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Climate Change, Urbanization - What citizens can do

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ABSTRACT
Anthropogenic Climate Change of post industrial era is expected impact on all sectors of the society and needs strategic steps to reduce it.
Mitigation efforts include global effort leading to curtailing the emission of green house gases. Adaptation measures on the other hand complement the mitigation measures by reducing the impact of global warming. Historically, mitigation has received more media attention due to its global canvas; while the adaptation measures have remained in the back ground. In this paper, authors have presented certain simple concepts which can be undertaken at the people's level to combat the impacts of Climate Change. In the field of mitigation, people can help reduce emission by reducing their consumption and demand for energy through use of:
(i) Energy efficient gadgets.
(ii) Eco friendly transport such as cycle for short distances and bus or car pool for longer distance travel.
(iii) Local products of food and clothing, thus avoiding energy expended in transportation.
(iv) Schools can encourage travel to and from by school buses rather than by individual transport
Urbanization is linked with development and has been quite rapid in recent years. While urban areas cover only 3% of the global land, it gives shelter to nearly 26% of the global population. The phenomenal increase in the population during the last fifty years has led to rapid industrialization and high rate of urbanization which have created tremendous pressure on natural resources like land, air and water. The urban population has increased three and half times, from 62.4 million in 1951 to 217.6 million in 1991 and it again increased to 286 million in 2001. A typical case is that during last 180 years, the urban area in the city of Pune has grown from a mere 5 Sq. Km to 700 Sq. Km. from 1901 to 2001. The urban population has grown from 1.64 lakhs to 42 lakhs. Bangalore, Hyderabad and other growing towns tell the same story. Such unplanned growth leads to widespread damage to existing ecosystem, deforestation and loss of agriculture land, apart from its effect on climate and environment. Tall concrete buildings cement roads and tarmac change the albedo of the urban areas and reduce the free flow of air. 'Heat island' is an urban effect, which is felt in all major cities in India. A study for Bangalore shows significant rise in minimum temperature during recent decades. Likewise the city of Pune shows these signatures also. Urban planning and decongesting the major urban centers by diversifying industries and other activities is needed to make urban climate more agreeable and safe for human settlement. More green cover, lakes and well spread parks are needed to make growing cities a more comfortable place to live. Action is needed now before it becomes too late to repair the damage to climate and environment due to urbanization. Citizens can play a crucial role in reducing the impacts of climate change and urbanization. Some of these are projected in the paper.

INTRODUCTION

Climate Change and Urbanization

Global warming and climate change is a widely accepted fact now. The impact of global warming are now reported all over the world. These include reduction in ice and snow covered areas, earlier timing of spring events, migration of birds etc. According to the fourth assessment report of the IPCC these impacts would be more (Parry, Canziani & Palutikaf 2008).

This paper highlights the various international efforts aimed at reducing the climate change or the global warming through mitigation. However, even if efforts to stabilize the emission at a desired and agreed

level (say 550 ppm by 2020) are successful; warming would continue after several decades from 2020. Adaptation provides a response to reduce the impact from such residual warming and is necessary as suggested in the latest assessment report of the IPCC. In this context the role of policy makers, government and private parties are important (Munasinghe & Swart 2005). Yet an individual citizen or group of citizens can also make a significant contribution to response strategies for reducing the impacts of global warming. The paper makes a central theme on this aspect.

Nearly 47% of the global population lives in cities; though cities cover barely 1.5% of the total land area of the earth. Though, the major attention has been on the mega cities, those with population of more then 10 million, however majority of urban dwellers live in cities with medium or small size. As per a recent UN survey, by 2050, nearly 70 % of the global population will be living in the cities. The migration will be most significant in Asia.

At the time of independence more than 75% of population was village based and the country was an agriculture-oriented nation. With the industrialization and development, more and more people migrated towards the big cities. New cities which were small, also developed and become large towns based on industries. Such growth caused large-scale changes in demographic patterns; for example a city like Pune has grown from small town of 1.5 lakh population in 1901 to population of 42 lakh in 2001.

Although cities grew in size and population they were not fully sustainable. Use of large energy in industries, automobiles, concrete buildings became more and more common. However, the infrastructure such as roads, bridges, drainage and water supply did not fully cope up with growing migration. This created a large divide in the quality of life between the richer and poorer section of population. Not only social and economic problems arose but also such growth led to problems related to environment and climate. The paper deals with the later two issues in detail in the following sections:

DISCUSSION

As a citizen we are using energy, air, water and other resources either collectively or individually. In the modern world of changing life style we can think of various small actions which can be made more rational and sustainable towards the environment and climate. These include the following:

(1) Use of energy through various daily appliances and gadgets, heating, cooling and ventilating in buildings

(2) Use of energy in the transport

(3) Use of water for our domestic needs

(4) Use of resources in our own life in the form of food and other manufactured goods

(i) Mitigation

The portfolio of actions which aim at reducing the emission is termed as mitigation. These include steps to increase the sinks of emission and decreasing the source of emission.

Globally most of the emissions occur in the production of energy through use of fossil fuel - coal, oil and natural gas. This is here that nearly 2/3rd of the global emission is produced. This energy is used in various day to day activities.

There is a great scope of reducing emission by citizen initiatives in all these sectors, by reducing energy demand.

- Design of buildings can be made in such a way to make optimum use of airflow and sunshine to cut down electricity bills.
- We use many electrical gadgets such as refrigerators, air conditioners, room heaters, washing machines in our daily life, these can be kept in good working conditions to avoid power loss and reduce energy demand. Buy electrical gadgets of higher energy star ratings. The BEE (Bureau of Energy Efficiency) Star Energy Efficiency Labels have been created to standardize the energy efficiency ratings of different electrical appliances and indicate energy consumption under standard test conditions.
- Use of CFLs can also reduce nearly 50% of electricity bill. The International Energy Agency (IEA) estimates that the global electricity bill could be reduced by nearly one-tenth if there were a global switch to energy-efficient lighting. Simple steps like switching off lights and other gadgets when not needed are a good habit for all of us.
- Transport is yet another sector which not only increase greenhouse gas emission mainly CO2 but also impairs the air quality through release of carbon mono-oxide, hydrocarbons and particulate matter. Using public transport, car pooling and for short distance walking makes good practice. Maintaining the car or two wheeler in efficient condition can reduce fuel cost and hence emission up to 20%. Changing over to CNG in place of liquid fuel is also a good move to reduce emission from automobiles in both personnel as well as public sector. Table I shows the rapid rise of automobiles in India during last 50 years.
- Water supply in modern cities to large residential

blocks is dependent on pumps which need energy. Proper and economy in use of water is thus essential to cut down electricity. In a city of one million people a saving of one liter per person per day will lead to a saving of 30 million liters of water per month to be pumped in a single big city.

There are many other steps which one can think of as a citizen to reduce demand on energy and hence the emission; for example by vigorously planting more trees in urban areas and preventing cutting and felling of trees in the name of development of roads and industries.

(ii) Adaptation

Each of the greenhouse gas released stays in the atmosphere for several years thus even if the emission targets are agreed to and are put in place the global warming would continue for several years.

In order to reduce the impact of this residual warming adaptation to climate change is equally important. As per the Fourth Assessment Report of IPCC a mix of mitigation and adaptation is needed in our response to global warming. So far we have seen how citizens can contribute to mitigation efforts by reducing emission. We shall now see how we as citizens can also help in adaptation to global warming.

- One of the major impacts of global warming will be on the water resources which will be under stress due to changes in the rainfall distribution. Thus the economic use of water and recycling of water will be needed. Water from kitchen can be used for gardening while recycled water can be used for toilets and washing roads etc.
- Rain harvesting is one of the important options to increase the water availability in domestic and industrial sector.
- In order to combat the fury of more and intense tropical storms provision of shelters and construction of dykes in the coastal areas are also good adaptation options.
- In the agriculture sector option to change the crops depending upon the changes expected in rainfall pattern is also a useful step.
- Extremely heavy rainfall like the July 2005 event over Mumbai (De< Rao & Rase 2006), may become more frequent causing flooding, loss of property and human life as a result of climate change. Adaptation options to counter such situations include, planning better drainage in the cities and keeping them functional before the wet season.
- By planting trees and providing better building design, the impact of intense heat wave can be reduced to a large extent.

(iii) Urbanization

Human settlements grew at central locations near river banks, ports for trade and commerce. Most of today's mega cities are examples. The matter of concern is that by 2050 it is projected that 70% of the people will live in cities. Furthermore the growth rate will be more in the developing countries and in medium small cities.

India will be dominated by its rural population for some more time. Number of urban agglomeration/ town has grown from 1827 in 1901 to 5161 in 2001 in India. In the 2001, countries urbanites made up 27.8 % of the total population. Number of cities with population more than one million has increased from 5 in 1951 to 23 in 1991 and to 35 in 2001. As per a UN report the urban population in Africa and Asia is expected to double between 2000 and 2030. Asia's urban population will rise from 1.3 billion to 2.64 billion meanwhile the urban population will change from 870 million to 1.10 billion. By then every 7 out of 10 urbanite will be from Asia and Africa (GEO, 2003). Unless proper city planning is put in place such growth will only produce inequality and degrade environment.

Most of the migrants will be the rural poor who will live in slums or scatter settlements. Urbanization leads to many changes which have direct linkage with the climate and environment. Some of the major changes are as follows:

(1) Change in land use pattern
(2) Growth in population density
(3) Use of transport and energy intensive operations
(4) Industrial growth
(5) Increased consumption and generation of waste

We shall now look into these aspects and their inter relationship with the environment which later affects the climate.

(iv) Urbanization and Environment

Landsberg (1981) drew attention to the role of urbanization on climate and environment. The urbanization leads to changes in the natural land use pattern; removal of trees, construction of building roads and tall buildings. These changes modify the surface albedo and natural drainage. Cement and concrete structure also change the thermal conductivity.

The growth of population density leads congested dwelling units, poor sanitation and unhygienic conditions. Large population also leads to greater consumption of food, water and energy; putting a great stress on environment.

Poorly constructed buildings lead to poor ventilation, lack of proper sunlight exposure, which affect the health of the residents. During heavy rains water logging, disruption of water supply and drainage lines create additional risk of water borne diseases. One of the biggest threats to the environment is the runaway growth of mega cities. These cities if located near the coast are responsible for marine pollution and could destroy coastal ecosystem and wetlands.

The city life is characterized by use of automobiles and other forms of transport using internal combustion engines, steam and diesel locomotives. Since 1960's the number of motor vehicles is increasing at rate faster than the population. It is estimated that there were 50 million cars all over the world in 1950, which have risen to 600 million in 2002. By 2020 it will be touching 1 billion mark. Vehicle production in India is increasing at the rate of 15-20% per year. As per a recent media report (T.O.I.), Delhi is adding 963 vehicles on its road every day while Bangalore is adding 500 vehicles. The story is no different in other metros or tier-II and tier-III cities. Table 1 shows the rapid growth of automobiles in India, in various sectors.

Table 1. Total Number of Registered Motor vehicles (in Lakhs) in India from 1951 - 2004

	All Vehicles	Two Wheelers	Cars, Jeeps, Taxies	Buses	Goods Vehicles	Others
1951	3.06	0.27	1.59	0.34	0.82	0.04
1961	6.65	0.88	3.10	0.57	1.68	0.42
1971	18.65	5.76	6.82	0.94	3.43	1.70
1981	53.91	26.18	11.60	1.62	5.54	8.97
1991	213.74	142.00	29.54	3.31	13.56	25.33
2001	549.91	385.56	70.58	6.34	29.48	57.95
2004	727.18	519.22	94.51	7.68	37.49	68.28

Source:Department of Road Transport and Highways, Govt of India

These cause the problem of air pollution, as a result of exhaust gases and particulate matter. As per a recent study by IIT, Chennai, 70% air pollutants are from automobile emission in the mega city of Chennai. Some of these exhaust gases like CO2 is a major greenhouse gas while Carbon Monoxide, NOx and hydrocarbons are major health hazards for the people on road as vehicle emit within the breathing zone of people. The increase of automobiles is major concern for air quality in the Indian cities.

Industries of various types are generally located near the cities and industries are the major source of air, water and land pollution. Release of dust, smoke and chemically hazardous gases lead to poor air quality near the industrial sites. Dust from mines specially coal and asbestoses when inhaled by the workers produce chest related diseases. Dust from brick clines, fly ash from coal fired thermal power plants cover large areas in the neighboring towns and cities. Efforts to reuse fly ash in form of bricks etc have not been very popular.

Most of the energy needed to support industries and urban life style is produced by using fossil fuel i.e. coal, petrol, diesel or natural gas. Each of these results in the increase in emission of greenhouse gas CO2. The fourth assessment report of Intergovernmental panel on climate change (IPCC) published recently states that most of the observed increase in global temperature since mid-20th century is very likely due to the observed increase in human induced GHG concentration.

Thus urban life style and industrialization have a definite role in causing global warming. Global warming can lead to climate change, including increased frequency and intensity of storms, flood and droughts. At the same time the rise in the sea level by 90 cm by the end 21st century would be disastrous to many urban centers located near the coast. While this is the picture in the global scale; urbanization leads to substantial changes in the urban climate. Some of these are as follows.

Urbanization produces a warmer city center as compared to the neighboring surroundings. The temperature could be 5-10 oC warmer particularly during the winter nights. The effect is known as the Urban Heat Island (UHI) and is seen almost at all the big cities of the world.

Tall buildings towers, bridges and flyovers retard the free flow of air so that suspended pollutants are not effectively removed. Lack of open ground leads to less infiltration of rainwater in the ground as the tar roads and cement pavements are impervious to the percolation of rainwater. This increased runoff leads greater risks of floods/water logging. Heavy rains during the southwest monsoon and northeast monsoon seasons cause floods in some location. Tropical cyclones are also responsible for such floods. The severity of floods is further enhanced in urban locations due to poor drainage system. The urban development very often takes place in a manner in which buildings and roads occupy the flood planes of the rivers and streams. This causes high run offs/ stagnation of water which cannot find its natural exit due to blocking of its flood plane. In August 2000 such an incident affected the popular city of Hyderabad,

which had 24 cm of rain on 27 August. More recently on 27 July Santacruz recorded a rainfall of 94.4 cm of rain, a record in itself. The event caused a loss of over 1000 crores and killed over 500 people. In 2006 such incidents though on a less severe scale were reported from Bangalore and Chennai.

Presence of dust and aerosols in the city air leads to reduced solar incident energy; and increase in humidity. These factors make the city 'microclimate' different from the surrounding semi-urban or rural location. Increased dust and aerosols also lead to lowering of atmospheric transparency, leading to poor visibility during winter. Studies carried out for the cities in India particularly large airports indicate that atmospheric transparency is greatly reduced during winter as the dust and other suspended particles stay close to the ground due to stable thermal stratification and low winds. The studies also indicate that the incoming solar radiation is also reduced due to the presence of dust and aerosols over urban areas. All the stations of IMD solar radiation network are showing decreasing trend in global solar radiation and bright sunshine duration. Figure 1 shows this effect for a few stations in India. The reduction in sunshine hours could be as high as 20% in Delhi, Kolkata and Bangalore. A study by Padmanabhamurty (2004) has shown that due to lower wind speed and lower mixing height (which depends on turbulence) the ventilation coefficient is low in most of the cities in winter making these areas of poor quality.

As indicated above the reduction of wind speed over the Indian cities varies from 54% for Delhi, 59% for Mumbai, 37% for Kolkata, 30% for Chennai, 58%

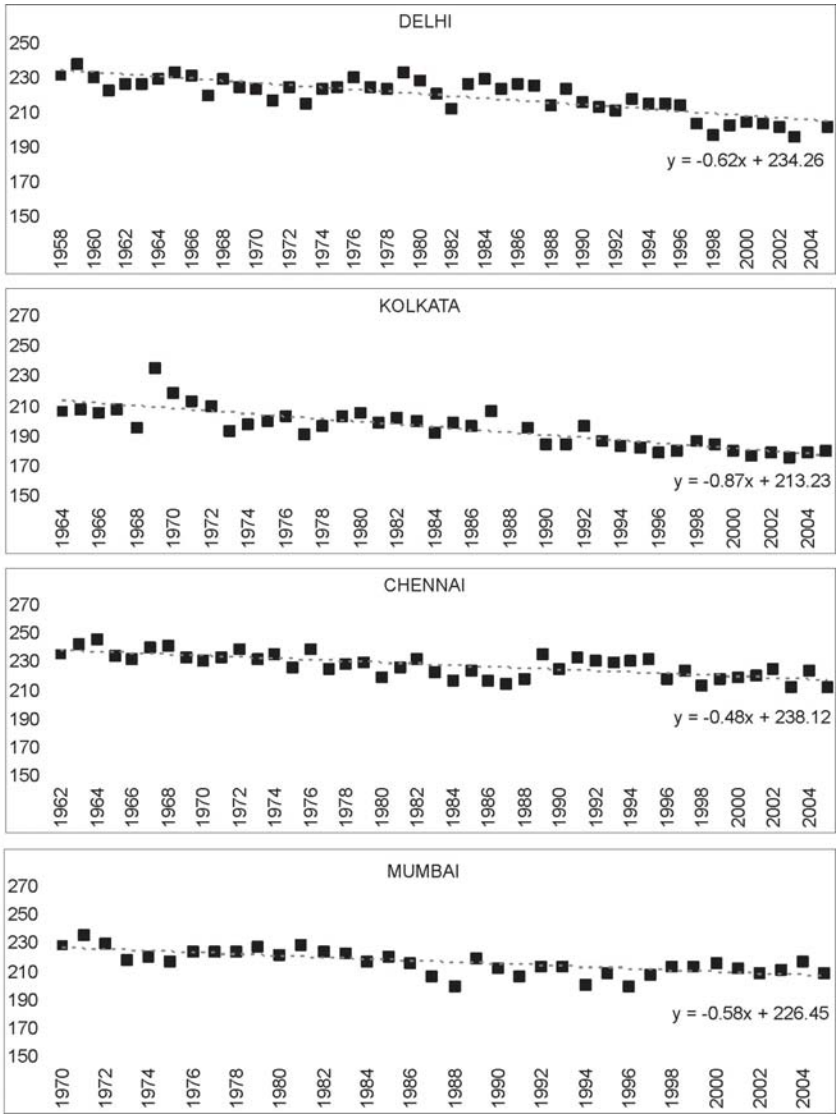

Figure 1. Long term trends in global solar irradiance (in Wm^{-2}) at major cities in India

for Bangalore and 23% for Nagpur (Rao & Jaswal 2000). The same study and the studies by De & Rao (2004) also support this and show an increasing trend in rainfall ranging from 14 to 4% in many cities. These features of the 'city climate' have been reported from different cities in the world. There also appears to be an increasing trend in rainfall over urban locations as seen in different cities of India. Development of urban cities should be sustainable and not economic and physical only. As stated earlier mitigation efforts as well as adaptation have to go hand in hand. Any agreement on freezing the emission at an agreed level will not have any immediate effect and global warming would continue for several years beyond. At the same time cost-benefit analysis is dependent on the precise knowledge of impacts at regional as well local levels (De 2001). The same is true for planning adaptation strategies. Thus while mitigation efforts need global participation and adaptation can be practiced regionally or locally in different sectors. In both these ways one aims at reducing the negative impact of climate change; participation at citizen level (De 2008) are important because of their cumulative influence in keeping our planet and environment at a lesser risk from these impact. Recycling of water, rain harvesting, use of eco-friendly devices and a less consumptive life style can help us in making a sustainable urban environment and better climate for its population (WMO 2004).

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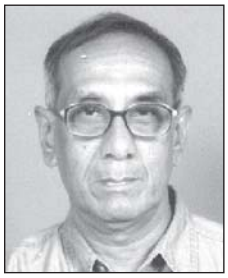

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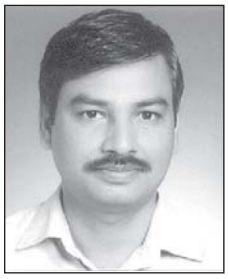

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