Climate Smart Cities

Colloquium Proceedings – August 28, 2013

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Proceedings of the Colloquium held on August 28, 2013 in Bangalore, organised by PAC and CSTEP
Climate Change is an emerging critical issue at the national and international levels that requires immediate policy intervention and programme action. Several studies show a rise in global average surface temperature and rapid variations in the frequency and intensity of rainfall. Unplanned and unsustainable urbanization is adding to the already persistent problems of environment and natural resources management. India had the second highest urban population in the world in 2012 and will be amongst the fastest growing urban populations globally between 2013 and 2020 in absolute terms. Unplanned urbanisation has led to an increase in the number of squatter, slums and illegal settlements in urban centres. This has led to an increase in pressure on the already over stressed resource management systems, and aggravates the problems of pollution and health management. The city planners and governors/governance are yet to equip and plan for disaster preparedness to face the eventualities due to Climate Change.

Public Affairs Centre and Center for Study of Science, Technology and Policy (CSTEP) organised a one day colloquium on “Climate Smart cities” on August 28, 2013 to explore how our cities can adapt better towards the changing climate and how its citizens can play a constructive role in this process. The Colloquium is part of a series where young researchers are given opportunities to interact and present ideas to experienced administrators. Papers included cases from the coast to the highlands, and in different sectors such as power and transport. While Bangalore featured prominently in the discussions, the issues spanned larger concerns such as weak governance and monitoring that affected all planning and implementation in cities.

Mr R Suresh, Director, PAC set the context for the colloquium, with focus of solutions. The Chief Guest, Ms. Sindhushree Khullar, Secretary, Planning Commission outlined the key principles of growth, inclusivity and sustainability by which urban planning was designed in the 12th five year plan. She said that urbanisation is inevitable, and 32% of India’s population is housed in cities that are growing daily through new migration for livelihood opportunities. In this context, service provision is strained and urban management grows very complex. The increasing number of extreme climate events such as unseasonal and very high rainfall and unnaturally high temperatures add to the misery. Dr V.S. Arunachalam, Chairman and Founder, CSTEP urged citizens and governments to accept this rapid transition and to work coherently towards alleviating the effects of its fall-out. Dr Samuel Paul, Founder, PAC urged a distinction between functional city and a climate smart city. The Vote of Thanks was given by Dr. Anshu Bharadwaj, Executive Director, CSTEP who stressed on evidence based solutions, in this context.
A majority of the cities that play home to a vast population are located along the coast and are vulnerable to sea level rise, storm surges, floods, extreme events and droughts. Mapping the areas of the city to identify their vulnerability is the fundamental step in understanding how to improve the resilience of a city. Climate responsive urban planning and sustainable development can help in a big way in reducing damages caused due to climate change.

This session was chaired by Dr Janakrajan, Professor, MIDS Chennai. He has been working on water and environment related issues over the past 20 years and is presently working on ‘Sustaining environment and ecology in Chennai.’

Mr Sunil Kraleti started the session by speaking on ‘Using Institutional mapping as a tool to assess climate vulnerability w.r.t capacities of ULBs.’ He spoke about the predicted impacts of climate change and its overlap with the achievement of the Millennium Development Goals. There is a strong link between urban vulnerability and public health especially those caused by lack of proper sanitation facilities. This research work uses institutional mapping to comprehend the governance capacities of a ULB and its requirement to conduct administrative capacities. Institutional mapping can play a crucial role in identifying the loopholes in the administrative capacities of the local body. The institutional set up of Hyderabad Metropolitan Water Supply and Sewerage Management Board (HMWSSB) was compared with the IAD Institutional Analysis and Development (IAD) Framework by Elinor Ostrom on operational level, collective choice and constitutional choice. HMWSSB has adopted the administrative reforms of 2005, thus decisions on sanitation can now be taken by the lowest tier of the organization i.e area sabhas. Mr Sunil concluded his presentation by saying that the Hyderabad experiment has shown that decentralization rooted in subsidiary has the potential to lead to effective citizen control on functions valued by them.

Mr Sarbeshwar Praharaj was the second speaker of the session. His topic was ‘Carbon Intensive Urbanization, Climate Variability and Urban Vulnerabilities in Hill Areas: A Case of Gangtok Urban Region, Sikkim.’ Gangtok has seen unprecedented growth and abrupt increase in population density, over the past decade. The rampant growth of vehicles in the city has had an adverse impact on the urban environment.

Another major challenge is that all economic activities in the city are concentrated in the central business districts (CBD). The gap between the average mean maximum and minimum temperature is increasing, this has micro-climatic implications. In the past years the frequency of natural disasters has increased owing to localized reasons. Mr Sarbeshwar ended his presentation with recommendations such as better traffic management techniques, transit oriented development and creation of sub-centers that would help the city of Gangtok the mitigate risks.
Mr Prerak Shah was the final speaker for the first session. The topic of his paper was ‘Vulnerability mapping for Indian Coastal Areas.’ The presentation began with explanation of intrinsic and extrinsic vulnerabilities of a place to risks posed by climate change. Census data, Land Scan data, Shuttle Radar Topography Mission (SRTM) data and data on per capita income was used with GIS to create a base for simulations. Then various simulations were carried out to see areas and population that would be effected if sea levels were to rise 1 meter and 6 meters. It was seen that the Western Ghats act as natural barrier and stop areas on the western coast from being inundated. Mr Prerak concluded his presentation by saying that this vulnerability assessment could be used in the fields of planning and development, port planning, early warning system for disasters, insurance and disaster and mitigation purposes.
Using Institutional mapping as tool to assess climate vulnerability with respect to capacities of urban local bodies
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Abstract

The impact of climate change on urban areas, involve stresses that are direct and easily understood impacts of storms, sea level rise, temperature change, and extreme climatic events. This apart, the impact is also felt through indirect stresses which reverberate through the systems — energy, transport, communications, etc. — that urban areas depend on. The dynamics of this phenomenon are complex, and the specific changes at the local level they induce, are often highly uncertain. Urban resilience is still a field in its early stages developing an understanding of the complex inter-relationships between these critical systems to identify the factors that ensure resilience. The unpredictability of these urban systems would require potent adaptive capacities in place, which essentially does reflect on the management capacities that drive city administration to serve the purpose for our cities, i.e. the local self governments. In a contemporary urban area, most shelter systems are only habitable if other networks function well. They depend on power systems, water supply, sanitation, and communication. The Cities Development Initiative for Asia (CDIA) in their study ‘Climate Change and infrastructure in Asian Cities’ indicate that infrastructure spending undertaken in Asian cities to establish climate resilient infrastructure, flood protection shares nearly 41% of investments and waste management constitutes 24%.

Under the Asian Cities Climate Change Resilience Network (ACCCRN) initiative in India, climate resilience plans were developed for 3 Indian cities with the help of local partners and stakeholders. The ACCCRN initiative has emphasised in improving infrastructure facilities in the cities, the lack of which is coined as one of the major causes for climate vulnerability. Improving infrastructure does not only reap investment benefits but also enhances the climate adaptive capacity of the system.

In the coming decades, climate change may further strain the lives of poor urban residents and the already frayed infrastructure and administrative systems of these cities. With increased decentralisation, and greater devolution of functions and responsibilities to local governments, administrative and...
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management functions are an important constituent of urban resilience. It is with this in mind, that the paper directs its attention towards the assessment of the organisational structures – influenced by 3 levels of governance: individual, community and the overarching regime– within local self-government as an attempt to map vulnerability.

In this present paper, we use the tool of institutional mapping to comprehend the governance capacity of a ULB (Urban Local Body) and its requirements to conduct administrative duties. This mapping, as we claim, can play a crucial role in identifying the loopholes in the administrative capacity of the local body, and the overall administration of urban resilience (in the urban area under consideration). It is a matter of fact that the capacity has to be enhanced, to serve as a better service delivery model with greater resilience to the indirect stresses of climate events. As such, the institutional vulnerability and gap analysis would help to define the policy objectives at the local level. For the same, policy level interventions would be suggested, to link this exercise to community based adaptation practices.

The aim is to define an institutional map – using the IAD framework conceptualised by Elinor Ostrom – for the study areas that provide the appropriate guidance to strategic decision-making, to guide the actors (identified through stakeholder mapping) through the social space mapped, i.e., operational environment. An institutional map like other maps, is shaped by interests, specific problems and objectives, which in this case is enhancing “urban resilience”. Most importantly, the exposition of this theory would regard with “What are the meta-theories that should shape the process of mapping the special domain of urban resilience in local self governments of Indian cities?”

This essentially would require us to comprehend the ‘operational environment’ of the urban system, so as to discover the vulnerabilities not merely as a response to predicted climate impacts, but that also fosters proactive and systemic approaches to prepare for unexpected and indirect effects of global change. The mapping and definition of the operational environment would attempt to incorporate the identification of the key actors, rules in use, decision nodes, and the specific context offers clues about the parameters that once modified may change the entire situation.
Carbon Intensive Urbanisation, Climate Variability and Urban Vulnerabilities in Hill Areas: A Case of Gangtok Urban Region, Sikkim

Sarbeswar Praharaj, Lovely Professional University, Punjab

Abstract

Rapid high carbon intensive urbanisation is one of the emerging concerns in the environmental and global warming debates in the context of environmentally fragile and sensitive areas like the Himalayas. Rapid urbanisation and urban growth leads to rapid destruction of green infrastructure, high emission of GHG from transportation, construction, manufacturing and associated sectors. High waste generation and improper management and disposal of waste further aggravate the problem. The ecological footprints of supplying food and basic services like water along with the destruction and deterioration of other eco system services makes the urban areas vulnerable to hazards and climate impacts both in the short and the long term-what?. The problems get further accentuated because of poor regional and urban planning practices and weak implementation of planning by-laws and development of control regulations. All these have significant impact on the local climate, including heat island effects leading to increased variability and intensity of rainfall, temperature and humidity. As a result the urban areas become more vulnerable to hazards, disasters and epidemics and disease. Under such circumstances vulnerability mapping and evolving response and coping mechanism by internalising them in sustainable habitat planning and development practices becomes important. Taking action to mitigate the problem is important but equally important is to evolve adaptation strategies which are locally conducive.

This paper intends to understand these issues with respect to Gangtok Urban region using the available census and other statistical information. An attempt has been made to understand the weather, climate variability over the last few decades in the region and document the history of hazards and disasters through secondary literature. The study also focuses on the impacts of rapid urban growth on the local environment and its impact on eco system services. To what extent planning and urban management practices have tried to address these concerns have been explored by reviewing existing plan documents, by-laws and their implementation mechanism. Based on these analyses the study highlights vulnerabilities in Gangtok urban region and suggests coping mechanisms and strategies in the form of regional spatio-environmental framework preparation, green infrastructure design initiation, environment friendly and hazard resistant building by-laws and zonal regulation implementation and city resilience strategy formulation etc. at the local level and regional co-operation and policy integrations at the state level to address urban vulnerabilities in Sikkim.

Keywords: Urbanisation, Urban Planning, Hill Development, Climate Variability, Urban Vulnerability, Heat Island, City resilience, Adaptation Framework, Sustainability.
Vulnerability Mapping for Indian Coastal Areas: Assessment of Sea level Rise Scenarios

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Abstract

Asian cities are centers for urbanization and are the most disaster-prone regions, where incidences of climate induced disasters are also high (Shaw, 2009). India has a vast coast-line of 7517 km., where more than 40 million people live. This population is distributed into 13 coastal states and union territories, which are about 72 coastal districts. This study assessed the socio-economic parameters for the coastal population which will help in understanding the vulnerability of the people that can help in planning a better future.

It is projected that the extent of 1-m sea level rise (SLR) could displace 7 million people; inundate 5764 sq. km of land and 6760 km of road. The study analysed the coastal vulnerability of 72 peripheral districts and agricultural lands at risk. The study considered both intrinsic as well as extrinsic vulnerability indicators. A comprehensive local level list of indicators is prepared to analyse the actual ground scenario. Analysis is done for the whole coast at a scale of 1x1 km grid to simulate the human life and economy at risk. Considering the flood being a topographic based event, administrative boundaries are not taken into account at this level for analysis. So the raster based analysis of micro level (1km x 1km) grid is carried. Sectoral economic impact and GDP contribution at risk is carried out which eventually helps us to analyse GDP at risk. Low elevation coastal zones (LECZ) are segregated to analyse the population living in potential threat zone. SLR simulations are carried out for 1 meter to 6 meter rise in sea level. The research also compared the 6 simulations to analyse the changing variation in human life and economy at threat due to the rise in sea level. It is analysed that 5.74% population of coastal districts would be at risk in 1meter SLR to 24.27% population of coastal districts at risk in 6meter SLR. Later, it projects the population for year 2100, and analyses that 65 million populations would be at risk due to 1 meter SLR in 2100. This analysis of human life and economy at threat helps to form adaptation strategies for coastal development activities. Also land-use mechanisms & planning recommendations & strict enforcement of the Coastal Regulation Zone (CRZ) Act, monitoring of impacts could be suggested for the threat zone.

Keywords- Vulnerability, Sea level rise, Impact assessment, Climate change, Indian coast
Cities should adapt to both long-term trends associated with climate change (e.g. sea level rise) and to extreme events such as flooding. Everyone has a role to play in this adaptation be it the policy makers, the administration, the research body or the community members. This session brought ideas, best practices, case studies and different types of approaches towards community based adaptation and ecosystem based adaptation.

This session was chaired by Dr. A Ravindra, former Chief Secretary of the Government of Karnataka and the Chairman of Centre for Sustainable Development. It was a privilege for all attending to have one of the most experienced and reform-oriented administrators to chair the session and provide a variety of inputs and comments.

Dr Ashwin Mahesh, the Co-founder of Mapunity was an invited speaker for the session. In his talk, he felt that the consolidation of all knowledge currently available in the city is an important first step. He said that there is a lot that can be done at the community level without waiting for the government to do it for us. All it needs is to imagine us as being a part of the system.

Ms Rinyo Ngilyang presented her work on ‘Understanding Ziro: Climate Change and Proactive Adaptation’. The study focused on how the identity of the Ziro could be retained through an integrated approach of traditional, cultural, ecological and intelligent development practise. Ziro is known for its environment friendly social, cultural and agricultural practises. The comparison between earlier traditional agricultural settlement and recent rapid settlement showed the lack of planning in the recent times, leading to a severe environmental degradation. This in-turn has also affected the local economy. This diversion from the local economy has also led to the diversion of the cultural practices. As a way of adapting to this change and bringing back the fading identity of the place, she presented some of the initiatives at the individual as well as the community level. The recycle and the reuse of the old materials with the integration of the modern techniques can help conserve the traditional elements. This can reduce pressure and impacts on the immediate natural surroundings.

Mr Jayaram Jangal spoke about ‘Adaptation perceived by City administration: A case of Bangalore’. The main objective was to assess the preparedness of residents and city administrators to face the impacts of climate change, the coordination between various agencies in case of climate vagaries and to evaluate Bangalore’s responsiveness to climate threats. The study captured the perceptions of officials from various civic agencies that are expected to respond in times of climate distress. Clearly, the study showed that there is very low awareness among the official community on what is climate change, how can the city of Bangalore be affected by this and how as City administrators they need to play a proactive role in adapting to this. The study shows that the income levels do play a role in adaptation to climate vagaries. Improve urban planning; foster institutional coordination, design and implement a consistent program for drainage maintenance- these were some of the policy recommendations that came out of this study.
Understanding Ziro: Climate Change and Proactive Adaptation

Ngilyang Rinyo

Buildaur, Auroville

Abstract

The village of Ziro in Arunachal Pradesh, inhabited by the Apa-tanii tribe, situated in an altitude of 1,700 m (5,600 ft), above the mean sea level, is known for its unique agriculture irrigational and pisciculture technique. With an approach towards sustainable techniques of land and water management in agriculture, the inhabitants of this land have managed to sustain its agricultural practice since a long period and create a worldwide recognition for the same.

This was the story until the whole system worked in balance with each other. The recent developments including rapid construction of housing, resorts and hotels to meet the growing demands from tourist, economic needs and other thoughtless constructions that have rapidly started to encroach the vast spread of forest. The residents of this land, who are highly dependent on the agriculture as their livelihood have been facing serious issues in the past few years owing to this sudden emergence of built structures that stand on the timber chopped down from the forest of this region. The whole agriculture system is largely dependent on the presence of this forest, some of which is deep rooted and holds the water in the soil and others helps in maintaining the balance of temperature, global warming also being other factor at a larger scale. In 2012, during the months of June – July, the Ziro valley suffered a heavy loss of crops. The paddy in almost every field had wilted, there wasn’t enough water flowing in the river for irrigation, the only river that was a source of irrigation was polluted by senseless disposal of waste. Upon enquiry of the locals, some of the logical reason found was the dramatic rise in the temperature in that region for past few years that led to this situation.

Aim and Methodology

From the above discussed situation, this paper is developed from a built environment perspective to address the following research question: How effective are the adaptation strategies and measures adopted from both public and private sector and by the local communities in mitigating and adapting to
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the climate change concerns? The analysis of this study reveals various impact situations on the natural resources and traditionally built environment and their concerned root causes. This study adopts an empirical case study approach not only to understand the development issues that are taking place in target areas of major construction sites but also to document the traditional settlement patterns and architectural features that are undergoing huge transformation process. Semi-structures from various municipal authorities, development agencies, local communities, and other important stakeholders those concerned with the sustainable development of the region has revealed various crucial cross cutting issues that are hampering the sustainable growth of the region. The findings of this study also help in understanding the state of community awareness towards the importance of ecological balance and the adaptive methods they are taking up as a proactive response to the climate change. Finally this study concludes with few recommendations from a built environment perspective to better address climate change concerns and to promote sustainable development in the region on along run.

Adaptation Perceived by City administration: A case of Bangalore

J.Jangal

Public Affairs Centre, Bangalore

Abstract

India's urban poor are often at the mercy of natural hazards, including weather events such as droughts, floods and cyclones, whose severity and frequency are likely to increase with climate change. Indian cities are slowly trying to protect their vulnerable residents through better planning, infrastructure and response systems. Simultaneously, good data on climate, weather and forecast is becoming increasingly open and available. However, the complexity and arcane nature of much of this data has deterred its full use by cities.

How Indian cities respond to climate threats and how they incorporate the impacts of routine weather into city planning and administration, are topics that lack sufficient systematic study. The research project focuses on Bangalore, India and how the city has responded to climate hazards in the past several years. This includes studying and evaluating emergency responses, preparedness, infrastructure sufficiency, and long-term planning. The study identifies significant barriers to building more climate-smart cities, and also entry points for citizens and civil society to start effecting change.

Proceedings of the Colloquium held on August 28, 2013 in Bangalore, organised by PAC and CSTEP
SESSION 3- CLIMATE CHANGE MITIGATION

Cities are an important contributor to global warming. However, they can play a significant role in mitigating climate change. They can reduce energy consumption, promote renewable sources of energy, reduce their carbon and water footprint. This session introduced ideas on how an urban system can collectively respond to the phenomenon of global warming and climate change.

This session was chaired by Dr Ashish Verma, Assistant Professor, Civil Engineering Department IISc.

Mr Karthik Gopal, General Manager New Business Development and Mobility Solution, Mahindra Reva who was the invited spoke about alternate fuel for mobility taking the example of electric vehicle (EV) market in India and associated policies. The National Electric Mobility Mission Plan 2020 focuses on developing a comprehensive and long term policy for electrification of road transport in India. More than ` 200 billion is likely to be invested in R&D and infrastructure in the next 5 years. The mission plan, speaks about the sale 6-7 million EV s on Indian roads by 2020; the energy requirement for the same would be only 0.3% of the present generation capacity. Mr Gopal further spoke about using solar panels as charging points for the EVs and grid sharing mechanisms. He concluded by reiterating that the available technologies could be exploited only by adopting new regulatory frameworks.

Mr Roger, Director ‘Cities Program’ at Atkins Global was the next to present on ‘Integrating Low Carbon Master Planning: futuristic approach-Mysore case study.’ The project looks at reducing carbon intensity of urbanization in India through integration of master planning approach with carbon tools in the spatial planning system. The rapid economic and urban transition taking place in India calls for an urgency for adopting sustainable development strategies. Various parameters such as matching land use plans with demographic and economic scenarios, addressing environmental risks facing the city and co-ordination of infrastructure investment in support taken into consideration during the planning process. A compact and poly-centric development model was recommended for the city, adopting this can bring about a saving of more than 40% in Co2 emissions till 2031. This approach not helps reduce energy intensity but also harmonizes the city with its natural systems. Mr Roger concluded by talking about number of national and state level policy recommendations in lines with the UDPFI guidelines and the long term benefits of the same.

Dr Piyush Ranjan Raut, spoke about ‘Visioning Indian Cities 2030 with Low Carbon Urban Planning.’ His presentation focused on the lack of proper planning and resultant issues across cities in India and the risks posed by climate change. He said that there is a lack of peer learning and knowledge sharing among Indian cities. The constant expansion of Indian cities has led to increased carbon intensity. Dr Raut concluded his presentation talking about the need and advantages of building low carbon cities.

Ms Srishti Singh was the next speaker; her topic was ‘Carbon Footprint estimation of Dehradun study and its reduction through energy management.’ Carbon footprint was calculated by classifying the city of Dehradun into 6 sectors (residential, commercial, industrial, municipal, transport and institutional), ‘energy consumption’ was taken as operation for calculating the same. The total carbon foot print was calculated by converting activity date into emission factors for different fuels and electricity. It was
concluded that the transport sector plays the biggest role in the city’s emission, diesel consumption was the highest amongst fossil fuels and the domestic sector consumed the maximum electricity. Adoption of renewable energy technologies will result in around 4.3% reduction in the total energy demand of Dehradun city within the city. Sristhi concluded her presentation by citing reduction in GHG emissions, cost savings and lesser environmental impacts as the advantages of adopting energy management techniques.

The last presentation for the day was by Ms Sayali Borole, who presented Dr Kala Seetharam Sridhar’s paper on ‘Economic Impacts of Climate Change in India Cities’. The focus of the paper was to find out how the economy of a district (district domestic product-DDP) was getting affected as a result of climate change. Coastal and inland districts were analyzed separately. The main objective of the paper was to find a link between rise in mean temperature and change in rainfall patterns and economic activities and livelihoods. The regression model, included factors such as population of a district, rainfall and mean temperature, type of employment and literacy rate. The results show that factors such as literacy rate and population have a greater impact on output (DDP) than factors like mean temperature and rainfall. The conclusions drawn from the research was that climate change has so far not affected Indian cities. Only conventional factors such as size of the population and their skills (measured by literacy rate) have significant impacts on economic output.

Officials from Government of Karnataka spoke about the solar policy that has been framed recently that includes policies for grid sharing and rooftop solar panels. And, said that cost effective proposals from civil society organizations will be readily considered.
Visioning Indian Cities 2030 with Low Carbon Urban Planning

Dr. Piyush Ranjan Rout, Local Governance Network, Bhubaneshwar

Abstract

Worldwide everyone is busy finding solution for planet’s rising temperatures, sea levels and climate change. So far research communities agreed greenhouse gas emissions are an outcome of human activity. Sufficient action must be taken now to reduce these emissions. Today more than half of the global population is living in urban areas. The problem with all city folks is that they use more resources than others, which means cities are generating more waste, contributes more to air & water pollution. It is not just a case of single city but globally cities contribute an estimated 70 percent of the world’s energy-related greenhouse gases (GHG). India is not far away with its urbanisation process; currently around one third of its residents are residing in cities but in the next two decades this figure will reach half of its population in urban areas. Presently India is the fourth largest green house emission emitters globally. The big question is can Indian cities turn themselves to a Low Carbon Future by increasing the share of green energy, minimising its waste generation, involving in sustainable mobility, generating more green spaces and managing water efficiently. This would be a major undertaking, since the trend over the past 60 years is ever-increasing high consuming lifestyles; the challenge then is how to break this trend.

So can India restructure its city planning process in line with principles of Low Carbon Climate Resilience Cities framework? Perhaps the answer is yes. It can achieve this by redesigning city planning in and around thoughts of Low Carbon Future. It means the city planning exercise should not just ensure putting infrastructure or adding concrete building but also need to imagine a city designed with low emission zones having undergrounds waste management system, access to green energy, runoff or sewerage water is filtered and re-used, biogas is extracted from household refuse, build attractive walkways and trams or bus system connected to various parts of the city. Perhaps Indian cities can achieve this by focusing integrated Low Carbon Future City plan at least in cities that will come up around 2030.

This paper explores the opportunity that Indian City has for transforming itself into Low Carbon. Many cities share common elements like public transit, dense housing, walk-ability, large scale infrastructure, vehicle congestion and so forth. Interventions in local city plans is a unique way to respond to global call on making cities resilient with low emission tools by integrating the principles of Low Carbon City initiatives in City Planning. On the other side the paper presents some of the good practices being practiced by various global cities, which can be integrated in Indian Cities. Finally the paper tries to convince research community & city management to understand that the cities that will take of half India’s urban population are yet to be born. The paper opens up opportunities for integrating LCC in Indian City Planning keeping in view not just retrofitting existing cities but also for future that are yet to sprout.

Key Words: Emission, Urbanisation, Mobility, Co-Benefits, City Planning, Low Carbon, Sustainability and Disaster Risk Reduction
Carbon Footprint estimation of Dehradun city and its reduction through Energy management

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Abstract

Carbon footprint is a measure of the impact of human activities on earth and in particular on the environment; more specifically it relates to climate change and to the total amount of greenhouse gases produced, measured in units of carbon dioxide emitted. Growing awareness of climate change has generated a demand for carbon dioxide (CO₂) reductions by individuals, institutions and businesses for specific activities and for offsetting their full carbon footprints. These decisions are mainly driven by business profit, environmental commitment, and civic responsibility and leadership goals. The voluntary carbon market is gaining momentum as growth in demand for CO₂ reductions is outpacing the wider introduction of low-carbon technologies in transport, energy production and manufacturing. The idea behind the paper is to quantify carbon emissions with a target of reducing consumption, achieving cost savings, and meeting greenhouse gas (GHG) emission reduction target, thus reducing urban environmental pollution. Carbon footprint calculation gives a quantifiable metrics which is important in order to be aware of the direct impact of emissions on environment. Carbon footprint calculation can be done at several levels from global to national to local. The accurate and precise estimation of the carbon footprint for an urban environment is gaining global attention as countries seek to comply with agreements under the Kyoto Protocol. In the study, baseline carbon emissions and energy profile for the year 2011-12 was developed through the collected data; thereafter energy management opportunities and processes to reduce Carbon Footprint are discussed in context to sector-wise electricity and fuel consumption. The Carbon Footprint of Dehradun is estimated to be around 659351.180 tones of CO₂ equivalent. Among them the most important parts are emissions caused by combustion of fuel mainly Diesel and LPG by public transport and local private consumption respectively. A comparison between the scenarios with and without energy management of Dehradun city on account of cost-effectiveness, greenhouse gas emissions and other significant environmental impacts shows that Dehradun with energy management would save huge amount of energy which would lead to high economic savings as well as low CO₂ emissions. Various energy other management techniques are to be put in place for reducing the energy consumption by another 5% or so which would further lessen the emissions. Future measurements of carbon footprint for a city would rely on the data for different scopes, and other greenhouse gases emitted.

Keywords: Carbon footprint; Energy Management; Baseline carbon emissions; energy profile.
Economic Impacts of Climate Change in India’s Cities

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Abstract

Ever since the earth came into being there has been a climate system. The climate of a place is the average weather that it experiences over a period of time. While changes in the weather may occur suddenly and noticeably, changes in the climate take a long time to settle in and are therefore less obvious. The Intergovernmental Panel on Climate Change (IPCC) concluded in 2007 that warming of the climate system is now “unequivocal,” based on observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (IPCC (2007)). According to the National Oceanic and Atmospheric Administration's (NOAA) 2007 State of the Climate Report and the National Aeronautics and Space Administration's (NASA) 2007 Surface Temperature Analysis, the eight warmest years on record since 1850 have all occurred since 1998, with the warmest year being 2005.

One of the expected impacts of climate change on South Asia is a general increase in both the mean minimum and mean maximum temperatures by 2 to 4°C (see Sharma et al. (2006)). A 10 to 15 percent increase in monsoon precipitation in many regions, a simultaneous precipitation decline of 5 to 25 percent in semi-arid and drought-prone central India and a sharp decline in winter rainfall in northern India is also projected (Ramesh and Yadava (2005)).

Given half of the world’s population started to live in cities in 2007, it is no exaggeration to say that the battle against climate change will be won or lost in cities. Since cities have high concentration of population density and economic activity, they are more vulnerable to climate change. India’s cities are characterised by high density of population, housing stock, and poor infrastructure, which make them vulnerable to climate change. Given that the most valued infrastructure is also located in cities than elsewhere, the economic and social costs of climate change will be much higher in cities. So climate change has impacts on the physical assets used within cities for economic production, on the costs of raw materials and inputs to economic production, the subsequent costs to businesses, and thus on output and competitiveness. For instance, at India’s sub-national level, an annual Gross State Domestic Product (GSDP) compression of about 2 percent has been estimated for Gujarat, of which drought makes up 57 percent, cyclone and storm surge, 12 percent, and inland flooding, 5 percent, over a 100-year time horizon (Revi (2008)).
Given the significance of climate change, economic importance of cities and lack of adequate research in India's context, in this paper, I deal with climate change impacts that are linked to market transactions and directly affect a city's value of output produced. I examine the impact of climate change which manifests in temperature differences and rainfall on city-level output in India.

I estimate city output regressions for India’s cities using several approaches. Since only growing areas are usually designated as towns, to get rid of this selection bias, I estimate the output of districts that are larger geographical areas than cities, which is similar to the approach Beeson et al (2001) take. I estimate the non-primary output of cities as dependent on rainfall, temperature differences, and other socio-economic characteristics determining city-level output such as its size, human capital, infrastructure, economic base, and regulations affecting urban land use.

While larger urban settlements tend to be more concentrated in coastal zones (e.g., Mumbai, Kolkata or Chennai), climate change is likely to have differential impacts on cities in coastal or riverine locations, as opposed to those in inland locations. I focus separately on the effects of climate change on output in India’s inland and coastal cities.

Further, agriculture in India continues to be highly sensitive to monsoon variability with 65 percent of the cropped area being rainfed (Revi (2008)). Since climate change is expected to increase the vulnerability of Indian agriculture, I estimate primary (agricultural) district domestic product as dependent on climate change characteristics such as temperature differences and rainfall, along with others, separately for inland and coastal districts.

I use the Census of India’s 2001 town directories for data on rainfall and temperature differences and other socio-economic characteristics for towns and districts, and newly published data by the directorates of Economics and Statistics in various Indian states for district domestic product. I've obtained a listing of India’s coastal districts from the Census, to enable me to do the estimations separately for coastal and inland districts.

Hunt and Watkiss (2007)'s review of the literature on studies of climate change on cities found the existing studies are mostly qualitative and suggested that impacts are likely to be more important for developing country cities. The study also found that most studies so far have focused on coastal cities and there is a lack of studies on inland cities. Moreover, in many cases, existing studies look at a single issue (or sector), most commonly sea level rise. This paper addresses these gaps in the literature and contributes to a more general debate regarding the economic impacts of climate change on India’s cities, and motivates the formulation of suitable policies in India’s cities to mitigate the impacts of climate change.

**Key Words:** Climate change--India, Cities, City output, District domestic product, Coastal and inland cities
THE WAY FORWARD

The colloquium provided a good platform for exchange of ideas on making cities climate smart. There were talks by sector experts on one hand and on the other, new and young budding researchers were provided with an opportunity to present their works. It was a good learning experience.

However, it was felt that to make sure that some of these ideas are translated into action, there is a definite need for a buy-in from the implementing machinery. Hence it was decided that as a Way forward to this exercise, there will be another colloquium held in partnership with a government agency. Efforts will be made to ensure greater participation of representatives from the government both administrators and policy makers so that the vast amount of knowledge generated through the deliberations in the colloquium can be translated into policy actions. The potential for joint research can also be explored based on the expertise in the research community and the need from the policy circles.

The conference was organized by members of the Environmental Governance Group at Public Affairs Centre, namely Prarthana Rao and Arvind L. Sha, under the guidance of the team leader J. Jangal and the Director R. Suresh and Sujaya Rati and Ananthalakshmi from CSTEP.

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Public Affairs Centre (PAC)

Public Affairs Centre (PAC) is a non-profit, non-partisan organization based out of Bangalore, India which has been dedicated in promoting good governance since 1994 through research, advocacy and action. Over the years PAC has developed various tools like Citizen Report Cards, Community Score Cards (CSC), Social Audit Toolkits and more to empower citizens in India and around the world.

In 2010, PAC established a group on Environmental Governance with a vision to improve the quality of life of the poor and marginalized sections of the communities in the environmentally affected areas of India. For the past three years, the group has been working with marginalized and highly vulnerable communities in coastal Tamil Nadu and highlands of Waynad in Kerala. PAC has also taken the lead in developing an interactive virtual forum on environment and climate – Know Your Climate.

Center for Study of Science, Technology and Policy (CSTEP)

CSTEP is a ‘not for profit’ research organisation incorporated with a vision to enrich the nation with technology-enabled policy options for equitable growth. CSTEP has grown to become a multi-disciplinary policy research organisation in the areas of Energy, Infrastructure, Materials and Security Studies.

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