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From Editor's Desk.....

Greetings!!!

It gives me great pleasure to bring out the first two combined issues of **Population and Environment Bulletin** for the year 2014. IIPS publishes Population and Environment Bulletin (ISSN No. 0975-7287) at regular interval. The Bulletin and Envis website (www.iipsenvis.nic.in) are supported by Ministry of Environment and Forests, Government of India.

This bulletin contains two research articles and a report on Mumbai's air quality. The first article presents the impact of changing lifestyles and consumption patterns on the environment. It concludes that the population growth can be recognized as one of the key factors contributing to CO_2 emissions followed by affluence and technology. The second article deals with household energy use and CO_2 emission in India and it highlights the overall per capita household CO_2 emission for rural and urban areas and variations in per capita CO_2 emission by economic class and level of urbanization among states.

This issue also includes information regarding Mumbai's air quality by the SAFAR project. This is a project, of the Ministry of Earth Sciences of the Government of India, is executed by IITM, Pune and has been recognized by GURME, World Meteorological Organization (WMO) as an important activity for India.

I hope you will find this bulletin interesting and useful.

Editor,

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Designed By: Chandrakala Ramnayan

21-03-2014

CONTENT

Quotes on Environment

- ✓ There is no fixed physical reality, no single perception of the world, just numerous ways of interpreting world views as dictated by one's nervous system and the specific environment of our planetary existence.

  —Deepak Chopra

- ✓ Without the land, the rivers, the oceans, the forests, the sunshine, the minerals and thousands of natural resources we would have no economy whatsoever

  — Satish Kumar

- ✓ Nothing living should ever be treated with contempt. Whatever it is that lives, a man, a tree, or a bird, should be touched gently, because the time is short. Civilization is another word for respect for life.

  —Elizabeth Goudge

Impact of changing lifestyles and consumption patterns on the environment in Assam: A comparative analysis of past three decades

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Abstract

According to the latest census of India, Assam is the homeland of 31,169,272 people. It is vested with a long tradition of art, culture and heritage and is gradually advancing technologically. The objective of this paper is to analyze how the growing population, affluence and technology did contribute to the environmental consequences with respect to Assam in the past, and takes a forward look at the environmental impacts based on the changes of these driving forces. For this purpose, the *I=PAT* (*Impact = Population × Affluence × Technology*) is used to analyze how these main driving forces contribute to the growth of CO_2 emissions over the last three decades of the twentieth century in Assam. The findings of this study show that population growth can be recognized as one of the key factors contributing to CO_2 emissions in the above mentioned decades. This study emphasizes the need to guide people about the negative aspects of population increase and educate them for sustainable ways of living in order to reduce CO_2 emission in the environment.

Keywords: I=PAT, CO_2 emission, Population, Afflue-nce, Technology, Assam.

Introduction

Ever increasing consumption is putting a strain on the environment, polluting the Earth and destroying ecosystems (Ryan, 2002). Changing lifestyles and consumption patterns have been a common feature of most developing Nations in recent decades. Increasing income provides people with more options in how they use it, and people's choices will largely determine what impact the economic growth will have on the environment (Hubacek et al., 2007).

Emission of greenhouse gases is one of the major sources of pollution in the world. The most well documented harmful effect of greenhouse gases is global warming (Ghoshal and Bhattacharyya, 2008). Of the five major greenhouse gases causing global warming, viz- methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbon (CFC), carbon dioxide (CO_2) and tropospheric ozone (O_3); carbon dioxide (CO_2) is the most abundant. It forms an inverted U-shape relationship with per capita gross state domestic product. Ghoshal and Bhattacharyya (2008) observed that coal is the most important source of CO_2 in all the states of India, and the relationship between per capita gross state domestic product and coal consumption is an inverted U-shaped curve.

There is widespread scientific agreement that the increased concentrations are the consequence of human activities around the globe. Among these anthropogenic factors, the principal ones (often called "driving forces") are (*i*) population, (*ii*) economic activity, (*iii*) technology, (*iv*) political and economic institutions, and (*v*) attitudes and beliefs (Stern et al., 1992). These forces usually are assumed to drive not just greenhouse gases emissions but all anthropogenic environmental change (Dietz and Rosa, 1997).

China and India are among the fastest growing economies in the world contributing significantly to global resource depletion, pollution and global warming. CO_2 emissions by Asian developing countries grew substantially between 1980 and 2001, rising by 151% -- 4.5% per year -- from 2,398 MMT[2] to 6,027 MMT[2]. China and India are the second and the fifth largest contributors to world carbon emissions, respectively (Hubacek et al., 2007).

Assam is the largest and centrally located state among '*the seven sisters*' in the North-East region of India. It covers an area of 78, 438 sq.kms. with a population of 31,169,272 and density of 397 person per square kilometer according to the census 2011. A note worthy recent demographic feature is that the decadal population growth rate has been 16.9 percent during 2001-2011 in Assam. The level of urbanization in Assam is about 14 percent which is less than the national average of 31 percent in 2011.

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Social development indicators like literacy rate is 73.2 and infant mortality is 57 per thousand (Census of India 2011; Annual Health Survey 2011-12).

In the chapter 'Prospects for Economic Growth' of Assam Development Report (http://planningcommission.nic.in/plans/stateplan/sdr_assam/sp_sdrassam.htm) stated that the gross state domestic product (GSDP) of Assam has been growing at a rate of about 3.3 percent per annum during the period 1980-2001. The average per capita income of Assam stood at Rs. 1,374/- for the triennium 1980-81 to 1982-83 at 1980-81 prices. It was about 18 percent lower than the corresponding national estimate of Rs.1,672/- for India as a whole. The difference widened to more than 45 per cent in recent years when average per capita income of Assam and pan-India stood at Rs.1,702/- and Rs.3,211/-, respectively at 1980 -81 prices for the triennium 1999-00 to 2001-02.

The economy of Assam state is mainly dependent on agriculture, but the economy of this state is better than the economy of other states in the same region. It is one of the pioneer states in the industrial development of the country during the British rule (1826-1947) in India. The first oil refinery, the first tea plantation and the first coalfield are found in Assam. However, after the British rule till now it has less than 2 percent of the country's medium and large industries (Sorokhaibam and Thaimei, 2012).

The tea industry dates back to mid-19th century and has played an important role in the economic and cultural life of upper Assam. Production, acreage and yield of tea have gone up over the years with large employment opportunities more favorable to rural areas and female employment. The petroleum refinery industry at Digboi is also about 100 years old. Refineries have also been set up at other places like Guwahati, Bongaigaon and Numaligarh. Other major manufacturing sectors in the state at present are cement, paper, petrochemicals, fertilizer and sugar (Assam Development Report).

Objective and database

The objective of this paper is to analyze how the growing population, affluence (i.e. consumption of goods and services per capita) and technology (i.e. emissions per unit of output) did contribute to the environmental consequences over the last three decades of the twentieth century in Assam i.e. 1980s, 1990s & 2000s and takes a forward look at the environmental impacts based on the changes of these driving forces. For this purpose, secondary data regarding population, energy consumption and carbon dioxide emissions were collected from diverse sources. Data on population of Assam was collected from the census reports, Govt. of India of the mentioned decades. Time-series data on energy consumption data were extracted from the official government publications and other authoritative sources like Statistical Handbook of Assam 1999, Economic Survey Assam 2000-2001 and Vision: Assam 2025. Assam's CO_2 emissions data were drawn on from Ghoshal and Bhattacharyya (2008).

Methodology

In order to avoid the obvious problems of heteroscedasticity, all variables were converted to logarithmic form. The *I=PAT* framework was used to examine the contribution of the three factors, i.e. population growth, affluence (representing different lifestyles and consumption patterns) and changes in technologies of Assam to CO_2 emissions and how the major contributors shift between these factors in Assam over a time period of 30 years. An I =PAT decomposition can be represented by the following equation,

$$CO_2 = POP \times \frac{GSDP}{POP} \times \frac{CO_2}{GSDP}$$

where CO_2 is the impact *(I)*, *POP* is population *(P)*, *GSDP/POP* represents affluence (*A*; consumption of goods and services per capita), and *CO_2/GSDP* represents Technology (*T*; i.e. emissions per unit of output) (adapted and modified after Hubacek et al., 2007). Contributions of each factor were estimated as the percentage of the total.

The *I=PAT* equation was first proposed in the early 1970s and resulted from the combined efforts of population biologists, ecologists, and environmental scientists who tried to assess the relationship between population growth *(P)*, economic growth or affluence *(A)*, technical change *(T)* and environmental impacts *(I)* (Hubacek et al., 2007).

The original argument of Ehrlich and Holdren (1971, 1972) was that population growth was the major threat to human welfare. They claimed "whatever other factors were involved, population growth caused a disproportionate negative impact on the environment" (Ehrlich and Holdren, 1971). Commoner et al. (1971) pointed out the economic growth and per capita consumption played an important contributing role to pollution. This discussion has been part of an ongoing debate concerned with the question of whether or not increase in population and affluence can be balanced by increasing efficiencies provided by technological systems. For example, Olson (1994) used the *IPAT* equation to discuss three scenarios of sustainable futures for an industrialized nation: continued growth with pollution control, technology improvements and transformation of society. The contributions of York, Rosa and Dietz (2003) have sparked a wider discussion on the importance of the various contributing factors, but also on methodological issues leading to reformulations of the original equations.

Results and Discussion

Over the observed time period, the calculation shows that for Assam population dominated the overall contribution to CO_2 emission. Table 1 showed that population growth contributed 85.11%, 84.79% and 85.09% in the 1980s, 1990s and 2000s; respectively of the total CO_2 emissions. In comparison, enhancement in affluence levels simultaneously contributed to about 8 to 9 percent only. In addition, technology had its contribution around 6 percent in the CO_2 emissions.

Decades	Population	Affluence	Technology
	In percentage (%)		
1980	85.1	8.7	6.2
1990	84.8	8.8	6.5
2000	85.1	8.8	6.1

Observation illustrates that increase in population growth dropped by 11% to 9% during the three decades, subsequent to various family planning programs implemented by Govt. of India which facilitated reduction of the states' population growth. In comparison, affluence levels increased by more than 70% in the 1980s-1990s and is still above 80% in the 2000s. This indicates the effectiveness of open economy policy in the Indian states.

In terms of technical change, which is an aggregate of factors such as energy mix, structural change and efficiency, measured as CO_2 emissions per unit of GSDP, large efficiency gains were observed in Assam in the 2000s with a decrease of CO_2/GSDP of 36%.

Conclusion

The analysis illustrates that population growth can be recognized as one of the key factors contributing to CO_2 emissions in the above mentioned decades followed by affluence and technology. This study emphasizes the need to guide people about the negative aspects of population increase, along with correction of their lifestyles and conducting them towards more sustainable ways of living in order to reduce CO_2 emission thereby protecting environmental stability.

With respect to the consumption side, this is much more difficult in developing or transition countries trying to emulate western lifestyles. Even though influencing consumers is difficult but this is routinely done by companies and marketing agencies and thus why should '*green campaigns*' not be able to achieve the same (Hubacek, Guan, and Barua, 2007). The Indian government has simultaneously introduced clean coal technologies like coal washing and introduced the use of cleaner and lesser carbon intensive fuel, like introducing auto LPG and setting up of Motor Spirit-Ethanol blending projects in selected states. These and similar measures, affirmed by the democratic and legislative processes have been implemented by committing additional resources as well as by realigning new investments (Sharma etal., 2006). In a similar tone with the government, the public agencies and NGOs should develop their programs towards green or recycling campaigns with the help of general people and policy makers on a routine/ periodic basis, thereby contributing to their environmental-friendly behavior.

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Quotes on Environment

- "A nation that destroys its soils destroys itself. Forests are the lungs of our land, purifying the air and giving fresh strength to our people. "

  — Franklin D. Roosevelt

- "We live in a wonderful world that is full of beauty, charm and adventure. There is no end to the adventures we can have if only we seek them with our eyes open."

  — Jawaharlal Nehru

- "Let us not pray to be sheltered from dangers but to be fearless when facing them."

  —Rabindranath Tagore

- "Everything comes to us that belongs to us if we create the capacity to receive it."

  —Rabindranath Tagore

- "Trees are Earth's endless effort to speak to the listening heaven."

  —Rabindranath Tagore

- "I am glad I will not be young in a future without wilderness."

  — Aldo Leopold

- "We do not inherit the earth from our ancestors, we borrow it from our children."

  —Native American

- "You can't make positive choices for the rest of your life without an environment that makes those choices easy, natural, and enjoyable."

  —Deepak Chopra

Household Energy Use and CO_2 Emission in India

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Abstract

A large majority of households in India depends on biomass for cooking and lighting. The paper analyses the latest National Sample Survey data of India (2010) to understand household fuel consumption and energy use pattern, CO_2 emission in rural and urban households with special emphasis on variations by consumption expenditure classes. Three fourth rural households and one fourth urban households rely on biomass cooking fuel. Overall monthly per capita fuel as well as energy consumption in rural areas is much higher than urban areas because of inefficient (biomass) fuel use in rural households. Even, about 30 percent poorer urban households use biomass for cooking. Overall per capita household CO_2 emission in a year is 61 kg and 161 kg for rural and urban areas respectively. Per capita CO_2 emission is 16 times higher for the highest economic class as compared to the lowest class in urban areas. When the per capita CO_2 emission in the rural area is showing linear growth by economic class, it is curvilinear (hockey stick) for urban area. More urbanized states and the richest urban households emit disproportionately high CO_2. Promotion, easy access, mass scale production, subsidized distribution and knowledge dissemination related to improved cook stove for the poor and rural people are the need of the hour. The richer urban class and more urbanized states can be targeted for renewable household energy use.

Introduction

India, being the second most populous country in the world bears considerable burden on resources. Global primary energy demand is projected to increase by 50 percent between 2005 and 2030. Almost 45 per cent of this increase will be in China and India (IEA, 2004, 2007). In India, the domestic sector is one of the largest consumers of energy accounting half of the total consumption (TEDDY, 2002/03). Delivery of clean and affordable energy for poor household in developing countries is an important requirement. Yet, lack of access to a sufficient amount of clean and efficient energy remains a serious challenge in India (Pachauri and Jiang, 2008). Rural India has an easy access to traditional forms of energy like firewood, charcoal and agricultural residues to fulfil their needs. These fuels carry adverse effects on health and environment (Balakrishnan, 2000; Parikh 2001; Mishra V 2005; Saha 2005). Hence, the rural energy demand in India is of low energy intensity, high domestic consumption, heavy dependence on solid biomass fuel and rapid environmental degradation. The choice of fuel and the amount of fuel consumed influence the exposure to indoor air pollution (IAP) and the total emission to the atmosphere, thus influencing the environment locally and climate globally (Mestl and Eskeland, 2009).

Choice of household energy: Literature on household energy need in developing countries is extensive. Residential energy use in developing countries varies mostly by rural and urban areas and among the high and low income groups (Ruijven et al., 2008). It is usually believed that in 'energy ladder attitude' (Leach, 1992), households switch to more suitable energy forms as their income increases. A partial appraisal of this approach has been given by Masera et al. (2000), who noticed that the rural Mexican household do not go up in the 'ladder' but slightly follow a 'stacking' procedure, that is traditional fuels are not totally rejected with rising income, but relatively used in combination with modern fuels due to cultural preferences. The importance of income as a factor affecting fuel use is till, apparent, even in the case where the switch to modern fuels is not always complete. In India, Pachauri (2004b) found that most significant factors determining household energy consumption are income and place. He (2008) carried out a comparative and descriptive analysis of household energy transitions in India and China and found that the most important drivers of the household energy transition are income, urbanization, energy access, and energy prices. As household become more rich, they tend to switch to more suitable, cleaner fuels for cooking, and for India this flows like, switching from biomass to kerosene and then liquefied petroleum gas (LPG) (Viswanathan and Kumar, 2005; Farsi et al.,2007). Mekonnen (2004), in his study conducted at seven major cities of Ethiopia reveals that, households with more educated members are more likely to have non-solid fuels as their main fuel. Secondly, female-headed households have more chances to choose either solid fuel only or a mix of solid and non-solid fuels as their main fuel.

Household energy use and CO_2 *emission:* There have been several studies on the emissions of greenhouse gases (GHGs) in India. Parikh and Gokarn (1993) made the earliest attempt in estimating emission levels in various sectors of the economy for the year 1983-84. Murthy et al (1997) made a detailed study of interactions among the economic growth, energy demand and carbon emissions for the Indian economy using Input-Output (IO) table for 1989-90 and projected emission for 2004-05. Sharma et al. (2006) analysed the total greenhouse gas emission from India for broad sectors such as energy, industrial processes, agriculture activities, land use change and forestry and waste management practices for 1990, 1994 and 2000.

All specified literature covers very broad issue of GHG emission at national level by economic sectors. Very few literatures highlight the issue of household fuel use and CO_2 emission in India. Mestl et al. (2009) analysed GHG emissions and health outcomes through three policy scenarios for household energy. Venkataraman et al (2005) showed that use of wood and other biofuels in South Asia has resulted in the release of black carbon to the tune of 172 gigagrams/year (Gg/year) in the year 1995 and almost similar amount (160 Gg/year) a decade earlier. Kumar (2011) also calculated per capita household CO_2 emission using 2004-05 national Sample Survey data. According to their estimate, CO_2 emission is 140 kg per year for rural and 350 kg per year for urban households.

In the above context, the paper tries to understand the household energy use pattern by 'fuel type' used for cooking and lighting and the environmental impact of household energy use in terms of CO_2 emission. This study may help revising formulate policies for promotion of sustainable energy use.

Data and Methodology

The paper is based on data of National Sample Survey Organization (NSSO), Government of India (66th Round NSSO, 2010). Total 100855 number of sampled household were surveyed, out of which 59119 and 41736 households were from rural and urban areas respectively. The respondents were asked to state their energy consumption by energy types in the past 30 days. The NSSO survey involves the collection of data on energy consumption in every five years. The energy consumption data from previous surveys have already been evaluated widely (Ekholm (2010); Pachuri (2007); Bhattacharyya (2006), and Gangopadhyay et al. (2005)). Here, we have used the most recent data i.e 2009-10 to understand the household energy consumption in India. In order to know the level of living standards, NSSO survey data compute monthly per capita expenditure (MPCE) by using consumption expenditure of goods and services. So splitting this data into 20 consumer groups- labeled as R1 to R10 and U1 to U10 for rural and urban population respectively, with expenditure rising with the group number-consisting of expenditure deciles for the urban and rural populations are being done. For biomass, kerosene and LPG our estimates record total energy input, not the useful energy, whereas electricity is measured as 'useful energy'. However, in emission calculation for electricity, the loss of energy in power production and transmission is considered. Thus, when we discuss GHG's, the CO_2 emission are from production, i.e., before efficiency and transmission losses. The CO_2 emission coefficients are adopted from Mestl and Eskeland (2009) and Parikh J. et al. (2009) (Table 1). The emission coefficients used are 1.614 and 3.102 tons of CO_2 per tons of coal and petroleum products respectively, and 0.0021 tons of CO_2 per cubic metre for natural gas. These coefficients are arrived by considering emission by fuel type in tons per Giga joule (tons/GJ) after adjusting for the calorific value of the fuel types used in India. Only one GHG is considered here namely, carbon dioxide (CO_2). While calculating the GHG emission from firewood, it is the common practice to consider it as a carbon-neutral fuel. However, given the significant supply-demand gap reported for firewood in various wood-balance studies, the present study assumes a non-renewability factor of 10% for firewood and hence treats it as a net emitter of CO_2. A similar approach is followed in other studies

(Venkataraman et al., 2010). Coal based electricity production in India had emission factor of approximately 1214g CO_2/KWh in 2003-05 (IEA, 2007). However, not all electricity is from coal, and the average for India in 2003-05 was 929g CO_2/KWh. By considering distribution losses, we used 1068g CO_2/KWh delivered electricity.

Results

➢ Patterns of household energy use

Per capita energy consumption in India is far less as compared to other countries (World Bank, 2006). Also, there are large differences in energy use between urban and rural areas. Table 1 (fig:1) highlights India's current patterns of household energy use. Biomass is used as the primary cooking fuel in 58.68 % households. As seen in fig.1, 82% of the rural households use biomass for cooking (76% firewood and chips, 6 % dung cake). LPG is used by 12% and kerosene by 0.79% households. A large proportion of households in central India are using unclean fuel, both in rural and urban parts compared to other regions (Table 2). In urban areas, the situation is different. LPG is the most common cooking fuel used by 64.6% households, followed by biomass (19%) and kerosene (6.4%). In India, 74% households have access to electricity (66% of the rural household and 94% of the urban).

Households do not completely depend on one type of energy for their daily cooking and lighting purpose. Most of the households are using LPG for their cooking and electricity for lighting in urban areas. On the other side, in rural areas, households are using firewood for daily cooking and water heating. Around 87 percent households use two to four types of energy for cooking and lighting. Highest numbers of households' i.e. 41 percent is using three types of energy. In some states, (like, Chhattisgarh, Gujarat, Madhya Pradesh, Orissa and Rajasthan), around 90 percent of rural households are using biomass to fulfil their need for cooking. On the other hand in urban areas of Himachal Pradesh, Jammu and Kashmir and Maharashtra, around 80 percent households are using LPG for cooking. In urban India, 60 percent or more households are consuming clean fuel for cooking in 2009-10, yet 30 to 50 percent poorest and poorer households depend on biomass.

➢ Relationship between fuel use, income and other household characteristics

We have considered monthly expenditure as a proxy of income. Figure 2 shows that, rural area is dominated by solid fuel for cooking (Fig 2). While electricity is the main source of lighting, though rural poor largely depends on kerosene (Fig 3). Around 80 percent rural households, belonging to first seven expenditure classes (R1-R7), are using solid fuel (fire chips, dung cake, charcoal, etc) for cooking. Only 40 percent households of highest expenditure class are using LPG as their primary cooking fuel in rural parts. While in urban areas, the situation differs. More than 60 percent of households are using solid fuel for their cooking in lowest (U1 and U2) classes. Around 80 percent of households of expenditure classes U7 to U10, are using clean fuel for cooking. So, in urban India, a strong positive association of expenditure class and use of clean fuel is observed. With an increase in education, use of clean fuel increases more sharply in urban areas compared to rural parts. Use of clean fuel in Muslim households is the lowest (11% in rural, 64.6% in Urban) followed by Hindus (12.8% in rural and 78 % in urban areas). Only 6.4% and 8% of scheduled tribe and scheduled caste households are using clean fuel respectively in rural parts.

➢ Per capita energy consumption

Energy consumption increases more steadily with an increase in income in rural areas than urban areas. Interestingly, till 8th income deciles, the amount of biomass consumption keeps on increasing in rural parts. While, in urban areas, the richest 10 percent household uses about 500 MJ fuels per capita against 250 MJ of the poorest 10 percent and 350 MJ of those households in the 9th income deciles (Fig 4). So, there is not much change in the amount of energy consumption by urban income class, except the highest class which stands as an outlier. Needless to say, variation of quality of fuel use by economic class is well observed in urban areas, but not so well in rural India. Also to note that, fuel consumption is more in rural parts against urban areas due to more use of un-clean fuel that have lower energy efficiency. Hence, the amount of energy needed for cooking the same meal is much higher for biomass users than for the kerosene or LPG users.

Kerosene, which is distributed mainly through public distribution system is not a preferred choice of household energy even among the poor for cooking. LPG and electricity are the choice by the well off in urban India. State level energy consumption reveals that rural people of Karnataka, Kerala, Orissa, Assam, and Uttaranchal consume 600MJ or more energy in a month while Uttar Pradesh, Bihar and Chhattisgarh consume less than 300MJ per month, the lowest. For urban areas, Kerala and Orissa consumes the highest per capita energy i.e., more than 400MJ/month. Also, the urban–rural difference in energy consumption is low in these states.

➢ Per capita CO_2 emission from households

In India, residential energy consumption contributes a negligible amount of CO_2 in overall CO_2 emission. Yet it is an important issue in the perspective of huge population of the country. Figure 5 shows the CO_2 emission per capita per year by expenditure class. The emission is higher among the richer class. The pace of emission increases faster for the urban households with an increase in income as compared to urban households. The richest- poorest ratio in emission is 16:1 in urban areas and 8:1 in rural areas.

Per capita household CO_2 emission in a year is 61 kg and 161 kg for rural and urban areas respectively, as shown in fig.6. It varies across states. Tamil Nadu emits highest CO_2 (140 kg for rural and 268kg for urban) followed by Punjab (136 and 226 kg for rural and urban respectively). Bihar emits least CO_2 followed by Uttar Pradesh, Assam and Rajasthan. Seven states are emitting more per capita CO_2 than the average for urban India i.e. 161kg, while twelve states emit more than the rural Indian average (61kg).

Discussion

The study, based on unit record data of the 66th round of the National Sample Survey (NSS) 2009-10 asses the pattern of household energy use and household CO_2 emission. Around 82 percent rural and 20 percent urban household rely on solid cooking fuel. Overall monthly per capita fuel and energy consumption in rural areas are much higher than urban areas, because of inefficient (biomass fuel) fuel use in rural households. Income (mainly in urban areas) and location (urban-rural) are main influencing factor for choice of cooking fuels. Education of head of the household also positively influences the choice of clean fuels. In India, 41% households are using three types of fuel to fulfill their need of household energy. About 7 percent urban households do not have any fuel use for cooking. Per capita CO_2 emission is 16 times higher for highest economic class as compared to the lowest class in urban areas and for rural parts the same is 8 times higher.

In spite of good progress of clean household fuel use in urban India, firewood and chips provide fuel for cooking for about 30 to 50 percent of the urban poorest-poorer class. In rural parts, as woods, chip, crop residue are relatively easily available, people prefer to make use of these materials mainly for cooking. However, it has an adverse health effect; it is a tiring task for collection of such materials. Kerosene is mainly used for lighting. Supply of kerosene is limited as per government distribution system rules and regulations. LPG subsidised rates are costly compared to 'free of cost' unclean fuels for the rural population. So even if their income is high, they still prefer to use the traditional fuels. Also as cooking is a women's job, adopting cleaner fuel is perhaps least priority issue in the household economy. Cleaner fuel is substantially more in the urban area and among the richer class, and it supports easy access to cleaner fuel and a better economic condition, more awareness among the urban class.

Conclusion

India is mainly rural in nature and depends greatly on biomass fuel at household level. In spite of educational and economic improvement and government efforts, a large section of households is using inefficient fuels for cooking. This article looks into the pattern of fuel and energy consumption and CO_2 emission scenario of Indian households. Based on our findings, we can propose suggestive measures at policy level: Firstly, Government of India has already launched improved cook stove program (NBCP) in 2009-10. It needs mass production, easy availability at a subsidized rate for the poor and knowledge dissemination through mass media - grass route workers for enhancing its use acceptance. Government provides excise duty exemption for manufacturing these stoves.

However, it needs further backup by the government to reduce its cost, at least in the initial stages of promotion for the poor. Mass media can play a key role in this regard. Needless to say, if the men of the households are convinced about improved cook stoves or use of cleaner fuel then only such use can be entertained at household level. So, while promoting cleaner fuels/better stoves, gender dimension should be kept in mind. Secondly, richer class, especially in urban India, can adopt renewable energy for cooking. Solar cooking system can be a good choice. Manufacturing of solar cells can be scaled up and promoted, targeting the richer class. Thirdly, as India is heavily dependent on crop residue for fuel, steps could be taken to generate ethanol and biogas and encourage the use at its level best. Also, government can take legal steps to reduce biomass use in case household has the economic backup to utilize clean fuel.

Figure 1: Percentage distribution of types of cooking fuels used in rural and urban India, 2009-10

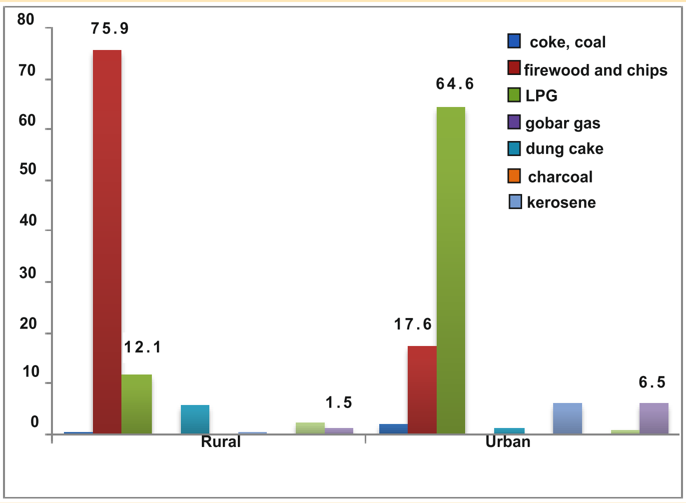
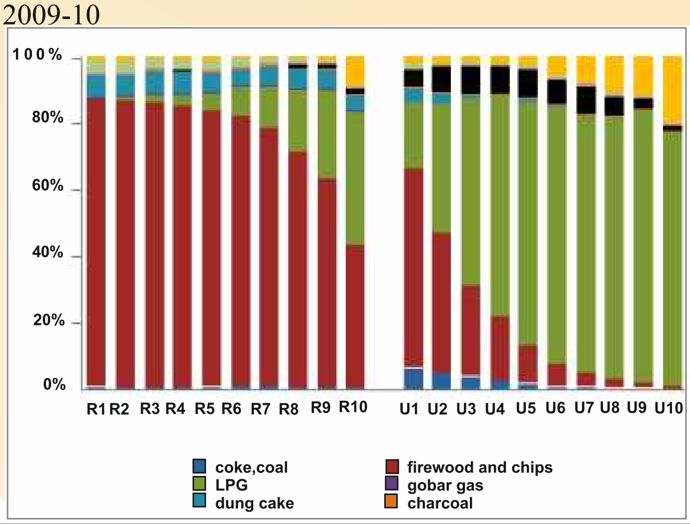


Figure 2. Share of different forms of primary cooking fuel in household energy consumption by expenditure classes, 2009-10



Note * : R1-R10 , Rural decile ; U1-U10, Urban decile
EC1-EC10, Total Consumable Expenditure class

Figure :3 Share of different forms of lighting fuel in household energy consumption by expenditure classes, 2009-10

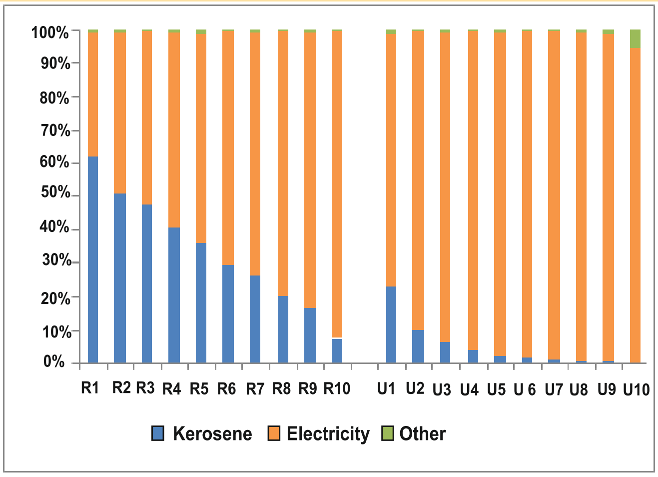


Figure 4. Rural and urban per capita energy consumption (MJ/Month) for cooking, 2009-10

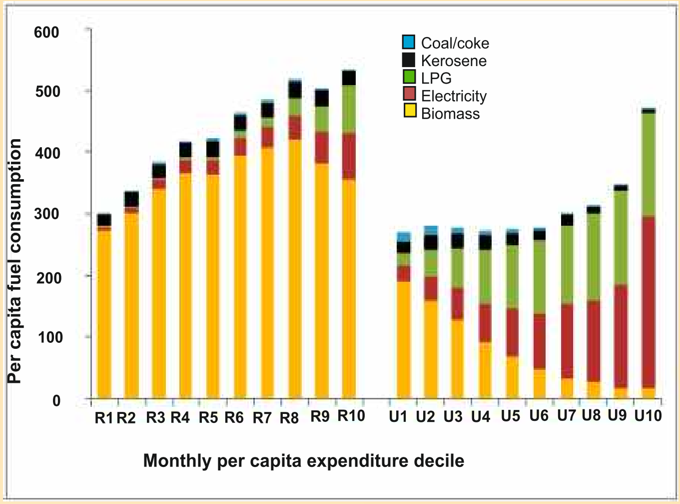


Figure 5. Per capita CO_2 Emission from household by expenditure classes, 2009-10

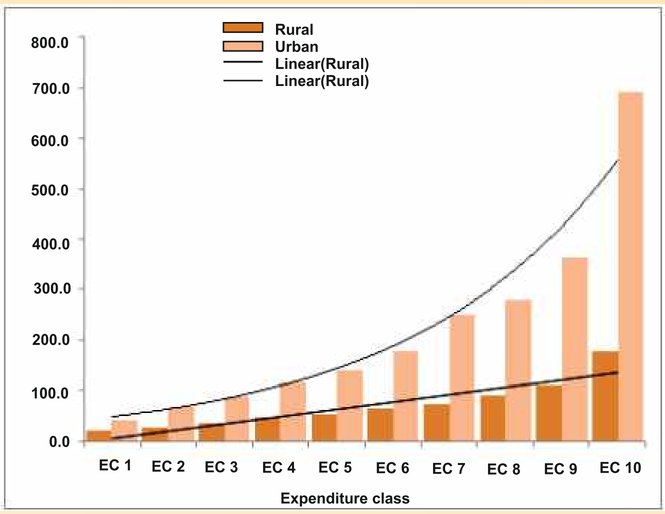


Figure 6. Per capita CO_2 Emission (KG) from household by Major States in India, 2009-10

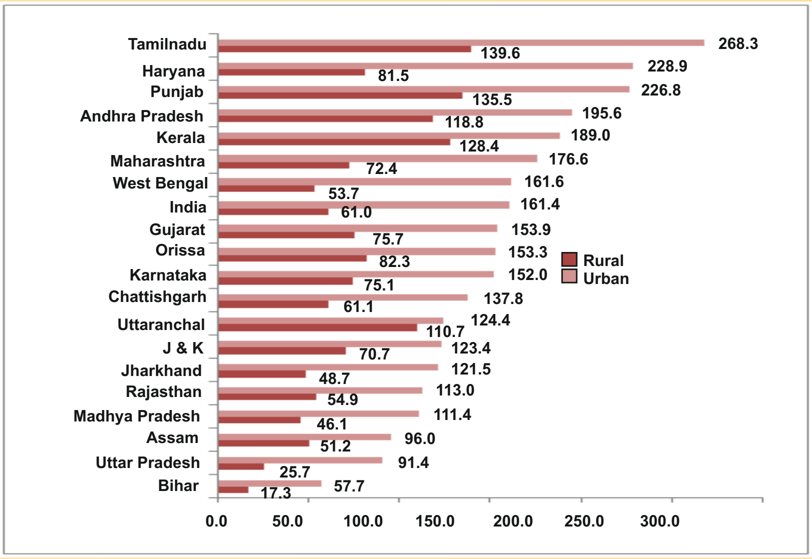


Table 1: Energy and emission coefficient from different types of fuel.

Fuel	Energy content (GJ/ton)	Tons of Co_2/ton of fuel
Biomass	16.2	0.3692
Kerosene	37.7	2.4882
LPG	0.0038 GJ/cubic metre	0.0021 tons per cubic metre
Electricity	3.6 MJ/std unit	0.0011 ton per std unit
Coal/coke	16.7472	1.5658

Source: Emission coefficients are from, Parikh Jetal.(2009), Venkataraman etal. (2010), and Mestl and Eskeland (2009)

Table 2: Percentage of households using clean and unclean fuel for cooking by regions of India: 2009-10

	Rural(%)			Urban(%)		
Rural	Unclean fuel	Clean fuel	Other	Unclean fuel	Clean fuel	Other
South	77.6	22.4	.1	21.1	78.7	.2
West	79.3	20.4	.3	12.6	85.6	1.7
North	80.2	19.5	.3	16.3	83.5	.1
North east	83.5	16.5	.0	21.8	78.1	.1
Central	91.2	6.3	2.5	32.9	66.5	.6

Unclean fuels: Firewood, Charcoal, Dunk cake, Coke/Coal ; **Clean fuels:** LPG, Kerosene, Gobar gas, Electricity

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IITM and IIPS in Safar, to Predict Mumbai's Air Quality

Compiled by Aparajita Chattopadhyay

The **SAFAR** project of the Ministry of Earth Sciences **of the Government of India** which is executed by **IITM,Pune** has been recognized by **GURME, World Meteorological Organization (WMO)** as an important activity of India. The **WMO** is a specialized agency of the **United Nations (Geneva)** for meteorology - weather and climate,operational hydrology and related geophysical sciences having ~187 member states, countries and territories.

IITM Pune in association with IIPS has organized a workshop on 3rd December, 2013 to disseminate knowledge about SAFAR and develop modus operandi to carry out its data collection in Mumbai. After Delhi and Pune, now it is the turn of Mumbai to get its own model to predict the quality of air. System of Air Quality Forecasting and Research (SAFAR) scientists will soon install air quality monitoring stations in Mumbai.

"In the light of the recent release of World Health Organisation (WHO) stating that particulate pollution was one of the major causes of lung cancer, the SAFAR project is important as it will forecast the quality of air 24-72 hours in advance. For instance, harmful gases are discharged from vehicles, industries, slums and get stagnated in a humid region like Mumbai. Our system will predict the quality of air and also provide city pollution maps and weather information, which help them to identify the most polluted and less polluted areas in Mumbai," said Dr Gufran Beig, programme director of SAFAR. This would help them take precautionary measures and protect themselves from harmful health effects, Beig added. At IIPS, Prof G. Beig and Nobel Laureate Dr. Patricia Romero Lankao delivered enthralling lectures on environmental quality, environmental perceptions and about Safar, Mumbai . Dr. Lankao is the recipient of the **2007 Peace Nobel Prize** together with Al Gore and hundreds of scientists and scholars authoring different components of the IPCC Assessments on climate change impacts and adaptation

Dr Lankao, said:

'I have developed research on the interactions between urban development and global environmental change. I am very active in both the international human dimensions community and the human dimensions community of US and Latin America. Urbanization is both a social and environmental phenomenon; it is one of the most influential, irreversible and evident anthropogenic forces in the Earth system. Many urban centers share characteristics (e.g., location in risk–prone areas, and governance deficits) that tend to make them more vulnerable to adverse climate change events. I have focused on crucial intersections between urban development and the environment, including the carbon cycle, the climate system and the water cycle. In particular, I have studied key issues of (a) how urban development impacts the environment (drivers); (b) what societal factors explain cities' vulnerability/resilience to heat waves, atmospheric pollution, water scarcity and pollution, among other hazards (impacts), and (c) how particular cities attempt to meet the challenges of reducing emissions while improving their capacity to cope with environmental impacts (responses).'

She is a "multidisciplinary sociologist" by training, joined NCAR in 2006 as (social) scientist. Although born in Mexico, she considers herself a citizen of the world. 'Thus I care not only about my two girls, who I love to death, but I am also engaged in finding options to move ourselves to a more sustainable and fair relationship with Earth's people, animals and plants.' It was a real honor for IIPS to listen to Dr Lankao. (Based on report of _Anuradha Mascharenhas: Pune, Fri Oct 25 2013, 02:39 hrs: Indian Express, SAFAR web page and Dr Lankao's speech)

Conference

1. **8th International Symposium on Ecosystem Behavior**

   Conference Date: July 13th – 17th, 2014, University of Bayreuth, Germany

   Date:
   (i) Second Announcement and Start of Registration: 11/2013
   (ii) Abstract Submission Deadline: 2014-04-04
   (iii) Acceptance Notification and Publication of Program: 2014-05-30

   Web Link: http://www.bayceer.uni-bayreuth.de/biogeomon2014/

2. **16th International Workshop on Quantitative Structure-Activity Relationships in Environmental and Health Sciences (QSAR2014)**

   Workshop Date: June 16-20, 2014 IRCCS - Istituto di Ricerche Farmacologiche "Mario Negri", Milan, Italy.

   The QSAR workshop's main aim is to give participants the possibility to present their work and their results to representatives of different communities (industry, regulators, developers, etc.). Indeed, the programme (talks and posters) will be based on abstract submitted by participants!

   Weblink: http://qsar2014.insilico.eu/

3. **2014 International Conference on Environment and Natural Resources (ICENR 2014)**

   Conference Date and Place: 29th to 30th July 2014, Hong Kong, China

   Website: http://www.icenr.net/

   Contact person: Ms Mickie Gong

   ICENR 2014 papers will be published in the Journal of Environmental Science and Development (IJESD, ISSN:2010-0264), and indexed by EBSCO, WorldCat, Google Scholar, Cross ref, ProQuest, CABI and sent to be reviewed by EI Compendex and ISI Proceedings

   Organized by: CBEES

   Deadline for abstracts/proposals: 5th April 2014

4. **The 1st South East European Conference on Sustainable Development of Energy, Water and Environ -ment Systems - SEE SDEWES Ohrid 2014**

   Conference Date and Place: 29th June to 4th July 2014, Ohrid, Macedonia

   Website: http://www.ohrid2014.sdewes.org

   Contact person: Prof. Zvonimir Guzovi?

   The 1st SEE SDEWES Ohrid 2014 Conference provides a venue for researchers from the SEE region, but also for world-wide researchers and specialists and those interested in learning about the sustainability of development.

   Deadline for abstracts/proposals: 30th April 2014

5. **Sixth International Conference on Climate Change**

Conference Date and Place: 27th to 28th June 2014, Reykjavik, Iceland

Website: http://on-climate.com/the-conference/call-for-papers

Contact person: Conference Director

Annual, interdisciplinary conference exploring scientific, policy, and strategic perspectives in climate change. Accepted proposals may be submitted as papers to peer-reviewed journal.

Deadline for abstracts/proposals: 27th June 2014

6. **International Conference on Water, Informatics, Sustainability and Environment**

Conference Date and Place: 26th to 28th August 2014, Gatineau - Ottawa, Canada

Website: http://www.iwiseconference.com

Contact person: W. A. Eldin

The conference provides opportunities for scientists from around the world to share their scholarly knowledge, skills and expertise with a focus on environmental challenges facing our planet and the future of our generation

Deadline for Abstract Submission: April 1, 2014

Full Paper Submission: June 26, 2014

7. **The 5th IASTED African Conference on Environment and Water Resource Management**

Conference Date and Place: 1st to 3rd September 2014, Gaborone, Botswana

Website: http://www.iasted.org/conferences/home-812.html

Contact person: Jessica Harkema or Lauren Babuik

AfricaEWRM 2014 will act as an interdisciplinary forum for decision-makers, academics, and professionals interested in the development and applications of technology for the sustainable use of the environment and the management of water resources.

Deadline for abstracts/proposals: 1st April 2014

8. **National Conference on Environment and Biodiversity of India**

Conference Date and Place: 4th to 5th October 2014, New Delhi, Delhi, India

Website: http://www.ebiconference.com
Contact person: JS Khuraijam

EBI 2014: National Conference on Environment and Biodiversity of India

Organized by: NECEER, Imphal

Deadline for abstracts/proposals: 31st August 2014

Knowledge dissemination and interaction with slum dwellers in Mankhurd :
An initiative of Pop- Envis and IIPS Students

Reported by: Anshu Baranwal, PhD scholar, IIPS

On the occasion of Children's day, a team of students from IIPS visited Mankhurd community under the guidance of Dr. Aparajita Chattopadhyay, coordinator of Pop- Envis .The visit was in the view of creating awareness regarding various social and health related issues among mothers and children of the community. Around 50 mothers and more than 100 children participated in the program. Sessions included during awareness program were importance of education, hygiene and sanitation, importance of Self-help group and health and Immunization, nutrition, child abuse, and reproductive health. The sessions were discussed by our PhD students, **Aiswarya Roy, Mukesh Ravi Roushan, Prahald Kumar, Absar Ahmad, Rajan Gupt, Arun Yadav** and **Kaveri Patil** respectively. At the end of the program, edibles and stationary items were also distributed among the children. **Anshu Baranwal, Rahman, Swarbhanu Nandi and Kaushlendra Kumar** facilitated the program by managing the logistics. Community leaders also participated in the programme.

Mankhurd is a non-notified community. This multi-religious community was comprised of more than 3000 households. The area is Muslim dominated and most of the residents have migrated from Uttar Pradesh. The infrastructure and hygiene conditions in the community are very poor. Community toilets are devoid of water leading to open defecation.

During the interactive **sessions of education**, it was found that most of the children in the community go to school. There are 4 private and 3-4 municipal schools. Most of the children go to municipal schools as private schools are not affordable. Mothers told us that teachers don't come regularly or come very late. Most of the children have to take tuitions for 200 rupees per month due to poor teaching in schools. Some general awareness questions were asked to the children. Most of the questions were correctly answered especially by the children from 4^{th} and 5^{th} class. Most of the children told that English is their favorite subject and few of them replied the answers in English.

In **Hygiene and Sanitation session**, importance of sanitation was explained. Different practices to maintain good hygiene and sanitation such as, cutting nails, importance of hand wash, proper disposal of waste water were told to the mothers and children of the community. How to manage hygiene and sanitation in the house was also explained to the mothers. During the session children were asked how they keep themselves clean. Children replied many answers enthusiastically, giving detail of bathing, cutting nail, washing hands etc. We came to know that mothers know the basic rules of maintaining hygiene and sanitation but due to other activities they don't bother much about these things. Both mothers and children took interest in this session.

In the session of importance of **self-help group**, it was found that no woman was aware of SHGs but they save fixed amount of money every month. Most of the women in the community are housewives and don't do income generating work. Keeping these things in mind, importance of SHGs was explained to them. How they can utilize their leisure time doing small scale business or other activities at home to earn and save their own money was also explained. In this context they were told about a self-help group Bachat Gadh Foundation based in Mumbai.

Session of **health** was very interesting as various flip cards were used to create awareness regarding management of health during pregnancy. Importance of institutional delivery was also explained. It was found that home delivery is prevalent in the community. During the session of reproductive health and family planning, importance of two children was explained to mothers. On an average most of the women have 3 to 4 children in the community and average age of women at the birth of first child was 21. Different family planning methods were also discussed in the session. Some women in the community don't want more children but they can't use FP methods because their husband is against the use of these methods. Also they have lot of misconceptions. Some of the women have undergone female sterilization and many are using IUDs in the community.

In the session of **immunization,** we found that most of the women were well aware of vaccination and their timings. All the mothers know that vaccination is important to save their children from different diseases like hepatitis, Measles etc. They also know about the TT vaccinations taken during the pregnancy. When mothers were asked why BCG is given? One of them told the right answer (TB). It was sad to know that in spite of knowing about the vaccination, sometimes they are unable to take vaccination or do it after the stipulated time because hospitals are far away.

During the session of **nutrition,** mothers were explained how to feed their babies up to five years and why taking nutritious food during pregnancy is important. When mothers were asked about initiation of breast feeding, some of them said that it should start after two days of birth, while some said after one hour of birth etc. We found that if child is in fever or suffering from any disease, he/she is less fed than normal days.

In the session of **child abuse**, when mothers were asked who is mostly abused? Mothers replied that mostly girls are abused. During the session, indicators of sexual abuse were explained to children and mothers. Mothers were told how to teach their children about sexual abuse. We have demonstrated about different types of abuse, how to protect children and how children will react if situation arises.

Women reading our pamphlet

Our Team

Kids and distribution of eatables/stationeries

Interacting with children

Explaining queries

A Pop- Envis Funded Student's initiative of IIPS

Census of India 2011: Houses, Household Amenities and Assets

Sr. No.	Houselist Items	Absolute number		
		Total	**Rural**	**Urban**
1	**Number of census houses**			
	Total number of census houses	3308,35,767	2206,95,914	1101,39,853
	Total number of vacant census houses	246,72,968	135,79,338	110,93,630
	Total number of occupied census houses	3061,62,799	2071,16,576	990,46,223
2	**Number of occupied census houses**			
	Total number of occupied census houses	3061,62,799	2071,16,576	990,46,223
	Occupied Census Houses used as Residence	2360,62,866	1599,28,652	761,34,214
	Residence -cum- other use	85,78,716	62,27,951	23,50,765
	Shop/ Office	176,72,786	69,76,051	106,96,735
	School/ College etc.	21,06,530	17,02,048	4,04,482
	Hotel/ Lodge/ Guest house etc.	7,20,806	3,43,657	3,77,149
	Hospital/ Dispensary etc.	6,83,202	3,60,170	3,23,032
	Factory/ Workshop/ Workshed etc.	24,96,655	9,99,689	14,96,966
	Place of worship	30,13,140	24,19,700	5,93,440
	Other non-residential use	335,47,747	276,05,772	59,41,975
	No. of occupied locked census houses	12,80,351	5,52,886	7,27,465
3	**Condition of census House**			
	Total	2446,41,582	1661,56,603	784,84,979
	Good	1301,24,755	763,64,051	537,60,704
	Livable	1014,41,740	789,74,413	224,67,327
	Dilapidated	130,75,087	108,18,139	22,56,948
4	**Predominent material of roof**			
	Total number of census houses	3048,82,448	2065,63,690	983,18,758
	Grass/ Thatch/ Bamboo/ Wood/ Mud, etc.	469,87,669	427,27,900	42,59,769
	Plastic/ Polythene	20,73,373	14,59,766	6,13,607
	Hand made Tiles	402,76,749	348,22,769	54,53,980
	Machine made Tiles	264,25,060	200,92,484	63,32,576
	Burnt Brick	202,54,881	148,60,852	53,94,029
	Stone/Slate	**269,81,694**	**191,19,151**	**78,62,543**
	G.I./ Metal/ Asbestos sheets	503,36,403	343,81,089	159,55,314
	Concrete	902,43,883	382,38,079	520,05,804
	Any other material	13,02,736	8,61,600	4,41,136
5	**Predominent material of wall**			
	Total number of census houses	3048,82,448	2065,63,690	983,18,758

	Grass/ Thatch/ Bamboo etc.	289,47,594	264,17,331	25,30,263
	Plastic/ Polythene	10,97,831	7,62,256	3,35,575
	Mud/ Unburnt brick	664,49,827	583,30,614	81,19,213
	Wood	27,81,271	21,32,342	6,48,929
	Stone not packed with mortar	104,41,142	77,51,666	26,89,476
	Stone packed with mortar	330,41,790	209,34,124	121,07,666
	G.I./ Metal/ Asbestos sheets	23,31,869	12,69,359	10,62,510
	Burnt brick	1465,45,805	836,18,436	629,27,369
	Concrete	109,83,679	36,99,096	72,84,583
	Any other material	22,61,640	16,48,466	6,13,174
6	**Predominent material of floor**			
	Total number of census houses	3048,82,448	2065,63,690	983,18,758
	Mud	1386,85,946	1274,31,172	112,54,774
	Wood/ Bamboo	25,75,590	20,88,961	4,86,629
	Burnt Brick	78,57,147	53,45,565	25,11,582
	Stone	239,75,772	122,90,562	116,85,210
	Cement	980,57,206	514,36,407	466,20,799
	Mosaic/ Floor tiles	322,70,627	74,34,415	248,36,212
	Any other material	14,60,160	5,36,608	9,23,552
7	**Households by condition of census house**			
	Total households	2466,92,667	1678,26,730	788,65,937
	Good	1310,19,820	770,41,343	539,78,477
	Livable	1024,70,426	798,55,814	226,14,612
	Dilapidated	132,02,421	109,29,573	22,72,848
8	**Households by ownership status**			
	Total number of households	2466,92,667	1678,26,730	788,65,937
	Owned	2135,26,283	1589,83,956	545,42,327
	Rented	273,68,304	56,44,581	217,23,723
	Others	57,98,080	31,98,193	25,99,887
9	**Households by number of dwelling rooms**			
	Total number of households	2466,92,667	1678,26,730	788,65,937
	No exclusive room	96,38,369	72,11,590	24,26,779
	One room	914,91,894	661,55,450	253,36,444
	Total number of households	2466,92,667	1678,26,730	788,65,937
	No exclusive room	96,38,369	72,11,590	24,26,779
	One room	914,91,894	661,55,450	253,36,444
	Two rooms	781,24,581	539,87,801	241,36,780
	Three rooms	358,03,824	213,08,634	144,95,190
	Four rooms	183,77,481	110,71,009	73,06,472

	Five rooms	63,95,066	38,42,346	25,52,720
	Six rooms and above	68,61,452	42,49,900	26,11,552
10	**Households by household size**			
	Total number of households	2466,92,667	1678,26,730	788,65,937
	1	90,43,243	61,95,096	28,48,147
	2	239,82,862	164,54,768	75,28,094
	3	336,61,722	211,08,028	125,53,694
	4	559,77,592	351,81,591	207,96,001
	5	462,63,178	316,75,109	145,88,069
	6-8	614,03,975	451,48,607	162,55,368
	9+	163,60,095	120,63,531	42,96,564
11	**Households by number of married couples**			
	Total number of households	2466,92,667	1678,26,730	788,65,937
	None	286,42,875	186,34,246	100,08,629
	1	1729,64,836	1168,52,830	561,12,006
	2	348,76,105	249,39,825	99,36,280
	3	79,11,927	56,66,191	22,45,736
	4	17,27,657	12,85,666	4,41,991
	5+	5,69,267	4,47,972	1,21,295
12	**Households by main source of drinking water**			
	Total Number of Households	2466,92,667	1678,26,730	788,65,937
	Tap water	1074,07,176	517,05,165	557,02,011
	Tap water from treated source	788,73,488	299,69,145	489,04,343
	Tap water from un-treated source	285,33,688	217,36,020	67,97,668
	Well	271,85,276	223,33,658	48,51,618
	Covered well	38,95,409	25,91,028	13,04,381
	Un-covered well	232,89,867	197,42,630	35,47,237
	Hand pump	825,99,531	732,45,349	93,54,182
	Tubewell/ Borehole	209,16,074	138,98,837	70,17,237
	Spring	13,14,556	11,84,498	1,30,058
	River/ Canal	15,50,549	14,12,565	1,37,984
	Tank/ Pond/ Lake	20,75,181	17,71,796	3,03,385
	Other sources	36,44,324	22,74,862	13,69,462
13	**Households by main source of lighting**			
	Total number of households	2466,92,667	1678,26,730	788,65,937
	Electricity	1658,97,294	928,08,038	730,89,256
	Kerosene	775,45,034	724,35,303	51,09,731

	Solar	10,86,893	9,16,203	1,70,690
	Other oil	5,05,571	4,07,919	97,652
	Any other	4,93,291	3,61,507	1,31,784
	No lighting	11,64,584	8,97,760	2,66,824
14	**Households by type of latrine facility**			
	Total number of households	2466,92,667	1678,26,730	788,65,937
	Latrine facility within the premises	1157,37,458	515,75,339	641,62,119
	Water Closet	898,52,052	326,16,824	572,35,228
	- Piped sewer system	294,71,391	36,96,144	257,75,247
	- Septic tank	547,58,885	246,71,448	300,87,437
	- Other system	56,21,776	42,49,232	13,72,544
	Pit Latrine	232,79,128	176,81,985	55,97,143
	- With slab/ ventilated improved pit	188,13,022	137,46,699	50,66,323
	- Without slab/ open pit	44,66,106	39,35,286	5,30,820
	Other Latrine	26,06,278	12,76,530	13,29,748
	-Night soil disposed into open drain	13,14,652	3,72,009	9,42,643
	- Night soil removed by human	7,94,390	5,86,067	2,08,323
	- Night soil serviced by animals	4,97,236	3,18,454	1,78,782
	No Latrine within the premises	1309,55,209	1162,51,391	147,03,818
	- Public latrine	79,97,699	32,53,892	47,43,807
	- Open	1229,57,510	1129,97,499	99,60,011
15	**Households by bathing facility**			
	Total number of households	2466,92,667	1678,26,730	788,65,937
	Bathroom	1036,79,719	425,45,003	611,34,716
	Enclosure without roof	404,48,190	329,84,319	74,63,871
	No	1025,64,758	922,97,408	102,67,350
16	**Households by type of drainage connectivity for waste water outlet**			
	Total number of households	2466,92,667	1678,26,730	788,65,937
	- Closed drainage	447,43,812	96,45,107	350,98,705
	- Open drainage	814,23,941	520,35,163	293,88,778
	- No drainage	1205,24,914	1061,46,460	143,78,454
	Total number of households	2466,92,667	1678,26,730	788,65,937
17	**Households by availability of kitchen facility**			
	Total number of households	2466,92,667	1678,26,730	788,65,937
	Cooking inside house:	2154,12,336	1398,53,780	755,58,556
	Has Kitchen	1375,94,123	762,38,077	613,56,046

	Does not have kitchen	168,85,487	152,75,890	16,09,597
	No cooking	7,96,965	3,94,607	4,02,358
18	**Households by fuel used for cooking**			
	Total number of households	2466,92,667	1678,26,730	788,65,937
	Fire-wood	1208,34,388	1049,63,972	158,70,416
	Crop residue	218,36,915	206,96,938	11,39,977
	Cowdung cake	196,09,328	182,52,466	13,56,862
	Coal, Lignite, Charcoal	35,77,035	12,98,968	22,78,067
	Kerosene	71,64,589	12,29,476	59,35,113
	LPG/ PNG	704,22,883	191,37,351	512,85,532
	Electricity	2,35,527	1,18,030	1,17,497
	Bio-gas	10,18,978	6,94,384	3,24,594
	Any other	11,96,059	10,40,538	1,55,521
	No cooking	7,96,965	3,94,607	4,02,358
19	**Households by possession of assets**			
	Total number of households	2466,92,667	1678,26,730	788,65,937
	Radio/ Transistor	490,16,595	290,57,003	199,59,592
	Television	1164,93,624	560,05,607	604,88,017
	Computer/Laptop - With Internet	77,08,521	11,89,627	65,18,894
	Computer/Laptop - Without Internet	156,54,325	74,53,608	82,00,717
	Telephone	1558,80,849	912,13,611	646,67,238
	Telephone/ Mobile Phone - Landline only	99,19,641	52,45,232	46,74,409
	Telephone/ Mobile Phone - Mobile only	1312,02,021	804,65,674	507,36,347
	Telephone/ Mobile Phone - Both	147,59,187	55,02,705	92,56,482
	Bicycle	1105,67,433	774,87,664	330,79,769
	Scooter/ Motorcycle/ Moped	518,62,242	240,73,045	277,89,197
	Car/ Jeep/ Van	114,73,587	37,85,355	76,88,232
	None of the specified assets	439,50,672	384,11,098	55,39,574
	Telephone/ Mobile Phone - Mobile only	1312,02,021	804,65,674	507,36,347
	Telephone/ Mobile Phone - Both	147,59,187	55,02,705	92,56,482
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Fig 1 : Condition of census House

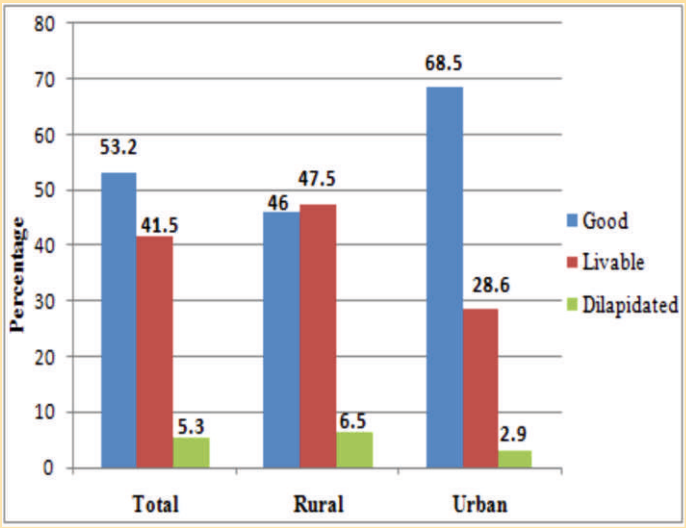


Fig 2 : Households by condition of census house

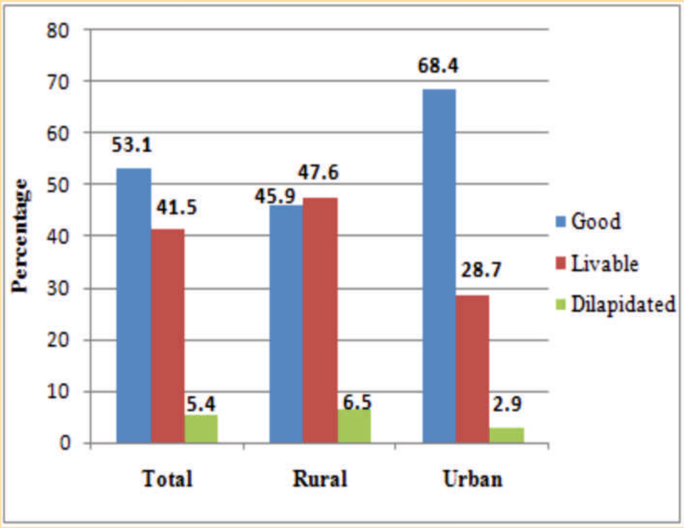


Fig 3 : Households by ownership status

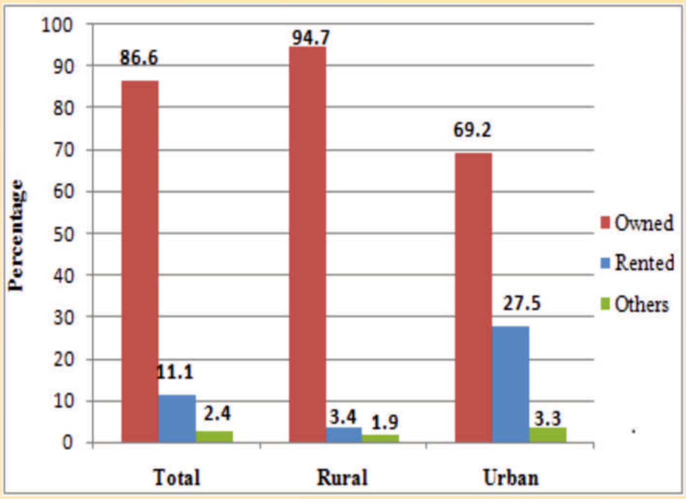


Fig 4 : Households by bathing facility

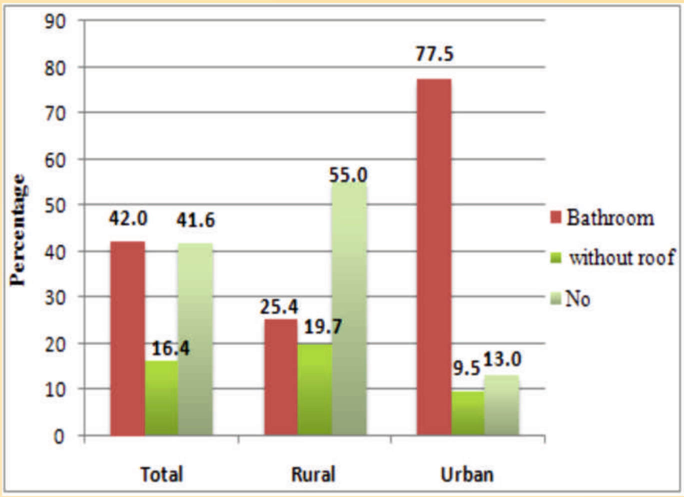
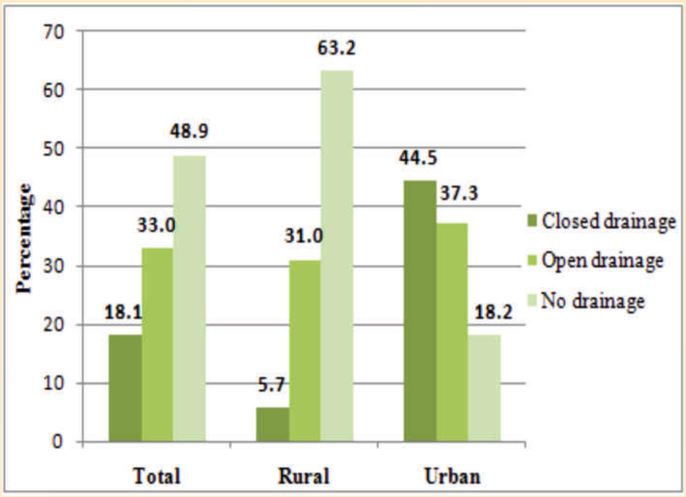


Fig 5 : Households by type of drainage connectivity for waste water outlet



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