity data is available (e.g., dung and crop residue), in each zone and sector the mean energy is first estimated at each decile using the available fuel quantity data. Then for the households reporting positive

expenditure on dung and other energy, the energy from these fuels is attributed as the difference between the mean cooking energy of the decile, sector and zone to which the household belongs and that household's own total cooking energy from the fuels with quantity data.

It may be noted that the corrections made in the above manner for assessing the true amount of cooking energy used by the households could underestimate the total energy and hence the level of indoor pollution that is discussed in the next section.

Household Cooking Energy – Salient Features

- One of the important features of household cooking energy in the recent years is increased expenditure share on dung and other fuels including crop residue. Figure 2 below shows the expenditure shares of dung and other fuels across different zones and expenditure deciles in rural areas in 2009-10 and 2011-12. The expenditure shares on these fuels have registered a clear increase in all zones for almost all expenditure deciles. It is possible that the expenditure share of these fuels could have increased due to increase in prices, or quantity consumed, or both. However, since these fuels are not availed through formal market, the changes in associated implicit prices are difficult to assess.

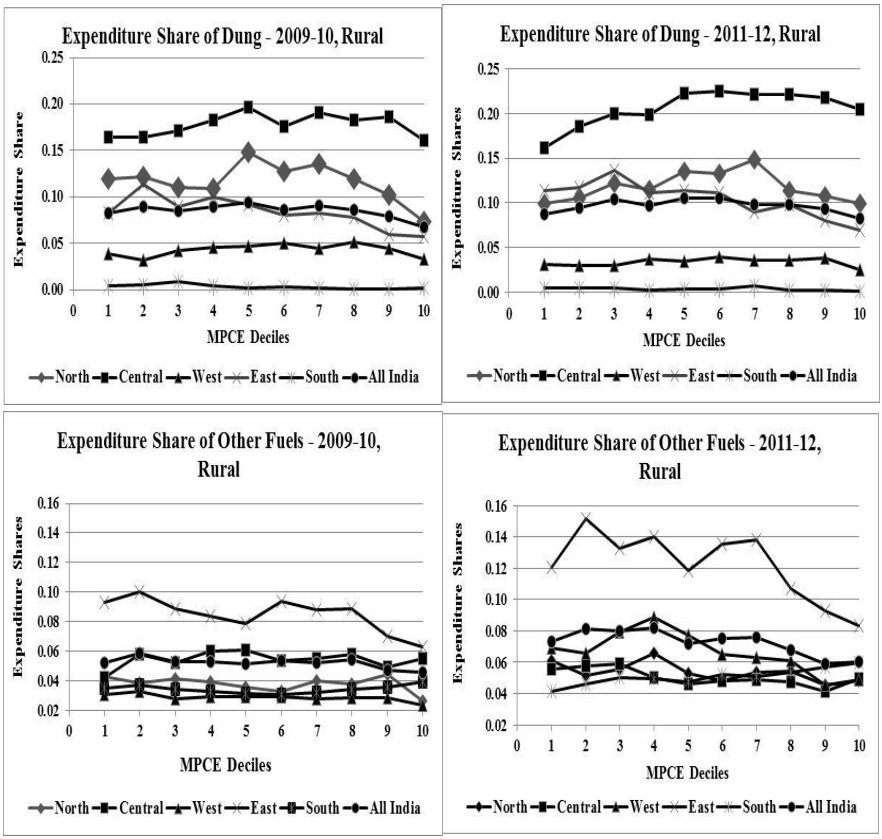


Figure 2: Expenditure Shares of Dung and Other Fuels – Rural India, 2009-10 and 2011-12

- Analysis of shares of various fuels in the household's energy mix shows that in the rural areas of Northern, Central and Eastern zones, the share of kerosene – sourced from both PDS and market – is very low compared to the Western and the Southern zones, and is also declining over time (see figure 3). Correspondingly, the other fuels (including dung) have significant share in the household energy mix, suggesting the possibility of households switching towards these inferior fuels due to non-availability of cleaner fuels including kerosene.

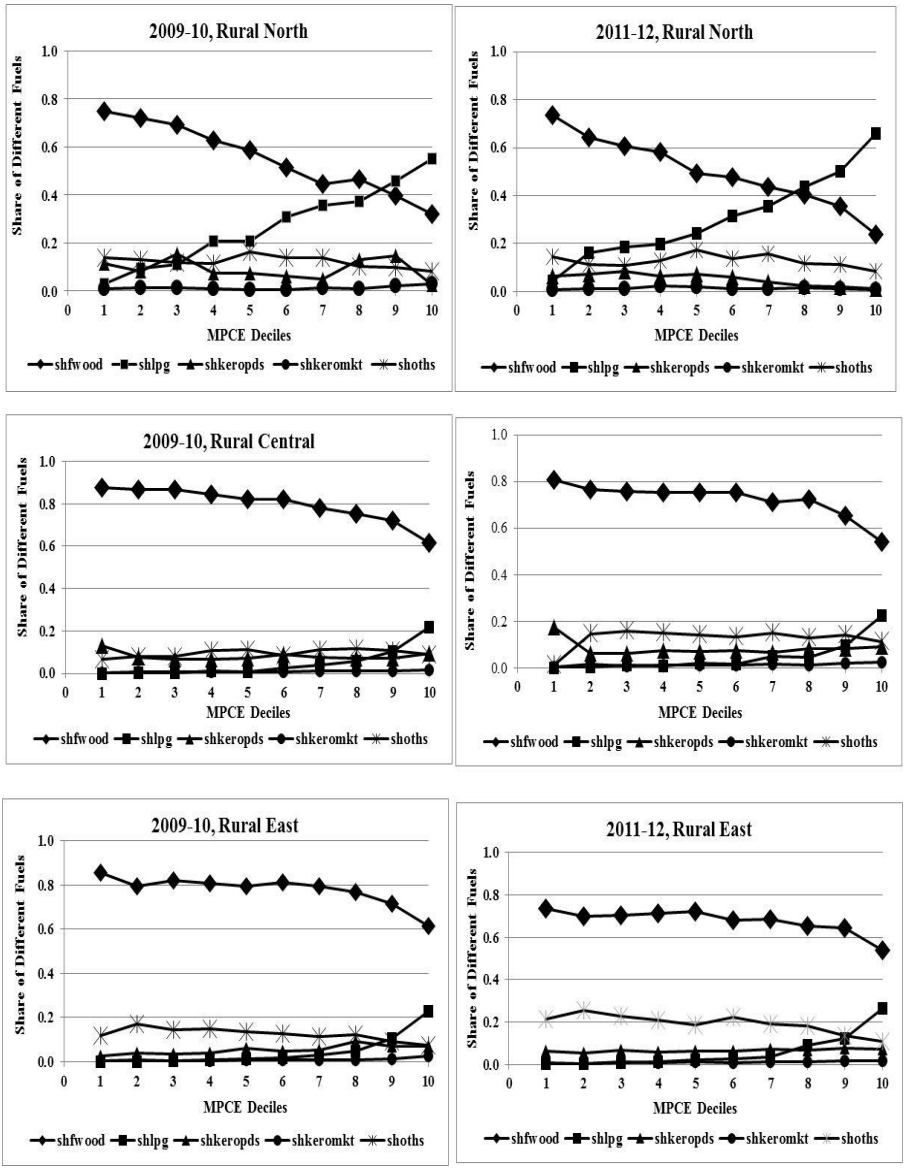


Figure 3: Shares of Different Fuels in Household Cooking Energy

Note: shfwood - Share of firewood; shlpg- Share of LPG; shkeropds- Share of kerosene from PDS; shkeromkt-Share of kerosene from market purchase; shoths-Share of other fuels like dung, crops residue, coke, coal etc.

- As per the norms, kerosene is meant for the rural households who report electricity as primary fuel for lighting. In the Southern zone despite better rural electrification, the states have allocated kerosene to the rural households over the period 2009-10 and 2011-12. This suggests urban to rural diversion of PDS kerosene. Such diversion however has beneficial effect of reducing indoor air pollution among rural households. A similar pattern is seen among the western states also.

RURAL INDOOR AIR POLLUTION – ROLE OF KEROSENE

Assessing indoor air pollution resulting from the combustion of cooking fuels is a complex task as detailed information on the fuel characteristics, combustion techniques, and kitchen characteristics is required. Since these details vary significantly across the households, simplifying assumptions have to be made to get some broad idea about the air quality status inside the house. Further, multiple pollutants constitute indoor air pollution with each pollutant having different impact on the human health. Since particulate matter is one of the dominant indoor air pollutants, the discussion here focuses on this pollutant.

Using the emission coefficients reported in the literature (Smith *et. al.,* 2000; Venkataraman *et. al.,* 2010), along with the fuel consumption quantities and the estimated cooking energy from other fuels, household level particulate matter emissions are estimated. Kumar and Viswanathan (2013) follow similar approach to analyze patterns of the household level pollution in India. The estimated particulate matter emissions are further analyzed to understand the spatial and temporal patterns, and to understand the role played by kerosene in determining the particulate matter emissions.

Particulate Matter Emissions – Temporal and Spatial Patterns

Figure 4 shows the annual per-capita particulate matter emissions across expenditure classes for the years 2009-10 and 2011-12 in the rural and

urban areas. As could be seen, the bottom expenditure classes in rural India experience higher pollution in 2011-12 compared to 2009-10, as the households in these expenditure classes seem to have switched to inferior cooking fuels due to non-availability of cleaner fuels, including kerosene. This pattern is more evident in the Northern, Western, and Central zones.

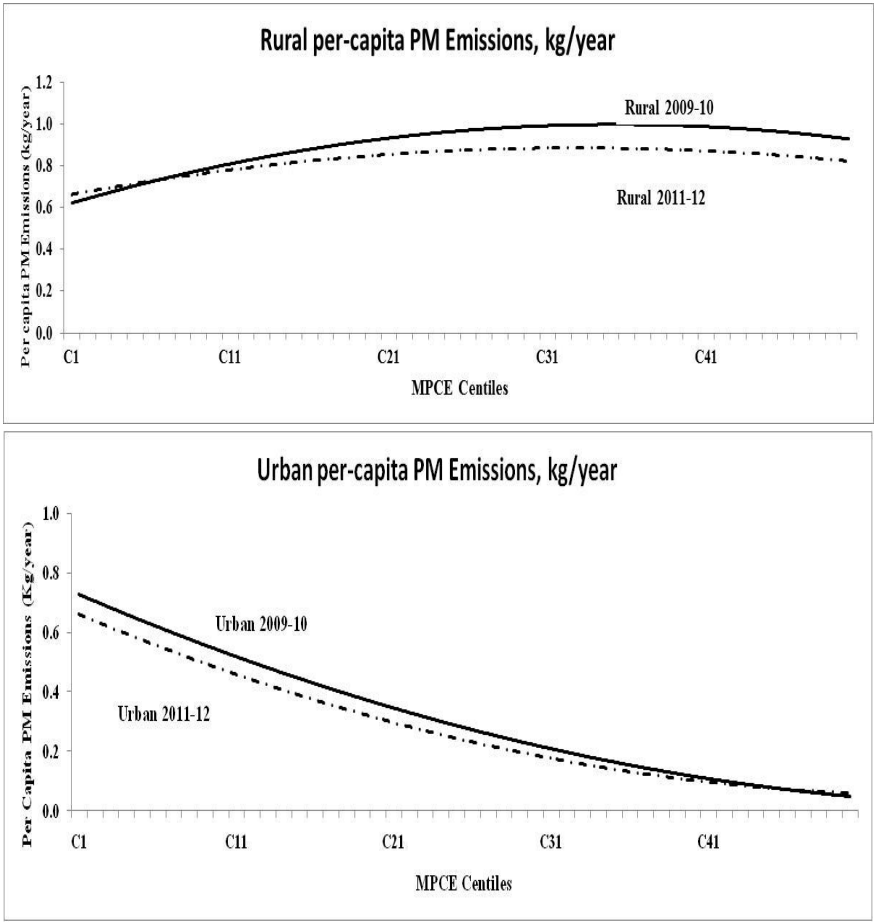


Figure 4: Per-capital Particulate Matter (PM) Emissions – 2009-10 and 2011-12

Determinants of Indoor Air Pollution

To gain further insight about the role played by kerosene in determining the indoor air pollution, the following modeling framework is used and estimated using the household level unit record data of NSS separately for the years 2009-10 and 2011-12. The analysis is separately carried out for each of the five geographical zones as well as for all India to understand the relative importance of kerosene in controlling particulate emissions across India. The econometric model is estimated using a linear regression model and the following equation gives the dependent and independent variables used in this analysis.

PM-Emissions = f(Econ-factors, Demog-factors, Social-factors, Energy-factors)

where, *PM-Emissions* is the logarithm of per-capita particulate emissions at the household level;

Econ-factors includes logarithm of monthly per-capita expenditure of the household and its square and occupation of the head of the household;

Demog-factors include household size, percentage of children, non-working adults;

Social-factors include religion, social groups, educational status of the head of the household;

Energy-factors include household's choice of primary fuel for cooking and lighting, share of various fuels in the household's cooking energy including kerosene accessed through PDS and the market.

Table 1 reports the estimated coefficients of the linear regression model separately for the years 2009-10 and 2011-12 for all the five geographical regions as well as for All-India. While the estimated model has several relevant demographic, social and economic control variables,

the table shows only a few relevant variables for brevity. The main results are summarized below.

- In line with the findings in the literature (see, Kumar and Viswanathan, 2013), the positive and negative signs of the coefficients associated with income (lnMPCE) and its square (lnMPCE Square) support Environmental Kuznets Curve hypothesis. The magnitude of the MPCE coefficient declines over time suggesting that improvements in household incomes (and hence MPCE) has led to improvement in reduction of harmful pollution within the household. These would have happened due to better kitchen ventilation and improved stove efficiency after controlling for the improvement in usage of cleaner cooking fuels.
- Households that access firewood as primary fuel show a positive impact on PM emissions while those who have access to LPG as primary fuel show a negative impact. In 2009-10, with limited use of other fuels at all India level the positive effect balances the negative of these two different fuel choices. However, this result changes in 2011-12 as the proportion of households reporting other fuels as primary, changes significantly thereby affecting the magnitude of these coefficients. The fact that the proportion of households for different primary fuel choice vary across the zones, shows that the magnitude of these two coefficients vary substantially.
- Since households reporting kerosene as primary fuel is very small, the role played by kerosene is only apparent as a fuel mix. Therefore we consider the share of kerosene in the total fuel mix to capture this aspect. We also split this into two sources of kerosene purchase. Both the estimated coefficients show clear evidence of kerosene in reducing the indoor pollution(in the household cooking fuel-mix). Further, the increasing magnitude of the coefficients associated with kerosene over time suggests

that lack of access to kerosene has indeed led to increase of indoor air pollution as the households have met their cooking energy needs by shifting towards inferior fuels such as dung and crop residue.

- The results also suggest that kerosene sourced from market has played relatively more significant role than the PDS kerosene in reducing indoor air pollution, as often the market sourced kerosene would be to fill the unmet energy needs.

KEROSENE SUPPLY – WELFARE ISSUES

As mentioned in the beginning, one of the main questions analyzed in the literature is to assess whether the kerosene supplied through PDS is reaching the needy and targeted population. To gain further insights in this regard, this section explores the following issues: (a) spatial and temporal trends in the share of implicit income transfers; (b) effectiveness of implicit income transfers as assessed through their reach to social and economically weaker groups; and (c) the progressivity of implicit income transfers.

The implicit income transfers to the household resulting from the purchase of kerosene through PDS are approximated to the first order and calculated as (see Anand *et. al.,* 2014):

$$\text{Income Transfer} = Q^{K}_{PDS} * (P^{K}_{Market} - P^{K}_{PDS})$$

where, Q^{K}_{PDS} is the quantity of kerosene purchased through PDS (in liters), P^{K}_{Market} and P^{K}_{PDS} are respectively, the price of kerosene in the open market and in the PDS shops. These income transfers are expressed as percentage of total household expenditure and analyzed across zones, expenditure deciles and social groups. These income transfers are only first order approximations as actual transfers will depend on substitution possibilities between kerosene and other fuels captured through the relevant elasticities and accessibility.

Table 1: Determinants of Indoor Air Pollution – Rural India, 2009-10 and 2011-12

2009-10	North		Central		West		East		South		All India	
	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value
lnMPCE	1.42**	0.017	0.532	0.380	2.35***	0.000	1.15*	0.093	0.66**	0.041	1.20***	0.000
lnMPCE Square	-0.08**	0.045	-0.025	0.591	-0.15***	0.000	-0.06	0.234	-0.04*	0.074	-0.07***	0.000
PryFuel-Fwood	1.29***	0.000	0.914***	0.000	1.64***	0.000	1.36***	0.000	1.07***	0.001	1.14***	0.000
PryFuel-LPG	-1.49***	0.000	-1.62***	0.000	-0.81***	0.003	-1.71***	0.000	-1.20***	0.000	-1.41***	0.000
Share-PDSkero	-0.23**	0.012	-0.61***	0.004	-0.46**	0.010	-0.54*	0.073	-0.61***	0.004	-0.50***	0.000
Share-Mktkero	-1.22***	0.000	-2.44***	0.000	-1.41***	0.000	-2.95***	0.000	-2.04***	0.000	-2.20***	0.000
Adjusted R^2	0.5719		0.4997		0.5510		0.6108		0.5376		0.5477	
Number of Obser.	7191		11799		8602		18848		12180		58620	

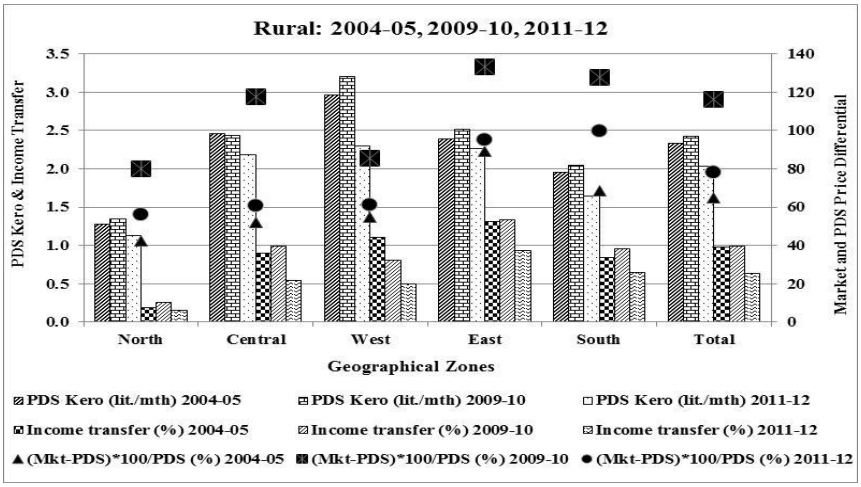
2011-12	North		Central		West		East		South		All India	
	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value
lnMPCE	0.60	0.329	1.69***	0.000	1.68***	0.000	2.10***	0.001	1.36***	0.004	1.99***	0.000
lnMPCE Square	-0.04	0.307	-0.10***	0.000	-0.11***	0.000	-0.13***	0.002	-0.08***	0.009	-0.12***	0.000
PryFuel-Fwood	1.38***	0.000	0.89***	0.000	1.70***	0.000	1.31***	0.000	0.38**	0.043	1.11***	0.000
PryFuel-LPG	-1.90***	0.000	-1.76***	0.000	-0.56***	0.000	-1.68***	0.000	-1.68***	0.000	-1.41***	0.000
Share-PDSkero	-1.48***	0.000	-0.84***	0.000	-0.47***	0.004	-1.18***	0.000	-1.62***	0.000	-0.94***	0.000
Share-Mktkero	-2.36***	0.000	-1.86***	0.000	-1.70***	0.000	-3.38***	0.000	-2.89***	0.000	-2.42***	0.000
Adjusted R2	0.6719		0.532		0.5447		0.6206		0.5001		0.5505	
Number of Obser.	7804		11797		8583		18906		12237		59327	

Note: (1) Dependent Variable is log of particulate matter emissions; (2) lnMPCE= log of Monthly Per Capita Expenditures; PryFuel-Fwood/PryFuel-LPG = takes a value 1 if firewood/LPG is the primary cooking fuel and 0 otherwise; Share-PDSkero/Mktkero=Share of energy contributed by kerosene in the households cooking energy mix purchased from PDS/Market; (3) Coefficients for other variables used in the regression model are not reported here and can be made available upon request; (4) ***, ** and * denote significance of the estimated coefficients at 1 percent, 5 percent and 10 percent levels of significance.

Trends in Implicit Income Transfers

The implicit income transfers calculated in the above manner are analyzed to assess their spatial and temporal trends. Figure 5 shows the income transfers as percentage of household income for rural and urban areas separately. The income transfers are shown for different time periods (2004-05, 2009-10 and 2011-12) and for different geographical zones. The figure also shows the differences across geographical zones in terms of the quantity of kerosene availed through PDS and the price differential between kerosene purchased from market and kerosene purchased through PDS in different time periods. The following insights can be drawn from the graphs:

- Over the period 2004-2012, PDS kerosene consumption has increased and then decreased in rural, whereas it uniformly decreased in urban areas;
- Share of income transfer in total household expenditure is uniformly higher in rural (poorer regions) than in urban, suggesting that the kerosene subsidy does matter for the needy population;
- Eastern region which has relatively more poor population, shows higher share of income transfer availed through kerosene subsidy;
- Income transfers in Southern and Western zones become comparable with those of Central (where poor population is higher again) perhaps due to better targeting and functioning of PDS



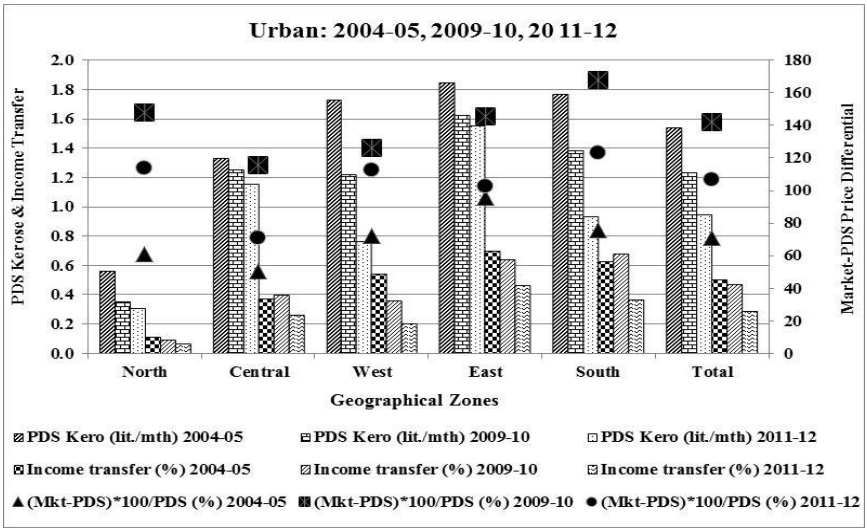


Figure 5: Spatial and Temporal Trends in Implicit Income Transfers Associated with Kerosene Supply through PDS, Rural and Urban

Note: (1) PDS Kero-monthly per capita consumption of kerosene from PDS, (2) Income Transfer (percent) = $[Q^K_{PDS} * (P^K_{Market} - P^K_{PDS})]*100/[\text{Total Household Expenditure}]$, (3) The price differential between market and PDS purchase of kerosene is reported as a proportion of PDS price.

Is Kerosene Reaching the Targeted Groups?

One of the often raised criticisms against kerosene supply through PDS is that it doesn't reach the targeted population. Figure 6, however shows that across geographical zones and across rural and urban sectors, the bottom 20 percent of the population avail higher quantity of kerosene through PDS compared to middle 30 to 70 percent population. Accordingly they also report higher share of implicit income transfer as a percentage of household income. Though kerosene supplied through PDS had exhibited urban bias in 2009-10, the data corresponding to 2011-12 show a decline in the urban bias, both in terms of quantity of kerosene availed and in terms of implicit income transfers.

The issue of benefits from kerosene supply reaching the targeted and needy population can also be analysed by looking at the benefits accruing to the disadvantaged social groups in comparison to the other groups in the society. Figure 7 provides a comparative picture of benefits associated with the consumption of kerosene from PDS accruing to scheduled casts (SC) and scheduled tribes (ST) along with the benefits availed by other social groups. As can be seen, the SC/ST population has been benefiting more than the other social groups in all geographical zones except the Central and the Eastern zones, where perhaps due to inadequate penetration of LPG is resulting in the diversion of PDS kerosene to other social groups.

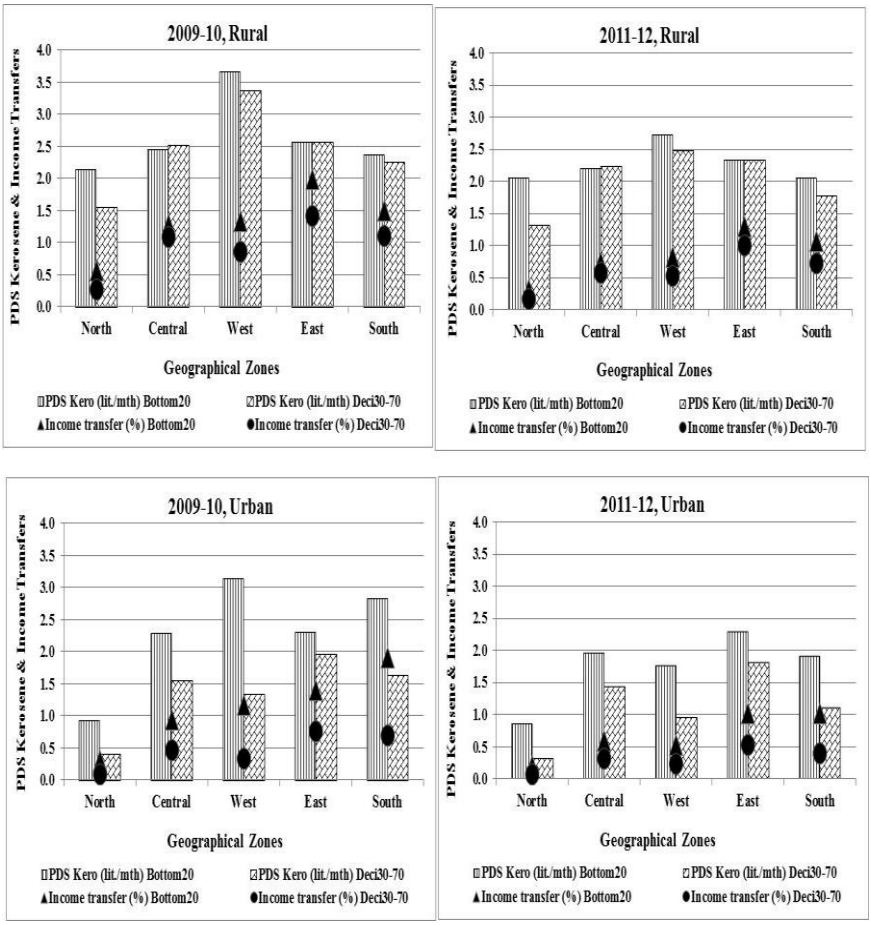


Figure 6: Pattern of Benefits Associated with Kerosene Supply through PDS across Economic Groups

Note: (1) PDS Kerosene refers to the monthly per capita consumption of kerosene from PDS and income transfers is defined the same manner as in Figure 5, (2) Bottom 20 -bottom 2 deciles of MPCE and Deci30-70 are the 3rd to 7thdeciles of MPCE.

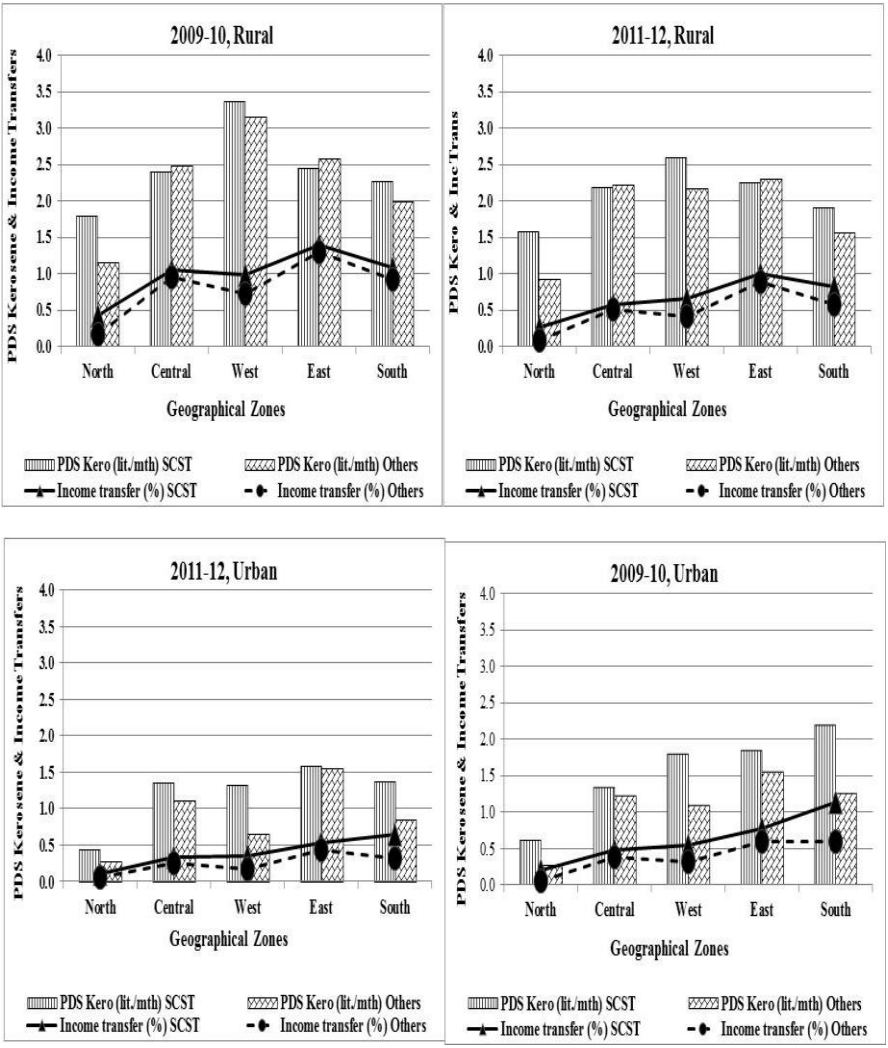
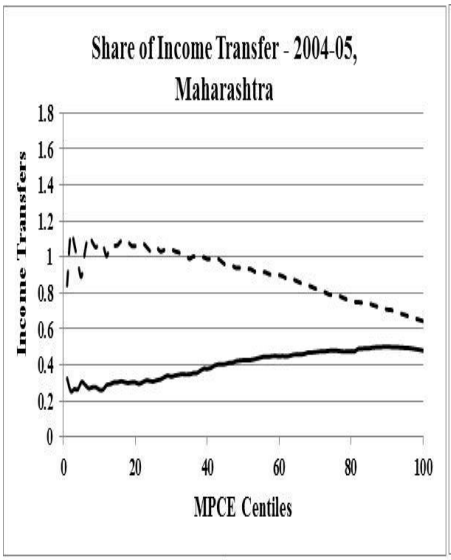


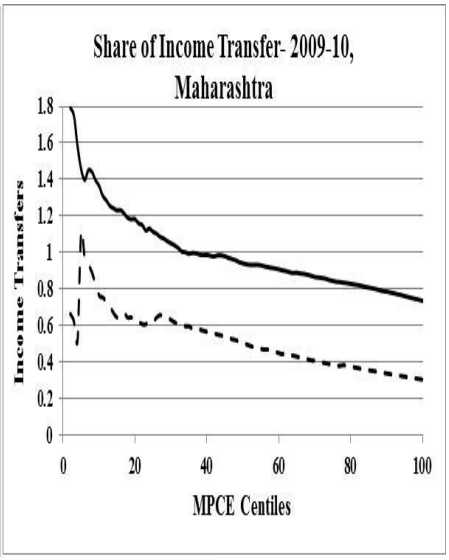
Figure 7: Pattern of Benefits Associated with Kerosene Supply through PDS across Social Groups

Note: (1) Same as Figure 6, (2) SCST- Scheduled Castes and Scheduled Tribes and Others- remaining caste groups.

Are Kerosene Subsidy Benefits Progressive?

Another aspect associated with subsidies in general including kerosene subsidies that received attention in the literature is the progressivity of the subsidies. Properly designed and well-targeted subsidies exhibit progressivity in the sense that the benefits as a percentage of household income are higher among the lower income groups compared to the richer income groups. Based on 2004-05 data, Rao (2012) while analyzing the implicit income transfers associated with PDS kerosene in the western state of Maharashtra argued that kerosene subsidy benefits are regressive in nature in rural areas whereas they are progressive in the urban areas. However, as shown in figure 8, recent data (2011-12) clearly indicates that the income transfers associated with kerosene subsidy have become progressive in rural areas of Maharashtra as well. Figure 9 further shows that across broad geographical zones, the income transfers have broadly been progressive in both rural and urban areas in the years 2009-10 as well as 2011-12.





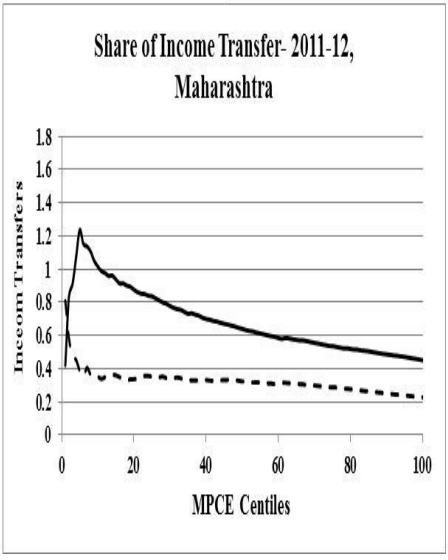


Figure 8: Pattern of Income Transfers Associated with Kerosene Supply through PDS – Rural and Urban Maharashtra

Note: Income Transfers is defined in the same manner as Figure 5.

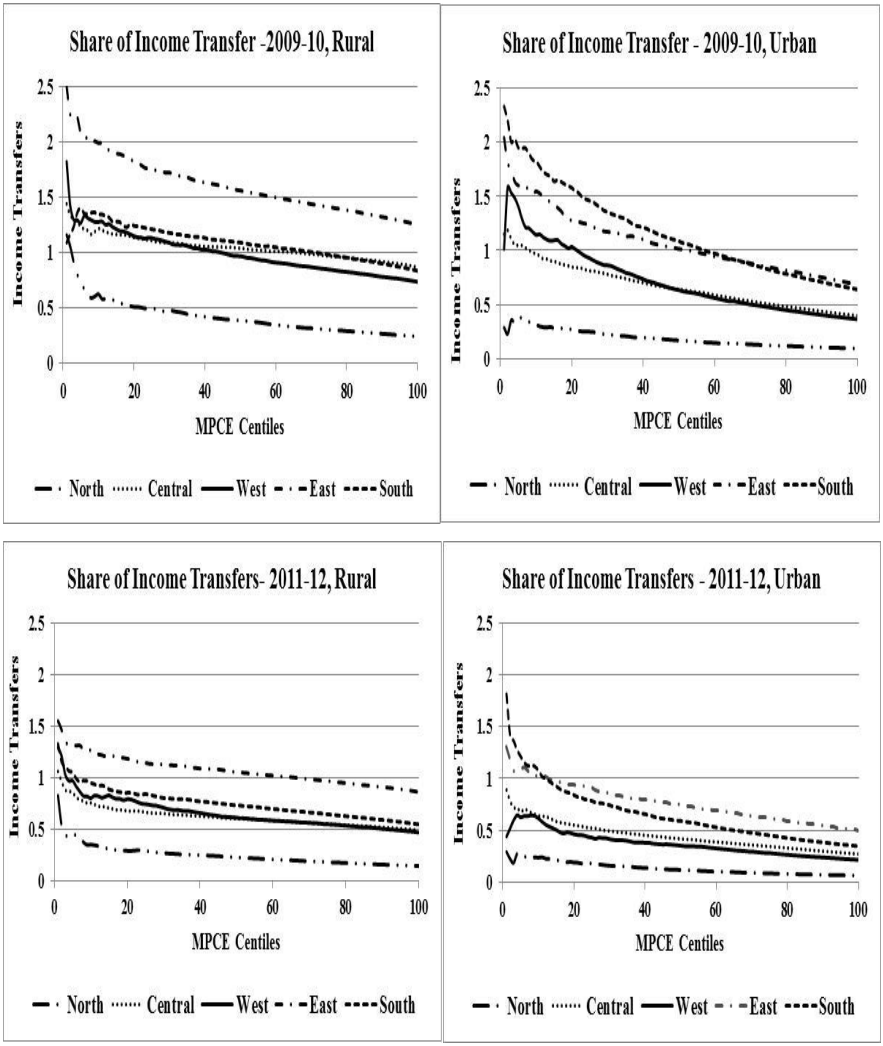


Figure 9: Patterns of Income Transfers Associated with Kerosene Supply through PDS – Geographical Zones of Rural and Urban India, 2009-10 and 2011-12

Note: Income Transfers is defined in the same manner as Figure 5.

KEROSENE DIVERSION: INTERSTATE COMPARISONS

Kerosene is allocated to the households in India at a subsidized price through public distribution system for meeting either lighting needs or cooking requirements. Broadly it is supplied in the rural areas for supplementing the lighting needs of households due to inadequate electrification, whereas in the urban areas the kerosene supply meets the cooking needs of the households where the LPG penetration is not adequate. The criteria used and actual allocation differ from state to state, with roughly 4 litres of kerosene allocated to the households for lighting purposes. The twin criteria of number of LPG cylinders possessed by the household and the household size determine the kerosene allocated for cooking purpose. For cooking purposes kerosene allocation is inversely related to the LPG cylinders possessed by the households (with zero allocation for the households with two cylinders) and directly related to the household size. Since poorer households typically tend to possess lesser number of LPG cylinders and have larger family size, the kerosene subsidy does in principle have the potential to serve as a redistributive instrument.

However, kerosene allotted to a state through PDS finds its way to two other markets – black market where the households can purchase kerosene for meeting their cooking and lighting needs, and to transport market for adulteration of diesel. Kerosene available in black market still meets the household's cooking needs, albeit at higher price, the kerosene diverted to the transport market completely defeats the intended purpose for which the subsidy is given. There has been significant diversion of kerosene across almost all states of India and this has often been cited as reason for doing away with kerosene subsidy. Figures 10 and 11 provide temporal trends in kerosene diversion at zonal level and at state level. For each state aggregate household level consumption of kerosene (accessed from both PDS and black market) is compared to the kerosene

off-take by the state[2] in that year to estimate the diversion of kerosene in percentage terms. Between the years 2004-05 to 2011-12, the Eastern zone registered the sharpest increase in kerosene diversion followed by the Southern zone, whereas the Northern and the Western zones continue to have high diversion rates throughout (see Figure 10). The kerosene diversion at state level is compared with the all-India average to understand which states are contributing relatively more towards the overall diversion of kerosene for adulteration purposes. Mostly the Northern states have been consistently reporting high diversion rates.

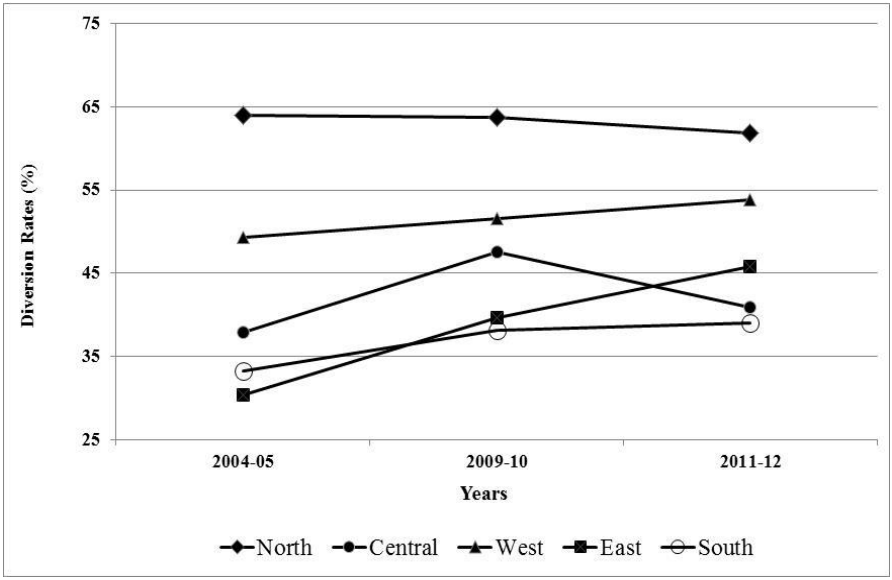


Figure 10: Percentage of Kerosene Diversion across Zones and over Time

Note: Diversion is expressed as ratio of aggregate state level consumption of kerosene (obtained from NSSO data) to the off-take of kerosene (obtained from by the state in a given year and expressed in percentage terms.

[2] Data accessed from India Stat data portal: www.indiastat.com/table/civilsuppliesandconsumeraffairs/4/publicdistributionsystem/79/367571/data.aspx.

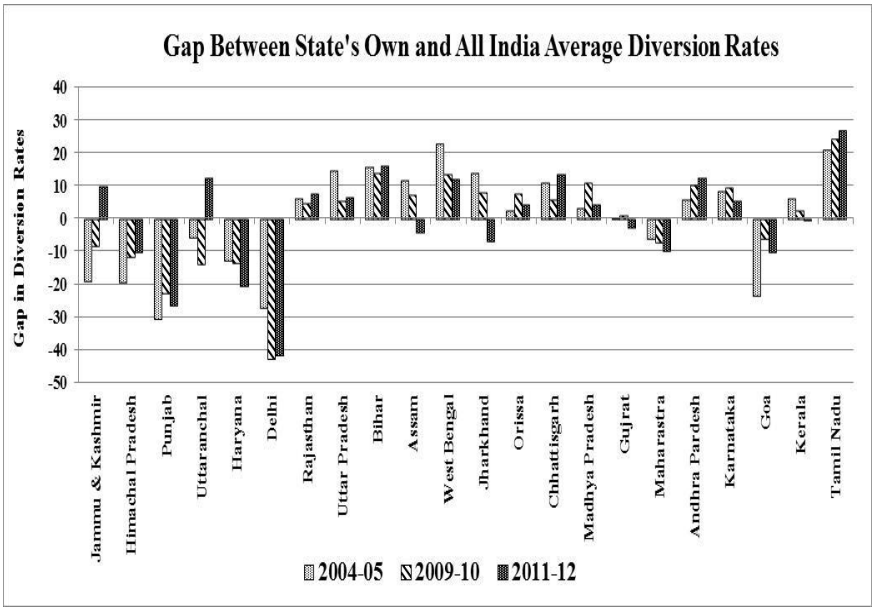


Figure 11: Percentage of Kerosene Diversion Compared to All-India Average Diversion Rates

Significant diversion shown above and also highlighted in the literature (Rao, 2012; Economic Survey, 2014; Gupta, 2014; Clarke, 2014) provides ground for phasing out kerosene supply through PDS. Since 2009-10, the Government of India has been progressively reducing the allocation of kerosene through PDS. Clarke (2014) estimates that the annual PDS kerosene allocations have declined by about 8 percent in 2011-12 compared to 2009-10 and have since been improved slightly to stand at about 4 percent lower in 2013-14 compared to 2009-10.

CONCLUSIONS

It has been argued in this paper that there are several reasons why reduction in kerosene supply subsidized and otherwise may not be justified. With regard to subsidized component of kerosene, the targeting has improved in recent years and the subsidy benefits are by and large

progressive in nature across zones and sectors. Kerosene subsidy removal may more adversely affect the poorer states, lower income groups, and disadvantaged social groups. Non-availability of kerosene is pushing households (especially in rural areas) to supplement their cooking energy needs through use of cheaper and dirty fuels such as dung and crop residue leading to more indoor air pollution and thereby increasing health risk of women, children and elderly.

It is no doubt that diversion of kerosene to alternate and unintended markets such as transport sector should be curtailed as strictly as possible but caution must be exercised to ensure that effective alternative options are provided to the households before attempting to phase-out kerosene subsidy as suggested early last year. In this sense the government policy towards implementing kerosene subsidy (albeit partially) is a welcome initiative (Prasad, 2016 and Raghavan, 2016)[3]. Transfer of subsidy amount directly to the bank account of the needy household once they purchase it from the open market would clearly improve the progressivity of the subsidy. However, it is not clear whether under this scheme kerosene would be made available for both cooking and lighting purposes. As has been shown in this study, the role of kerosene in meeting households' cooking needs is equally important. In this sense, the criteria for kerosene allocation as well as the quota allocated to the households lower down the energy ladder do not make enough sense. Clearly long term impacts of the health burden from indoor air pollution and the role of black carbon (from firewood, dung, charcoal and crop residue) in increasing the country's carbon foot print need to be taken into account while also trying to reduce the fiscal burden due to kerosene subsidy. Moreover, as long as it not possible to direct usage of kerosene exclusively for lighting and cooking needs and

[3] To begin with, the direct benefit transfer for kerosene subsidy is likely to be implemented in 26 districts covering the states of Chhattisgarh, Haryana, Himachal Pradesh, Jharkhand, Madhya Pradesh, Maharashtra, Punjab, and Rajasthan from April 1, 2016. The government is expecting it to be taken further in due course of time to the remaining districts and states after this initial initiative.

there exists a price differential between kerosene and diesel, it will be difficult to control the use of kerosene for adulteration in the transport sector.

Since kerosene is an intermediate fuel with lower energy content, higher pollution potential and also more cumbersome to manage while cooking, clearly LPG stands out as a better cooking fuel. Once again, in regions where kerosene could be phased out as cooking fuel and replaced with LPG, the new scheme will be a welcome change. Here again the policy suggestion to reduce subsidy burden by removing subsidy for LPG for the better off households (above 10 lakh rupees per annum) is important. There will possibly be debate for some time on whether this criterion would help in identifying all the non-needy households and what would be the administrative hurdles in locating them (Jain and Agarwal, 2016). In case of cooking, in addition to increasing penetration of LPG, efforts should be made to increase use of improved cook-stoves, which as Kumar and Viswanathan (2013) argue could provide win-win option of reducing both local and global pollution.

Similarly, for lighting, in addition to electrification, efforts should also be made to facilitate the households to use solar power. A related issue also raised in context of improving access to subsidized kerosene for lighting is the reluctance of households to not want to shift to this alternative source once kerosene is provided (Raghavan, 2016). If there is a proper provision for accessing this source, clearly, solar power would provide the option of using it for lights, fans, water heating and also a few other gadgets that kerosene cannot provide. Hence there is no reason why households may not want to use these amenities to improve their day to day life in the presence of electricity from solar power. In this sense, if the policy formulation had taken this aspect into account then the need to provide kerosene for lighting could have been completely avoided and could be provided only for cooking until LPG is made available to all. Interestingly, if diesel becomes less adulterated with

kerosene then its demand would also rise and it is unclear what kind of subsidy burden that will bring in. It appears at the moment that the policy is still narrow and focusing on the reduction of leakages from kerosene and subsidy burden from both kerosene and LPG while there is a need to take a more holistic view of providing cleaner energy to all and for all purposes to further the cause of sustainable development.

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