



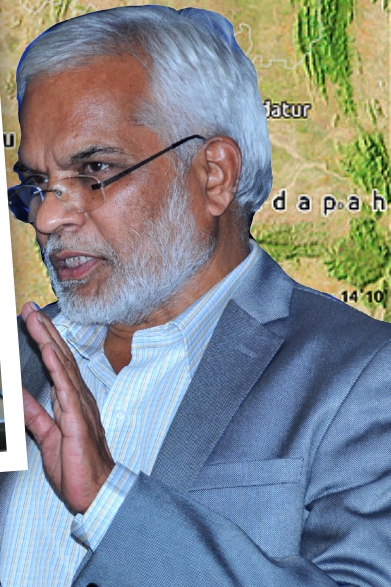
# Karnataka State Pollution Control Board

Recommendations to State Action Plan on

# Climate Change

Based on state wide public consultations and internal studies





**ಹವಾಗುಣ ಬದಲಾವಣೆ** ಭಾಗಿದಾರರ ಅಭಿಪ್ರಾಯ ಸಂಗ್ರಹ ಕಾರ್ಯಕ್ರಮ ಸರಣಿಗೆ **ವ್ಯಾಪಕ ಜನಸ್ಪಂದನೆ**

Dakshin Kannad  
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Kodagu  
Kerala  
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Mysore  
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Dharmapuri

# Recommendations to State Action Plan on Climate Change

Based on state wide public consultations and internal studies

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May 2015



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# Acknowledgement

The confidence shown by the Chairman and Members of KSPCB in entrusting this sacred job to me is gratefully acknowledged.

The huge efforts put in by the staff of KSPCB in the entire exercise are admirable, and their enthusiasm to make the task successful and meaningful deserves a lot of appreciation. Their contribution in the preparation of this report is also admirable. In particular, the assistance /co-operation provided by Sri. Nanda Kumar, Sri. Ganeshan G R, Sri. Harishankar Y S, Sri. Ramesh C, Dr. Ravi D R, Smt. Vijaya Hegde, and Smt. Viji Karthikeyan are thankfully acknowledged.

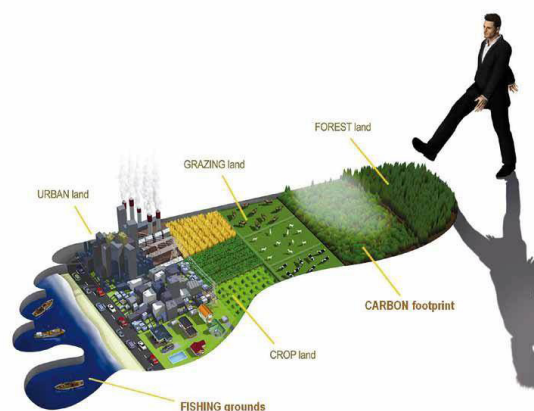
During the course of public consultations many institutions, industries, Government Departments, NGOs and civic conscious individuals have contributed hugely to the successful conduct of the meetings, and also have provided kind hospitality. Their kindness is well acknowledged.

It is heartening to note that in the midst of what appears to be general ignorance/indifference to the threats of Climate Change at the societal level, the participating public came in decent numbers and enthusiastically contributed to the consultation process, and have made the overall recommendations truly meaningful. Many NGOs and individuals have sent articles over e-mail. Many individuals and groups have also responded enthusiastically for the request to prepare high level district/regional plans for sustainable development keeping in perspective the threats of Climate Change. Their civic sense and enthusiasm on matter of societal importance deserve a lot of appreciation and gratitude from the larger civil society.

Acknowledgements are also due to Dr. Bhamy V Shenoy and Col C P Muthanna, who helped in fine tuning some of the themes in the report.

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While credit for some of the photographs used in this report is given to various openly shareable sources, and to NIE-CREST, the origin of few others is not known. However, their usage is thankfully acknowledged.





## Dedication

This report is dedicated to all those people, flora and fauna which have been either impacted adversely because of the accelerated degradation of the environment, and/or have become 'Climate Refugees' because of the looming Climate Change.

It is sincerely hoped that the admirable objective of the State Government in initiating such public consultations, and the continuing efforts by civil society groups and individuals in climate related fields will lead to the minimization of the risks of Climate Change and prepare our communities to face the same with adequate knowledge and enabling mechanisms.

## Preface by the author



The phenomenon of Global Warming and the consequent impacts of Climate Change (CC) are increasingly being seen as an existential threat to the life on this planet. The international community such as IPCC has said that without additional mitigation efforts beyond those in place today, and even with adaptation, warming by the end of the 21st century will lead to high to very high risk of severe, widespread and irreversible impacts globally. IPCC is also of the conviction that there are multiple mitigation pathways which can limit warming to below 2°C relative to pre-industrial levels. These pathways would require substantial emissions reductions over the next few decades and near zero emissions of CO<sub>2</sub> and other long-lived greenhouse gases by the end of the century. Implementing such reductions poses substantial technological, economic, social and institutional challenges, which will increase with delays in additional mitigation and if key technologies are not available for all countries. Many adaptation and mitigation options can help address climate change, but no single option is considered sufficient by itself. Effective implementation depends on policies and cooperation at all scales and can be enhanced through integrated responses that link mitigation and adaptation with other societal objectives. Such

integrated responses that link mitigation and adaptation with other societal objectives cannot be feasible without an objective participation of various sections of our society on a continuing basis.

The recent decision by the State Government to seek feedback on the state action plan on CC from the line departments / state undertakings, and the consequent decision by KSPCB to go for multiple public consultations need to be deeply appreciated from this perspective. The recommendations from these public consultations are meant to be included in the state action plan on Climate Change with the overall objective to make the state plan clearly relevant to the state's ground realities and also to reflect the public opinion.

In this context Karnataka State Pollution Control Board (KSPCB) constituted a study to address the climate change issues falling within Board's purview. The objective of this study to prepare an exhaustive report on the list of recommendations for the development of policy proposals to 'mitigate' and 'adapt' keeping in view the related issues in Karnataka, and which were to be based on interactive meetings with various stakeholders was a novel idea, associated with the uniqueness that such an effort might not have been undertaken anywhere else in the country. Participating public also appreciated these efforts, and have recommended that such public consultations should be held in all taluks of the state, and across the length and breadth of the country for enabling effective 'mitigation' and 'adaptation' at the national level.

It was in this context that the author was delighted to accept the assignment as a consultant for the overall coordination of stake holder meetings and to compile an exhaustive report on people's action plan on CC. Keeping in view the huge importance of such an action plan for the long term interest of the state, the civil society groups in the state were looking for such public consultations in order to make the action plan people centric.

Twenty one public consultations, which were held in different parts of the state, were a great opportunity to meet people from diverse backgrounds and listen to their views on Climate Change, and to know about their ideas for the developmental pathway for the state. It was an enriching experience to know about traditional knowledge based ideas for sustainable life styles, which have become highly relevant and urgent from CC perspective. It was a pleasure to receive a large number of recommendations of huge relevance to address the threat of CC, even from non-specialists on CC issues.

People from diverse background such as teachers, college Professors, doctors, engineers, NGOs, State Government employees, college students, activists, industrialists, farmers and others participated in the public consultations. It can be said that there was participation from most sections of our society, and hence these recommendations can be considered as a fair representation of public opinion on the developmental pathways for the state to 'mitigate' and 'adapt' to the CC.

A large number of concerns /recommendations have been expressed in these meetings, and they are grouped under 19 headings as in Chapters 4 and 8. These headings are: Water and Sanitation; Land use and planning; Forests and biodiversity; Western Ghats; Coastal Ecology; Agriculture, horticulture and animal husbandry; Food, dietary needs and human health; Waste management; Air quality; Transportation; Industries; Energy; Urbanisation, buildings and infrastructure; Education and general awareness campaign; Rural Karnataka, North Karnataka, and regional/district level development plans; Women's perspective; Traditional Knowledge and life style issues; KSPCB issues; other issues of importance from the perspective of state action plan.

Few overarching principles of huge importance to the society from CC perspective, and which were based on the issues raised in the public meetings, have been deliberated on in Chapter 3.

Keeping in view the fact that the focus of this study was on public consultations, the study report has been structured in two parts. Part A focuses mainly on the people's concerns/recommendations grouped under nineteen headings, and Part B provides explanatory notes on the relevant issues.

Keeping in view the huge importance of effective participation by women at all levels of developing and implementing the state action plan, additional focus was given to elicit women's views on the relevant topics. Few meetings with women's groups were held to understand their concerns. Such focused meetings revealed surprisingly different dimensions to the CC. These dimensions are critical for the overall success of the state action plan, and hence the women groups need to be involved much more effectively at the state level. These views have been compiled under a separate heading 'Women's Perspective'.

It was natural to observe in most of the public meetings that the participants focused generally on the local issues / issue of relevance to them, but they were also deeply concerned on the larger societal level issues such as forest degradation; pollution of land, water and air; agricultural crises; urbanisation; threats from plastic and other wastes etc. In this context it would be very useful to develop taluks / district levels action plans keeping in mind the characteristics / peculiarities of the local geography and the requirements of the local communities. Such local level plans can be clubbed together to prepare regional level and state levels action plans for effective implementation. For example, the action plan can be different to the north Karnataka region, southern plains region, Western Ghats region and coastal region.

The staff members of KSPCB, who are highly qualified in the fields of pollution control in particular, and in protecting the environment in general, played a stellar role in making the public consultations as representative of the public opinion as feasible under the circumstances. They dedicated a considerable part of their time to invite and involve the people from all walks of life in the public consultations. Through their regional offices the public were invited in all districts with the help of media and through personal contacts. The field officers of KSPCB provided very enthusiastic arrangements for the public consultations, and provided very kind hospitality to the author at all venues. KSPCB's initiatives to hold public consultations came for much appreciation by the public.

The staff members of KSPCB also enriched author's own knowledge through active participation in discussions in focused groups meant for them. Their rich experience in the field of pollution control also provided a strong base for the recommendations in this study report. Author's involvement in this assignment was made even more pleasant by KSPCB's field staff who kindly arranged visits to few industrial units to understand the pollution control related issues.

The Climate Change cell, which was set up in KSPCB to facilitate the public consultations and the associated activities, did a great job to provide a state level profile for the study, and few members of the cell travelled with the author for every public consultation meetings. They have also contributed to the explanatory notes on specific topics such as air and water pollution, waste management, transportation and industries, agriculture. They also provided very useful feedback during the discussions on the draft report, which were helpful in improving the study report. Their overall role in this study is deeply appreciated.



KSPCB has highly qualified and dedicated staff to deal with the task of controlling the pollution of air, water and land. They also understand the issues of Climate Change, probably, better than any other department/ agency of the state Government . Hence there is both the scope and need for vastly enhancing KSPCB's role in protecting the general environment and in particular in implementing the state action plan. The participating public also was, generally, of this view.

Whereas the number of participants in each of the public consultative meetings varied between 50 to 150, the number could have been much more given the effort by KSPCB's field staff to involve all sections of our society. While the quality of presentations made by the public in these meetings was generally good, it should be a matter of concern that the general awareness on CC issues, and the interest of the public to take part in the state action plan was seen as disappointing. The lack of general awareness and interest on CC issues should be a major concern because it has the potential to hinder the efforts of the STATE in mitigation and adaption. In this context, massive public awareness campaigns, on the lines of Clean India Mission and polio eradication campaign, targeting all sections of the society, including the people's representatives and Government officials, has become critical.

It was nice to notice high level of enthusiasm in some of the meetings. For example, the Deputy Commissioner and the Additional Deputy Commissioner took part in the meeting at Mangalore, and a senior forest department officer participated in Dharwad meeting.

The overarching principles behind the recommendations of the public can be said to be generally consistent with those advocated by many credible / influential sections of the globe such as UN, UNEP, FAO, World Bank, etc. and even by India's own National Action Plan on Climate Change. Also, it is not difficult to see how the letter and spirit of the Constitution of our country, and various Acts of the Parliament such as Air Act, Water Act, Environmental Protection Act, the Forest Conservation Act, the Wild Life Protection Act , Electricity Act etc. seek the implementation of these recommendations.

Hence it can be said with a high degree of confidence that, if these recommendations are converted into credible state action plan after due diligence with the concerned stake holder groups and effectively implemented, they will lead to satisfactory 'mitigation' and 'adaptation' w.r.t the looming Climate Change.

It is earnestly hoped that this report will enthuse other departments also to hold similar public consultations in at least those district places where such public consultations could not be held. There is also a modest hope that other states in the Union will take similar initiatives to involve the public in respective state action plans on climate change.

While credit for this exhaustive report should go to many people and organizations, the responsibility for any errors or omissions should be that of the author.

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# Contents

Acknowledgement.....	i
Dedication .....	ii
Preface by the author .....	iii
List of Tables .....	viii
Annexure .....	viii
Abbreviations and acronyms .....	ix
<b>Part A</b>	
Executive Summary .....	16
Chapter 1 Preamble to the report.....	22
Chapter 2 Karnataka’s ground realities - .....	24
Chapter 3 Discussion on major Issues Raised in the Consultative Meetings .....	27
Chapter 4 Recommendations from public consultation meetings.....	58
4.1 Water and Sanitation .....	58
4.2 Land use and planning.....	60
4.3 Forests and biodiversity.....	61
4.4 Western Ghats.....	64
4.5 Coastal Ecology.....	65
4.6 Agriculture, horticulture and animal husbandry .....	66
4.7 Food, dietary needs and human health.....	70
4.8 Waste management .....	71
4.9 Air Quality.....	73
4.10 Transportation.....	74
4.11 Industries.....	77
4.12 Energy .....	80
4.13 Urbanisation, buildings and communication infrastructure.....	82
4.14 General Awareness and Educational Campaign .....	83
4.15 Rural Karnataka, North Karnataka, and regional/district levels development plans .....	84
4.16 Women’s perspective .....	86
4.17 Traditional Knowledge, life style issues, best practices and public awareness .....	99
4.18 KSPCB issues.....	99
4.19 Other issues of societal concern .....	101
4.20 Brief discussion on the analysis of costs and benefits.....	102

## Part B

Chapter 5	Explanatory notes on the phenomenon of Climate Change.....	104
Chapter 6	Major findings from IPCC .....	108
6.1	Findings from Assessment Report 5 (AR5) .....	109
6.2	Relevance of national and international literature on CC to Karnataka .....	112
Chapter 7	Discussion on NAPCC and of KSAPCC .....	118
7.1	National Action Plan on Climate Change (NAPCC).....	119
7.2	Discussions on NAPCC .....	121
7.3	Karnataka State Action Plan on Climate Change (KSAPCC).....	123
7.4	Discussions on KSAPCC.....	126
Chapter 8	Sectoral issues raised in public consultation meetings.....	128
8.1	Water and Sanitation.....	128
8.2	Land use and planning.....	132
8.3	Forests and biodiversity.....	137
8.4	Western Ghats.....	139
8.5	Coastal Ecology.....	143
8.6	Agriculture, horticulture and animal husbandry .....	146
8.7	Food, dietary needs and human health.....	156
8.8	Waste management .....	159
8.9	Air quality .....	162
8.10	Transportation.....	164
8.11	Industries.....	165
8.12	Energy .....	173
8.13	Urbanisation, buildings and infrastructure.....	188
8.14	Education and general awareness campaign .....	192
8.15	Rural Karnataka, North Karnataka, and regional/district levels development plans.....	193
8.16	Women’s perspective .....	195
8.17	Traditional Knowledge and life style issues .....	196
8.18	KSPCB issues.....	198
8.19	Other issues of importance from the perspective of state action plan.....	199
Chapter 9	Best Practices and Conclusions .....	200
9.1	Best Practices.....	200
9.2	Conclusions.....	201
Annexure	.....	205-225

## Tables



Table 1	Time taken for economy to get multiplied at constant CAGR
Table 2	Planetary Boundaries
Table 3	Major issues with coal based power policy
Table 4	Annual Green House Gas emission by Sector at the Global Level
Table 5	Global Electricity Consumption and CO <sub>2</sub> Emission
Table 6	Sector wise % GHG emission in India
Table 7	Greenhouse gas emissions by economic sectors for Y2010
Table 8	Approaches for managing the risks of climate change through adaptation
Table 9	GHG emission inventory of Karnataka
Table 10	Number & Type of Hazardous Waste Re-processors
Table 11	Abstract of number of industries certified for ISO14001
Table 12	Available Power capacity in Karnataka
Table 13	RE Potential in Karnataka
Table 14	“Global”- Level Questions and Initiatives on RES
Table 15	Best Practices for addressing Climate Change

## Annexures

Annexure 1	List of public consultation meetings
Annexure 2	Power Project Proposals in Karnataka
Annexure 3	Transcript of news paper report in Deccan Herald of 9 September 2008
Annexure 4	“The coal curse’
Annexure 5	Comparison of electricity technologies in a matrix form
Annexure 6	Staff strength position in various state Pollution Control Boards
Annexure 7	The status of industries and organisation in Karnataka
Annexure 8	Summary of pollution control status of 17-categories of industries in Karnataka
Annexure 9	Abstract of CETPs in Karnataka
Annexure 10	Status of power plants with respect to utilization of fly ash generated
Annexure 11	Greening initiatives in industries and industrial areas during 2013-14
Annexure 12	Widening roads – are there wider issues?
Annexure 13	Activities pertaining to KSPCB in respect of KSAPCC
Annexure 14	List of Major Organic/Kitchen Waste Biogas Plants Implemented/ Installed by NIE-CREST, Mysore

## Abbreviations and acronyms

<b>ADB</b>	Asian Development Bank
<b>AEH</b>	All Electric Home
<b>AT&amp;C loss</b>	Aggregate Technical & Commercial loss
<b>AQI</b>	Air Quality Index
<b>BMRC</b>	Bangalore Metropolitan Rail Corporation
<b>CAGR</b>	Compounded Annual Growth Rate
<b>CBD</b>	Central Business District
<b>CBA</b>	Costs and Benefits Analysis
<b>CC</b>	Climate Change
<b>CCTV</b>	Closed Circuit Television
<b>CEO</b>	Chief Executive Officer
<b>CEPI</b>	Comprehensive Environmental Pollution index
<b>CETP</b>	Common Effluent Treatment Plant
<b>CFL</b>	Compact Fluorescent Lamp (a lighting devise)
<b>CH<sub>4</sub></b>	Methane gas
<b>CNG</b>	Compressed Natural Gas
<b>CO<sub>2</sub></b>	Carbon Di-oxide gas
<b>CRZ</b>	Coastal Regulation Zone
<b>CSR</b>	Corporate Social Responsibility
<b>CSP</b>	Concentrated Solar Power
<b>DG set</b>	Diesel Generating set
<b>DSM</b>	Demand Side Management
<b>EIA</b>	Environmental Impact Assessment
<b>ESCOM</b>	Electricity Supply Company
<b>ETP</b>	Effluent Treatment Plant
<b>FAO</b>	Food and Agricultural Organisation
<b>GDP</b>	Gross Domestic Product
<b>GHG</b>	Green House Gas
<b>GIS</b>	Global Information System
<b>GoK</b>	Government of Karnataka
<b>GNP</b>	Gross National Product
<b>GPS</b>	Global Positioning System
<b>GSDP</b>	Gross State Domestic Product
<b>GW</b>	Giga Watt (= 1,000 MW)
<b>IBM</b>	Indian Bureau of Mines

<b>IEA</b>	International Energy Agency
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>IP Sets</b>	Irrigation Pump Sets
<b>IT&amp;BT</b>	Information Technology & Bio –technology
<b>IT-ITES</b>	Information Technology - Information Technology Enabled Services
<b>Kalyanies</b>	Sacred ponds in front of temples
<b>KPCL</b>	Karnataka Power Corporation Limited
<b>KSAPCC</b>	Karnataka State Action Plan on Climate Change
<b>KSPCB</b>	Karnataka State Pollution Control Board (KSPCB)
<b>KSRTC</b>	Karnataka State Road Transport Corporation
<b>kMPH</b>	Kilo meter per hour
<b>kV</b>	kilo Volt (=1,000 Volts)
<b>kW</b>	KiloWatt : A common unit of electrical power = 1,000Watts = total power of 10 incandescent bulbs of 100Watt power capacity each
<b>kWh</b>	kiloWatt Hour = 1 Unit: A common unit of electrical energy (power consumed in a given period); 1 kWh = 1 kW of electrical power used continuously for 1 hour
<b>LED</b>	Light Emitting Diode (a lighting devise)
<b>LNG</b>	Liquefied Natural Gas
<b>LPG</b>	Liquefied Petroleum Gas
<b>LULUCF</b>	Land Use, Land-use Change and Forestry
<b>MAF</b>	Million Acre Feet
<b>MNRE</b>	Ministry of New & Renewable Energy
<b>MoEF</b>	Ministry of Environment and Forests (now its MoEF &CC, MoEf and Climate Change )
<b>MoU</b>	Memorandum of Understanding
<b>MSW</b>	Municipal Solid Waste
<b>MToE</b>	Million Tons of Oil Equivalent
<b>MTPA</b>	Metric Tons Per Annum
<b>MW</b>	Mega Watt = 1,000 kW (Enough power to electrify about 4,000 Indian rural houses)

<b>NAPCC</b>	National Action Plan on Climate Change
<b>NGO</b>	Non Governmental Organisation
<b>NTPC Ltd</b>	A Government of India undertaking in coal power
<b>OB van</b>	Outdoor Broadcasting van
<b>O&amp;M</b>	Operation & Maintenance
<b>PES</b>	Payment for Ecological Services
<b>PGCIL</b>	A Government of India undertaking in power sector
<b>PPB</b>	Parts per billion
<b>PPM</b>	Parts per million
<b>R&amp;D</b>	Research & Development
<b>RE</b>	Renewable Energy
<b>RES</b>	Renewable Energy Sources
<b>RSPM</b>	Residual Suspended Particulate Matter
<b>RWA</b>	Resident Welfare Association
<b>RWH</b>	Rain Water Harvesting
<b>SEZ</b>	Special Economic Zone

<b>SPM</b>	Suspended Particulate Matter
<b>SSI</b>	Small Scale Industry
<b>STP</b>	Sewage Treatment Plant
<b>SPV</b>	Solar Photo Voltaic
<b>T&amp;D</b>	Transmission & Distribution
<b>UGD</b>	Under Ground Drainage
<b>UMPP</b>	Ultra Mega Power Project; large size coal power project; generally of more than 1,000 MW capacity
<b>UN</b>	United Nations
<b>UNCTAD</b>	United Nations Commission on Trade and Development
<b>UNEP</b>	United Nations Environment Programme
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>WGEEP</b>	Western Ghats Ecology Expert Panel
<b>WGs</b>	Western Ghats
<b>WHO</b>	World Health Organisation

# Part A

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Public consultations and recommendations

Executive Summary

Chapter 1 : Preamble to the report

Chapter 2 : Karnataka's ground realities

Chapter 3 : Discussion on major Issues Raised in the Consultative Meetings

Chapter 4 : Recommendations from public consultation meetings

# Executive Summary



*'Scarring Efforts' - of the earth and man's future*

## Preamble to the report

**K**arnataka State Pollution Control Board (KSPCB) vide its Work Order no. PCB/671/COC/2014-15/4912 of 5 January 2015 has constituted a study to address the climate change issues falling within Board's purview. The principal objective of this study was to prepare an exhaustive report on the list of recommendations, based on the interactive meetings with various stakeholders in the state, for inclusion into the state action on Climate Change.

## Phenomenon of Climate Change

As per Inter Governmental Panel on Climate Change (IPCC) some of the catastrophic consequences of Global Warming beyond 20 Centigrade increase are: famines and droughts threatening millions of lives; worldwide drop in agricultural and horticultural crops; up to 3 billion people at risk of flooding and without access to fresh water supplies; destruction of half the world's nature reserves and a fifth of coastal wetlands; global sea levels increase by more than 20 feet; significant effects on biodiversity and ecological productivity; potential for international conflicts, border disputes, war due to water and food shortages, forced migration, extreme weather events, huge impact on general health etc. It is not difficult to visualise how each of these catastrophic consequences can impact our masses.



In the Climate Change context Karnataka has many serious issues to contend with, and hence needs all possible policy interventions on mitigation and adaptation. In the context of long term welfare of our society, there is no alternative but for all sections of the society to take active part in the formulation and implementation state action plan on Climate Change.

### **Karnataka's ground realities- geographic / climatic strengths and constraints**

- About 77% of the total geographical area of the state is arid or semi-arid; drought is a threat to reckon with as two thirds of the state receives less than 750 mm rainfall per annum. Karnataka ranks second in India, next only to Rajasthan, in terms of total geographical area prone to drought. 54% of total geographical area of the state is drought prone.
- The state is endowed with limited water resources that are already stressed and fast depleting.
- 64.6% of the total geographical area of the state is said to be under cultivation; and farmers and agricultural laborers account to 56.5% of the total workforce of Karnataka. The state experiences rich and diverse agriculture practices which contribute 28.61% to the Gross State Domestic Product (GSDP).
- With its urban population at about 34% of total population, is currently ranked as the fifth most urbanized state in the country.
- With less than 20% forest and tree cover, and with Western Ghats as one of the Global bio-diversity hotspots, the state has an important role to play as a Carbon sink at the global level. This is in contrast to the national forest policy target of 33% forest and tree cover.
- Electricity (35.9%); industry (22.5%); agriculture (20.2%); and transport (10.4%) are the major contributors of GHG emissions in the state.
- Karnataka has no known reserves of coal or petroleum products. Hence this prominence of fossil fuels in its energy mix, which also lead to high GHG emissions, needs a thorough review.
- Karnataka ranks seventh in the production of cement in the country. Karnataka is also the third largest steel producer in India. These two industries account for over 20% of the overall emissions of the state and over 40% of the emissions due from industrial sector.

Climate change is projected to pose severe risk to all the important socio-economic activities in the state including agriculture and allied activities; health; fresh water availability; forestry and bio-diversity; coastal ecology in numerous ways. Hence all possible efforts to minimize these risks has become essential.

### **National Action Plan on Climate Change (NAPCC) and Karnataka State Action Plan on Climate Change (KSAPCC)**

These two action plans have listed and discussed many issues of serious concern to our communities, and have stressed on the need to move to a sustainable, low carbon pathways, which shall also be equitable.

### **Consultative Meetings**

A climate change cell, consisting of few experienced officers in the areas of administration of Air and Water Acts, was formed at KSPCB. A number of public consultations were held between 26<sup>th</sup> January 2015 and 5<sup>th</sup> May 2015 at different parts of the state. Teachers, college Professors, Doctors, engineers, NGOs, State Government employees, college students, women, activists, industrialists, farmers and other sections of the society expressed their views on the steps needed to combat CC. A large number of written feedbacks, including best practices, were received to make the final report fairly representative of the public's view.

The public raised many issues on the following overarching principles / policies which have direct impact on Climate Change phenomenon.

### **“Impact of high GDP growth centered developmental paradigm on GHG emissions”**

Asustained high GDP growth rate year after years will mean the manufacture of products and provision

of services at an unprecedented pace leading to: setting up of more factories/manufacturing facilities; consumption of large quantities of raw materials; unsustainably increasing demand for natural resources such as land, water, minerals, timber etc.; acute pressure on the Government to divert agricultural/forest lands for other purposes; huge demand for energy; accelerated urban migration; clamor for more of airports, air lines, hotels, shopping malls, private vehicles, express highways etc. Vast increase in each of these activities, while increasing the total GHG emissions, will also add up to reduce the overall ability of natural carbon sinks such as forests to absorb GHG emissions. There will also be increased air and water pollution along with huge issues of managing the solid wastes.

Keeping in view the need to contain the GHG emissions and the vastly increasing pollution loading, the relevance of a high GDP growth rate paradigm should be effectively discussed at the societal level.

### **“Economic development’ and ‘Global Warming”**

Very often the issues of ‘economic development’ and ‘environment’ are wrongly pitted against each other instead of focusing on how economic development can be achieved on a sustainable basis without compromising on the all important environment. Since everything we see around us is provided by the nature the necessity of harnessing the natural resources on a sustainable basis need not be over emphasised.

The scientists assert that once human activity has passed certain thresholds or tipping points, defined as “planetary boundaries”, there is a risk of “irreversible and abrupt environmental change” threatening the life on this planet. The scientists have identified nine Earth system processes which have boundaries that, to the extent that they are not crossed, mark the safe zone for the planet. However, because of human activities some of these dangerous boundaries have already been crossed, while others are in imminent danger of being crossed.

A study by the Sustainable Development Commission (SDC), which was the UK Government’s independent adviser on sustainable development, argues that the overall development of the society is feasible without high growth.

Since the true objective of national level and state level climate action plans is to protect effectively the vulnerable sections of our society from the ravages of the Global Warming, there cannot be any compromise in the much needed paradigm shift in the development concept for our densely populated communities.

### **“Should the target of 33% forest and tree cover be sacrosanct?”**

National Forest Policy, in section 4.1 (Area under Forests) says: “The national goal should be to have a minimum of one-third of the total land area of the country under forest or tree cover. In the hills and in mountainous regions, the aim should be to maintain two-third of the area under such cover in order to prevent erosion and land degradation and to ensure the stability of the fragile eco-system.”

As against this target of 33% forest and tree cover, at present it is about 20% both at the national level and in the state. The Green India Mission, which is one of the eight National Missions under NAPCC, has the objective to double the forest & tree cover by 2022 at a budgetary estimate of Rs. 40,000 Crores. Whereas the industries are required to have 33% tree cover in the respective areas, it is worth the question as to why the thick, natural, evergreen forests in a tropical country with huge ecological value should not be allowed to be present at least in 33% of the land area.

### **“Industrialisation and Urbanisation”**

The state of Karnataka, with its urban population at 34% of total population, is currently ranked as the third / fifth most urbanized state in the country. Its industrialisation also is considerable as indicated by the fact that it is seventh in the production of cement and the third largest steel producer in India. Industrial

sector contributes about 22.5% of the state's total GHG emissions, second only after electricity sector. The industrial sector is also the second largest consumers of electricity after agriculture in the state.

As per the global experience the urban areas are estimated to consume more than 70% of natural resources and energy, and produce more than 70% of pollutants. As per UNEP the urban air pollution is linked to up to 1 million premature deaths and 1 million prenatal deaths each year. Urban air pollution is estimated to cost approximately 2% of GDP in developed countries and 5% in developing countries.

If the large scale industrialization and urbanisation is considered necessary for the sake of employment opportunities, shall we not aim for industries /enterprises based on agriculture, horticulture, floriculture, forestry, IT-ITES, hospitality, educational and tourist hubs etc. which will put much less pressure on natural resources such as land, water, electricity, minerals etc., and which are associated with minimum GHG emissions and pollutants?

### **“The concept of Sustainable Development and Global Warming”**

U.N World Commission on Environment and Development says: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their needs.” .. “Sustainability secures people's quality of life within the means of nature in a way that is fair and equitable to all humanity, other species and to future generations. Sustainability recognizes the inter-relatedness of the economy, society, and environment. It requires that we should not consume resources faster than they can be renewed nor produce wastes faster than they can be absorbed.” In this context it becomes evidently clear as to how the threats of global warming cannot be addressed effectively without adopting sustainable development concept at the societal level.

### **“Over-reliance on coal power and the consequent GHG emissions”**

Coal's share in energy related CO<sub>2</sub> emissions at the global levels is about 72%. It is widely acknowledged by the global scientific community (IPCC) that 80% of fossil fuels have to be left in the ground in order to keep the global warming below 2<sup>o</sup> C. Since coal's share in global energy generation is also high (about 41%), our energy related priorities should become obvious. Since coal is the predominant emitter of GHG emissions in the power sector, it is not difficult to surmise that coal power is also the major contributor to GHG emissions in the state. Keeping in view the fact that the state has no coal reserve and is also water stressed, the rationale of the over reliance on coal power for the state should be diligently reviewed.

### **“India as a potential leader in low carbon life style”**

The seriousness of carbon associated with energy issues in our country: (i) about 77% of our petroleum products are being imported; (ii) the coal reliant power sector has not been able to provide electricity for about 33% of the population; (iii) the carbon dependent energy sector is projected to make India the third largest GHG emitter; (iv) pressure on our natural resources to supply the energy demands will be enormous, and with a business as usual scenario the foreign exchange burden will be enormous. There is a tremendous scope for the country to take a technological leap to renewable energy, low carbon path and simple way of life styles, without passing through the high carbon pathways followed by the industrialised countries.

### **Relevance of ‘Options Analysis’ and ‘Costs & Benefits Analysis’ in containing GHG emissions**

As a developing country with huge poverty levels and aiming towards a welfare society, we need to be absolutely certain that every resource and every rupee spent brings maximum benefits to the whole society; not to just to the project developer. Only an objectively conducted Costs & Benefits Analysis (CBA) preceded by ‘Options Analysis’ can provide satisfactory answer to such questions. CBA can be an effective mechanism to determine the least cost option for the society in a given situation. Such a rigorous economic analysis through CBA would entail all the direct and indirect costs to the society, include the

sustainability option and helps to reduce the total GHG emissions.

### **Sectoral issues raised in public consultation meetings**

1. Water and Sanitation
2. Land use and planning
3. Forests, biodiversity and Western Ghats
4. Coastal Ecology, Energy
5. Agriculture, horticulture, animal husbandry, food and human health
6. Waste management , Air quality, transportation, urbanisation and industrialisation
7. Air quality, transportation, urbanisation and industrialisation
8. Education, general awareness campaign, rural Karnataka, and district levels development plans
9. Women's perspective
10. Traditional Knowledge, life style and other issues
11. KSPCB issues

These issues are detailed in Chapter 8.

### **Best Practices, recommendations and Conclusions**

A large number of highly relevant recommendations have been compiled from the public meetings. The summary is:

- (a) Participants seem to fully agree with the view that Climate Change is set to inflict “severe, widespread, and irreversible impacts” on people and the natural world unless carbon emissions are cut sharply and rapidly. The implications of Climate Change are so huge and so important for all sections of our state that the STATE has no option but to take resolute steps to ‘mitigate’ and ‘adapt’. Anything less than a fully committed and comprehensive action plan should not be acceptable.
- (b) It has become critical to examine the best practices already in vogue around the world, and carefully consider implement those which are relevant to our state’s requirements at an early date. In the context of Climate Change there is a vast amount of literature and statistics indicating best practices in various sectors of our economy. Such practices can be modified to suit an individual scenario, or there may be better practices in the future.
- (c) Sectoral considerations and holistic approach to the overall welfare of the society will demand that specific action plan with clearly identified targets and accountability should be developed for each sector and each district, and implemented through active participation of various stake holders at all levels. Various departments and agencies of the State Government should embark on similar public consultation process reaching to all talukas and all sections of the society in order to develop a people centric action plan for the state.
- (d) Public felt that such an initiative for public consultation should be escalated to the level of a serious awareness campaign on all related issues of CC at the societal level. State Government officials and people’s representatives should receive maximum attention for such an awareness campaign because of their status as change agents. There is a critical need for the society to deliberate objectively on all overarching policies at the societal level and take principled stand to mitigate and adapt to CC.
- (e) Water stressed characteristic of the state and absence of fossil fuel reserve should determine the developmental pathway for the overall economic development of the state in general, and for agriculture and industries in particular. Sustainable agricultural, horticultural and animal husbandry practices should become a norm from CC perspective. An integrated approach consisting of suitable measures for highest possible efficiencies, optimal demand side management, responsible energy conservation and widespread usage of distributed RE sources has become essential to meet the

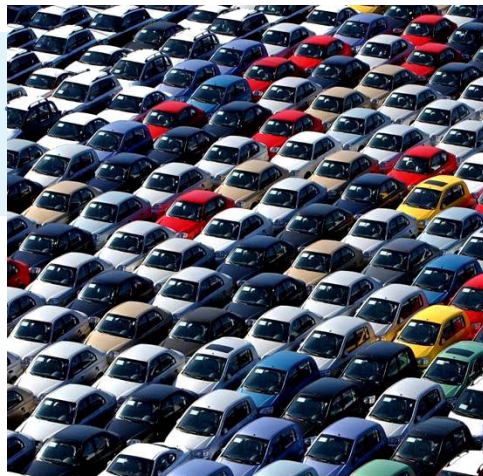
growing energy demand of the state. Industrialisation, urbanisation and rural development should be considered in a holistic manner keeping the overall welfare of every community in the state.

- (f) The WGs, which are one of the eight hottest of bio-diversity hotspots in the world, are critical for the welfare of the state, and hence must be protected and enhanced with utmost priority. Air pollution associated with the large number of vehicles in operation, and water pollution associated with chemical contamination cannot be ignored any longer, and hence should be addressed with adequate pollution control measures on a war footing.
- (g) Traditional knowledge and the role of women in mitigation and adaptation should receive the attention they richly deserve.
- (h) A coordinating agency, preferably a standing committee of responsible officers, credible NGOs and committed individuals, directly reporting to the Chief Minister, should oversee the development and implementation of the state action plan on a continuous basis.
- (i) Keeping in view that KSPCB is already entrusted with the administration of Air Act, Water Act, and Environmental Protection Act in the state, it should be considered to be nominated as the coordinating agency for the implementation of state's action plan on CC.
- (j) A rational analysis of all the relevant issues in the state would indicate that an effective CC policy for the state will need clear and committed statements on the following requirements:
  - The state proposes to reduce the energy reliance on coal by certain percentage by 2025, 2040, 2050 etc. w.r.t the base year of, say, 2000
  - that it proposes to reduce the consumption of petroleum products by certain percentage by 2025, 2040, 2050 etc. w.r.t the base year of, say, 2000
  - that it will stop diverting the existing forests until the forest policy target of 33% of the land cover is reached again; and that it will take effective measures to increase the forest cover area by atleast by 0.5% every year for the next 30 years
  - that the chemicals used in agriculture will be gradually reduced so as to make our agriculture completely sustainable /organic by 2040/50
  - that a minimum 75% of our electricity needs will be met by new and renewable energy sources by 2050
  - that it will take all possible measures to reduce the urbanisation, and keep the urban population to less than, say 30% by 2040/50.

In the backdrop of the fact that a good number of people from diverse background such as teachers, college Professors, Doctors, engineers, NGOs, State Government employees, college students, women, activists, industrialists, farmers and others have participated in the public consultations, and have expressed their views on the kind of developmental plan for the state, it is reasonable to assume that these recommendations truly reflect the public's desire to the extent feasible under the circumstances. Hence these recommendations should be considered objectively for implementation with all the seriousness they deserve.

## Chapter 1

# Preamble to the report



*'Too many' – cars and problems*

Consequent to the formation of National Action Plan on Climate Change (NAPCC) and the Karnataka State action plan on Climate Change (KSAPCC), the State Government of Karnataka has mandated individual departments and State agencies / undertakings to prepare action plan to address specific issues under their jurisdiction. Subsequently, KSPCB decided to hold a series of consultations with stakeholder groups in different parts of the State to elicit views to mitigate and adapt to the fast evolving Climate Change (CC).

Karnataka State Pollution Control Board (KSPCB) vide its Work Order no. PCB/671/COC/2014-15/4912 of 5 January 2015 has constituted a study to address the climate change issues falling within Board's purview. The principal objective of this study was to prepare an exhaustive report on the list of recommendations for the development of policy proposals to 'mitigate' and 'adapt' keeping in view the related issues in Karnataka. These recommendations are meant to be included in the State Action Plan on Climate Change and are based on based on the interactive meetings with various stakeholders such as the bodies of farmers and industrialists; entrepreneurs; NGOs and other related institutions; domain experts; civil society groups/leaders; academicians, women's groups etc..In the Climate Change context Karnataka has many serious issues to contend with. About 77% of the total geographical area of the State is officially identified as arid or semi arid; drought is a threat to reckon with as two thirds of the State receives less than 750 mm rainfall per annum. 54% of total geographical area of the State is drought prone. With about 20% forest cover and with Western Ghats as one of the Global bio-diversity hotspots, the State also has an important role to play as a carbon sink at the global level. Global Warming is projected to severely impact tropical areas, and exacerbate the climate related problems already prevailing in the state. Hence the drought prone characteristics of the sate should be a crucial consideration for any developmental plan for the State. With about 65% of the State's population still living in rural areas and with most of them dependent on forestry, agriculture, horticulture and related sectors, state's drought prone nature and its traditional practices should be critical considerations while formulating development action plan for the state in the Climate Change context.

Since the Climate Change is projected to impact all sections of our society, and since the measures to adapt and mitigate are required at all levels of our lives and economy, there is a critical need to involve all sections of the State and at different levels of the civic administration. Hence, an attempt was needed to make the consultation / interactive process as much inclusive as feasible under the circumstances.

The principal objective of such consultations was to elicit opinion of the stake holders on issues relevant to the objective of minimisation of pollution impacts in particular, and to the State's overall developmental imperatives in general, so as to contribute effectively to the overall state action plan on Climate Change.

While the pollution control issues, as part of mandate to KSPCB, were important, the objective of these consultations was to capture all recommendations from the participating public on various aspects of mitigation and adaption for the entire state, and to prepare an exhaustive report feeding to the state action plan on climate change so as to improve it further, and make it a people's developmental plan for the state.

### Three study reports were used as basic reference documents.

- (i) National Action Plan on Climate Change (NAPCC) which was prepared in 2008
- (ii) Karnataka State Action Plan on Climate Change (KSAPCC) which was prepared in 2011
- (iii) The fifth assessment report (AR 5) of IPCC (2014)

There are also a large number of credible reports on the subject from many international agencies such as UNEP, FAO, World Bank, ADB, and many Government agencies. These also have been referred to in this report.

State Action Plans on Climate Change for the states of Tamil Nadu and Gujarat, which were readily available, have been looked into.

- The key economic sectors aimed which were be covered in the study but not limited to were:
  1. Water and sanitation
  2. Land use and planning
  3. Waste management
  4. Air quality
  5. Transport
  6. Industries
  7. Energy
  8. Agriculture and horticulture
  9. Forestry and biodiversity
  10. Urbanisation

While these sectors got primary focus, the other areas such as coastal areas, Western Ghats, north Karnataka regions, rural Karnataka, women's participation, public awareness etc. have also been looked into. Women's perspective of the measures to 'adapt' and 'mitigate' was given additional focus.

Whereas the CC issues relevant to pollution of air, water and land were of primary focus because of their importance to KSPCB, the overall objective was to make use of the opportunity of this study to consider various issues impacting the overall welfare of all sections of the state on a sustainable basis, and to make relevant recommendations to the Board and through it to the State Government

There was also a mandate from KSPCB to provide additional focus to three action points pertaining to KSPCB which were as follows:

- Promoting treatment plants at point source, and CETPs for cluster of small scale industries
- Data on type and amount of Hazardous Chemicals released by different sectors
- Research on implementation of advanced technology to reduce pollutants entering the sea.

### References

- National Action Plan on Climate Change (NAPCC) which was prepared in 2008.  
*[http://www.moef.nic.in/sites/default/files/Pg01-52\\_2.pdf](http://www.moef.nic.in/sites/default/files/Pg01-52_2.pdf); accessed on 10.5.2015*
- EMPRI prepared a Karnataka State Action Plan on Climate Change (KSAPCC) which was prepared in 2011.  
*<http://www.empri.kar.nic.in/Karnataka-SAPCC-EMPRI-TERI-2012-03-22.pdf>; accessed on 10.5.2015*
- The fifth assessment report (AR 5) of IPCC (2014) <http://ipcc-wg2.gov/AR5/> ; accessed on 10.5.2015

## Chapter 2

# Karnataka's ground realities - geographic / climatic strengths and constraints



*'Vulnerability' – for women and agriculture*

Climate change occurs over decades or longer time scales. Until now, changes in the global climate have occurred naturally, across centuries or millennia, because of continental drift, various astronomical cycles, variations in solar energy output, and volcanic activity. Over the past few decades, it has become increasingly apparent that human actions are changing atmospheric composition, thereby causing global climate change. Humankind's activities are altering the world's climate by increasing the atmospheric concentration of energy-trapping gases (greenhouse gases [GHGs]), thereby amplifying the natural "greenhouse effect" that makes the Earth habitable. These GHGs comprise, principally, carbon dioxide (mostly from fossil fuel combustion and forest burning) plus other heat-trapping gases such as methane (from irrigated agriculture, animal husbandry, and oil extraction), nitrous oxide, and various human-made halocarbons.

While deliberating on a set of action plan for the state, the state's geographic / climatic strengths and constraints play critical role. In the Climate Change context Karnataka has many serious issues to contend with.

Whereas the state is considered to be lucky in many aspects of its geographical/climate aspects, such as Western Ghats (WGs), a beautiful coastline, and salubrious climate in many places etc. it also faces some severe constraints, which can be further exacerbated by the projected impacts of Climate Change. The statistical figures/salient features mentioned in Karnataka State Action Plan on Climate Change (KSAPCC) and listed below, if considered from an objective perspective, should lead to the critical elements of a credible Climate Action Plan.

- About 77% of the total geographical area of the state is arid or semi-arid; drought is a threat to reckon with as two thirds of the state receives less than 750 mm rainfall per annum. Karnataka ranks second in India, next only to Rajasthan, in terms of total geographical area prone to drought. 54% of total geographical area of the state is drought prone, affecting 88 of 176 taluks and 18 of the 33 districts. Global Warming is projected to severely impact tropical areas. Hence the drought prone characteristics of the state should be a crucial consideration for any developmental plan for the state.
- The state is endowed with limited water resources that are already stressed and fast depleting. Water



resources are officially considered to be under severe threat in Karnataka. The sectoral demands for water are growing rapidly on account of increase in population, urbanization, rapid industrialization and rising incomes. This fact too should be a crucial consideration in Climate Action Plan.

- Karnataka has seven river basins and receives a total of 236 billion m<sup>3</sup> of water every year, 92% of it through rainfall. Around 47% are 'lost' through evapo-transpiration and another 46 % flow into the Arabian Sea, into Andhra Pradesh and Tamil Nadu. The state meets its requirement from the remainder of about 7.5% paired with ground water. There are nearly 37,000 tanks and lakes with a water spread area of 6.9 lakh hectare and more than 20,000 irrigation tanks. Such a large number of water bodies built by our ancestors should be seen as a wealth, and should be optimally utilized.
- Ground water provides for 45% of irrigation in the state and GoK places emphasis on its expansion.
- 64.6% of the total geographical area of the state is said to be under cultivation; and farmers and agricultural laborers account to 56.5% of the total workforce of Karnataka. The state experiences rich and diverse agriculture practices which contribute 28.61% to the Gross State Domestic Product (GSDP). This should be seen as a rich tradition to be taken care of.
- Karnataka is the largest producer of coffee, raw silk, sandalwood, ragi, sunflower, tomato, coffee, areca nut, spices, aromatic and medicinal plants, and second largest producer of maize, sunflower, grapes, pomegranate and onion. Horticultural crops contribute to over 40% of total income generated from agriculture. In floricultural production, Karnataka occupies second position. These facts are great strength to start from in efforts to reduce the total GHG emission. Hence it becomes evident that the state should carefully consider the legitimate needs of agricultural/ horticultural communities who are in a clear majority as compared to other economic sectors.
- The state of Karnataka, with its urban population at about 34% of total population, is currently ranked as the fifth most urbanized state in the country. Increasing urbanization, which is contributing hugely to Global Warming, demands a thorough review of the related policies. The absence of basic amenities and the lack of employment opportunities in rural areas act as push factors driving away the population from rural areas.
- The vehicular population in the state has increased by almost 70% between 2003 and 2009 and is continually increasing. It should be a cause for concern as it demands more of fossil fuel burning, and leads to increased pollution impacts. India imports about 75% of its petroleum requirements, and a significant percentage of this is used by transportation sector.
- With less than 20% forest and tree cover and with Western Ghats as one of the Global bio-diversity hotspots, the state has an important role to play as a Carbon sink at the global level. Also in view of the national forest policy target of 33% forest and tree cover, the forest wealth of the state should not only be protected but vastly enhanced effectively.
- Karnataka ranks seventh in the production of cement in the country. Karnataka is also the third largest steel producer in India. These two industries account for over 20% of the overall emissions of the state and over 40% of the emissions due from industrial sector.
- Karnataka's overall energy intensity has been estimated at 521.11 toe/\$ Million, which is lower than the national average. The energy intensity of the state has dropped by 25.2% since the 1990s, which is attributed to the expansion of services sector in the structure of Karnataka's economy.
- The industrial sector is also a large contributor of GHG emissions as well as largest consumers of electricity in the state.
- The services sector dominates the state economy; the tertiary sector (services) contributing 55.17% to GDSPs. The contribution of secondary sector (industry) and primary sector (agriculture) are 28.61% and 16.22% respectively. Since manufacturing/industries contribute hugely to the GHG emissions, the role of services sector which demands much lower quantum of energy and which generally has a much smaller carbon foot print should be rationally considered for employment generation/ wealth creation.

- Electricity (35.9%); industry (22.5%); agriculture (20.2%); and transport (10.4%) are the major contributors of GHG emissions in the state. GHG emission from state coal power sector has almost doubled from 2006-07 to 2010-2011. Further, CO<sub>2</sub> emission from private coal power combustion has increased many folds between 2006-07 and 2010-11. Concerted efforts are needed to contain the runaway scenario of GHG emissions from coal power in the state, which is being planned to grow exponentially.
- Coal provides 51.7% of primary energy; Petroleum products also form a major share of the energy sources at 38.6%. In 2009-10, petroleum supplied almost one-third of Karnataka's commercial energy consumption. Karnataka has no known reserves of coal or petroleum products. Hence this prominence of fossil fuels in its energy mix, which also lead to high GHG emissions, needs a thorough review.
- According to the Annual Reports of Karnataka Power Transmission Corporation Ltd (KPTCL) the percentage of the total coal power capacity comes to about 40.6%. If the actual annual electricity production is considered the percentage of electricity from coal power would be much higher than that of hydro or renewable. The overreliance of the state on coal power despite having no coal reserve of its own becomes clear and should be a matter of concern as coal is the predominant source of GHG emissions within the power sector.
- During 2009-10 most of Karnataka's electricity consumption was by 4 major categories: IP Sets (35%); domestic lighting and AEH (22%); industries (24%); and commercial & public lighting (15%). This composition can be said not to have changed much since 2009-10.
- Peak Demand for electricity in Karnataka is projected to grow by about 100 % between 2012-13 and 2021-22 from 9,317 MW to 18,403 MW. The annual electrical energy demand in the same period is projected to increase by about 87 % from 57,947 Million Units to 108,012 million Units. (as per the 18th Electric Power Survey report of the Ministry of Power in a business as usual scenario). How to meet such an increase in demand with no reserve of fossil fuels in the state should be a major issue for the state's planning.
- Climate change presents severe risk to human health in numerous ways. Hence any investment in minimizing such risks is worth considering.

The state also has no reserve of any kind of fossil fuels, because of which it has to depend on external sources for its fossil fuels. A considerable portion of the Western Ghats of the country is in Karnataka, both in the density and ecological richness. WGs are critical not only to the water security of the state, but also for the entire peninsula, while they have huge importance from the Climate Change perspective.

Whereas the state had a rich tradition of diverse agricultural, horticultural, floricultural, forest based and animal husbandry practices, which provided employment for a large percentage of the population and were of low carbon intensity, the same have been pushed to the background during last few decades. Heavy use of chemical fertilizers and pesticides; unscientific approach to the choice of crops; preference to mono culture and commercial crops etc. have created many problems associated with un-sustainability and of course huge emission of GHGs.

Cottage industries and traditional village based enterprises, which had provided useful employment opportunities to a large section of the population and with a low carbon foot print, have been replaced by energy & carbon intensive industries, which are also leading to serious concerns on pollution of land, air and water.

These ground realities must be kept in proper perspective while developing an action plan for the state's developmental pathway while 'mitigating' and 'adapting' to the fast evolving threat of Climate Change.

## Chapter 3

# Discussion on major Issues Raised in the Consultative Meetings



*'Many Concerns' – on global warming*

The process of public consultations brought many critical issues to the fore. The society has the need to debate rationally on all the issues raised by the public and take rational developmental pathways.

### 3.1 The process of public consultation

The process adopted in developing this KSPCB document was as follows.

A climate change cell was formed at KSPCB. Five experienced officers in the field of pollution control, and who have developed special interest in the phenomenon of Climate Change formed the core of this Climate Cell, and took all the responsibilities associated with the logistics of arranging the public consultations, and also to contribute to the compilation of the final report. A Chief Environmental Officer at corporate head quarters led the efforts of this team. The services of a private citizen, who is an electrical engineer in profession and who has been working on the Climate Change issues for over a decade, was used as a consultant to coordinate all the related activities and to compile the final report.

Twenty one public consultations were held between 26<sup>th</sup> January 2015 and 5<sup>th</sup> May 2015 at different parts of the state. Teachers, college Professors, Doctors, engineers, NGOs, State Government employees, college students, women, activists, industrialists, farmers and other sections of the society were invited through personal communications and media release. Each of the participants was given opportunity to express their views in such meetings, but no discussions on such views were held. The stake holders were also requested to send their detailed write up over e-mail / post. A large number of written feedbacks, including best practices, were received to make the final report, which can be said to be fairly representative of the public's view.

List of public consultation meetings is as in **Annexure 1**.

Such feedback were compiled, and along with the help of few internal studies, and published national and international reports on the subject an exhaustive report reflecting the public's view on the state action plan has been prepared.

### 3.2 Discussion on few overarching principles

Participants in these public consultations raised many serious issues on overarching principle / policy related to climate change perspective, and urged for fundamental changes in approach at the societal level. Serious consideration to such overarching policy /principles of huge importance in the long term interest of the society is necessary. It is, therefore, considered necessary that the societal level and objective discussions are held at the earliest so as to arrive at a consensus on such issues. Brief discussion on some of the major issues raised in the public consultation meetings are as follows:

### 3.2.1 Impact of high GDP growth centered developmental paradigm on GHG emissions

Whereas many conventional economic analysts argue that in order to have adequate human development index the state's and country's economy has to grow continuously at an appreciable rate, a densely populated and resource constrained society such as ours cannot afford to ignore the implications of high energy / material consumption (which will be a consequence of high growth of the economy). As the table below indicates, whereas the economy can increase by 400% in 40 years at CAGR of 4%, it takes only 18 years to grow the economy by 400% at 10% CAGR. In this context it is essential to try to address the question as to how much energy / material consumption increase is considered acceptable from the CC perspective?

**Table 1: Time taken for economy to get multiplied at constant CAGR**

CAGR Growth Percentage	Increase by 100%	Increase by 200%	Increase by 300%	Increase by 400%
@ 4%	19 Years	29 Years	36 Years	40 Years
@ 6%	13 Years	20 Years	25 Years	29 Years
@ 8%	10 Years	15 Years	19 Years	22 Years
@ 10%	8 Years	13 Years	16 Years	18 Years

The consequences of high GDP growth rate year after year need to be kept in mind w.r.t the true welfare needs of the communities in the state, which is possible only if the GHG emissions and all the associated problems are targeted to be contained within the manageable limits. A question arises whether this ultimate objective can be compromised for any reason, since it involves the existential threat to the man kind in the form of Climate Change. Successive governments have proceeded with the assumption that India needs to sustain a high economic growth over next 20 years (and possibly beyond) to eradicate poverty and to meet its human development goals. It appears that the social, economic and environmental impacts associated with such high GDP growth on the vulnerable sections of our society were not considered objectively.

It is a fact that a sustained high GDP growth rate will mean the manufacture of products and provision of services at an unprecedented pace leading to: setting up of more factories/manufacturing facilities; consumption of large quantities of raw materials; unsustainably increasing demand for natural resources such as land, water, minerals, timber etc.; acute pressure on the Government to divert agricultural/forest lands for other purposes; huge demand for energy; accelerated urban migration; clamor for more of airports, air lines, hotels, shopping malls, private vehicles, express highways etc. Vast increase in each of these activities, while increasing the total GHG emissions, will also add up to reduce the overall ability of natural carbon sinks such as forests to absorb GHG emissions. There will also be increased air and water pollution along with huge issues of managing the solid, liquid and gaseous wastes.

These consequences will result in depriving the weaker sections of the society even the access to natural resources, while driving the fragile environment to a point of no return. Does our society need such an eventuality? Is this what we want from Global Warming perspective?

#### **Tamil Nadu State Action Plan on Climate Change (TNSAPCC)**

"Global development experience reveals that one percent growth in agriculture is at least two or three times more effective in reducing poverty than the type of same growth emanating from non-agricultural sector."

Since the primary objective of high GDP growth centered policy is to create jobs, it is worth repeating what Tamil Nadu State Action Plan on Climate Change (TNSAPCC) has said about the importance of agriculture to TN's economy. This statement becomes relevant from the perspective of overall welfare of our masses.

Karnataka, being traditionally an agrarian economy, should consider the role of agriculture in providing more employment keeping in proper perspective that good agricultural practices will lead to much reduced

GHG emissions than the best set of industrial practices.

The net effect associated with high GDP growth target will be that the total GHG emissions will increase by considerable margin, even if we adopt most energy efficient processes, and the reduced emission intensity of the state's GDP is feasible. The desirability of such high GDP growth rate scenario to our society needs to be questioned in the context that the increase in total GHG emissions will be closely associated with the increased pollution of air, land and water; and the increased denial of access to natural resources to the vulnerable sections of the society. Reduced area and density of forests, dammed rivers, polluted air, forced displacements which will all be the consequences of a frenetic 8 - 9% GDP growth are bound to impact the vulnerable sections of our society. Since the vulnerable sections of the society are also the most impacted lot due to climate change, the larger civil society has a crucial role to ensure that their legitimate interests are protected adequately.

### **Gross National Happiness**

The phrase "Gross National Happiness" (GNH); was coined in 1972 by Bhutan's fourth Dragon King, Jigme Singye Wangchuck. The phrase was coined as a signal of commitment to building an economy that would serve Bhutan's culture based on Buddhist spiritual values instead of the western material development that was represented by gross national product (GNP).

The GNH concept has inspired a modern political happiness movement. Through the contribution of several western and eastern scholars, economists and politicians, the concept evolved into a socioeconomic development model. In July 2011, the United Nations passed Resolution 65/309, that was adopted unanimously by the General Assembly in July 2011, placing "happiness" on the global development agenda. The four pillars of GNH philosophy are the promotion of sustainable development, preservation and promotion of cultural values, conservation of the natural environment, and establishment of good governance.

The GNH concept evolved through the contribution of international teams of scholars and researchers to become a socioeconomic development framework. The GNH policy now serves as a unifying vision for Bhutan's five-year planning process and all the derived planning documents that guide the economic and development plans of the country. Proposed policies in Bhutan must pass a GNH review based on a GNH impact statement that is similar in nature to the Environmental Impact Statement required for development in the U.S.

Today, GNH has come to mean so many things to so many people but to me it signifies simply - Development with Values. Thus for my nation today GNH is the bridge between fundamental values of kindness, equality and humanity and the necessary pursuit of economic growth.

— Jigme Dorji Wangchuk

A quick look at the possible impact of sustained high GDP growth on the critical sectors of the Indian economy can reveal a disturbing trend. The transport sector will demand much higher consumption of energy such as diesel, petroleum and LNG. These products which already have about 80% import content can only increase with disastrous consequences on energy security. The pollution loading of vastly increased consumption of petroleum products, which has given rise to concerns in urban areas already, is likely to reach extremely unhealthy levels. Along with increased GHG emissions and much higher levels of suspended particulate matter, the pressure on the transportation infrastructure can become unmanageable. Increased use of private passenger vehicles, which is already a huge concern, will escalate to choke our roads and lungs.

Vastly increased industrial activities, as a consequence of high GDP growth rate, will put unbearable demand on land, fresh water, energy and other raw materials. Such a demand on land (such as in SEZs, coastal industrial corridors, large size coal power plants, nuclear power parks, IT&BT parks etc.) have already given rise to a lot of concerns to social and health scientists, and already has witnessed social upheavals as in Narmada valley, Singur in West Bengal, Niyamgiri Hills in Orissa etc.. Under such a scenario the industrial

sector, which is already responsible for about 21% of GHG emissions, will contribute hugely to the increase in total GHG emissions of the state. Similarly, high GDP growth rate will lead to steep increase in demand for building activities in the form of factories, transportation infrastructure, offices, hotels, airports etc. which in turn will put huge demand for construction materials and energy. In this scenario can the increase in GHG emissions be contained adequately?

The most telling impact of frenetic economic growth of 8 - 9% over the next 20 years will be on forests, rivers and other natural resources, which in turn will lead to reduced capacity of nature's carbon sinks. As against National Forest Policy target of 33% of forests & tree cover, the country / state has less than 20% of the same, whereas the forests in tropical countries are considered to be very important sinks of CO<sub>2</sub>. The demand for additional lands and minerals for the increased activities in all the above mentioned sectors will further reduce the forest & tree cover, which in turn will severely impact the availability of fresh water and on the nature's ability to absorb GHGs. The impact of vastly reduced forest & tree cover on human health and on all aspects of our society is well known, and hence requires no detailed elaboration. Whereas the increased economic activities associated with high GDP growth rate will certainly result in vastly increased GHG emissions, the same will also reduce the ability of forest & tree cover to absorb GHG emissions from the atmosphere. In this scenario it is anybody's guess as to how the state's net GHG emissions can be reduced to an acceptable level.

The base line assumption (in Integrated Energy Policy of the erstwhile Planning Commission) that the country needs to sustain an economic growth of 8 - 9 % over next 20 years to eradicate poverty and to meet its human development goals will lead to very many intractable problems for the society from social and environmental perspectives. Such a high growth rate has never been found necessary in developed economies, where even at the highest growth period they are reported to have registered only 3-4 % growth. The so called "trickle down" benefits to vulnerable sections of our society through 8-9 % growth will be negligible as compared to the all round benefits associated with inclusive growth of a much reduced rate, say 3-4%, if we harness our natural resources responsibly and equitably. Hence the obsession with target GDP growth rate of 8-9 % should be considered against a paradigm shift in our developmental objective, which will give priority for inclusive growth aimed at sustainable and responsible use of natural resources.

There is a need to appreciate the fact that there is a limit to the nature's ability to support human activities / desire. Such a demand on the nature must be carefully managed, which is not possible if we set a target of 8-9 % GDSP growth rate year after year for a huge population, which is growing every year.

A World Bank report of June 5, 2013 has highlighted how the environment has suffered in India consequent to past decade of rapid economic growth. The report with the title "Diagnostic Assessment of Select Environmental Challenges, Economic Growth and Environmental Sustainability: What Are the Tradeoffs?" has many revelations of critical importance to the future of our communities; provided our leaders take cognizance of it.

Salient features of this report are as follows:

- Although the past decade of rapid economic growth has brought many benefits to India, the environment has suffered, exposing the population to serious air and water pollution.
- A new report finds that environmental degradation costs India \$80 billion per year or 5.7% of its economy.
- Green growth strategies are needed to promote sustainable growth and to break the pattern of environmental degradation and natural resource depletion. Emission reductions can be achieved with minimal cost to GDP.
- In this context it can be added that in the medium to long term such emission reductions can even

add to GDP through positive feedback impacts.

- Simultaneously, poverty remains both a cause and consequence of resource degradation: agricultural yields are lower on degraded lands, and forests and grasslands are depleted as livelihood resources decline. To subsist, the poor are compelled to mine and overuse the limited resources available to them, creating a downward spiral of impoverishment and environmental degradation.
- Environmental sustainability could become the next major challenge as India surges along its projected growth trajectory.
- A low-emission, resource-efficient greening of the economy should be possible at a very low cost in terms of GDP growth. While a more aggressive low-emission strategy comes at a slightly higher price tag for the economy it promises to deliver greater benefits.
- For an environmentally sustainable future, India needs to correctly value its natural resources, and ecosystem services to better inform policy and decision-making

The report says Green growth is eminently feasible: Green growth is necessary; Green growth is affordable; Green growth is desirable; Green growth is measurable. It can be argued that without green growth, India's future development however measured will be at great risk.

- A low-emission, resource-efficient greening of the economy should be possible at a very low cost in terms of GDP growth. A more aggressive low-emission strategy comes at a slightly higher price tag for the economy while delivering greater benefits.
- Emissions reduction would have a minimal impact on GDP which would be offset by savings through improving health while substantially reducing carbon emissions.
- A 10% particulate emission reduction will lower GDP only modestly. GDP will be about \$46 billion lower in 2030 due to interventions, representing a loss of 0.3 % compared to business as usual.
- A 30% particulate emission on the other hand reduction will lower GDP by about \$97 billion, or 0.7 %.
- GDP growth rate will be negligibly reduced by about 0.02 to 0.04% in both scenarios. There will be significant health benefits under both scenarios which will more than compensate for the projected GDP loss.
- The savings from reduced health damages will range from \$105 billion in the 30% case and by \$24 billion with a 10% reduction.
- Under both the scenarios, another important benefit would be a substantial reduction in CO<sub>2</sub> as a co-benefit which has a potential of being monetized.
- Taken together the CO<sub>2</sub> reduction and the health benefits will be greater than the loss of GDP in both cases.

Keeping in view the need to contain the GHG emissions and the vastly increasing pollution loading, the relevance of a high GDP growth rate paradigm for the state/country need to be effectively discussed at the societal level from the perspective of overall welfare of every section of our society.

### **3.2.2. 'Economic development' and 'Global Warming'**

Very often the issues of 'economic development' and 'environment' are wrongly pitted against each other instead of focusing on how economic development can be achieved on a sustainable basis without compromising on the all important environment. Since everything we see around us is provided by the nature the necessity of harnessing the natural resources on a sustainable basis need not be over emphasised. There are also concerns among the environmentalists, that the policy of growth at any cost is seriously compromising the environment, as evidenced by the deteriorating environment all over the world. A frenetic growth in non-agricultural sectors, as happening in many states, can lead to the instability in production and productivity of food and other agricultural products. The environmental scientists have been raising the issue whether high growth of economy is sustainable over longer periods, and whether

it should be pursued at the cost of environment. Environmental economists also emphasise that the developed countries never had a high growth rate, but achieved adequate level of HDI by inclusive growth, as against what has been occurring in most of the developing countries.

Which Indian in his senses would want to be anti-development? The question, therefore, is about the nature of development and what we mean by that term. Is it a true development to cut down mountain ranges in the Western Ghats for putting up industrial plants or power plants or railway lines or power lines or dams? Is it a true development to take tribal lands away without giving the tribals either a say in the matter or meaningful rehabilitation plans? Our developmental pathway has to be reviewed in the context that thirteen of the world's most polluted 20 cities are in India, with New Delhi ranking as the most polluted city in the world (WHO report, 2014).

The Cocoyoc Declaration, Mexico, 1974 organised by UNEP and UNCTAD has unequivocally stated the need to limit our needs within the nature's limits.

#### **UN's Cocoyoc Declaration, Mexico, 1974 (UNEP and UNCTAD)**

Organized by UNEP and the United Nations Commission on Trade and Development (UNCTAD), the symposium identified the economic and social factors which lead to environmental deterioration (UNEP/UNCTAD 1974). "The combined destructive impacts of a poor majority struggling to stay alive and an affluent minority consuming most of the world's resources are undermining the very means by which all people can survive and flourish".

Other statements in the Cocoyoc Declaration illustrate the awareness of the difficulty of meeting human needs sustainably from an environment under pressure:

- (a) 'The problem today is not one primarily of absolute physical shortage but of economic and social maldistribution and usage.'
- (b) 'The task of statesmanship is to guide the nations towards a new system more capable of meeting the inner limits of basic human needs for all the world's people and of doing so without violating the outer limits of the planet's resources and environment.'
- (c) 'Human beings have basic needs: food, shelter, clothing, health, education. Any process of growth that does not lead to their fulfillment - or, even worse, disrupts them - is a travesty of the idea of development.'
- (d). 'We are all in need of a redefinition of our goals, or new development strategies, or new lifestyles, including more modest patterns of consumption among the rich.'

This issue of 'economic development' V/S 'environment' seems to have been satisfactorily addressed by a report "Prosperity without growth? - The transition to a sustainable economy" by the Sustainable Development Commission (SDC), which was the UK Government's independent adviser on sustainable development. It has called the present age as the "Age of Irresponsibility". Among other things it says:

- "In short, this report challenges the assumption of continued economic expansion in rich countries and asks: is it possible to achieve prosperity without growth?"
- "It is a unique opportunity to address financial and ecological sustainability together. And as this report argues, the two things are intimately related."
- "... a new macro-economics for sustainability must abandon the presumption of growth in material consumption as the basis for economic stability. It will have to be ecologically and socially literate, ending the folly of separating economy from society and environment."
- "... Above all, there is an urgent need to develop a resilient and sustainable macro-economy that is no longer predicated on relentless consumption growth. For the advanced economies of the Western world, prosperity without growth is no longer a utopian dream. It is a financial and ecological necessity."

<http://www.sd-commission.org.uk/>; accessed on 10.5.2015



‘Planetary boundaries’ is the central concept in an Earth system framework proposed by a group of Earth system and environmental scientists. In 2009, the group proposed a framework of “planetary boundaries” designed to define a “safe operating space for humanity” for the international community as a precondition for sustainable development. This framework is based on scientific research that indicates that since the Industrial Revolution, human actions have gradually become the main driver of global environmental change. The scientists assert that once human activity has passed certain thresholds or tipping points, defined as “planetary boundaries”, there is a risk of “irreversible and abrupt environmental change”. The scientists identified nine Earth system processes which have boundaries that, to the extent that they are not crossed, mark the safe zone for the planet. However, because of human activities some of these dangerous boundaries have already been crossed, while others are in imminent danger of being crossed.

**Table 2: Planetary Boundaries**

(Source: “How Defining Planetary Boundaries Can Transform Our Approach to Growth”, May 2011)

Earth-system process	Control variable	Boundary value	Current value	Boundary crossed	Preindustrial value
1. Climate change	Atmospheric carbon dioxide concentration (ppm by volume)	350	387	yes	280
	Alternatively: Increase in radiative forcing (W/m <sup>2</sup> ) since the start of the industrial revolution (~1750)	1.0	1.5	yes	0
2. Biodiversity loss	Extinction rate (number of species per million per year)	10	> 100	yes	0.1–1
3. Biogeochemical	(a) anthropogenic nitrogen removed from the atmosphere (millions of tonnes per year)	35	121	yes	0
	(b) anthropogenic phosphorus going into the oceans (millions of tonnes per year)	11	8.5–9.5	no	-1
4. Ocean acidification	Global mean saturation state of aragonite in surface seawater (omega units)	2.75	2.90	no	3.44
5. Land use	Land surface converted to cropland (percent)	15	11.7	no	low
6. Fresh water	Global human consumption of water (km <sup>3</sup> /yr)	4000	2600	no	415
7. Ozone depletion	Stratospheric ozone concentration (Dobson units)	276	283	no	290
8. Atmospheric aerosols	Overall particulate concentration in the atmosphere, on a regional basis	not yet quantified			
9. Chemical pollution	Concentration of toxic substances, plastics, endocrine disruptors, heavy metals, and radioactive contamination into the environment	not yet quantified			

There is a huge amount of published literature on the topic of “Sustainable Economic Development” all of which strongly advocate very careful approach to how the humanity uses the limited natural resources. A high GDP growth rate strategy year after year does not appear to be consistent with this approach. It is such an unsustainable model that has landed the world in climate change problem. It is a disaster for a developing country like India which has contributed very little to create the current problem faced by mankind.

The group identified nine “planetary life support systems” essential for human survival, and attempted to quantify just how far seven of these systems have been pushed already. They then estimated how much further we can go before our own survival is threatened; beyond these boundaries there is a risk of “irreversible and abrupt environmental change” which could make Earth less habitable. Estimates indicate that three of these boundaries—climate change, biodiversity loss, and the biogeochemical flow boundary—appears to have been crossed. A study “Steffen, W.; Rockström, J.; Costanza, R. (May 2011),”How Defining Planetary Boundaries Can Transform Our Approach to Growth” has done an estimate of various parameters of the “planetary Boundary” and has shown the present estimated values as in the chart below.

Those who raised concern on this issue during the public consultation meetings also felt that steps should be taken to put Indian development on a totally different path of sustainable living which minimize the use of materials / and energy. The goal of development should not be ever increasing GNP but minimizing the number of people living below the poverty line in the shortest possible time. It should be a development based on India’s much celebrated civilizational message of “simple living and high thinking”. It is a message demonstrated by Mahatma Gandhi not just in words but in actual deeds.

It is high time we also questioned the very fundamental concept of the need for ever increasing gross domestic product to achieve the fantasy of development. This development concept requiring mindless consumption of unsustainable natural resources is the root cause for the current energy and material consumption crisis, and hence must be thoroughly reviewed.

An indication of the importance of various ecosystems around the world can be seen in a paper “Payment for Ecosystem Services (PES) in Kodagu, in Kodagu, Western Ghats of India: A Case study, 2012” by College of Forestry, Ponnampet, Kodagu. The paper starts with the threat facing the ecosystems around the world. It says: “The planet is experiencing a period of rapid ecosystem degradation, species loss and climate change. The deterioration of biodiversity is reaching unprecedented levels, with an extinction rate reported in the 2005 Millennium Ecosystem Assessment to be 1,000 times higher than what has been typical over most of the earth’s history (UNEP, 2010). Biodiversity loss threatens the well-being of human societies and less diverse and degraded ecosystems are compromising the livelihoods of many vulnerable communities around the world.”

Unfortunately, despite all the advantages – namely still rural based economy, not yet addicted to much of commercial energy, potential to transit to knowledge economy from agricultural economy skipping industrial economy, and inheriting the values from more than 5,000 years old civilization –the governance in the country is influenced more by the western belief of material wealth than by Mahatma Gandhi’s “My Experiment with Truth”.

Since the true objective of national level and state level Climate Action Plans is to protect effectively the vulnerable sections of our society from the ravages of the Global Warming, there cannot possibly be any compromise in the much needed paradigm shift in the development concept for our densely populated communities. Chronic issues such as clamor for materialism, unabated energy requirement, increasing demand for diversion of forest lands, unending urban migration etc. cannot be ignored any longer if we hope to see the possibility of containing the Global Warming within manageable limits. Keeping in view

the constraints of the geographical features of Karnataka, such as vast stretches of arid/semi arid zones, large drought prone areas, limited fresh water resources, absence of coal/fossil fuel reserves etc. the developmental plan for the state should focus on eliminating the poverty while conserving/enhancing the CO<sub>2</sub> sinks by encouraging those employment sectors which can provide jobs for a large number of people and consume minimum of the natural resources and energy, and without causing too much pollution impacts. In this context forest based and agriculture based industries seem to be the best option.

### **“Payment for Ecosystem Services (PES) in Kodagu, Western Ghats of India: A Case study”**

College of Forestry, Ponnampet, Kodagu

The much talked climate change and water crisis at local level often have resulted from poorly managed ecosystems and biodiversity loss in addition to other causes of environmental degradation. Biologically diverse and healthy ecosystems provide essential benefits for water supply, ranging from water filtration and erosion control to the regulation of flood, carbon sequestration to sink excess CO<sub>2</sub> from the atmosphere. Nevertheless, little has been invested in maintaining ecosystems and sustaining their services. Too often, human-built infrastructure is adopted as the solution to problems that ecosystems have been addressing for millennia. For instance the costs of setting up a water treatment facility can run into billions of dollars, the opportunity cost of having the same filtration services provided by ecosystems are often considerably lower. As a result, it is becoming increasingly recognized that the preservation and maintenance of ecosystems and the services that they provide often makes good economic sense and well being of the mankind.

The ability to meet our needs without jeopardizing the prospects of future generation has become one of the major causes of concern. This is true in case of many ecosystem services we derive from natural forests and various tree based land use systems. These services include climate modification functions that may result from carbon uptake and storage (FAO, 1998) water and soil protection, biological diversity of various life forms, wildlife habitat protection and recreational use opportunities. From ages these profound ecological services have been used indiscriminately. However, studies done in the recent past have clear indications to show that, natural resources are not eternal and need to be conserved and used in sustainable manner. All these years natural resources have been thoroughly exploited or even abused without proper accountability. In this regard, United Nations initiative in the form of Convention of Conference on Environment and Development, has developed a concept of accounting the Natural resources and termed it as “Green accounting” under System of National Accounts (SNA). Here, the natural resources can be duly accounted and incorporated into the Gross Domestic Product (GDP)

*(Pushpam Kumar eWtal., 2006).*

### **3.2.3. ‘Should the target of 33% forest and tree cover be sacrosanct?’**

As per the sections 48 (a) and 51 (a) (g) of our Constitution it is the duty of the STATE and every citizen to make honest efforts to protect and improve our environment by protecting and improving rivers, lakes, forests and living beings.

The preamble to the National Forest Policy of 1988 say: “ ... over the years, forests in the country have suffered serious depletion. This is attributable to relentless pressures arising from ever-increasing demand for fuel-wood, fodder and timber; inadequacy of protection measures; diversion of forest lands to non-forest uses without ensuring compensatory afforestation and essential environmental safeguards; and the tendency to look upon forests as revenue earning resource. .... Conservation includes preservation, maintenance, sustainable utilisation, restoration, and enhancement of the natural environment. It has thus become necessary to review and revise the National Forest Policy.”

In section 4.1 (Area under Forests) it says “The national goal should be to have a minimum of one-third of the total land area of the country under forest or tree cover. In the hills and in mountainous regions, the aim should be to maintain two-third of the area under such cover in order to prevent erosion and land degradation and to ensure the stability of the fragile eco-system.”

As against this target of 33% forest and tree cover, at present it is about 20% both at the national level and in the state. Though the seriousness of the consequences of such a low level of forest and tree cover

has not been fully appreciated at the policy levels, it may be seen as a partial indicative of the realization of the same that NAPCC has Green India Mission as one of the 8 national missions. 6 Million hectares of degraded forest lands would be afforested with the ultimate objective of bringing 1/3 rd the land of area of the country under forest cover. It is reported that about Rs. 40,000 crores has been earmarked for this purpose.

While this figure of 33% forest and tree cover has been based on the UNEP target itself, one of the senior politicians was reported to have questioned the scientific basis of this target few years ago. Since this target has been accepted as a feasible and necessary target since 1988, and since the recent Green India Mission is also based on this target, the question about the scientific basis of this target by a minister can be ignored.

A new analysis by Centre for Science and Environment (CSE) says the Union ministry of environment and forests and Climate Change (MoEF&CC) is approving projects at an unprecedented speed – and even clearing some which had been denied clearance earlier. Latest information available as per MoEF's own records indicates that the area of forestland diverted every month has gone up significantly. Since January 2013, MoEF has cleared 12,571 hectare (ha) of forestland, an average monthly figure of 3,143 ha. In 2012, MoEF had cleared 26,595 ha of forestland with a lower average monthly figure of 2,216 ha. Thus the area of forest diverted has registered a 42 per cent increase. The report says "Our analysis shows that not only the area of forest being diverted for projects is being done at a faster pace but also the rejection rate has gone down significantly." While the project rejection rate is 3.5 per cent for 2013, it was about 6 per cent for all forest clearances granted since 1981 after the Forest (Conservation) Act 1980 came into force.

*(<http://www.cseindia.org/content/ministry-environment-and-forests-diverting-forestland-development-projects-much-faster-rate->); accessed on 10.5.2015*

The Green India Mission, which is one of the eight National Missions under NAPCC, has said as follows: "Forests are repositories of genetic diversity, and supply a wide range of ecosystem services thus helping maintain ecological balance. Forests meet nearly 40% of the energy needs of the country overall, and over 80% of those in rural areas, and are the back bone of forest-based communities in terms of livelihood and sustenance. Forests sequester billions of tons of carbon dioxide in the form of biomass and soil carbon. The proposed national programme will focus on two objectives, namely increasing the forest cover and density as a whole of the country and conserving biodiversity."

A report by MoEF "Achieving 2010 Biodiversity Target: India's contributions" has copiously described the rich bio diversity in the country, the threats to it and the tall claims about the remedial measures taken. As per State of Environment Report 2009 by MoEF India is a mega diversity country with only a 2.4 percent of land area of the Globe but is accounting for 7-8% of the recorded species of the world. It is the home for 11.8% of the plant species documented so far.

The Western Ghats (WGs) of Karnataka are one of the 25 global priority hotspots for conservation and one of the two in the Indian subcontinent. Reserve forest constitutes 74.94%, protected forests 10.27% and unclassified forest is 14.79%. As per the State of Forests Report 2005, 1.21% has very dense forest cover, 56.51% is moderately dense, 34.36% is open forest and 8.23% is scrub forests. Karnataka forests support 25% of the elephant population and 10% of the tiger population of India. 150 The wildlife population of India includes 395 tiger, 6185 elephants, 817 panthers, 2324 bear, 15760 wild bear, 25850 deer, 8484 bison, 4998 sambar and 957 oxen (Source: KSPACC).

The rich bio diversity of the forests of the state can be appreciated by the fact that there are 300 freshwater and 405 marine species; 1,493 medicinal plants belonging to 808 genera and 108 families; 176 species of orchids from 49 genera; over 300 species of butterflies. Most of these are endemic and / or endangered. Endangered species of fauna found in Karnataka include the tiger, Indian elephant, lion tailed macaque,

turtle and dhole, the Indian wild dog. (Source: KSPACC).

The Western Ghats of the country stretches for 1,600 kilometers and includes various forest types - tropical evergreen, moist and dry deciduous, high altitude shoal forests, savannas and scrubs. There are over 4,500 species of flowering plants (38% endemic), 330 butterflies (11% endemic), 156 reptiles (62% endemics), 508 species birds (4%endemics), 150 mammals (12% endemics), 289 fishes (41% endemics) and 135 amphibians(75% endemics) in the Western Ghats. (Source: KSPACC).

As per Inter Governmental Panel on Climate Change (IPCC) - IV Assessment Report “Emissions from deforestation are very significant – they are estimated to represent more than 18% of global emissions”; “Curbing deforestation is a highly cost-effective way of reducing greenhouse gas emissions.”

Though the WGs in Karnataka are just a part of the overall Western Ghats in the country, they have huge significance because of the rich bio-diversity present in its forests.

It is reported in the media that the forest diversion for non forest purpose during 2002-06 period was 3,38,345 ha (75,135ha per year) and that of 2007-12 was 2,04,425 ha (40,885 ha per year) (MoEF Data). Should the enormity of such huge loss of ecologically rich forest lands be lost in the din of economic development; is the question.

While it seems futile to value the hugely rich eco services offered by the forests, some efforts have been made at the national and international levels to assign some indicative values.

#### **“The value of the world’s ecosystem services and natural capital”**

In this article Robert Costanza and others have reported the findings of their study. This paper says: The services of ecological systems and the natural capital stocks that produce them are critical to the functioning of the Earth’s life-support system. They contribute to human welfare, both directly and indirectly, and therefore represent part of the total economic value of the planet. We have estimated the current economic value of 17 ecosystem services for 16 biomes, based on published studies and a few original calculations. For the entire biosphere, the value (most of which is outside the market) is estimated to be in the range of US\$16–54 trillion per year, with an average of US\$33trillion per year. Because of the nature of the uncertainties, this must be considered a minimum estimate. Global gross national product total is around US\$18 trillion per year.”

*NATURE | VOL 387 | 15 MAY 1997*

It is reasonable to surmise that the current economic value of eco system services must be much higher since additional relevance of ecosystems have been acknowledged by the scientists since 1997. On the basis of this study if we assume that the value of the eco-system in our country is about 1.5 times its GNP, the value of the ecosystem in the country becomes clear. Gross National Product in India during 2013 was about is 99,965,000 Crore INR. On this basis the value of the eco-system in our country comes to about 150,000,000 Crore INR. Such an enormous economic value to our communities should be kept in mind while diverting our forest lands.

Another report by Forestry College, UAS, Ponnampet has attempted to assign a value for the eco-system services in Coorg district. This report “Payment for ecosystem services (PES) in Kodagu, Western Ghats of India, a case study” has considered PES under four categories: (i) Water Services (ii) Carbon sequestration (III) Bio-diversity conservation and (iv) Landscape Beauty. Various parameters discussed under these headings provide a vivid picture of the immense value of these eco-system services. A welfare society can ignore the value of such a rich ecology at its own peril.

As Dr. Vandana Shiva, a social and environmental activist says: “The ecological shift involves not seeing ourselves as outside the ecological web of life, as masters, conquerors and owners of the earth’s resources. It means seeing ourselves as members of the earth family, with responsibility to care for other species and life on earth in all its diversity, from the tiniest microbe to the largest mammal. It creates the imperative

to live, produce and consume within ecological limits and within our share of ecological space, without encroaching on the rights of other species and other people.”

Convention on Biological Diversity was signed by 156 states in 1992, the objectives of which are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources.

In this context it is unfathomable as to how the society can continue to divert such rich natural forests for non-forestry purposes despite the fact that the forest & tree cover is much less than the national target. Many participants in the public consultations raised their concerns that despite the fact that the percentage of forest and tree cover in the state as well as in the country is about 20% at present, the diversion of forest lands for other purposes such as mining, dams, transmission lines, roads, railways, housing etc. is continuing unabated. In such a scenario it is highly questionable as to how the massive amounts earmarked for Green India Mission for artificial forestry can be substantiated while the natural tropical forests of huge ecological value continues to be diverted. In the context of Climate Change such massive diversion of tropical natural forests, which are the best sinks of carbon, becomes a matter of huge concern.

Whereas the large industries and industrial estates are being asked to have 33% tree cover in the respective areas, it is worth concerning ourselves with the question as to why the thick, natural, evergreen forests in a tropical country such as ours cannot be allowed to be present at least in 33% of the land area, atleast in those areas which have been forests for hundreds of years.

#### **3.2.4. “Industrialisation and Urbanisation ”**

Sir M Vishweshwaraiah, ex-Dewan of Mysore, was reported as saying ‘Industrialisation or perish’ in early part of the last century. This might have been true for his time, certainly not today as mankind is realizing the damage done by unplanned industrialisation. If Sir M Vishweshwaraiah were to be alive today, he could have changed his mind. One of the participants in the public consultations, even said ‘Industrialisation and perish’. There were many animated presentations by a good number of participants about the problems created by the phenomenon of ever increasing industrialisation. Many participants squarely blamed the unchecked industrialization as the root cause of all sorts of pollutants in our environment and also for the fast depletion of our natural resources.

There were also many concerns on the ever growing phenomenon of urbanization, and consequent phenomenon of slow but sure death of our villages.

KSAPCC has listed the following facts on industrialisation and urbanization:

- Karnataka ranks seventh in the production of cement in the country. Karnataka is also the third largest steel producer in India. These two industries account for over 40% of the emissions due from industrial sector.
- Most of the industries in Karnataka, being small scale industries, do not meet current energy efficiency standards, thus pose a greater threat to the already scarce energy resources.
- Industrial sector contributes about 22.5% of the state’s total GHG emissions, second only after electricity sector;
- The industrial sector is also the second largest consumers of electricity after agriculture in the state.
- The state of Karnataka, with its urban population at 34% of total population, is currently ranked as the third most urbanized state in the country. Increasing urbanization, which is contributing hugely to Global Warming, demands a thorough review of the related policies. The absence of basic amenities and the lack of employment opportunities in rural areas act as push factors driving away the population from rural areas.
- The rapid growth in urban population in the state has been driven by both push and pulls factors.

The absence of basic amenities and the lack of employment opportunities in rural areas act as push factors driving away the population from rural areas as well as small urban settlements. On the other hand, the perceived presence of such facilities in larger urban settlements acts as the pull factor leading to the migration of rural population into the urban areas.

- The state, with rich mineral resources, is famous for cement, and ore industries like iron ore, limestone etc. Other major industries include sugar, coconut, and pulp and paper industries.
- The state is also a leader in IT – ITES sectors, and is the largest IT exporter.
- Increased urbanization has both positive and negative effects. The increased rate of migration to urban cities has led to demand for more vehicles, leading to more demand for fuel and thus more GHG emissions. Growing population also offer the challenges of managing increasing solid waste and also poses a threat to the existing natural resources like water and air quality.

It is predicted that in a business as usual scenario by 2050 about 64% of the developing world and 86% of the developed world will be urbanized.

*(“Urban life: Open-air computers”, The Economist, 27 October 2012)*

As per the global experience the urban areas are estimated to consume more than 70% of natural resources, and produce more than 70% of pollutants. India also is reported to have the world’s most toxic air. India scored a miniscule 3.73 out of a possible 100 points in the analysis, lagging far behind the next worst performer, Bangladesh, which scored 13.66. In a study by Yale and Columbia Universities, India holds the very last rank among 132 nations in terms of air quality with regard to its effect on human health.

Urban air pollution is linked to up to 1 million premature deaths and 1 million prenatal deaths each year. Urban air pollution is estimated to cost approximately 2% of GDP in developed countries and 5% in developing countries.

*(UNEP: [http://www.unep.org/urban\\_environment/Issues/urban\\_air.asp](http://www.unep.org/urban_environment/Issues/urban_air.asp)); accessed on 10.5.2015*

A substantial portion of this urban air pollution is due to transportation needs of urban areas. As per KSAPCC transport sector contributes about 10.4% to state’s GHG emissions.

Due to uncontrolled urbanization in India, environmental degradation has been occurring very rapidly and causing many problems like land insecurity, worsening water quality, excessive air pollution, noise, dust and heat, and the problems of disposal of solid wastes and hazardous wastes. Creation of heat islands is another effect of urbanization.

*(“International Journal of Research in Engineering & Applied Sciences; Volume 2, Issue 2 (February 2012)”)*

The mix of changing environmental conditions and the growing number of people living in urban regions, according to UN experts, will strain basic sanitation systems, health care, and potentially cause a humanitarian and environmental nightmare.

In this context the participants raised the question as to how many industries are desirable /acceptable to the state. Since they are also large contributors to GHG emissions, how many of them are in the best interest of the society? Even if each of the industry becomes extremely efficient with highly responsible methods of waste management, the total GHG emissions into the atmosphere will still be a concern if the number of such industries is not rationalised.

Unacceptable levels of pollution of air, water and land have been the consequences of industrialization and urbanization in India. Acknowledgement of the problem is a must for being in a position to solve it. In this regard, the recent National Air Quality Index (AQI) can be said to be a step in the right direction. The index has uniform six categories - Good, Satisfactory, Moderately polluted, Poor, Very Poor, and Severe. The AQI also considers eight pollutants (PM10, PM2.5, NO<sub>2</sub>, SO<sub>2</sub>, CO, O<sub>3</sub>, NH<sub>3</sub>, and Pb) for which short-term (up to 24-hourly averaging period) National Ambient Air Quality standards are prescribed. Unless

such an index persuades policymakers and citizens to decide which road to take for development, all the associated investment will be a waste.

“Fueled by the desire to become more westernized, countries around the world are turning into industrialized nations at a rate not yet seen before. With such internal growth, countries have seen an increase in the demand for urbanized areas to cater to the increase in population, economic demands, and technological advances. Urbanization causes an increase in the emission of pollutants into the atmosphere, a higher need to clear lands, and a loss of biodiversity in virgin forests on a global scale. Narrowing the view point into two particular influential developing nations, such as Brazil and China and focusing on how they have been affected, we have been able to examine, in better and more detailed ways, how urbanization has been an increasingly important factor within each country’s present state. The development of these countries has boosted their GDP and economic standing; however, it has come with great environmental costs. If these countries do not change their current patterns of consumption and production, the negative consequences will outweigh the economic benefits halting their development all together.”

*“The Environmental Effects of Urbanization on Developing Countries”  
University of Michigan, 2007; accessed on 10.5.2015*

India’s rank on global indices like the Social Progress Index (SPI) is a cause of concern. The Index goes beyond pure GDP measures and looks at social and environmental measures that are imperative for social progress and quality of life. No wonder that the recently released SPI ranks India at a dismal 101st position out of 133 countries considered for the Index. Striking underperformance is observed in the Index under ‘household pollution’ (110th rank) and ‘health and wellness’ dimensions (120th rank) factors.

All this reflects the need is to look at the environment in a holistic manner. The path taken by other countries, particularly America, for personal fulfillment and growth over the past few centuries may not be appropriate for India at this juncture with the kind of population and resources that we have. Also, a sense of civic duty towards our surroundings / environment will contribute to making the country clean. More importantly it will also make people healthy and productive. It may indeed unleash the ‘demographic dividend’ that will boost growth and competitiveness.

The common theme of all these concerns by the stake holders was: if the large scale industrialization and urbanisation is considered necessary by the larger society for the sake of employment opportunities, can we not aim for industries /enterprises based on agriculture, horticulture, floriculture, forestry, IT-ITES, hospitality, educational and tourist hubs etc. which will put less pressure on natural resources such as land, water, electricity, minerals etc., and which are associated with minimum GHG emissions and pollutants?

Similarly, another question raised was: is it in the true interest of the larger society to have many more urban conglomerates such as Bangalore, which seems inevitable in a business as usual scenario? Instead shall we not consider developing all taluka places, and the villages so as to provide necessary infrastructural facilities so as to minimise urban migration?

### **3.2.5. “The concept of Sustainable Development and Global Warming”**

The concept of sustainable development has been a major issue being debated across the globe for a number of years. The participants also raised this issue in many public consultation meetings.

Many definitions of sustainable development have been advocated so far across the globe. “Our Common Future” is a report issued in 1987 by the U. N. World Commission on Environment and Development, and is also popularly known as the Brundtland Commission. It says: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their needs.” “Sustainability secures people’s quality of life within the means of nature in a way that is fair and equitable to all humanity, other species and to future generations. Sustainability recognizes the inter-relatedness of the economy, society, and environment. It requires that we should not consume resources faster than they can be renewed nor produce wastes faster than they can be absorbed.”



A number of conferences have been held and many initiatives have been taken by UN. “Sustainable development has been the overarching goal of the international community since the UN Conference on Environment and Development (UNCED) in 1992. Amongst numerous commitments, the Conference called upon governments to develop national strategies for sustainable development, incorporating policy measures outlined in the Rio Declaration and Agenda 21. Despite the efforts of many governments around the world to implement such strategies as well as international cooperation to support national governments, there are continuing concerns over global economic and environmental developments in many countries. These have been intensified by recent prolonged global energy, food and financial crises, and underscored by continued warnings from global scientists that society is in danger of transgressing a number of planetary boundaries or ecological limits.” “Whilst the concept of green economy has only recently gained significant international attention, green economy policies have been discussed and analysed for some decades by economists and academics, particularly in the fields of environmental and ecological economics.”

*(<https://sustainabledevelopment.un.org/content/documents/GE%20Guidebook.pdf>); accessed on 10.5.2015*

Few other definitions of the concept of sustainable development:

i) Activities are sustainable when they:

- use materials in continuing cycles
- use continuously reliable sources of energy
- come mainly from the potentials of being human, i.e., communication, creativity, coordination, appreciation, and spiritual and intellectual development.

ii) Activities are non-sustainable when they:

- require continual inputs of non-renewable resources,
- use renewable resources faster than their rate of renewal
- cause cumulative degradation of the environment, require resources in quantities that could never be sustainable for all people,
- lead to the extinction of other life forms.

iii) “Sustainability is part of a trend to...consider the whole instead of the specific. Sustainability emphasizes relationships rather than pieces in isolation...Sustainability is not all about regressing to primitive living conditions. It is about understanding our situation, and developing as communities in ways that are equitable, and make sense ecologically and economically.”

iv) “Sustainable means being able to keep going or able to endure; sustainability, then, is acting in such a way that life on Earth endures on into the future, providing for the needs of all citizens and creatures while maintaining the natural functions, resources, and beauty of the planet...Sustainability is rooted in looking to the inherent workings of nature as a model, with the idea that the natural systems of the world do work in balance to perpetuate life, and by working in harmony with those natural systems, we can sustain our own lives.”

v) “We stand at a critical moment in Earth’s history, a time when humanity must choose its future. As the world becomes increasingly interdependent and fragile, the future at once holds great peril and great promise. To move forward we must recognize that in the midst of a magnificent diversity of cultures and life forms we are one human family and one Earth community with a common destiny. We must join together to bring forth a sustainable global society founded on respect for nature, universal human rights, economic justice, and a culture of peace. Towards this end, it is imperative that we, the peoples of Earth, declare our responsibility to one another, to the greater community of life, and to future generations.”

A common theme of all these definitions is to suggest that the concept of sustainable development is inextricably linked with the responsible use of our natural resources by every generation without depleting

it to such a stage where the subsequent generations cannot meet their needs. Since an uncontrolled harnessing of natural resources is intractably linked to GHG emissions, the obvious link of high levels of economic activities to Global Warming should become evident.

In a National Conference on sustainable welfare measures of our communities held on 19.4.2015 at Badanavalu, near Mysore the concept of sustainable development was one of the themes for a discussion session. People felt strongly about the failure of the human kind not to have followed the basic tenets of sustainable development since industrial revolution. The lack of appreciation/concern that the nature has a limit in providing resources, on which we depend, and the greed for ever increasing comforts level were squarely blamed for all the environmental issues being faced today. Major concerns expressed w.r.t sustainable developments in India were:

- High GDP growth rate based economic policies of the succeeding governments are resulting in unsustainable withdrawal of products from the nature
- Inequitable access to the natural resources is resulting in a large number of super-rich persons in recent years whereas a substantial part of the population is said to be living below the poverty line
- Whereas the natural resources are needed for the betterment of life for all, appropriate skills development for all sections of the society and adequate awareness can lead to minimization of GHG emissions from these activities.
- Whereas the UN charter for sustainable development lays down four tenets: (i) reduce fossil fuel usage; (ii) reduce the dependence on minerals; (iii) ensure adequate green cover; (iv) ensure that the future generations are not deprived of adequate access to natural resources, the present day economic growth rate focused policies and practices have lead to a situation where none of these tenets are adhered to.
- The concept of economic development in modern times has basically aimed at high level of material comforts necessitating large scale exploitation of the natural resources. Since such an economic development has not targeted the equitable access to natural resources the distribution of such comforts (in turn the wealth) has been highly in-equitable leaving very small percentage of hugely wealthy individuals and vast packets of poor people.
- In the garb of bringing comforts to those who have remained poor much more exploitation of nature continues; but again the wealthy and powerful people gain mostly from such exploitation processes and poorer sections remain more or less unchanged. Hence the process of exploitation of the nature goes in the garb of poverty alleviation.
- In this entire process the more and more materials are removed from the nature and more and more energy is spent in converting such material to comforts. All these result in high energy spending and accelerated depletion of those natural resources such as forests, which could have been good sinks of CO<sub>2</sub>.
- This entire process of economic development, since the beginning of the industrial revolution, has lead to global warming.

As opposed to such economic development in a sustainable development paradigm, as our ancestors practiced, the objective is primarily to provide equitable access to natural resources to all, and to preserve the natural resources. In summary, the sustainability in a true sense, should secure people's quality of life within the means of nature in a way that is fair and equitable to all humanity, other species and to future generations.

The National Conference at Badanavalu on 19.4.2015 strongly felt the need to bring a paradigm shift in our society's approach to the concept of development of our communities. Some such recommendations were:

- Economic development need not mean a 9 to 5 office or factory job for all. It can also mean part time job for a large number of men / women who may not like to go far away from their homes / villages,

or those who may not have skills level to work in a factory or office. Jobs for such people can be much simpler in the form of tailoring, embroidery, employment in cottage industries locally, making food items, etc. Income from such part time jobs can make massive improvements to the families of such people, and bring better levels of confidence to such people.

- Instead of aiming for creating few thousands of high paying jobs in one location, the economic development paradigm should aim at creating an enabling environment where lakhs of part time or lower/medium wage jobs are created all over the country.
- Many cottage industries such as Khadi clothing or handicrafts etc. which can provide jobs for women working from the comforts of their homes can do wonders for the overall society.
- Such jobs put much less pressure on the nature and need much less energy. Much of the raw materials needed can be renewable in nature and most of the energy used can be in the form of human energy or renewable energy such as solar / bio-mass power.
- A 2013 census has revealed that about 80% of the jobs in handloom sector were held by women. This indicates a vast potential to provide useful employment to millions of uneducated and poor village women/men when other cottage industry and rural development options are also effectively deployed.
- Such options can be highly sustainable, and also minimise the need for urban migration.
- Traditional knowledge bases in villages, which are being largely neglected in recent years, can provide many life skills to children without making them child laborers.
- The modern educational concept of making children concentrate only on studies upto the age of 20-25 years, and not engage in any apprenticeships while studying is putting economic pressure on the families, while depriving the society's economy of the services of millions of young hands and legs, which could go a long way in minimizing the poverty levels.
- There were strong recommendations that the education beyond high schools should be part time extended over many more years, but at the same time providing an opportunity for the students learn many skills such as farming, weaving etc. and to earn as apprentices while learning.
- Such part time education can assist in enabling the students to learn multiple skills from the parents, and to be of economic assistance to the family.
- There were clear recommendations that such traditional skills should be encouraged and preserved by creating small time jobs in villages.
- Along with such traditional job bases, horticulture, agro forestry, medicinal plantations, water management, animal husbandry etc. can be massive job opportunities supporting sustainable economic development.

There was an unanimous recommendation that the new economic development paradigm, for the country in general and the state in particular, should be aimed at creating large scale traditional employment opportunities in rural areas, which will minimise the pressure on our fragile natural resources, need minimum energy, and result in least pollution of air, water and land. Industries which need vast quantities of raw materials, energy, water and land areas, and which leads to various kinds of pollutants should be minimised, and permitted only with adequate levels of compliance requirements.

### **3.2.6 “Over-reliance on coal power and the consequent GHG emissions”**

The Climate Change implications of over-reliance on coal power in the state were the other concerns raised in the consultation meetings.

As per Central Electricity Authority (CEA) data, as on 31.1.2015 the state had the total power generation /availability capacity of about 14,550 MW, out of which thermal power (coal and diesel) was 6,380 MW, hydel power was 3,600 MW and renewable power (other than hydro) was 3,985 MW. Coal power's capacity was about 43% of the total. If we leave out the central sector share of about 1,946 MW from the total

capacity, the coal power's percentage capacity in the state comes to about 50%. Such a high percentage dependence on coal power, which is likely to increase further in a business as usual scenario (as more coal power plants are being implemented), should be considered with a holistic approach keeping the Climate Change in proper perspective. The economic, social and environmental issues associated with the over-reliance on coal power also need to be considered in a holistic manner from the perspective of overall welfare of our society.

Since coal is the predominant emitter of GHG emissions in the power sector, it is not difficult to surmise that coal power is the major contributor to GHG emissions in the state. Keeping this in proper perspective, it becomes obvious that state's efforts to mitigate global warming should have a major focus on minimizing GHG emissions from coal power sector. Coal's share in energy related CO<sub>2</sub> emissions at the global levels is about 72%. It is widely acknowledged by the global scientific community (IPCC) that the percentage of fossil fuels that have to be left in the ground in order to keep the global warming below 2° C is about 80%. Since coal's share in global energy generation is also high (about 41%), our energy related priorities should become obvious.

An announcement in 2010 by Environment Ministry (MoEF) has indicated that about 33% of all coal reserves in the country are below very thick forests, and hence will be 'NO GO' areas for mining. Increase in the number of coal power plants will mean opening of more coal mines and the consequent destruction of such thick tropical forests which are also very good sinks of carbon. The auctioning of rights to open about 215 additional coal mines in the country are ongoing, and large chunks of forests, below which are thick tropical forests, will face destruction.

When the overreliance of coal power in the state is considered in the context of the fact that the state has no reserve of any fossil fuels and that it is the second most water stressed state in the country, the continued policy of building more coal power plants comes into sharp focus. Whereas the first coal power plant in the state was built at Raichur way back in 1980s, in what appears to be a knee jerk reaction to the fast exhausting hydel power potential, the policy of continuing to build more and more coal power plants in the state raises many questions on the rationality of such a policy decision. Since 8 Units at Raichur were built in 1980s, two more coal power generators near Bellary and two more near Udupi have been built. More than 15 more coal power projects are reported as planned. One more coal power unit at Bellary, and two projects with multiple units at Yermarus and Kudigi are reported to be under construction. The information from the websites of KPCL and Ministry of coal indicates that another 13 coal power projects have been planned with an additional generating capacity of about 16,000 MW. **(Annexure 2)**

Such a huge additional capacity throws up many issues to the state:

- Vast quantities of coal has to be either brought from the distant states such as Jharkhand or Chattisgarh, or from overseas, despite the huge difficulties in getting reliable quantity and quality coal for the existing power plants;
- Vast quantities of fresh water need to be supplied for these power plants which are all to be located in water deficit areas, against the more important demand from other purposes such as drinking water and agriculture.
- Massive additions to GHG emissions from these power plants and coal ash leading to massive pollution of air and water.
- Coal power plant sites, ash disposal facilities, water storage facilities, coal storage yards and additional transmission lines required for evacuating the power from these plants will need diversion of agricultural lands and also may need felling of large number of trees.
- Huge demand for coal from various states such as Karnataka will lead to additional coal mines, all of which may lead to destruction of thick natural tropical forests below which are such coal deposits.
- Burning of vast quantities of coal will lead to various pollutants and GHGs of huge proportion.

It is highly relevant in this context to recall what a former Chief Minister of the state had said about the relevance of coal power to the state. In Sept. 2008, a news paper report attributed a statement to the then CM of the state in the context of signing an MOU for setting up a coal power plant in Chattisgarh for the use of Karnataka: “The chief minister justified the MoU stating that transporting coal from other states is very costly. The transportation expenditure turns out to be four times the cost of coal. It is therefore not economical to locate the thermal power stations in the State. If power is produced at the pit-head, the cost of power will come down by 30 to 40 per cent.” **(Annexure 3).**

### How Large Are Global Energy Subsidies?

Fossil fuel companies are benefitting from global subsidies of \$5.3tn (£3.4tn) a year, equivalent to \$10m a minute every day, according to a startling new estimate by the International Monetary Fund. The IMF calls the revelation “shocking” and says the figure is an “extremely robust” estimate of the true cost of fossil fuels. The \$5.3tn subsidy estimated for 2015 is greater than the total health spending of all the world’s governments. The vast sum is largely due to polluters not paying the costs imposed on governments by the burning of coal, oil and gas. These include the harm caused to local populations by air pollution as well as to people across the globe affected by the floods, droughts and storms being driven by climate change.

Nicholas Stern, an eminent climate economist at the London School of Economics, said: “This very important analysis shatters the myth that fossil fuels are cheap by showing just how huge their real costs are. There is no justification for these enormous subsidies for fossil fuels, which distort markets and damages economies, particularly in poorer countries.”

Lord Stern said that even the IMF’s vast subsidy figure was a significant underestimate: “A more complete estimate of the costs due to climate change would show the implicit subsidies for fossil fuels are much bigger even than this report suggests.”

The IMF said that ending subsidies for fossil fuels would cut global carbon emissions by 20%. That would be a giant step towards taming global warming, an issue on which the world has made little progress to date. Ending the subsidies would also slash the number of premature deaths from outdoor air pollution by 50% – about 1.6 million lives a year.

Furthermore, the IMF said the resources freed by ending fossil fuel subsidies could be an economic “game-changer” for many countries, by driving economic growth and poverty reduction through greater investment in infrastructure, health and education and also by cutting taxes that restrict growth.

Another consequence would be that the need for subsidies for renewable energy – a relatively tiny \$120bn a year – would also disappear, if fossil fuel prices reflected the full cost of their impacts.

<http://www.imf.org/external/pubs/cat/longres.aspx?sk=42940.0>

<<http://bit.ly/1LLxylF>>

The huge concerns on the pollution impacts of coal power industry should become clear to us by the new regulations being enacted across the world to control the emission of dangerous elements associated with coal power. Emissions of heavy metals and coal combustion residuals are also acquiring special emphasis in such emission control standards. Of these trace elements of major concern are arsenic (As), boron (B), cadmium (Cd), lead (Pb), mercury (Hg), molybdenum (Mo) and selenium (Se); of moderate concern are chromium (Cr), vanadium (V), copper (Cu), zinc (Zn), nickel (Ni) and fluorine (F); and radioactive elements of uranium (U) and thorium (Th). (Ref. Reports of World Coal Association).

US President and the G20 nations had called for an end to fossil fuel subsidies in 2009, but little progress had been made until oil prices fell in 2014. In April this year, the president of the World Bank, Jim Yong Kim, told the Guardian that it was crazy that governments were still driving the use of coal, oil and gas by providing subsidies. “We need to get rid of fossil fuel subsidies now,” he said.

Emission Performance Standards, as part of GHG emission containment measures across the world, are becoming norms in many countries. UK, USA, Canada, and EU are reported to be in various stages of enacting Acts to restrict the CO<sub>2</sub> emission in the range of 400 - 450 g CO<sub>2</sub>/kWh of electricity production. New Zealand’s Emissions Trading Scheme, Australia’s Carbon Tax (under review now), proposals in Korea,

Taiwan and China are the other initiatives to minimise the pollution from coal burning. Such initiatives will demand much higher investments in pollution control measures, and make the price of coal power much higher, and may even make it less competitive to electricity from REs.

**Table 3: Major issues with coal based power policy**

<b>Economic</b>	Puts huge pressure on natural resources such as land, water and minerals; demands a lot of construction materials like cement, steel, sand; will increase average cost of power; road and rail transportation infrastructures need a lot more strengthening; pressure on ports will increase due to the need for import of coal; land costs around coal power projects will become unaffordable to locals; overall efficiency from coal energy to end use of electrical energy is very poor of the order of about 10% only.
<b>Social and health</b>	Peoples' displacement will cause additional unemployment & increase in slums; will affect agricultural production and health; prospect of displacement will create social tensions and stiff opposition; local buildings of heritage importance will degenerate; nearby places of tourist and religious importance loose prominence; causes serious erosion of local community development; livelihood and drinking water needs of the local communities will be threatened. Coal plant emissions contribute to some of the most widespread diseases, including asthma, heart disease, stroke, and lung cancer.
<b>Environmental</b>	Safe use for all the ash generated is not available yet; acid rain will affect flora and fauna including forests and agricultural crops; coastal power plants will affect marine creatures; destruction of forest lands to open more of coal mines; have to contend with nuclear radiation in coal ash; credible threat to bio-diversity; fresh water sources will be polluted; reduces the access to fresh water sources near mines; huge contribution to Global Warming and Climate Change; negates the purpose of National action Plan on Climate Change.

In April 2015, MOEF&CC has released a draft notification for tighter emission standards and water consumption for Thermal Power Plants in the country. These emission standards will most certainly increase the average cost of coal power, which can only keep going upwards due to such costs in future too. As against this the cost of REs are coming down every year and is expected to do so for many more years.

A study by Conservation Action Trust and Urban Emissions (Pvt. Ltd.) in 2014 has found significant impacts from the existing fleet of coal fired power plants in India, including between 80,000 and 115,000 deaths annually due to exposure linked their particulate emissions in 2011-12.

According to the World Health Organization, ten most polluted cities in the world are from India. The Global Burden of Disease assessments for 2010 estimated that 6,27,000 premature deaths in India can be attributed to outdoor air pollution. With about 65% of the electricity generated in the country coming from coal power plants, it is easy to deduce that coal power plants contribute most to the outdoor pollution.

The fact that coal power plants demand large tracts of land is a very disconcerting issue being faced by our communities. It is mostly agricultural /forest lands, on which tribals and other vulnerable sections of our society live on without skills to do anything else for livelihood. Because of the threat to their livelihoods and because of the past bitter experience of inadequate compensation (and R&R) such people are reluctant to part with their lands. This situation has led to the revenue and police officials forcefully acquiring lands to help the project developers to set up coal mines and/or coal power plants. Massive oppositions to such forceful acquisitions, subsequent retributions by the authorities, and suffering by such families are being reported regularly in the media. Such a scenario, instead of preparing the vulnerable communities for the impacts of Climate Change, will make them even worse off than they are now. This will be totally against the 'adaptation' strategy required.

A news item of April 21, 2015 from US refers to a report: "Severe weather is the leading cause of power

disruptions, costing the U.S. economy from \$18 billion to \$33 billion a year, and climate change will only make it worse, a White House review on energy infrastructure concludes. The report, released by the Energy Department, recommends investments in the electric grid to protect it from the severe storms that may be occurring more frequently because of global warming, as well as from physical and cyber-attacks.” The state of Karnataka needs to keep such economic threats also from the looming Climate Change, and plan accordingly to minimise such losses. (<http://www.bloomberg.com>)

A Prayas Energy Group’s report in 2011 had estimated that those power plants which already have Environmental Clearance from MoEF& CC may demand about 4.6 billion cubic meters of water per year. Even if 50% of the proposed 700,000 MW power plants are to get to fruition the number of potential water conflicts can be great. The report had also estimated that this much of water can provide irrigation to more than 900,000 hectares of land each year. The gravity of the situation becomes clear when we also realise that 4.6 billion cubic meters per year can meet the drinking water needs of about 7% of the population in India at present. (*THERMAL POWER PLANTS ON THE ANVIL: Implications and Need for Rationalisation* ; Prayas Energy Group, Pune, Aug 2011); accessed on 10.5.2015

In a groundbreaking article (Life-cycle study: Accounting for total harm from coal would add “close to 17.8¢/kWh of electricity generated”) in the Annals of the New York Academy of Sciences, Dr. Paul Epstein, associate director of the Center for Health and the Global Environment at Harvard Medical School, details the economic, health and environmental costs associated with each stage in the life cycle of coal – extraction, transportation, processing, and combustion. He says that these costs, between a third to over half a trillion dollars annually, are directly passed on to the public. Unfortunately these externalised costs are not reflected in the price of coal powered electricity in India, and hence a wrong picture is advocated that the coal power is cheap.

A recent study, “Heat on Power”, done under CSE’s Green Rating Project (GRP), India’s first-ever environmental rating of coal-based power plants, finds the sector’s performance to be way below global benchmarks. It has listed a number of serious concerns from the perspective of overall environmental degradation (**Annexure 4**).

Some of the issues highlighted in this study are:

- Sector (47 plants, covering half of the sector and spread over 16 states) scores poorly on all parameters getting a mere 23 per cent score compared to 80 per cent that a plant following all best practices can get; 40 per cent of the plants rated received less than 20 per cent score
- Inefficient resources use and technological backwardness leading to high levels of pollution and with immense scope for improvement
- Over 70 percent of the total freshwater withdrawal by industrial sector in the country is by these plants, which are also water inefficient. As against the global best of 1.6 m<sup>3</sup>/MWh of water use, the average water use by coal-based power plants in India is 4 m<sup>3</sup>/MWh.
- Of the total industrial sector pollution in the country, coal-fired power plants are responsible for 60 per cent of particulate matter (PM) emissions, 45-50 per cent of sulphur dioxide (SO<sub>2</sub>) emissions, 30 per cent of nitrogen oxide (NO<sub>x</sub>) emissions, and more than 80 per cent of mercury emissions.
- Of the 47 power plants rated, four plants made it to the Three Leaves category, scoring between 40 and 60 per cent. Seven companies got Two Leaves (30-40 per cent), and 16 One Leaf (20-30 per cent). Twenty plants got less than 20 per cent score. The performance of NTPC Ltd., which refused to disclose data to the GRP team, was found to be below par (16-28 per cent).
- On the basis of environmental clearance granted, CSE has calculated that till February this year, 2.85 lakh hectares (ha) of land has been diverted for such projects. Of this 0.75 lakh ha is for the plant sites and 2.1 lakh ha is for the coal mines, which includes 46,719 ha of forest land.

Plants are operating at 60-70 per cent capacity only. If capacity utilisation is improved, sector can meet

additional power requirement without building new plants.

Serious health problems in mining communities and pollution around coal power plants have been well known and cannot be ignored in the context of Climate Change. Coal power (because of mining extraction, handling, transportation, burning and ash handling etc.) has huge impact on outdoor pollution, consequent SPM at dangerous levels in the atmosphere, and also the consequent impacts on human health.

There has been a worldwide movement going on against the socio-environmental impacts of coal power in the context of global warming, and a strong advocacy to move away from it towards renewable energy sources is gaining widespread support. According to the December 2014 release of Platts World Electric Power Plant database (WEPP), China retired 29,393 MW of existing coal plants from 2000 through 2014, and the United States retired 26,930 MW of existing coal plants in the same period. Between 2010 -14, 118,885 MW were cancelled and an additional 70,140 MW were shelved in China (i.e. put on hold). {Source:Global Coal Plant Tracker, EndCoal. Org.} In the United States, 20,503 MW of proposed projects were cancelled in the 2010-2014 period and an additional 3,150 were shelved. {Source: Global Coal Plant Tracker, EndCoal. Org.} For the period 2000-2010 in the United States, 110 proposed projects totaling 65,054 MW were cancelled in the United States. (Source: SourceWatch)

IPCC (AR 5) has also come to the conclusion that in order to limit the global warming to less than 2 degree C, more than 80% of all the fossil fuel reserves should be left in the ground. Keeping this long time target in mind many international agencies such as UN, UNEP and WHO; many governments such as US and Norway; many international financial institutions such as World Bank and European Bank, and pension funds etc. have decided to move away from coal power. Hundreds of coal power plants have been retired or halted in China and US during last 10 -12 years for these associated reasons of health and sustainability.

A joint statement by international community on the impacts of coal power has listed the following as main concerns:

- Coal is NOT cheap. It comes with a horrifyingly huge cost to people and the environment
- Coal is fuelling climate change, and exacerbating its impacts
- There is NO such thing as “Clean Coal”
- Coal is NOT about energy for all

A recent article published in The New York Times by Michael Greenstone (the Milton Friedman professor of economics at the University of Chicago, and a former chief economist of President Obama’s Council of Economic Advisers) has projected a grave scenario. It says: “ .... the use of all reserves and resources (fossil fuels) would lead to a total increase of 16.2 degrees (of the global temperature).”

In 2015 a group of CEOs (from 43 companies and 20 economic sectors with operations in over 150 countries and territories) have published an open letter to world leaders urging concrete climate action, with specific request to reduce environmental and carbon footprints, setting targets to reduce our GHG gas emissions and/or energy consumption.

*(<http://www.dsm.com/corporate/media/informationcenter-pub/2015/04/2015-04-17-open-letter-from-global-ceos-to-world-leaders-urging-concrete-climate-action.html>); accessed on 10.5.2015*

Even a heavily coal reliant country like Australia, is coming under increasing domestic and global pressure to move away from coal. A recent study by its Australian National University (ANU) has shown that it is techno-economically feasible and in the clear interest of the society there to move over to 100% renewable by 2050.

As per International Energy Agency projection the looming water shortages may be aggravated by an 85 per cent increase in water demand from the energy sector alone by 2035. In this context alone, India and the state of Karnataka, which are already officially known as water stressed, should be extremely careful as to what are the suitable energy options for energy requirements in future.



The issues confronting the power sector in India have been discussed in length in a book “Integrated Power Policy” released in year 2012. This book has discussed major issues of concern to the society and analysed how the reliance on projects based on fossil fuels, dams and nuclear power can be drastically reduced, replaced by renewable energy sources, and achieve minimum GHG emissions from the power sector. A separate chapter to the power sector issues of Karnataka has been dedicated in this book.

*(<http://freebookculture.com/integrated-power-policy-a-framework-for-people-centric-environment-friendly-and-sustainable-power-policy-for-india-shankar-sharma/>); accessed on 10.5.2015*

Should Karnataka, which has no known coal reserves, invest in importing the fuel, and contribute to the Climate Change, and all the associated threats to its communities?

### **Green energy potential remains untapped: MNRE**

April 16, 2015. India has 900 GW (900,000 MW) of commercially exploitable sources of renewable energy if 3 percent of the country’s wasteland is made available, according to the Ministry for New and Renewable Energy (MNRE). The renewable sources of energy include wind and solar power, biomass and waste-to-energy apart from small hydro power plants. The solar power potential of the country remains largely untapped with only 3 GW of installed power compared with 750 GW of potential. Wind power, on the other side, has been developed at a much faster pace with an installed capacity of 22.5 GW as on December 31, 2014 compared with a total potential of 100 GW. A State-wise list of renewable energy potential has been drawn up by the National Institute of Wind Energy, National Institute of Solar Energy, Indian Institute of Science for and the Alternate Hydro Energy Centre. The Ministry’s annual report for 2014-15 pegs the highest renewable energy ORF Centre for Potential in Rajasthan at 148 GW followed by Jammu and Kashmir with 118 GW. Both the States also have the highest amount of solar energy potential. While Rajasthan has embraced solar power and has the second highest installed capacity at 851 MW, J&K’s solar power potential remains completely untapped. However, despite the potential, only around 34 GW of renewable generation capacity is installed in the country, largely driven by wind power plants. Though the government has a target of having 175 GW of renewable energy generation by 2020, capacity addition in 2014-15 has been slow.

*(<http://www.thehindubusinessline.com>)*

Keeping in mind the fact that Karnataka has no fossil fuel reserve and that it is already stressed in fresh water supply, the true relevance of coal power to the state need to be carefully reviewed. In the context of all these issues the state should debate as to whether the increased reliance on coal power is in the overall interest of our communities, and whether it will be consistent with the ‘mitigation’ action needed w.r.t Climate Change. A dispassionate analysis is required as to why other benign alternatives such as energy efficiency, demand side management, energy conservation measures cannot be objectively pursued along with optimal usage of renewable energy sources (for which Karnataka has a huge potential) to meet most of the electricity demand in future. All these measures can come at much lower overall cost to the society and can be associated with vast benefits from social and environmental perspectives.

The REs are considered most beneficial when they are deployed in distributed mode such as roof top solar power systems. Following are the main advantages of distributed renewable energy sources as compared to the present grid based system of large conventional power plants:

- Will greatly reduce the effective demand on the grid based power supply system; will drastically reduce the T&D losses; and vastly improve the power supply to those consumers essentially needing the grid supply; much better voltage profile; leads to much reduced spending on grid management;
- Will drastically reduce the need for fossil fuel based, dam based and nuclear power stations and the associated transmission & distribution network; reduced complexity in system operation;
- Will assist in drastically reducing the GHG emissions and other pollutants;
- Will provide a sustainable, environmental and people friendly energy supply model;
- Will accelerate the rural electrification due to shorter gestation period of individual projects;
- Will lead to increase in rural employment opportunities, and hence assists in minimizing urban migration;

- Will require negligible or nil additional resources such as land and water;
- Their impact on the environment will be minimal, and they are inexhaustible;
- Lead to much reduced growth in demand for grid electricity;
- Avoided costs of recurring fuel expenditure and of peak load power stations;
- Absence of the need for people's displacement.

**“Towards a Green Economy – Pathways to Sustainable Development” is an UNEP document advocating wise investment in renewable energy. Its main findings are:**

1. Investments in renewable energy have grown considerably with major emerging economies taking the lead.
2. Renewable energy can make a major contribution to the twin challenges of responding to a growing global demand for energy services, while reducing the negative impacts associated with current production and use of fossil fuels.
3. Renewable energy can help enhance energy security at global, national and local levels.
4. Renewable energy can play an important role in a comprehensive global strategy to eliminate energy poverty.
5. The cost of renewable energy is increasingly competitive with that derived from fossil fuels.
6. Renewable energy services would be even more competitive if the negative externalities associated with fossil fuel technologies were taken into account.
7. Substantially increasing investments in renewable energy can be part of an integrated strategy to green the path of global economic development.
8. A shift to renewable energy sources brings many new employment opportunities, but not without transitional challenges.
9. Policy support will need to be expanded considerably to promote accelerated investment in renewable energy.
10. Government policy to support increased investment in renewable energy needs to be carefully designed in an integrated manner; there is no one-size-fits-all approach.

What is urgently needed for our resource constrained society is a careful choice of the most suitable energy option for a given category of consumers and in a given geographical area. It is already acknowledged at various levels of administration that a grid based energy system with large conventional power plants at the centre of focus cannot meet the energy requirements of rural areas in general, and remote villages in particular, satisfactorily. Most of the small and remote loads throughout the state can be and must be supplied reliably and economically with renewable energy sources locally.

If a majority of small loads, which we generally find in rural areas, are shifted to locally controlled renewable energy sources a considerable amount of power from the grid will be released, which in turn can be supplied to large loads such as factories and electric traction in urban areas. Such an approach will drastically reduce the need for conventional power plants, and hence lead to considerable reduction in GHG emissions. A holistic and objective outlook to meet the legitimate energy demand of the entire state is needed in this regard.

While the electric power sector is reported to be contributing heavily for the global warming phenomenon, the consequent Climate Change is also projected to impact the sector in many ways. Asian Development Bank's (ADB) Year 2012 report "Climate Risk and Adaptation in the Electric Power Sector" has discussed such issues as applicable to Asian countries. Electric power investment decisions have long lead times and long-lasting effects, as power plants and grids often last for 40 years or more. This explains the need to assess the possible impacts of climate change on such infrastructure, to identify the nature and effects of possible adaptation options, and to assess the technical and economic viability of these options. Vast demand for fresh water in the case of coal power plants is likely to be a determining factor whether to keep a coal power plant operating or not in the not too distant future because of the impact of Climate Change on fresh water resources. Also due to increasing incidences of sea borne storms and floods the power transmission network and coal power plants located on the coast are likely to be heavily impacted.

Many issues of the energy sector at the national level, which also have huge relevance to the state's energy sector should be considered in this context.

An article “Policy: Rethink India’s energy strategy” in Nature magazine of 13th May 2015 has rightly pointed out many issue of critical consideration from the perspective of GHG emissions in the country. This article says among other things: “ .. providing everyone with access to energy, securing energy supply and trying to limit carbon emissions without encumbering the nation’s growth should be the priority; .. the promise of reliable electricity through centralized infrastructure and systems remains unfulfilled; already, imports account for more than 80% of India’s crude oil and 25% of its coal and gas, raising worries about supply and price volatility; manufacturing consumes nearly one-third of India’s primary energy supply, and contributes to 16% of gross domestic product (GDP) and more than 20% of direct emissions. These emissions would grow, should India achieve its target of 25% contribution to GDP from manufacturing. The best opportunity for decarbonization, therefore, is the power sector — which contributes nearly 38% of overall emissions. Here, renewable energy could account for about 30% of the electricity mix by 2030.”

*(<http://www.nature.com/news/policy-rethink-india-s-energy-strategy-1.17508>) accessed on 14.5.2015*

At the global level what is left of the carbon budget does not allow any additional coal power plants to be built, while requiring the GHG emissions to be drastically reduced from even the existing coal power plants. Since the state has no coal reserve of its own, it cannot be called a prudent policy to rely of coal power plants to meet the growing electricity needs of the state. Fortunately there are much benign alternatives. If the state and the country as a whole has to play a responsible role in containing the GHG emissions, a low carbon pathway of our life style becomes sacrosanct.

Keeping all these issue in proper perspective the society needs to arrive at a rational decision on the relevance of coal power plants to the state.

### **3.2.7. “India as a potential leader in low carbon life style”**

The ever increasing demand for energy and materials associated with the growing population and the associated aspirations of people has taken the country to the cross roads where it has to carefully choose the correct path. Such a path should lead to meeting the legitimate demand of energy for all sections of our society at reasonable price, and on a sustainable basis. The two paths can be identified as: (i) to follow the path chosen by the western industrialized societies wherein high per capita energy consumption and high carbon path are essential features; and (ii) the Indian way of low per capita energy consumption and transformational changes towards renewable energy pathway with a heavy focus on simple and low carbon life style.

The gravity of the issues confronting our society becomes evident from the following issues: (i) about 77% of our petroleum products are being imported; (ii) the coal/fossil fuel reliant power/energy sector has not been able to provide electricity/energy for about 30% of the population even after nearly 7 decades of independence; (iii) about 40 of the country’s total population and about 80% of the rural population are dependent on forest bio-mass for energy; (iv) per capita energy consumption of the nation is one of the lowest in the world; (v) the carbon dependent energy sector is soon projected to make India the third largest GHG emitter; (vi) the growing population will demand few times more energy during next few decades; (vii) pressure on our natural resources to supply this much of energy will be enormous, and with a business as usual scenario the foreign exchange burden will be enormous; (viii) the investment needed in the energy sector if we are to continue in the business as usual scenario will be enormous, and will hamper our efforts in other welfare activities such as poverty alleviation, drinking water needs, health, education, hosing etc.

The integrated Energy Policy (IEP) document prepared in 2006 under the Planning Commission has discussed the serious energy sector issues confronting our society. It has also projected a huge increase in demand for various forms of energy by 2032 in a business as usual scenario, and also has stressed on the need for measures such as efficiency improvement, demand side management and conservation. However

the social, economic and environmental implications of such a demand, assuming that the country will make efforts to meet such a demand, have not been addressed diligently.

### **India's vast investment need in energy sector in a business as usual scenario**

India is looking at reducing energy consumption by 10% over the next five years but the country would still need \$100 billion in investments every year to feed its growing hunger for fuel and electricity.

"As we increase our energy consumption from one trillion units to two trillion units, we will be looking at a saving of 200 billion units by bringing down transmission losses," coal and power minister Piyush Goyal said at a conference organized by NITI Aayog and International Energy Agency on Monday.

Goyal said the government also plans to scale up the contribution of clean power to 15% of the 2 trillion units envisaged in the next five years from 6% at present. To meet the energy requirements, India needs "\$100 billion investment each year," IEA chief economist Fatih Birol said.

He said three-fourth of this investment would need to go into the power sector to create new generation capacity, transmission lines and distribution networks. The remaining funds would be needed for developing oil and gas fields, refineries and gas infrastructure.

*(Source: <http://timesofindia.indiatimes.com/business/india-business/India-needs-100bn/yr-to-meet-energy-demand-IEA/articleshow/>); accessed on 10.5.2015*

The total potential of solar PV and Solar Thermal in the country was estimated to be about 2,400 Million Tons of Oil Equivalent (Mtoe) per year in 2006 as per IEP. This is in stark comparison to the estimated total primary commercial energy requirement of the country in 2031-32 of about 1,700 Mtoe. What it basically means is that if enough emphasis is given, solar power alone has enough potential to meet all our energy demands.

It can be said that India in many respects is just beginning its journey on the path of the 'development'. Hence there is a rare opportunity to set a different development paradigm at least in energy sector. Obviously influenced by Chinese impressive 'development', expert recommendations from international institutions like the World Bank, and the general craze for ever expanding consumer material wants, India seem to have embarked on a unsustainable 'development' model. India should have devoted more time and its enormous talents in developing a viable but sustainable energy strategy.

Whereas the phenomenon of greenhouse gases resulting mostly from the increasing use of fossil fuels (coal, oil and gas) has now been accepted as a cause for global warming and climate change, the oil sector subsidies are said to be resulting in generating more than Rs 30,000 crores per year of black money. If LPG diversion is also included, as per some estimates, the black money can be more than Rs 50,000 crores per year. This can be termed as the mother of all corruptions in India.

As compared to automobile dependent US economy, fortunately India is still not close to reaching heavy dependency on auto industry for economic viability. Non-motorised transport and public transport is still a feature. India should have a well defined plan to reduce ownership of private vehicles and should promote public transportation. Many Indian cities seem to have reached the critical stage of complete break down, and life for most in such cities is unbearable because of traffic congestion, lack of drinking water, frequent brown outs and black outs, ever present garbage etc.

Even assuming that all our future energy production capacity, say by 2050, can be through renewable energy sources, there will certainly be nature's constraint as to how much total energy we can produce. Hence, while the energy experts consider it essential to move resolutely towards new and renewable energy sources, the society cannot ignore the need to minimise the total energy demand to a sustainable level through sustained and well thought our measures such as of highest possible energy efficiency, optimal demand side management and responsible levels of energy conservation with all the earnestness possible.

In a thought provoking article “India can be a shining example to solve energy crisis by Gandhian approach” Dr. Bhamy Shenoy, an expert in energy related issues at the global level say: “Sustainable living should not remain as a simple slogan. It should be the main deciding factor influencing India’s developmental and energy policies. The competition among countries should be not to increase per capita income or per capita energy consumption, but to have the lowest number of people below the poverty line. Human Development Index should be redesigned based on percentage of people living below the poverty line, educational achievement, longevity, discretionary time available to spend with family and friends, and inversely proportional to per capita energy consumption, murder rate, violent crimes and harm done to environment. These are the goals which Indians are familiar with thanks to our much celebrated civilization. By incorporating these at this point of our development, we can avoid the energy crisis and become a shining example to the world.”

“India’s energy consumption has increased from 415 million tons of oil equivalent (mtoe) in 1998 to 565 mtoe in 2007 at the rate of 3.5% per year. This is considerably less than the GNP growth of 6.7% per year. This impressive energy and GNP relationship does not reveal the disturbing trends in India’s energy sector. For developed countries when they were at the so called economic take off point, energy/GNP ratio was more than 1.0. The poor in India are continuing to depend mostly on the non commercial bio mass and agricultural waste while the rich in India is increasing the consumption of commercial energy sources.”

A “sustainable and just world order” requires a change to “simpler lifestyles”, “small, highly self-sufficient local economies largely independent of the global economy”, “more cooperative and participatory ways”, a “new economy . . . not driven by profit or market forces” and “different values” of “cooperation” and “frugality”.

*(Ted Trainer, “The Simpler Way”, University of New South Wales, <http://socialsciences.arts.unsw.edu.au/tsw/>); accessed on 10.5.2015*

Karnataka, having no fossil fuel reserve of its own, with fresh water scarce scenario, and with a huge potential in renewable energy resources has the critical need to consider all these issues in an objective manner and develop suitable action plan for a sustainable future.

### **3.2.8. Relevance of ‘Options Analysis’ and ‘Costs & Benefits Analysis’ in containing GHG emissions**

During the public consultations one issue which also figured prominently is how our society is taking decision to divert the rich natural forests without due diligence. As a developing country with vast number of people below poverty line and aiming towards a welfare society, we need to be absolutely certain that every resource and every rupee spent brings maximum benefits to the whole society; not to just to the project developer and to a small section of the society. A decision to benefit one section of the society should not lead to harm to other sections; and certainly not at the unacceptable cost of environment degradation. Without a rigorous economic analysis how can we be sure that a railway line through Western Ghats, or a road through central Indian forest, or a dam in Arunachala Pradesh is in the best interest of the society?

An example of how comparison of various options for a given objective can be useful in making a rational decision can be seen by a matrix for comparison of technologies suitable to Karnataka’ power sector **(Annexure 5)**.

Only an objectively conducted Costs & Benefits Analysis (CBA) preceded by ‘Options Analysis’ can provide satisfactory answer to such questions. CBA can be an effective mechanism to determine the least cost option for the society in a given situation. If deployed objectively it can capture all the direct and indirect costs and benefits to the society of a given project, and also can provide a realistic comparison of economic value of costs and benefits. Developed countries resort to such a rigorous economic analysis to determine the viability of power projects. This route, if taken up logically, will mandate the project developer to

discuss all the credible options to achieve a given objective (let us say meeting the increased demand for electricity for a city); take 3 or 4 of the best options from this group of credible options; subject each of them to CBA; compare them; apply sensitivity analysis to the best two options; and then only submit the best option for approval along with the detailed explanation as to why the next best option/options are not considered. Such a rigorous economic analysis through CBA would entail all the direct and indirect costs to the society, include the sustainability option and any intangible costs and benefits. The sensitivity analysis as an essential part of CBA will help to reduce the uncertainty associated with costs and benefits. In this analysis, the estimated costs can be increased and/or benefits decreased by 5, 10 or 20%, to see how various indicators such as Net Present Value (NPV), pay back period, Internal Rate of Return (IRR) or the ratio of benefits to cost will vary under different scenarios. As a much more vigorous analysis the costs are increased and the benefits are decreased at the same time to determine how credible a given option is. Sensitivity analysis in these options can reduce the uncertainty associated with costs and benefits. An objective comparison of all these options can provide the best option from the society's perspective.

### The example of Gundia hydel project

Karnataka Power Corporation Limited (KPCL) had proposed a 400 MW Gundia hydel project in thick rain forests of Western Ghats, Hassan district. The benefit of this project was mentioned as certain quantity of electrical energy at a low annual load factor of about 35%. But the true societal costs involved can be identified as huge. If an objective CBA is applied to this situation, many other credible options can emerge: (1) can we get 400 MW equivalent from replacing all incandescent lamps in the state with CFLs?; (2) can T&D loss reduction in the state from the present level of about 25% to 10% provide about 900 MW virtual additional capacity?; (3) how much power can be generated by the bio-mass of the identified forest of the project on a sustainable and environmentally friendly manner?; (4) how much savings in energy can be achieved if the project cost of about Rs. 2,400 Crores is deployed in energy efficiency and energy conservation measures within the state? All the associated costs and benefits of so many options can be rigorously analysed.

Even without a detailed economic analysis it is evident that the alternatives in this case have much better benefits to costs ratio. But in the absence of any legal mandate for such CBA, the project developer proposes only one option. In such a situation it is left to the civil society to undertake such CBA studies under a lot of constraints and oppose such ill-conceived projects.

Such a due diligent approach of Costs & Benefits Analysis (CBA) preceded by 'Options Analysis' to large projects, needing diversion of natural resources will go a long way in reducing the environmental impacts, and in minimizing the GHG emissions.

Without the mandate to provide such a rigorous analysis the project developers, including the Public Sector Undertakings, are known to be proposing ill-conceived project proposals. It is a matter of concern that many proposals of this nature may be getting license to implement the project with disastrous consequences. One example of a hydel project can better illustrate the relevance of CBA mechanism in finding the best option amongst various alternatives available in a given situation. In 1980s a medium size hydel project across the river Bedthi in Uttara Kannada district was shelved after few crores of money was spent on the project consequent to the demonstration by civil society groups that the total value of renewable bio-mass energy from the forests marked for diversion from that project was much more than the value of hydel power from that project.

An oft repeated statement while planning for new power generation schemes is that the capital cost of new and renewable energy sources (as alternative to conventional power plants) is exorbitant. Without taking all the direct and indirect costs to the society in respective life-cycles of different projects based on conventional technology, comparison of these sources on capital cost basis only with renewable energy sources will never be pragmatic. Whereas the coal, nuclear and dam based hydro power industries have enjoyed patronage in the form of many subsidies, tax holidays and freebies for a number of decades, the new and renewable energy sources had no such comparable patronage in even in the last 15-20 years

of their true existence. The externalities of the conventional energy sources, such as social, health and environmental costs which have been conveniently ignored in such comparison, if taken into objective account will clearly tilt the balance in favor of new and renewable energy sources. Additionally, since the fuel costs and O&M costs are negligible in case of new and renewable energy sources, if we compare the life cycle cost of the two technologies there will be no doubt as to which ones are better.

A UNEP document “Towards a Green Economy – Pathways to Sustainable Development” says: (i) The cost of renewable energy is increasingly competitive with that derived from fossil fuels; and (ii) Renewable energy services would be even more competitive if the negative externalities associated with fossil fuel technologies were taken into account.

- A modest understanding of the crises within power sector, may lead to the conclusion that an objective application of CBA model to conventional power projects is likely to reveal their unacceptably high environmental costs to the society, and the fact that the benefits from them largely accrue to the project developers only instead of to the larger society.
- If due diligence of Costs & Benefits Analysis (CBA) preceded by ‘Options Analysis’ were to be applied, many credible alternatives of much less overall societal cost could have emerged in projects such as the proposed Hubli-Ankola Railway line through forests of Western Ghats, or 400 kV power transmission line from Mysore to Kozhikode through forest of Coorg, or it could have avoided massive damage to environment because of iron ore mining in Bellary.
- At the global scale the value of ecological functions as well as resources of the environment has been estimated to be about \$33 trillion per year, which is almost twice the global domestic product (*reference: Bio-diversity Impact of Large Dams, prepared for IUCN / UNEP / WCD*). In this context if we care to assign a financial value to the ecological services associated with forests and fresh water resources in the country the enormity of loss to the nation’s economy in the form of destruction to forests, rivers and bio –diversity, which is happening every year, becomes evident. As per the Convention on Biological Diversity it will be a wise policy to apply Precautionary Principle and take necessary action to conserve Bio-diversity before components of it are permanently lost.
- In cases where diversion of forest lands is required, there can be no doubt about the huge loss to the environment and the society. Polluting projects or projects needing diversion of natural resources such as forest lands and water may have credible alternatives if due diligence of Costs & Benefits Analysis (CBA) preceded by ‘Options Analysis’ is applied.

### Precautionary Principle

World Charter for Nature was adopted by consensus by UN General Assembly in 1982. It has provided some guiding principles for protecting biodiversity (Bio-diversity Impact of Large Dams, prepared for IUCN / UNEP / WCD). Some key principles so enunciated are: (i) Activities which are likely to cause irreversible damage to nature should be avoided; (ii) Activities which are likely to pose significant risk to nature shall be preceded by an exhaustive examination; their proponents shall demonstrate that the expected benefits outweigh potential damage to nature, and where potential adverse effects are not fully understood, the activities should not proceed; (iii) Environmental Impact Assessment should be thorough, be given sufficient time, and be carried out in an open and transparent fashion.

### 3.2.9. “Public Consultation as an essential tool in sustainable economic development”

Another issue which was prominently raised in the public consultations is the issue of people’s participation in case of those projects where natural resources such as forests, agricultural lands, water, minerals etc. are harnessed. It is unfortunate that the many such projects, which are actually supposed to benefit the society, are instead associated with the accelerated degradation of the environment and the societal welfare in many respects. Projects like constructing large size dams, hydropower stations, industries etc. without due diligence have led to fast degradation of our natural resources. The concern in this regard was that even in a modern democratic society of ours the effective public consultation on projects of high

social impacts is almost negligible. People asked the question; isn't it high time we start inspecting the issue of public consultation?

A number of high profile projects have been stalled / delayed because the affected public was not taken into confidence. Effective public consultation from the early stages of project planning would have allowed many of these projects to see successful completion on time.

### Climate Mitigation Models for Karnataka

- *Karnataka should showcase some exemplary methods to demonstrate its willingness to mitigate the climate crisis. The aim should be to address three main issues, namely (1) drought (2) flood and (3) energy crisis and provide drinking water. Because it is necessary to attain a learning curve before the crisis actually looms it is imperative that following ten steps be taken on war footing.*
- *Showcase rainwater harvesting in one village in each drought prone district, particularly in Kolar and Chikkaballapura. The villagers should be trained to build the structure and attain technical expertise to maintain it to a level where the villagers do not need any other source of water from January till June.*
- *Showcase one solar village in each district such that the residents are fully self sufficient in all their energy needs. The villagers should be trained to set up and maintain similar facility in other villages too.*
- *Develop one Biofuel Orchard in each district to showcase the importance of energy plantations. It should have everything from seed nursery to oil extraction units. The villagers should be able to harvest at least 50% of their energy requirements from these plants in ten years from now and 100% in 15 years.*
- *At least one micro watershed in one Panchayat in each district should have zero surface runoff. Every drop of rainwater should be made to get into the aquifer even during heavy rainfall. This would showcase the methods to mitigate flood havoc and prevent soil erosion.*
- *Set up at least one desalination pilot plants in each district of the coastal Karnataka using solar energy.*
- *Showcase in each district one commercial dairy which runs all its operations including the cold storage using biogas alone.*
- *Showcase one brick kiln which does not burn agriculture wastes or timber yard wastes or paddy husks.*
- *Showcase one town in each district where there is a complete system of trash to methanization is in place. The energy so generated should be used to tertiary sewage treatment plants and the water is supplied to energy plantation.*
- *Showcase one taluk in each district where every school should meet its energy requirement from solar ovens for cooking mid-day meal.*
- *Showcase one watershed which includes a small town (preferably in a coastal district) where all the above 9 methods are demonstrated without any hitch.*

*Nagesh Hegde, Media Person and Columnist, Bangalore*

A hydel power project in 1980s across river Bedthi in Uttara Kannada district was stopped due to strong opposition from the locals despite the fact that an expenditure worth few crore of Rupees was already spent. Another example of such a waste of public money was in Uttarakhand state wherein a large hydel power project was stopped across river Bhagirathi after few hundred crores were spent. There have also been examples of where projects have been delayed by many years due to public opposition, resulting in huge waste of society's time, money and resources. Such large scale opposition generally leads to social disharmony. Effective public participation at all levels of the project would help to avoid such societal costs.

In this regard the practices prevailing in developed countries should be a lesson to our country. It becomes obvious that the public consultation is a norm in those societies. The government in these nations frequently carry out referendums, public opinion polls, online discussions etc, in order to enable the public to voice their opinions; not only are the voices being expressed but they are also being heard by the authorities concerned. Before reaching any decisions on major projects the government in those nations undertakes in-depth analysis of various options and hold discussions with all the affected sections of the society.



Whereas there is a provision for public hearing under EIA rules of MoEF & CC, the objectivity of public consultation is generally alleged to be lost because of the negligence of the concerned authorities in effectively following the norms.

In a welfare society such as ours, with a considerable percentage of population below poverty line and already threatened natural resources, effective public consultation with the stake holders will help in not only minimizing the hardships to the locals, but also will minimise the environmental degradation by choosing the lowest overall cost project option.

Effective public consultation is also a certain way of minimizing the corruption in safeguarding the biodiversity and other natural resources. The participating public wanted the same spirit of public consultation to prevail on which the State Government has asked for public consultations on Climate Change issues.

## References

- “Integrated Energy Policy”: ([http://planningcommission.gov.in/reports/genrep/rep\\_intengy.pdf](http://planningcommission.gov.in/reports/genrep/rep_intengy.pdf))
- “Economics of Hydro power”, Bharat Jhunjhunwala, Kalpaz Publications
- “Hiding Behind the Poor”, GreenPeace India; <http://www.greenpeaceindia.org>
- “Still Waiting”, GreenPeace India, <http://www.greenpeaceindia.org>
- “Energy Savings Potential In Indian Households From Improved Appliance Efficiency”, Prayas Energy Group, Pune
- “Radiological Impact of Airborne Effluents of Coal and Nuclear Plants”; Former ORNL researchers J. P.McBride, R. E.Moore, J. P.Witherspoon, and R. E. Blanco; December 8, 1978, issue of Science magazine.
- “Dams and Development: A New Framework for Decision-Making”; World Commission on Dams (WCD) ; <http://www.internationalrivers.org/dams-and-development-new-framework-decision>
- ‘Chernobyl 25 years later: Many lessons learned’: Mikhail Gorbachev, Bulletin of the atomic Scientists; (<http://bos.sagepub.com/content/67/2/77.full>)

## Chapter 4

# Recommendations from public consultation meetings



*'Sustainability' – of life styles and the nature*

The issues raised in the public consultation meetings have been compiled as 'Major Concerns', and 'Recommendations' under each economic sector.

The large number of recommendations received from the public has been compiled under 19 groups. They are also listed under two large headings: (i) Easy to implement and quick benefits – tactical in nature; (ii) Medium & long term benefits – strategic in nature. The first ones are those which are easy to implement, without much expenditure, and which can provide early benefits. The second group of recommendations consist those which need more deliberations and time, and some of which may also require amendment to the existing Acts.

Whereas the STATE needs to consider all of them urgently in the context of huge risks to our communities, the recommendations may have to be implemented in different phases.

### 4.1 Water and Sanitation

#### 4.1 (a) Major Concerns

- Pollution of rivers and water bodies was flagged as a huge concern in all meetings
- Pollution of Cauvery and other rivers due to illegal settlement on river banks
- Untreated / inadequately treated sewage and industrial waste entering the rivers and other water bodies
- Inequitable water supply to different sections of the society
- Lack of safe drinking water and hence the threat of diseases to many sections of the society
- Wastage of scarce water resources in agriculture and industry; high percentage of ground water for irrigation

- Absence of adequate efforts for rain water harvesting and ground water recharging
- Unacceptable number of bore wells came under a lot of criticism
- Violation of river bank conservation law was flagged as a major concern
- Unabated sand mining activities in rivers
- Lack of adequate number of toilets and safe drinking water in villages.

#### **4.1 (b) Recommendations**

##### **Easy to implement and quick benefits – tactical in nature**

- Urgent and focused need in water usage efficiency and conservation at all levels of the administration
- Rain water harvesting and ground water re-charging should be made compulsory in Government buildings, and in all large size buildings; say, with a built-in area of more than 2,000 sq. ft.
- Treatment and reuse of water from resorts and other large establishments should become mandatory.
- Pollution from various religious activities at temples and religious ceremonies such as Ganapathy processions should be effectively checked
- Pollution of rivers and other water bodies from the agricultural run-off of water from agricultural fields which use chemical fertilizers and pesticides should be prevented at all costs.
- The regulations on the number and operation of bore wells should become effective.
- The serious crises due to unabated sand mining activities in rivers must be addressed effectively
- Accurate measurement of water drawn from every bore well, and sustainable management of the same.
- De-silting of dams, lakes and other water bodies should be scientifically undertaken with active participation of the locals.
- Specific water consumption guidelines for industries and agriculture should be developed urgently and implemented over next 5 years.
- The existing open wells should all be rejuvenated and harnessed optimally; they can be very critical in the context of looming CC implications
- Water auditing at every stage of the usage in all sectors of our economy has become imminent.
- Waste water recycling, which is already a standard practice in countries such as Singapore and in Middle East, should become a norm in the state.
- Focus / awareness on general sanitation and toilets at the societal level have become urgent.
- Collection of RWH charges before construction permits given for buildings should be considered.
- Proper pricing strategy for re-cycled water will encourage the re-use of water
- Building of suitably designed check dams on the slopes of hills should be encouraged.
- Low cost technologies on water and sanitation should be identified /developed and provided for the water deficient rural population.
- Suitable alternative for sand in construction industry should be popularised
- 100% treatment of water and re-use should be a must at industries and large establishments
- Policy decision needed to make it mandatory for Government buildings to use the treated water wherever possible
- Huge potential for RWH and ground water recharging in large industries and other premises should be harnessed
- Conservation of all water bodies and catchment areas should be of high priority for the departments of water resources, forestry and revenue.

##### **Medium to long term benefits – strategic in nature**

- The issue of water usage intensity should be studied in every sector of our economy, and suitable standards should be set.
- Equitable distribution and price issues should be addressed for the entire state

- Responsible water shed management upto the levels of Village Panchayats
- A huge emphasis is needed at the state levels to ensure the purity and adequacy of flow in all the rivers, especially in the river Cauvery since a considerable percentage of state's population is dependent on it.
- Adequate flows or "environmental flows" in our rivers should be ensured.
- ETPs on the tributaries of Bedthi river in Uttara Kannada district was stressed to keep the purity of its water. The same requirement was emphasised for all other rivers.
- The need for development of suitable forecasting models for effective forecast of water availability in different climate zones to assist farmers in the changed climate conditions was stressed.
- High percentage of ground water usage for irrigation needs urgent and suitable regulations.
- Case studies and best practices in water management and re-use should be advertised widely
- Effective flood forecasting is needed in view of the projected increase in flash flood and intense rainfall events.
- Strict and implementable target dates for local bodies for action on water sanitation and waste management should be issued.
- Awareness on potability of river water as compared to borewells, and the need to avoid mixing them should be launched where it is relevant.
- Effective water budgeting and auditing across industries and agriculture should be implemented
- Instead of large water diversion schemes over hundreds of KMs, such as Yettinahole project, rain water harvesting schemes such as ponds, lakes, open wells should be taken up for sustainable water supply.

## 4.2 Land use and planning

### 4.2 (a) Major Concerns

- How much of forest lands can we afford to loose further in the context that the forest & tree cover is already much below the national forest policy target of 33%?
- How much of the fertile agricultural land can be diverted to other uses appreciating the fact that the growing population will need much more food than has been possible with the shrinking agricultural land?
- Can we afford to loose other ecologically sensitive land covers such as marshes, lagoons, wetlands, river banks, river deltas etc. without reaching the tipping point for the global warming?
- Poor planning and lack of buffer zones while creating industrial clusters
- In adequate care in allotting lands for industrial parks to minimize the non-usage of such lands; example of Belur industrial area near Dharwad, where substantial lands, which were acquired from agricultural usage, but not being used now. Many examples of SEZ were also highlighted.
- A common complaint in all the public consultation meetings was that there is no strict enforcement of all the relevant Acts.

### 4.2 (b) Recommendations

#### Easy to implement and quick benefits – tactical in nature

- River banks, catchment areas for rivers and tanks should be kept free from any other usage
- Properties with more than certain size (say more than 4,000 Sq. feet) should be encouraged to process the solid and liquid waste within their property through approved environmentally friendly methods; subsequently there should be a sort of penalty for violations.
- Efforts should be to maximize the vegetation cover on the land, including all vacant lands, even if for a temporary periods
- A diligent approach should determine as to how much of our lands can be converted from forestry and agriculture

- Scientific zoning of land usage for industries and residences must become a norm to optimize the processing of industrial wastes.
- Protection of top soil and fertile soil should be a major focus in such usage changes
- Areas under KIADB should not be transferred for housing purpose without due care for all the related issues such as water, drainage and sewage facilities
- Frequent violation of Karnataka Revenue Land Act should be stopped
- Suitable guidelines and initiatives should not only be developed but strictly implemented while allocating the lands for various projects to optimize the usage of diverted lands.
- The new residential / industrial /commercial layouts should have wider roads to facilitate not only the growth of trees on either sides but also to ensure smooth movement of vehicles to minimise the vehicular pollution

#### **Medium to long term benefits – strategic in nature**

- Land usage and conversion issues should be addressed through scientific approaches through which the GHG emissions are kept at the minimum levels
- Appropriate planning of land usage changes backed by consistent and well thought out policy should be adhered to.
- Relevance of Kerala's Act on land use change to Karnataka should be studied to protect fertile and marshy lands
- The emphasis should be on planned settlement and based on scientific approach and wide public consultations; sustainable planning activities should be the criteria
- Integrated and scientific approach to land and water related projects
- Necessary arrangements should be made to protect all vacant government land in urban spaces by fencing and guarding to provide not only adequate space to grow urban gardens, but also for earmarking clearly identified space for temporary shelters during disasters

### **4.3 Forests and biodiversity**

#### **4.3 (a) Major Concerns**

- Whereas the forest and tree cover has been about 20% for many years as against the national forest policy target of 33%, the diversion of forest lands for other purposes is continuing unabated.
- Vast number of species of flora and fauna may be getting extinct every year because of the unsustainable pressure on the natural resources; and the consequences of such depletion of species can be grave
- Whereas India has been a signatory of UN bio-diversity convention to safeguard the bio-diversity through objective application of Precautionary Principle, the participants notice scant regard to the provisions of this convention.
- The human – animal conflicts as being noticed in the areas adjacent to forests are symptomatic of the grave issues confronting our natural resources.

#### **4.3 (b) Recommendations**

##### **Easy to implement and quick benefits – tactical in nature**

- Until the forest and tree cover in the state reaches a level of 33%, as per National forest policy target, no additional forest land diversion should be allowed.
- There should be much higher focus to improve and preserve the forest and tree cover by various departments / agencies of the state Government , the forest department in particular, and all the stake holders such as industries, Village Panchayats, municipalities, city corporations, educational institutions, private entrepreneurs etc.
- Unscientific felling of trees on road side by various agencies, especially during the road widening

- projects, should be completely eliminated.
- All possible measures should be taken to widen the road on one side only so that the existing trees on the other side can be saved. Effective consultations should be held with the locals to minimize the tree felling.
  - There were very strong demands for planting of compensatory trees in adequate numbers before an existing tree is felled. Additionally, a specific agency, preferably that agency which cuts the tree, should be mandated to grow the newly planted trees for a certain number of years.
  - Quality against quantity in plantations, and preference for local varieties / bio-fuel species should be of adequate focus. Fruits and flower varieties should form about 50% of such population.
  - Suitable payment for ecological services associated with trees should become an attractive incentive for people to grow and preserve more trees. Increased focus on social forestry and agro forestry will be benefited by such incentives.
  - Various plantations and coffee estates were viewed as repositories of plant diversity, and as contributing to preservation of tree cover. Regular auditing of trees in these places should be held and adequate carbon credits for maintaining these trees should be provided. This is the only way of discouraging the monoculture practices.
  - The increasing need for eco plantations on waste lands, such as revenue lands, estates of other Government agencies such as railways. Tree plantations should be earnestly taken up on unused waste lands, even if for only few years before the land is used for other prior identified purposes.
  - Improper utilization of CAMPA funds and the unused amounts in it were quoted as the major reasons against diversion of forest lands. The need to assign this responsibility to one or more specific agencies was stressed on. There was also a suggestion that until the funds in CAMPA comes down to 50% of the funds needed for the next two years of compensatory afforestation activities, no new clearances should be given for diversion of forest lands.
  - There have been allegations that some of the responsible agencies are getting paid by industries for compensatory afforestation but the same is not carried out satisfactorily. Compensatory afforestation should be characterized by local varieties of high ecological value and reliable statistics on afforestation.
  - The necessity to protect the existing sacred groves was stressed. Number and extent of sacred groves should be increased. Medicinal and herbal species should become an essential part of such efforts.
  - The havoc created by the plantation of alien species such as Acacia and Eucalyptus in place of native species in forest areas came up for heavy criticism. There was widespread agreement that such alien species, only if proved absolutely essential, should be grown in non-forest areas of north Karnataka with due diligence. Elimination of alien species in forest areas and replacement by local species in 5 years should be an important target for the state.
  - Massive tree plantation drive by all the Government agencies, similar to polio eradication drive, should be launched until the forest and tree cover reaches 33%; and a time bound programme for developing adequate tree canopy in forests should be undertaken.
  - The importance of managing micro-climate around individual premises, such as residences, educational institutions, hospitals, offices, industries, agricultural plots etc. should be spread through effective awareness programmes.
  - Conservation of 'Soppina Betta', the importance of which were recognized even by the British rule, should become a high priority in hilly areas.
  - The need for creating bio-diversity register in each village as per bio-diversity Act and development of bio-diversity interpretation centres in each taluk /district was stressed.
  - 'Pavitra Panchavati' (herbal garden) at every village should become a mandate for the horticultural department.
  - There is the need for publication of accurate and adequate information on forest cover every year.

- Protection and development of water bodies, such as rivers and lakes, will help in growing more trees, and if taken on a priority basis can go a long way in preserving the ecology of forests while protecting the animals.
- Extreme care, due diligence, and objective application of 'Options Analysis' and 'Costs and Benefits Analysis' was stressed as essential before finalising linear projects through forests such as power transmission lines, dams, railway lines, roads, water diversion projects such as Yettinahole project etc.
- Such large scale linear projects should be minimised / avoided with all the seriousness they deserve because they lead to fragmentation of forests and human –wild animal conflict, and have huge impacts on wild animals like elephants and tigers.
- Those projects requiring tree felling should be avoided by choosing less benign options.
- Whereas the traditional knowledge of the usage of mango and neem leaves, and banana shoots residence, during religious occasion, to cleanse the indoor air should be propagated for general health of the communities, the usage of the same in public functions for decoration purposes should be minimized in order to save such plants in the nature.
- As a suitable alternative option, there should be massive encouragement to grow these plants throughout the state in all vacant lands in view of the fact that they are major carbon sinks
- A major drive by the forests department to grow and nurture large number of local fruit species, such as mango and jack fruits, in forests so as to minimise the monkey menace in adjoining areas
- Hold effective consultations with the stakeholders to consider banning of vehicles in forests between 6.00 PM and 6.00 AM throughout the state
- The decision to ban the plying of vehicles through the reserve forests in Chamarajanagara district should not be reversed
- In the same context all perspective plans to create new roads or for widening roads for vehicle movement in forest areas should be dropped
- Resorts in forest areas should be minimised or eliminated all together to enable the nurturing of forest ecology
- Even a mini/micro hydel power plant should not be allowed unless it is for the use of a single local community or a single house within the forests. Even such exceptions should be diligently considered to ensure zero loss of local bio-diversity, and all possible measures to find suitable alternatives should be examined.

#### **Medium to long term benefits – strategic in nature**

- Increased intensity of rains (heavy rains in short durations) in recent years leading to aggravated soil erosion was highlighted; and the absence of adequate forest and tree cover was squarely blamed for this phenomenon. Major focus should be to reverse this phenomenon to the extent possible, and prepare the population to adapt to the threats from this phenomenon.
- In view of the fact that more and more forest lands are being diverted for agricultural purposes also, there were strong suggestions on 33% tree cover for agricultural sector also. Bio-fuel species as fringe crops in farms were preferred. Suitable incentives in this regard may be considered. Adequate encouragement for tree farming.
- Instead of diluting various environment related Acts, they should be further strengthened to protect bio-diversity remaining in our forest lands.
- Keeping in view the fact that the forests in UN heritage sites of WGs in the state have already been degraded to a dangerous level (less than 1 % of dense forest cover) no more infrastructural developmental works, including roads, railway lines, and power transmission lines in the forests should be taken up.

## 4.4 Western Ghats

### 4.4 (a) Major Concerns

- Poor appreciation at all levels of the Government of the true relevance of WGs to the overall welfare of the state, and specifically in the context of CC.
- Disregard for the credible recommendations of the expert committees such as WG task force, WGEEP etc.
- Impact on fresh water availability in the rivers of the state and on various ecological services because of the huge pressure on the WGs through various infrastructure projects.
- There were also concerns that one operating coal power project in the foothills of WGs on the coast may lead to long term damage of the vegetation due to pollutants such as Sulphur di-oxide, which is likely to cause acid rains due to the moisture from the ocean.
- I the impact of alien species and weeds, such as Acasia and Eucalyptus, on the local flora and fauna.

### 4.4 (b) Recommendations

#### Easy to implement and quick benefits – tactical in nature

- It is much easier and vastly beneficial to protect the existing forests than to destroy the natural forests and to try and grow artificial forestry in a different place.
- Strong focus should be on the preservation of bio-diversity, and controlling alien plant species.
- Utmost priority to protect the natural forests of WGs as in addition to the proposal under Green India mission for reforestation on all degraded forest lands of the region.
- Complete ban on small and large power projects in the area such as coal and hydel power projects, including power transmission lines. In this context the people were firm in their analysis that already a number projects for hydro electricity and power transmission have done a lot of damage to the ecology of WGs, and the precious ecology of the region can no longer take additional damages.
- Diligent studies to minimize alien species and weeds, such as Acasia and Eucalyptus in the region are urgent needs.
- High level of water and air pollution in Dandeli area of Uttara Kannada district due to many industries in a small area need urgent remediation.
- Because of the huge deleterious impacts, a complete ban on any sort of mining, including sand mining of the rivers, in WGs was strongly recommended.
- Sustained and focused action plan to conserve and develop the herbal treasure trove of areas such as Kappathagudda in Gadag district were stressed.
- Suitable Incentives should be considered for assisting in growing bio-diverse and local species within and the adjacent areas of WGs.
- Damages due to monoculture of shading trees in estates within the WGS should be minimized by persuading, and mandating if necessary, to practice certain percentage of bio-diversity.
- Sacred groves, which have huge significance in conserving the ecology and which have been practiced for thousands of years, should be massively increased
- Adequate bio - diversity of local variety in plantations should be encouraged
- There is an urgent need for declaring / protecting ecologically sensitive areas in WGs in an objective manner, and by taking the local people into confidence.
- In view of the fact that the forests and coffee estates of Coorg district are critical parts of the global bio-diversity hotspots, and since they are also contributing to the health of few rivers including Kavery, suitable financial incentives should be considered for the ecological services being provided by them.
- Tourism in some hilly districts, such as Coorg, are leading to major environmental degradation, and hence need to be adequately addressed through close consultations with the locals.



### Medium to long term benefits – strategic in nature

- Any amount of short term sacrifice or financial expenditure in conserving the ecology of WGs was advocated as vastly essential as compared to the long term devastation associated with the degradation of WGs.
- Different set of measures, including a comprehensive Act if found necessary, to preserve ecology in hill districts of the state were emphasised.
- Whereas there were strong recommendations to fully implement the recommendations of WGEEP report, there were also recommendations to further strengthen the conservation measures of WGs.
- Coorg and the other hilly areas should be considered for payment for their ecological services (PES).
- Forest restoration projects should not be done by monoculture plantation. The original indigenous mixed varieties must be planted
- Ban linear projects such as Yettinahole water diversion or Netravathy water diversion projects
- Kodagu is the Principal catchment area for Cauvery River and provides almost fifty percent of the total inflow. Therefore, it would be ideal to take Kodagu as a model district for PES and then apply the same concept to other Western Ghat Districts of Karnataka.

## 4.5 Coastal Ecology

### 4.5 (a) Major Concerns

- Coastal erosion other pollution threats to the coast are major threats
- Ever increasing Coastal Constructions and large projects such as power and ports
- Levelling of Sand dunes and salination of agriculture land
- Destruction of Sand dune flora and other flora and fauna
- Construction of Buildings in the 200 metre mark from High Tide Level
- Reduced forestry and rainfall
- Sand mining on the shoreline; dredging and constructions on the shoreline
- Construction of sea wall in the erosion prone region; reef constructions
- Substandard constructions along the estuarine bank and sea water intrusion & salination
- Destruction of mangroves, aquaculture and salination of drinking well water and agriculture land
- Indiscriminate Sand mining in the estuarine area.

### 4.5 (b) Recommendations

#### Easy to implement and quick benefits – tactical in nature

- Coastal erosion and other pollution threats to the coast need to be addressed earnestly and holistically
- Massive efforts to rejuvenate the depleting fish population due to over fishing should be launched
- The recommendations made in various studies on the coast, including the DANIDA report, should be seriously considered for effective implementation.
- Pollution of sea water due to effluents and untreated sewage should be eliminated through adequate number of effluent treat plants and sewage treatment plants.
- Higher expectations of the people on the cleanliness of the coast should be respected.
- The red category industries in Dakshina Kannada district should get adequate focus in pollution control measures; and gradually eliminated
- Revenue generation opportunity from waste management should be effectively used as a tool to minimize such pollution
- Danger of salt water ingress due to reduced flow in rivers should be taken seriously in the context of supply of fresh water to the people on the banks of coastal rivers.
- The lack of adequate animal husbandry activities in the region should be overcome by suitable policy interventions

- Continued licensing of polluting industries is considered a major threat to the coastal ecology, and hence should be carefully reviewed.
- Need to restrict additional large size projects on the coast; already many industries present
- Threat for the nesting site of Olive Ridley should be eliminated
- Legal enforcement of clean beaches and pollution fines should become a priority
- Health of estuaries should be protected from a holistic perspective
- Preservation of Kagga type local rice species needs a lot more attention
- Bee keeping in Kandla forests should be taken up in large scale
- There were serious concerns on Tadadi and Honnavara port proposals; there are already many ports in the region, and they need to be optimally utilized
- Additional trains on Konkan railway route should be a measure to reduce road transport pollution
- Diversion of forest lands should be completely banned
- Compensatory forestry should be made compulsory
- Careful management of fishing in estuaries and sand mining
- Massive campaign on mangrove forests restoration and enhancement
- The threats of large scale industrial corridors such as petrochemical industries with huge pollution potential should be diligently addressed
- All industrial project proposals need effective stake holder consultation
- The concept of stone walls for coastal erosion need to be reviewed scientifically
- Reconstruction of open beach with sand dunes and dune flora (green belt) and prevention of further destruction needed.

#### **Medium to long term benefits – strategic in nature**

- Reduced paddy cultivation in the region impacting the local economy should be studied
- There is a need for suitable studies on the carrying capacity of each coastal taluka / district and the region as a whole before planning for any large scale projects
- Reduced oxygen content in sea water, suffocation for marine creatures, fish population moving away due to pollution impacts should be addressed
- Scientific study needed for additional fishing Jetty
- Full implementation of conservation action before project implementation should be mandated.

## **4.6 Agriculture, horticulture and animal husbandry**

### **4.6 (a) Major Concerns**

- Due to various reasons the number of people actively engaged in these sectors are moving away, which can be a cause of major concern from the food security point of view.
- As a consequence the land use changes and the associated GHG emissions are also the major concerns
- Unsustainable practices are not only making these activities inadequately remunerative, but also leading to the pollution of land, water and air, and the contamination of food products

### **4.6 (b) Recommendations**

#### **Easy to implement and quick benefits – tactical in nature**

#### **Key adaptation measures in agricultural practice to climate change include:**

- Changes in practices to adopt to climate impact – change in sowing dates, change in crops, use of drought resistant variety, etc.
- Changes in water management for efficient water use – rainwater harvesting, drip irrigation, mulching
- Increase the level of awareness in rural area with respect to new sustainable technologies
- Agricultural diversification – multiple cropping like planting horticultural/ commercial trees with

- cereal and vegetable crops, and crop rotation
- Reducing the bureaucratic hurdles for the farming community
- Increase in the production and distribution of improved seeds and other agricultural inputs
- Agricultural information systems – free and ready information on internet, toll free telephonic advice, and SMS advise
- Adaptation of new sustainable technologies such as SRI
- Crop insurance and communities training for adaptation of natural calamities through self help groups.
- Adopt sustainable agriculture that uses:
  - no tillage or minimum tillage, no chemical fertilizers or pesticides, but uses only organic fertilizers that put back plant residues and animal waste on to the soils enriching them in the process, and increasing absorption of more carbon from the atmosphere
  - Nitrogen-fixing leguminous trees should be planted 30 feet apart in fields growing food crops or commercial crops
  - Subsidize such farming wherever necessary
  - Levy heavy taxes on chemical fertilizers, pesticides and weedicides
  - Tax appropriately the excessive use of irrigation water that runs into water bodies polluting them with nitrogen and phosphorus, and cause production of N<sub>2</sub>O which is a highly potent GHG.
  - Stop cutting forest trees for planting plantation crops
  - Encourage and subsidize growing fruit and/or nut trees that increase food production
  - Return all crop residues back to the soil rather than using it for producing animal feeds, to increase the carbon content of soils
  - Reclaim huge tracts of encroached forest lands, and reforest them, except those that are used by poor farmers for subsistence farming
  - Encourage building energy efficient smaller houses, multistoried houses occupied by several families to minimize conversion of agricultural land for building houses etc.

#### **Other recommendations:**

- Rice farming, which has traditionally been associated with huge consumption of water, is also known to be possible with much reduced water consumption through a system known as SRI. In view of larger requirement of water the amount of rice grown should be carefully linked to the amount of rice required in the state, the overall demand, and good returns to the farmer.
- Alternative staple crops such as ragi, maize, millets etc. which are known to demand less water, and which are also suitable for large areas of arid north Karnataka should be encouraged in massive scale.
- Karnataka's natural advantage, because of which it is the largest producer of raw silk, sandalwood, ragi, sunflower, tomato, coffee, spices, aromatic and medicinal plants, and the second largest producer of maize, sunflower, grapes, pomegranate and onion should be fully harnessed.
- Horticultural crops and floricultural production, where Karnataka occupies strong positions, also should be vastly encouraged. Fruits and nuts, and many types of vegetables which are not very water intensive, should be encouraged to be grown in adequate quantities so that the demand for water intensive rice comes down.
- The other water intensive crops such as sugar cane and arecanut should be carefully managed so as to make them optimally water efficient.
- Suitability of arecanut, which is not a food product, and which was originally found suitable to valley of Western Ghats region with plenty of water availability, should be carefully considered before efforts to grow in other areas because of its high water requirement.
- Water usage in agriculture/horticulture/floriculture should be scientifically priced / regulated such

that most optimal value of a scarce resource is accrued to the society. Any subsidy in its usage, if considered essential for any group of users, should be carefully targeted to ensure maximum overall efficiency.

- In view of large areas of arid and semi arid nature in the state, widespread use of scientific dryland farming practices such as horticulture should be encouraged in northern, eastern and central parts of the state.
- Wide spread use of renewable energy sources such as wind, solar and bio-mass at individual household level or community level should be encouraged in lighting, water heating/pumping, crop drying and processing applications. Adequate technical/financial assistance should be provided.
- Many indigenous species such as jack fruit, mango, gauva and banana have huge potential to reduce the dependence on water intensive crops, and have huge significance in nutritional value to the locals; hence should be adequately protected and encouraged.
- Impact on agricultural production from the pollutants, chemical fertilisers and pesticides should be informed to the public
- The projected impacts on our food and dietary needs due to Climate Change should be disseminated widely
- The farmers should be assisted with accurate forecasting of weather
- The importance of organic farming and appropriate policy should be focused on
- The credible risks of genetic contamination should be carefully addressed
- Widespread usage of solar energy, gobar gas and wind power (wherever feasible) should be the sustainable energy pathways to our farmers not only to make their lives better but also to make them sustainable
- There is a critical need for development and usage of bio-char to reduce the reliance on fossil fuels
- The issues with unscientific cultivation of ginger should acquire adequate prominence
- The preference, amongst some farmers, to shift to cash crops against food crops should be addressed appropriately
- The farming communities should be persuaded to retain soil fertility and reduce soil erosion through sustainable means, and the same should become a priority for the Agricultural Department .
- Reduction in the population of cattle, birds and bees need to be addressed effectively
- Nitrogen fixation in the soil through natural methods should become a common practice
- Nitrate leaching through collective rearing of animals should be a feature in farming
- In the case of small agricultural land holdings as prevailing in the state, aerial spray of pesticides has no place, and hence should be banned completely
- Effective incentives for cardamom plantation in the role of increasing the bio-diversity should be considered
- The role of tobacco cultivation / processing in Hassan and Mysore districts from Climate Change perspective should be diligently reviewed
- There should be an early end to the use of Endosulphan
- Usage of bio-pesticides in place of chemical pesticides should be encouraged widely across the state along with a target end year for the use of chemical pesticides in the state.
- Small size flower plants and herbs instead of lawns should be considered all over the state
- Community support and proper price for agricultural products should begin early and subsequently extend for organic agricultural, horticultural and floral products
- Encouragement for localized production and consumption of food items is needed
- Efforts to bring much higher efficiency in agriculture should be launched immediately to make up for the loss of agricultural lands for other uses, and looming threat of water scarcity due to CC
- Short duration and drought resistant crop varieties should be encouraged
- Huge focus is needed on dry land agricultural issues

- Compulsory water ponds in agricultural farms should become a standard practice
- Huge focus needed on biological control of weeds
- Ban on diversion of agricultural lands except for few essential infrastructure projects should be seriously considered
- Adequate control on the run-off from agricultural lands to fresh water sources to prevent chemical contamination
- Bio-fuel species for greening/fencing/shading should be encouraged with financial incentives of necessary
- Usage of various kinds of bio-waste for farming practices should be encouraged
- Encouragement of millets in mid day meals
- The impact of unreliable grid electricity on agriculture should be addressed by encouraging the use of solar powered IP sets, but care is needed to optimize the ground water usage

#### **Medium to long term benefits – strategic in nature**

- Spices and sandal wood for which Karnataka has been known for ages, and which are also environmentally friendly, should become the centre of focus of again.
- Permission to cut tress after 20 years in one's own estate/land should be considered in order to encourage greening of the landscape
- The level of encouragement for organic vegetables and organic farming should be increased many folds
- The farmers should be helped with adequate knowledge on change of crops and cropping pattern to adapt to CC; pulses and cereals should occupy a prominent role because of their suitability to reduced water and increased temp. conditions
- The role of plantation emissions should be properly accounted for in mitigation measures
- Farmers need to be provided with fairly accurate projection of agricultural yields during distress years as an adaptive measure
- As used to happen in the not too distant past, there should be concerted efforts at the community levels to preserve certain level of buffer stock of food grains and quality seeds for distress years.
- Appropriate insurance cover against crop loss for farmers, after giving them adequate advance information on the risks for a given crop, should be considered.
- Carbon credit for traditional and sustainable agricultural practices should be seriously considered
- There should be adequate encouragement for terrace gardens, at least in urban areas.
- Adequate focus needed at the societal level on possible impacts from Climate Change on agriculture and horticulture
- Encouragement/ mandate for drip irrigation for all kinds of crops, especially in water deficit areas should become a norm
- Co-operative farming, integrated farming methods and water conservation should become widely practiced ways of life for our farmers
- Suitable guidelines for a minimum no. of crop variety for individual farmers to ensure crop diversity
- Much higher and effective role for agricultural Universities in dissemination of knowledge to mitigate and adapt
- Appropriate levels of duties on chemical fertilizers and chemical pesticides should be levied
- Community supported agriculture and price support should encourage farmers to remain in farming profession
- Micro/ drip irrigation should be encouraged/ mandated for water intensive crops such as rice and sugar
- Encourage even the farmers to dedicate 1/3rd agricultural land for tree planting
- Enhancement measures for the live stock of local varieties for farm applications

- Suitable adaptive guidelines should be issued by agricultural universities on agro-climatic zones
- Identifying and conserving the draught resistant agricultural seeds
- Overcoming difficulties in expansion of agriculture to dry areas
- Farmers should be helped to regain the self sufficiency they enjoyed once
- Adequate encouragement for cotton and cotton products
- Identifying and adapting agro-eco zoning methodology for all agricultural crops

## 4.7 Food, dietary needs and human health

### 4.7 (a) Major Concerns

- The poorer sections of our society, which are all suffering from nutrition related health problems, will face additional risks due to CC.
- Vector borne diseases and water related diseases, which will impact all communities, are not being given due importance
- Chemical contamination of food articles are not only impacting the health but also are contributing to GHG emissions

### 4.7 (b) Recommendations

#### Easy to implement and quick benefits – tactical in nature

- There is a need for taking action on high pollution levels, and the initiative should be taken by the health department in collaboration with the pollution control board and the local authorities.
- Social and health impact assessment of any developmental plan should become mandatory.
- Improve the health of general population by educating people on developing a holistic and healthy lifestyle that includes consumption of substantial quantities of organic vegetables, fruits, whole unrefined grains, oilseeds, other seeds and nuts.
- If the usage of non-organic / pesticide-polluted vegetables and fruits becomes inevitable, use only those that can be peeled off to remove polluted peelings
- Minimise the usage of refined flours such as maida, white flour, polished rice, and flours of other grains from which the highly nutritious bran has been removed
- Use oilseeds that contain rich proteins, minerals, vitamins and fiber, rather than vegetable oils that contain only fats. Preferably use peanut oil (groundnut oil), canola oil, olive oil or sesame oil, rather than palm oil, sunflower oil or even soya bean oil
- Reduce consumption of bakery products and soft drinks that contain baking powder which destroys some B complex vitamins in the body and thereby cause nutrition deficiency diseases
- As far as possible, use locally grown organic products that do not require transportation to reduce CO<sub>2</sub> produced by fuels used for transportation
- Dietary guidelines to the common man to discourage to minimize the impacts of inorganic chemicals.
- Massive awareness and educational campaigns on the risks faced in ready made foods and the precaution needed in consuming such foods.
- The importance of consuming locally grown fresh food, fruits and vegetables should be highlighted.

#### Medium to long term benefits – strategic in nature

- Capacity building of health department and all other health agencies (such as medical colleges and public health schools) should be strengthened
  - in the context of role in disaster mitigation and relief
  - in liaising with other departments
  - in both mitigation and adaptation
  - in adequate engagement with the pollution control board and municipal corporations on health related issues from CC context

- Encourage farmers to adopt sustainable agriculture that uses no chemical fertilizers or pesticides, but uses only organic fertilizers or pesticides .
- Massive public awareness campaign on the relationship between food, agriculture, health and CC.

## 4.8 Waste management

### 4.8 (a) Major Concerns

- Waste management has been highly inadequate and unscientific having hue impact on CC and human health
- The ineffectiveness of various agencies in the state in managing the waste has flagged as a major concern for the participants
- Strict implementation of pollution related Acts
- Pollution and contamination of fresh water resources and of air from untreated wastes
- Dumping of waste by resorts in Kodagu and other hilly regions
- Poor waste management by local bodies
- Absence of route optimization for solid waste collection leading to higher diesel consumption
- Absence of Refuse, Reduce, Reuse, Recycle, and Recovery principles in the public domain.

### 4.8 (b) Recommendations

#### Easy to implement and quick benefits – tactical in nature

- Quantification of food waste and publicity for the same by each restaurant
- Separation of dry and wet waste at the source and the need for an enabling environment
- Encouragement for conversion of waste to energy/composting at home
- Much higher focus for municipal and industrial waste management
- Effective implementation of polluter pays principle and effective recycling
- Identify and hand over responsibility of waste sector to only people with integrity.
- Encouraging waste grinders to convert wet waste to pulp which can be discharged to sewers will reduce carbon emission that would have emitted from transportation.
- Calculating manpower required based on work load as on date and filling all the posts in the concerned agencies.
- Not to use people meant for waste management in local bodies to other work like census and election duty.
- Wet waste processing has to be localized ward wise, and waste collection should be a prepaid service to discourage citizens of not increasing the wastage
- City waste should not move out of city limits
- Rural waste should be considered for recycling/composting, may be by using the urban infrastructure
- Vastly higher focus on safe disposal of plastic waste and plastic menace
- Small scale decentralized solution for sewage management and at village levels
- Issue of societal responsibility should be widely disseminated
- Usefulness of kitchen waste; availability of suitable gas plants
- Focus on management of garbage in resorts
- Focus on medical waste management; infection waste and safe incineration
- Need for bio-medical wastes to be processed separately
- Issues with Methane emissions and the associated cost to the society should be widely propagated
- Need for waste treatment plants in Coorg
- Daily dump waste collection method should be reviewed
- Close monitoring and control of plastic entry at sensitive places such as parks and religious places
- Adequate encouragement for bio-manure
- Prohibition of bio-mass burning in public places such as on roads by municipal workers

- Composting of waste / gasification; tree leaves and branches in cities
- Treated sewage as a resource
- Paper conservation through e-governance should become a norm
- Vermi-composting at household level should be made popular
- More of CETPs and distributed sewage treatment plants
- Recycling of electronic gadgets should become mandatory
- Strict action against open defecation should be enforced
- Providing waste collection bags (jute bags instead of plastic bags) to residences
- Providing adequate number of garbage collection vehicles
- Collecting waste from industries
- Supply of jute bags in place of plastic bags in shops
- Adequate encouragement for industries in waste management
- Distributed waste management through mini STPs
- Strict responsibility for local bodies in waste collection and disposal
- Disconnect between ministries and industries should be effectively addressed
- Stiff penalties for compliance failures should be imposed

#### **Medium to long term benefits – strategic in nature**

- Allocate funds for waste management at least to the tune of 1% of total expenditure in state budget.
- Fix responsibility of waste collection and disposal to producers of goods (Currently only applicable to electronic goods as per E-waste (Management and handling) Rules, 2011) which include – Vehicles, chemicals, plastic articles, sanitary napkins, medicines, cloths, meat products, food items(including cool drinks, liquor, packed water, and milk). The principle can be first made compulsory for all branded products.
- Need for zero waste practice
- Need for ETP/STP at all levels
- Fixing GPS based vehicle tracking system to all the goods vehicles as they are likely to indulge in illegal waste transportation.
- Reducing retirement age so that the waste managing intuitions will be young and energetic
- Compulsory retirement or reallocation of work for people who are sick and unable to work effectively in waste management
- Educating the public on responsibility of consumers to ensure the reuse or safe disposal of tyres and batteries, and other health risk materials, through manufacturers, and infrastructural arrangement for the same
- Systematic efforts towards segregation, composting, reduce, reuse and recycling of wastes, towards a zero waste society
- Focus on final solution for plastic waste at the community level; plastic as a fuel source
- Special courts for speedy disposal of cases related to waste management and pollution related issues should be considered
- Efforts to make bio-degradable wastes not going out of one's premises
- Proper projection of waste quantity during next 25-30 years
- Effective solid waste management can provide employment for a large no. of people, such as rag pickers by making the job much more safer and remunerative
- Focus on pollution control measures at individual and community levels
- Land minimisation efforts in waste management and proper infrastructural needs
- Bio-degradable wastes should be managed in one's own premises
- High potency of Methane as a GHG should be a major factor in sewage treatment
- Solid waste management should be the responsibility of a single agency all over the state to gain



quality and consistency; only specialized agencies should be engaged and not multiple agencies which normally are known to be without scientific approach and tools

- Bio-gas generation from food waste to be made compulsory for large hotels and hostels
- MSW at district level should be with a separate and dedicated department with necessary levels of autonomy
- Reuse of refined motor oil should become a practice.

## 4.9 Air Quality

### 4.9 (a) Major Concerns

- Air pollution has become a major source of respiratory and other ailments
- More number of cities and urban areas are becoming unfit for healthy living
- Ever increasing vehicle population, while being a major contributor to air pollution, is also throwing up many other issues
- Traffic congestions and very low average speed of vehicles in urban areas (especially in Bangalore) contributing to high levels of air pollution.

### 4.9 (b) Recommendations

#### Easy to implement and quick benefits – tactical in nature

- Focus on minimising the 'Black Carbon' or carbon soot by reducing the bio-mass burning, forest fires, vehicle fumes etc.
- Consider banning all cars that give mileage less than 20 km/litre of petrol/diesel. Alternatively ban petrol/diesel cars and allow only those cars that run on LPG/CNG.
- Hence GPS based vehicle tracking may be made compulsorily installed to all government vehicles to curb misuse of vehicle and curb air pollution.
- Establish at least one air quality monitoring station in each taluk.
- No power connection shall be given to any industry which does not have CFE/CFO of KSPCB.
- Cultivation of tobacco shall be diligently managed or totally banned in Karnataka. Further green tax shall be imposed on tobacco products which shall be used to grow trees.
- Pubs and bars should be considered to be closed at 10.00 PM clock to curb unnecessary power consumption for lighting and air conditioning. Further green tax shall be imposed on alcoholic beverages which shall be used to grow trees or installing solar lights in rural area or streets.
- Green tax can be imposed on meat and tax collected can be used to grow trees that act as sink to carbon in the atmosphere.
- Impose green tax on petrol/diesel/coal and use it to subsidize efficient public transportation.
- Consider restricting/rationing the sale of fuel to vehicles. Cars may be sold only 100 liters/month of fuel and two wheelers can be sold only 25 liters/month.
- CO<sub>2</sub> in ambient air is not monitored currently by KSPCB. Hence monitoring of CO<sub>2</sub> in ambient air shall be started at the earliest.
- The public servants should take the lead in maximizing the usage of day light hours for office work so that other citizens also follow such a good practice later..
- Treated waste water can be sprinkled on roads as practiced in Japan. This would reduce temperature of city and suppress dust.
- Inadequacy of railway infrastructure, which is leading to road transport related pollution, should be effectively addressed; at the least between major urban areas in the first phase. The State Government should not hesitate to make adequate investments in this regard.
- Issues of affordable price in public transport and attractiveness of fares and services should be addressed urgently to reduce vehicular pollution
- Good co-ordination / management of KSRTC buses and trains should be facilitated

- Modify transportation systems on scientific basis
- Mandate on servicing of vehicles and emission tests at regular intervals; say every 6 months or one year
- Proper limit on the operating life of vehicles or link it to certain efficiencies
- Noise pollution and dust due to stone crushing must be controlled
- Accurate measurement of air pollution and necessary publicity at different locations
- Daily report on air pollutants, pollution levels through automatic digital instruments
- Arresting the run away growth of vehicle population
- Display of pollution levels at taluka and district places
- Emission standards to be implemented strictly
- 'Agnihotra day' should be considered as a public function periodically all over the state to cleanse the air
- Noise level control in vehicles at the production stage
- Compulsory greening around factories and in buffer zones
- Making provision for pollution monitoring and reduction measures at Petrol bunks
- Massive awareness campaign and encouragement for the health benefits of using cycles.
- Dedicated cycle paths in urban areas
- GHG auditing at all places and industries/enterprises
- Capturing Methane from municipal waste and using it
- Air pollution control measures during Deepavali
- Noise barriers along major roads passing through thickly populated areas; and on metro rail routes
- Banning honking of horns in urban areas
- Adequate control of dust during road widening and construction activities
- Provide improved and efficient cooking stoves for rural women
- Accurate inventory of GHG emissions in Red category industries
- Adequate incentives for using solar charged battery systems will assist in minimising the DG sets
- Massive campaign and support for growing bio-fuel species of plants and usage of bio-fuels
- Ban the usage of DG sets for OB vans of TV channels and provide local grid connection wherever feasible; such as near Vidhana Soudha, Palace Grounds, People's Park in Bangalore.

#### **Medium to long term benefits – strategic in nature**

- Indoor and outdoor air quality due to bio-mass waste burning / incineration should be monitored and controlled
- Usage of advanced technologies to minimize vehicle emissions
- Resolve slow traffic issues in urban areas contributing to huge quantities of GHG emissions, and also in wastage of petroleum products
- Pollution due to micro wave towers should be studied
- Proper inventory of GHGs and sources; carbon soot, and measurement
- Issues with SPM 2.5 pollution should be managed well.
- Projection of industrial GHG emissions in the future should be done to draw the attention of the public
- Pollution control at source should gain much higher importance
- Emission controls in unorganized sectors
- Promotion of environmental guidelines/ ISO 14001
- Impacts of mining pollution on dairying and agriculture should be addressed

## **4.10 Transportation**

### **4.10 (a) Major Concerns**

- Poor overall management of the transportation sector is leading not only to dangerous levels of air

pollution, but also to several other social and economic concerns

- Unless the number of vehicles on the road is restricted and all of them are made to be efficient and use sustainable fuels, the transportation sector has the potential to create havoc on our society.

#### **4.10 (b) Recommendations**

##### **Easy to implement and quick benefits – tactical in nature**

- Adequate usage of available technologies to minimize vehicle emissions
- Highest possible efficiency in fuel usage should be implemented
- Vehicle free zones should be implemented in all cities, starting from 4 or 5 cities immediately
- All feasible options to reduce CO<sub>2</sub> emission and different components of SPM should be deployed
- Affordable price and attractiveness of fares and services in public transport to minimise the number of private vehicles
- Provide incentives to all institutions, trade bodies, corporate bodies, commercial establishments which encourages its staff to use public transport.
- Levy increased special environmental tax on all sorts of new private vehicles purchased / used inside the city.
- Transport service providers need to break their present vehicular system and flood in smaller / mini buses (battery operated) within neighborhoods / group of localities to eliminate / reduce smaller vehicles such as auto rickshaws, cars and two wheelers on roads
- Declare Belagavi as the earliest Climate Change mitigation city since the city uses Bicycles on a large scale. This model can be further upgraded and showcased across the state/nation.
- A norm of one vehicle for one family should be considered
- Enhancement of frequency (at least once in half an hour) of trains Between Bangalore and Mysore; Bangalore and Tumkur, Bangalore and Bangarpet would decrease population in Bangalore as more people would settle away from Bangalore. This would also reduce road congestion and carbon emission.
- Video conferencing may be preferred against physical meeting to curb carbon emission due to transportation.
- One definitive way of reducing the GHGs from the transportation sector is to reduce the number of automobiles on the road. Massive improvement in the public transportation and/or adequate disincentive to use private vehicles is essential in this regard. The option of 'auctioning the right to buy vehicle' as is the practice in Singapore should be considered.
- Stringent rules on vehicle parking spaces, stiff hike in parking/entry fees (atleast in CBD/busy areas), suitable incentives for car pooling, cess/tax on private vehicles are some of the options to be considered seriously.
- Occupancy of foot paths may be reduced to encourage people using foot paths. Development of dedicated bicycle lines in Bangalore would encourage people to use bicycles and reduce emission.
- Sexual harassment, pickpocket and too the over crowded buses or trains discourage effective usage of public transportation. Adequate number of buses and trains, and installing CCTV inside public transport would increase use of public transport.
- Use celebrities from movie, politics, sports to sell (by social marketing) the idea of using public transportation.
  - Infrastructural facilities in rural areas should be improved by a massive scale so that the alarming rate of urbanization that is occurring all over the state is minimized.
- Compulsory servicing of vehicles periodically and the limit to the operation life of vehicles
- Poor management of large vehicles; especially the Government vehicles should be addressed early
- Banning of vehicles in sensitive / religious areas should be diligently considered
- Usage of low carbon fuels and bio-fuels should become a priority

- Effective usage of empty spaces on either sides of railway lines and roads to grow bio-fuel plants
- Care needed in widening the NHs, which may result in additional road traffic and pollution
- Improvement of overall road infrastructure as against poor status to minimize pollution
- Vehicle usage holiday once a week should be seriously considered
- Adequate greenery on either side of the roads
- Encouragement for electric vehicles
- Staggering of office timings and allowing for tele-commuting/flexi timings
- Pollution related issues associated with BMRC should be thoroughly studied and acted on
- Noise and dust barriers should be made compulsory along the routes of BMRC
- Restriction on usage of 4 wheelers for one person's usage
- Electrically charged vehicles such as e-motorbikes, e-scooters and e-cars charged from roof top solar PV systems, particularly in urban areas, have a huge relevance in addressing the urban transportation and pollution related issues.

#### **Medium to long term benefits – strategic in nature**

- Infrastructural facilities in rural areas should be improved by a massive scale so that the alarming rate of urbanization that is occurring all over the state is minimized. With more than 65% of the population still in rural areas, this should have been a priority for the successive governments anyway.
- Massive review of layouts within urban areas to minimise the transport of materials and men/women, between residences and workplace, will greatly reduce the consumption of energy and hence the GHG emissions. There has been a fourfold increase of vehicular population in Karnataka in less than 20 years. Most of this increase is in urban areas and due to the growth of urban areas. Energy consumption reduction in urban transportation system is essential from GHG emissions perspective, but also is imperative to reduce the burden of huge foreign exchange outgo for fuel import.
- A responsible management of urban transportation system is also critical from the point of view of cleaner environment and the need to limit the urban growth.
- Avoidable expansion of urban areas through additional industrial estates, commercial establishments, higher educational institutions, entertainment and sports facilities etc. should be diligently discouraged. In this regard necessary amendments to Urban Planning Acts should be considered. Additionally, suitable incentives to wean away such activities to rural areas should be seriously considered.
- Additional charges (such as a levy or Cess) should be considered in urban areas for usage of each of the facilities (such as land, water, electricity, petrol, diesel, wood, building materials etc.) which are also available in rural areas.
- Since the country is expected to be dependent on imports to an extent of 80% by Year 2015, and since the state has no known reserve of petroleum products, the options before the state are fairly simple: (a) responsible management of the meager resources in minimising the usage by deploying highest possible efficiency measures; (b) high priority to develop alternative fuels such as bio-fuels.
- In view of the fact that the petrol/diesel vehicles are generally designed to have maximum fuel efficiency at a speed of 40 to 50 KMPH, and that the average vehicle speed is less than 30 KMPH in urban areas (it is reported to be less than 20 KMPH in Bangalore), GHG emissions from the transportation sector will continue to increase unless drastic corrective measures are taken early. Discussions should be held with vehicle manufacturers to find out whether the fuel consumption and hence GHG emissions can be reduced at such lower operating speeds.
- Railways network in Karnataka is very poor. Hence connecting all district head quarters with railways would not only reduce emission it would also ensure sustainable development.
- Establish all government offices in each district in single campus like university campus. The quarters

for staff within the campus would also reduce lot of emission.

- Currently Bangalore is not safe during disasters. Hence a new green field smart city may be proposed away from Bangalore like Gandhinagar of Gujarat where in all head offices of government department and quarters for public representatives/servants can be built to reduce fuel consumption.
- Development of new layouts around Bangalore may be stopped and development of other cities may be encouraged with good connectivity with Bangalore.
- Frequent public shuttle between bus stand and railway station is absent in many cities of Karnataka including Mysore. Introduction of such shuttles would reduce dependency on auto rickshaws and carbon emission.
- Introduce fuel quota (like 100 l/ car/month and 25 l/ motor-cycle/month) for each of vehicles owned for private transportation. Allow people to trade their unused excess quantity on-line like carbon trading.
- Stop trading of kerosene/naphtha and increase availability of LPG in Karnataka to discourage adulteration. Alternatively, add dark distinct colour to kerosene and naphtha so that adulterations are easily identified if sold in petrol bunks.
- Massive review of layouts within urban areas to minimise the transport of materials and men/women, between residences and workplace, will greatly reduce the consumption of energy and hence the GHG emissions. There has been a fourfold increase of vehicular population in Karnataka in less than 20 years.
- A responsible management of urban transportation system is also critical from the point of view of cleaner environment and the need to limit the urban growth.
- Avoidable expansion of urban areas through additional industrial estates, commercial establishments, higher educational institutions, entertainment and sports facilities etc. should be diligently discouraged. In this regard necessary amendments to Urban Planning Acts should be considered. Additionally, suitable incentives to wean away such activities to rural areas should be seriously considered.
- One innovation from the state, which has acquired US patent, claims to improve the fuel efficiency of buses and trucks which are already on the road, and reduce emissions from the vehicles. The State Government should study this technological claim, and examine whether some of the Government vehicles can be tried with this innovation, and share the results with the public at large.  
*(<https://kspcb.wordpress.com/2015/04/18/global-solutions-to-reduce-pollution-from-over-a-billion-petrol-diesel-engines-across-the-world/>); accessed on 10.5.2015*
- The demand /proposal for additional airports should be diligently reviewed from the Climate Change perspective, and minimised.
- Optimal utilization of the existing road infrastructure to minimize the need to fell trees for road widening and the need for more no. of vehicles
- R&D efforts on vehicle pollution

## 4.11 Industries

### 4.11 (a) Major Concerns

- The substantial contribution to GHGs and other pollutants, along with the pressure on land, water, energy and raw materials have not been objectively considered in the industrial policy of the state.
- The kind of industrialisation, the spread of industries in the state, and the true relevance of each industry for the overall welfare of the state have not been considered in a holistic manner.

### 4.11 (b) Recommendations

#### Easy to implement and quick benefits – tactical in nature

- Each of industrial premises or any large size enterprise shall maintain 33% area cover by bio-diversity

- of suitable local varieties. This cover shall be increased if GHG emissions are more.
- The industry shall adopt rain water harvesting and ground water recharging in its premises
  - The industry shall be persuaded to install and adopt new technology in the process and pollution control equipment to minimise the consumption of raw materials, energy and water, to minimise the wastage
  - The industry shall be persuaded use eco friendly fuels
  - The industry shall be persuaded to avoid use of fossil fuel in the boilers
  - The industry shall be persuaded to adopt 3 R systems (Refuse, Reduce and Re-use)
  - The industry shall produce at least 20 - 30% of its energy requirement from the renewal energy sources like solar and bio-mass
  - The polluting cupola based foundries shall be avoided
  - The industry shall be asked to install heat recovery units where ever applicable
  - The industry shall carry out more awareness among its staff members for resource conservation and waste minimization
  - The industry shall be made aware of various facilities under the new Industrial Policy 2014-19.
  - Extreme care is needed while considering license for new industries and mines in Bellary District.
  - Mass transportation, where feasible, shall be adopted for movement of industrial raw material and/ or goods instead of private road vehicles
  - Maximum efficiency in fuel / energy usage in all industries should be mandated by specifying specific energy standards after due consultation with industry bodies and experts
  - Measuring and monitoring pollution generated during production and disposal must become mandatory for all industries
  - Industries should be encouraged to ensure green supply channel in both the backward and forward integration
  - SSIs too should be encouraged/persuaded to declare pollutants and hazardous substances
  - Strict enforcement of energy auditing and subsequent conservation should become a state policy for all industries drawing electricity from the grid in the first phase, and for all industries in the second phase
  - Carbon foot print measurement for every industry, big or small should become a norm.
  - Greening of factory premises and green code for manufacturing processes should become a standard practice
  - Focus should be on setting up those industries with least requirements of land, water, energy and on those which have least pollution loading; examples are agricultural/ horticultural/ dairy products based industries
  - Suitable controls (both voluntary and mandatory) should be implemented on manufacturing; needs, wants and luxuries of the products should be determined; how much of such products and where to manufacture should also be studied.
  - Hand-holding in the beginning to manage the waste may be needed for many industries.
  - Disclosure of GHG emissions for every industry at regular intervals should be considered as an option of being made mandatory
  - Green codes and GHG auditing for all manufacturers
  - Climate Change policy for every industry should be encouraged
  - Massive awareness campaign and incentives should be launched to encourage the use of local raw materials and products
  - Industries should be persuaded /mandated to develop suitable action plan to control/minimise the waste at the production stage
  - Customs controls should be adequately strengthened to prevent polluting products such as plaster of Paris Ganesha idols entering from other states

- Environmental audit, with suitable yardsticks, should be launched for industries
- There should be industry level effort to apply bench marking against international standards
- Change over from furnace oil to natural Gas where feasible should be encouraged
- Usage of red-mud from Aluminium industries in cement industries should be maximised
- Tree planting outside ones' own premises, and in schools should become a part of CSR
- All efforts should be made to provide level playing field for eco-friendly industries
- Discouragement for bad practices and incentives for good practices
- Usage of brown paper instead of white paper, wherever feasible, to reduce pollutants
- Adequate encouragement for cottage / traditional industries as a mode of massive employment opportunity in rural areas
- Industries should be encouraged/ persuaded to use re-usable packaging materials
- Usage of molded paper for packaging instead of thermo cool material should be encouraged

#### **Medium to long term benefits – strategic in nature**

- Large and Medium Red category industries should be insisted to obtain ISO14001 certification.
- Adequately treated waste water from the industry should be considered for refilling of the tanks/ lakes in drier regions of the state.
- The Government shall make policy for not giving fresh river water to the new industry. The industries shall use the treated waste water from the STP/ETP
- Refuse, reduce, re-use concept (3R concept) as policy for all industrial and commercial establishments
  - Collaborative approach in various industrial processes to minimise the overall consumption of raw materials and energy within the group, and in managing the wastes/pollutants should be encouraged in groups of industries.
- CII corporate guidelines should be sought as additional incentive to control the wastes
- Promotion of ISO 4001 to ensure appropriate levels of environmental compliance
- Persuade every industries to keep the Vision of reaching the international best practices
- Distributing industrial / economic activities to rural areas should be encouraged
- Instead of concentrating many industries in one town/city they should be rationally spread over the state
- Efforts should be made to have clusters of industries to make use of CETPs
- CEPI for all industrial estates should be implemented
- Renewable energy purchase obligation should be considered for each industry
- Making use of group campaigning mode to sensitise the employees and family members on climate change issues
- Auditing of processes and material usage by all vendors should be mandated.
- Adopt extended producer responsibility to create carbon sinks.
  - Let coal mines/importers/users plant and nurture one tree for every 1,000 tons of coal produced/imported/used in Karnataka
  - Let paper mills plant one tree for every ton of paper produced
  - Let oil companies (like HPCL/IOCL/Shell) plant one tree and nurture one tree (preferably trees capable of producing bio-fuel) for every 100 tons of fuel sold by them in Karnataka
  - Let cement manufacturer plant and nurture one tree for every 1,000 tons of cement manufactured by them
  - Let the sawmills plant 100 tree sapling for every tree sawed by them
  - Let railways and transport corporation (both government and private) plant one tree sapling for every 1,000 km/vehicle travelled by them
  - The above producers need not plant trees in land owned by them. They can do it on road side and waste land with proper permission from owners/custodians of land. The cost can be charged to customers.

## 4.12 Energy

### 4.12 (a) Major Concerns

- Massive GHG emissions from the sector, the absence of fossil fuel reserve in the state, and the huge potential for REs have not been considered in an integrated manner so far.
- There has not been adequate focus on addressing the gross inefficiency prevailing at all levels of energy production, transportation and utilization.
- The overall demand for grid quality electricity has not been considered in a holistic manner aiming at the true welfare of all sections of our society.

### 4.12 (b) Recommendations

#### **Easy to implement and quick benefits – tactical in nature**

- Utmost priority in the sector should be given for the highest levels of efficiency, optimal demand side management and responsible energy conservation. In this context specific targets and specific agencies accountable for the same should be fixed. For example, the T&D losses in the power sector should be brought down below 10% by 2020; and to 5% by 2030.
- Clean and affordable energy technology/systems, such as smokeless bio-mass stoves, solar cookers, solar pumps, solar power panels should be made easily available to rural areas.
- Roof top solar water heaters must be made compulsory to all residences in urban areas by 2020, and to all pucca houses by 2025.
- Solar street lights must be made compulsory in all towns in the first phase of 5 years; should be extended to villages in 10 years.
- Roof top solar power generation, to meet at the least 50% of their monthly electricity needs, should be made compulsory for all Government buildings, sports bodies, entertainment places in 3 years.
- Such a system should become compulsory to all other buildings with larger roof top surface area of say, more than 2,000 sq. ft or more than 200 units of monthly electricity demand or more than 5 kW of connected load
- Single window agency / solar energy cell to promote solar energy should be established in each ESCOM for consumer related issues.
- Subsidy on capital costs, incentives on generation of electricity from RES should be considered; and all the administrative procedures should be simplified to attract consumers
- A panel of about 10 quality suppliers should be notified and all possible technical assistance to the consumers in choosing a suitable technology / size of the RES should be extended
- Large establishments such as 3 star and 5 star hotels, choultries, educational institutions industries, commercial establishments should be encouraged to establish captive green energy generating plants.
- Very high priority for energy conservation and DSM is needed
- Private consultancy agencies offering consultancy in energy management systems should be encouraged
- Concerted efforts should be made to reduce the reliance on coal and diesel power in the short run, and complete elimination by 2040 should be the aim; specific target such as reducing annual coal energy to less than 40% of the total annual electrical energy by 2020, and less than 20% by 2030 should be the aim.
- Keeping such an aim in proper context no new coal power plants or diesel power plants should be built in the state.
- Keeping in view the impacts on bio-diversity no new hydel power projects should be taken up. Only micro-hydel units with utmost care and with local consents may be considered for building.
- Annual energy auditing associated with electricity, diesel, gas and coal power usage should become



mandatory for medium and large industries/enterprises by 2018. For this purpose specific energy target should be identified after effective consultations with the end users and experts

- Adequate incentives for energy reduction/conservation in energy intensive industries should be considered.
- There have been many examples of converting certain wastes to energy; example of bio-mass briquettes. These are being used efficiently in many places, and should be encouraged for wider deployment.
- The usage of efficient IP Sets in agriculture should be encouraged
- Rationalisation of electricity to malls and large buildings by mandating certain percentage of electricity purchase from REs
- LEDs should be made compulsory in offices, industries and commercial buildings; phasing out incandescent lamps in the first phase and CFLs in the next stage
- Specific energy consumption for different categories of consumers should be determined and enforced with the necessary levels of incentives and fines.
- Measurement of both absolute and specific energy consumption and CO<sub>2</sub> emission at every industry should become a regular feature
- Compulsory use of solar power in commercial complexes and disincentive for not making use of it
- Community bio-gas projects should be encouraged
- Usage of grid electricity in sports should be reviewed as against captive power generation through REs; a good example of KSCA cricket stadium in Bangalore commissioning 400 kW solar power system on its roof
- Subsidy for setting up bio-gas digesters for more than 10 kg of waste should be considered

#### **Medium to long term benefits – strategic in nature**

- Specific time bound targets to reduce the percentage of fossil fuels in the energy mix of the state should be declared by the state.
  - that the reliance on coal power will be reduced to 20% by 2025, to 10% by 2030, and completely eliminate the coal power plants in the state before 2050.
  - that a minimum 75% of our electricity needs will be met by new and renewable energy sources by 2040
- Adequate subsidy systems to popularize clean energy systems in rural areas should become a top priority; there should be accountability to make such clean energy systems work properly; adequate focus on repair, maintenance and warranty issues needed
- All possible encouragement / incentives should be offered to make the usage of bio-energy and gobar gas popular throughout the state
- Carbon credit should be considered for the usage of sustainable energy sources to reduce people's dependence on forest wood and fossil fuels
- Renewable energy sources should replace the coal power plants in due course of time
- Due diligence should be deployed to find suitable alternatives instead of building transmission lines through forest areas such as such as the 400 kV PGCIL line between Mysore and Kozhikode being opposed through forests and coffee estates of Coorg district
- R&D on development of small size bio-gas cylinders for house hold cooking should be encouraged.
- Production of Ethanol should be considered as a must for sugar factories to facilitate bio-fuel usage; ethanol blending should be promoted
- Co-generation of electricity should be encouraged where it is techno-economically feasible
- Adequate investment to improve electricity distribution system to global standards should be a priority; such a high standard is needed to make use of micro/smart grid concepts, which are going to be future of electricity supply systems

- Operational performance of the electricity distribution network (service standards) should be escalated to the best in the country in order to prepare the same to face the implications of CC
- Provide adequate encouragement for commercial usage of bio-gas by individuals
- Specific Act to incentivize usage of bagasse should be considered
- Strict implementation of energy conservation Act
- Rationalisation of supply of electricity to shopping / commercial malls and large buildings should be considered
- Suitable technical assistance by specialist agencies to study of heat losses and minimizing the same should one of the functions of energy / industry departments
- Diesel Generators in Outdoor Broadcasting vans around Vidhana Soudha should be severely curtailed; provision should be made to supply grid electricity at realistic prices for such purposes
- Bar-coding of the Carbon Footprint of packaged products should become a norm.
- Launch an awareness campaign against usage of packaged foods that are imported from a long distance / foreign country, which results in massive carbon footprint.
- As the first step, all the packaged products should reflect the distance covered and the carbon emission created out of such transport and packaging.
- RWAs and other citizen driven community forums should take up afforestation within their governing / neighbourhood areas.
- Make the younger generation aware of the need to follow eco-friendly life style.
- Every individual should be made aware of his carbon foot-print index through wider media coverage, and this need to be a vital parameter in determining the citizens environmental complying laws, which could be linked to IT concession and rebate as incentives.
- A task force on energy, with adequate responsibilities and resources, should be set up urgently to address the complexities of the energy sector in the state.

## 4.13 Urbanisation, buildings and communication infrastructure

### 4.13 (a) Major Concerns

- Unabated urbanisation is leading to very serious pollution related issues;
- There have been no objective considerations at the societal level to address the complexity of issues of urbanisation, buildings and communication infrastructure from the perspective of climate change, and other social and economic issues.
- The direct and indirect encouragement of the STATE for the unabated urbanisation will attain crisis proportion, unless urgent and diligent measures are taken by the authorities.

### 4.13 (b) Recommendations

#### Easy to implement and quick benefits – tactical in nature

- Strict implementation of the need for separation of wet and dry wastes at the source, and proper disposal
- Alternative building materials should be encouraged for sustainability
- Special areas should be reserved for growing vegetables locally
- Cycle paths / lanes, and other encouragement for cycle usage
- Provision of dust-bins at public places
- Discount in property tax for being green
- Loss of water bodies, forest cover and agricultural lands due to expansion should be addressed
- Footpaths and good quality roads should lead for lower pollution
- RWH at every large size buildings; say of site area, say more than 3,000 Sq. ft; lead should be taken by Government buildings; cluster buildings and at community level
- Role of town planning agencies in RWH

- Ground water recharging facilities in all premises with more than certain areas; say 3,000 sq. feet; Government agencies should take the lead;
- Appropriate pricing for water supply to reflect the true costs to the society and also to bring in maximum efficiency in usage
- Terrace gardens, and medicinal herbs instead of lawns
- Localised economic planning; local products, usage and consumption
- Demand side management principle on all natural resources
- Polluter pays principle should be diligently applied
- Much more effective participation of the stakeholders in the related decision making processes.

#### **Medium to long term benefits – strategic in nature**

- Address zoning issues in urban areas for scientifically developed residential, commercial and industrial layouts
- Much more co-ordinated lay -out planning to minimise the movement of people and materials in the urban areas
- Green buildings and parks around new residential blocks
- Popularisation of /mandate on green building concepts; development of Indian standards
- Punitive measures for not complying with RWH requirements
- Integrated approach at the state level for making buildings greener
- Mandatory green buildings for Government Departments.
- Ward committees in urban areas to act on CC
- Ecological audit of large size buildings
- Much higher focus on road design, repair and maintenance for reducing the urban pollution
- Serious review of increased urbanization and measures to minimize migration from rural areas
- Avoiding expansion of smaller urban areas into large cities
- Construction standards to be developed keeping in perspective the CC
- Take economic activities to villages and away from urban areas
- Address the absence of buffer zones between industrial and residential areas

### **4.14 General awareness and Educational campaign**

#### **4.14 (a) Major Concerns**

- Very low level of awareness on the causes and implications across all sections of the society, including the officials and people's representatives is tagged as a huge concern.
- Complete absence of awareness campaigns in any sector/part of the state.

#### **4.14 (b) Recommendations**

##### **Easy to implement and quick benefits – tactical in nature**

- Launch effective awareness campaign through media and educational institutions on general environment and Climate Change on a continuous basis
- Awareness campaign for teachers schools, colleges, community levels; and for students through text books
- Awareness campaign and training for Government staff
- Effective involvement of people's representatives at various levels
- Awareness on various kinds of pollutants and safe disposal; on the usage and handling of pesticides
- Popularising the culture of hygiene and water conservation
- Effective campaigns for and with women's self help groups
- Awareness campaign on the true relevance of worshipping the nature
- Use the route of NCC/NSS organizations

- Exposing the children and students to useful traditional knowledge and on the importance of preserving the nature
- Awareness through herbal parks in educational institutions
- Effective control on the import of chemicals in the state borders

#### **Medium to long term benefits – strategic in nature**

- ‘Parisara Sammelana’ and ‘Parisara Mitra College’ concepts should be effectively initiated
- UGC sponsored green auditing in educational institutions and universities
- Massive and sustained campaign on causes, implications and options on CC at village level
- Environment Science as an effectively studied subject in all educational institutions either with suitable credits or with a certificate
- Adaption of a geographical area for conservation by students as University curriculum
- Continuation of KSPCB’s radio programmes on environment, and expansion to TV programmes
- Massive and effective state-wide awareness programme similar to pulse-polio programme
- University outreach programme as an option
- Teaching of traditional practices on nature conservation in schools and colleges
- Awareness campaigns of careful usage of irrigation water
- Preventing agricultural lands from becoming fallow due to chemical pollution
- Knowledge dissemination on impacts of polluted / contaminated food and the relevance of sustainable life styles
- Creation of separate TV/radio channel for “Parisara Issues”
- Regular consultation with women’s groups on all the related issues
- Seeking sponsorship for educational advertisement
- Public awareness campaign on pollution related issues; for workers and people’s representatives through crash courses, if necessary
- Public awareness on which department does what, and who is responsible for what
- Public utilities should take lead in awareness campaigns

### **4.15 Rural Karnataka, North Karnataka, and regional/district levels development plans**

#### **4.15 (a) Major Concerns**

- Water stressed geography, lack of adequate vegetation cover, low agricultural yields are all leading to migration to other areas, and for the increased GHG emissions
- If adequate water management measures such as rain water harvesting are not taken up widely, the region is likely to face massive water scarcity issues in the changed climate
- Poor infrastructure and inadequate employment opportunities, if not corrected early, will lead to large scale migration to urban areas with disastrous consequences

#### **4.15 (b) Recommendations**

##### **Easy to implement and quick benefits – tactical in nature**

- Provide basic infrastructural facilities needed in rural areas to achieve an acceptable level of human development, and to minimise the need for urban migration
- Belgaum should be considered as a center for putting up milk-based manufacturing units like dairies, cheese, chocolate, cattle fodder etc.
- Upgrade value addition of these products using improved technology with VTU as a technical coordination agency
- Ranebennur and Byadagi towns should be popularized with a seed museum, chilli museum, hotels and motels to cater to the visiting businessmen and tourists
- Agro tourism in these areas should be encouraged

- The Black Buck sanctuary near Ranebennur should be developed
- Dhārwad should become the center for higher education with a focus on literature, music, Mathematics, Philosophy and the like
- The entire rural Dhārwad should be considered for promoting Khadi products on modern lines
- The tradition of best Khadi products around Hubli-Dharwar region should be further strengthened
- A training, design and fashion center for Khadi can be set up in this area where thousands of people can be employed
- A conclave for cottage, handloom and handicraft products can be set up in the region where all existing products like Navalgund carpets, Kalaghatagi cradles, Hebbali Khadi, Ilakal Sarees and many such products made all over the region be accommodated, displayed and marketed
- They should all be technologically upgraded so as to add value, similar to the Kolhapuri footwear which gained good market within and outside the country once the quality got upgraded through a simple technology
- The ecological advantage of this region being a natural habitat for several varieties of wildy grown fruits like Carandas, Sisyphus or wild zuzuba, Jamoon and mango, which can be grown along the roadside, should be harnessed fully to increase the green cover
- These should be encouraged to become the livelihood sources of hundreds of families as in the past
- The Tamarind trees which are found alongside the roads and which served as sources of livelihood for certain communities should be protected while roads are widened and townships getting expanded.
- The value as spices and medicines of the locally grown fruits should be fully harnessed.
- The vast swathes of barren and semi barren lands and uncultivable agricultural lands should be extensively used to grow tamarind, jamoon and others to provide employment to hundreds of rural communities.
- Such lands can also be developed as urban forests and community forests, sandalwood parks, mango gardens, guava gardens and the like.
- The Carandas bushes and Jamoon trees should be rejuvenated all along the country roads and state highways as hedges, especially in Dhārwad, Karwar and Haveri districts where they are endemic.
- Suitable dry land development programmes should be launched in a massive scale
- Focus should be given to adequate investment in rural development
- ‘Smart villages’ should be priority against ‘ Smart cities’
- There should be a 10 year target to attain 33% forest cover at Village Panchayat level;
- Schools should become the centre of green development at villages
- Assist the rural population with sustainable and adequately remunerative agricultural, horticultural, and animal husbandry options
- Provide efficient and low carbon based energy options such as solar, bio-mass and wind power
- Provide sustainable employment opportunities suitable for low carbon life styles, which will not demand large tracts of land, water, energy and metals

#### **Medium to long term benefits – strategic in nature**

- The huge potential of rural and North Karnataka areas to contribute to GHG emissions should be kept objectively at the centre of our focus in planning a developmental pathway
- The low carbon life style of these areas should be preserved as much as possible and should be examples for the urban areas
- Sustainability at local level, making villages self sufficient, should become the principal paradigm
  - Such a holistic approach is the ideal way to bring about a synergy between ecology and the economy, which should be based on the effective utilization of traditional knowledge and local resources.

## 4.16 Women's perspective

The feedback from participating women and women's groups have been retained as they were, even though many of them are same as expressed by the general public. This is basically to reflect their concerns on the societal level issues.

### 4.16 a) Major Concerns

#### Water and sanitation: Women's perspective

- Entry of sewage in to lakes, ponds and tanks and other water bodies and growth of water hyacinths and algae disabling the water for public use.
- Improper and unscientific methods of Municipal solid waste disposal
- Concern over silted Kalyanis (sacred ponds) /open wells in villages
- Open wells in villages getting unfit for use because of sewage entry or other urbanization problems.
- Treated Industrial waste water discharged into streams and rivers
- Lack of sewerage network in towns and cities
- Water scarcity in villages and cities
- The need for women to walk long distance everyday to places in search of water in rural areas, and the potential for sexual exploitation for women.
- Over exploitation of ground water in villages and cities
- Many festivals like Ganesh Chaturthi, Village fairs, Jathras in age old Temples responsible for spoiling the water quality of the rivers and streams
- Unscientific practices in Solid waste /garbage disposal leading to pollution of water bodies, including lakes and rivers.
- Land use and planning
- Encroachment of Government land, lakes, tanks etc by the builders in city limits
- Overlapping of industries and residences leading to formation of mixed zones in city limits

#### Waste management: Women's perspective

- Mixed or co-mingled solid waste getting in to dump site losing its track for recycling.
- In villages there is no segregation of solid waste in to recyclable and compostable matters at the point of generation. All the solid wastes are dumped in piles outside the village and once in a year during festival time, they are burnt, which leads to GHG emissions on one side and also toxic/ carcinogenic chemicals released to the environment.
- Open burning of garbage or dry leaves along with plastics is a common scene in urban areas too.
- Plastics of different kinds are being mixed with the compostable wastes.
- Wet waste like waste food, vegetable peelings are disposed in plastic carry bags leading to consumption of plastics by cattle.
- Dumping of solid wastes in vacant sites is a common problem in urban areas.
- Waste transportation to far off places results in contribution of GHG.
- Segregation and recycling of dry waste and composting of wet waste can reduce by about 15% the waste going to land fill; and will also reduce the GHG emissions and save the water bodies from getting polluted.
- Arkavthi and Vrushabhavathy rivers in Bangalore are carrying waste water from industries and residential colonies which is a serious concern.
- Land fill is a large source of GHG emissions
- It is estimated that about 1% of population in developing countries earn their livelihood from waste picking (World Bank study), and the potential of savings to the municipal authorities because of the waste pickers is being ignored.

**Air quality:** Women's perspective

- Indoor pollution due to fire wood burning in village homes, exposure to toxic, flammable substances like kerosene, paints, varnishes, mercury spills in the broken thermometers, broken tube lights and CFL bulbs, dry cell discharges, at house hold levels.
- Air and noise pollution due to automobile sector, vehicular emissions in the cities and towns
- Air pollution due to mining, cement, thermal power and other major industries
- Noise pollution due to urban traffic, temples and mosques during festival seasons like Deepavali, Ganesh Chaturthi, new year day celebrations etc.

**Transport:** Women's perspective

- Ability to access different kinds of educational and employment opportunities for women gets very limited if secured transport system is not adopted.
- Roads are designed and constructed for a specific purpose, but, used indiscriminately.
- Similarly, in cities too, traffic diversion to residential roads causes havoc in terms of noise and air pollution

**Industries:** Women's perspective

- Competition for fresh water from industries
- Pollution of rivers and streams due to industrial effluent discharge
- Discharge of sewage effluents from the huge infrastructure projects
- Disposal of solid wastes and hazardous waste from industries
- Granite slurry disposal on roads and highways.
- Absence of policy on refuse, reduce, reuse, recycle, reprocess the wastes
- Industrial waste being dumped in village limits
- Mining activities in forest area are destroying the forest cover and loss of bio-diversity and wild life.
- Climate change induced flood or famine can destroy the agricultural crops leading to loss of job in the rural sectors.

**Energy:** Women's perspective

- Rural women are crippled with the problem of energy for cooking, heating, lighting etc. Women are assigned the job of bringing fire wood from the far off places risking their lives; and to cook the food for their families. Their entire time is spent in fulfilling their family needs and they are hardly left with any time for developing their own skills or getting hands on training or education for life.
- Also, travelling to far off places for procurement of fire wood may lead to sexual assault on women.
- Load shedding / power shortages in rural and urban areas during summer seasons
- Problem of fire wood in rainy seasons in the high rain fall areas of coastal and Malenadu areas.
- Lack of access to information, lack of awareness.
- Women not in policy making and decision making levels

**Agriculture and horticulture:** Women's perspective

- Indiscriminate use of chemical fertilizers and pesticides has contaminated soil and water, which affects the health of the people.
- Requirement of proper education and financial independency for women in villages.
- Women working in plantation crops sectors (coffee seed plucking, pollination of cotton etc.) do not have access to facility of climate services. Mobile facility, radios are with men. Women are engaged in other activities like fetching of water, preparing food, looking after children, their health and

- nutrition etc on which too they have no access to information.
- Self help groups generally do not have safety network for selling their products as their market is very limited. In case of extreme weather conditions or droughts in the village their products can be without any buyers.
  - Women in the villages depend on nature for their nutritional requirements, for eg, leafy vegetables are grown in the villages and this keeps their health and nutrition intact, but, in times of drought, have to pour money on these nutritional supplements which is an economic burden on them.
  - Increased use of high yielding varieties of seeds resulting in the extinction of local disease resistant, low water requiring varieties of seeds.
  - Green revolution has lead to over application of fertilizers and pesticides on land to get more productivity, but, this has resulted in to land becoming useless and barren and this in turn has lead to more dependency on fertilizers/manures for crop growing. Land pollution has also increased because of this.
  - Catchments are used for housing; and as such tanks and reservoirs are not filled leading to failure of agricultural crops and ground water depletion.
  - Women are very close to the farms, 60-80% of the food is produced by utilizing the services of women, but, she doesn't own any farm land. She has a very little say in Education, Income, land, life style and technologies.
  - Impact of Animal agriculture (utilization of animals for food or otherwise) on environmental green house gas emissions is neglected in the climate change action plan. As per statistics of FAO, about 18% of anthropogenic green house gas emission is coming from animal agriculture. This activity is responsible for emission of both CO<sub>2</sub> and CH<sub>4</sub>. CO<sub>2</sub> emission is produced through the nitrogenous fertilizers from feeds that are given to these animals. Enteric fermentation and manure management are the key causes of methane gas emissions from the animal agriculture. About 49% of India's methane gas emission is from this sector, but, the report has neglected the contribution from this sector. Also they use lot of steroids and hormones for injections in to the animals to increase its muscles and the same will come out in faeces and urine and ultimately pollute the water bodies.
  - Climate change has serious ramifications in food availability, food accessibility and also food utilization.
  - Traditional food sources can become more unpredictable and scarce. For example, in the face of climate change, there will be erratic rain falls, flood, famine leading to water shortage and the women farmers cannot grow food in their fields as such leading to starving and anemia.
  - Related increases in food prices make food more inaccessible to poor people, in particular to women and girls whose health has been found to decline more than male health in times of food shortages.

### **Forestry and biodiversity:** *Women's perspective*

- Climate change is likely to become the dominant driver for the loss of biodiversity
- Deforestation and excessive tree cutting has resulted in the depletion of rain fall and infertility of soil.
- Loss of forestry and bio diversity is a cause of concern for tribal people who earn their livelihoods through forest resources.
- Lack of efforts in conservation of natural habitats, conservation of mangroves and drought-resistant crops.
- Rural women and men are highly dependent on biomass, such as wood, agricultural crops, wastes and forest resources for their energy and livelihoods. However, in the face of climate change, the ability of women and men to obtain these indispensable resources is reduced.
- The richness of biodiversity has been due the wealth of knowledge on the environment that



indigenous people and communities possess. Indigenous knowledge comprises: an understanding of wild ancestors of food, medicinal plants and domestic animals; symbiotic relations with ecosystems; an awareness of the structure of ecosystems and the functionality of specific species; as well as the geographic ranges of said species. In the context of climate change induced deforestation, how to preserve this wealth of knowledge is an issue concern.

### **Urbanisation:** Women's perspective

- Arkavathy and Vrushbhavathi rivers are carrying only waste water either from industries or domestic sewage.
- People have a taboo over using recycled water even for washing of vehicles. Main reason being they are not sure about the level of treatment provided by the authorities.
- Rural people migrating to urban areas in search of livelihood have led to the problems of urbanization only to get worse. In the context of climate change the situation can become unmanageable because of the disasters and droughts.

### **Education:** Women's perspective

- In poor communities, women and girls are responsible for collecting water and traditional fuels, a physically draining task that can take from 10 to 20 or more hours per week. As a result, women have less time to fulfil their domestic responsibilities, earn money, engage in politics or other public activities, learn to read or acquire other skills, or simply rest.
- Girls are sometimes kept at home from school to help gather fuel leading to the continuation of the cycle of disempowerment.
- Education is very important if the needed changes have to be brought in. Sensitization to the problems alone does not work well without information and knowledge and necessary know-how.

### **Coastal ecology:** Women's perspective

- Declining fish populations have major implications for fishermen communities that depend on fish. In the context of climate change, Fishing communities have to travel longer distance and stay longer time in the sea leading to their women totally being responsible for their families.
- Women will face much higher burden due to severe coastal weather events, the erosion of shorelines, coastal flooding, droughts and agricultural disruption.
- Migratory consequences result in higher death rates for women, as a direct link to their socioeconomic status and poor access to information.
- Frequent human resettlement due to climate induced disasters further aggravates the loss of biodiversity and ecosystems given the fact that migration encompasses vast changes in land-use, the physical modification of rivers or water withdrawal from rivers, the loss of coral reefs, and damage to sea flows, etc.
- Building of dams in close proximity to the estuaries can lead to problem of salt water in the upper stretches of the river during high tide. This can also change the entire ecosystem in the area leading to even extinction of the species specific to fresh water in the area.

### **Awareness programme and traditional knowledge:** Women's perspective

- Lack of awareness campaign and dissemination of information on the impacts of climate change, possible mitigative and adaptation techniques designed in a holistic way is a cause of concern.
- In a tropical country like India, where solar light is available in plenty, people are suffering from Vit-D deficiency. Similarly hormonal imbalances in women leading to Thyroid problem have become very common. These are all the problems triggered by human induced environmental pollution and climate change.

**Others: Women's perspective**

- Climate change triggered disasters can cause migration of people in search of shelter, livelihoods, mostly to the cities. This will increase the burden on women.
- Women are often excluded from power of decision-making process.
- Open urination by roadside is an unacceptable menace.
- Lack of financial independence.
- Lack of adequate dissemination of relevant information on climate change to different age groups
- Without the changes in the behavioural aspects of citizens, we will not be able to adapt and mitigate the impacts of climate change.

**4.16 (b) Recommendations**

Public Affairs Centre, an NGO in Bangalore working on women's issues recommend that the State's adaptation plan should be built around the four 'Cs':

- Counting women in planning, designing, implementing, resourcing and evaluating stages of all programmes and schemes.
- Converging programmes and schemes at the planning and design stage through multi-sectoral and multi ministerial bodies and at the implementation stage through District Rural Development Agencies (DRDAs) and the Panchayat Raj Institutions (PRIs).
- Capacity development and empowerment of women and men at the level of local Panchayats, line agencies, NGOs and community based organizations to build institutions that will be adaptation responsive.
- Collaborating with key stakeholders – adaptation scientists, government line agencies and departments, PRIs, user groups and civil society groups – to build resilience among the most vulnerable people through participatory innovation, utilization of traditional and local knowledge, adding value through scientific and technological interventions and converging all resources.

Extracts from 'Women's Perspective on Climate Change Adaptation'; PAC

*(<https://kspcb.wordpress.com/2015/04/16/womens-perspective-on-climate-change-adaptation/>)*

The recommendations from 'women's perspective' were compiled by two senior women officers of KSPCB after various consultative meetings. Whereas many of these recommendations are common to the recommendations made by the general public in the public consultation meetings, these recommendations have been retained as they were to give a sense of appreciation of women's perspective on the various sectors. Many terminologies used in colloquial language have been retained as they are to make it easier for the public to understand the issues.

**i) Water and sanitation**

- Ban on phosphorous containing detergents so as to stop the algal bloom and hyacinth growth in tanks and lakes
- Adopt water conservation & auditing techniques; plug in the leakage of water at the points of supply and points of transportation and also wastage of water in the irrigation fields. Use water saving techniques in irrigation.
- Stop the entry of sewage in to water bodies by providing sewerage network to the entire city or town and taking up end of pipe treatment of city/town sewage. Give tertiary treatment for the sewage, meet the strict quality standards wherever necessary and supply to industries, public for use other than for drinking purpose.
- Part of the treated waste water meeting irrigation standards can be diverted for agricultural/forestry purpose.
- Prevent the apartments and high rise buildings discharging the sewage into the lakes, tanks and

- water bodies. Strict vigil on them and heavy penalties in case of non-compliance shall be charged.
- Strict implementation of Rain Water Harvesting plans at the individual houses, industries, commercial complexes or any such civil structures including schools and colleges, agricultural lands so that this water could be used for washing, cleaning of vehicles, gardening, etc.
  - Water used for washing clothes in washing machines with minimum usage of detergents or with bio-degradable detergents can be used for vehicle wash or in toilet flushes.
  - Reuse and Recycle of water shall be made compulsory.
  - Strict vigil over the encroachment of catchment area of lakes, tanks or any water bodies so as to increase the water storage capacity and also creating additional capacity for storage in the tanks by way of regular de-siltation.
  - Take up the rejuvenation of lakes, reservoirs and dried up rivers on priority by way of massive afforestation, cleaning of silted reservoirs, blocking the entry of domestic sewage etc.. Use the services of NGOs and villagers in this task. Use of Local knowledge systems such as, panchayat, local senior citizens, and councillors enriches the rejuvenating process.
  - Encouraging the people in the villages to clean up the open wells, old Kalyanis in their fields or villages. This can be done by way of providing some incentives or subsidies.
  - Educate the village leaders; take up massive awareness campaigns among the women folks at the grass root levels; catch hold of Stree Shakti groups, or any Community based organizations, Environmental NGOs for this work. Use the mass media extensively for creating awareness. Educate them over the impact of climate change on the society as a whole and on the less privileged groups such as women and children and aged ones. Educate them on the necessity and techniques of water conservation, on the reuse, recycling of water wherever possible and necessity to protect our water resources from getting polluted by way of sewage entry or improper methods of solid waste disposal, motivation can be given to such groups who take up the awareness programmes.
  - Create more number of storage ponds/tanks or provide small barriers along the flow of rain water in high rainfall areas so as to allow sinking of rain water in to the earth as far as possible and recharging the ground water.
  - It shall be made compulsory for every home, School, College, Industry to plant trees so as to allow creation of a micro-climate within their premises and thereby rainfall.
  - Take up the afforestation measures in villages and fix responsibility for its protection among the villagers, educate them to that level.
  - Ban on cutting old trees on streets without consultation with locals.
  - During Ganesh and Durga pooja where idols are immersed in water bodies, Government should ensure only eco friendly idols made of natural clay and without paint are available to the public at low price. There should be a complete ban on manufacture of idols made of plaster of Paris with or without paint (to avoid pollution and solid waste).
  - Government shall take up projects for rejuvenating the Arkavathy and Vrushabhavathy rivers in Bangalore by identifying the outfalls and plugging them right away.
  - Recharge of abandoned bore wells should be done by the Government
  - In order to avoid extraction of water from the ground, for construction of huge apartments, treated waste water from sewage treatment plants shall be made available.
  - During Jathras at the big temples which are along the river banks, special care to be taken to protect the water bodies during those events. Arrangement can be done to collect the waste water generated during festival season and send for treatment, thus preventing direct entry of pollutants in to river or streams.
  - People/farmers in villages cannot think water as a universal commodity and that they should protect this resource for the future generations. They should be educated on the related issues.

**ii) Land use and planning**

- There should be clear cut demarcation with respect to land use by the Government and land should be used only for the purpose for which it is designated, i.e, as per revenue records, if a land belongs to a particular public purpose, that has to be maintained.
- Measures should be taken to ensure that land reserved for parks and other civic amenities should not be used for other purposes.
- There are complaints on noise and fugitive emissions from cement go downs, LPG cylinder storage, fabrication and welding shops. Hence NOC from neighbours shall be taken prior to sanction.
- Maintaining buffer zones between industrial and residential area shall be done on priority. Industrial activities in residential area, even though small scale sectors shall be strictly prohibited by Government.
- Zero waste approach to be propagated at all levels across the state.

**iii) Waste management**

- Source segregation of waste to be done, targets for recycling to be set, minimize waste to the landfills, move away from centralized approach, adopt decentralized policy. Invest in providing necessary infrastructure such as, establishing dry waste collection centers at each ward.
- Provide access to waste and livelihoods to waste pickers, especially women. Hence, waste pickers should be given the first priority for running the dry waste collection centers.
- Equip waste pickers to do the job efficiently and safely. Provide them training and necessary safety tools.
- Social security to waste pickers to achieve decent standards of living
- Formalization of informal sectors. Not only providing the ID cards to waste pickers, but also, they should be provided with access to finance, access to loan, access to education and access to market information.
- Extended producer's responsibility should be fixed as this has direct bearing on the public health. Special tax can be collected towards this and can be utilized for the benefit of the waste pickers.
- Government's approach should be from collection, transportation and segregation to Segregation, collection and transportation. Because transportation cost again contribute to the GHG emissions.
- 1 KG of plastic segregated and recycled saves 1.5 to 2 Kg of CO<sub>2</sub> equivalent as the waste contains up to 40 % of plastic; recycling of plastic has to be undertaken on war footing.
- Both waste to energy and waste to landfills are no good ideas; wet waste has to be properly segregated and composted.
- Hotels, marriage halls, market places and malls shall segregate their wet waste and arrange for composting the same.
- Dry waste including old garments and cloths shall be segregated and handed over to rag pickers; the Government could collect the same once in a month decide how to make use of or dispose it off safely.
- No e-waste shall be mixed with municipal solid waste. Each ward shall have separate e-waste collection bins at some important centrally located places and the e-waste so collected could then be handed over to PCB authorized recyclers.
- Bio-medical waste generated from homes shall also be collected by the nearest common bio-medical waste treatment facilities as part of their CSR. KSPCB should co-ordinate with the Common waste facilities in this regard. Biomedical waste from hospital, clinics and pharmacies has to be segregated and given to the Common treatment facilitators.
- Dumping of wastes in vacant sites is commonly noticed; Government should insist the owners of these sites to construct houses within a fixed period OR the owners of the vacant site shall be made responsible for handling such waste.

- Government should think of immediate measures to ban use of plastics carry bags, containers, cups and plastic rolls at the manufacturing level itself.
- Complete segregation and recycling of plastic carry bags and papers shall be taken up on priority by the Government through Local bodies.
- There shall be a heavy penalty for burning of garbage.
- Leaf litter should not be burnt. Pits could be constructed in the local parks for composting of leaf litter and manure generated could be used for the plants in the park. Local bodies shall be made responsible for this.
- Recyclables containing metal waste shall be sent for re-melting which also is an energy saver compared to extracting metal from its ores.
- Educate the women in the localities to gear up to the solid waste segregation.
- Urban local bodies should have an integrated method of solid waste disposal mechanism in place such as, sanitary land fill, Incinerator and Composting. Wherever incinerators are installed, it shall go for waste heat recovery and power generation. Similarly, sanitary landfills can be developed to tap the methane gas and there by power generation.
- Government shall develop a system for disposal of municipal solid wastes in every local body limits. System drives people in to action. System has to be in place before we create any awareness to the public also.
- Large scale awareness among the public especially women shall be taken up at the ward levels and village levels involving community based organization and other environmental NGOs. Suitable training shall be given for the women.
- Behavioural changes to take place in the individual and community level by way of education and training.
- Mixed wastes after separation of recyclables can be used for production of bio-diesel also. Government to think on these lines too.
- Households shall segregate dry and wet waste. The wet waste shall be composted either in their own homes or in their respective wards. Home composting shall be encouraged. A training programme and materials for doing home composting shall be supplied and also, Government can make a scheme where they can buy back the compost so produced at household level for use into farms and parks nearby.
- Municipality workers to be given training and awareness in impacts of open burning of municipal solid waste and importance of collecting segregated wastes.
- In villages, Panchayats and Grama Sabha shall take the lead to train and create awareness among the women to segregate the plastic and paper from the waste so that they can convert the waste directly in to manure and use it in their fields. Vermi-composting and composting done using dry leaves involving these women shall be encouraged.
- Educate the masses on what is happening to their waste, how it is collected, where it is disposed, what are the concerns of the Government in managing the waste- involve the community in to the system of waste management.
- Garbage management should be made the responsibilities of the generators, whether it is the individual houses or organizations like choultries, industries. Government should only supervise and guide them on how to manage their wastes, by way of segregation and composting. Government or municipal authorities can arrange for a location or bins in each ward for disposal of dry wastes which can be collected once in a while by recyclers.
- Zero garbage kitchens and zero garbage dining, Success stories of Adama Chetana, Bangalore- an NGO can be emulated.
- There are many institutes/agencies which can set up the wet waste to energy plants, and even run them. For example, CREST-NIE in Mysore. Such entities should be fully made use of.

**iv) Air quality**

- Government should put a brake on the number of vehicles especially in cities. 15- year old diesel vehicles, especially buses and trucks shall be banned by Government in cities.
- Alternate fuels shall be encouraged. All the vehicles used by Government shall be run on alternate fuels.
- Government should also give financial and technical support to R & D in the field of alternate fuels.
- Car pooling should be made mandatory. The number of working days for all employees shall be 5 days similar to Central Government to avoid traffic and pollution on weekends.
- Industries should not be permitted in residential areas.
- In rural areas gober gas/LPG/ solar usage shall be encouraged to prevent cutting of trees for firewood.
- Supply of efficient chulas to poor houses and villages. This will ensure good air quality and health of the women in rural areas. The Government shall give subsidies for the same, if necessary.
- Bursting of crackers during Deepavali festival, elections, birth and death events shall be totally banned to prevent noise and air pollution and waste generation.
- Labourers involved in cracker manufacturing shall be employed in other eco-friendly product manufacturers such as gunny bags, cloth/pollution free bags etc.,
- Free flow of traffic shall be ensured to prevent idling of vehicles

**v) Transport**

- Any transport systems-such as Metro, pushing the bicycles in the lanes or more number of buses, women's safety should be kept in mind
- Public transport shall be user friendly and cheaper, which will encourage more people to opt for it. One day in a week should be "Cycle Day" to curb air pollution.
- There should be good road connectivity and affordable transportation facilities for rural women to market her produce or otherwise.
- The roads shall be well concreted and pot holes filled for smooth driving and efficient transport.
- Government shall make it mandatory for schools to bring the children by buses/other public transport to avoid individual vehicles.
- Traffic diversion to narrow roads in villages or cities shall be avoided.
- Free movement of ambulance vehicles shall be ensured.

**vi) Industries**

- Rural development and women empowerment shall be the focus of the Government while considering job creation. In this regard, Government can encourage "Badanavalu model" as a part of rural development initiative. Government can revive the Khadi and handloom and similar small scale cottage industries and involve the rural women in such industries.
- Women should be able to work from home at their leisure time and earn their livelihoods without compromising their own family life. Training shall be given to the rural women in this regard by involving the social activists.
- Industries shall use only eco-friendly fuels and have proper air and water pollution control systems in place.
- Industries shall be insisted to go in for modern eco-friendly technologies for production and control of pollution.
- Common effluent treatment plant shall be established for similar kind of industries and operation and maintenance of the same shall be monitored strictly by the Government
- State Government shall award high performing industries from time to time and maximum publicity shall be given in local media.
- A common website for recyclers/re-users shall be created so that there is exchange of information / waste/technology between industries.

- Industries shall compulsorily plant trees in 33% of the area allotted to them.
- In urban areas those with knowledge of computers like women Engineering graduates can be encouraged to get in to business through E-commerce platforms. As per statistics about 60-70% of urban people have access to internet and 32% are buying things through e-marketing. Women can make use of this opportunity to grow in to business. They can form groups one for textiles, another for Electronic goods, books, home appliances etc., and get connected to each other and do wonders in e-business. Government can help them giving required infrastructure such as hardware and software, and help to kick start the process. Awareness and training shall be created among the urban women community regarding this type of pollution free industry.
- Incentives shall be given to industries to move to Tier-II and Tier-III cities.
- Open cast mining causing loss of forest resources and bio diversity shall be seriously curtailed. Mine closure shall be as per the plan approved by IBM. Forest land shall not be used for mining purpose.
- Training for women to come forward in entrepreneurship for eco-friendly industries.

#### **vii) Energy**

- Government shall provide energy security in rural villages so that they can dedicate their time for their personal growth.
- Solar roof panels on every individual houses, school buildings, Government buildings in the nook and corner of the state shall be taken up. Cost may appear to be high, but, Government shall subsidize these projects and involve NGOs to help the public to get this installed and commissioned to minimise the overall cost to the society.
- CFL/LED bulbs shall be sold at subsidized prices so that people buy them and conserve energy.
- Incentives should also be given to manufacturers of solar photovoltaic cells and CFL/LED lights by the Government
- Household appliances like solar cooker, solar lantern, solar water heater, solar stove, solar lightings etc, shall be subsidized to encourage the public to buy them.
- All Government Offices, Government undertakings, Government Schools and Colleges including Vidhana Soudha and Vikasa Soudha shall adopt energy efficient lightings and set an example for others.
- Auto sensors for switching on/off lights shall be installed in Government Offices and made available to the public at subsidized prices.
- Energy efficient manufacturing technologies shall be adopted and encouraged in industries.
- Energy saving mechanisms to be encouraged and massive awareness campaigns shall be taken up at the rural levels with the help of Stree Shakti groups and Community Based Organizations (CBOs) and environmental NGOs.
- Available bio mass can be utilized for the production of bio gas/gobar gas. This shall be subsidized.
- Replicates of Barefoot College, Rajasthan, can be implemented in the state wherein they have trained the illiterate women in making solar lamps and this has helped their entire villages.
- NGOs also can take up initiatives to sponsor the solar street lights, solar cookers, solar heaters etc by adopting villages.

#### **viii) Agriculture and horticulture**

- Encourage Integrated farming model in villages. Proper education and training shall be given to the women who participate in the farming activities.
- Organic farming and vermi -composting shall be encouraged.
- Livelihood diversification shall be provided to women by way of training in proper livestock management. Training shall be provided to those who are in to this business.
- Provide climate services facility to women. They may need training to use these facilities. Also, incorporate more number of services on mass media on health, nutrition, water food, looking after

the children etc.

- Self help groups and Stree Shakti groups have to be given guidance on robust income earning opportunities. As in Andhrapradesh and Tamil Nadu, these groups shall be federated to have stronger market linkages for their products even in drought situations.
- Cropping pattern shall match with the water availability in the region and farmers shall be educated about the same.
- Gene pooling/Gene bank /Knowledge bank about the seed varieties of the local origin shall be created to preserve the local seed varieties (bio diversity of seeds).
- Encourage growth of lesser known cereals also to preserve bio-diversity of food crops
- Providing percolation pits in the farm lands can help conserve more water for agriculture
- If a farmer's borewell gets dried up, he should take the responsibility for rejuvenating it by way of providing infiltration ponds in his farm land, before digging a new bore well. Ground water authority should keep strict vigil on this issue.
- Women groups should be involved in tree plantation in Government land in villages. Stree Shakti groups can be motivated. They can choose to plant trees which give income such as mangoes, tamarind or neem so that returns from such things can be used by them. They can also be provided with some seed money for this purpose initially.
- Prevention of GHG emissions from animal agriculture is possible only when we adopt life style changes, because as far as there is high demand for the animal meat there will be supply and there will be rearing of animals specially for this purpose. So, reduction of usage of animals for food and use of plant based diet is the only solution for this. So, it is important to bring in awareness in the society on these issues. Plant based diets are consuming less resources rather than animal based diet.
- There should be adequate planning and preparation to provide food security in times of droughts or flood or any natural disaster.

#### **ix) Forestry and biodiversity**

- Indiscriminate cutting of trees in the forest shall be stopped.
- Effective Watch dog team shall be setup to preserve the forests.
- Bio-diversity register shall be compulsorily prepared and maintained in all the districts.
- Aromatic and Herbal gardens shall be maintained in each ward or new residential areas.
- Every park shall have nest so as to attract birds. Butterfly parks shall be maintained in all cities.
- All measures shall be taken to prevent forest fires.
- Involve women in tree plantation; take the inspiration from (fast track) Salumarada Thimmakka.
- Subsidized LPG/Cooking gas / solar cookers shall be supplied to rural areas so as to safeguard forests.
- Greenery nurturing programme where industries nurture the schools nearby by providing saplings, RWH, etc shall be part of their CSR wherein KSPCB shall be a facilitator.
- Conservation of mangroves and drought-resistant crops can reduce the impacts of climate change such as flooding and famine

#### **x) Urbanisation**

- Necessary infrastructural facilities like roads, Power, Water, Sanitation, good schools and colleges shall be made available in rural areas to prevent migration to cities.
- IT and Software parks shall be set up in different districts in the State so as to ease the pressure on Bangalore.
- Road dividers in cities shall be replaced by trees /plants wherever feasible.
- All the residential Apartments can have a captive system for waste management including segregation of dry wastes and wet wastes. Wet wastes can be taken to in house composting and the dry waste to be segregated and sold to recycling industries. This way waste going to landfill can be reduced to



15% and GHG emissions reduced and water bodies can be saved from pollution.

- By using technologies, we can now treat the sewage water to such a degree that it is drinkable. Government can think of such projects and we can make use of women groups for this purpose to educate others.
- Government should provide basic facilities available in the city to the villages also like water and power supply. Let there be entrepreneur development programmes, skill development programmes like TV, mobile repairs, enable rural women to learn computer operations, provide employment.
- Women can think of an opportunity to grow vegetables or nursery plants in the waste plastic bags / roof gardens.
- At village level we can educate the people to segregate their wet and dry wastes through Panchayats and ask them to put the dry waste in bins provided to them. This can be collected by the recyclers for further process, as part of their CSR.
- Climate change induced environmental degradation is likely to increase the flow of both internal and cross-border human migration. Hence urbanisation should be checked.

#### **xi) Education**

- Quality education shall reach the rural masses. School Curriculum shall compulsorily include environment protection, prevention of pollution and climate change as the main subjects.
- Women shall be included in all major policy decisions of the Government at all levels.
- For successful implementation of all the above ideas, massive awareness campaigns shall be carried out involving NGOs, prominent women in the Government sport personalities, cinema and theatre artists and environmentalists, MLAs, MPs, and public.
- Head of each ward shall carry out informal meetings of all schemes like water supply, road, lights, municipal solid waste disposal and other environmental issues every month at fixed time and place involving the locals.
- These meetings shall compulsorily be attended by Government Officers of different departments like KSPCB, ESCOMs, PWD, BWSSB, KUWSSB, etc and redress the problems of the public. The decisions taken in these meetings shall be reviewed by Head of the Ward to ensure implementation.
- Women development cell in each and every college and institution can be created wherein they can be given awareness and training about composting, recycling and other aspects of waste management.
- Educational institutions shall have waste segregation and management systems in place and students shall be strictly guided on disposal of the waste in the right places.
- Solid waste management should become the priority aspect in every local body and they should take into confidence the communities for the examples of best practices and it should be people-driven movement, free from vested interests.
- Government shall bring in the ancient practice of yoga and meditation into the education system.

#### **xii) Coastal ecology**

- Coastal belt of Karnataka should be the priority area in the climate change mitigation plan of the Government.
- As the climate change induced disasters like flood and famine can cause severe coastal weather events, the erosion of shorelines, coastal flooding, droughts and agricultural disruption, Government shall give special attention towards conservation of mangroves and drought-resistant crops so as to reduce such impacts in the area.
- Fishermen community who depend on fish population shall be given special consideration in climate change mitigation plan. They shall be provided with enough training on the climate change impacts and job securities shall be given.
- Greater numbers of people on the coast may be displaced due to severe coastal weather events, the

erosion of shorelines, coastal flooding, droughts and agricultural disruption. Hence, a special fund shall be created to deal with the requirements of climate change induced refugees.

- Special care should be taken to the protection of coral reefs.
- Government shall ensure that all Government bodies involved in coastal management shall carry out their duties in a responsible manner in the interest of protecting marine life.

### **xiii) Awareness programme and traditional knowledge**

- Those with knowledge of computers like Engineering students can be encouraged to get in to e-commerce platforms. Women can make groups pertaining to textiles, electronic goods and home appliances and get connected and engage in business. Training and awareness can be imparted in this regard to get rid of the mental blockages among the women community towards such work.
- Massive awareness campaigns involving Stree Shakti and other groups for management of solid wastes in the rural areas,
- Government shall set in motion the awareness campaign on global warming as a non-political Environmental Movement. Just like Jan Dhan Yojana or Swachh Bharat Andolan, it should start as a mass movement initiated by major industries and organizations as CSR activities.
- There are microfinance associations in rural areas which has 18-20 lakhs of women associated with it. Catch hold of such groups, educate them, achieve the goal of creating awareness on the challenges of global warming and the possible mitigative measures. Environmental NGOs in the state, self help groups, Stree Shakti groups and other different associations should be motivated and brought within the network of awareness and education.
- Rural women shall be educated not to imitate the use and throw culture prevalent in urban areas.
- Generally, we show the success stories of those who protected the environment. Along with that, people who throw wastes secretly in to vacant sites, or who put fire to the garbage and leaf litters etc could be video graphed and played in the television networks to discourage others from doing such activities. Government has to take the confidence of the mass media in this respect.
- The scientific research results on environmental impacts of “Roti, Kapada and Makan” should be used in the strategy on awareness campaign.

### **xiv) Other Issues**

- Solutions to climate change effects shall be gender friendly.
- Government shall give a special rehabilitation package for climate induced migration or climate refugees.
- Government can involve the NGOs to train the women community in rural area to get in to entrepreneurial development programmes. Government should join hands with such NGOs to bring forth the entrepreneurship in rural women.
- Government to seriously take up the issue of open urination and provide toilet facilities at suitable places through PPP or otherwise
- Concerted co-ordination of all state departments to address climate change issues to be taken on priority.
- Strict implementation of the existing Acts and Rules.
- Marginal women from rural area should be encouraged to join together to form co-operatives.
- Awareness on traditional knowledge to be given.
- Awareness on all food products, its ingredients and calorific value and its origins to be given by the manufacturer.
- Onset of early puberty and early menopause in women due to climate change can occur which necessitates the Health Department to address this issue.
- Health supplements shall be supplied free of cost to women especially in rural areas.
- Government shall think of scientific method of disposal of the menace of used sanitary napkins in houses, colleges, schools and hostels.

- Harmful effects of using chemicals, hair-dyes, lipsticks, and other cosmetics which may contain lead or other heavy metals shall be published keeping the health of women in mind.
- Female students to be made green ambassadors
- Encourage dry toilet establishment and usage at subsidized levels.
- Disaster management teams involving locals to be formed at local levels.

#### **4.17 Traditional Knowledge, life style issues, best practices and public awareness**

##### **4.17 (a) Major Concerns**

- The modern society has ignored the glorious traditional knowledge which were tested and practiced for thousand of years, and which can lead us to a sustainable life style.
- Not much organized efforts by the STATE to capture and study various good practices of our ancestors, which may be of huge relevance to CC, can be noticed.

##### **4.17 (b) Recommendations**

There is a dire need for the state to dedicate adequate resources to take an objective study of the highly relevant ideas to manage our natural resources on a sustainable basis. The following areas of study will be highly relevant.

- Capture, study and implement all the relevant traditional knowledge in managing our natural resources
- Implement sustainable food habits and life styles of our ancestors
- Coorg's glorious traditions should be studied and implemented where feasible
- The relevance of Ayurveda system of health care to CC should be adequately propagated
- Population control measures through traditional practices
- Traditional festivals should become suitable mechanism in raising the awareness levels of the society to respect and preserve the importance of a clean environment
- Involvement of locals and students in identifying the sources of pollution on all rivers of the state as done recently for Bedthi river
- Traditional knowledge of how to use the fresh water resources should be revived
- The relevance of traditional agricultural practices in seed collection, tilling, water usage, harvesting, drying and storing should be effectively studied and implemented
- Appropriate storage practice for seeds and food articles to take care of draught affected periods should be emulated
- Traditional practice in retaining the seed and crop varieties, and natural ways of maintaining soil fertility and pest control should be invariably studied and adopted effectively to minimise GHG emissions and to avoid food contamination.

#### **4.18 KSPCB issues**

##### **4.18 (a) Major Concerns**

- KSPCB has a large number of staff vacancies, which seem to be impacting its ability to discharge its mandated functions on CC satisfactorily
- It may not be getting adequate support by other departments of the State Government in enforcing the pollution control measures
- It has not been given a much higher profile from CC perspective, despite its pre-eminent position to be a critical player at the state level.

##### **4.18 (b) Recommendations**

###### **Easy to implement and quick benefits – tactical in nature**

- KSPCB should expand its 'Parisara Mitra School' programme, which has been recognized as a great

- success, to colleges and other educational institutions
- KSPCB should also be entrusted with holding 'Parisara Sammelana' at regular intervals on the lines of 'Kannada Sahitya Sammelana'
  - Need for increased role for KSPCB at planning stages of land conversion to residential and industrial layouts; and in the infrastructure development and other developmental projects
  - Much more powers needed for KSPCB in strict implementation of the relevant Acts
  - Pollution from red category industries need much more focus
  - The vast number of vacancies in KSPCB should be filled at the earliest so as not to impact on its important role in mitigating CC
  - KSPCB need to work with NGOs in wider dissemination of important issues in waste management
  - It should take a lead role in raising awareness level on the risks of unscientific methods adopted in ginger cultivation and tobacco processing
  - Much higher focus on controlling the pollution from stone crushers and red category industries
  - Much more effective role in controlling the pollution of fresh water resources such as rivers and lakes
  - KSPCB buildings should become role model for RE usage with compulsory usage of solar power and RWH
  - Strengthening the monitoring and public display mechanisms on air pollution levels
  - Should consider effective usage of private labs in monitoring pollution levels across every taluks places in the state
  - Need for increased number of monitoring stations and public display of pollution levels
  - Should have a major role at the stage of consent issue to insist on RWH and solar PV systems for industries and large enterprises
  - Linking the consent for establishment with incentives and disincentives for making a buildings / processes greener
  - Involvement of locals and students in suitable awareness campaigns such as associating them in environmental walks along the water bodies and in identifying the sources of water pollution
  - Centralized application submission at Help Desk results in lot of carbon emission. Arrangement may be made to accept application and water cess in Bangalore one and Karnataka One
  - Pollution cannot be tackled without curbing corruption. Train all staff (permanent/ contract/ agency) and officers on anti-corruption. If possible take public opinion on how to curb corruption
  - Consider replacing all city based vehicles of KSPCB with electric cars

#### **Medium to long term benefits – strategic in nature**

- KSPCB should acquire a much higher profile than at present in the context that it already has a huge role in mitigating CC through the administration of Air Act, Water Act and in protecting the general environment
- KSPCB's role in organizing the public consultations came for wider appreciation by the participants, who also want this initiative to be expanded to all taluka levels
- More autonomy, powers and resources are required to assist in full discharge of its responsibilities
- District level awareness campaign cells with KSPCB as a rallying point should be seriously considered
- KSPCB as an effective facilitator between industries and Pollution related Acts
- Support by KSPCB for industrial estates /cluster (such as electronic city in Bengaluru) in notification and enforcement activities
- Should consider a possibility of assisting with budgetary allocation for waste management implementation measures in municipalities
- Mandatory involvement of KSPCB at district level planning stages and in cities
- Take initiative to conduct district level carrying capacity study in each district to assist in district / taluka level planning process.
- In view of the increasing pollution threats source apportionment studies of all fresh water sources,

and all polluted towns/areas in the state should be considered to be undertaken with the help of competent agencies. The assistance of local science /engineering colleges can be considered for such studies to enable awakening process amongst the locals.

- Such technical capability should be considered to be developed in-house.

#### **4.19 Other issues of societal concern**

Participating public raised a large number of issues, which could not be put into any of the above groups, but still have relevance to the state action plan.

##### **Easy to implement and quick benefits – tactical in nature**

- Regular publication of localised data on pollutants
- Green bazaars and green technology throughout the state
- Encouraging levels of carbon credit for Coffee growers to increase the bio-diversity
- Studies, data base and modeling on CC in the context of state's geographical and climatic scenario
- Locals should have a major say in deciding what is needed for hill districts from CC perspective
- Fair projection of rainfall and water availability at block levels
- Developing credible decision support mechanisms for agriculturists
- Flood forecasting models, especially for urban areas
- Disaster preparedness plans at taluka/ district levels
- Identification of hot spots of climatic concerns within cities
- Identification and adaption of best practices in all sectors of our economy
- Consider the concept of Ombudsman on environment at taluk / district levels
- Strengthening the public health system through
  - Implementing integrated standards and adequate funds allocation
  - Publishing reliable Statistics on various diseases
  - R&D encouragement
- Publication of all relevant and reliable stats /data so as to enable the society to take corrective measures
- District level CC action plans for development and a mechanism to co-ordinate activities of various departments
- Producer responsibility to take back the waste/used items
- GHG emissions score card at regular intervals and display for the public
- Collate and publish the relevant knowledge from different institutions
- A mechanism for co-ordination between departments for pollution related issues
- Setting up a standing committee of the civil society groups and reputed individuals to assist the Chief Minister in ensuring implementation of recommendations made in this report
- Implementation of all the relevant recommendations made in the earlier reports

##### **Medium to long term benefits – strategic in nature**

- The need to strategise and adapt to CC at all levels in the state's planning and implementation mechanisms
- Diligent study on the impact of high GDP growth rate linked developmental paradigm with high consumption of raw materials, water and energy, and the associated pollutants including the GHGs
- Non-viability of engineering solutions for CC mitigation should be objectively considered
- Issues with mega projects and over emphasis on industrialisation for job creation should be addressed
- Need for macro and micro level considerations for sustainable development in every sector and community
- Over consumption of natural resources, and the associated social and technical issues in CC
- Consider vastly larger role for credible NGOs in mitigation and adaptation

- Proper perspective of livelihood issues in CC discourse
- Take cognizance of the opposition of Kodagu people on conservation reports such as Kasturirangan report
- The important role of cultural heritage in preserving the ecology
- Much more involvement of civil society in CC issues
- The true welfare of tribals, who are generally custodians of bio-diversity, must not be ignored due to industrial /commercial activities in the forests
- Task force on CC at community levels, which can also act as emergency disaster relief mechanisms
- Effective societal level discussions on green based economy against GDP based paradigm
- Value based credit to forest dependent people in preserving the rich bio-diversity
- Infrastructure development should be adequately planned to face CC implications in future
- High GDP growth rate for the state means more usage of natural resources; and hence the same should be carefully considered in the context of consequential higher GHG emissions
- Huge wastage of natural resources as happening now should be at the focus while considering high GDP growth rates; this should lead to careful management of resources
- Demand Side Management of all the natural resources and energy should be of highest priority
- Linking Government incentives to the action taken on CC
- Right to pure and water should be considered as part of the relevant Acts
- Specific targets for Government bodies in CC action plans
- Population as the root cause; viewing the huge population as a resource than as a burden
- Fast track courts on pollution related issues
- Consider setting up a dedicated “Climate Change University”
- ‘Green Cells’ in all state departments / agencies for pollution control promotion measures
- Collaboration between industrial hubs and /or estates in minimizing the wastes
- Deployment of Precautionary Principles in using the natural resources
- Encouraging e-administration at all levels to reduce the usage of paper
- Promote employment opportunities in consultancy services for RWH and urban agriculture
- Strong disaster management cells to be set up at district and their operations should be reviewed regularly
- RWH and ground water recharging as a CSR
- Make public consultation highly effective to reduce corruption in environmental governance

#### 4.20 Brief discussion on the analysis of costs and benefits

Whereas the costs and benefits analysis (CBA) would be useful and may even be considered essential before investing any public money, it would probably impossible to apply such an analysis to every recommendations made in this report, which are few hundred in number. It is so because of the non-availability of the required data and the vastness of the task. However, such a CBA can be and should be done at the state level with the help of concerned departments.

Additionally, in the context of the very nature of gigantic societal risks associated with the CC, it may be reasonable to assume that the overall benefits to the society from the investment in any recommendation leading to mitigation and adaptation will be much more than the costs.

Hence it is recommended that the costs and benefits analysis for the implementation of any given action plan be undertaken by the concerned department /state undertaking, since such an agency will have all the required information / data to conduct the analysis.

# Part B

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## Explanatory Notes

Chapter 5 : Brief introduction to the phenomenon of Climate Change

Chapter 6 : Major findings from IPCC

Chapter 7 : Brief discussion on NAPCC and of KSAPCC

Chapter 8 : Sectoral issues raised in public consultation meetings

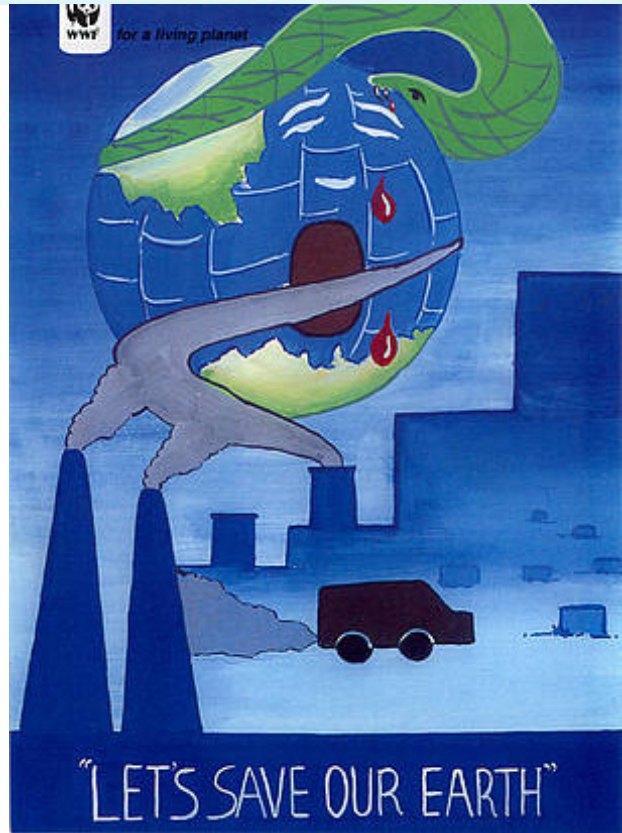
Chapter 9 : Best Practices and Conclusions

Tables

Annexure

## Chapter 5

# Explanatory notes on the phenomenon of Climate Change



Climate Change is generally associated with a lasting change in weather patterns over long periods of time. It can be a natural phenomenon, and has occurred on Earth even before people inhabited it. As compared to this natural phenomenon is the current situation that is also referred to as climate change, anthropogenic climate change, or global warming. This change in weather patterns appears to be happening much faster and is linked to human activity contributing to the greenhouse effect.

Focused research across the world since early 1980s has established that Climate Change is the most serious global environmental challenge today. As per the global community of scientists the changes in the chemical composition of the atmosphere and increase in concentration of Green House Gases (GHGs) pose a significant threat to the ecological balance and bio-geo-chemical cycles including rainfall and temperature on the planet.

As per Inter Governmental Panel on Climate Change(IPCC) some of the catastrophic consequences of Global Warming beyond 2<sup>o</sup> Centigrade increase are: famines and droughts threatening millions of lives; worldwide drop in agricultural and horticultural crops; up to 3 billion people at risk of flooding and without access to fresh water supplies; destruction of half the world's nature reserves and a fifth of coastal wetlands; global sea levels increase by more than 20 feet under extreme circumstances; significant effects on biodiversity



and ecological productivity; potential for international conflicts, border disputes, war due to water and food shortages, forced migration, extreme weather events, huge impact on general health etc. It is not difficult to visualise how each of these catastrophic consequences can impact our masses.

**Table 4: Annual Green House Gas emission by Sector at the Global Level**

Sector	GHG gases (%)	CO <sub>2</sub> (%)	Methane (%)
Power Stations	21.3	29.5	-
Industrial Processes	16.8	20.6	-
Transportation fuels	14.4	19.2	-
Agricultural bi-products	12.5	-	40
Fossil fuel retrieval, processing and distribution	11.3	8.4	29.6
Residential, commercial and other sources	10.3	12.9	4.8
Land use and bio-mass burning	10.0	9.4	6.6
Waste disposal and treatment	3.4	-	18.1

(Source: IPCC Rep 4.7 ort 2009)

**Table 5: Global Electricity Consumption and CO<sub>2</sub> Emission (Year 2009)**

Country	Per Capita Consumption (kWH)	Per Capita CO <sub>2</sub> Emission (Tons)
United Arab Emirates	17,296	31.97
Sweden	14,141	4.48
USA	12,884	16.9
Australia	11,038	17.87
Japan	7,833	8.58
Germany	6,781	9.16
China	2,631	3.03
World Average	2,730	4.29
India	597	1.37
Indonesia	609	1.64

(Source: Key World Energy Statistics, IEA, 2011)

In order to combat the Global Warming phenomenon, the need to minimize the CO<sub>2</sub> emission from the power sector becomes obvious by the close association between electricity consumption and GHG emissions as depicted in the table 5.

In a report released by MoEF in 2010 (*India: Greenhouse Gas Emissions 2007*) it is indicated that the CAGR of GHG emissions from electricity sector between 1994 and 2007 was 5.6%, and that about 38% of all GHG emissions in our country is associated with electric power sector. Additionally, within the energy sector electricity alone can be associated with 65.4 % of all GHG emissions. In view of such large contribution of electricity to the total GHG emission of the country, there is an urgent need for reducing the emissions from this sector, which is possible only by minimising the number of large conventional power projects.

**Table 6: Sector wise % GHG emission in India**

	Energy	Industry	Agriculture	Waste
Electricity	37.8 %	-	-	-
Transport	7.5 %	-	-	-
Domestic	7.2 %	-	-	-
Others	5.3%	-	-	-
Cement	-	6.8%	-	-
Iron & Steel	-	6.2%	-	-
Others Industries	-	8.7%	-	-
Total	57.8 %	21.7%	17.6%	3.0%

(Source: MoEF Report in 2010)

IPCC, in its five successive reports, has projected that the changes in the natural cycles will severely affect the socio-economic texture and environment at global as well as regional levels impacting all sections of the society. Changes in the rainfall pattern will most affect agriculture and water resources. The fifth assessment report (AR 5) of IPCC (2014) has reiterated the earlier reports that the countries most affected by climate change would be agrarian dominated, eco sensitive economies and tropical countries such as India. India, because of the second largest population, high density of population and disproportionately limited natural resources, is projected to face many serious issues impacting every section of its society.

The fifth assessment report (AR 5) of IPCC (2014), which is described as the most important assessment of global warming yet published, has said that Climate Change is set to inflict “severe, widespread, and irreversible impacts” on people and the natural world unless carbon emissions are cut sharply and rapidly.

“Science has spoken. There is no ambiguity in the message,” said the UN secretary general, Ban Ki-moon, attending what he described as the “historic” report launch. “Leaders must act. Time is not on our side.” He said that quick, decisive action would build a better and sustainable future, while inaction would be costly. The UN has said inaction would cost “much more” than taking the necessary action.

What the report has said about the implications on India is even more worthy of our notice. “Among Flood Risks and Losses, literature assesses that India is among the top 20 most at risk from extreme events and can experience an 80 per cent increase in population at risk from sea level rise by 2050, including Kolkata and Mumbai for at risk population and assets. Additional health costs from diarrheal and malarial illness are also expected by the 2030s. Sustainable development with adaptation helps in managing these impacts,” said Dr. Dasgupta, who was one of the lead authors of the IPCC report. “The Indian economy is hugely dependent on climate sensitive sectors such as agriculture, fisheries, forestry and even electricity generation. But it is the poorest people who suffer most from climate change. For example, 58 percent of our people solely rely on agriculture so these new changes in rain or temperature can affect the whole country’s food security and economy. India has already experienced several extreme weather events in the last 2 years. And our long coastline of over 7,500 kilometers makes us highly vulnerable to sea level rise and oceans becoming acidic”.

Human activities which are contributing to GHG emissions are certainly causing many other serious problems: pollution of air, land and water thereby severely impacting the humans; accelerated depletion of natural resources with disastrous consequences; and inequitable developmental opportunities to different nations/communities. In this context it becomes undeniable that those human activities which are contributing to GHG emissions must be contained within the nature’s limits, even if the cynics of Global Warming are not to be ignored.

Those activities, such as mining and industrial processes, which lead to excessive GHGs in the atmosphere are also closely associated with the increased pollution of air and water, which can already be seen in the form of contaminated water bodies and polluted air in industrial and urban areas. Minimising such pollution levels can be seen as the most effective way of arresting the GHG emissions in the atmosphere.

According to the Government of India's own assessment, country's agriculture sector is facing serious risks due to the current impacts of climate change: increasing temperatures, erratic rainfall patterns and a higher number and severity of floods, droughts and cyclones. A number of studies project that unless India adapts to the impacts of climate change early, there is a probability of 10-40% loss in crop production in India by 2080 - 2100 due to global warming. Economic growth, food security and fighting poverty stand to lose. Effective mitigation measures are also urgently required in order to minimise the Climate Change impacts in the medium to long term.

There is a vast amount of literature on the implications of Climate Change. One such weblink is:

*(<http://freebookculture.com/climate-science-factsheets-2015/>); accessed on 10.5.2015*

In the Climate Change context Karnataka has many serious issues to contend with, and hence needs all possible policy interventions on mitigation and adaptation. In the context of long term welfare of our society, there is no alternative but for all sections of the society to take active part in the formulation and implementation state action plan on Climate Change.

Adaptation Gap report of UNEP 2014 says: "Even if emissions of greenhouse gases are stabilised at a level that is consistent with the ultimate goal of the United Nations Framework Convention on Climate Change (UNFCCC), both the risks and the impacts of climate change are expected to increase significantly in coming decades. Adopting a strategic framework for adaptation—with clearer goals and targets—would help set the direction for and track progress on adaptation universally and in relation to the ongoing negotiations under the UNFCCC. There is considerable scope for using existing knowledge on adaptation more effectively. Integrating knowledge from different sources and making it available to decision-makers at different levels is arguably the most important knowledge need."

In this context there is a critical need for the state to compile relevant knowledge from different sources, and to take all possible measures to mitigate and adapt as soon as possible to minimise the cost of such measures, as compared to being forced to take such measures because of the Climate Change factors in a distant future at a huge cost many times more than that it would be now.

## References

- 'Coping with Climate Change: Principles and Asian Context': Ramesha Chandrappa, Sushil Gupta Umesh Chandra Kulshrestha, 2011
- 'The Adaptation Gap report': UNEP 2014  
*([http://www.unep.org/climatechange/adaptation/gapreport2014/portals/50270/pdf/AGR\\_FULL\\_REPORT.pdf](http://www.unep.org/climatechange/adaptation/gapreport2014/portals/50270/pdf/AGR_FULL_REPORT.pdf)); accessed on 7.5.2015*

## Chapter 6

# Major findings from IPCC



*'Drowning Civilisation?'*

The Intergovernmental Panel on Climate Change (IPCC) is the international body for assessing the science related to climate change. The IPCC was set up in 1988 by the World Meteorological Organization (WMO) and United Nations Environment Programme (UNEP) to provide policymakers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation. IPCC assessments provide a scientific basis for governments at all levels to develop climate related policies, and they underlie negotiations at the UN Climate Conference – the United Nations Framework Convention on Climate Change (UNFCCC). The assessments are policy-relevant but not policy-prescriptive: they may present projections of future climate change based on different scenarios and the risks that climate change poses and discuss the implications of response options, but they do not tell policymakers what actions to take.

IPCC has so far come out with five Assessment Report (AR); AR1 to AR5. AR5 in Sept 2014 has provided very definitive recommendations on Adaptation and mitigation measures.

Adaptation and mitigation are complementary strategies for reducing and managing the risks of climate change. Substantial emissions reductions over the next few decades can reduce climate risks in the 21st century and beyond, increase prospects for effective adaptation, reduce the costs and challenges of mitigation in the longer term and contribute to climate-resilient pathways for sustainable development.

## 6.1 Findings from Assessment Report 5 (AR5)

- Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased.
- The atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years. Carbon dioxide concentrations have increased by 40% since pre-industrial times, primarily from fossil fuel emissions and secondarily from net land use change emissions. The ocean has absorbed about 30% of the emitted anthropogenic carbon dioxide, causing ocean acidification.
- Human influence on the climate system is clear. This is evident from the increasing greenhouse gas concentrations in the atmosphere, observed warming, and understanding of the climate system.
- Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.
- Climate-related hazards exacerbate other stressors, often with negative outcomes for livelihoods, especially for people living in poverty.
- Climate change is a threat to equitable and sustainable development.
- Continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. Limiting climate change would require substantial and sustained reductions in greenhouse gas emissions which, together with adaptation, can limit climate change risks.
- It is very likely that heat waves will occur more often and last longer, and that extreme precipitation events will become more intense and frequent in many regions. The ocean will continue to warm and acidify, and global mean sea level to rise.
- Climate change will amplify existing risks and create new risks for natural and human systems. Increasing magnitudes of warming increase the likelihood of severe, pervasive and irreversible impacts for people, species and ecosystems. Continued high emissions would lead to mostly negative impacts for biodiversity, ecosystem services and economic development and amplify risks for livelihoods and for food and human security.
- A large fraction of terrestrial, freshwater and marine species faces increased extinction risk due to climate change during and beyond the 21st century, especially as climate change interacts with other stressors.
- Coastal systems and low-lying areas will increasingly experience submergence, flooding and erosion throughout the 21st century and beyond, due to sea level rise.
- All aspects of food security are potentially affected by climate change, including food production, access, use and price stability.
- Health impacts include greater likelihood of injury and death due to more intense heat waves and fires, increased risks from food-borne and water-borne diseases and loss of work capacity and

reduced labour productivity in vulnerable populations. Risks of under-nutrition in poor regions will increase. Risks from vector-borne diseases are projected to generally increase with warming, due to the extension of the infection area and season, despite reductions in some areas that become too hot for disease vectors.

- Rural areas are expected to experience major impacts on water availability and supply, food security, infrastructure and agricultural incomes, including shifts in the production areas of food and non-food crops around the world.
- From a poverty perspective, climate change impacts are projected to slow down economic growth, make poverty reduction more difficult, further erode food security and prolong existing poverty traps and create new ones, the latter particularly in urban areas and emerging hotspots of hunger.
- Sustainable development and equity provide a basis for assessing climate policies. Limiting the effects of climate change is necessary to achieve sustainable development and equity, including poverty eradication.
- Without additional mitigation efforts beyond those in place today, and even with adaptation, warming by the end of the 21st century will lead to high to very high risk of severe, widespread and irreversible impacts globally.
- There are multiple mitigation pathways that are likely to limit warming to below 2°C relative to pre-industrial levels. These pathways would require substantial emissions reductions over the next few decades and near zero emissions of CO<sub>2</sub> and other long-lived greenhouse gases by the end of the century. Implementing such reductions poses substantial technological, economic, social and institutional challenges, which increase with delays in additional mitigation and if key technologies are not available.
- Many adaptation and mitigation options can help address climate change, but no single option is sufficient by itself. Effective implementation depends on policies and cooperation at all scales and can be enhanced through integrated responses that link mitigation and adaptation with other societal objectives.
- Mitigation options are available in every major sector. Mitigation can be more cost-effective if using an integrated approach that combines measures to reduce energy use and the greenhouse gas intensity of end-use sectors, decarbonize energy supply, reduce net emissions and enhance carbon sinks in land-based sectors.
- The most cost-effective mitigation options in forestry are afforestation, sustainable forest management and reducing deforestation, with large differences in their relative importance across regions. In agriculture, the most cost-effective mitigation options are cropland management, grazing land management and restoration of organic soils.

**Table 7: Greenhouse gas emissions by economic sectors for Y2010**

<b>Economic sector</b>	<b>GHG Emissions (% of the total)</b>
Electricity and heat production	25
AFOLU (Agriculture, Forestry and other land Uses)	24
Industry	21
Transport	14
Buildings	6.4
Other energy usages	9.6

*(Climate Change 2014; Synthesis Report; IPCC)*

**Table 8: Approaches for managing the risks of climate change through adaptation**

Category	Examples
<b>Human development</b>	Improved access to education, nutrition, health facilities, energy, safe housing & settlement structures, & social support structures; Reduced gender inequality & marginalization in other forms.
<b>Poverty alleviation</b>	Improved access to & control of local resources; Land tenure; Disaster risk reduction; Social safety nets & social protection; Insurance schemes.
<b>Livelihood security</b>	Income, asset & livelihood diversification; Improved infrastructure; Access to technology & decision making fora; Increased decision-making power; Changed cropping, livestock & aquaculture practices; Reliance on social networks.
<b>Disaster risk management</b>	Early warning systems; Hazard & vulnerability mapping; Diversifying water resources; Improved drainage; Flood & cyclone shelters; Building codes & practices; Storm & wastewater management; Transport & road infrastructure improvements
<b>Ecosystem management</b>	Maintaining wetlands & urban green spaces; Coastal afforestation; Watershed & reservoir management; Reduction of other stressors on ecosystems & of habitat fragmentation; Maintenance of genetic diversity; Manipulation of disturbance regimes; Community-based natural resource management
<b>Spatial or land-use planning</b>	Provisioning of adequate housing, infrastructure & services; Managing development in flood prone & other high risk areas; Urban planning & upgrading programs; Land zoning laws; Easements; Protected areas.
<b>Structural/physical</b>	<b>Engineered &amp; built-environment options:</b> Sea walls & coastal protection structures; Flood levees; Water storage; Improved drainage; Flood & cyclone shelters; Building codes & practices; Storm & wastewater management; Transport & road infrastructure improvements; Floating houses; Power plant & electricity grid adjustments.
<b>Structural/physical</b>	<b>Technological options:</b> New crop & animal varieties; Indigenous, traditional & local knowledge, technologies & methods; Efficient irrigation; Water-saving technologies; Desalination; Conservation agriculture; Food storage & preservation facilities; Hazard & vulnerability mapping & monitoring; Early warning systems; Building insulation; Mechanical & passive cooling; Technology development, transfer & diffusion. <b>Ecosystem-based options:</b> Ecological restoration; Soil conservation; Afforestation & reforestation; Mangrove conservation & replanting; Green infrastructure (e.g., shade trees, green roofs); Controlling overfishing; Fisheries co-management; Assisted species migration & dispersal; Ecological corridors; Seed banks, gene banks & other ex situ conservation; Community-based natural resource management. <b>Services:</b> Social safety nets & social protection; Food banks & distribution of food surplus; Municipal services including water & sanitation; Vaccination programs; Essential public health services; Enhanced emergency medical services.

<b>Social</b>	<p><b>Educational options:</b></p> <p>Awareness raising &amp; integrating into education; Gender equity in education; Extension services; Sharing indigenous, traditional &amp; local knowledge; Participatory action research &amp; social learning; Knowledge-sharing &amp; learning platforms</p> <p><b>Informational options:</b></p> <p>Hazard &amp; vulnerability mapping; Early warning &amp; response systems; Systematic monitoring &amp; remote sensing; Climate services; Use of indigenous climate observations; Participatory scenario development; Integrated assessments.</p>
<b>Social</b>	<p><b>Behavioural options:</b></p> <p>Household preparation &amp; evacuation planning; Migration; Soil &amp; water conservation; Storm drain clearance; Livelihood diversification; Changed cropping, livestock &amp; aquaculture practices; Reliance on social networks.</p>

*(Climate Change 2014; Synthesis Report; IPCC); accessed on 10.5.2015*

## 6.2 Relevance of national and international literature on CC to Karnataka

### 6.2.1 Climate Change Implications on Health

Overwhelming evidence shows that climate change presents growing threats to public health security – from extreme weather-related disasters to wider spread of such vector-borne diseases as malaria and dengue. The impacts of climate on human health will not be evenly distributed around the world. The Third Assessment Report (Intergovernmental Panel on Climate Change, IPCC-2001) concluded that vulnerability to climate change is a function of exposure, sensitivity, and adaptive capacity. Developing country populations, particularly in small island states, arid and high mountain zones, and in densely populated coastal areas are considered to be particularly vulnerable. India is a large developing country, with the Great Himalayas, the world's third largest ice mass in the north, 7,500 km long, and densely populated coast line in the south. Nearly 700 million of her over one billion population living in rural areas directly depends on climate-sensitive sectors (agriculture, forests, and fisheries) and natural resources (such as water, biodiversity, mangroves, coastal zones, grasslands) for their subsistence and livelihoods. Heat wave, floods (land and coastal), and draughts occur commonly. Malaria, malnutrition, and diarrhea are already major public health problems. Any further increase, as projected in weather-related disasters and related health effects, may cripple the already inadequate public health infrastructure in the country. Hence, there is an urgent need to respond to the situation. Response options to protect health from effects of climate change include mitigation as well as adaptation. Both can complement each other and together can significantly reduce the risks of climate change.

Climate change is a significant and emerging threat to public health. In 2008, the World Health Organization (WHO) focused on the need to protect health from the adverse effects of climate change. The World Health Day – 2008 theme “Protecting health from climate change” raises the profile of health dangers posed by global climate variability and change. It was selected because overwhelming evidence shows that climate change presents growing threats to international public health security.

### 6.2.2 Implications on Agriculture and allied activities

Contributing 21% to the country's GDP, accounting for 11% of total exports, employing 56.4% of the total work force, and supporting 600million people directly or indirectly, agriculture is vital to India's economy and the livelihood of its people. The national mission on agriculture will focus on four areas crucial to agriculture in adapting to climate change, namely dry land agriculture, risk management, access to information, and use of biotechnology (NAPCC; Section 3.7).



An article in “Climate News Network” has analysed the growing concerns on the impact of Climate Change on the India’s agriculture, and on millions of families dependent on it. It refers to a study by Oxford University academic, Professor Barbara Harriss-White, of the Oxford Department of International Development. Over the last 30 years India has nearly doubled its rice production, mainly through the introduction of new, high-yielding varieties. While 95% of production is consumed domestically, India recently supplanted Thailand as the world’s biggest rice exporter. But the increase in rice output has led to a massive over-exploitation of water resources, with millions of farmers using electric pumps to harness well waters for their rice fields.

The Oxford team has found out that there are GHG emissions in each phase of rice production and its marketing: for example when fields are cultivated and flooded large amounts of soil methane are released. Bullocks also produce a lot of methane. But it’s the coal needed to produce the energy to lift the water that’s the biggest problem. Over-exploitation of water resources has not only led to more GHG emissions but could result in future rice shortages.

“Many farmers are forced to drill bore holes right down to fossil layers for water – and those waters won’t be replenished.” Changes in climate are also likely to have an adverse impact on India’s rice production. “Rice is vulnerable to climate change,” says Harriss-White. “A rise in temperature means more pests – and a greater likelihood of periods both of flooding and drought. Rice production must adapt to climate change. Most farmers we talk to don’t talk in terms of climate change – instead they talk of the monsoons becoming less reliable.”

It is not difficult to imagine the impact of Climate Change on all other agricultural activities, including horticulture, floriculture, and dairying in Karnataka also.

### **6.2.3 Major impacts projected on agriculture due to Climate Change**

- Food production will be under threat due to unreliable weather patterns
- Pest attacks will increase significantly and new pests will evolve
- Crop yield will reduce – every 1 degree rise
  - will reduce wheat production by 4-5 million tons
  - most cereal crops production will go down due to less water availability
  - quality of produce will decline
    - Heat stress will reduce milk production by 10-25%
    - Fisheries will suffer – while crops can adapt to climate changes animals and fishes cannot.

### **6.2.4 Impact on farmers**

For no fault of theirs, Indian farmers, like the most marginalized everywhere, are paying a high price for man-made climate change. The worst-hit, as usual again, are small holders in marginalized locations with social disadvantages to begin with. They have the least resources to deal with the natural disasters like droughts and floods that are increasing with climate change.

Reduced productivity and climate impacts will have impacts on farmers’ incomes, and will result in increased farm expenditures.

The Green Revolution model dominant in India is considered by many to be the main contributor to climate change phenomenon through the agriculture. Current mainstream green-revolution practices of Indian agriculture are also considered as the cause of 30% of climate change. CO<sub>2</sub>, N<sub>2</sub>O and Methane are three of the main Green House Gases emitted from Agriculture.

The mono-cropping intensive model focused on cash crops and grains only and dependent on heavy usage of chemicals is directly contributing to emissions of green house gases. In India, it is estimated that 28% of the GHG emissions are from agriculture. Monoculture model leads to loss of agricultural biodiversity. Also more intensive models use more fossil fuels for machinery like tractors, harvesters, pumps for irrigation

etc. Inundated paddy fields are one of the main sources of GHG emissions in the form of methane. There is an urgent need to shift to less water intensive forms of agriculture like SRI (System of Rice Intensification) in rice.

Another major contributor of GHGs is the burning of crop residues. Burning of crop residues also impacts the soil fertility. Heat from burning straw penetrates into the soil upto 1 cm, elevating the temperature as high as 33.8–42.2°C. Bacterial and fungal populations get decreased immediately.

### **6.2.5 Implications on fresh water availability– water and energy nexus**

A major projection by IPCC and other bodies on the implications of Climate Change has been on the water resources. All these projections have been almost unanimous that the availability of fresh water will come under increasing pressure all over the world, and certainly in tropical countries. Competing demands for water from agriculture, industries and the growing population, when viewed from the perspective of droughts as a consequence of Climate Change, will give rise to serious concerns as to how the growing demand for fresh water of the growing population can be satisfactorily met.

### **6.2.6 Water for Energy**

All types of electricity generation consume water either to process the raw materials used in the facility or fuel, constructing and maintaining the plant, or to just generate the electricity itself. Renewable power sources as photovoltaic solar and wind power, which require little water to produce energy, require water in processing the raw materials to build the turbines and solar panels. If a wind turbine is mounted on a concrete or steel tower, additional tons of water are required in the tower's construction.

In the US, about 2 US gallons (7.6 L) of water is evaporated to create one kilowatt hour (kWh) of energy. This water is consumed in thermoelectric plants which are power plants converting waste heat into electrical power and evaporated in reservoirs for hydroelectric plants. An average of 18 gal (68 L) of fresh water is evaporated to generate 1 kWh of electricity at Hydroelectric plants. The production of electricity to power one 60W incandescent light bulb over the course of a year would evaporate about 3,000 to 6,300 US gallons (24,000 L) of water.

*(U.S. Energy Sustainability [http://www.sandia.gov/energy-water/nexus\\_overview.htm](http://www.sandia.gov/energy-water/nexus_overview.htm)); accessed on 10.5.2015*

Thermal power plants require large amounts of cooling water. 39% of all freshwater withdrawals in the USA are used for thermoelectric energy production. Most of the cooling water is returned but at a higher temperature, and only around 3% is actually consumed, mostly by evaporation. The demand for cooling water can be in competition with agriculture and municipal demands in some areas with the demand for water for irrigation around 40% overall. As a result of climate change some rivers are running lower in the summer, putting additional strain on power production.

### **6.2.7 Energy for Water**

As energy requires water, water supply and sewage disposal also needs energy. In areas where fresh water is scarce and drinking water must be brought in from a long distance, the energy footprint for this drinking water can be extremely high. The energy consumed for pumping groundwater can be typically between 537 kWh and 2,270 kWh per million gallons depending on pumping depth. As an example, southern California receives potable water from the Sacramento-San Joaquin Delta which travels over low-lying mountains and requires 9,200 kWh per million gallons.

Treatment of wastewater and storm-water can also consume significant energy. Combined sewer systems use the same pipes for conveying storm-water and wastewater. According to the River Network, the U.S. consumes at least 521 million MWh a year for water-related purposes which is the equivalent to 13% of the nation's electricity consumption. The energy required to heat water is even higher. Fuel oil, propane, electricity, and natural gas are used to heat water in the US, all together consuming the kWh equivalent

of 304.2 billion kWh each year. Water related energy use in California alone including the conveyance, storage, treatment, distribution, wastewater collection, treatment, and discharge sectors, consumes 19 percent of the state's electricity.

*(“The Carbon Footprint of Water” <http://www.rivernetnetwork.org/resource-library/carbon-footprint-water>); accessed on 10.5.2015*

India gets on an average 1,197 mm of rainfall every year. This amounts to a total precipitation of 4,000 billion m<sup>3</sup>. However, 3,000 billion m<sup>3</sup> of this is lost due to runoff, and only 1000 billion m<sup>3</sup> is available as surface and ground water sources, amounting to 1,000 m<sup>3</sup> per year per capita water availability. This is about 115<sup>th</sup>-111<sup>th</sup> of that of many industrialised countries. Many parts of India are water stressed today and India is likely to be water scarce by 2050. The problem is likely to worsen due to climate change impacts. It is therefore important to increase the efficiency of water use, explore options to augment water supply in critical areas, and ensure more effective management of water resources. New regulatory structures with appropriate entitlements and pricing and incentives to adopt water-neutral and water positive technologies may be required. Integrated water policies will help to cope with variability in rainfall and river flows at the basin level (NAPCC; section 3.4).

### **“Energy Demands on Water Resources”**

Water is an integral element of energy resource development and utilization. It is used in energy-resource extraction, refining and processing, and transportation. Water is also an integral part of electric-power generation. It is used directly in hydroelectric generation and is also used extensively for cooling and emissions scrubbing in thermoelectric generation. For example, in calendar year 2000, thermoelectric power generation accounted for 39 percent of all freshwater withdrawals in the U.S., roughly equivalent to water withdrawals for irrigated agriculture (withdrawals are water diverted or withdrawn from a surface-water or groundwater source).

In a business-as-usual scenario, consumption of water in the electric sector could grow substantially, though increased demand for water would provide an incentive for technologies that reduce water use, thus dampening the increase in water use. Technologies are available that can reduce water use in the electric sector, including alternative cooling for thermoelectric power plants, wind power, and solar photovoltaics, but cost and economics, among other factors, have limited deployment of these technologies. Meanwhile, climate concerns and declines in groundwater levels suggest that less freshwater, not more, may be available in the future. Collaboration on energy and water resource planning is needed among federal, regional, and state agencies as well as with industry and other stakeholders. Available surface water supplies have not increased in 20 years, and groundwater tables and supplies are dropping at an alarming rate. New ecological water demands and changing climate could reduce available freshwater supplies even more.

Energy Water Infrastructure Synergies –When the energy infrastructure is evaluated in a system context, significant improvements in energy and water conservation can often be realized through implementation of innovative processes or technologies, co-location of energy and water facilities, or improvements to energy and water infrastructures.

*– US Department of energy (Dec. 2006)*

Groundwater accounts for nearly 40% of the total available water resources in the country and meets nearly 55% of irrigation requirements, 115% of rural requirements and 50% of urban and industrial requirements. However, overexploitation of the resource has sharply lowered the water table in many parts of the country, making them increasingly vulnerable to adverse impacts of climate change (NAPCC; section 3.4.2).

From 1970 onwards India has been in the forefront of countries in the exploitation of ground water. It is much ahead of a group of 13 countries studied, including Mexico, Pakistan, Bangladesh, Tunisia, Ghana, china and US. This indicates a scenario of fast depleting ground water table, because the ground water recharging efforts have become hugely lagging as compared to the extraction of the ground water. The situation can lead to serious emergencies unless effective mitigation measures are taken urgently keeping

in view that the Climate Change will exacerbate the availability of surface water.

The issues associated with water and energy in India can become clear with certain statistical evidence:

- About 71 Billion Kg of food crops are grown in India annually
- about 100 Billion kWh of electricity is needed for irrigation pumping out of a total annual electrical energy consumption of about 1,000 BU
- At parts of India about 3 kWh of electricity is required to grow 1kg of food grain
- At 3 kWh of electricity to grow 1 kg
- Ground water demand for agricultural usage (39.75 MAF Million Acre Feet) has become much greater than the ground water availability (29.64 MAF)
- Water table receding at the rate of above 80 cm per year; consequently greater amounts of energy is needed to pump the ground water.

*(‘Food, Water and Energy Nexus in India’ - Columbia Water Center; Columbia University)*

*(<http://www.un.org/en/ga/second/66/docs/modi.pdf>); accessed on 10.5.2015*

A recent news paper report indicates that at the national level India’s 11 million electric tube-wells use 117 billion units of electricity and emits 110 million metric tons of CO<sub>2</sub> annually. In addition, 9 million diesel pumps burn some 7 billion litres of diesel for irrigation and emit additional 20 million metric tons of CO<sub>2</sub>. By using solar power for irrigation water pumping, we can curtail India’s annual CO<sub>2</sub> emissions by nearly 6%.

*(<http://www.financialexpress.com/article/fe-columnist/harvesting-solar-riches/59262/>); accessed on 10.5.2015*

India and the state of Karnataka, which are already known as fresh water stressed, have this issue of water and energy nexus to seriously contend with. While the water related issues linked to the increasing demand from agriculture and the growing population can become self evident, it is the nexus between energy and water which becomes more pronounced in the fast changing global environment. Energy and water are essential and interdependent resources. When we consider all the related issues of water, energy, agriculture and health in the context of Karnataka, which is already the second most water stressed in the country, the projected scenario can be alarming unless appropriate and adequate measures are taken urgently.

### **6.2.8 Forestry and bio-diversity**

The report of the Working Group on Forests for the 11thFive-Year Plan puts the annual rate of planting during 2001/02 to 2005/06 at 1.6 million hectares and proposes to increase it to 3.3 million hectares during the 11thPlan. The final target is to bring one-third of the geographic area of India under forest cover. Conservation of wildlife and biodiversity in natural heritage sites including sacred groves, protected areas, and other biodiversity ‘hotspots’ is crucial for maintaining the resilience of ecosystems. (NAPCC: section 3.6.2).

But the major concern has been that large tracts of tropical forests of high ecological value are being diverted year after year for other purposes. Diversion of forests will lead to extinction of many species of flora and fauna, which are endemic to such stretches of forests. It has become highly imperative to deliberate on policies and practices to stop the diversion of such forests.

The implications to global community from Climate Change has acquired such a serious proportion that Vatican city had made arrangements for 28 April 2015 where scientists, religious figures and policymakers had gathered at the Vatican to discuss the science of global warming and the danger posed to the world’s poorest people. The conviction is that the world’s 3 billion poorest people produce a fraction of humanity’s annual greenhouse-gas emissions — about 5% — but are predicted to suffer disproportionately from the impacts of climate change, such as more extreme weather.

As per 'Vital Forest Graphics', UNEP, FAO, UNFF, 2009: "The world's forests provide a multitude of environmental, economic and social services, all of which are invaluable in supporting human development. Forests sustain the livelihoods of hundreds of millions of people globally, and contribute directly to the economies of numerous countries. Yet, about 13 million hectares of forests continue to be lost every year with far reaching consequences in terms of carbon emissions, loss of biodiversity and environmental degradation.

Whereas forests and forest soils store more than one trillion tons of carbon, current rate of deforestation and forest degradation is responsible for close to 17.4 percent of all anthropogenic greenhouse gas emissions, contributing to climate change. Increasingly, afforestation and reforestation are being promoted as means of climate change mitigation and adaptation. Forests often are at the nexus of the most pressing issues high on the global environmental and sustainable development agenda, namely: climate change, biodiversity loss, poverty eradication, ecosystem management, and environmental governance.

To help communicate the value of forests to policy-makers and the wider public, the United Nations Environment Programme, the Food and Agriculture Organization of the United Nations and the United Nations Forum on Forests Secretariat of the United Nations Department of Economic and Social Affairs joined efforts to analyse, synthesize and illustrate topical forest issues in a publication, the "Vital Forest Graphics." This publication indicates that the world is losing about 20,000 hectares of forests every day, with huge consequences.

Keeping in view the huge implications to the water deficient Karnataka, there can be no doubt that all possible efforts should be devoted to develop and effectively implement an appropriate action plan for the state involving all section of the society.

### **6.2.9 Relevance of these findings to India and Karnataka**

The diverse geographic and climate conditions in India make it highly vulnerable to most of the projected threats in IPCC reports. Tropical characteristics, vast and increasing population, high density of population, about 50% of the population who can be said to be poor, already stressed fresh water resources, fast depleting natural resources, threatened forests and bio-diversity, climate dependent and agrarian economy etc. all are reasons for serious concerns under the fast changing climate.

Similarly, Karnataka being the second most water stressed state in the country has very many concerns to address. However, there are also many heritage strengths such as rich and diverse agricultural, horticultural, animal husbandry and dairying practices; continuously evolving services sector; world heritage Western Ghats etc. which also can provide a good basis for adaptation and mitigation. There are nearly 37,000 tanks and lakes with a water spread area of 6.9 lakh hectare and more than 20,000 irrigation tanks. But the society in general and the government in particular, need to take urgent, sustained and carefully prepared action plan at various levels of the administration and all walks of life.

"CLIMATE CHANGE AND INDIA: A 4X4 ASSESSMENT A SECTORAL AND REGIONAL ANALYSIS FOR 2030S" by Indian Network for Climate Change Assessment, 2010, MoEF has conducted a detailed assessment of impacts of Climate Change on various sectors of Indian economy, and has huge relevance to Karnataka w.r.t the Western Ghats and the coastal assessment made in the report.

### **References**

- 'Vital Forest Graphics', UNEP, FAO, UNFF, 2009
- 'The Economics of Climate Change'; <http://www.sciencemag.org> VOL 317 13, JULY 2007
- "The Anatomy of Silent Crisis": Global Humanitarian Forum, Geneva

## Chapter 7

# Discussion on NAPCC and of KSAPCC



*'Gigantic sizes' – machines and GHG emissions*

**A**dequate reference to these two plans ( NAPCC and SAPCC) will help in synergic approach to the overall developmental plan of the state. These two plans have also highlighted major issues for the country as a whole and for Karnataka in particular.

While considering the economic impacts of Climate Change it will be useful to note what Sir Nicholas Stern, a former economic adviser to UK Government say in his seminal work 'The Economics of Climate Change'. As per STERN REVIEW, the Climate Change could have very serious impacts on growth and development. The costs of stabilising the climate are significant but manageable, while delay would be dangerous and much more costly. The benefits of strong, early action on climate change outweigh costs. This Review has estimated that certain scenario of Global Warming may result in poor countries like India suffering economic costs of about 20 % of its GDP, whereas the mitigation of the same now can be achieved at a cost of about 1% of present GDP. The Review also indicates that more we delay in addressing the Global Warming the higher we will have to spend in mitigation of the same in future. In this background adequate

investment to minimise the Global Warming impacts of conventional power plants is considered worth the huge cost.

## 7.1 National Action Plan on Climate Change (NAPCC)

The overview of National Action Plan on Climate Change (NAPCC), which was accepted by the Union government in 2008, highlights the following issues:

- India is faced with the twin challenge of sustaining its rapid economic growth while dealing with the global threat of climate change.
- Climate Change may alter the distribution and quality of India's natural resources and adversely affect the livelihood of its people.
- While engaged with the international community to collectively and cooperatively deal with this threat, India needs a national strategy to firstly, adapt to climate change and secondly, to further enhance the ecological sustainability of India's development path.
- With its economy closely tied to its natural resource base and climate sensitive sector such as agriculture, water and forestry, India may face a major threat because of the projected changes in the climate.
- India's development path is based on its unique resource endowments, the overriding priority of social and economic developments and poverty eradication, and its adherence to its civilisational legacy that places a high value on the environment and maintenance of ecological balance.
- In charting out a developmental pathway which is ecologically sustainable, India has a wider spectrum of choices precisely because it is in its early stage of development.
- Our vision is to create a prosperous, but not a wasteful society, an economy that is self sustaining in terms of its ability to unleash the creative energies of our people, and is mindful of its responsibilities to both the present and future generations.
- India is determined that its per capita GHG emissions will at no point exceed that of developed countries even as we pursue our developmental objectives.

In order to achieve a sustainable development path that simultaneously advances economic and environmental objectives, the National Action Plan for Climate Change (NAPCC) states that it will be guided by the following principles:

- Protecting the poor and vulnerable sections of society through an inclusive and sustainable development strategy, sensitive to climate change.
- Achieving national growth objectives through a qualitative change in direction that enhances ecological sustainability, leading to further mitigation of greenhouse gas emissions.
- Devising efficient and cost-effective strategies for end use Demand Side Management.
- Deploying appropriate technologies for both adaptation and mitigation of green house gases emissions extensively as well as at an accelerated pace.
- Engineering new and innovative forms of market, regulatory and voluntary mechanisms to promote sustainable development.
- Effecting implementation of programmes through unique linkages, including with civil society and local government institutions and through public private-partnership.
- Welcoming international cooperation for research, development, sharing and transfer of technologies enabled by additional funding and a global IP Rregime that facilitates technology transfer to developing countries under the UNFCCC.

There are eight National Missions which form the core of National Action Plan representing multipronged, long term and integrated long term strategies for achieving key goal in the context of climate change. The eight national missions are:

### **i. National Solar Mission**

- A National Solar Mission will be launched to significantly increase the share of solar energy in the total energy mix while recognizing the need to expand the scope of other renewable and non-fossil options such as nuclear energy, wind energy and biomass. India is a tropical country, where sunshine is available for longer hours per day and in great intensity. Solar energy, therefore, has great potential as future energy source. It also has the advantage of permitting a decentralized distribution of energy, there by empowering people at the grassroots level.

### **ii. National Mission for Enhanced Energy Efficiency**

- To enhance energy efficiency, four new initiatives will be put in place. These are:
  - A market based mechanism to enhance cost effectiveness of improvements in energy efficiency in energy-intensive large industries and facilities, through certification of energy savings that could be traded.
  - Accelerating the shift to energy efficient appliances in designated sectors through innovative measures to make the products more affordable.
  - Creation of mechanisms that would help finance demand side management programmes in all sectors by capturing future energy savings.
  - Developing fiscal instruments to promote energy efficiency

### **iii. National Mission on Sustainable Habitat**

- A National Mission on Sustainable Habitat will be launched to make habitat sustainable through improvements in energy efficiency in buildings, management of solid waste and modal shift to public transport. The Mission will promote energy efficiency as an integral component of urban planning and urban renewal through three initiatives.
  1. The Energy Conservation Building Code, which addresses the design of new and large commercial buildings to optimize their energy demand, will be extended in its application and incentives provided for retooling existing building stock.
  2. Recycling of material and Urban Waste Management will be a major component of ecologically sustainable economic development. India already has a significantly higher rate of recycling of waste compared to developed countries. A special area of focus will be the development of technology for producing power from waste. The National Mission will include a major R&D programme focusing on bio chemical conversion, waste water use, sewage utilization and recycling options wherever possible.
  3. Better urban planning and modal shift to public transport. Making long term transport plans will facilitate the growth of medium and small cities in ways that ensure efficient and convenient public transport.

### **iv. National Water Mission**

- A National Water Mission will be mounted to ensure integrated water resource management helping to conserve water, minimize wastage and ensure more equitable distribution both across and within states. The Mission will take into account the provisions of the National Water Policy and develop a framework to optimize water use by increasing water use efficiency by 20% through regulatory mechanisms with differential entitlements and pricing.

### **v. National Mission for Sustaining Himalayan Ecosystem**

- A Mission for sustaining the Himalayan Ecosystem will be launched to evolve management measures for sustaining and safe guarding the Himalayan glacier and mountain eco-system.



## vi. National Mission for a Green India

- A National Mission will be launched to enhance eco system services including carbon sink to be called Green India. Forests play an indispensable role in the preservation of ecological balance and maintenance of bio-diversity. Forests also constitute one of the most effective carbon-sinks. The national target of area under forest and tree cover is 33% while the current area under forests is 23%.

## vii. National Mission for Sustainable Agriculture

- The Mission would devise strategies to make Indian agriculture more resilient to climate change. It would identify and develop new varieties of crops and especially thermal resistant crops and alternative cropping patterns, capable of withstanding extremes of weather, long dry spells, flooding, and variable moisture availability.

## viii. National Mission on Strategic Knowledge for Climate Change

- To enlist the global community in research and technology development and collaboration through mechanisms including open source platforms, a Strategic Knowledge Mission will be set up to identify the challenges of, and the responses to, climate change. It would ensure funding of high quality and focused research into various aspects of climate change. The Mission will also have, on its research agenda, socio-economic impacts of climate change including impact on health, demography, migration patterns and livelihoods of coastal communities.

## 7.2 Discussions on NAPCC

Whereas the NAPCC has been presented to the international community as being a responsible act by India in addressing the challenges of Climate Change, there has also been criticism from within the country on many lacunae in the same. Mr. Shyam Saran, the then Special Envoy of the Prime Minister for Climate Change, was eloquent about India's Climate Change Initiatives, and has praised its strategies for a Greener Future. In 2009 he has referred to NAPCC as a very responsible act by India towards mitigation and adaptation of Climate Change.

The biggest issue with the National Action Plan on Climate Change is that it appears not to have the involvement of the people since there have been no effective deliberations on it. It is reported that even the people's representatives were not consulted before formalizing it.

A glaring inconsistency with NAPCC has been mentioned as that while it refers to establishment of eight missions to address the Global Warming it states unequivocally that this issue should not be in conflict with the objective of fast economic growth. This stand is described as clearly contradictory to each other. While power and transport sectors account for more than 40% of GHG emissions, these are the sectors to which the successive governments have been giving priority in the name of economic growth. Climate Change is not one of the components of the environmental impact assessment (EIA). In recent years it is reported that more than 650 mining projects and about 300 Special Economic Zones (SEZs) and other projects like Coastal Corridors have been sanctioned without taking the impacts of Climate Change into account.

The NAPCC mentions biodiversity as a national priority but the government is planning to build a large number of major and minor dams in Himalayas and sub-Himalayas, which are one of the 25 mega biodiversity zones of the world. The state of Uttarakhand alone is reported to be planning about 150 major and minor dam based hydel projects. A number of large dams are also being proposed for Arunachal Pradesh and North East, which are still having a good percentage of land area under rich forests. The Western Ghats and coastal regions in the country will be devastated if the rush to install dams, coal power stations and

SEZs get implemented in these ecologically sensitive areas. More than 80 major thermal power plants are reported to be in various stages of planning and implementation in the eastern and western coastal areas alone which too are rich in biodiversity. Such projects, while leading to huge amounts of GHGs, will also cause serious damages to bio-diversity and the ecosystems.

In 2008 two national level round table conferences were held to discuss the civic society participation in the crises of Climate Change. In these two meetings a number of NGOs and individuals, who were involved in studies on Climate Change, expressed their concerns regarding the inadequacy of the National Action Plan on Climate Change. A major issue mentioned in this regard was that there are no clear targets, dead lines or accountabilities in NAPCC. Many useful recommendations to the Government for strengthening the National Action Plan on Climate Change were made in these meetings. Some of the major concerns expressed and recommendations made in these two meetings (at Delhi on September 25-26, 2008 and at Visakhapatnam, November 5-7, 2008 ) were as follows:

- It can be said that traditionally the poor had much less impact on the environment because of their simpler life styles, and they continue to do so. The country needs to find ways of recognising the traditional knowledge systems, because the ecosystem communities are the first to suffer the ill-effects of climate change.
- There is a need to ensure involvement of civil society in future processes of the NAPCC. In this regard the following steps are needed:
  - Up-scaling adaptive measures at the grassroots level based on experiences gained across the country.
  - Up-scaling energy efficiency initiatives and decentralised energy options at the grassroots level.
  - Adaptation to and mitigation of Climate Change is feasible only by preserving/ protecting bio-diversity, forests, fresh water bodies; using agricultural waste for bio-fuels and through livestock improvement; organic farming; vast improvements in governance of electric power production, distribution and utilisation; undertaking renewable decentralised energy options such as micro hydro, solar and bio-mass based initiatives.
- A definitive shift in emphasis from a centralized production model to a decentralized/ democratic production model is needed.
- There is a need to recognize that economic growth will not automatically result in sustainable development, and therefore strong regulatory measures are critical to protect lives and livelihood in India.
- Climate change concerns can only be effectively addressed when GDP growth stops becoming an excuse for endless energy / material consumption. The GDP growth and increased energy consumption must be decoupled. The overall developmental goal instead should be to reduce poverty and not increase GDP at any cost.
- We must apply the “Precautionary Principle” especially in situations where there are high risks of ecological/ social costs, such as use of GM technology in agriculture or big sized dams and big sized coal power projects or Carbon Capture and Storage for power plants, or large scale deployment of bio-fuels.
- Recognize and respect that the traditional knowledge systems and practices are a science and have great relevance for dealing with climate change alongside modern science and technologies.

Another analysis of NAPCC (‘STRATEGIZING CLIMATE CHANGE’) by Dr. S G Vombatkere lists many high level issues to the country as a whole.

*(<https://kspcb.wordpress.com/2015/05/03/strategizing-climate-change-by-dr-s-g-vombatkere/>); accessed on 10.5.2015*

The fourth assessment report of IPCC (AR4) shows that emissions of the greenhouse gases that contribute

to global warming must fall by 2050 by 50-85% globally compared to the emissions of the year 2000, and that global emissions must peak well before the year 2020, with a substantial decline after that, in order to limit the growth in global average temperatures to 2 degrees Celsius above pre-industrial levels. In the near term, by 2020, emissions from industrialized countries (listed in Annex I of the Kyoto Protocol) need to be reduced by 25-40% below 1990 levels, while substantial deviations from the current trend in developing countries and emerging economies will also be required. In this context it is difficult to imagine how India's total GHG emissions can become less unless definitive measures are taken with concerted efforts to reduce the GHG emissions from critical sectors such as the power sector.

### 7.3 Karnataka State Action Plan on Climate Change (KSAPCC)

In 2009 the Union Government asked the states and Union Territories to initiate the preparation of state action plans. Such an action plan was needed to reflect the specific needs of the states / UTs keeping in view their geographic and climatic strengths and constraints, and traditional practices.

KSAPCC represents the first action plan on climate change adopted by Government of Karnataka in 2012. KSAPCC has focused on seven major sectors of the state's economy.

- Agriculture and Allied Sectors
- Water resources
- Forestry, biodiversity and Wildlife
- Coastal Zone
- Energy
- Urbanisation
- Human Health

Issues highlighted in this document are as follows:

#### 7.3.1 Climate Trends

Karnataka's annual rainfall is 1,151 mm on average. Around 80% of it is received during the southwest monsoon, 12% in the post monsoon period, 7% during summer and 1% in winter. Within the state there are considerable variations. It was inferred from a recent study that overall reduced precipitation and continuous warming is a possible, perhaps probable scenario for Karnataka. It is predicted that regions that already witness less rainfall and higher temperatures, such as northern Karnataka, will further experience lesser rainfall and increases in average temperatures.

#### 7.3.2 GHG Emissions

Carbon dioxide (CO<sub>2</sub>) is the major greenhouse gas. Other GHGs include methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O). Carbon dioxide is released from the combustion of fossil fuels (coal, oil, gas) but its flows also increase from the reduction and degradation of forests. Methane is emitted from ruminants (live stockholdings) and paddy cultivation while nitrous oxide is emitted from manure and agricultural soils.

For Karnataka, annual emissions of the major three greenhouse gases are estimated to amount to 80 million tons of CO<sub>2</sub>-equivalent (or 4.6% of India's emissions). In this, CO<sub>2</sub> accounts for 73% of GHG emissions, methane for 23% and N<sub>2</sub>O for 3.3%. In terms of sectoral distribution, electricity generation accounts for 35.9 % of annual GHG emissions, industry for 22.6%, agriculture and allied sectors for 20.2%, transport for 10.4%, house holds (excluding electricity) for 7.3% and waste for 3.6%.

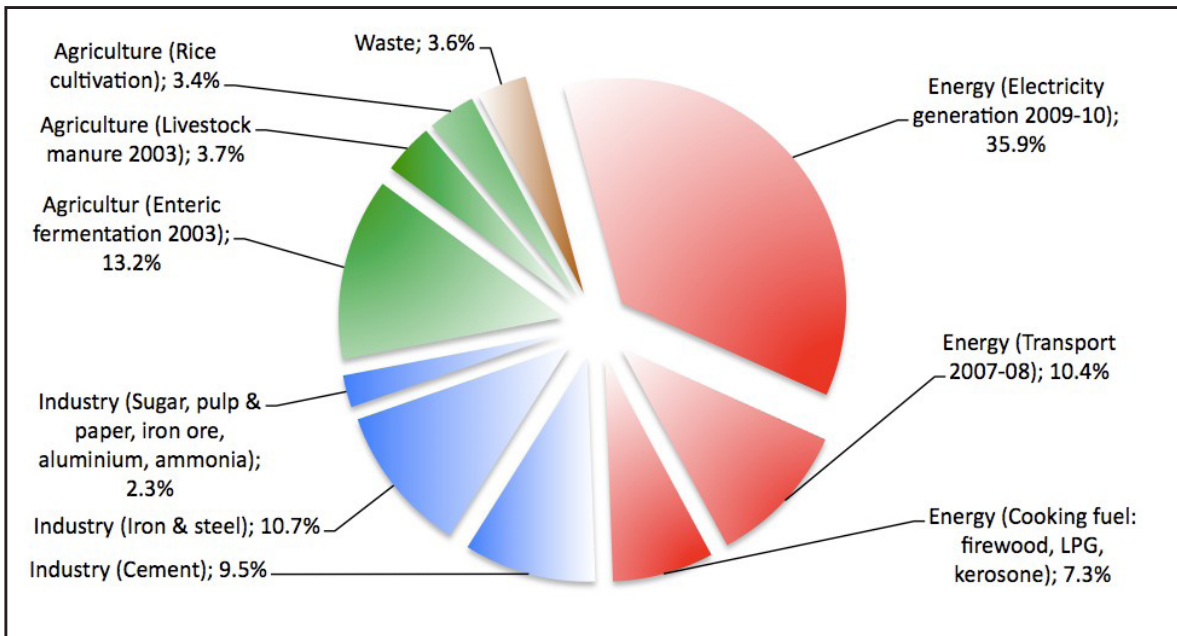
#### 7.3.3 Agriculture and allied sectors

Farmers and agricultural laborers account for nearly 57% of the Karnataka's work- force. The state has ten agro-climatic zones and observes three growing seasons. These ten agro-climatic zones, have taken into consideration the rainfall pattern, soil types, texture, depth and physio-chemical properties, elevation, topography, major crops and the type of vegetation. Among these kharif, the monsoon season lasting from

July to October, accounts for 70% of the annual food grain and oil seed production. An overall increase in production and yield of major crops has been observed over the last decade. Yet the introduction of high yielding varieties has progressively reduced the cultivation of traditional varieties in the state. The loss of agricultural biodiversity is a serious concern. Droughts affect agricultural production in the state to a great extent, so do floods, to which especially kharif crops are prone.

Agriculture is highly vulnerable to climate change because of its wide exposure to temperature, precipitation, pests and diseases. Studies predict that a number of districts may become vulnerable in respect of crops presently grown. Likewise opportunities emerge in terms of improving cultivation conditions for certain crops in certain areas. All in all, a net decline of 2.5% in agricultural production has been projected by a recent study over the next two to five decades with a major reduction in coastal regions.

### Sectoral breakup of Karnataka's GHG emissions (CO<sub>2</sub> equivalent)



(Section 3.1 of KSAPCC)

### 7.3.4 Water Resources

Water resources are under severe threat in Karnataka. The state is endowed with limited water resources that are stressed and depleting. Sectoral demands are growing rapidly on account of increase in population, urbanisation, rapid industrialisation and rising incomes.

Karnataka has seven river basins and receives a total of 236 billion m<sup>3</sup> of water every year, 92% of it through rainfall. Around 47% are 'lost' through evapo-transpiration and another 46% flow into the Arabian Sea, into Andhra Pradesh and Tamil Nadu. The state meets its requirement from the remainder of about 7.5% paired with ground water. There are nearly 37,000 tanks and lakes with a water spread area of 6.9 lakh hectare and more than 20,000 irrigation tanks.

The huge potential with RWH and ground water recharging by harnessing the vast amounts of rainfall in the state become evident. Even if 2 to 5% of this 93% water 'lost' is saved and properly made use of, the state can overcome the water scarcity.

Ground water provides for 45% of irrigation in the state and GoK places emphasis on its expansion. Karnataka experienced a decline in net annual ground water availability by 3.2% between 2004 and 2009, attributed to ground water extraction beyond replenishment. There are 8.6 lakh irrigation wells, 94% of which are equipped with electric pumps. Ground water development stands at 68%. As much as 64

watersheds covering 35 of the 176 taluks of the state are over-exploited. It is projected that the Krishna basin may see a decline in rainfall while the Cauvery basin may experience an increase. Yet contrary to expectation, this may not lead to an increase in surface run-off. A net decline of 2% is projected because of the enhanced rate of evapo-transpiration.

### **7.3.5 Forestry, bio-diversity and wild life**

Karnataka has 3.83 million hectare of forest area accounting for about 20 % of the geographical area. The state has varied forests ranging from evergreen in the Western Ghats to the scrub jungles in the plains. The Western Ghats are among the eight hottest spots among global bio-diversity hotspots and one among the two on the Indian subcontinent.

Reserve forest constitutes 74.9% of the state's forests, protected forest 10.3% and un- classified forest 14.8%. Very dense forest covers 1,777km<sup>2</sup>, accounting for 0.93% of Karnataka's geographical area. Moderately dense forest covers 20,181km<sup>2</sup> (10.5%), opens forest 14,232km<sup>2</sup> (7.4%) and scrubs 3,167km<sup>2</sup> (1.7%).

Forests in Karnataka declined by about 2% between 2001 and 2007; especially dense forests were affected (-16%). The Western Ghats are among the 8 hottest of global biodiversity hotspots. Likewise the coastal area has a rich and diverse biodiversity. A large number of species are identified as rare, endemic or threatened in both biota.

Karnataka's forests are home to 25% of India's elephant and 18% of the tiger population. Wildlife of the state includes 395 tigers, 6,185 elephants, 817 panthers, 2,324 bears, 15,760 wild boar, 25,850 deer, 8,484 bisons and 4,998 sambar deers.

It is widely accepted that higher CO<sub>2</sub> levels will stimulate carbon sequestration by plants and increase net uptake. Nevertheless, the prediction that climatic changes will impact existing vegetation and forests in particular is a concern. A recent study finds that about 38% of the present forest area, mostly in the central and northern parts of the Western Ghats, is predicted to experience shifts in respect of the forest type.

### **7.3.6 Coastal Zone**

Karnataka's has 320 kilometres of coastline lined with coastal plains and undulating hills of 50 to 80 km and high hills further east. Fishing is a major source of livelihood with about three lakh people directly or indirectly engaged. Within the agriculture sector, the share of fisheries is increasing albeit marine fish production has witnessed considerable variation. The per-unit effort and return on investment in marine fishery is declining. A study cited estimates that over the last 20 years the peak catch in the state was 0.22 million tons against a projected maximum sustainable yield of 0.15 million tons. There has been substantial increase in trawler trips in recent years. Particularly, selective scooping exerted has tremendous pressures on benthic organisms and their survival.

Though the coastal hinterland has an average height of 70 to 75 meters, studies have estimated that, if the present trend continues sea levels could rise by 25 cm in 100 years, inundating around 461 km<sup>2</sup> of coastal wetlands. Exacerbated by sand mining, erosion has been found to be significant. Likewise, encroachments and coastal pollution are notable.

### **7.3.7 Energy**

As per KSAPCC about 10.5% of Karnataka's renewable energy potential of 28,500 MW have been tapped so far. Rapid progress is expected here, driven in particular by Renewable Purchase Obligations notified as mandatory in 2011. Apart from the successful Belaku scheme, energy efficiency is still in an infancy stage.

To this statement of the document it can be added that if we take all kinds of renewable energy such as roof top solar, ocean energy into account, the true RE potential will be much higher.

### 7.3.8 Urbanisation

37% of Karnataka's 61.1 million population live in urban areas. The vehicular population rose by an alarming 70% in merely six years. Congestion, increased travel times, vehicular air pollution and noise have come to define urban standards. While efforts are being made to improve infrastructure and public transport and successfully so, the rise of private motor vehicles is probably irreversible. Efforts are directed to promote non-motorised transport (walking, cycling) by creation of the necessary infrastructure as incentive. Likewise, attention is being paid to the better integration of public transport into mobility concepts and door-to-door solutions.

The management of Karnataka's 9,000 tons solid waste per day across 218 urban local bodies (ULBs) has seen frantic activities and tangible improvements. Plans adopted at ULB level are in the process of being completed. While some have achieved compliance with legislation, prerequisite land acquisitions are subject to court proceedings in other cases and time lines are thus difficult to define. Illegal dumping and uncontrolled burning of waste continues to elude efforts.

### 7.3.9 Human health

Human health is vulnerable to climatic changes in multiple ways: increases in the temperature can increase thermal stress. Increased incidence of floods and droughts would reduce crop productivity, affecting nutrition and consequently resistance to infections. Floods could contaminate drinking water causing outbreaks of water borne diseases. Warming trends could also favour the spread of vector borne diseases (malaria, Kala Azar, dengue). The transmission window for malaria in the state is already 10-12 months and hence further increase is impossible.

## 7.4 Discussions on KSAPCC

KSAPCC can be considered as the base document on which the future course of development initiatives is to be taken in the state. It has captured a critical set of credible data on various segments of the state's economy, and focused on major issues of importance. Through consultations with various departments of the Government the document has captured the official view of major issues confronting the state, and also a projection of how the Climate Change will impact in various economic sectors, the flora, fauna and the vast population.

The document has relied on official statistical data to explain the ground realities of the state, referred to various Acts and policies of the state and central governments, and has made a number of recommendations on the action plan for the future. It has also listed various initiatives already undertaken by the state and central governments. It has made use of a number of published articles and news paper reports; and the Climate Change studies conducted by few private agencies such as: (i) Bangalore Climate Change Initiative – Karnataka (2011). Karnataka Climate Change Action Plan; Final Report; (ii) Centre for Multi-Disciplinary Development Research (2008). Natural Resource Accounting in Karnataka: A study of the land & forestry sector (excluding mining); (iii) Centre for Sustainable Development (CSD), (2011). Karnataka Climate Change Action Plan; (iv) Idso, C. and Singer, S.F.(2009). Climate Change Reconsidered, Report of the Non governmental International Panel on Climate Change (NIPCC). The Heartland Institute, USA.

However, the recommended action plan could have been much more inclusive and effective if it were to have the benefit of statewide public consultations. There can be no doubt that a state's developmental plan on various aspects of human life, such as action plan on CC, cannot be expected to be effective unless it has active participation by the public. Such active participation by the public is feasible only when the public are also consulted widely in the planning stage itself.

The consultative process initiated by KSPCB can be seen as filling such a gap, although it would be ideal if all other line departments of the State Government also hold such public consultations on their respective

domains, and elicit public's views. Such public consultations in different parts of the state, at least by few State Government departments, will go a long way towards not only involving the public in the planning process, but also will assist in general awareness campaign on the phenomenon of Climate Change itself, which has become so important in the long term interest of the mankind.

Through public consultations in different parts of the state, KSPCB's initiative has provided a good opportunity for various sections of the society to contribute to the recommendations to improve upon the state's action plan. Teachers, college Professors, Doctors, engineers, NGOs, State Government employees, college students, women, activists, industrialists, farmers and other sections of the society have expressed their views as to how the state's action plan should be. On the basis of this it is reasonable to state that the present document by KSPBC has representative views of the society on how the future course of action in the state should be.

Many of the larger issues of concern to the society, which were not discussed in KSAPCC document, were raised by the stakeholders in various public consultations. Some of these issues were: (a) the implications of high GDP growth rate paradigm adopted by the successive governments; (b) how the developmental process in recent decades has lead to fast depletion of natural resources; (c) the inevitable debate on development and environment; (d) the precautionary principle; (e) the polluter pays principle; (f) equitable distribution of natural wealth; (g) effective public participation in major public policy decisions etc.

There were also expressions of concern that the common man and the nature have not been at the centre of policy decisions.

## Chapter 8

# Sectoral issues raised in public consultation meetings



*Climate Justice or Climate Chaos?*

### 8.1 Water and Sanitation

Pressure on fresh water resources may be the main global threat in the next decade due to population growth alone, whereas the impacts due to Climate Change are projected to take it to a point of global crisis. But the world is failing to mitigate the risk and avoid a crisis, according to a survey of leaders from business, government, universities, international organisations and NGOs by the non-profit foundation the World Economic Forum (WEF) released in 2015. This survey reveals a belief that water crises pose the greatest risk in terms of global impact, and places it ahead of hazards such as the spread of infectious diseases, the failure to adapt to climate change and inter-state conflicts.

The WEF defines water crises as a significant decline in freshwater quality and quantity, resulting in damage to human health or economic activity or both. The report points to a study projecting that, by 2030, the global demand for water will exceed sustainable supplies by 40 per cent. Most of the world's water supply is currently used in agriculture, according to the UN, with the World Bank predicting that food demand will rise by fifty per cent in the next two decades, as population grows and dietary habits change. The looming shortages may be aggravated by an 85 per cent increase in water demand from the energy sector by 2035, the International Energy Agency anticipates. Problems will be particularly severe in areas where factors such as urban sprawl, make it harder to manage available water resources. By 2050, the report says, two-thirds of the world's population is likely to live in cities. In countries such as India, urban centres are predicted to expand up to five times.



The responses to this survey also suggest that a water crisis, along with extreme weather events and natural disasters, is among the problems the world is least prepared to deal with. According to the UN, one in nine people still lack access to drinking water, and one in three lacks proper sanitation. The 3.5 million deaths this causes each year are set to increase, as urbanisation and climate change add to the stress. “The report highlights the interconnection between different risk factors such as water, food security, human health,” ..... “None of them can be addressed in isolation, but all of them are part of an ‘ecosystem of risk’” that, according to the report’s authors, must form the basis of any risk preparedness policy.

*(<http://www.scidev.net/global/water/news/water-crises-top-threat-next-decade.html>); accessed on 10.5.2015*

A high level understanding of the Indian scenario indicates that the situation in India is already of considerable concern due to the fact that it is acknowledged as water stressed and that it has huge population base which is expected to grow continuously for next few decades. The ever increasing urbanization in the country and poor urban planning mechanism will add to these concerns.

An MIT Study (April 2015, on removing salt from the brackish ground water) has estimated that India has 16 percent of the planet’s population but just 4 percent of its fresh water. Much of this water is underground, and about 60 percent of it is brackish — not quite true seawater, but too salty to be safely consumed by plants, animals, or people. Still about 70 percent of Indians are being forced drink groundwater, even when it’s too salty, because of non-availability of any better options. This team was reported as successfully removing salts from such brackish water at an affordable price through a system known as ‘electrodialysis’ wherein the sodium and chlorine ions are removed by two opposite charged plates and with the system getting it’s power from solar panels.

*(<https://www.bostonglobe.com/business/2015/04/16/mit-team-makes-clean-water-from-sun/W7SYjat7GfHAsEGE4TyFOP/story.html>); accessed on 10.5.2015*

Some of the major issues faced in cities in India in water sector can be listed as follows:

- Sewage treatment: Currently a small percentage of sewage generated in the cities gets treated and nearly none of it is reused. It is reported that more than a Billion of liter per day of untreated sewage clogs Mumbai’s Rivers and coastline daily. If only 50% of such sewage was reused after being treated, cities can overcome the existing water crises and it will also clean the rivers and coasts.
- Most of the cities have several traditional water bodies, which are existing and still supplying water. (For example, Bangalore, Mysore, Dharwad have a number of lakes in and around them). However, cosmetic beautification plans do not appreciate the water supply potential of these systems, which is a cheaper, suitable and reliable option for many cities. There is a need to protect such local water bodies, rivulets and streams and rejuvenate those that have died.
- Rainwater Harvesting (RWH) and groundwater recharge: The condition of Rainwater mechanism in our urban areas is either absent or pathetic. RWH exists on paper, but there is no conscious support and encouragement for the scheme from government. Despite this, citizens have demonstrated remarkable success stories (like Sea Line Apartment, Khetwadi Slum and Jago Mumbai Movement in Mumbai). Rejuvenation of Rainwater harvesting and groundwater recharge are easy, affordable and excellent solutions to local water crises.
- Distribution losses and absence of water auditing or discipline: As per media reports, the present distribution in water reticulation systems of urban areas is leading to about 40% losses.

Even a modest 50% reduction in losses in Karnataka can remove the tag as water stressed state. Concerted efforts in treating and reusing 50% of the waste water and rainwater harvesting in 25% of the buildings can transform the status from one of water stressed state to that of a water sufficient state !

There are indicative examples, which are being implemented by vibrant metros around the world to

reduce their reliance on far flung water sources. There are several other options like dual plumbing, using sea water for some uses etc. All the above mentioned options along with modest desalinization at local level put together can be a much better and cheaper option than building more dams.

(<https://sandrp.wordpress.com/2015/01/13/water-smart-mumbai-open-letter-to-cm-devendra-fadnavis/>); accessed on 10.5.2015

Wetlands (lakes) are considered very important as they may help in solving the water problems of many urban areas such as Bengaluru. According to experts 30-40 percent of Bangalore's drinking water requirement is met by borewells, which are being recharged only through wetlands. But there is a general feeling that agencies are undertaking works without clearly understanding the ecology of the lakes, which is worsening the lake crisis.

### Karnataka's water saga

Karnataka has seven river basins and receives a total of 236 billion m<sup>3</sup> of water every year, 92% of it through rainfall. Around 47% are 'lost' through evapo-transpiration and another 46 % flow into the Arabian Sea, into Andhra Pradesh and Tamil Nadu. The state meets its requirement from the remainder of about 7.5% paired with ground water. There are nearly 37,000 tanks and lakes with a water spread area of 6.9 lakh hectare and more than 20,000 irrigation tanks. Such a large number of water bodies built by our ancestors should be seen as a wealth, and should be optimally utilized.

If only 3 to 5% of the state's annual surface run off is harvested effectively, through measures such as efficient water shed management, rain water harvesting and ground water re-charging there is no reason why the state cannot move from the status of one with the deficit tag to one with surplus tag. Such sustainable options will eliminate the need for unsustainable options such as diversion of water from one region to other

But do we have the necessary societal level will power?

Wetlands include a wide range of aquatic habitats such as marsh, fen, peat land (open water), flowing water (rivers and streams) or static (lakes and ponds). These eco-systems are the transition zone between land and water and are ecologically important in relation to stability and biodiversity of a region. According to ecologists, these ecosystems perform a vital function of uptaking nutrients and heavy metals and are aptly often referred to as the 'kidneys of landscapes'. They help recharge groundwater aquifers and stabilise shorelines. Wetlands are also repositories of rich diverse biodiversity and support food chain. They are like giant sponges, which help in slowing floodwaters, lowering flood heights, reducing shorelines and stream-banking erosion. A wetland can be valued with presence of good fish, fodder, suitable water for agriculture, recharging groundwater, storm protection and removing nutrients.

Rapid dumping of solid waste, inflow of partial and untreated sewage generated have polluted water bodies. Encroachment is another major problem.

Ground water provides for 45% of irrigation in the state and GoK places emphasis on its expansion.

These two factors, large no. of tanks and ground water potential, should be seen as strengths to build on. If only a small percentage of water lost through evapo-transpiration and that which flows in the river are properly utilized, the water scarcity of the future can be addressed satisfactorily.

The IISc experts say, for instance, that Jakkur lake can be made an ideal wetland with minimal intervention. There is a Sewage Treatment Plant (STP) to let treated water into the lake. But if algae is introduced and properly harvested, water will then be free of nutrients and bacteria, making it suitable for drinking. This should be followed in all lakes.

('Don't ruin the oxygen, you'll lose the nutrients' : <http://www.deccanherald.com/content/398788/dont-ruin-oxygen-youll-lose.html>); accessed on 10.5.2015

The experts also list few recommendations for effective wetland management. They are integration of

different government agencies for effective implementation of activities related to restoration of wetlands, their sustainable utilisation and conservation; a national committee for lake and wetland reclamation, restoration and development could be set up to formulate a national policy to evolve strategies for their sustainable utilisation and conservation; constitution of regional wetland protection committees with the involvement of all stakeholders; a comprehensive plan should be prepared to study selective, representative wetlands in a phased manner to create database with regard to their present status, sustainable use, management and conservation and strategies formulated for their long-term management; regular monitoring of wetland ecosystems through the involvement of educational institutions and curriculum on development concerning protection of wetlands and ecosystem; mass awareness programme should be chalked out and implemented through government organisations and NGOs for spreading word on the importance of the lakes, wetlands, rivers and their role in the aquatic biodiversity and sustenance of human civilisation; lakes and ponds in each zilla panchayat limits should be identified and their streams recharged through people's participation.

### **“Sustainable Water Engineering : theory and practice”**

‘Virtually all business decisions will affect natural resources. Of these natural resources, water is the most affected by business decisions all over the world. As other resources have been extracted, the water fit for direct human consumption diminished; often it is not even directly suitable for other purposes, for example industrial and agricultural uses.’ ‘While people in dry areas of India took a bath once a week or once a month, others in the same country tried to build huge dams across rivers and diverted the water course through a system of canals. While the urban agglomeration grew, these approaches could not be sustained. The wisdom of engineers four decades back is no longer meeting the needs of present population. Systems designed half a century ago have placed environmental and economic burdens on countries and communities alike. Many of the solutions have now become problems. Examples include huge wastewater treatment plants that are not adequate to cater for today's sewage generation. The entrepreneurs who built industries in the past did not bother to construct sound waste treatment plants. As a result, mankind depends on technology that requires large amounts of energy and chemicals, resulting in high carbon emissions and large ecological foot prints.’ ‘A reduction in consumption could be done by avoiding water-intensive crops but, people just refuse to switch over from foods with a higher water footprint to those with a lower water footprint. People do not switch over to vegetarian food instead of meat and dairy products to save water, even though the water footprint of vegetarian food is far smaller than that of food derived from animals. Hence, the only choices people prefer to make is (i) reducing wastage, (ii) reducing/avoiding pollution and (iii) reusing/recycling water.’

This book elaborates on various methodologies, strategies, issues and challenges in achieving these three objectives.

*Ramesha Chandrappa, Diganta B. Das; 2014*

“Burning Our Rivers: The Water Footprint of Electricity” Published by © River Network, April 2012, Portland, Oregon has focused on the close relation between the electricity production and usage to water. This report says : “Today, on average in the U.S., approximately 42 gallons of freshwater is withdrawn or used to produce a kilowatt hour of electricity. Every gallon withdrawn or used is impacted in some way, whether by passing through a turbine (straining out and damaging aquatic life), being lost through evaporation in cooling towers, warmed in a reservoir (impacting aquatic life and water quality) or chemically polluted. In many places, the freshwater used to generate electricity might be more valuable for other uses, such as drinking water for cities, irrigation water for farms or environmental flows for fisheries and habitat restoration.”

Whereas the above discussions should help us to refocus on much more responsible water management in the state, a recent article analysing how the water, as a natural resource if not managed responsibly, has the potential to lead to very serious conflicts. The article by title “The World Will Soon be at War Over Water” in the 24 April 2015 issue of the News Week has highlighted seven water conflict hot-spots around the world.

*(<http://www.newsweek.com/2015/05/01/world-will-soon-be-war-over-water-324328.html>); accessed on 10.5.2015*

Another article in the same magazine “Drying Up: The Race to Save California From Drought” has discussed the serious water scarcity issue in California, US. If a country such as US, which is considered as resource rich is facing such serious crises, the issues for the state of Karnataka can be much harsher, which calls for an urgent attention, to avert a disaster in the near future.

(<http://www.newsweek.com/2015/05/01/can-science-save-california-drought-324087.html>); accessed on 10.5.2015

Relentless and rampant sand mining is killing the rivers of Karnataka. The ‘sand mafia’ thrives on feeding the existing model of ‘Development through Urbanisation’. There is also an urgent need to identify viable alternatives to sand for construction.

A decent understanding of the fresh water related issues from around the globe indicates that a sustainable water engineering should have close interaction between four components: (i) conservation of ecology; (ii) good intentions among decision makers; (iii) involvement of society; (iv) affordable economy. Ensuring such an effective interaction is the challenge before the state of Karnataka.

The Millennium Development Goals (MDGs), which are international development goals that all United Nations member states have agreed to achieve by the year 2015, will remain a distant dream without an effective management of our water resources.

***In view of the dangerously low levels of ground water table in many districts due to over extraction of ground water, and the huge potential in collection of rainwater for productive use, groundwater recharge and temporary storage in water bodies in order to reduce the irrigation dependency on ground-water should be of utmost priority. In view of the unacceptably high levels of inefficiency in urban water supply systems, there is no doubt that effective rainwater harvesting can bring down the cost of supplying water to these places by a huge margin. In view of the ongoing disputes with TN, Maharashtra and Andhra Pradesh w.r.t interstate rivers responsible usage of river water should be of high importance. Since the consumption of electricity and diesel in pumping water is a considerable percentage of the usage of those sources, the STATE has to explore the ways and means of minimizing this energy consumption. The drought prone nature and water deficient status leaves no other option to the state but to be extremely diligent in managing its scarce water resources which can only get worse in the changed climatic conditions.***

## Reference

- “Sustainable Water Engineering : theory and practice”; Ramesha Chandrappa, Diganta B. Das; 2014
- “The Carbon Footprint of Water”: by Bevan Griffiths-Sattenspiel and Wendy Wilson; 2009
- <http://www.rivernet.org>

## 8.2 Land use and planning

Being a densely populated state (as also the country), land as a natural resource for most of the economic activities has a huge role in the lives of the people in India. When we consider the fact that the farmers and agricultural laborers account for nearly 57% of the state’s work force in the backdrop that a good percentage of others in the state are dependent on forests directly or indirectly, the enormity of the reliance of our communities on the land use should become clear.

“Ever since independence, India’s planners and Policy makers have shown concern for efficient use of land, water and other natural resources for accelerated as well as sustainable economic development. The questions of efficiency, equity and environment protection have been flagged in almost all Five Year Plans. However, notwithstanding these concerns, it is often reported that the problems of land degradation and groundwater depletion have assumed serious proportions in many regions which threaten not only the sustainability of agriculture, but also the overall livelihood system of the people. To make the situation worse, there seems to be a growing misconception in the minds of many scholars and administrators,

particularly in the wake of economic liberalisation that market alone should determine the land use patterns, even though in reality the relevance of land use planning for efficiency, equity and sustainability remains intact. In a developing country like India, land is not only an important factor of production, but also the basic means of subsistence (if not prosperity) for majority of the people. Agriculture contributes less than 30 percent to India's Gross Domestic Product, but absorbs nearly 64 percent of the country's working population. About three-fourth of the total population draw their livelihood from agriculture."

"..... all lands and locations are not equally suitable for profitable, alternative farming and hence, there is need for cluster approach to development. However, land is required for both agriculture and non-agricultural purposes, including establishment of industries, housing, roads, parks, railway lines etc. The problem arises because market driven, albeit unplanned diversification as well as urbanisation often results in non-sustainable patterns of development. A market driven land use pattern may yield higher returns in the short run, but may pose several unmanageable problems for future generations due to unplanned overexploitation of land, water and other natural resources. Hence arises the need for appropriate land use planning. There is no denying the fact that under free market forces, it is the relative profitability of various enterprises and their suitability from the points of view of agro-climatic characteristics which largely determine the land use patterns. But, while market forces should be allowed to operate, the management of land, water and other natural resources and also our orientation of technological and institutional changes should be such as to meet both present and future needs. In other words, the development process should be sustainable both in the short run and long run, based on conservation, of land, water, plant and animal genetic resources. Besides, such sustainable development would be environmentally non-degrading, technically appropriate, economically viable and socially acceptable." "..... a number of research studies point out that due to indiscriminate use of land, water and other natural resources, there is a threat not only to sustainability of agriculture, but also to overall livelihood system of the people in many green revolution as well as non-green revolution areas. ".....under various market forces, there is a growing tendency towards conversion of prime agricultural lands to non-agricultural uses, particularly around the urban centres. Finally, there is need for update and accurate land use data for various regions. The differences in data from the available sources would have to be reconciled."

*([http://www.ncap.res.in/upload\\_files/workshop/ws5\\_chapter1.pdf](http://www.ncap.res.in/upload_files/workshop/ws5_chapter1.pdf)); accessed on 10.5.2015*

"Official estimates place the number of people displaced due to development projects since Independence at 60 million, less than a third of whom have been properly resettled. Most of the displaced are the asset less rural poor, marginal farmers, poor fisher-folk and quarry workers. Around 40 per cent of them are Adivasis and 20 per cent Dalits. Official statistics testify that on all indicators of development, Dalits and Adivasis have been the worst off groups. Already at the bottom of the development pyramid, being deprived of their land and livelihoods has completely bankrupted them, forcing many to move and live in subhuman conditions in our metros. The last two decades have also seen unprecedented agrarian distress, with more than two lakh farmers committing suicide, as per the National Crime Records Bureau. This is something that had never happened before in Indian history."

"Given that 90 per cent of our coal, more than 50 per cent of most minerals, and prospective dam sites are mainly in Adivasi regions, there has been, and is likely to be, continuing tension over issues of land acquisition. Through these tensions, not only has a question mark been placed over our development strategy, the delicate fabric of Indian democracy has become terribly frayed at the edges."

*(<http://bit.ly/1erXrIV> ; accessed on 10.5.2015)*

Most greenhouse gases are released by the burning of fossil fuels for heating, cooking, electricity generation, transportation, and manufacturing, but they are also released as a result of the decomposition of organic materials, wildfires, deforestation, and land-clearing activities.

Land use, land-use change and forestry (LULUCF) is defined by the United Nations Climate Change Secretariat as “A greenhouse gas inventory sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use, land-use change and forestry activities.”

LULUCF has impacts on the global carbon cycle and as such, these activities can add or remove carbon dioxide (or, more generally, carbon) from the atmosphere, influencing climate. LULUCF has been the subject of two major reports by the Intergovernmental Panel on Climate Change (IPCC). Additionally, land use is of critical importance for biodiversity.

### Land use change and global warming

There are a number of ways in which changes in land use can influence climate. The most direct influence is through the alteration of Earth’s albedo, or surface reflectance. For example, the replacement of forest by cropland and pasture in the middle latitudes over the past several centuries has led to an increase in albedo, which in turn has led to greater reflection of incoming solar radiation in those regions. This replacement of forest by agriculture has been associated with a change in global average radiative forcing of approximately  $-0.2$  watt per square metre since 1750. The rate at which tropical regions are deforested is also relevant to the process of carbon sequestration (see Carbon cycle feedbacks), the long-term storage of carbon in underground cavities and biomass rather than in the atmosphere. By removing carbon from the atmosphere, carbon sequestration acts to mitigate global warming. Deforestation contributes to global warming, as fewer plants are available to take up carbon dioxide from the atmosphere. In addition, as fallen trees, shrubs, and other plants are burned or allowed to slowly decompose, they release as carbon dioxide the carbon they stored during their lifetimes. Furthermore, any land-use change that influences the amount, distribution, or type of vegetation in a region can affect the concentrations of biogenic aerosols, though the impact of such changes on climate is indirect and relatively minor.

*(<http://www.britannica.com/EBchecked/topic/235402/global-warming/274830/Land-use-change>); accessed on 10.5.2015*

Land-use change can be a factor in CO<sub>2</sub> atmospheric concentration, and is thus a contributor to climate change. IPCC estimates that land-use change (e.g. conversion of forest into agricultural land) contributes a net  $1.6 \pm 0.8$  Gt carbon per year to the atmosphere. For comparison, the major source of CO<sub>2</sub>, namely emissions from fossil fuel combustion and cement production amount to  $6.3 \pm 0.6$  Gt carbon per year.

According to it is mandatory for Annex 1 Parties to account for changes in carbons stocks resulting from deforestation, reforestation and afforestation and voluntary for others to account for emissions from forest management, cropland management, grazing land management and re-vegetation.

The extent and type of land use is known to directly affect wildlife habitat and thereby impact local and global biodiversity. Human alteration of landscapes from natural vegetation (e.g. wilderness) to any other use typically results in habitat loss, degradation, and fragmentation, all of which can have devastating effects on biodiversity. Land conversion is the single greatest cause of extinction of terrestrial species. Of particular concern is deforestation, where logging or burning is followed by the conversion of the land to agriculture or other land uses. Even if some forests are left standing, the resulting fragmented landscape typically fails to support many species that previously existed there.

In this larger context diligent planning of how we use the land resources becomes a major factor in mitigating and adapting the Climate Change. In recent years the pressure on land has become so huge in the state that there have been frequent allegations of misuse of land usage policies, while all such diversions continue to contribute to the increased GHG emissions.

Two factors must be taken in to account for the site selection for projects; whether the project is a location specific and location non-specific. Irrigation, mining, etc. are used site specific. The other location non-specific projects should look for identifying the government lands and if they are not available, then should look for lands that are not-ecologically sensitive areas and other areas where there is no intensive

agricultural activity. But successive governments are being alleged to acquire lakhs of hectares of fertile agriculture lands and ecologically sensitive zones for various developmental projects. This has not only become a serious cause of social unrest in the project affected areas, but also for serious concerns from global warming implications.

#### **Land use and land use changes can significantly contribute to climate change**

Land use and land use changes can significantly contribute to overall climate change. Vegetation and soils typically act as a carbon sink, storing carbon dioxide that is absorbed through photosynthesis. When the land is disturbed, the stored carbon dioxide along with methane and nitrous oxide is emitted, re-entering the atmosphere. Carbon dioxide, methane, and nitrous oxide are greenhouse gases, which contribute to global warming. The clearing of land can result in soil degradation, erosion, and the leaching of nutrients; which can also possibly reduce its ability to act as a carbon sink. This reduction in the ability to store carbon can result in additional carbon dioxide remaining in the atmosphere, thereby increasing the total amount of greenhouse gases. There are two types of land use change: direct anthropogenic (human-caused) changes and indirect changes. Examples of anthropogenic changes include deforestation, reforestation and afforestation, agriculture, and urbanization. Indirect changes include those changes in climate or in carbon dioxide concentrations that force changes in vegetation. A 2002 NASA study argued that human-caused land surface changes in areas like North America, Europe, and Southeast Asia redistribute heat within the atmosphere both regionally and globally. On a global scale, carbon dioxide emissions from land use changes represent an estimated 18% of total annual emissions; one-third of that from developing countries and over 60% from the lesser developing countries. Urbanization is another change in land use that can affect the climate, sometimes significantly. Local climates tend to be warmer due to the increased amount of heat released within a densely populated area. Average temperatures in city centers can increase even more due to the high density of construction materials such as pavement and roofing materials since they tend to absorb, rather than reflect, sunlight. The phenomenon of higher urban temperatures, compared to lower temperatures in the surrounding rural areas, is known as the urban heat island effect.

*(<http://enviroliteracy.org/article.php/1346.html>); accessed on 10.5.2015*

Considering the status of land use management system, the possible intervention that could enhance the efficient land use management for optimum land resources utilization are:

- First of all it is necessary to perceive that the land resource is finite resource where there is no scope for regeneration, then only we can adopt optimum utilization measures and a fear has to be created among the general public/every stake holder that without land resource there is no existence of life on this earth.
- Land resource accounting in the state & regional level shall be carried out to have budget on the available land resources. This helps for efficient allocation of water resource. It is also necessary to have regional/local land resource stock for allocating the land for specific usage.
- Land allocation shall be made based on the project requirement and shall be implemented strictly based on the specific purposes and any additional land in excess of the requirement shall be taken back from the proponent to encourage judicious usage/discourage excessive consumption.
- Policy shall be evolved for allocation of land for pollution control activities like establishment of ETP/STP/Solid waste management facility, Hazardous Waste Management facility, e- Waste processing plant etc whenever the land is allotted to develop designated industrial area.
- Policy based on the scientific study (like GIS, GPS and carrying capacity studies etc) shall be evolved for zoning of land and only designated activities shall be allowed in the specific zones (i.e Residences in Residential area, Industries in industrial area etc).
- At no point of time/circumstances inter mixing/inter changing of zones shall be allowed. Buffer of sufficient width shall be allowed between two consecutive zones especially between residential & industrial land use.
- Policy shall be evolved for protecting water resources in any land use and water conservation measures shall be strictly implemented around the water source within the specific land use.

- Proper storm water drainage system to carry rain water & underground drainage system to carry sewage shall be provided within the specific land area. The storm water drainage shall be connected finally to surface water source and the UGD shall be connected to Sewage treatment Plant for further treatment & Disposal.
- Proper policy shall be evolved to implement the land use for establishment of Schools, Colleges, Office, Industry within the reach, so that long distance commutation shall be avoided which reduces fuel consumption vis-à-vis pollution apart from reducing GHG gases.
- Suitable policy shall be evolved for re-categorization of industries in the back drop of the location/zoning of the industry to prevent surrounding environment and its impact on the regional community.
- Urbanization shall be controlled by developing 2 & 3 tier cities with self sustainability for water, energy and etc.
- Proper policy shall be evolved not to change the forest land use and agricultural land use pattern for any other purposes.
- Preparation & implementation of action plan for conservation of land, reclamation of polluted land and to take up bio remediation if the land is contaminated with high toxic effluent/waste discharge.
- Proper amendments shall be incorporated in the Land Revenue Act for making provisions to give incentives/tax exemption to all the individuals who have provided efficient land use management by providing rain water harvesting system, dual piping system, ground water recharge pits, solar energy capture etc as sustainable resource conservation measures.
- Regular interaction meetings/awareness programmes shall be conducted (similar to a market day in every village on a particular day) wherein all the issues like success stories of resource conservation measures, latest technological developments in the field of water conservation etc shall be discussed and information sharing shall be done along with a small get-together, which can change the attitude of people towards water usage, conservation and protection of natural source.
- Community based activities shall be undertaken for conservation of natural resources especially land resources as this is a common property resource.
- Policy shall be evolved and implemented for achieving sustainable transportation to enhance efficiency and reduction in travel demand by integrating land use and transportation planning.
- The policy intervention in urban transportation shall be planned for achieving mitigation as well as inclusive growth, through reduction of GHG and providing equitable share of the modes which are mostly used by urban poor.

***Keeping all these discussions in proper perspective an effective state action plan on Climate Change should be developed and implemented by the society as a whole after addressing the following issues in a diligent manner by involving as many stake holders as possible:***

- How much of forest lands can we afford loose further in the context that the forest & tree cover is already much below the national forest policy target of 33%?
- How much of the fertile agricultural land can be diverted to other uses appreciating the fact that the growing population will need much more food than has been possible with the shrinking agricultural land?
- Can we afford to loose other ecologically sensitive land covers such as marshes, lagoons, wetlands, river banks, river deltas etc. without reaching the tipping for the global warming?

## Reference

- ENSURING FOOD, WATER AND ECONOMIC SECURITY: A CASE FOR ZONE-SPECIFIC PLANNING-INDIA AND BEYOND  
<https://kspcb.wordpress.com/2015/05/17/ensuring-foodwater-and-economic-security-a-case-for-zone-specific-planning-india-and-beyond/>



### 8.3 Forests and biodiversity

Karnataka Forest Department says in its website: “Forest resources in India have always been one of the richest resources. Forests provide renewable natural resources and contribute considerably to the economic development of the nation. Forest Resources in India provides protection to environment and wildlife. It also enhances water holding capacity of soil and rainfall, helps in gaseous cycles of atmosphere, maintains the soil fertility, checks soil erosion, reduces flood disaster etc.. The state of Karnataka is a part of the highly biodiversity rich regions of India. Karnataka supports 10% of total tiger population and 25% of elephant population of the country. The state has around 4,500 species of flowering plants, 600 species of birds, 160 species of mammals, 160 species of reptiles (turtles, snakes, lizards and crocodiles), 70 species of frogs, and 800 species of fish.”

These figures give a good account of the floral and faunal diversity richness of the state.

The land area under forest cover declared by the forest department as per the “Details of Notified Forests and Deemed Forests of Karnataka” in its website is 4,335,694.80 Hectares.

*(<http://aranya.gov.in/Static%20Pages/ForestArea.aspx>); accessed on 10.5.2015*

As per the Karnataka Government website: “Karnataka State has a geographical area of 1,91,791 sq.km of which 38,724 sq.km (20 per cent) is under the control of the Forest Department. The forests are classified as reserved (28,611 sq.km), protected (3,932 sq.km), unclassified (5,748 sq.km), village (124 sq.km) and private (309 sq.km). The percentage of forest area to geographical in the State is less than the all-India average of about 23%, and 33% prescribed in the National Forest Policy.”

*(<http://www.karnataka.com/profile/forest/>)*

The National Green Mission under NAPCC indicates that about 40% of the energy needs of the country and about 80% energy needs of rural India are being met by forests. The degradation of the forests in the state becomes glaring when seen in the back drop of the fact that only about 1% of the state’s forest can be considered as dense. Forests also constitute one of the most effective carbon-sinks.

At the national level, there are serious concerns that the country is losing many species of flora and fauna every year. As per a report in The Hindu of 21 April 2015, “India has added 15 more species to the “Red List” of threatened species published by the International Union for Conservation of Nature (IUCN) in 2014, and the country has a spot at the seventh position. By the year-end, India had 988 threatened species on the list, which lists critically endangered, endangered and vulnerable species. In 2013, the number was 973. With 659 species in 2008, the increase over seven years is 50 per cent, in part due to better research identifying more threatened species and deforestation.” “This is definitely a concern ... There is a tendency of decision-makers to focus on ‘charismatic’ mammals for conservation, while others are left out of programmes ... A more holistic approach is needed to conservation in India.” “A recent World Bank mapping of endangered mammals shows India as having the fourth largest number of threatened species in the world, 31 of them endemic to the region.”

When all these issues are viewed from the perspective of overall welfare of our communities and the Global Warming, it should become evidently clear that all possible efforts should be to increase our forest and tree cover to 33% as per the national forest policy target, and conserve flora, fauna and other its bounties for sustainable benefits.

Keeping in view that ecologically rich forests such as the ones in Karnataka can be good buffers against the impacts of Climate Change, the state has a very serious issue to contend with urgently; whether it should protect the true interests of its people by increasing its forest & tree cover to 33% of the land area and sustainably harvesting its bounty; or allow the diversion of forest lands for other purposes at unimaginable costs to the society in the long run.

As per Inter Governmental Panel on Climate Change (IPCC) - IV Assessment Report “Curbing deforestation is a highly cost-effective way of reducing greenhouse gas emissions.”

As per a report ‘Vital Forest Graphics’, UNEP, FAO, UNFF, 2009: “More than 1.6 billion people around the world depend to varying degrees on forests for their livelihoods – not just for food but also for fuel, for livestock grazing areas and for medicine. At least 350 million people live inside or close to dense forests, largely dependent on these areas for subsistence and income, while about 60 million indigenous people are almost wholly dependent on forests (World Bank 2006c). Forests play an important role in the livelihoods and welfare of a vast number of people in both developed and developing countries; from urban citizens taking a recreational stroll in a nearby forest to isolated hunter-gatherers who live in and off the forest.” The scenario in the case of tribals living in forests of Karnataka cannot be totally different, indicating the huge importance of protecting our forest wealth.

In a report by the College of Forestry, UAS, Ponnampet, titled “Payment for Ecosystem Services (PES) in Kodagu, Western Ghats of India – a case study” the vast array of bio-diversity in the forests of Coorg district and multiple benefits to the society from various services provided by these forests have been described. It also provides an indication of the economic value of the huge benefits from the forests of WGs.

*(<https://kspcb.wordpress.com/2015/04/16/payment-for-ecosystem-services-pes-in-kodagu-western-ghats-of-india-a-case-study/>); accessed on 10.5.2015*

People from Coorg districts also expressed concern on how even the micro-environment of coffee estates is being destroyed due to a power transmission line being constructed through the district. They provided many examples of how many elephant – human conflicts have been reported in recent years from such areas because of the disturbance to the habitats of elephants within and in the vicinity of coffee estates. Such elephant – human conflicts are also reported by people from Hassan district in Sakaleshapura taluk, where many projects such as mini hydel project and Yettinahole project have impacted the serene atmosphere of the animals there.

Many proposed linear projects such as Hubli - Ankola railway line, Talaguppa – Honnavar railway line, Mysore – Madikeri railway line, another road from Karnataka to Kerala through forests, 400 kV Double Circuit power transmission line through Coorg, Gundia hydel project in Hassan district, water diversion and mini/micro hydel projects, jungle resorts etc. should all be diligently reviewed in this context with active involvement of the stake holders.

Stakeholders in hilly districts of the state have huge concerns with the way the rich ecology of these hilly regions are being over exploited. ‘Kodagu Model Forest Trust’ has provided very useful feedback to this report on how the ecology of our state, especially of the hill ecology, should be protected through four articles as in the weblink below.

*(<https://kspcb.wordpress.com/2015/05/04/feedback-from-kodagu-model-forest-trust-on-climate-change/>); accessed on 10.5.2015*

The hugely deleterious impact on forests around Hunsur in Mysore district by Tobacco processing units has been highlighted by a research project. This report with the title “Tobacco curing and fuel efficiency in Karnataka, India” Working paper No.77-13 – South Asian network for Development and Environmental Economics, Kathmandu; Nepal: 2013 has detailed how large volumes of wood is required to process tobacco which is also grown in the area. Anti-Tobacco Forum has suggested a number of measures for tackling various issues on the tobacco front.

Illegal deforestation from the eastern plains of Western Ghats is said to be a regular feature for this purpose. As per this report Tobacco curing in Karnataka requires nearly 700,000 tons of fuel wood every year. Field data shows that a very small percentage of the wood used for curing is collected from forest depots with the rest coming from private plantations and, possibly, natural forests. Thus, fuel wood plantations,

which are very profitable, could be encouraged, particularly on wastelands. The consequent denudation of natural forest lands appear to be responsible for creating changes in seasons, rainfalls, sowing, water supply, climate change and ultimately global warming. If all fuel wood using tobacco farmers are persuaded to adopt the two fuel-saving technologies (using improved technologies such as Venturi furnaces and barn insulation), 12 percent less fuel wood would be used on aggregate.

Critics have been drawing our attention to the fact that a lot of wood can be saved and green cover/carbon sinks can be maintained if policy makers stop adopting dual policies - help tobacco farmers with subsidies, inputs, support price, research, O&M for marketing tobacco products, infrastructure for auctioning, etc. while making tall claims on mitigation of Climate Change. They also point out that India is a signatory to the UN/WHO sponsored Framework Convention on Tobacco Control along with other 174 nations, and that every country has its own role to play in safeguarding the health of its people. India is the third largest producer and 2nd largest consumer of tobacco in the world. The control measures in place at the state / national level should have been commensurate with these issues in proper context.

([http://www.sandeeonline.org/uploads/documents/publication/1007\\_PUB\\_Working\\_Paper\\_77\\_Nayantara.pdf](http://www.sandeeonline.org/uploads/documents/publication/1007_PUB_Working_Paper_77_Nayantara.pdf));  
accessed on 10.5.2015

***During the public consultations the public expressed very serious concerns about the poor status of our forests, the consequences of such degradation on the Climate Change, and the dire need to improve the quality of the forests on a priority basis. The way our state has managed the forest resources came up for heavy criticism. Continued diversion of forest lands for various 'developmental projects' despite the fact that the extent of forests in the state does not meet the national forest policy target was a grave concern. The public were clear in their expectations that the forests of the state, which are ecologically of huge value in the fast changing climatic conditions, must be preserved and enhanced in the long term welfare perspective of the state.***

## 8.4 Western Ghats

The Western Ghats (WGs) are a 1,600-km-long mountain range spread over a 140,000 sq km area in Gujarat, Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu. About 60 per cent of these Ghats lie in Karnataka. The Western Ghats are home to rare plants and various birds and animal species but are threatened by a number of developmental activities such as roads, railways, dams, etc..

Tropical Western Ghats are also considered as the sentinels of our environment, as well as fountains of fresh water not only to Karnataka but for the entire peninsular India. With less than 20% of forest & tree cover in the state; with only about 1 % of dense forest covers; and with huge pressure to divert the forest lands, the state has a major challenge even to maintain the present level of forest & tree cover.

In view of the environmental sensitivity and ecological significance of the Western Ghats region and the complex interstate nature of its geography, as well as possible impacts of climate change on this region, the Ministry of Environment & Forests Government of India has constituted a Western Ghats Ecology Expert Panel (WGEEP).

“The hill chain of the Western Ghats, a treasure trove of biodiversity and the water tower of Peninsular India, runs parallel to the West coast of India from the river Tapi in the north to Kanyakumari in the south.”  
“Western Ghats and the Eastern Himalayas are today the most significant repositories of India’s biodiversity. Amongst them, the Western Ghats scores over the Eastern Himalayas in harboring a larger number of species restricted to India alone. Not only are the Western Ghats and Eastern Himalayas biological treasure troves, they are also two of the world’s biodiversity hot spots, a hot spot being a biodiversity rich area that is also under a high degree of threat.” (WGEEP Report)

The Western Ghats are second only to the Eastern Himalaya as a treasure trove of biological diversity in

India. Western Ghats are also considered one of the eight “hottest hot spots of bio-diversity in the world. “At the same time, the high human population density and major transformation of the landscape since the mid-18th century also emphasize the urgency of conservation of the Ghats and sustainable use of its resources. A study in the southern region, comprising the states of Karnataka, Kerala and Tamil Nadu, showed that between 1920 and 1990 about 40% of the original vegetation cover was lost or converted to another form of land use. It is estimated that not more than about 7% of the area of the Western Ghats is presently under primary vegetation cover, though a much larger area is under secondary forest or some form of tree cover. Nearly 15% of the Ghats is also under the Protected Area system.”

“Western Ghats are a treasure trove of biodiversity, surpassed only by the Eastern Himalayas. However, they score over the latter region in harbouring a larger number of species confined within Indian limits. The Western Ghats also constitute the water tower of Peninsular India.” (WGEEP Report)

Water, food security and very many other eco-services provided by the Western Ghats can only be sustained by appropriate conservation measures and not by short-sighted exploitation of the resources as has been happening all these years.

UNESCO’s World Heritage Committee inscribed the Western Ghats as a world heritage site on July 1, 2012. The decision was expected to ensure the mountain range, spread across seven states, gets international support for its conservation. Older than the Himalaya, the Western Ghats mountain chain is recognised as one of the world’s eight “hottest of 25 hot spots” of biological diversity. The World Heritage Committee, which met in St Petersburg in Russia, acknowledged that the Western Ghats forests include some of the best representatives of non-equatorial tropical evergreen forests anywhere and are home to at least 325 globally threatened flora, fauna, birds, amphibians, reptiles and fish species. Its ecosystems influence the Indian monsoon weather pattern. “Moderating the tropical climate of the region, it presents one of the best examples of the monsoon system in the planet,” says a news release of the committee.

Many experts have welcomed the UN heritage tag to WGs.

“The Western Ghats are home to several rare, as well as endemic species and its soil and forests are rich in carbon content. It is a source of several non-timber forest products and medicinal herbs which support the livelihood of around that 160 million people who reside here. It aptly deserved the world heritage status,”

“ -- At the same time, there should be sincere and effective efforts on the part of all the concerned governments, departments, corporates, media and local people, to ensure that all development is sustainable and benefits the local environment and livelihoods.”

It should be noted that UN Heritage tag was issued after a lot of deliberations at the UN level, after a close scrutiny by a group of countries on the importance of WGs to the global environment. Since the union Ministry of environment also has supported such a claim, it is highly unfortunate that in the context of huge importance of the ecology of WGs to the country as a whole and to Karnataka in India, there were some uninformed opposition to the UN Heritage tag by few politicians. Such opposition seems to have origin in complete ignorance about the ecology of the WGs, and probably because of short term vested interests. Accepting the UN Heritage tag, and implementing suitable action plan consistent with such a high profile will not only assist in preserving the rich bio-diversity of WGs but also provide huge benefits to our society on a perpetual basis.

Some of the special characteristics of WGs as compared to the other forests of India are as listed in a report of Down to Earth magazine on July 2, 2012.

- Western Ghats are home to several rare as well as endemic species of birds, animals, insects, fish, amphibians and plants. There are over 5,000 species of flowering plants, 139 mammal species, 508 bird species and 179 amphibian species

- Northern Western Ghats are known for several species of endemic limbless amphibians (caecilians) and floral diversity plateaus, such as Kaas
- The floral vistas of Neela Kurunji in Kerala and Karvi in Maharashtra are a visual treat in monsoons after periodic intervals
- Several streams originating in Western Ghats are home to endemic species of hill stream fish
- The forests of the Western Ghats have a stabilizing effect on the climate, which induces heavy rains on the western slopes and the western coast and moderate rains on the eastern slopes
- The ports and creeks along the western coast, which are so crucial to the economy of the region and transportation, can be kept navigable and silt free, only if the forests on the Western Ghats are preserved
- The almost continuous forests along the crest and the base of the Western Ghats and the mangrove forests along the coast play a vital role in carbon sequestration and reduction of global warming

*(<http://www.downtoearth.org.in/content/western-ghats-get-world-heritage-site-tag>); accessed on 10.5.2015*

In the case of Western Ghats it is considered wise to state: instead of “Develop recklessly – conserve thoughtlessly” persevere with one of “Develop thoughtfully - conserve thoughtfully”, as Western Ghats Ecology Expert Panel (WGEEP) has averred. On the basis of careful and extensive compilation of information, and wide-----ranging field visits, consultations and analysis, the WGEEP has designated the entire Western Ghats as an Ecologically Sensitive Area (ESA) and, assigned three levels of Ecological Sensitivity to different regions of it. These are termed as Ecologically Sensitive Zone 1 (ESZ1), Ecologically Sensitive Zone 2 (ESZ2) and Ecologically Sensitive Zone 3 (ESZ3). Though the recommendations of WGEEP have not been accepted by the Government it is of high relevance that such an expert body has declared the entire WGs as ecologically sensitive area. Forests in Karnataka, which contain about 60% of WGs, cannot be anything but ecologically sensitive that being the source of or catchment area of all the rivers in the state.

Fragmentation of forests, as is happening in WGs, due to projects through forests, including linear projects and dams etc. causes fragmentation habitat for wild animals. This cuts off corridors for wildlife and results in increase of Human Animal Conflict, especially Human Elephant conflict, as has been reported from Coorg, Hassan and Chamarajanagar districts. The fragmentation of habitat and severing of corridors degrades the genetic pool for species and this leads to accelerated species extinctions. In this context, any river interlinking project will have to be carefully reviewed w.r.t severe ramifications.

Government of India set up another high level committee, under Dr. Kasturi Rangan, to reconsider the conservation methodology on Western Ghats. This committee too has recognized the criticality of adequately conserving the ecology of the WGS, but its recommendations are seen as much watered down as compared to the recommendations of WGEEP. There are many environmental experts, with a deep understanding of the flora, fauna and general ecology of WGs, who believe the recommendations of the WGEEP itself should have been much more stringent in order to conserve the bio-diversity there and the ecological richness of the region. But WGEEP in its deliberations seem to have made provisions for some sort of continued developmental projects, while it is generally considered that WGs have been overexploited since independence and that they need many decades of least human interference to regenerate.

But sadly some sections of our society have opposed even the watered down recommendations of Dr. Kasturi Rangan committee for what appears to be short term gains.

In a report by College of Forestry, UAS, Ponnampet titled “Payment for Ecosystem Services (PES) in Kodagu, Westerh Ghats of India – a case study” an indication of the vast benefits from the forests of WGs can be seen.

*(<http://bit.ly/1RqEgap/>); accessed on 10.5.2015*

There is a critical need to lay greater stress on the WGs as catchment areas providing water to downstream

users. The document on Payment of Ecological Services by College of Forestry, Ponnampet needs to be taken up by policy makers to implement the PES concept in Kodagu, as a model project. Kodagu is the Principal catchment for Cauvery River and provides almost fifty percent of the total inflow. Therefore it would be ideal to take Kodagu as a model district for PES and then apply the same concept to other Western Ghat Districts of Karnataka.

Now in the context of Climate Change, there can be no vacillations on whether the WGs need maximum care in order to protect our communities from the perils of Climate Change. The society at large need to carefully deliberate on all the related issues, and take highly diligent steps in conservation, protection and rejuvenation of the WG region and its invaluable ecology.

The WG Task Force, which was appointed by the State Government few years ago, has made far reaching recommendations to protect and enhance the ecology of the Western Ghats.

Karnataka Forest Minister C P Yogeshwar on Thursday assured the Western Ghats Task Force of implementing its 14 main recommendations on conservation and sustainable development on the issue. "Our government has taken the issue conservation of Western Ghats seriously and would implement all the 14 chief recommendations made by the Western Ghats Task Force," he said addressing the Force. Yogeshwar said the recommendation on strengthening Village Forest Committees (VFCs) would be taken up in the cabinet meeting. The task force had recommended that the VFCs should be given the right share in the benefits generated through forest protection and development work by the department periodically so that they could engage in the activities related to forest conservation.

The task force also recommended that all taluks in Western Ghats should be brought under "Naxal Package" benefits so that all remote villages in the forest area get the basic facilities. The task force also recommended the government to come out with a clear policy to ban major mining in Western Ghats region, which involve minerals like iron ore, manganese and bauxite. It also recommended that the government should not give permission to any form of hydroelectric projects in the forest valleys of Western Ghats and its foothills in Karnataka. The task force further recommended that many tribal and dwellers in the forest areas have not yet been able to get the basic facilities like all season roads, power and primary health centre. Government should take it up on priority, along with optimum utilisation of central assistance, it said.

*Press Trust Of India / Chennai/ Bangalore November 30, 2012, 0:43 IST*

Sir Nicholas Stern, a former economic advisor to the Government of UK, has said in his famous report "Economics of Climate Change" that any investment to combat the global warming now can be minuscule as compared to the investment needed in future, which will be a considerable percentage of a nation's GDP. In this context there were strong recommendations that the state should do all that is feasible to conserve, protect and rejuvenate WGs and the other forest stretches in the state.

The Conference of the Parties (CoP) established under the Convention on Biological Diversity (CBD) at its sixth session in 2002 set common global targets to reduce the loss of biodiversity by 2010. These include:

- Conservation of biodiversity at the level of ecosystems, species and genes;
- Addressing risks such as invasive alien species, global warming and developments that threaten the natural environment;
- Maintaining the function of ecological services that support human livelihood;
- Maintaining the rights of the aboriginal people and protecting their traditional knowledge;
- Ensuring equal and equitable distribution of profits from the use of genetic resources.

*"CLIMATE CHANGE AND INDIA: A 4X4 ASSESSMENT: A SECTORAL AND REGIONAL ANALYSIS FOR 2030S" prepared for MoEF describes copiously the importance of Western Ghats from CC perspective.*

Another study "Biodiversity, Ecology and Socio-Economic Aspects of Gundia River Basin in the context of proposed Mega Hydro Electric Power Project" by IISc has discussed the value of forest wealth in WGs.

([http://wgbis.ces.iisc.ernet.in/biodiversity/pubs/ces\\_tr/TR122/section5.htm](http://wgbis.ces.iisc.ernet.in/biodiversity/pubs/ces_tr/TR122/section5.htm)); accessed on 10.5.2015

What Late Prime Minister Indira Gandhi said in 1980 is relevant even today: “The interest in conservation is not a sentimental one, but the rediscovery of a truth well known to our ancient sages. The Indian tradition teaches us that all forms of life — human, animal and plant — are so closely interlinked that disturbance in one gives rise to imbalance in the other.” “Our welfare is intimately connected with the welfare of wildlife; by saving the lives of wild plants and animals we may be saving our own. Time is running out. We can no longer remain spectators. We need to think globally but act locally, rededicating ourselves to protecting biodiversity in forests, coastal ecosystems and in our own neighborhood.”

A recent opinion piece in Deccan Herald (1 May 2015) by A K Varma, former Principal Chief Conservator of Forests, Karnataka describes the “Importance of preserving Karnataka’s Western Ghats, tigers”.

(<http://www.deccanherald.com/content/474687/importance-preserving-karnatakas-western-ghats.html>); accessed on 10.5.2015

The STATE will do well not to ignore such warnings from domain experts, and the general opinion of the public on the great relevance of protecting our bio-diversity in CC perspective.

***The common opinion expressed in the public consultation process was that all possible steps must be taken by the society at large and by the government in particular, in conservation, protection and rejuvenation of WGs. No efforts should be spared in this context, including the tough decision to keep only the long term interest of the peninsular India instead of looking at short term gains for tiny sections of the society.***

## 8.5 Coastal Ecology

The narrow coastal strip of the state, running for about 320 km, has huge ecological significance to the state in addition to positively assisting the Western Ghats through its moist winds. Major ecosystems in the coastal areas of the state include mangroves, mudflats, salt marshes, coral reefs, seagrass beds and lagoons, all of which are highly productive and support extensive fisheries and associated livelihoods. Coastal wetlands are among the most productive of ecosystems on the planet. Tourism is also a major economic activity in the region. The ecological health of coastal zone should be a major consideration in the state’s overall development plan.

KSAPCC says: “Similar to problems across the globe, the situation is no different in Karnataka – industrialization, improper land use, unsustainable economic activities and overexploitation of natural resources have adversely affected the coastal environment. The effluents and emissions discharged by large industries and power plants, unregulated tourism, and intensive aquaculture have negatively affected the coastal environment. Decline in mangroves and coastal wetlands have eroded its pollutant-filtering capacity.” “Uttara Kannada district has the highest percentage (84.4%) of uncultivable land followed by Dakshina Kannada (51.8%). Out of total uncultivable land, around 27% is covered under forest in Udupi and Dakshina Kannada while Uttara Kannada district has land as high 79.5% under forest. Approximately 28% land is under cultivation in Udupi and Dakshina Kannada while Uttara Kannada has only 10.6% land under cultivation.”

“The state of Karnataka has a rich biodiversity supporting number of ecological functions in the coastal eco-systems including livelihood opportunities to millions of people. Karnataka’s coastline extends over a length of 320 kilometres with numerous river mouths, lagoons, bays, creeks, cliffs, sand dunes and long beaches. There are 26 estuaries with more than 70,000 ha water spread area and 8,000 ha of brackish water area, making the coastal line of Karnataka very rich in marine, estuarine and riverine biodiversity. The Western Ghats, which run parallel to the coastline, is indeed an integral part of the coast. Fourteen rivers which originate in these Ghats run westward and join the Arabian Sea. These rivers carry silt and

organic debris from the forested hinterland into the estuarine areas and the coastal sea and contribute greatly to the productivity and diversity of the coastal ecosystems.”

Many reports on sustainable development of coastal Karnataka have unequivocally explained the fragile nature of the coast, and have advocated extreme care in the type of developmental activities there. Five such reports are: (i) “Industrial and Economic perspective of Dakshina Kannada” by Karnataka Centre for Infrastructure Planning; (ii) A report by DANIDA – Management of Sustainable Development- 1993-95, (iii) NEERI Report – 1996, (iv) Carrying capacity for industrialisation of a region – 1998, (v) Karnataka’s Environmental Status and Action Plan -2003. All these reports have said one thing in common: that the local conditions of any region in the coast, which are all ecologically very sensitive, should be major considerations while selecting the site for any large scale polluting project like coal fired power station. Another clear recommendation has been to conduct the ‘Carrying Capacity’ study of the region, which includes the impact of all the existing and planned projects for the region, before finalizing the site for each such project.

The government and the society should take seriously the recommendations by such expert committees, which have been set up by the governments. Polluting industries and large scale diversion of coastal land to industrial activities are certain to have serious impacts on coastal environment including that of the coastal water. Polluting industries such as coal power plants, as the one at the foot hills of WGS in Udupi district or the ones proposed earlier in Uttara Kannada district can devastate the vegetation in WGs. Hence careful management of the ecology of the coast also is critical in managing the Global Warming impacts in the state. While the flue gases and fly ash from such a plant can result in acid rain and impact the flora, the transmission lines required through the forests can impact the WGs.

Sunita Narain of Centre for Science and Environment says in her foreword to a report ‘The Challenged Coast of India’: “There is a pincer attack on our coasts. As a result, the Indian coast is doubly vulnerable today. On the one hand, it is facing unprecedented pressures because of industrial and urban development. On the other hand, it will see threats of climate change related devastations – from growing intensities of cyclonic storms to sea surges and eventual sea level rise. All this requires increased attention and vigilance for the protection of the coast and the people who live there. It is also clear that coastal areas are the habitats of fishing communities. These communities are today also in double danger – ironically from conservation and from development. Current conservation strategies have been exclusionary and do not account for their livelihood needs. Current development strategies have been destructive – taking away the little that fishing communities have in the name of progress and growth. It is for this reason that future policies for coastal area management must reverse these trends and find approaches to conserve and protect vulnerable ecosystems and secure livelihood and habitats of its people. This is the challenge.”

The executive summary of the study ‘The Challenged Coast of India’ says: “Coastal areas have played an important role in the socio-economic development of a country primarily because seaborne trade remains the cheapest method of transporting large quantities of goods over long distances. Today’s globalization requires movement of large quantities of raw materials and finished goods, and consequently there is strong emphasis on the development of ports. Concomitantly, the areas around the port are also under development pressure – for industries, tourism and settlements. As more people migrate towards the coast, there is extensive change in land use and an increasing pressure on resources. Marshy areas and tidal flats are ‘reclaimed’, creeks are diverted, mangroves are felled, and in their place large industries and ports emerge, together with the various developments that go with them. The entire land-use pattern undergoes many undesirable changes. From a natural landscape it becomes a mosaic of human activity. The natural ecosystems around are put under stress and there is a breakdown or deterioration in ecosystem services as well as loss in biodiversity. Destruction of habitats has been reported as one of the top causes for loss of biodiversity according to the Convention on Biological Diversity. Overall, the coast



is under tremendous pressure – from population and ‘development’. However, there are no assessments available at the national level to provide estimates of the extent of the coast that is actually occupied by various human activities, and their possible impacts on coastal biodiversity.”

“A clear conclusion that can be drawn from this study is that India’s coastal areas (and hence the biodiversity that they contain) are challenged, due to very aggressive development and the indiscriminate construction of coastal structures. Settlements, commercial areas, ports and water bodies already occupy over 43% of the coast. It is not just biodiversity that is being compromised but also the livelihoods of millions who depend on primary resources from coastal areas, especially the coastal wetlands, apart from displacement due to land acquisition and alienation from their traditional livelihoods. Unfortunately, in spite of all the laws and guidelines, coastal degradation has reached alarming proportions. To implement all the proposals of various ministries a coastline many times longer than what is actually available will be needed. There is an urgent need to rationalize development if we are serious about conserving the coastal ecosystems and biodiversity and ensuring that the coastal communities are not displaced or affected.”

This report has made a number of recommendations to rationalize development if the society is serious about conserving the coastal ecosystems and biodiversity and ensuring that the coastal communities are not displaced or affected.

*([http://deepakapte.com/attachments/article/20/Challenged%20Coast%20of%20India\\_Lowres.pdf](http://deepakapte.com/attachments/article/20/Challenged%20Coast%20of%20India_Lowres.pdf)); accessed on 10.5.2015*

Dr. V N Naik, a retired Professor of Marine Biology, Karnataka University, and who has been involved in the study of coastal ecology in Uttara Kannada district for decades, has identified the following major concerns to the coastal areas in Karnataka in general, and to Uttara Kannada district in particular.

### **8.5.1 Coastal erosion**

This is a natural phenomenon all over the world. Erosion is followed by accretion if it is natural. Construction of dam, excessive sand mining in the estuary, destruction of mangroves, dredging in the sea, construction of sea wall and waterfronts affect the current pattern in the sea leading to excessive erosion in a specific point where the accretion will be less than erosion thus causing loss of shoreline and the associated properties. The Coastal Regulation Zone (CRZ) Notification, therefore, restricts activities in the 200metre zone from the HTL. Through CRZ Notification if applied properly, preventing any construction in the limits, the threat becomes negligible.

### **8.5.2 Port construction and dredging**

This may lead to erosion as evident from Devbag region (near Karwar port), Bhavikeri (near Belekeri). Also, Pavinkurve erosion is due to sand bar formation in the mouth of Sharavati estuary, possibly, due to dam construction for Sharavati tailrace project. Therefore, it is suggested that no more dams for west flowing rivers in the Western Ghats region and no more harbours as the already existing ports are not working to the full capacity.

### **8.5.3 Sand mining in the Estuary**

Estuarine sand mining is a prohibited activity. Generally sand accretion and movement is a natural phenomenon. Any sand bar formed in the estuary will be due to constructions in the bank affecting the natural movement of water. This leads to collapsing of bunds and salination of agriculture land due to inundation of tidal water. Sand mining has to be carefully viewed in this context.

### **8.5.4 Destruction of Mangroves**

Mangrove destruction causes seepage of sea water into the agriculture land and also salination of well water. Also, this leads to erosion of the bank and collapsing of bunds. Resurrection of mangroves needed.

### 8.5.5 Disaster management and green wall

Impact of tsunami and cyclone are high in the barren open area as against sheltered belt. This has been proved beyond doubt in East Coast of India, Japan during tsunami and Orissa cyclone. Any artificial wall cannot face the fury of the sea. However natural green belt can definitely reduce the impact. Traditionally, the coast was protected by the green belt. This was destroyed to develop tourism, construction etc. and to extend agriculture land. All the grave problems along the coast are due to leveling of sand dunes and destruction of sand dune flora. CRZ specifically restricts leveling of sand dunes. Reconstruction of open beach with sand dunes and dune flora (green belt) and prevention of further destruction needed.

### 8.5.6 Protection of Coastal Biodiversity

Coastal biodiversity is seriously affected by encroachment into sea, sea wall construction, and destruction of sand dune flora, destruction of mangroves, sand mining, pollution and now the proposed reef formation. The fishery in the inshore waters is affected due to these activities. A review of the status and prevention of further damage has to be carried out.

A detailed analysis of the issues facing the coastal areas of Karnataka by Dr. V N Nayak can be seen in the weblink: <http://wp.me/p34Lf5-hv>; accessed on 10.5.2015

A critical issue being faced by the coastal India is of the management / mis-management of natural beaches especially w.r.t to the sand. An informative documentary on the beaches of Puducherry is in the link provided below.

“India’s Disappearing Beaches - A wake up call”: (<https://www.youtube.com/watch?v=KgTn6Qpgjok>); accessed on 10.5.2015

We must learn from such valuable lessons in our own backyards, and take all necessary measures to protect our coast lines. Such lessons should be in focus while recommending against additional ports in the country, which as per a report may see a day when there can be a port every 15 km of the coast. Are so many ports needed for the true welfare of our communities, and in what way they will assist in mitigate and adapt to CC?

***The narrow coastal strip of the state has huge ecological, economic and social significance to the state in addition to positively assisting the Western Ghats through its moist winds. It is facing serious threats to its rich ecology from the fast changing climate. Current development strategies have been considered by experts as destructive – taking away the little that fishing communities have in the name of progress and growth. Future policies for coastal area management must reverse such trends and find approaches to conserve and protect vulnerable ecosystems, and secure livelihood and habitats of its people.***

## 8.6 Agriculture, horticulture and animal husbandry

These sectors are projected to be at maximum risk in the fast changing climatic conditions. KSAPCC has dealt with this sector in detail and has made many recommendations to make the some of the ongoing practices adapt suitably for the change in climate. KSAPCC says: “.. all the available evidences indicate that agriculture is the most vulnerable sector to climate change. The direct effects of climate change on agricultural production includes variability in temperature, precipitation, and carbon dioxide concentrations while change in soil moisture contents and the increased frequency of pest infection and consequent diseases are indirect effects.”

Karnataka’s agricultural economy remains a major lively hood for about 56.5% of total workforce living in various levels of poverty. In spite of enormous rural-urban migration, rural poverty is expected to stay dominant for several more decades. Modern agriculture has sharply increased yields of crops, but has also caused ecological damage as well. Global agriculture is under significant pressure to meet the demands

of rising populations using finite land resource. Intensive animal husbandry has raised meat, poultry and dairy products but has also resulted in cruelty towards animals, and also in pollution loading land, water and air.

**8.6.1** Agriculture is a form of natural resource management and agricultural products can be classified into foods, fibers, fuels, and raw materials.

Agriculture in Karnataka is mainly dependent on southwest monsoon. As per KSAPCC only 26.5% of the total sown area is irrigated. KSAPCC has also noticed that the food production in state is largely dependent upon the annual precipitation and there have been many incidents when inadequate precipitation led to decreased food production in the state like in the 1960s and 1970s. Hence the drought prone nature of the land should be a major consideration in formulating the future action plan for the sector.

The gist of many scholarly articles found on the web on the subject is as follows:

Not all crops can grow in all climatic conditions. Dates need hot and dry climate, whereas apples need cold climate. Rice crops demand ensured water but needs dry weather during harvesting. Wheat will fail if the water stagnates in wheat field. Cotton balls will be spoiled due to rain. Mangos grow well in dry climate and rain will make flowers fall and bring down yield during flowering season. Carrot and potato will rot at high water supply. Individual crops demand varying macro and micro nutrients as well as differing caring.

Hence it is safe to say that the future of agriculture is tied to better stewardship of natural resources, and hence become a critical factor in mitigating and adapting to the Climate Change.

Different climatic regions will have different constrains with respect to agriculture. The major crops in highland terraces are vegetables, millets, tea, medicinal plants, and horticultural crops (like apple, apricot, pineapple, citrus fruits, apple, peer, peach, and banana). Crops like potato, maize, mustard, millets and paddy can be observed in valleys. Mule, sheep, goat and yak major animals reared in the hilly area. The major constraints in hilly area are: low choice of crops; heavy runoff and severe erosion due to steep slope, soil degradation due to shifting agriculture; intense leaching during high runoff, water stagnation in valleys during rainy season.

Research shows that crops which were under organic farming and grown on soils which had higher organic matter could survive the dry spell longer than crops in farms under conventional farming with more of chemical fertilisers. Multiple cropping and integrated farming systems performed better than the mono-cropping systems in the face of droughts and floods. This is a major consideration in the fast changing climate.

Following paragraphs summarize impacts of climate change on major crops and livestock:

### **Rice**

Long periods of sunshine are favourable for high rice yields and growth is optimal when the daily air temperature is between 24 and 36°C. The variation between day and night temperatures must be minimal during flowering and grain production. An irrigation water temperature of not less than 18°C is favoured.

Past studies revealed that flowering, heading, milking stage and crop maturity period has decreased due to the increase in temperature (Malla 2008). Grain yields may decline by 9–10% for each 1°C rise in temperature. Flooded rice ecosystem cannot be sustained if the drought conditions are prolonged and it may be necessary to develop non flooded and dry land rice cultivation. Increase in temperature will increase yield due to increase in photosynthesis. But, the flavour of the rice might be affected as the quantity of magnesium in the rice grains may decline.

### **Potato**

Potato needs relatively mild temperature during early growth and cool weather conditions during tuber development.

Humidity and rains lead to insect-pest, disease, viruses and epidemics. Poor drainage and lack of aeration restricts the tuber development and leads to rotting of tubers. Higher temperature has an adverse effect on the tuber growth, and temperature above 30° C stops tuber formation.

### Rice and Methane Emissions

It gets frequently mentioned that rice cultivation consumes huge quantities of water and that it gives rise to Methane emission. However, in the context of the hilly WG districts, rice is grown in the valleys that were originally wet land eco-systems. Rice cultivation duplicates the function of wetland ecosystems by impounding water. In Kodagu, if full paddy cultivation is taken up, approximately 60million cubic meters of water can be impounded for a period of four months. This enables recharge of sub surface aquifers and enables gradual release of water into the rivers and streams, thus fulfilling a major watershed function. It is a matter of concern that in Kodagu [and perhaps also in other Western Ghat districts of Karnataka], paddy cultivation is beginning to be neglected for a variety of reasons such as non-remunerative prices. Paddy fields are giving way to other crops including coffee and oil palm. Paddy fields are also rapidly being converted to residential sites and layouts. Karnataka needs to bring regulations to protect paddy fields in the WG Districts through regulations such as in Kerala, where conversion of paddy fields for other purposes is not permitted. The Karnataka Government will need to look into a slew of measures including regulations and incentives to protect the rice growing areas of the WG Districts.

### Wheat

Climatic parameters like rain and temperature strongly affect the crop. Physiological growth stages like panicle initiation, heading, flowering, milking and physiological maturity decreases due to increase in temperature. Increase in the CO<sub>2</sub> level will help increase the production. The study conducted in India showed that, there will be a decrease in potential yield by 1.5–5.8% in subtropical region and 17–18% in tropical zone (Agrawal and Kalra 1994). But impact due to droughts, storms and floods cannot be overlooked.

### Maize

Being a photosynthetic pathway plant, grain productivity is less responsive to increase in atmospheric CO<sub>2</sub> level. But the impacts due to winds, droughts, storms and floods cannot be overlooked.

### Tomato

The tomato is sensitive to frost and does not thrive at low temperatures. Both high and low temperatures interfere with the setting of fruit. Fruits will crack if moisture supply follows drought. Rainfall in flowering stage will lead to loss of crop. Shortage of tomato supply created crisis in India during December, 2010.

### Cassava

Cassava is a shrubby, tropical, perennial plant. It requires a minimum temperature of 25 degree C to grow and many varieties are drought resistant. But storms and floods will affect the crop.

### Rubber

Rubber is best suited to a tropical climate. Even distribution of rainfall with no dry seasons exceeding 1 month along with high mean daily air temperature of between 25 and 28 degree C, and high rainfall exceeding 2,000 mm/year are ideal conditions for growing rubber. Increase in rainfall results in loss of tapping days and crop washout. A crop decrease of 3–15% will occur due to drought conditions (Government of Malaysia 2000).

### Sugar Cane

Sugar cane needs warm growing season along with proper irrigation, long hours of bright sun shine and high relative humidity to yield more tonnage. The crop needs a ripening season of around 2–3 months with warm days, clear skies, cool nights and a dry weather without rainfall for buildup of sugar. A higher

temperature leads to reversion of sucrose into fructose and glucose resulting in less accumulation of sucrose. Rain in ripening period will result in poor juice quality, higher vegetation growth, formation of water shoots and rise in tissue moisture. Severe cold weather slow down bud sprouting and stop cane growth.

High wind velocity leads to cane breakage and leave leaf damage. Transpiration rate will decrease on cloudy days resulting in reduction in uptake of nutrients (Ikisan 2010).

### **Groundnut**

Groundnut is grown in tropical region and demands a good irrigation as well as warm temperature. The groundnut crop cannot stand frost for long and water stagnation. Cool and wet climate results in slow germination, plantlet surfacing, seed rot and diseases.

### **Garlic**

Garlic is a major tropical crop that will survive well in varying climate. But it will fail during extreme climatic events like drought and floods.

### **Onion**

The crop grows well in warm temperature with soils having good drainage. High soil moisture, humidity during rains leads to diseases and rotting of crop. Unseasonal rains in India, the second largest onion producer, resulted in shooting of onion prices three to five times during December 2010. The issue became national crisis and authorities have to suspend export of the commodity to fulfil the local demand. The situation was not new but is repetition of similar shortage in 1980 and 1998.

### **Oil Palm**

Oil palm flourishes in humid tropical climate in which rain occurs mostly at night and days are bright and sunny. Minimum monthly rainfall required is around 1,500 mm with absence of dry seasons, and an evenly distributed sunshine exceeding 2,000 hours per year will result in optimum yield. A mean maximum temperature of about 29–33 °C and a mean minimum temperature of 22–24 °C results in highest bunch production. Increase in drought and flooding will affect the crop (Government of Malaysia 2000).

### **Cocoa**

Cocoa flourishes in areas where annual rainfall is 1,500–2,000 mm with three or less number of dry months. It should not be planted in areas with annual rainfall less than 1,250 mm unless irrigation is provided. Areas with annual rainfall more than 2,500 mm are also not preferred as it reduces yield by 10–20% due to water logging. The excessive rainfall causes high disease incidence, particularly Phytophthora and pink diseases (Government of Malaysia 2000).

## **8.6.2 Horticultural Crops**

Climate induced impacts on horticultural crops are gaining importance. Past studies revealed that Oleic acid concentration increased and linolenic acid decreased in soybean seed with rise in temperature (Thomas et al. 2003). Seventy-five percent increase in air CO<sub>2</sub> content increased sourness in orange and Vitamin C (antioxidant) by about 5% (Malla 2008).

## **8.6.3 Livestock**

Livestock includes poultry, dairy production and rearing animals such as cattle, buffaloes, sheep, goats and pigs. Live stock sector plays the major role in developing countries. Meat and milk products are perishable goods, demanding energy to conserve the products. Livestock sector generates about 1.4% of the world's GDP and 40% of agricultural GDP. Live stocks are considered one of the leading stressors of ecosystem. But they stress ecosystem only if they are reared in fragile ecosystem by people who own them. Livestock

which are cause of climate change are also victim of climate change.

Very often the livestock is an essential part of small house holds providing the only income. They can be seen on streets of roads in many Indian cities. Rise in temperature by 2 ° C would decrease the meat and milk quality; hatchability of poultry; and enhances the possibility of disease in the livestock (Malla 2008).

Livestock is usually raised under shade to avoid direct heat load from solar radiation. Air temperature, relative humidity and airflow affect production. Since livestock maintain a constant deep body temperature, heat generated must be lost to the atmosphere. Animals experience heat stress due to rise in temperature (Government of Malaysia 2000). Large animals die due to fall of trees and smaller animals are vulnerable to the strong wind.

#### **8.6.4 Pests and Diseases**

Increase in temperature and CO<sub>2</sub> will lead to an increase in population of pests due to increase in the rate of reproductive cycle of insects and pests. The rise in temperature increases severity of diseases in presence of host plant. Pest and disease of plain ecosystem may gradually shift to hills and mountains affecting the ecosystem over there.

Other events which crisscross climate related events that affect fall in food crops are:

- Air Pollution
- Water Pollution
- Drop in surface water and ground water resources
- Human-Animal conflict near forest area wherein wild animals like elephants often consume and destroy crops due to shortage of food in forests
- Short-circuit and sparks in live wires running across agricultural lands during heavy rainfall

Due high level of uncertainties in rain fed agriculture and reduced runoff, investment in water resources as a critical ingredient to agricultural and the related activities is essential. With rising costs of large-scale irrigation schemes and environmental damage associated with it, it is prudent to implement small-scale schemes and rain water harvesting.

#### **8.6.5 Intensive agriculture and climate change**

We may be able to learn even from a country like Singapore where vegetable growing is a limited economic activity. Agriculture is very limited in Singapore economy. Agricultural products in Singapore include vegetables, eggs, fish, milk, ornamental plants and ornamental fish. With limited land and sea Singapore's agricultural developments take place in Agro technology Parks on land and Marine Parks at sea. Food fish production happens in floating cages at sea. Hydroponic cultivation adapted by Singapore may become widely accepted in developing countries if the conventional agriculture becomes too difficult. This is a method of growing plants using mineral nutrient solutions, in the mineral nutrient solution only or in an inert medium, such as gravel, mineral wool, or coconut husk.

#### **8.6.6 Dropping Fish Reserves**

The human kind has been depending on fishing even before dawn of civilization, and millions still rely on fishing for their income and nutrition. But fish resource is under threat of collapse endangering the livelihoods of these millions and degrading the health of the oceans. Fisheries are over fished and exhausted by some people of few generations at the cost of future generations and natural ecosystems. The fisheries sector, environmental and agricultural sectors have many features in common. Current fishing practices have overstressed the natural resource base.

Fishing was first industrialized in the early nineteenth century with the invention of steam trawlers. The sector quickly expanded in 1950s and 1960s. Invention and use of radar, and acoustic fish finders added to mechanized fishing.

It is now common and vital for those fishing communities already vulnerable to the impacts of present day climate changes that successful adaptation must be accomplished through actions that reduce the vulnerabilities. While big fishermen travel farther looking for new location to fish, poor become more prevalent as the climate changes.

Climate change is an additional problem to already existing fishing pressures; loss of habitat, pollution, disturbance, and introduced species. The reasons which govern the biological response are: (1) Changing temperature; (2) light supply (determined by ice cover, cloudiness and surface mixed-layer thickness); (3) alteration in nutrient supply in marine ecosystem due to change in vertical stability; (4) Increase in population of rivals in food chain like sardines. Tropical marine species are highly vulnerable to anthropogenic pressure.

Climate change has many impacts on sea species that include increases in sea temperature, changes in salinity, alterations in ocean currents and more extreme storm events. Studies by Boris et al. (2006) revealed the global collapse of all marine taxa currently fished by the mid-twenty-first century to 100% in the year 2048 in the business as usual scenario but concluded that, these trends are still reversible at this point of time.

It is relevant here to consider the action points highlighted in the KSAPCC document as below:

- Subsidies supporting farming lack mechanisms for shifting cropping patterns in line with projected climatic shifts across agro climatic zones.
  - Preparation of an inventory of cropping patterns and the changes in the same pattern with respect to agro-climatic zones of the state.
  - Studies on adaptation and mitigation measures in agriculture sector of the state.
  - Establishment of a state level policy body to develop suitable mechanisms for encouraging cropping shifts through re-distribution of existing subsidies (refer explanation at KSAPCC, pages 165-196).
  - Re-assess the state agriculture policy and provision for subsidies and incentives to grow climate hardy crops.
- The current level of knowledge on the spatial dimension/ time scale and magnitude, of climatic changes is too limited make predictions for cropping pattern with necessary certainty
  - Research studies on the regional level prediction on the likely impact of climate change on cropping pattern
  - Development of weather derivative models.
  - Re-evaluating all agriculture related policies and programmes in order to integrate climate change issues.
- Widespread absence of scientific dry land farming practices.
  - Priority Action: Creation of model farms and villages, establishment of fodder banks under use of instruments provided by National Mission on Sustainable Agriculture (refer explanation at KSAPCC, pages 165-196).
  - Developing suitable drought and pest resistant crop varieties under use of instruments provided by National Mission on Sustainable Agriculture.
  - Significant untapped minimization potential in the application of synthetic agro-chemicals (pesticides, fertilizers).
    - Promotion of integrated Pest Management (IPM) and Integrated Nutrient Management (INM) to reduce chemical consumption.
    - Government of Karnataka is already promoting organic farming [Bhoo Chetana), IPM and INM through specific schemes. The coverage of these needs to be extended.
    - Block wise data on the agro-chemical usage at farm level.

- Pest and disease surveillance
- Research on the nutrient requirement of soils, agro-climatic zones wise.
- Research on the spread of pests and climate change linkages.
- Soil resource mapping using GIS and remote sensing
- Provision for incentives/subsidies on the organic farming, integrated pest management (IPM) and integrated nutrient management (INM).
- Significant untapped potential for enhancing irrigation efficiency in northern Karnataka. The expansion of micro irrigation is also hampered by security concerns of theft of distribution pipes
  - Promote pressurized micro-irrigation techniques at larger scales.
  - Create awareness through the demonstration of efficient irrigation technologies.
  - Identify available land for possible micro irrigation practices district wise.
  - Priority Action: Eradication of the market for stolen pipes through re-distribution of existing subsidies on micro irrigation so as to bring farmer's net cost of distribution pipes below the black market prices
- Agro-biodiversity is jeopardized, indigenous, resilient varieties of crops like maize, rice/sorghum require interventions to safeguard their preservatives
  - Priority Action: Classification of indigenous varieties of crops through creation of a market for such products. The network of state agencies including HOPCOMS could help market these as specialties for a higher price (refer explanation at SAPCC pages 165-196).
  - Preparation of a comprehensive inventory of agro-biodiversity of the state in regular intervals. For this the ongoing preparation of People's Biodiversity Registers is establishing a solid fundament.
  - Creation of a policy framework to create viable markets for indigenous species.
  - Development of agro-biodiversity parks.
  - Crop insurance schemes, particularly Weather Based Crop Insurance needs to be expanded through adequate packaging to cover a greater share of farmers.
  - Research on specific livelihood risks and possible solutions considering the local contexts.
- Significant un-utilized portions of degraded- land/ arid land are unsuitable for agriculture but suitable for horticulture, especially in northern Karnataka
  - Promotion of development of pasture-land.
  - Promotion of drought resilient trees for arid areas.
  - Create awareness through massive tree plantation campaigns in arid/semi-arid regions.
  - Comprehensive block-wise data on the type, area and problems of degraded lands.
  - Research focusing on the local solution to reclaim degraded lands.
  - Development of drought and pest resistant crop varieties.
  - Research into highly productive crop varieties.
- Necessary food processing facilities and marketing mechanisms supporting horticultural produce from degraded/arid lands do not exist at required scale.
  - Development of larger scale food processing parks.
- Horticultural biodiversity is jeopardized; Indigenous resilient varieties such as mango and jack fruits require interventions to safeguard their preservation.
  - Priority Action & Preservation of indigenous varieties of crops through creation of a market for such products. The network of state agencies including HOPCOMS could help market these as specialties for a higher price.
  - Preparation of comprehensive inventory of agro-climatic zones based agro-biodiversity in regular intervals. For this the ongoing preparation of People's Biodiversity Registers is establishing a solid fundamental base.



Key adaptation measures in agricultural practice to climate change include:

- Changes in practices to adopt to climate impact – change in sowing dates,
- Change in crops, use of drought resistant variety, etc.
- Changes in water management for efficient water use – rainwater harvesting, drip irrigation, mulching
- Increase awareness in rural area with respect to new technology.
- Agricultural diversification – multiple cropping like planting horticultural/commercial trees with cereal and vegetable crops, crop rotation
- Decreasing the bureaucratic hurdles for farming community
- Increase in the production and distribution of improved seeds and other agricultural inputs like agro chemicals and agro machineries
- Agricultural information systems – free and ready information on internet, toll free telephonic advice, and SMS advise
- Adaptation of new technologies
- Crop insurance, and communities training for adaptation of natural calamities through self help groups.

India's National Mission for Sustainable Agriculture aims to focus on four areas crucial to agriculture in adapting to climate change, namely dry land agriculture, risk management, access to information, and use of bio-technology.

#### **Agriculture in TN State Action Plan on Climate Change (TNSAPCC)**

“Global development experience reveals that one percent growth in agriculture is at least two or three times more effective in reducing poverty than the type of same growth emanating from non-agricultural sector. During the period 2000- 11, this sector (in TN) registered negative growth in five years and positive growth in six years shows the vulnerability of the sector and is also a cause of distress arising due to the instability in production and productivity.”

Keeping the geographic and climatic features of the state in proper perspective, it becomes imperative that the emphasis should be to adopt those agricultural, horticultural and floricultural practices whose demand on water, energy, inorganic pesticides & chemical fertilizers will be minimum, and which will provide climate/drought resistant produces. This can be achieved only by effective involvement of various stake holders such as farmers and agricultural scientists in the policy/decision making levels. Since this sector has traditionally provided a large employment base (farmers and agricultural laborers account to 56.5% of the total workforce), and since it is possible to make this sector environmentally friendly, adequate emphasis should be given to this sector for employment generation. As compared to industries, this sector (contributing 28.61% to the state's GDP) can be made to have minimum carbon footprint. Hence it deserves lot more focus than that has been given all these years.

Major observations in this context can be:

- Rice farming, which has traditionally been associated with huge consumption of water, is also known to be possible with much reduced water consumption through a system known as SRI. In view of larger requirement of water the amount of rice grown should be carefully linked to the amount of rice required in the state, the overall demand, and good returns to the farmer.
- Alternative staple crops such as ragi, maize, millets etc. which are known to demand less water, and which are also suitable for large areas of arid north Karnataka should be encouraged in massive scale.
- Karnataka's natural advantage, because of which it is the largest producer of raw silk, sandalwood, ragi, sunflower, tomato, coffee, spices, aromatic and medicinal plants, and the second largest producer of maize, sunflower, grapes, pomegranate and onion should be fully harnessed.

- Horticultural crops and floricultural production, where Karnataka occupies strong positions, also should be vastly encouraged. Fruits and nuts, and many types of vegetables which are not very water intensive, should be encouraged to be grown in adequate quantities so that the demand for water intensive rice comes down.
- The other water intensive crops such as sugar cane and arecanut should be carefully managed so as to make them optimally water efficient. Suitability of arecanut, which is not a food product, and which was originally found suitable to Western Ghats region with plenty of water availability, should be carefully considered for growing in other areas because of its high water requirement.
- Water usage in agriculture/horticulture/floriculture should be scientifically priced / regulated such that most optimal value of a scarce resource is accrued to the society. Any subsidy in its usage, if considered essential for any group of users, should be carefully targeted to ensure maximum overall efficiency.
- In view of large areas of arid and semi arid nature in the state, widespread use of scientific dry land farming practices such as horticulture should be encouraged in northern, eastern and central parts of the state.
- Wide spread use of renewable energy sources such as wind, solar and bio-mass at individual household level or community level should be encouraged in lighting, water heating/pumping, crop drying and processing applications. Adequate technical/financial assistance should be provided.
- Vast number of indigenous species such as jack fruit, mango and banana has huge potential to reduce the dependence on water intensive crops, have huge significance in nutritional value to the locals, and hence should be adequately protected and encouraged.
- Spices and sandal wood for which Karnataka has been known for ages, and which are also environmentally friendly, should become the centre of focus of again.

A report dated 24 January 2014, by Human Rights Council, UN General Assembly has made very important observations on the modern agricultural systems with reference to the human rights and global warming. It says among other things:

“The exclusive focus on increasing agricultural production has also had severe environmental impacts. The twentieth-century “Green Revolution” technological package combined the use of high-yielding plant varieties with increased irrigation, the mechanization of agricultural production and the use of nitrogen-based fertilizers and pesticides. The Green Revolution was an attempt to meet the challenge as it was framed at the time: to ensure that increases in agricultural productivity would match population growth and the dietary transition facilitated by rising incomes. It led, however, to an extension of monocultures and thus to a significant loss of agrobiodiversity and to accelerated soil erosion. The overuse of chemical fertilizers polluted fresh water, increasing its phosphorus content and leading to a flow of phosphorus to the oceans that is estimated to have risen to approximately 10 million tons annually. Phosphate and nitrogen water pollution is the main cause of eutrophication, the human-induced augmentation of natural fertilization processes which spurs algae growth that absorbs the dissolved oxygen required to sustain fish stocks.”

“The most potentially devastating impacts of industrial modes of agricultural production stem from their contribution to increased greenhouse gas emissions. Together, field-level practices represent approximately 15 per cent of total human-made greenhouse gas emissions, in the form of nitrous oxide (N<sub>2</sub>O) from the use of organic and inorganic nitrogen fertilizers, methane (CH<sub>4</sub>) from flooded rice fields and livestock, and carbon dioxide (CO<sub>2</sub>) from the loss of soil organic carbon in croplands and, due to intensified grazing, on pastures. In addition, the production of fertilizers, herbicides and pesticides, the tillage, irrigation and fertilization, and the transport, packaging and conservation of food require considerable amounts of energy, resulting in an additional 15 to 17 per cent of total man-made greenhouse gas emissions attributable to food systems. The resulting climate changes could seriously constrain the potential productivity of current agricultural methods. For some countries, the changing climate conditions of the past thirty years already appear to have offset a significant portion of the increases in average yields that arose from technology, carbon dioxide fertilization and other factors. Under a business-as-usual scenario, we can anticipate an average of 2 per cent productivity decline over each of the coming decades, with yield changes in developing countries ranging from -27 per cent to +9 per cent for the key staple crops.”

The 5<sup>th</sup> National Organic Farmers' Convention, 2015, Chandigarh, India has also recommended the following measures in making our agricultural practices mitigate and adapt.

- Adopt sustainable agriculture that uses:
  - No tillage or minimum tillage, no chemical fertilizers or pesticides, but uses only organic fertilizers that put back plant residues and animal waste on to the soils enriching them in the process, and increasing absorption of more carbon from the atmosphere.
  - Nitrogen-fixing leguminous trees should be planted 30 feet apart in fields growing food crops or commercial crops.
  - Subsidize such farming wherever necessary.
  - Levy heavy taxes on chemical fertilizers, pesticides and weed killers.

Such measures have been successfully implemented in several European nations for reducing nitrate and phosphate pollution of drinking water wells. (Gore, 2006)

- Tax heavily excessive use of irrigation water that runs into water bodies polluting them with nitrogen and phosphorus, and causes production of N<sub>2</sub>O which is a potent GHG.
- Stop cutting forest trees for planting plantation crops.
- Encourage and subsidize growing fruit and/or nut trees that increase food production
- Return all crop residues back to the soil rather than using it for producing animal feeds, to increase the carbon content of soils.
- Reclaim huge tracts of encroached forest lands, and reforest them, except those that are used by poor farmers for subsistence farming.
- Encourage building energy efficient smaller houses, multistoried houses occupied by several families to minimize conversion of agricultural land for building houses etc.

“Ecological Agriculture In India: Scientific Evidence On Positive Impacts & Successes”; 2015 by Alliance for Sustainable and Holistic Agriculture has compiled a vast number of studies dealing with the scientific evidence readily available in India on the various benefits from organic farming, including on productivity and farm economics, on environmental impacts (soil, biodiversity etc.), on validation of various practices as well as on challenges facing organic farming.

***These observations indicate the criticality of sustainable agricultural practices. With over 30% of anthropogenic GHG emissions attributable to agriculture and food systems, the importance of providing high priority to the sectors of agriculture, horticulture and animal husbandry from the climate change perspective becomes evident. All possible measures to reduce the GHG emissions in these sectors have also the potential to make those sectors sustainable, while largely addressing the poverty related issues.***

## References

- Boris Worm, Edward B. Barbier, Nicola Beaumont, Emmett Duffy J, Carl Folke, Benjamin S. Halpern, Jeremy B.C. Jackson, Heike K. Lotze, Fiorenza Micheli, Stephen R. Palumbi, Enric Sala, Kimberley A. Selkoe, John J. Stachowicz, Reg Watson, 2006: Impacts of Biodiversity Loss on Ocean Ecosystem Services, Science 314, 787; DOI: 10.1126/science.1132294, PP 787–790
- Malla G, 2008: Climate Change And Its Impact On Nepalese Agriculture, The Journal of Agriculture and Environment Vol.:9, pp 62–71
- Agrawal P.K and Kalra N, 1994: Analysing the limitation set by climate factors, genotype, and water and nitrogen availability on productivity of wheat II. Climatically potential yield and optimal management strategies. Field crop res. 38:93–103
- Government of Malaysia, 2000: Initial National Communication Submitted to The United Nations Framework Convention on Climate Change, Ministry of Science, Technology and The Environment
- Iklan, 2010 [http://www.ikisan.com/links/ap\\_sugarcaneSoil%20and%20Climate.shtml](http://www.ikisan.com/links/ap_sugarcaneSoil%20and%20Climate.shtml) retrieved on 20, September, 2010
- “Composting: A Green House Gas Mitigation Measure”, Dr. Raja Naika, (<http://wp.me/p34Lf5-ju>); accessed on 10.5.2015

- “Trade and Environment Review 2013: Wake Up Before It is Too Late”; UNCTAD/DITC/TED/2012/13, UNITED NATIONS PUBLICATION, ISSN 1810 – 5432
- “Food & Climate; Connecting The Dots, Choosing The Way Forward”, Center for Food Safety, March 2014
- “Ecological Agriculture In India: Scientific Evidence On Positive Impacts & Successes”; 2015 by Alliance for Sustainable and Holistic Agriculture

## 8.7 Food, dietary needs and human health

KSAPCC says: “Any kind of deterioration in environmental quality severely affects the community health, either by providing suitable conditions to various vector borne diseases to spread (indirect affect) or by inducing food insecurity and physical-chemical environment related illnesses (excessive heat and cold, flood, drought, environmental pollution etc). Pollution in air, water and soil finds their way into the human body through inhalation, ingestion, dermal contact, occupational exposure etc. A major share of budget of any nation is spent on providing efficient medical facilities to its citizen in order to ensure human health. Public health depends on availability of enough food, safe drinking water, decent housing, protection against disasters, a reasonable income and good social and community relations.”

A report dated 24 January 2014, by Human Rights Council, UN General Assembly has made very important observations on the modern agricultural systems with reference to the human rights and global warming. It says among other things:

Agroecology refers to a range of agronomic techniques, including intercropping, the recycling of manure and food scraps into fertilizers, and agro-forestry, that reduce the use of external inputs and maximize resource efficiency. It is consistent with, and complementary to, genetic improvement, as done by the CGIAR (formerly known as the Consultative Group on International Agricultural Research) research centres through marker-assisted breeding, and as done by generations of farmers cultivating landraces. There are strong environmental arguments in favour of agroecology. But agroecology also provides other social and health benefits. Diverse farming systems contribute to more diverse diets for the communities that produce their own food, thus improving nutrition. Because agroecology reduces the cost of farming by minimizing the use of expensive inputs, it improves the livelihoods of farming households, particularly the poorest households. And it supports rural development: because it is knowledge-intensive and generally more labour-intensive, it creates employment opportunities in rural areas. Though easier to implement on smaller-sized farms, agroecological techniques can be disseminated on a large scale, and should also inspire reforms in how large production units operate.

Far greater attention should also be paid to demand-side issues. A first priority is to mitigate the negative impacts of industrial livestock production by discouraging the increase in demand for meat where meat consumption has already reached levels that are more than sufficient to satisfy dietary needs.

A second priority is to constrain the demand for liquid biofuels in the transport sector of high-income countries. Agroenergy may improve access to clean energy in many developing countries and reduce their dependency on fossil-fuel energies. Under certain conditions, it can improve the incomes of small-scale farmers. But the rapid expansion of the demand for liquid agrofuels for transport in rich countries results in higher food prices and speculation on farmland, and encourages land grabs on a large scale.

A third priority is to take significant measures to improve the efficiency of food systems, by reducing losses and waste. A 2011 study estimates that 1.3 billion tons of food produced for human consumption – about one third of the total – is lost or wasted. In low-income countries, losses occur primarily as a result of inadequate storage and packaging and processing facilities, and a poor connection of farmers to markets, resulting in economic losses for food producers. These inefficiencies result in food production exerting a much higher pressure on natural resources than would otherwise occur.

These observations from an UN agency aptly put emphasis on ‘agroecology’ which may be equated with organic farming.

All these factors are expected to be severely impacted by Climate Change. Section 10.1 in KSAPCC has listed various health issues which will be concerns in the changed climate. Some of the major ones are:

- frequent incidents of heat waves and thermal stress leading to heat cramps, dehydration, influenza,

- cardio-vascular and respiratory diseases
- floods or droughts are likely to lead to food shortage, and consequently to malnutrition or inadequate nutrition and nutrition related diseases .
- The increased temperature is likely to result in vector borne diseases (malaria, Kala Azar, dengue) spreading into new areas.
- Contamination of safe drinking water supply due to floods may cause outburst of epidemiological diseases

Table 60 under section 10.1 in KSAPCC has listed potential health risks under the changed climate.

While all out efforts must be made to minimize the GHG emissions in future, the health related issues from the inevitable changes in climate can pose severe risks to community health, and hence adequate attention to strengthen the health infrastructure becomes critical.

In addition to the recommendations made in KSAPCC, the public consultations have provided some more recommendations. Dr. A. N. Nagaraj, formerly a food and agriculture consultant to UN and an organic farmer himself for over 3 decades, has contributed an article “Human Health, Environmental Pollution and Global Warming” containing many recommendations to minimize the GHG emissions attributable to food sector.

- Capacity building of health department and all other health agencies (such as medical colleges and public health schools) should be strengthened in the context of climate change
  - in the context of role in disaster mitigation and relief
  - in liaising with other departments
  - in both mitigation and adaptation
- Engagement with the pollution control board and corporation;
  - Air pollution is linked with fossil fuel consumption and has an organic link to climate change. Bangalore’s air quality is very low, and has a significant impact on the health of the people of Bangalore, including the children. There is a need for taking action on high pollutant levels, and the initiative should be taken by the health department in collaboration with the pollution control board and the corporation.
- Social and health impact assessment of any developmental plan should become mandatory. Development cannot, even in principle, come at the cost of health and social well being one or more communities.
- Human health is hugely impacted by the quality of food. The quality of food will be affected by the implications of Climate Change unless mitigative measures are taken.
  - Adopt sustainable agriculture that uses no chemical fertilizers or pesticides, but uses only organic fertilizers or pesticides
- Improve the health of general population by educating people on developing a holistic healthy lifestyle that includes consumption of substantial quantities of organic vegetables, fruits, whole unrefined grains, oilseeds, other seeds and nuts. If one has to use non-organic pesticide-polluted vegetables and fruits use only those that can be peeled off to remove polluted peelings..
- If the usage of non-organic / pesticide-polluted vegetables and fruits becomes inevitable, use only those that can be peeled off to remove polluted peelings.
- Minimise the usage of refined flours such as maida, white flour, polished rice, and flours of other grains from which the highly nutritious bran has been removed.
- Use oilseeds that contain rich proteins, minerals, vitamins and fiber, rather than vegetable oils that contain only fats. Preferably use peanut oil (groundnut oil), canola oil, olive oil or sesame oil, rather than palm oil, sunflower oil or even soya bean oil.
- Reduce consumption of bakery products and soft drinks that contain baking powder which destroys

some B complex vitamins in the body and thereby cause nutrition deficiency diseases.

- As far as possible, use locally grown organic products that do not require transportation to reduce CO<sub>2</sub> produced by fuels used for transportation.
- Dietary guidelines to the common man to discourage to minimize the impacts of inorganic chemicals.

(Ref: 'Human Health, Environmental Pollution and Global Warming'; Dr. A. N. Nagaraj; (<http://wp.me/p34Lf5-h1>); accessed on 10.5.2015

Dr. A N Nagaraj has also dealt with many more of food, nutrition, and health related issues from the perspective of global warming in his book "A Holistic Life Style for Healing". The relevance of holistic approach to our life styles based on simple food, peaceful living and adequate physical exercise to minimize the GHG emissions has been stressed in this book. The society should do well to deliberate on these issues and adopt those recommendations which are most beneficial and easy to practice.

Another article by Adithya Pradyumna, Environmental Health Researcher, SOCHARA, Bangalore has listed many concerns to the society.

(<https://kspcb.wordpress.com/2015/04/18/climate-change-and-health-some-observations-by-adithya-pradyumna/>); accessed on 10.5.2015

UN's Food and Agricultural Organisation (FAO) has published a number of scholarly articles / reports on how a move towards the vegetarianism can assist in the context of global warming. One such report of great interest to us is "Livestock's long shadow – environmental issue and options" in year 2006, which had dealt with all the relevant issues in exhaustive details. Some of the major issues highlighted in this report are:

- There is substantial contribution from animal agriculture to climate change and air pollution, to land, soil and water degradation, and to the reduction of bio-diversity.
- The livestock sector emerges as one of top two or three most significant contributors to the most serious environmental problems, at every scale from local to global.
- This sector is by the single largest anthropogenic user of land.
- The sector is responsible for 18% of total GHG emissions measured in CO<sub>2</sub> equivalent.
- The sector is a key player in increasing water use, accounting for over 8% of global human water use, mostly for the irrigation of feed crops.
- The livestock sector is the largest sectoral source of water pollution, contributing to eutrophication, 'dead zones' in coastal areas, human health problems, emergence of antibiotic resistance etc.
- It is a major player in reduction of biodiversity and a major driver in deforestation.

(<http://bit.ly/1enDpJb>); accessed on 10.5.2015

A quick look at the water foot print of various kinds of food systems will indicate the urgency to prioritise our food habits in the Climate Change context. At the global level whereas vegetables are generally associated with a water foot print of about 322 liters /kG, fruits are associated with about 962 liters/kG and bovine meat with about 14,414 liters/kG.(Source: based on data in Mekonnen and Hoekstra, 2010)

There are also a number of scholarly articles on the link between livestock issues and the Climate Change on the web.

([https://scholar.google.co.in/scholar?q=vegetarianism+and+global+warming&btnG=&hl=en&as\\_sdt=0%2C5&as\\_vis=1](https://scholar.google.co.in/scholar?q=vegetarianism+and+global+warming&btnG=&hl=en&as_sdt=0%2C5&as_vis=1)); accessed on 10.5.2015

Climate change will significantly affect Australians' health, report finds

<http://www.theguardian.com/environment/2015/apr/29/climate-change-will-significantly-affect-australians-health-report-finds>; accessed on 10.5.2015

**The common theme of all these articles/reports is that the society's approach to food & nutrition (such**

*as reduced consumption of meat) has an important role to play in mitigating and adapting to the Climate Change, whether it is in the form of impacts on resources such as water, energy and land, or on chemicals, nutrition, and health or on poverty alleviation and drought proofing etc.. The state of Karnataka, facing multiple crises in these related areas, has a critical responsibility to undertake diligent discussions at the societal level on the issues of food, nutrition, related health aspects and take informed policy decisions to herald a new era in facing the threats of Climate Change.*

## 8.8 Waste management

At a global scale, the waste management sector is estimated to be associated with approximately 3-5% of total anthropogenic emissions in 2005 and is in a position to move from being a minor source of global emissions to becoming a major saver of emissions (UNEP, 2010). The anaerobic digestion of municipal solid waste and treatment of wastewater i.e. domestic as well as industrial produces significant amount of methane. Considering the projected 37% state urban population in 2011, BCCIK estimated 69,000 tons of methane emissions. Further it was estimated that 19000 tons of CH<sub>4</sub> is emitted from wastewater treatment in the state. Thus a total of 2.89 million tons of CO<sub>2</sub> equivalent GHGs emission is attributed to Waste sector (EMPRI & TERI, 2011).

Although minor levels of emissions are released through waste treatment and disposal, the prevention and recovery of wastes (i.e. as secondary materials or energy) avoids emissions in all other sectors of the economy. Hence priority should be given to waste minimisation, re-use, recycling, waste-to-energy, and finally landfill. But land fill is still a new concept and there is only one landfill site for hazardous waste in Karnataka and the progress achieved in respect of establishment of the MSW site identification and establishing 213 landfill sites are satisfactory. However, the waste in landfill sites is not scientifically being processed for its disposal as well as reprocessing for various materials recovery to an extent of 80%. The vision of the Board is to allow every municipality to landfill only 20% and the remaining to be completely reprocessed for recycle/reuse.

### Food system that fails poor countries needs urgent reform, says UN expert

The existing food system has failed and needs urgent reform, according to a UN expert who argues there should be a greater emphasis on local food production and an overhaul of trade policies that have led to overproduction in rich countries while obliging poor countries – which are often dependent on agriculture – to import food.

“Measured against the requirement that they should contribute to the realisation of the right to food, the food systems we have inherited from the 20th century have failed,” he told the UN human rights council. “Of course, significant progress has been achieved in boosting agricultural production. But this has hardly reduced the number of hungry people.”

The increasing demand for meat is another area of concern. The UN’s Food and Agriculture Organisation estimates that annual meat production would have to reach 470m tons to meet projected demand in 2050, an increase of about 200m tons from 2005-07.

“This is entirely unsustainable ... Demand for meat diverts food away from poor people who are unable to afford anything but cereals ... Continuing to feed cereals to growing numbers of livestock will aggravate poverty and environmental degradation,” says De Schutter, who urges governments to discourage meat consumption where it has already reached levels that are more than enough to satisfy dietary needs. He is optimistic that public attitudes towards meat will change in rich countries, but less so about attitudes in emerging economies such as China, where eating meat is akin to a status symbol.

As an alternative to existing systems, De Schutter champions agroecology, a range of techniques including intercropping, the use of manure and food scraps as fertiliser and agroforestry (planting trees). This approach would not only be more environmentally friendly, but would contribute to more diverse diets and improve nutrition. Although easier to implement on smaller-sized farms, agroecology is also applicable to large farms.

<http://bit.ly/Pje9rf>; accessed on 10.5.2015

The method of reprocessing has been completely discussed in the review meeting and proper advice and clarification have been given to understand the concept of reprocessing. The progress made by the local bodies in this regard is not satisfactory. The main reason quoted by them is reported to be on the administrative and technical approval delays in the Office of Directorate of Municipal Administration and Deputy Commissioner and also in defective tender notifications (expression of interest).

The Municipal Solid Waste Management in the BBMP area is termed as catastrophic after closure of Mavallipura site from July 2012. Except certain progress in dry waste collection centres established by the BBMP, no progress is achieved in establishing new landfill sites recommended by KSPCB. Meanwhile the KSPCB is the first Board to frame guidelines on (1) Buffer zone/No development zone around landfill site (2) Municipal solid waste management in big campuses/universities (3) Management of construction debris waste and (4) Location of slaughter houses.

The Board has also identified a simple concept of shredding machine which can be utilized in most of the local bodies at the landfill sites for shredding the organic waste and segregation of plastics so that the farmers can collect and transport to their fields for further simple composting at their site itself. The concept was duly agreed by the Board in Board Meeting held and as a matter of encouragement, Board has sanctioned financial assistance to 30 local bodies in the State at a cost of 4 Lakh each. Koppal local body has adopted this concept successfully and other towns are in process of following the same. The implementation requires some time due to some teething problems in the local management. This is being encouraged in the BBMP area in the outskirts as a trial run. Other such machineries are also being identified to suggest the same to the local bodies suitably on case to case basis.

There are considerable co-benefits of waste management in the context of climate change.

In developing countries of Asia, controlled incineration of waste is not practiced regularly because of high capital and operating costs. Haphazard burning of waste is still a common practice that contributes to urban air pollution and CO<sub>2</sub> (Chandrappa & Das, 2011). The fact is true for India and Karnataka also. In many instances the kerb side waste heaps are often put on fire by employees of local to reduce waste quantities due to ignorance. The waste dumps in the outskirts are ignited by people or it catches fire due to spontaneous combustion of material with low ignition points like fuel in lighter or spray cans.

As per Annual report 2013-14 of KSPCB the estimated quantity of hazardous waste is 2,43,350.44 MTPA out of which, Recyclable/reprocessible, incinerable and landfillable waste is estimated as given below:

1. Recyclable/reprocessible waste : 1,20,594.78 MTPA
2. Incinerable waste : 61,692.82 MTPA
3. Landfillable waste : 61,062.84 MTPA

The quantity of above waste is solely from industries and does not include house hold hazardous waste like used pesticide containers, cells, discarded medicine etc. The recyclable/re-processible hazardous waste has to be handed over only to the KSPCB authorized recyclers/re-processors. There are 137 hazardous waste recycling units (e.g. reprocessing used oil, waste oil, spent solvents, spent etchant, discarded containers, lead, copper & zinc waste) are functioning in Karnataka State. Board has issued authorization to five Common Incineration Facilities in Karnataka. Board has also issued authorization to captive incineration facilities to 30 units in the State of Karnataka.

Karnataka generates about 5,522.6 tons/day (TPD) of municipal solid waste and about 9,118 Tons Per Annum of e-waste (as published by Rajya Sabha Secretariat in June 2012) and about 83 TPD of biomedical waste.

Prevention of pollution from reaching major water bodies such as lakes have attracted the public concern in the recent days. Due to illegal acquisition of land for various activities, the number of lakes over the



years has reduced considerably. This adversely affects the recharge of ground water in the locality. Hence the local people are facing paucity of drinking water from nearby bore wells. Hence there is absolute necessity to monitor all these water bodies and also insist the establishment of STP in all local bodies/towns etc. (KSPCB, 2014)

Unfortunately, out of 219 local bodies including Bangalore in the State, only 55 STPs have been established so far. All of them are conventional treatment system without considering carbon foot print issues. In spite of availability of low cost and low carbon emission options (like constructed wetlands, use of readymade bio-culture) consultants usually have not considered them as alternative options. Use of fine bubble aeration and high efficiency pumps have been used only in sewage treatment of in Bangalore and some industrial effluents. Energy recovery from wastewater has not been still an option despite the scope for financial payback.

But not all attempts are not disappointing as energy recovery attempts from solid waste by co-incineration has been beneficial to cement industry who have invested to alter the equipment to feed high calorie solid waste thereby reducing fuel consumption. There is also some attempt being made to contain and sell methane produced from solid waste.

Further the sewage is entering into the water bodies, including rivers. Hence the KSPCB has realized the serious non-compliance and therefore an effort is made to identify the bottle-necks in providing these facilities including underground drainage and therefore constituted Core Committee and meeting of same was held on 16.01.2013. However the Board has observed no progress in establishing these facilities even after two years. Hence the public complaint also increased in Bangalore and other areas.

Till date 62 e-waste recycling/dismantling units have obtained Consent for Establishment (CFE) in Karnataka. Out of 30 Common biomedical waste treatment facilities that have obtained CFE, 21 facilities are operational and disposing biomedical waste by both burning and non burn technologies. Non burning technology used for waste such as syringes which contain plastic which can be recycled after disinfection and shredding.

Combustion of waste having chlorine will produce dioxins and furans which are carcinogens. Further many hazardous chemicals are also GHGs that find their way into hazardous waste. In spite of considerable progress there are many news articles published about waste mafia (The Hindu, 2014; DNA, 2014).

Apart from general public, the government and educational intuitions also generate huge quantities of e-waste but accumulate within the office/institution due to unfriendly disposal policies. Many end of life vehicles, furniture, computers and electronic equipments still lie in government offices due to absence of policy in fixing the length of life of these articles. There is fear among the staff to dispose them off thinking any mistake in following office procedure would lead to recovery from their salary and non settlement of pension. As a result huge space is being occupied by waste in prime locations of cities.

KSPCB is the enforcing agency in Karnataka and is now operating with the highest number of vacancies in India as per the data compiled and published by Centre for Science and Environment presented in **Annexure 6**. The staff strength in KSPCB is also not comparable to the staff strength employed in other countries. USEPA (population: 313 million) employs about 17,000 people. Environment agency (environmental enforcing agency in England and Wales) has a staff strength of about 11,500 people across England (population: 53.01 million) and Wales (population: 3.064 million). Number of staff in ministry of environment in Japan (population: 127.3 million) is 1,185. National Institute for Public Health and the Environment of Netherlands (population: 16.8 million) has 1,400 employees. **(Annexure 6)**

Waste management in KSPCB itself needs lot of improvement as many end of life electronic equipment are not disposed in spite of formation of absolute committee to dispose e-waste from the organization.

GHG emission from solid waste management mainly comes from

1. Transportation
2. Combustion at source and kerb side
3. Presence of GHGs in the waste
4. Combustion of waste that can be recycled/reused

**Major concerns about waste sector were raised in public consultation meetings. One participant made a very valid observation: “There is a need to show that positive change is possible – and it can begin with addressing well acknowledged existing issues such as waste management in Bangalore (which is something that should be far easier to address than climate change, and should be a collaborative effort) – systematic efforts towards segregation, composting, reduce, reuse and recycling of wastes, towards a zero waste society. This can make people confident that other issues such as air pollution and even climate change can be addressed by everyone together as a group. In addition, it would be important for the action plan on climate change to be a long term commitment, irrespective of the political party in power.”**

## References

- Chandrappa R and Das DB (2011) Coping with Climate Change, Principles and Asian Context, Springer-Verlag, Heidelberg
- UNEP (2010) Waste and Climate Change, Global Trends and Strategy Framework
- The Hindu (2014) Mafia controlling solid waste management in city: councilor, <http://bit.ly/T2HU1k> accessed on May 15th, 2015
- DNA (2014) Policy watch: Converting waste into energy can spell end of garbage mafia, <http://bit.ly/1Br9ncC>
- KSPCB (2014) Annual Report
- EMPRI & TERI (2011) Karnataka State Action Plan on Climate Change
- CSE, (2015) <http://www.indiaenvironmentportal.org.in/files/spcb-final.pdf> accessed on March 26th 2015

## 8.9 Air quality

Main components of Greenhouse gases (GHGs) are carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), sulphur hexafluoride (SF<sub>6</sub>), hydrofluorocarbons (HFCs) and perfluoro carbons (PFCs). The increasing concentration of GHGs in the atmosphere disturbs the global energy balance by sending infrared radiation back to earth resulting in global warming. Anthropogenic global GHGs emissions in the state witnessed a growth of 70% between 1970 and 2004 (EMPRI & TERI, 2011).

CO<sub>2</sub> is main and the largest contributor of GHG with its annual emissions growing by about 80% between 1970 and 2004. As per IPCC report, CO<sub>2</sub> and CH<sub>4</sub> levels have enhanced from 280 parts per million (ppm) and 700 ppb in year 1750 to 379 ppm and 1,774 ppb respectively in year 2005. Global increase in CO<sub>2</sub> concentrations is mainly due to fossil fuel consumption, and shrinking carbon sinks i.e. land-use change (EMPRI & TERI, 2011)

The power sector (electricity – 35.9%) is the major contributor of GHGs emission followed by Agriculture (20.2%). As is clear from the figure, Karnataka with well-developed transportation sector of the state contributes 10.4% to total state GHGs emission. Except the agriculture sector which emits a major amount of CH<sub>4</sub>, most of the other sectors emit CO<sub>2</sub> as main GHG mainly due to combustion of fossil fuels (Coal, and petroleum products) (EMPRI & TERI, 2011).

Development of civilisation would not have happened without increased carbon emission in most cases. But carbon emissions are now believed to add to global warming and subsequent climate change events. Scientists believe that the world has already burnt half the fossil fuels necessary to bring about 2° C rise in global temperature (Chandrappa and Das, 2011).

As the humans began to settle, their energy requirement increased with wood as main source of energy. By the 1280s, people started using coal for fuel in processes such as lime kilns as well as metalworking which resulted in air pollution having black smoke and oxides of Sulphur in its emissions. Late eighteenth and early nineteenth centuries witnessed major changes in agriculture, production, mining, manufacturing and transportation. The industrial revolution marked turning point for climate change. The use of coal gas in street lighting was replaced with the electric lights. With the evolution of electric power in the nineteenth century, coal's future became closely tied to electricity generation. Coal still plays a vital role in the global primary energy mix, providing 23.5% of global primary energy and 39% of the world's electricity in 2002 (Chandrappa and Das, 2011).

Air pollution is a complicated issue and is most often a symptom of inadequate urban planning. Lack of power supply leads to the use of diesel generator sets; lack of buses to support the public transport demand leads to higher use of personal vehicles; lack of infrastructure to promote walking and cycling leads to more motorised transport; lack of road maintenance and traffic management by allowing on-road parking leads to congestion; lack of a sufficient waste management system leads to garbage being left behind and often burnt in residential areas; and lack of paved or covered roads leads to re-suspension of dust when vehicles are passing by. The fact that air pollution is an externality from multiple sectors means that it needs to be addressed by multiple ministries that are willing to coordinate with one another. Technical solutions alone, like introducing CNG or changing standards for vehicles and industries, will not be sufficient to control air pollution in Indian cities. We need a change in the institutional setup in ways that will allow department and ministries to work together.

*<http://bit.ly/1ArllGR> accessed on 10.5.2015*

According to the World Health Organization, 25-30 cities in the top 100 most polluted cities in the world are from India. The Global Burden of Disease assessments for 2010 estimated that 6,27,000 premature deaths in India can be attributed to outdoor air pollution.

Recent reports suggest that India has extremely high levels of environmental pollution especially air pollution. A recent report by World Health Organization (WHO) points to the fact that India is home to 13 of the top 20 cities for air pollution. It is because India's air has a lot of PM (particulate matter) 2.5 that is instrumental in a large number of lung ailments. The health risks of living in such a toxic environment cannot be overstated. These include the onset of asthma and cancer as well as triggers to heart attack and stroke. Most of the diseases reduce life expectancy and cause losses in the productive capability of a nation. The collective impact of pollution is thus detrimental and not just limited to quality of life today but for the future as well.

### **Role of black carbon and other short life climate pollutants**

It is crucial to understand that there would be a considerable influence on local climate from the emissions of certain green house gases and aerosols from. The local emissions create a Regional climate impact that combines with the overall global warming to further accentuate the temperature rise

The Asian Brown Haze is caused mainly by domestic wood and coal fires and vehicle exhaust fumes. Certain mega-city hotspots such as Delhi, Beijing, Dhaka etc have been identified that contribute significantly to the Black Carbon in the Asian Brown Haze. The Asian Brown Haze is causing a regional heating effect.

The concept for cutting down on regional emissions, combined with efforts to improve the forest cover could herald a new dimension to dealing with Climate Change.

While CO<sub>2</sub> remains in the atmosphere for several decades, Black Carbon, the main Short Life Climate Pollutant, has a life of only a couple of weeks. Hence drastic reduction of Black Carbon could bring immediate results in mitigation of Climate Change at a regional level.

*G. Carmichael, V. Ramanathan; Nature Geoscience, 2008, Vol 1, Issue 4, pp 221-227*

Poor maintenance of the vehicles is contributing hugely to the air pollution as well as to the wastage of precious petroleum products. Necessary changes to motor vehicles Act should be urgently considered to mandate the effective servicing of vehicles at regular intervals. Six monthly servicing of vehicles is compulsory in some countries such as New Zealand.

The importance of quality monitoring of the air pollutants through Air Quality Index (AQI) is highlighted in an article “What will it take to make our cities environment-smart?” in web portal ‘India Together.

*(<http://indiatogether.org/cost-of-environmentally-smart-cities-and-air-quality-index-environment>); accessed on 10.5.2015*

Whereas the vehicular population has a huge impact on the air quality in urban areas, the relevance of electric vehicles charged from roof top solar PV systems should be considered as a priority option.

## References

- EMPRI & TERI (2011) Karnataka State Action Plan on Climate Change; Chandrappa R and Das DB (2011)
- Coping with Climate Change, Principles and Asian Context, Springer-Verlag, Heidelberg
- “Climate Impacts and Mitigation Costs of Non CO<sub>2</sub> Gases” ; John M Reilly, Henry D Jacoby, Ronald G Prinn, Massachusetts Institute of Technology
- Research paper by Centre National De La Recherche Scientifique ; “Analysis of air quality in eastern China and its interaction with other regions of the world” ; Chunsheng Zhao, Xuexi Tie, Geli Wang, Yu Qin, Peicai Yang

## 8.10 Transportation

Transportation has become an important element of modern development. Transportation has deep impact on every economic activity, be it of an individual or an industrial unit. Transportation is also very important determinant of land use patterns. If automobile revolution has made transportation a very dynamic factor of socio-economic life, it has also made deep impact on earth’s climate. Extraction of oil as fuel and its transportation per se are surely the pollutants of nature but its usage has a very diabolic impact on climate via Green House Gases.

The example of Mysuru can be a good indicator of what should be done in urban areas. Mysuru is deeply linked with Bengaluru in many ways than merely economic. This relationship has intensified since the Y2K impact on Bengaluru, making it India’s Silicon Valley. With Infosys Leadership Institute and several other IT companies getting located in Mysuru has created an entirely new interdependence between these two cities. It is estimated that on an average on a week days KSRTC buses make 550 trips between these two cities, and this increases to about 700 trips on weekends. As per the KSRTC Survey done in 2014, every day about 2500 cars were making trip between Bengaluru and Mysuru. About 350-400 taxis make trips to Bengaluru International Airport every day from Mysuru. All these vehicles use petrol and diesel, which is mostly imported, and a big drain on the exchequer. But their impact on the overall climate because of GHG and pollution is one that can be avoided.

Nearly 80 unscientific humps, crowding of bypasses by commercial establishments have further enhanced the GHG and pollution on this road. If we were to have efficient railway service, much of these vehicular traffic could be avoided. Early completion of Double Tracking, which can facilitate many more trains, and speeding up of the trains have become critical. Electrification of track can massively improve the connectivity and minimize road transportation.

*(Mysuru’s Defective Transport Systems & Avoidable Pollution; R. Chandra Prakash; President, MGP)*

Transportation sector including road, air and waterways is also a major GHGs emitter in the state (10.4%). Most of the petroleum products like ATF (aviation turbine fuel) HSD, (high speed diesel), LDO (light diesel oil) etc are used in transportation sector. The state of Karnataka has recorded a very fast growth in the number of vehicles registered i.e. 75.19 lakhs in 2009 against 33.52 in year 2000. Thus total CO<sub>2</sub> emission from this sector has been estimated to be 8.35 million tons of CO<sub>2</sub>. There has been a fourfold increase of

vehicular population in Karnataka in less than 20 years<sup>3</sup>. In 2007-08, emissions due to transportation were 8.35 million tons in Karnataka. Emissions from the transportation sector at state GDP growth rate of 8% is likely to be 23 million tons<sup>9</sup>EMPRI & TERI, (2011).

Unlike European countries, Karnataka has vehicles more than 15 years old and which are highly inefficient. Adulteration and in efficiency along with increase in number of vehicles are increasing carbon emissions. Mixing of naphtha and kerosene to petrol /diesel are not only decreasing quality of air, it is also augmenting rate of climate change. Vehicle manufacturers have always pushed their products into market without making any assessment of impact of their products on climate change.

The transportation sector is also major consumer of steel. The emission from vehicle happens at the manufacturing stage and during usage. Use of ethanol would not reduce emission of carbon but will have lesser impact on earth as the carbon emitted is part of carbon cycle. What is of greater concern is combustion of carbon which was present in the deep layers of earth's crust.

The unchecked growth in the number of vehicles has resulted in serious issues to the other road users, and the overall road infrastructure. The relentless pressure to accommodate more and more vehicles has resulted in the constriction of footpaths and total elimination of the same in some places. This has huge impacts on pedestrians. Widening of the roads has also lead to felling of large number of old trees of huge significance in carbon sequestration. The presence of so many powerful vehicles on our roads has literally pushed the bicycles out, and the pedestrians also feel unsafe to walk. The result is further in increase in the number of vehicles with all the attendant issues of air pollution, strain on the foreign exchange and accidents.

Whereas the air pollution from the ever growing number of vehicles should be a huge concern, there have been continuous innovations to reduce the pollution and increase fuel efficiency. One such innovation from the state, which has acquired US patent, claims to improve the fuel efficiency of buses and trucks which are already on the road, and reduce emissions from the vehicles. The State Government should consider this technological claim, and examine whether some of the Government vehicles can be tried with this innovation, and share the results with the public at large.

Global Solutions To Reduce Pollution From Over One Billion Air Breathing Petrol & Diesel Engines in use across the World.

(<http://bit.ly/1Fcr7cd>); accessed on 10.5.2015

Electrically charged vehicles such as e-motorbikes, e-scooters and e-cars charged from roof top solar PV systems, particularly in urban areas, have a huge relevance in addressing the urban transportation and pollution related issues.

***Uncontrolled growth in the total number of vehicles has posed severe problems to the society, without commensurate benefits, and is resulting in many dimensions of social injustice while impacting the health of the entire population. Transportation sector must be managed responsibly not only to arrest the running away of GHG emissions, but also to safeguard the true welfare of our communities.***

## References

- 'Strengthen public transport to reduce congestion'; (<http://bit.ly/1JMbS04>); accessed on 10.5.2015

## 8.11 Industries

As per KSAPCC the industrial sector is a substantial contributor of GHG emissions (22.5%) as well as a large consumer of electricity (24%). Hence it should be diligently considered in the climate action plan. This sector also has led to a lot of GHG emissions in the form of reducing the capacity of natural carbon sinks

i.e. land-use change by demanding land diversion from agriculture and forestry. Since it also demands a lot of water and minerals, the use of all of which leads to GHG emissions, the need for the responsible management of this sector becomes obvious.

The issue of industry-based emissions of GHGs has become a critically important environmental and political topic over the last decade. After the Industrial Revolution, productivity and efficiency increased dramatically as production of goods shifted from the home into factories. Unfortunately, along with the technological advances came an enormous increase in the amount of atmospheric concentrations of GHGs. Since the Industrial Revolution, concentrations of carbon dioxide have increased by nearly thirty percent, concentrations of methane have more than doubled, and nitrous oxide concentrations have risen by about fifteen percent. These gases are released through the burning of fossil fuels such as oil, natural gas, and coal, which are used to operate cars and trucks, heat homes and businesses, and run factories.

A new study sponsored by NASA's Goddard Space Flight Center has highlighted the prospect that global industrial civilisation could collapse in coming decades due to unsustainable resource exploitation and increasingly unequal wealth distribution. The study based on the 'Human And Nature DYnamical' (HANDY) model has been accepted for publication in the peer-reviewed Elsevier journal, *Ecological Economics*. It finds that according to the historical record even advanced, complex civilisations are susceptible to collapse, raising questions about the sustainability of modern civilization. Noting that warnings of 'collapse' are often seen to be fringe or controversial, the study attempts to make sense of compelling historical data showing that "the process of rise-and-collapse is actually a recurrent cycle found throughout history." Cases of severe civilisational disruption due to "precipitous collapse - often lasting centuries - have been quite common." By investigating the human-nature dynamics of these past cases of collapse, the project identifies the most salient interrelated factors which explain civilisational decline, and which may help determine the risk of collapse today: namely, Population, Climate, Water, Agriculture, and Energy. These factors can lead to collapse when they converge to generate two crucial social features: "the stretching of resources due to the strain placed on the ecological carrying capacity"; and "the economic stratification of society into Elites [rich] and Masses (or "Commoners") [poor]" These social phenomena have played "a central role in the character or in the process of the collapse," in all such cases over "the last five thousand years."

*NASA-funded study: industrial civilisation headed for 'irreversible collapse'?*

*Nafeez Ahmed; 14 March 2014*

*<http://bit.ly/1gjyS3u> accessed on 10.5.2015*

Adaptation and mitigation will have costs and opportunities for industrial development, but differing across the globe. Generally, the challenge is to ensure that industrial development and the prospects for industrial development is not adversely affected by climate change and that industrial development takes place without worsening global warming—ideally contributing towards moving global production, distribution and consumption towards a low-carbon and eventually de-carbonized economy.

It is an established fact now that the vast increase in GHG emissions and consequent concerns of Global Warming at the global level has been a result of massive industrialisation and consumerist way of life in the developed world. In order to protect the humanity, there can be no alternative other than to carefully review such a policy, and adopt a low carbon way of life. Such a paradigm shift is feasible in our country, which has been experiencing the problems associated with degraded environment, even before embracing massive industrialisation and consumerism as happened in the developed world. In this context extreme caution is required in determining how much and what type of industrial development is suitable for the state. The policy of the state should be to encourage those enterprises / industries which consume minimum amounts of energy, produce minimum GHGs/pollutants, and provide sustainable employment/development opportunities to a large number of people.

A welfare state cannot afford to ignore the essence of such far reaching studies. Looking at the amounts

of raw materials and energy being consumed and the amounts of pollutants generated in the present day industrial civilization, it is not difficult to visualize the chances of such a calamitous event. We should do all that is feasible to avert such a disaster by diligently reviewing the past policies and make suitable course corrections.

**8.11.1** On the basis of the data provided in KSAPCC, the following issues for the state can be highlighted.

- Karnataka ranks third and seventh respectively in the production of steel and cement in the country. These two industries account for over 20% of the overall emissions of the state and over 40% of the emissions due from industrial sector. The massive impact of mining (as experienced in Kudremukha and Bellary) and various pollution loadings associated with these industries have to be carefully considered in allowing more of these industries to be set up.
- As compared to energy intensive and polluting manufacturing industries, the true relevance to our state of small scale industries, cottage industries, and industries associated with agriculture, horticulture and floriculture, dairying, animal husbandry, forestry, fishing etc. should be carefully considered not only from the point of view of reducing the GHGs but also from the perspective of larger employment opportunities and lesser pollution loading.
- The fact that the modern manufacturing industries are becoming highly automated because of which they are less suitable from the perspective of providing large employment, has also made them less suitable to our state because of higher carbon foot print and pollution loading (they also demand more energy because of automation).
- The services sector, which is contributing about 55% to GDSP, demands minimum amounts of energy as compared to manufacturing industries, and is generally known to have much less carbon/pollution loading. Karnataka is also known as a leader in IT, ITES and BT sectors; and hence there is a great potential in this sector to achieve the twin objectives of greater employment/development opportunities and minimised GHG emissions.
- In addition to IT and BT, the other areas of considerable employment/development opportunities with low carbon footprint in the state are education, financial services, tourism, and health services, which should be given a high priority.
- The state has to take very carefully considered decisions as to how much of mining, cement, steel, chemical industries etc. are required OR are in the interest of the state, and what are the true costs and benefits to the society in each such case.

In the recent years Karnataka has emerged as the knowledge and technology capital of the country making rapid strides in the new economy as well. Karnataka is the Knowledge Hub of Asia with 201 plus Engineering colleges, 114 plus Medical colleges/institutions, 50 Universities and 13 International Schools apart from presence of more than 370 plus world renowned high end research and development organizations. The World Economic Forum has identified Karnataka among the top four innovation hubs in the World. Karnataka's capital Bengaluru is globally recognized as the Silicon Valley of Asian region and is considered technology capital and knowledge capital of the country.

With good rail, road & air connectivity, logistic support, infrastructure, good telecommunication network and generally peaceful labour environment, the State has been a preferred destination for investment attracting 4th largest Foreign Direct Investment (FDI) in the country. The State is considered as the fastest growing market in India. State has been ranked 1st for a healthy business climate and attracting investments by World Bank's Investment Climate Index and Bangalore – Best India City to Live in - 'Quality of Living Survey - Worldwide Rankings, 2011' – Mercer.

Karnataka is also among the top five industrial states in the country. The achievements of Karnataka in

promoting high-tech industries in key sectors like telecommunication, electronics, information technology, precision engineering, automobiles, readymade garments, bio-technology and food processing have been note worthy.

Karnataka's pre-eminent position on the industrial and business map of India is based on several factors. The State is rich in natural resources and known for its salubrious climate. It has a strong resource base of highly educated people, backed by an extensive educational infrastructure comprising world-renowned schools, colleges, institutes of higher learning and research and development centres. Labour force is highly skilled, disciplined and hardworking. And, above all, it has a far-sighted, development-oriented, investor-friendly government that firmly believes in, and actively encourages, public – private partnerships.

Karnataka is blessed with 320 KM of coastal line with 2 major ports at Mangalore and Karwar and 10 minor ports. State has a share of about 4,490 KMs of National Highway and about 20,774 KMs of State Highway network across the length and breadth of the State apart from other major district road network of about 49,905 KMs. Karnataka has a total of 3,250 KMs of railway line spread along the length and breadth of the State.

Karnataka has five functional Airports of which two are International Airports (Kempegowda International Airport, Bangalore and Mangalore Airport, Mangalore). State proposes to upgrade the Hubli Airport to international status. Belgaum Airport connects northern Karnataka with other States and Mysore Airport is being expanded. It is proposed to develop minor Airports at Gulbarga, Shimoga, Bijapur, Bellary and Hassan thereby providing air connectivity across the State. State also has two Air Force flying stations in the State, one at Bidar and the other at Belgaum. Logistics parks are also being developed for planned and systematic handling of goods in and around major cities.

### **8.11.2 Other infrastructure highlights**

Metro Rail Project for Bangalore (42.3 km in phase - I) is expected to be completed by the end of 2015 and phase - II of 72 Kms has been approved.

Gas Authority of India Limited (GAIL) has laid main trunk pipelines with a design capacity of 16 MMSCMD for about 746 kms for transporting gas from Dhabol to Bangalore and it covers nine districts in Karnataka from Belgaum to Bangalore. The total length with spur lines is proposed to cover 1,370 kms. This pipeline is in the influence region of the proposed Bangalore - Mumbai Economic Corridor (BMEC) and Chennai – Bangalore - Chitradurga Industrial Corridor (CBCIC) being initiated by Government of India, and is expected to give fillip to development of industrial areas / regions as nodes along the BMEC and CBCIC.

The commissioning of Dhabol–Bangalore gas pipeline is expected to be a catalyst for industrial development. This corridor is being proposed to be developed as “Green Corridor” considering the relatively low carbon footprint of natural gas. The Gas pipe line is aimed to cater to the needs of Industry, Transport sector and City Gas Distribution (CGD) in the major cities along the corridor commencing with Bangalore city.

### **8.11.3 General Industrial Scenario**

There are about 1,054 large & medium manufacturing industries in various sectors in the State which include Machine Tool, Steel, Cement, Automotive and Aerospace industries. In addition, about 2,500 IT and ITES companies including 700 MNCs, about 600 Textile units and a large Agro based industries providing substantial employment opportunities to the youth are thriving in the State. The state is also the Biotech Capital of India and home to nearly 60% India's biotech units. It has planned dedicated Biotechnology parks and centers such as Nutri / Nutraceutical and Phyto-Pharmaceutical Park (N2P2) at Mysore, Marine Biotech Park at Mangalore, Agri Biotech Park at Dharwad and Vivarium (Animal House) at Bidar.

With the presence of HAL, NAL, ISRO etc and with a good ecosystem the State is emerging as the favoured global destination in Aerospace Sector. MSME sector is a vibrant and vital sector of the State economy in



terms of employment generation and share of production. There are nearly 4.81 lakh registered MSMEs in Karnataka as on 31.03.2014 providing employment to over 28 lakh persons with a total investment of around Rs. 18,635 crore.

The State has also carved a niche for itself in the textile sector. It is the largest producer and exporter of silk and silk products in the country and produces over 20% of the national garment production. The State has planned dedicated apparel zones in Bangalore Rural, Tumkur, Kolar, Mandya, Belgaum, Bidar and Dharwad.

Karnataka Industrial Area Development Board (KIADB) has developed 148 Industrial Areas in Karnataka State. The progress of the industrial estates during the last four-decades increased enormously, and the Karnataka Small Scale Industrial Development Corporation (KSSIDC) as on date has established network of 159 developed Industrial Estates throughout the State in almost all the districts and taluka of Karnataka and has constructed 5,746 Industrial Sheds apart from formation of 3,976 Industrial Plots.

The Karnataka State Pollution Control Board (KSPCB) has categorised the industry and organisation as Red, Orange and Green as per the direction of Central Pollution control Board (CPCB). The Red category industries are polluting industries, the Orange category industries are moderately polluting industries and Green category industries are less/ non polluting industries. The List of Large and Medium scale industries in Karnataka is as per **(Annexure 7)**.

KSPCB has covered 82,988 organizations (this includes Industries, Health Care Establishments, Stone Crushers, Telephone Towers, Infrastructure projects, Mines, Coffee pulping units and local bodies) under pollution control laws during the reporting period. 3,528 working industries have been covered under the Hazardous Waste (Management, Handling & Trans-boundary) Rules, 2008.

Prominent industries in the State are Iron & Steel, Pulp & Paper, Sugar, Distillery, Cement, Engineering, Electronics, Chemicals & Pharmaceuticals, Mining, Software, Garment stitching and washing industries.

The Central Pollution Control Board (CPCB) has categorised 17 types of industries as highly polluting industries in Red category. The status of 17 category industries as on 31-03-2014 in Karnataka is as in **Annexure 8**.

#### **8.11.4 GHG Emissions**

More than 73% of Karnataka GHG emissions are result of fossil fuel consumption. The power sector is with 35.9% the single largest contributor. The industry is contributing about 22.5%. The industry sector emits 18.1 million tons CO<sub>2</sub> equivalent per year. Cement and Iron & Steel account for 90% industrial emissions.

#### **River Water Quality Monitoring**

The KSPCB is monitoring and analyzing river water samples under 'Global Environmental Monitoring System' (GEMS) at 5 locations and 'Monitoring Indian Natural Aquatic Resources System' (MINARS) at 59 locations.

#### **Inference on the River Water Quality Monitoring**

CPCB has specified water quality criteria depending on the designated best use and activities in the river. The classifications are:

- Class "A" - Drinking water source without conventional treatment but after disinfection. Class "B" - Out door bathing (organized).
- Class "C" - Drinking water source with conventional treatment followed by disinfection.
- Class "D" - Propagation of wild life, fisheries.
- Class "E" - Irrigation, Industrial Cooling, Controlled Waste disposal.

Monitoring of the major rivers under various programmes indicates that the major pollutants in these water

bodies are mainly organic and bacterial contaminants. This is mainly due to domestic waste discharged into the rivers from towns and villages located on the river banks. Secondly, the quality has a bearing on the flow.

**Table 9: GHG emission inventory of Karnataka**

Industry (2008-09)	Quantity (Lakh T/Annum)	CO <sub>2</sub> Emissions in Million Tonnes per Annum
Cement	120.97	7.64
Iron & Steel	115.4	8.59
Ammonia	2.36	0.19
Aluminium	1.09	0.18
Iron Ore	423.14	0.29
Pulp & Paper	3.65	0.38
Sugar	33.97	0.82

(Source: KSPCB AR 2013-14)

At the following three locations, the treated industrial effluents are permitted for discharge into the rivers. The water quality at these locations about 100 meters downstream of the treated effluent discharge point are as under;

- Mysore Paper Mills treated effluent into Bhadra River near Bhadravathi, Shimoga District. Bhadra river water quality downstream of Bhadravathi conforms to Class-C
- Harihara Poly Fibres and Grasilene Division treated combined effluent into Tungabhadra River near Harihar, Haveri District. Tungabhadra river water quality downstream of Harihara Polyfibres conforms to Class-C.
- West Coast Paper Mills Ltd treated effluent into Kali River near Bangur Nagar near Dandeli, Uttara Kannada District. Kali river water quality, monitored quarterly indicates that at the downstream of the industry it conforms to Class-C in the month of April, Class 'A' in the month of July and Class-B during the rest of the period.

#### 8.11.5 Ambient and Continuous Air Quality Monitoring

The KSPCB has monitored the ambient air quality of Bangalore city at 15 locations including two Continuous Ambient Air Quality Monitoring Stations and using manual equipments under National Ambient Air Quality Monitoring Programme (NAMQP) covering Industrial Area, Mixed Urban Area and Sensitive Area. Two continuous ambient air quality monitoring stations (CAAQMS) at Bangalore are placed at City Railway station and at KSPCB Regional Office Complex, Nisarga Bhavan at Shivanagar (S.G Halli). Monitoring is being carried out on 24 hourly basis.

#### Industrial Zones :

Four ambient air quality monitoring stations have been set up in the industrial zones of Bangalore city viz.

- Graphite India Limited, White Field Road.  
RSPM values have exceeded the national limit (60.0 Micro gram /M<sup>3</sup>) in all measured years, whereas SO<sub>2</sub> and NO<sub>2</sub> are within the limit during the period 2009-2014. High levels of RSPM may be due to the construction activities and vehicular movement and road dust.
- KHB Industrial Area, Yelahanka  
RSPM values are exceeded the national ambient air quality standard (60.0 ug/M<sup>3</sup>). During 2011-2014

RSPM values are around 3 fold higher than national limit, may be due to construction of International Air Port Road whereas SO<sub>2</sub> and NO<sub>2</sub> are within the limit during the measured years 2009-14.

- Peenya Industrial area, Regional Office, Peenya  
RSPM values are exceeded the national ambient air quality standard (60.0 ug/M<sup>3</sup>) and SO<sub>2</sub> and NO<sub>2</sub> are within the limit during 2009-14.
- Peenya Industrial area, Gymkhana  
RSPM values are exceeded the national ambient air quality standard (60.0 ug/M<sup>3</sup>) and SO<sub>2</sub> and NO<sub>2</sub> are within the limit during 2013-14.

KSPCB is also monitoring the Ambient Air Quality in other Districts under NAMP. There are 18 monitoring stations covering 15 cities.

**Table 10: Number & Type of Hazardous Waste Re-processors**

Sl.No.	Type of reprocessors	Number of Units
1	Aluminium Re-processors	01
2	Copper Re-processors	06
3	Discarded container washing units	19
4	Etchant Re-processors	11
5	Ferrous sulphate	01
6	Lead Re-processors	28
7	Molybdenum Acid Units	01
8	PCB Sludge processors	01
9	Spent Solvent Distillation units	26
10	Silver extract by X-ray solutions	01
11	Spent Catalyst Re-processors	02
12	Used oil Recycling units	27
13	Waste oil Re-processors	07
14	Waste PCB Re-processors	01
15	Zinc Re-processors	05

(Source: KSPCB AR 2013-14)

#### **8.11.6 Common Effluent Treatment Plant (CETP):**

The industries are disposing the waste water in to the CETP when they are not having their own waste water treatment plants. There are eleven Common Effluent Treatment Plants (CETPs) of which nine are operating in Karnataka. Abstract of CETPs in Karnataka is in **Annexure 9**.

#### **8.11.7 Treatment of Fly Ash**

Status of Implementation of Fly Ash Notification is as in **Annexure 10**.

#### **8.11.8 Hazardous Waste**

The KSPCB has covered 3,528 hazardous waste generating industries in Karnataka and issued authorization. The estimated quantity of hazardous waste generated has been assessed based on the authorizations issued and classified as under (assuming units are operating at 100% capacity).

- Recyclable/reprocessable waste : 1,20,594.78 MTPA
- Incinerable waste: 61,692.82 MTPA
- Landfillable waste: 61,062.84 MTPA

#### 8.11.9 Re-processable waste:

There are 137 hazardous waste recycling units (e.g. reprocessing used oil, waste oil, spent solvents, spent etchant, discarded containers, lead, copper & zinc waste) are functioning in Karnataka State.

#### 8.11.10 Incinerable Waste

Board has issued authorization to five Common Incineration Facilities in Karnataka. Board has also issued authorization to captive incineration facilities to thirty units in the State of Karnataka.

#### 8.11.11 ISO 14001 standards

International Standard Organization has published ISO14000 series of standards which will help the organization to establish a structured and systematic approach to environmental management and address the environmental issues in a holistic manner. Establishment of an environmental management system in conformity with ISO14001 standard will enable industries to systematically comply with requirements of the law, prevent pollution and improve the environmental performance continually. It will enable industries to demonstrate their commitment to environmental protection.

As on 31.03.2014, 276 industries have obtained ISO14001 certification.

#### 8.11.12 Greening Initiatives In Industrial Areas

The KSPCB is incorporating a condition to provide green belt inside the boundary of industries for a minimum of 33% of its total area in the clearances issued for the establishment of the new industries and in the consents for the operating industries. Greenery not only enhances aesthetics but also contributes in reducing global warming. The KSPCB in co-ordination with Department of Forests has motivated industries to take up the Greening programme. During the year 2013-14 the total number of saplings planted are 13,47,583. Greening initiatives in industries and industrial areas are as in **Annexure 11**.

**Table 11: Abstract of number of industries certified for ISO14001**

Sl. No.	Zonal office	Number of industries certified for ISO 14001
1	Bangalore City	24
2.	Bangalore South	78
3	Bangalore North	22
4	Bangalore East	40
5	Mysore	27
6	Chitradurga	17
7	Dharwad	30
8	Mangalore	23
9	Bellary	15
	TOTAL	276

(Source: KSPCB AR 2013-14)

Karnataka already has a good ranking for industrialization in the country. It is a leader in steel and cement industries, and is in number one position in IT- ITES and BT industries. Bengaluru is also known as an educational and technological hub. Such a status has also given rise to very many pollution related problems.

In many industrial areas the RSPM values have exceeded the national ambient air quality standard. The overall pollution issue cannot be said to be fully under control. In view of the fact that state has been encouraging setting up of more industries, the need for additional land, water, raw materials and energy has to be carefully considered in a holistic manner. Keeping in view the issue of dealing with industrial wastes and contribution to Global Warming, very high levels of diligence is required in determining how much more industrialisation, what type of industrialisation and in which parts of the state is in the interest of the state. Various stake holders in such a policy making should be effectively involved.

The public consultation meetings had participation by industrialists in almost all the venues, and received very good recommendations to minimize the GHGs. Other sections of the civil society also expressed their clear opinion on what the state's industrial policies should be.

## References

- EMPRI & TERI (2011) Karnataka State Action Plan on Climate Change
- Chandrappa R and Das DB (2011) Coping with Climate Change, Principles and Asian Context, Springer-Verlag, Heidelberg
- KSPCB Annual report 2013-14
- Industry & Commerce website
- KIADB Website
- KSSIDC Website
- Karnataka Industrial Policy 2014-19

## 8.12 Energy

While adequate quality and quantity of energy supply is the key driver in the modern economic structure, its massive usage has also given rise to very many serious issues to the humanity including the imminent threats of global warming and Climate Change. As per IPCC report of 2009 more than 75% of GHG emissions at the global level can be associated with various forms of energy production and usage. As per MoEF report of 2010 various forms of energy in India can be associated with the same level of GHG emissions. As per KSAPCC nearly 80% of GHGs emission in the state has been estimated to be from the fuel combustion process in various sectors like power generation, transportation and industries. Electricity / power sector alone contributes nearly 36% of the total GHGs in the state. When we also objectively consider other pollution loading of the Electricity / power sector such as coal ash, SPM, traces of radio active elements (from coal ash), huge demand for fresh water in coal power plants, land for the power plants, mining and transmission line etc. the enormity of the problem of managing the Electricity / power sector from Global Warming perspective becomes evident.

It becomes, hence, clear (as through many of the national and international reports) that minimizing the consumption of energy from conventional technology sources (such as fossil fuel based, nuclear based and dam based hydro power), and hence the emission of GHGs is critical to contain the Global Warming. There is no alternative for the state but to take definitive steps to minimise the consumption of energy per se, and especially from conventional technology sources; irrespective of the financial cost. Fortunately, there are suitable alternatives with much lower overall cost to the society, and hence there must be a resolute move in that direction.

As per KSAPCC coal provides 51.7% of primary energy of the state. Petroleum products also form a major share of the energy sources at 38.6 %. In 2009-10, petroleum supplied almost one-third of Karnataka's commercial energy consumption. Karnataka has no known reserves of coal or petroleum products. Hence this prominence of fossil fuels in its energy mix, which lead to high GHG emissions, pollution loading and pressure of natural resources, needs a thorough review.

### 8.12.1 Petroleum products

Since the state has no reserve of petroleum products, and since the country itself imports about 77% of these products, the issue of foreign exchange burden on the nation's economy is itself a huge concern. Since transportation sector also contributes a considerable percentage of the state's GHG emissions (10.4%) and to the air pollution, there is an urgent need to put in place a suitable action plan to minimize all these. At a higher level it appears that two measures i.e (i) the drastic restriction on the number of vehicles on the road, and (ii) to replace the petroleum products by bio-fuels seem to be the best options available to the society. But the complexities involved in these measures need to be examined in detail. This has been dealt in the section on transportation.

### 8.12.2 Coal

Karnataka has no known reserve of coal. Combustion of coal to produce electricity consumes vast quantity of fresh water; emits highest GHGs amongst all the fossil fuels; produces huge amounts of pollutants such as coal ash; demands vast tracts of lands and forests (for coal mining, power plants, coal dumps, ash ponds and transmission lines). Burning coal to produce electricity is a low efficiency energy conversion process. From whatever perspective we look at it coal power cannot be seen as being suitable to the overall societal welfare needs in Karnataka.

**Table 12: Available Power capacity in Karnataka (MW); as on 31- 1- 2015**

	Hydro	Thermal (Coal + diesel)	Nuclear (Share)	Renewable	Total
State's own capacity	3,600	2,848	0	1,032	7,480
Private Generating Companies	0	2,166	0	2,953	5,119
Central (NTPC & NPCIL)	0	1,471 (Share)	476	0	1,947
<b>STATE TOTAL</b>	<b>3,600</b>	<b>6,380</b>	<b>476</b>	<b>3,985</b>	<b>14,546</b>

(Source: CEA Website)

In this context the people in the public consultations expressed concern that the state continues to see coal power as a major part of its energy policy, despite the fact that Karnataka is the second most water stressed state in the country (severely constrained in the availability of fresh water, which is needed in huge quantities in a coal power plant). The state has been experiencing the growing crises of coal supply/prices as experienced at Raichur and Bellary coal power plants. In this context the massive GHG emissions to be added by a number of proposed coal power plants such the ones proposed at Bijapur, Edlapura, Eramarus, Raichur, Afzalpur etc. should be kept in proper perspective.

Information available through official websites in 2009 indicate that more than fifteen additional coal power projects have been planned in different parts of the state, mostly in north Karnataka, including Raichur, which was identified as a critically polluted area few years ago (**Annexure 2**). The very conceptualization of so many additional coal power plants in a state which has no coal reserve and which is already water stressed gives rise to huge concerns for the people. There is a need to objectively review the planning of so many coal power plants keeping in perspective all the attendant problems associated with coal power technology and GHG emissions.

It is to be noted in this context, the then Chief Minister of Karnataka is on record for having said (while participating in a ceremony on 8 Sept. 2008 to sign a MOU with Chhattisgarh Government to set up a

coal power plant in the state of Chhattisgarh) that since setting up a coal power plant in Karnataka is not economical, a coal power plant was being set up in Chhattisgarh. (A copy of the transcript of the relevant news paper report is enclosed as in **Annexure 3**).

There has been a worldwide movement going on against the socio-environmental impacts of coal power in the context of global warming, and a strong advocacy to move away from it towards renewable energy sources. A large number of coal power plant have been retired due to environmental reasons alone in US and China, and very many fresh coal power plant proposal have been and are being shelved in recent years for environmental and economic reasons across the globe.

The existing fleets of coal fired power plants in the country are already associated with many health impacts due to water and air pollution, including between 80,000 and 115,000 deaths annually due to exposure linked their particulate emissions in 2011-12. Further increase in the number of coal power plants will definitely lead to further escalation of such health risks.

Proponents of coal industry have been making tall claims of eliminating GHG impact of coal burning through Carbon Capture and Storage (CCS) technology. But CCS is failing to deliver because of high costs, environmental concerns and community opposition. CCS is increasingly being abandoned by industrialised countries also. International Energy Agency (IEA) projects that only 1% of the total fossil fuel capacity is likely to be equipped with CCS by 2035.

Keeping Karnataka's scenario in proper perspective there seems little doubt that it has no alternative but to move away from coal based power policy. Participants in the public consultations were of the opinion that the state must not only take a definitive policy decision not to build any additional coal power plants, but also to make concerted efforts to decommission the existing ones as soon as possible. It should be noted that there are many benign alternatives for the state to meet the legitimate electricity demand on a sustainable basis. Such options include the highest possible efficiencies in the existing electricity infrastructure, demand side management, energy conservation measures, and effective use of renewable energy sources such as solar, bio-mass and wind.

A realistic pricing policy not only for the supply of electricity for every consumer group but also for the produce of farmers, and an effective application of costs and benefits analysis will assist in finding the correct electricity supply options for the state.

### **8.12.3 Dam based hydro power:**

The large dams in India (a tropical region) are reported to be responsible for about 20% of the country's total global warming impact in the form of Methane, CO<sub>2</sub> and Nitrous Oxide (as per a report by Ivan B.T. Lima et.al (2007): "Methane Emissions From Large Dams as Renewable Energy Sources"). Destruction of forests for the sake of dams, hydraulic structures, power plant buildings, staff colonies, roads, transmission lines, vastly reduced flow in the downstream of the dam etc. have serious implications to the environment, bio-diversity and the affected people. Reservoirs created from the dams have resulted in fragmentation of forests with serious hindrance to the free movement of wild animals such as elephants and tigers in addition to destruction of forests which are very good sinks of CO<sub>2</sub>. Karnataka has already exploited much of its dam based hydro potential (about 30% of total installed power capacity in the state is from dam based hydro); further exploitation of rivers in Western Ghats can only be disastrous. Good potential is existing in Mini and micro hydro power (about 3,000 MW); but the state has to exercise extreme caution to minimise environmental and social impacts through any type of hydro power development. Unambiguous recommendation of the Western Ghats Ecology Expert Panel (WGEEP) against the proposed Gundia hydel Project in Sakaleshpur taluk should be a good indicator in this regard.

### **8.12.4 Nuclear power**

Karnataka already has one nuclear power plant at Kaiga in Uttara Kannada district, and there are proposals

to expand its capacity. Nuclear power technology is associated with serious concerns due to potential risks due to accidents, costs and environmental footprint. . The potential impacts on the flora, fauna, air, land and water consequent to a nuclear accident have given raise to credible concerns against viewing it as a reliable energy source. Even the proposed capacity extension at Kaiga nuclear power plant is likely to result in the destruction of thick forests worth thousands of acres in WGs to build additional transmission lines required.

The advocacy for a large number of nuclear power plants as a mitigation measure should be considered from the perspective of the overall welfare of the society. Though the GHG emissions are negligible during the operation of a nuclear reactor there are GHG emissions associated with various stages of the life cycle of a nuclear power plant from the fission material mining, processing milling, transportation, building, spent fuel storage and decommissioning of the defunct reactors. There are estimations that the total GHG emissions in the life cycle of a nuclear power plant can be considerable. When the energy /money required for safeguarding the spent fuels for hundreds of years is considered objectively, the issues may become clear. A study report “Nuclear power, energy security and CO<sub>2</sub> emission” by Jan Willem Storm van Leeuwen independent consultant Ceedata, Chaam, May 2012 gives what appears to be a comprehensive analysis of the life cycle of nuclear power, and indicates that the overall energy balance may be negative. This study is a physical assessment of nuclear power with a global perspective and a long time horizon and comprises an energy analysis based on a comprehensive life cycle assessment of the full complex of industrial activities and processes needed to generate useful energy from uranium.

*([http://www.stormsmith.nl/Media/downloads/nuclearEsecurCO<sub>2</sub>.pdf](http://www.stormsmith.nl/Media/downloads/nuclearEsecurCO2.pdf)) accessed on 10.5.2015.*

While there are articles to question the findings of this article, there is also a wealth of literature on the implications of nuclear power on the overall welfare of the society.

Additionally, in order to make considerable impact on the global GHG emissions, a very large number of nuclear power reactors have to be built. An estimate indicates that on the assumption that about 33% of the total electricity production capacity at the global level by Year 2075 (for a population of 10 Billion) needs to be from nuclear power (in order to really have an impact on global warming) about 3,000 reactors (assuming average capacity of 1,000 MW) may be required. The article estimates that such a scenario would mean over 48 new reactor builds a year from now on, compared to 3.4 per year which is the highest historic rate (in France between 1977 to 1993). It would require even those countries, which have no nuclear power as of now, to construct nuclear reactors.

The reality behind the dream of nuclear power reducing the net GHG emissions by a considerable margin should be diligently studied in the Indian context of high population density, already stressed natural resources, and the huge potential of renewable energy sources.

The implications of coal based, dam based and nuclear based power policy and credible alternatives for the country are discussed in more detail in the book “Integrated Power Policy”.

*(<http://freebookculture.com/integrated-power-policy-a-framework-for-people-centric-environment-friendly-and-sustainable-power-policy-for-india-shankar-sharma/>); accessed on 10.5.2015*

### **8.12.5 Renewable energy sources (RES)**

Karnataka is endowed with vast potential of new and renewable energy sources. As detailed in chapter 7 Section (g) the RES have very many advantages over the conventional power sources, and are considered as essential for the future as energy sources, especially from the perspective of Climate Change. As per KREDL, the potential for new & renewable energy (RNE) in Karnataka is estimated to be about 18,800 MW (as against the present total installed capacity of about 12,000 MW within the state) excluding solar power (which itself is huge). This potential consists of about 13,200 MW of wind power, 3,000 MW of small hydro, 1,500 MW of co-generation, and 950 MW of Bio-mass.



**Table 13: RE Potential in Karnataka**

Technology	Estimated Potential (MW)	Installed Capacity (MW) (as on 31.3.2014)
<b>Wind Power</b>	8,591 (at 50 Mts) 13,593 (at 80 Mts)	2,318
<b>Bio-mass Power and Bagasse Co-generation</b>	No estimate indicated, but projected as huge because of the agrarian nature of the economy	603
<b>Small and mini hydel Power</b>	4,141	1,031
<b>Solar Power</b>	Over 5,000 trillion kWh/year Potential in the country	Not much as compared to the potential
<b>Ocean power</b>	Significant over 320 km	No information

(Source: Based on MNRE Annual Report 2013-14)

These renewable energy sources, if managed effectively, can meet the total electricity needs of the state with a very low carbon foot print. These sources also will assist in much faster rural development, and minimise the need to cut trees for firewood. In reality the true potential of RES is vast if deployed in innovative ways. The RES are considered most beneficial when they are deployed in distributed mode such as roof top solar power systems.

Though it is true that the initial cost of these new and renewable energy sources are seen as high as compared to the conventional energy sources, it is only because the society has already invested very heavily for the infrastructure required for the development of the latter. In recent years the capital cost of solar and wind power installations have come down considerably, and are expected to continue to do so. Also, the real cost of recurring fuel needs in case of coal, diesel, natural gas or nuclear fuel will be avoided in the case of renewable energy sources. Whereas both the capital cost and energy cost from the conventional energy sources is increasing all the time, the same is opposite in case of new and renewable energy sources. Already the cost of new and renewable energy sources has come down by many times in the last decade alone. In addition, if we take the environmental costs, social costs, health costs, Global Warming mitigation costs, T&D losses and the large infrastructure required for the grid quality conventional energy sources, the distributed energy generation based on new and renewable energy sources will be much cheaper. If the total budgetary spending on new & renewable energy sources by the union Government since independence were to even 50% of that on nuclear power, the cost of RE would have been much less today.

The IPCC report 'Special Report Renewable Energy Sources (SRREN)', which was released in May 2011, has projected a very critical role for renewable energy sources, and hence deserves greater attention for enabling a paradigm shift in our energy policy to eliminate the chances of Nuclear Accidents. This report has projected that the renewable energy could account for almost 80% of the world's energy supply within four decades. The report has said that if the full range of renewable technologies were deployed, the world could keep greenhouse gas concentrations to less than 450 parts per million, the level scientists have predicted will be the limit of safety beyond which climate change becomes catastrophic and irreversible.

Ramon Pichs, co-chair of one of the key IPCC working groups, has said: “The report shows that it is not the availability of [renewable] resources but the public policies that will either expand or constrain renewable energy development over the coming decades. Developing countries have an important stake in the future – this is where most of the 1.4 billion people without access to electricity live yet also where some of the best conditions exist for renewable energy deployment.” Sven Teske, renewable energy director at Greenpeace International, and a lead author of the report, has said: “The IPCC report shows overwhelming scientific evidence that renewable energy can also meet the growing demand of developing countries, where over 2 billion people lack access to basic energy services and can do so at a more cost-competitive and faster rate than conventional energy sources. Governments have to kick start the energy revolution by implementing renewable energy laws across the globe.”

A Greenpeace report titled “energy {R}evolution, A Sustainable India Energy Outlook”, with international authorship has dealt with the Indian energy scenario in good amount of detail, and has come up with a credible set of solutions. An important point highlighted in this report is the huge potential available in reducing the demand for energy without adversely affecting the legitimate needs of our society. This projection has discussed the feasibility in reduction of about 38% in demand by 2050 as compared to the reference scenario of International Energy Agency (IEA). The study report is confident that by adopting suitable measures “by 2030 about 35% of India’s electricity could come from renewable energies” AND “by 2050, 54% of primary energy demand can be covered by renewable energy sources”. The report states: “A more radical scenario - which takes the advanced projections of renewables industry into account - could even phase out coal by 2050. Dangerous Climate Change might force us to accelerate the development of renewables faster.”

Karnataka state is in the forefront of the states in harnessing RES but a lot more needs to be done to make itself sustaining in managing the energy sector in the state. It has formulated a renewable energy policy, and it has met its renewable purchase obligation more than that was needed under the rule. The state has the second largest wind power capacity, and Bengaluru is considered the solar water heater capital of India, with an estimated reduction of around 1,000 WM in the morning hour demand on the electricity grid. Necessary incentives/mandates to make roof top solar water heaters a common phenomenon across the state is essential and techno-economically feasible.

Other enabling policies such as feed-in-tariff policy for Roof top Solar power systems, and incentives for farmers to become solar power generators etc. are all great initiatives in the right direction, but these policies should be implemented optimally. Reports from the consumers and in the media indicate that these policies are not being implemented well, and the consumers are finding less than enthusiastic approach from the concerned authorities in the ESCOMs. Creation of dedicated single window cells in each of the ESCOMS to co-ordinate all such activities for consumers end has become urgent. Until these policies become widely known and used in the state, adequate technical and financial advises by these cells to the consumers are also essential.

#### **8.12.6 Bio-energy**

Being an agrarian state Karnataka is generally known as having a huge potential in bio-mass based energy sources. Bio-energy sources, if harvested and harnessed diligently, have the potential to drastically reduce our reliance on petroleum products, to reduce the energy related GHG emissions, lead to adequate rural development, and towards sustainable development pathways.

Bio-fuels are liquids or gaseous fuels produced from biomass resources and used in place of, or in addition to, diesel, petrol or other fossil fuels for transport, stationary, portable and other applications. Biofuels are a ray of hope to reduce the quantity of fuel import by using them as alternatives for traditional fuels like petroleum. Unlike the greenhouse gases which lead to the increase in global warming, bio-fuel is a neutral substance, and is environment friendly.

## Selection of Sustainable Energy Technologies Based on Energy Availability-Consumption Pattern A Region Specific Analysis

It is important to take into consideration the close relationships between resources, technologies and development while preparing any region-specific planning models.

Selection of sustainable energy technology studies carried out within development perspectives is very good for enhancing the quality of debate on technology-development issues.

The major energy contributors for different end-use services in the study region are firewood (44%) and electricity (13%). Also energy demand is maximum for cooking (54%) and heating (20%).

It is estimated that about 65% of the energy requirement for the study region can be met with locally available energy resources and about 35% of energy needs have to be met with outside energy sources.

Total electrical energy consumption per month in the rural area of the study region is about 40 million units. It is estimated that using gasifier and fluidized bed gasification technology about 12 million units of electrical energy can be generated per month by using only major agro-residues available in the rural area of the study region ( about 31% of total electrical energy requirement).

Average volume of biogas potential for each taluk is about 30,07,392 m<sup>3</sup>/month but average volume of biogas required is about 10,42,448 m<sup>3</sup>/month. Animal dung available in study region can produce 2,10,51,750 m<sup>3</sup> of biogas per month. This can meet about 60% (100%, if community biogas plants are utilized) of energy requirement for cooking.

Biogas potential is maximum in Soraba (94%), Hosanagara (94%) and Thirthahalli (74%) taluk. It is observed that possible replacement (electrical energy) using locally available resources is maximum in Bhadravathi (82%), Hosanagara (70%) and Thirthahalli (73%) taluks.

It is possible to provide energy security for the region using locally available energy sources only and village people need not depend on natural forest for their energy needs.

Further, the study also reveals that integrated use of certain technologies such as community and individual biogas plants, biomass gasifier, bio-diesel extraction unit, fluidized bed gasifier, briquettes from sugarcane trash, briquetting of biomass leads to self-reliant regional development.

*(<https://kspcb.files.wordpress.com/2015/05/shimoga-action-plan.pdf>) ; accessed on 10.5.2015*

Annual production of bio-mass in the state, which can be used for bio-energy, is considerable, and the state is already considered as pioneer in the development of bio-energy. Native plant species, which can be tapped for bio-fuels also, are good in number. These should be harnessed optimally without compromising the food security on a sustainable basis. Recognising the need for such a focus the Karnataka Bio-fuels Development Board was set up in Year 2010. Bio-mass potential of more than 1,000 MW, if harnessed effectively, can have a major influence on the energy needs of rural Karnataka on a sustainable basis.

A good bio-fuel based development policy comes with many other advantages to the society. They are: development of rural environment and beauty by growing more trees; more number of trees means good rain and better yield; shelter for birds, animals and plethora of other creatures; pieces of wood branches cut during pruning process can be used as firewood by rural women; species such as Pongemia are useful in nitrogen fixation of the soil; the wastes can be good non-chemical pest repellent.

*(<http://biofuelkarnataka.in/>); accessed on 10.5.2015*

Bio-energy based integrated approach to meet the legitimate demand for energy of a district is well demonstrated by a project survey undertaken as shown in an article by H.B. Suresh and Sreepathi. L.K, J.N.N. College of engineering, Shivamogga, Karnataka, India.

“Selection of Sustainable Energy Technologies Based on Energy Availability-Consumption Pattern-A Region Specific Analysis”;

*(<https://kspcb.files.wordpress.com/2015/05/shimoga-action-plan.pdf>) ; accessed on 10.5.2015*

### 8.12.7 Solar energy

Of various sources of new & renewable energy, solar energy potential is immense in the state, and can come with least impact on the environment. The potential is very huge if the roof tops of various types of buildings in the state are considered for effective installation of solar photo voltaic panels. A high level estimate indicates that if roof top solar photo voltaic panels of 2 kW each are installed on 50% of the households in the state (those houses which are structurally and economically strong) a total solar power capacity of about 15,000 MW can be achieved with virtually nil GHG emissions and needing no water or additional land. Such roof top solar photo voltaic panels will drastically reduce the energy lost in transmission and distribution, and if suitably connected to the existing grid network can eliminate the need for additional conventional power plants. If the roof tops of other buildings in the state such as schools, colleges, industries, offices, ware houses etc. also are effectively used the total solar power capacity which can be realized will be huge.

The state is endowed with about 300-330 days of bright sunshine on an average, which means a very huge potential to meet most of our energy needs through solar power. The use of solar power for agricultural purposes has a huge potential in the state. The solar water pumping appliances have huge relevance to agricultural sector pumping requirements which need water during summer and during day time. Such applications have already been successfully used in Rajasthan and Gujarat, and the technology is known to be fairly mature. With adequate incentives and technical assistance our farmers can move over to solar power quickly and reap huge benefits while contributing to vastly reduced GHG emissions. But care is needed that such plentiful solar energy should not lead to unsustainable water pumping from the ground.

Solar power can also be ideal for drying processes of agricultural produces where heating indoors is required. With about 35% of the state's electricity going to agricultural sector, effective usage of solar power in its activities will be a huge boost in minimizing the GHG emissions in the state.

Solar power can also appreciably reduce the demand for grid electricity, and hence the GHG emissions, in water heating requirements of residences, hostels, restaurants, hospitals, industries, dairies etc. Solar lanterns and solar charging points for cell phones have become popular in many rural areas, because of the inability of the grid to reach them or due to highly unreliable nature of supply.

As per 'expert group on low carbon strategies for inclusive growth' (of Planning Commission) several parts of India are endowed with good solar radiation, and deploying solar panels even on 1 percent of the land area could result in over 500,000 MW of solar power. When we consider that approximately 100 Sq. ft of the area of a roof top can house 1 kW of solar PV panel, the huge potential possible with solar energy and the scope to drastically reduce the GHG emissions in the state becomes obvious. The State Government should take up the solar power deployment with a missionary zeal if the total GHG emissions and all the associated problems are to be minimized. As in the case of deployment of solar water heaters, wherein Karnataka is known as a leader, the deployment of solar PV panels also can be a vastly beneficial option, and is viable because of the presence of a number of suppliers of such panels in the state.

The fact that about 75% of the state is arid or semi arid (as per KSAPCC) indicates that most parts of the state are highly suitable to harness solar power. Entire north Karnataka, the districts of Kolar, Tumkur and Chikkaballapura have huge potential for solar power, and vast tracts of lands in these areas which have not been used for agricultural activities for a long time should be considered diligently for harnessing the vast amounts of solar energy. It may not be an exaggeration to suggest that these districts alone have the solar potential to supply most of the electricity requirements of the state, if carefully managed.

While it is true that the capital cost of solar power is seen as higher as compared to conventional power sources, it is also true that many externalities of conventional power sources, such as pollution, environmental and hidden subsidy costs, have been ignored all these years. If all such direct and indirect

costs to the society are objectively considered, and the global warming implications of continuing with the fossil fuels power plants are taken into account, the effective cost to the society from solar power will be revealed to be much less compared to that of conventional power sources. Additionally, since the state has no other conventional sources to produce the electricity needs of the future, solar power should be the key to our energy policy.

Adequate financial incentives and a suitable feed-in-tariff mechanism, wherein the excess energy generated in such installations can be fed to the grid, can dramatically transform the electricity related GHG emission scenario in the state.

#### **8.12.8 Wind energy**

As per KREDL Karnataka has a potential of about 13,200 MW out of which about 1,500 MW has been realized so far. Even if 75% of the remaining potential is realized in next 10-15 years with adequate care, total GHG emissions in the state can be brought down considerably. However, large wind turbines have issues such as occupying grazing lands, demanding lands for approach roads, impacting the flight path of birds, driving away grazing animals because of the noise, impacting bio-diversity etc. The state should initiate efforts to launch a state / national level campaign to develop small size wind turbines of capacity 2 to 5 kW suitable for lower wind speeds (suitable for roof tops and community usage). Much of the potential if tapped at roof top levels or community levels will be ideal for containing GHG emissions with low social & environmental impacts.

#### **8.12.9 Ocean energy**

With about 320 km of coast line, Karnataka should also consider harnessing the energy from the ocean, which can protect the coastal environment from the ghastly coal power plants and the Western Ghats from the ravages of Transmission lines and hydel power plants. Recently a pilot project for harnessing the tidal energy on the basis of an international patented technology was reported as launched near Udupi. Such efforts should be adequately encouraged to harness the enormous potential of the ocean energy, which can at the least meet the electricity needs of coastal areas.

#### **8.12.10 Small Hydro**

Small hydro power units have huge relevance to hilly districts of the country, but extreme care is needed in protecting the bio-diversity of the areas. There are many serious concerns expressed from the people from the districts of Western Ghats on how many such small hydro power plants have lead to large scale destruction of what is already a fragile ecology. Recent court ruling stopping the works on some of the mini hydel projects in WGs should be kept in mind. Effective public participation at all stages of such projects will be of great help.

#### **8.12.11 Energy plantation**

Instead of the plantations of alien species such as acacia and eucalyptus, energy plantations of native bio-fuel seed varieties such as Pongamia on large scale should be seriously considered as a part of waste land/dry land development programmes. Bi-fuels have to play a major role in our energy sector in place of fossil fuels, and the huge potential of the state should be optimally harnessed.

#### **8.12.12 Emissions and energy efficiency**

As per the 'expert group on low carbon strategies for inclusive growth', the emission intensity at the national level as expressed in grams of CO<sub>2</sub>-eq per Rs. of GDP has fallen from 66.8 in 1994 to 56.21 in 2007, indicating the impact of government policies that encourage energy efficiency / conservation in various sectors of the economy. This report also indicates that aggressive efforts in bringing optimum energy efficiency to domestic and commercial appliances can save about 150 Billion kWh by 2020 at the national level. Hence the highest possible levels of energy efficiency at all stage of generation, transportation and

utilisation at the state level also is critical for minimizing the GHG emissions.

Appropriately implemented pricing mechanisms will be essential to fully harness the potential in energy efficiency, and hence in emission reduction.

### 8.12.13 Electricity Sector

Electricity sector, contributing about 36% of all GHG emissions in the state, is also contributing to accelerated depletion of ground water table (through uncontrolled use of IP Sets), reduction of forests as carbon sinks (through dams and power lines), consumption of large quantities of fresh water (in coal power plants), emission of SPM (in coal power plants) etc. The sector also is known to be responsible for about 54% of all CO<sub>2</sub> emissions at the national level. Since it is also associated with human development index, adequate attention to address its myriad problems will be in the best interest of the state.

While the available electrical power generating capacity for Karnataka has gone up by about 150 times since 1948 the demand also has been going up continuously (more so since 1980s) so much so that the state is not known to have been free from power cuts except for few years in late 1970s.

Inefficiency prevailing in various segments of the sector is considered to be the primary cause for the chronic power cuts, perceived need for additional power plants, and increasing contribution to GHG emissions. Transmission & Distribution (T&D) losses, though as per official figures have come down from about 32% in 1990s to about 21% in 2009, is known to be much more as compared to the international best practices of 5%. When added to this, the commercial losses in the form of theft and unaccounted electrical energy, takes the total losses (called as Aggregate Technical and Commercial losses or AT&C losses) to more than 30%. The reduction of these AT&C losses to about 10% alone can result in eliminating the prevailing deficits (power deficit is widely believed to be about 10%). What is needed is a set of committed, definitive and scientifically arrived at tariff policies to encourage efficient usage and disincentivise wastage.

IP sets, which consume about 35% of the state's total electrical energy, are known to be very inefficient resulting on average 45-50 % avoidable losses. This technical loss, due to friction in suction and delivery pipes, bearings, non-optimal size & location of the motor-pump size, low voltage etc. can be reduced to about 5-10%, thus saving about 35 – 40% of the agricultural sector electricity. This savings alone is estimated to be about 15 - 18% of the total electricity consumption in the state.

Domestic lighting & AEH, which consume about 22% of the state's total electrical energy, also is known to be inefficient. A survey by Prayas Energy Group, Pune has shown that by deploying the efficient domestic appliances such as lighting fixtures, fans, TVs, fridges etc. which are already available in the Indian market, the total electricity consumption in domestic sector can be reduced by about 30%. This works out to about 5 - 6% of total electricity consumption in Karnataka.

Similarly, the energy savings/conservation potential in industries, commerce, public places, street lights, water and sewerage systems etc. is estimated to be more than 10% of the total electricity consumption in the state.

Efficiency improvement measures in the generation of electricity (such as improving PLF of coal power plants and up-rating of old hydel power plants etc.) can provide virtual additional capacity of about 5%.

Demand Side Management (DSM), wherein the total demand for electricity can be reduced effectively without compromising on welfare/economic activities of our society, also has a huge potential. If the society undertakes an objective study of the essential nature of huge illumination & hoardings of commercial establishments; effective illumination requirements of street light systems; avoidable nature of night time sports; lifts, escalators, air conditioning etc. it will be evident that a substantial amount of electricity, which is being consumed in these applications are avoidable, and hence can be saved with huge benefits to the society while minimizing GHG emissions.

If the efficiency improvement measures in various segments of electricity sector, which are techno-economically viable, are implemented diligently it can bring down effective demand on the electricity grid by about 30-40 %. It is pertinent to note here that these efficiency improvement measures will cost only about 20-25% of the cost of green site conventional power plants of equivalent capacity, and are completely free from GHG emissions, and other socio-environmental impacts.

Suitable tariff policy to heavily discourage wastage or luxurious usage of electricity and to incentivize efficient usage of electricity is another important policy tool to minimize the GHG emissions and consequent implications for the state.

If the renewable energy sources, the technology for which are already fairly mature and available in the market such as solar water heaters, solar PV panels, solar water pumps, bio-gas/mass plants, wind turbines etc. are deployed effectively even in small numbers the pressure on the state's electricity grid can be reduced considerably, and the GHG emissions and other air pollutants associated with electricity sector can be minimized or even eliminated in the long run.

There can be no doubt that such efforts should be backed by highest possible efficiency, optimal demand side management and responsible levels of energy conservation. Without such measures even the full deployment of the RES will not be able to reduce the GHG emissions to an acceptable level.

With the more and more RES installations such as roof top solar panels across the state, certain simulation studies may indicate that there is a likelihood that large addition of base load power plants, such as coal power plants, may result in excess base load capacity by 2030 and lead to gross underutilization of the so created infrastructure. Hence, instead of the prevailing practice of GDP centred demand projection, it becomes essential to determine the least amount of electricity/energy required to eliminate the poverty, and plan all the associated activities based on such a projection.

#### 8.12.14 Issues with grid integration and intermittency of RES

Ever since the issues associated with RES and Global Warming implications of fossil fuels came to the fore, questions have been raised whether it is feasible to meet the energy needs of the future, say by 2050, satisfactorily by RES with equity and realistic prices for all. The compilation of such questions and answers to them by credible studies is in the table below.

**Table 14: “Global – Level” Questions and Initiatives on RES**

Question on alternative energy scenario	Credible report answering this question
Given the threat that fossil fuels pose to a stable climate, as well as their declining availability, can alternative, non-nuclear sources be found that provide the same amount of usable energy demanded by a fossil dependent system equally cheaply and in an equally convenient way?	Wind, water and sunlight could provide electricity and electrolytic hydrogen “for all purposes” worldwide by 2030 at no extra cost, using only one per cent more of the earth’s land surface than currently occupied by energy-related installations (Jacobson and Delucchi, 2011)
What is the minimum amount of energy required to power industrial processes, cars, buildings and so forth? How could this energy be supplied in a sustainable way? In particular, how much could the use of fossil fuels and nuclear energy (which now provide more than 80 per cent of total world energy) be reduced by 2050 assuming continued growth in industrial output and freight transport?	Through end-use energy savings, further electrification and replacement of traditional with renewable energy sources, everyone on the planet could be supplied with the energy they need by 2050 using 95 per cent renewable sources, reducing greenhouse gas emissions from the energy sector by 80 per cent, at a net cost of 2 per cent of global GDP or less annually (World Wide Fund for Nature/ Ecofys, 2011)

<p>Is it possible to transform the way the world produces, consumes and distributes energy, while maintaining economic growth, protecting the world from catastrophic climate change by phasing out fossil fuels, and ensuring “energy security for growing economies and populations”?</p>	<p>Energy efficiency combined with a major expansion of renewable energy technologies, including both decentralised local grids and large power plants connected to new super grids, could “reduce energy related CO<sub>2</sub> emissions to a maximum of 3.5 giga tonnes by 2050 and phase out over 80 per cent of fossil fuels by 2050”, while maintaining economic growth, avoiding nuclear power, and providing energy “to the two billion people currently without access to energy services”. Global energy consumption would be stabilized “within the next two decades”, while efficiency would reduce overall primary energy demand in 2050 to 40 per cent of today’s. By 2050, “almost the entire global electricity supply, including the majority of the energy used in buildings and industry,” would come from renewables, for the use of which binding targets would be set. Subsidies for fossil and nuclear energy would be phased out and the social and environmental costs of energy production “internalized” through emissions trading (Greenpeace, 2012)</p>
<p>How can “present levels of production and consumption and resource use” be reduced?</p>	<p>A “sustainable and just world order” requires a change to “simpler lifestyles”, “small, highly self-sufficient local economies largely independent of the global economy”, “more cooperative and participatory ways”, a “new economy . . . not driven by profit or market forces” and “different values” of “cooperation” and “frugality” (Trainer, 2012)10</p>

(<http://bit.ly/1cg9Yau>); accessed on 10.5.2015

There have been an increasing number of such studies from around the world. Germany has been assiduously working on its ‘energy transformation’ to move away from fossil fuels and nuclear power. Recently Australia’s ANU was also reported to have come up with a report indicating the techno-economic feasibility of meeting most of Australia’s electricity demand by REs by 2050. A recent report by from China indicates on how it is planning to use its renewable energy to meet over half of the country’s power needs by 2030 and 86% by 2050.

(<http://www.rff.org/Documents/Events/150420-Zhongying-ChinaEnergyRoadmap-Slides.pdf>

[https://www.scribd.com/document\\_downloads/262478415?extension=pdf&from=embed&source=embed](https://www.scribd.com/document_downloads/262478415?extension=pdf&from=embed&source=embed)): accessed on 10.5.2015

With US, EU and Germany already having been convinced about such a techno-economic feasibility, the pressure on India to be thinking on this line can only escalate. If the huge energy demand in China can see this possibility, it should certainly be possible in India with much less energy demand and with much more solar energy potential.

Two most common questions raised in case of new and renewable energy sources are that they are not firm power and that their comparable cost with conventional energy sources is high. The reality behind these issues as far as Karnataka is concerned is as follows:

- Many applications like lighting loads, water pumping for domestic and smaller agricultural needs,



water heating for bathing etc. are not heavy and do not require 24 hours supply. Lighting loads can be adequately met by backup battery systems when the main sources like solar or wind energy is not available. These battery systems can be charged by the respective energy sources. Applications like solar water heating with adequate capacity water storage facility need no battery backups. Solar water pumps for lighter agricultural or domestic loads are ideal for usage during the sunlight hours. These can also function much more reliably in conjunction with other renewable energy source of bio-mass and wind turbines where feasible.

- There have been advances in solar thermal technology, wherein molten salts are being used to capture the abundant solar heat during the day time to use the same during night times to generate steam for generating electricity. This technology is reported to being increasingly used in USA to take care of the absence of sunlight during nights. When the solar PV installations are deployed in conjunction with such technologies, the issue of 'infirm' power can largely be resolved. Additionally, when various renewable energy sources such as wind and bio-energy are used in conjunction with solar PV panels or solar Concentrated Solar Power (CSP), it is credible to assume that the issues with 'infirm power' can be resolved satisfactorily.
- Though it is true that the initial cost of these new and renewable energy sources is seen as high as compared to the conventional energy sources, it is only because the society has already invested very heavily for the infrastructure required for the development of the latter. The capital cost of solar and wind power installations have been coming down considerably. Also, the real cost of recurring fuel needs in case of coal, diesel, natural gas or nuclear fuel will be avoided in the case of renewable energy sources. Whereas both the capital cost and energy cost from the conventional energy sources is increasing all the time, the same is opposite in case of new and renewable energy sources. Already the cost of new and renewable energy sources has come down by many times in the last decade. In addition, if we take the environmental costs, social costs, health costs, Global Warming mitigation costs, T&D losses and the large infrastructure required for the grid quality conventional energy sources, the distributed energy generation based on new and renewable energy sources will be much cheaper.
- As a comparison it should also be noted that the total budgetary spending on new & renewable energy sources by the union Government is a small fraction of that on nuclear power. Given adequate time and resources the RES will be much cheaper to the conventional energy sources.
- In an article titled "A path to Sustainable energy by 2030", in Scientific American in November 2009, the authors have illustrated a plan as to how wind, water and solar technologies can provide 100 percent of the world's energy, eliminating all fossil fuels and nuclear power. It has referred to a 2009 Stanford University study which ranked energy systems according to their impacts on global warming, pollution, water supply, land use, wildlife and other concerns. The very best options were wind, solar, geothermal, tidal and hydroelectric power— all of which are driven by wind, water or sunlight. It was found in this analysis that the nuclear power, coal with carbon capture, and ethanol were all poorer options, as were oil and natural gas. Such a plan calls for millions of wind turbines, water machines and solar installations such as roof top SPV systems, but considered feasible.
- There have been many such studies globally, which have proved that the integration of RES into the existing electricity grid is technically viable, and can provide reliable power supply needs of the future. Such integration is being increasingly deployed around the world.
- In April this year when Europe witnessed a important solar eclipse, the grids across different countries such as Germany, Spain and Italy did not collapse, and the grid operators were able to keep the supply with some manageable changes to the operation regime.
- As far as integration of RES to the existing grid is concerned, what is of essence is the need for high efficiencies, effective consumer participation, accurate data management, reliability of various network elements, and adequate levels of information and control technology applications.

- A number of Smart and micro grids connecting vast number of small and medium RES and individual consumers are seen as the future of the power sector.

A recent news item in Washington Post (April 30, 2015) “Why Tesla’s announcement is such a big deal: The coming revolution in energy storage” can be seen as summing up what is happening in the field of electricity storage. It would be reasonable to assume that by Y 2020 the storage battery technology would have matured and become affordable so much that the usage of RES can be become a primary option for powering our homes.

*(<http://www.washingtonpost.com/news/energy-environment/wp/2015/04/30/why-teslas-announcement-could-be-such-a-big-deal/>); accessed on 10.5.2015*

When faced with perceived need for every additional MW of electricity capacity, we should diligently consider how to meet that energy requirement at lowest overall cost to the society without compromising on the environmental well being of our communities on a sustainable basis. In this regard an objective application of decision making tools “Options Analysis” and “Costs and Benefits Analysis”, which considers various alternatives, must be essential in our planning processes.

The Annual Report for 2013-14 by MNRE has copiously recorded a number of applications of RES for lighting, heating, drying, pumping etc. each of which can bring down the need for conventional forms of energy. It lists practical applications across the country, which should clear various concerns once aired on RES. There are a number of innovative applications of RES to reduce the dependence on fossil fuels: energy efficient solar/green buildings, energy recovery from urban industrial and agricultural waste, bio-energy and co-generation in industry are some major classification of such applications of huge relevance to Karnataka.

#### **8.12.15 Task force on energy**

Energy sector is very complicated, and requires many dimensions of expertise and commitments to make it highly efficient and adequately responsible in the context of the looming Climate Change. The human resources available to the state’s energy department as of now seem to be inadequate to discharge the onerous responsibilities on it. A realistic overview of the various energy needs of different segments/communities of the state, and a holistic approach to its multi dimensions seem to be outside the capability of the energy department in its present form, which is burdened with many administrative responsibilities. A Task Force of domain experts and committed individuals representing different consumer groups, reporting directly to the Chief Minister, can fill this requirement by diligently studying all the related issues in a holistic manner and recommend rational policies and action plans. Such a Task Force can achieve many tasks found difficult by the energy department and the electricity regulator, because it can bring consensus from wider sections of our society.

It is unfortunate that whereas a Task Force on bio-fuels (which can be seen as a small sub-set of energy portfolio) was considered necessary few years ago, a similar Task Force for the huge energy portfolio itself was not considered necessary. Action Plan on Climate Change is a good opportunity to set right the situation.

In view of the chronic power cuts, ever increasing electricity prices, never ending public dissatisfaction, deleterious impacts on social and environmental aspects, and most importantly in view of the need to contain Global Warming, the state has the need and scope to restrict the GHG emissions to an acceptable level. It will not be an exaggeration to suggest that if the state takes all the techno-economically viable measures available to the state with the required level of objectivity, it can eliminate the need for fossil fuel power plants in next 10-15 years, and most of the dam based hydro power plants in next 25 years. GHG emissions from the sector can be brought down by a considerable level by such a holistic approach.

Whereas the electricity sector is acknowledged as the major sector impacting the global warming, the sector itself is projected to be highly vulnerable due to the impending Climate Change. Asian Development

Bank (ADB) in its 2012 study “Climate Risk and Adaptation in the Electric Power Sector” has discussed the Climate risks to the power sector, and the adaptation strategies. It says that a recent assessment of the vulnerability of 193 countries to climate change rated 30 of these countries at extreme risk, of which 9 are ADB developing member countries (DMCs). The assessment excluded a number of ADB Pacific DMCs, many of which are also considered to be at extreme risk. A similar study ranked 14 DMCs as being at extreme risk from natural disasters and climate change.

“The energy industry is both a major contributor to climate change and a sector that climate change will disrupt. Over the coming decades, the energy sector will be affected by global warming on multiple levels, and by policy responses to climate change. In the absence of strong mitigation policies, economic growth and the rising global population will continue to drive energy demand upwards, and hence GHG emissions will also rise. Climate change itself may also increase energy use due to greater demand for cooling. The means and infrastructure to produce and transport energy will be adversely impacted by climate change. The oil and gas industry is likely to suffer from increased disruption and production shutdowns due to extreme weather events affecting both offshore and onshore facilities. Power plants, especially those in coastal areas, will be affected by extreme weather events and rising sea levels. Critical energy transport infrastructure is at risk, with oil and gas pipelines in coastal areas affected by rising sea levels and those in cold climates affected by thawing permafrost. Electricity grids will be impacted by storms, and the rise in global temperature may affect electricity generation including thermal and hydroelectric stations in some locations. Weather changes may also affect bio-energy crops. In general, the industry has options for adapting to climatic changes, but costs are likely to be incurred.”

“Climate Change: Implications for the Energy Sector”;  
(<http://bit.ly/1RpPPhZ>); accessed on 7.5.2015

The report says: “The power sector is vulnerable to projected changes in many dimensions of climate, including likely increases in the frequency and intensity of extreme weather events, higher air and water temperatures, changes in rainfall and river discharge patterns, and sea level rise. Climate change is expected to affect the entire electric power sector: fuel mining and production, fuel transportation to power plants, electricity generation, transmission through high voltage grids, and low voltage distribution to consumers. Patterns of energy load growth and end-use demand by consumers will also be altered by climate change. Given the rapidly increasing growth in energy use in the region and the large investments required in coming decades, attention must be given to ensuring a full accounting—and management—of risks to these investments related to climate change.” “Extreme weather events, such as stronger and/or more frequent storms, can reduce the supply and potentially the quality of fuel (coal, oil, gas), reduce the input of energy (e.g., water, wind, sun, biomass), damage generation and grid infrastructure, reduce output, and affect security of supply.”

A report prepared for the US administration in 2015 (Quadrennial Energy Review (QER)) by title “Transforming U.S. Energy Infrastructures In A Time Of Rapid Change”, envisions increased threats to energy infrastructure from climate extremes and cyber-hackers, but also much opportunity to create jobs, lower greenhouse gas emissions, and empower consumers if the right changes to the energy system are adopted today.

([http://energy.gov/sites/prod/files/2015/04/f22/QER%20Summary%20final\\_1.pdf](http://energy.gov/sites/prod/files/2015/04/f22/QER%20Summary%20final_1.pdf)); accessed on 10.5.2015

The coastal power assets are likely to be affected most because of the extreme weather events such as storms from the ocean. It should be obvious that the present grid based and centralized power generating system can be highly vulnerable to such threats.

Energy sector attracted a lot of attention in the public consultation meetings. People were clearly convinced that the sector needs a lot more focus in its effective overall management than that has been given so far. Most of the comments focused on the efficiency, impacts of dam based and coal power plants and renewable energy resources.

***Keeping the large percentage share of GHG emissions from the electricity sector and its various impacts on the natural resources, energy/electricity sector in the state needs a lot more focus and holistic approach than is at present. A holistic approach to the electricity sector points towards the need to take a thorough review of the electricity infrastructure in the state from the threat perception due to Climate Change, and adopt the right changes early. Such a review may reveal that the electricity generation, transmission and distribution system based largely on distributed type of renewable energy sources is the most suitable option for the state. Such a review may also be a good opportunity to consider a technological jump to micro/smart grid concept for the power network.***

## References

- “Climate Change: Implications for the Energy Sector”; (<http://bit.ly/1Fcr7cd>); accessed on 7.5.2015
- “Energy Intensive Sectors of the Indian Economy - PATH TO LOW CARBON DEVELOPMENT”; World Bank, 2011
- “The OECD Environmental Outlook to 2050 (OECD, 2012)”; <http://www.oecd.org/environment/outlookto2050>; accessed on 7.5.2015
- 12 Insights on Germany’s Energiewende; <http://www.agora-energiewende.de>
- “energy {R}evolution, A SUSTAINABLE INDIA ENERGY OUTLOOK” : Greenpeace International: <http://www.energyblueprint.info/>
- “A path to Sustainable energy by 2030”, Scientific American, November 2009
- ‘Special Report Renewable Energy Sources (SRREN)’, IPCC, May 2011; <http://srren.ipcc-wg3.de/>
- “Plan B energy economy of 2020”; Earth Policy Institute, Washington
- “Towards a Green Economy – Pathways to Sustainable Development”; UNEP, [http://unep.org/greeneconomy/Portals/88/documents/ger/6.0\\_RenewableEnergy.pdf](http://unep.org/greeneconomy/Portals/88/documents/ger/6.0_RenewableEnergy.pdf)
- “Taking Charge”; GreenPeace India: [www.greenpeaceindia.org](http://www.greenpeaceindia.org)

## 8.13 Urbanisation, buildings and infrastructure

Extensive human activities for the economic growth/development to fulfill the increased human needs & welfare have modified the environment in the recent years. Population explosion, migration, and accelerated socioeconomic activities have all intensified these environmental changes over the last several centuries. The impact of these changes on the environment have been found at different levels like local, regional, and global trends through change in atmospheric temperature and other relevant climatic indicators.

As per Rio+20 conference in 2012, at the global level Cities collectively consume 75 per cent of world’s natural resources, generate 50 per cent of waste and emit about 70 per cent of the greenhouse gas.

“Urbanization and climate change are co-evolving in such a way that populations, often in densely packed urban areas, will be placed at much higher risk from climate change.” Rapid urbanization and the growth of megacities, especially in developing countries, have led to the emergence of highly vulnerable urban communities, particularly through informal settlements and inadequate land management.

India is the second largest urban system in the world, with 510 million people in over 5,161 cities as of 2010. Presently the urban centers hold less than 40% of the total Indian population, this figure is expected to rise to 60-65% by 2030 in an estimated 70,000 urban settlements. By 2025, 70 Indian cities are expected to have more than 1 million inhabitants. With 60% of the population living in rural areas, India’s contribution for carbon emission is much less than other developed countries as the energy consumed by a rural economy in terms of heat, lighting, and transport is much lower than the urban areas. But this will dramatically change in the next decades due to the increase in the urban population.

Urban centers are highly dependent on energy than rural areas where activities like agriculture, animal husbandry and local artisanal work have a low ecological footprint. As population in cities grow, pressure

on ecosystems increases. Large quantities of food, water and fuel need to be transported into the cities and huge amounts of garbage and sewage have taken out from these urban cities. Nutrient-rich human wastes – an asset in a rural area will become an economic liability in an urban environment.

The combination of rapid population growth and transformation of the global economy means that almost all growth in the near future will take place in urban centers of developing countries. However the cities can provide increased economic opportunities, better educational choices, and an improved quality of life; life expectancy is higher for urban residents. At the same time, urban residents who cannot afford to live in areas with adequate infrastructure, housing, and sanitation face increased risks from environmental emergencies.

### **Greening the urban jungle; The Hindu Editorial of 27.6.2012**

Urbanisation took centre-stage at last week's Rio+20 conference for good reasons. Cities collectively consume 75 per cent of world's natural resources, generate 50 per cent of waste and emit about 70 per cent of the greenhouse gas. With no slowing down of urbanisation in sight, this consumption is bound to increase. It is now abundantly clear — as UNEP's recent report on sustainable cities convincingly demonstrates — that unless cities become resource efficient and reduce waste generation, national and global sustainable development would be impossible to achieve. This is a warning bell to Indian policymakers, who have so far focused on the economic growth of cities and ignored their environmental performance. Consuming 40 billion tonnes of raw material every year has its consequences. The first visible challenge is the staggering waste cities produce. Conventional wisdom has been to find more landfill sites. This approach would demand more land over time and cities cannot endlessly appropriate the resources of their region. It would lead to potential conflicts and the loss of productive agricultural land would partly offset the economic benefits provided by the cities. Pursuing standard solutions and treading the beaten path of town planning would not help. Only a radical change in course will create zero-carbon, zero-waste habitats, which is imperative.

It would be impractical to cap the growth of cities. Neither is it the objective of the current debate. The question is how to transform them. Certain cities have taken the lead and shown a way forward. For instance, Copenhagen recycles most of the waste it generates and lets only 3 per cent go to the landfill. Extending the idea of recycling, Kitgum town in Uganda traps used water from houses and utilises it to grow food in grey water gardens. Cities in Malta have opted for a smart bi-directional grid system to regulate their power consumption. There are more inspiring examples. With the Central government dithering on commitments to reduce emission levels and the National Mission on Sustainable Habitats failing to offer anything substantial, Indian cities can no more rely on centrally directed policies and projects. They have to adopt best practices on their own and launch projects with clear green benchmarks. A good beginning would be to promote non-motorised transport. Even in larger cities such as Chennai, the share of bicycle trips, despite poor arrangement, is as high as 12.5 per cent of the total trips. Building dedicated bicycle tracks would significantly reduce transport related emissions. If Indian cities are keen to improve the quality of life and remain economically competitive, they have to leapfrog to become desirable green places to live in.

*<http://www.thehindu.com/opinion/editorial/article3573728.ece>; 27.6.2012*

#### **8.13.1 Urbanization in India**

The Geographers and planners describe the physical growth of urban centers as dense and centralized and expanding outwards from consolidated urban areas (Park et al. 1925). They describe the current urban growth trajectories in the frame work of social and environmental consequences. The present fashion of growth establishes significant link between the patterns of uncoordinated urban growth which is termed as 'fragmented', consisting of leapfrog developments and with little consideration for planned infrastructure development, pollution of air environment, traffic problems, and contamination of drinking water, causing extensive illnesses and deaths from waterborne illnesses (USAID 2006).

In India 21% of communicable diseases are related to unsafe water, and that diarrhea alone causes more than 2,100 deaths per year (World Bank 2010). Many efforts to improve access to good quality of water resources are in place; policies regulating effluent discharges, progressive pricing for urban water use, and incentives for reuse and rainwater programs (Gupta et al. 2004). Recent Central Government policies to increase direct foreign investment and expand economic output have the potential to place extensive

pressure on the water systems, causing many water management systems (e.g. wastewater treatment, public water delivery, and storm water retention) to be overwhelmed and unable to accommodate rapid increases in demand (Mukherjee et al. 2009).

The impact of climate change on the urbanization can be listed as follows:

### 8.13.2 On Water supply & Sanitation

The changes in precipitation patterns and water cycle will enhance the existing water supply and quality problems in urban areas. The pressing *water quality* and quantity challenges posed by the depletion and degradation of water resources in urban India are confounded by climate change and variability (Jha et al. 2009). Water in the Indian subcontinent is highly susceptible to climate change, particularly in some regions where 80% of the water comes from monsoons. The climate change may force the pace of rural-to-urban migration to increase over the next few decades, which adds to the ongoing water shortages in the agrarian communities of rural India. These water shortages are themselves being further exacerbated by increases in extreme climate events, greater monsoon variability (Zickfeld 2005), endemic drought, flooding, and resource conflict (Gosain et al. 2006; Mall et al. 2006). Such climate-induced challenges of water scarcity, the breakdown of environmental services, and increases in water-borne diseases are affecting urban populations throughout India (Ramesh et al. 2005). Climate change will become an increasingly important strategic economic and political concern as changes in water availability begin to impact India's economic growth rates and affect the lives and livelihoods of millions of people.

### 8.13.3 Health impacts

The Climate change increases the incidences of environment-related diseases in the urban areas. Warmer and/or wetter period of breeding due to global warming will provide ideal conditions for expansion of mosquito-borne diseases which are created either by excessive rainfall or by droughts in rivers. Lack of sanitation and shortage of potable water in urban centers will increase contaminated water and food-borne diseases like cholera, typhoid, diarrhea, hepatitis, and gastroenteritis. Warmer cities will also induce an increase in respiratory diseases due to pollution whose effects are reinforced by higher temperatures.

Analyses show that the greatest health burden is arising in the regions where vulnerability and population growth are greatest in the urban centers of developing countries. Health alignment due to climate change is mainly due to low cloud cover and greater intensity of solar radiation; increased/low rainfall and temperature. It is also true that water-borne diseases such as cholera and dysentery will also become common due to urban flooding and improper disposal of wastes (Anyadike, 2009). Warmer and more humid conditions could enhance the growth of bacteria and mould on many types of stored foods, increase food spoilage and create some specific toxicological health hazards (Ozor, 2009). Due to the very large number of people that may be affected, malnutrition and water scarcity may be the most important health consequences of climate change (Bates et al., 2008).

Poor health increases vulnerability and reduces the capacity of individuals and groups to adapt to climate change. Poor people may suffer more as they have lesser possibilities to adapt. As stated by UNFPA, "poor areas that lack health and other services, combined with crowded living conditions, poor water supply and inadequate sanitation, are ideal for spreading respiratory and intestinal conditions, and for breeding mosquitoes and other vectors of tropical diseases such as malaria, dengue, typhoid and yellow fevers. Changes in temperature and precipitation can spread disease in previously unaffected areas and encourage it in areas already affected." The slum dwellers, squatters, migrants, people living in informal settlements which are generally situated in vulnerable areas (river beds, flood plains, hill slopes) will be directly affected. They already suffer from insecurities due to "poor governance, lack of investments in infrastructure and in the commons, strong connections between the political class, real-estate developers and public agencies" (Aromar EVI, 2008)

### 8.13.4 Urban Heat waves

The Global warming will be felt more in cities because of the “urban heat island effect” that makes cities warmer than their surrounding from 2 to 6°C because of the modification of the land surface and waste heat produced by high-energy use. The Climate change will also cause more frequent, intense and longer-lasting extreme heat events that can kill hundreds of people.

### 8.13.5 Green Buildings

Buildings in the modern society are associated with substantial levels of GHG emissions in the form of raw materials used, transportations involved, energy foot print during construction and usage etc.

A green building can be defined as one which uses less water, optimises energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building. The residential building sector is one of the largest consumers of electricity in India. Continuous urbanisation and the growth of population result in increasing power consumption in buildings. Thus, while experts express the huge potential for energy conservations in this sector, the belief still predominates among stakeholders that energy-efficient buildings are more expensive than conventional buildings, which adversely affects the “greening” of the building sector. This belief is contested by studies finding evidence for the opposite being the case.

*(<http://www.adelphi.de/en/publications/dok/43509.php?pid=1971>); accessed on 10.5.2015*

Glass facades, absence of adequate ventilation and for natural lighting, lack of vegetation and rainwater harvesting around buildings in urban areas are all matters of huge concern from Climate Change perspective. The society has the critical responsibility to review these issues in a holistic manner, and arrive at effective measures to minimize the GHG emissions from the buildings and infrastructures.

Indian Green Building Council, formed by Confederation of Indian Industry (CII) in 2001, is continuously striving towards wider adoption of eco-friendly and green building concepts in the Indian industry. The Confederation of Indian Industry (CII) – Green Business Centre building in Hyderabad is one of the green buildings in India, which can be used as a reference.

With the projection that about 66% of all the buildings we can expect by 2050 are yet to be built in India, the huge importance of making the building sector vastly greener should become evident. The society, especially the governing agencies, cannot afford to ignore this harsh reality any more.

### 8.13.6 Infrastructures– road, rail and information

The storms, floods, cyclones, coastal flooding which are expected to be more frequent put infrastructure at great risk. This includes transportation (roads, railways, bridges, ports and airports) and communication networks, water supply, sewage, gas pipelines, drainage, flood and coastal defense systems, power and telecommunication infrastructures, industrial units, plants. As far as buildings are concerned, informal and traditional housing are the most vulnerable to storms and floods. Three-quarters of the carbon dioxide, which is the biggest greenhouse gas, is emitted by urban cities even though half the population of the globe is living in urban centers. Half of this carbon dioxide is contributed by buildings, which need to heat or cool their interiors; the rest is generated by motorized transport, which is growing exponentially in our country. This phenomenon is further emphasized by the change towards high-energy consuming buildings for middle and business-class. Because of globalization and adoption of new technologies, traditional patterns of construction are abandoned for homogenized types of building that largely use cement and glass, air conditioning regardless of the environmental and climatic conditions. The glass and concrete, which trap the heat, are used more often now than bricks and stone which are much more energy efficient.

Adequate and efficient levels of infrastructure for road, rail and information have become essential not only to make the modern day life style leading to human development, but also to minimise the GHG

emissions. Bad and inadequate infrastructure (as we see today of pot holed roads, infrequent / inefficient trains, and unreliable telecommunications etc.) will make people spend more time in unproductive ways, but also lead to higher GHGs in idling and slow moving vehicles/trains. Good tele-communication infrastructure will assist people to work from home; reduce the need for travels by tele-conferencing, e-mails, e-purchase etc.

Concerted and society level efforts, involving various agencies, to convert the present inefficient and unreliable infrastructure to one of world class has become essential if we want to proceed in the western style of development.

Whereas the successive governments have considered the widening of the existing roads as the single most important option to address the transport related issues, there are very many issues with this option. A quality discussion on the same can be seen in an article by Dr. S G Vombatkere, as in **Annexure 12**.

### **8.13.7 Increased Migration due to climate change**

The Climate change related drought and floods are expected to increase the rural to urban migration, which in-turn leads to overpopulation of cities and increase in the proportion of poor and vulnerable people living in urban areas. It is estimated that 500 million people are going to be affected by water problems in India because of global warming.

The migrants are also the most vulnerable groups in the urban cities with no access to the city's livelihood network and a lack of skill sets to help them survive. These groups live in the slums which are illegal and that have no access to basic amenities. These groups are thus highly vulnerable to a variety of risks living on hazardous sites, environmental health risks via poor sanitation, water supply, little or no drainage and solid waste services, air and water pollution and the recurrent threat of being evicted.

### **8.13.8 Economic impacts due to urbanization AND climate change**

The urban centers form the center of the economy in many countries, so climate change's impact on urban populations also damages the nation. For every one-meter rise in sea levels, the World Bank estimates a loss of 2% in national Gross Domestic Product due to shortage of fresh water, damage to agriculture and fisheries, disruption of tourism, reduced energy security, and other consequences. Apart from this, health consequences of climate change could have a great impact on economy. The episodes of heat cramps, heat exhaustion and heat stroke would affect the population, primarily the large poor section of the society. As the immune system weakens due to heat stress, susceptibility to diseases would further increase. The resulting increase in expenses on health care by individuals would escalate leading to greater stress. Hence, this vicious cycle would lead to depreciation of human resources. As temperatures increase, the workable days for heavy works like construction will decrease and this may have a negative impact on economic growth.

The absence of basic amenities and the lack of employment opportunities in rural areas act as push factors driving away the population from rural areas as well as small urban settlements. On the other hand, the perceived presence of such facilities in larger urban settlements acts as the pull factor leading to the migration of rural population into the urban areas.

***Keeping all these issues in proper perspective the society has to carefully deliberate on the urbanization phenomenon that is escalating, and take all possible measures to minimise the impact of climate change on urban population. One obvious option is to minimise the migration to urban areas, and decongest the urban sprawls we see today. Thorough review of the existing urban facilities in the context of Climate Change, and early course correction has become long overdue.***

## **8.14 Education and general awareness campaign**

It was clearly evident during the public consultation meetings that the general awareness on the issues of



global warming / climate change among the common public was very low. A low level of Climate Change literacy should be a cause of serious concern because such a status will seriously hinder the urgently needed efforts to mitigate and adapt to the fast changing climate.

The basic knowledge on the causes and implications of the Climate Change, even amongst the educated class, was observed to be highly inadequate. The ignorance /indifference towards the climate related issues, and what can / should be done in that regard can be said to be shocking, when we consider the seriousness of the threats faced by all sections of our society.

The participating publics were of the common view that a massive educational and awareness campaign should be undertaken urgently aiming every section of the society. While it may seem inappropriate to leave out any section of the society from such a campaign in the beginning, there is also a need to prioritise such sections due to the vastness of the campaign needed. The participating publics were of the opinion that such a campaign should start with the people's representatives at various levels because they can influence other sections of the society, while taking urgent appropriate actions to mitigate and adapt. The State Government employees in key departments such as transportation, industries, energy, water resources, forestry, health etc. should be the second priority in such a campaign. The students and common public can be targeted simultaneously through educational institutions and mass media.

Many articles from the participating public on many aspects of Climate Change w.r.t Karnataka are posted on KSPCB website as in the weblink below.

(<https://kspcb.wordpress.com/category/climate-change/>); accessed on 10.5.2015

***There can be no doubt that without effective involvement of all sections of the society the state action plan on CC cannot be effective. All possible efforts should be directed to launch a massive educational and awareness campaign at the earliest, and should continue indefinitely.***

### **8.15 Rural Karnataka, North Karnataka, and regional/district levels development plans**

Whereas the state is recognized as a leader in IT, ITES, BT, technological and educational hubs, and is 3<sup>rd</sup> or 5<sup>th</sup> most urbanized state, the scenario in the rural areas of the state has left a lot to be desired, and the rural development can be said to be below par. As per the state's planning document for 2010-11 Karnataka has 59,630 rural habitations including 27,481 inhabited revenue villages. According to 2001 census, about 66 per cent of the total population of 529 lakh people lives in villages. About 67 lakh households who live in rural areas depend mainly on agriculture for livelihood. While the backwardness of the rural areas in industrial and commercial sectors can be seen as a positive feature from the global warming perspective, the legitimate ambition of the rural population to attain the developmental status of the urbanites leads to the potential of being a source of vast GHG emissions in an unplanned development scenario, and can lead to accelerated depletion of our natural resources. Rural development on the basis of sustainability and environmentally friendliness can address the state's global warming concerns by a considerable level. Also, looking at the drought prone nature of a large percentage of the land, the developmental pathway for the rural Karnataka should be vastly different to that of polluted and resources constrained urban Karnataka. Hence, proper planning and developmental activities for rural Karnataka should acquire a more prominent role than it is at present in the developmental discourse of the state.

Poverty in Karnataka continues to be highest among the southern States. Incidence of poverty based on Planning Commissions poverty line, yields poverty ratio of 15.82 percent with 5.87 million poor in rural areas and 23.54 percent with 5.09 million poor in urban areas, and 18.52% with 10.87 million poor for Karnataka as a whole in 2009-10.

(<http://planning.kar.nic.in/sites/planning.kar.nic.in/files/AnnualPlan2010-11/2010-11-volumel/Chapter-06.pdf>); accessed on 10.5.2015

The distinguishing features of the rural society in India are:

- Large number of scattered and small habitations;
- More or less complete dependence on agriculture and related activities;
- Lack of adequate opportunities in others sectors of our economy;
- Infrastructure like roads, electricity, housing, potable water, sanitation is much below the expected levels;
- Backwardness in terms of human development parameters like literacy, health services and skill endowments;
- Lack of such infrastructure and facilities are encouraging urban migration;
- State's domestic produce, compared to the proportion of population, being low, the per capita income is also low;
- Low levels of energy needs and consequent GHG emissions;
- Life style can be said to be more sustainable than can be noticed in urban areas.

Hence, the key to development of rural areas in the state can be said to be through improving agricultural productivity and encouraging other suitable economic activities locally, thereby enhancing the availability and quality of infrastructure, improving the quality of those services which contribute to the up gradation of human development.

The public consultation meetings reflected the true concerns of the larger population, wherein a lot more attention / investment towards the rural development were demanded. The recommendations were clear in that there is no alternative but to provide suitable developmental opportunities and the necessary infrastructural facilities in rural areas as a high priority to minimise the urban migration, and the consequent increase in GHG emissions. Whereas the urban areas are contributing disproportionately high levels of GHG emissions, the simpler life styles in rural Karnataka can be said to be the factor which has kept the overall GHG emission of the state at a low level disproportionate to the rural population. If much of the rural areas in the state were to be as much dependent on the fossil fuels as the urban areas are, the things could have been far worse. It is in this context that the state has to take a very careful view of how much more urbanisation is desirable. If the overall GHG emissions of the state are to be kept at low levels, the rural areas need to be taken on a low carbon pathway and sustainable life style by providing at least the following infrastructures:

- Assist the rural population with sustainable and adequately remunerative agricultural, horticultural, and animal husbandry options;
- Provide efficient and low carbon based energy options such as solar, bio-mass and wind power;
- Provide other sustainable employment opportunities suitable for low carbon life styles, which will not demand large tracts of land, water, energy and metals;
- Provide basic infrastructural facilities, along with good quality education facilities, needed to achieve an acceptable level of human development, and to minimise the need for urban migration, and hence the GHG emissions.

Northern part of the state, which is generally referred to as north Karnataka, are associated with less vegetation, low levels of annual rainfall, large chunks of unused lands, and richness in solar power. The socio-economic development as well as the literacy level is also less than that of other parts of the state. A sustainable pathway for this region could be to optimally harness the geographic strengths of the region such as fertile soil to grow millets; harness solar / wind power; growing bio-fuel species of plants; other drought prone plant species of use as raw material for industries; optimizing the use of traditional skills and cottage industries; IT and BT industries, tourism, education, dairy based manufacturing units, fruit and agro based manufacturing units etc. This region is also in need of adequate development of transport and communication infrastructure, drinking water and waste management systems. Since the region is

drought prone the suitability of large industries, such as coal power plants, steel and cement industries, which need large quantities of water should be carefully studied.

In view of the fact that the poor people are likely to be at much higher risks from the fast changing climatic condition, there is a very high need to focus on the rural communities to prepare them not only to face the future threats, but also equip them to have a low carbon life style on a sustainable basis.

Since the state has many areas which are geographically and climatically different, it will be useful to consider the development pathway at district levels. During the public consultation meetings the participants were invited to recommend high level developmental plans for each district after adequate discussions among the locals, experts and academics. Few such developmental plans have been received, and the same are referred to in this report as representative views of the people.

The high level development plans received from the public were:

- A development plan for north Karnataka region, including the districts of Dharwad-Hubli, Belgaum, Bijapur, Bagalkot, Uttar Kannada and Haveri: Suresh Heblikar of ECO\_Watch foundation.  
*(<https://kspcb.wordpress.com/2015/05/06/a-concept-note-on-north-karnataka-development/>), accessed on 10.5.2015*
- A development plan for coastal Karnataka region; Dr. V N Naik, retired Professor of Marine Biology of Karnataka University.  
*(<https://kspcb.wordpress.com/2015/04/21/coastal-region-and-climate-change-dr-v-n-nayak-karwar/>), accessed on 10.5.2015*
- A development plan for Chamaraja Nagar;  
*(<https://kspcb.wordpress.com/2015/05/06/specific-plan-on-climate-change-in-chamarajanagar-district/>), accessed on 10.5.2015*
- A development plan for Coorg  
*(<https://kspcb.wordpress.com/2015/05/09/to-protect-and-save-kodagu-land-of-cauvery/>), accessed on 10.5.2015*
- A development plan for Hassan  
*(<https://kspcb.wordpress.com/2015/05/06/high-level-developmental-plan-for-hassan-district-from-global-warming-prospective/>), accessed on 10.5.2015*
- A development plan for Shimoga; (<http://wp.me/p34Lf5-jr>), accessed on 10.5.2015

Such development plans at each district / taluk levels are essential for effective involvement of all sections of the society.

## 8.16 Women's perspective

Globally there is an increasing level of concern amongst the social scientists that the women, who should have been at the centre of attention in both mitigation and adaptation measures, are not effectively involved at any level of action plan on climate change. Women in general, and poor and marginalized rural women in particular, are the worst sufferers of climate change impacts. They can also be critical change agents in implementing climate solutions.

The CC impacts on women and men can be different in Indian scenario; hence there is need to consider them both objectively.

Women in India, especially in rural India, have traditionally taken a huge role in managing the affairs of the family, including that of fetching bio-mass for cooking and water for the family. They also have a major role in agriculture, horticulture and animal husbandry. Since they also have a critical role in the upkeep of the homes; health and education of the children, they must be the centre of all climate change related action plans in India.

India's national and state-level adaptation policies need to not only target women but also make them

equal partners for adaptation to be successful on the ground. Their traditional knowledge and skills and their role in household consumption choices are critical resources not only to help adapt to climate vagaries but also to minimise the GHG emissions.

Women in rural Karnataka are less likely to have the education, opportunities, authority and resources they need to adapt to climate impacts. Socio-cultural barriers and women's traditional role as caretakers means they have little time for taking part in community discussions. Suitable opportunities can change this scenario. Thus, women's perspectives and needs are often not heard in various processes leading up to macro policy formulation. Climate change is adding another layer of inequality between women and men.

Women in rural Karnataka are known to spend a majority of a typical day in collecting bio-mass and water for their homes. They also are subjected to many health issues due to indoor pollution associated with inefficient type of bio-mass stoves and inadequate ventilation. These issues are projected to exacerbate in the changed climate.

There is a critical need to mainstream women farmers at all levels of implementation and decision-making because women are generally known to shoulder a larger share of farm activities but play a much smaller role in decision-making.

In villages where monsoons fail, many male farmers are seen to migrate to larger cities leaving behind resource-poor women to care for the entire household. In recent times, the proportion of women agricultural laborers has been growing faster than male agricultural workers, (Census, 2011; Planning Commission, 2008 and 2011).

Keeping in view these critical issues to our society, the Climate Cell of KSPCB provided special focus on women's perspective w.r.t CC. Many public consultation meetings dedicated to get feedback on women's perspective were held in Bangalore, and another was arranged by Mysore Grahakara Parishad (MGP), at Mysore. These meetings saw participation by many women and women's groups. A good number of recommendations were made in these meetings, and a good perception of women's perspective was obtained. While the participants deeply appreciated such dedicated sessions on women's perspective, which are probably the first of its kind in the country, there were also very serious concerns that women have not had any role in the state level discourse on such major policy initiatives. The participants recommended that such consultations should be held at more places in the state, preferably at every taluka place, and should be largely inclusive.

Public Affairs Centre (PAC), an NGO which participated in the meeting at Bangalore, has shared its views in detail through an article by title "Women's Perspective on Climate Change Adaptation", and has elaborated on the role of women in adapting and mitigating the CC.

*(<https://kspcb.wordpress.com/2015/04/16/womens-perspective-on-climate-change-adaptation/>); accessed on 10.5.2015*

## References

- Women, Gender Equality and Climate Change  
*([http://www.wcdrr.org/wcdrr-data/uploads/854/Women\\_and\\_Climate\\_Change\\_Factsheet\\_UNWomenWatch.pdf](http://www.wcdrr.org/wcdrr-data/uploads/854/Women_and_Climate_Change_Factsheet_UNWomenWatch.pdf)); accessed on 10.5.2015*

## 8.17 Traditional Knowledge and life style issues

India, being a country with long history, has witnessed sustainable life styles as practiced by our ancestors for thousands of years. There is a strong conviction by many in our society that but for the simplistic and sustainable life styles by our ancestors there would not have been much of forests and rivers to be seen

today. While the counter argument could be that the population was much less in the past and hence it was possible to have a sustainable life style, we cannot ignore the fact that almost all aspects of the life style of our ancestors were truly sustainable in the overall approach, and hence can be hugely relevant even today.

### Why Traditional Knowledge Holds the Key to Climate Change

“One significant manifestation of the marginalization of indigenous peoples from the climate change policy and decision-making is the paucity of references in the global climate change discourse to the existing traditional knowledge on climate change. Such international discourse has often failed to consider the valuable insights on direct and indirect impacts, as well as mitigation and adaptation approaches, held by indigenous peoples worldwide. This is particularly evident in the Intergovernmental Panel on Climate Change (IPCC) Assessment Reports released every few years.”

“The most authoritative and influential reference on climate change in the world, the IPCC Assessment Reports guide governments, policy- and decision-making communities, and non-governmental organizations in planning and implementing their actions. The last IPCC Assessment (AR4, published in 2007) noted that indigenous knowledge is “an invaluable basis for developing adaptation and natural resource management strategies in response to environmental and other forms of change”. “This was reaffirmed at the 32nd Session of the IPCC in 2010: “indigenous or traditional knowledge may prove useful for understanding the potential of certain adaptation strategies that are cost-effective, participatory and sustainable”. “Previous IPCC Assessments, however, were unable to access this type of information because, for the most part, traditional knowledge either appears in grey literature outside of peer-reviewed academic forums, or remains in oral form, thereby falling outside the scope of IPCC process.”

(<http://unu.edu/publications/articles/why-traditional-knowledge-holds-the-key-to-climate-change.html>); Accessed on 6.5.2015

Whether it is the deep respect they had for the nature, simple life styles, vastly much more equity in the access to natural resources, or much less dependence on non-human energy resources etc, all should be relevant even today. The participants in various public consultations meetings expressed their conviction that the only way of averting the environmental catastrophe was to study and adopt as much of traditional knowledge as feasible in our life styles. Many examples of such traditional practices were quoted. Some such examples were:

- Treating water resources with utmost respect; keeping them clean at all times
- Worshipping all creatures of the nature including forests, rivers, mountains etc. which led to their proper preservation
- Sacred groves in each village or community, which assisted in protecting bio-diversity
- Growing medicinal herbs / gardens around houses and temples, and performing certain rituals to cleanse the air (based on Vedic knowledge such as Agnihotra fire)
- Sustainable agricultural practices suitable to agro-climatic zones with only bio-fertilisers and plant based pesticides
- Having air cleansing tree/plant species around the residence, living near a Peepal tree, or near a Tulsi plant, sleeping under a sacred tree can all be cited as good examples of the understanding of the nature.

A good example of the glorious traditional knowledge our ancestors had developed over thousands of years can be: “Start with the rising sun and work toward the setting sun. Take only the mature trees, the sick trees, and the trees that have fallen...and the trees will last forever.” Menominee (Native American tribe) Oral History.

Even if the modern society does not subscribe to the view of worshipping plants/trees, the ecological importance of preserving bio-diversity is becoming increasingly evident in the context of Climate Change. It is interesting that our ancestors did so many things admirable in preserving the pristine environment they had inherited from their ancestors without writing truckloads of books on Climate Change. The Indian belief that all the plants are abodes of the divine personality itself is enough to substantiate the point that

our concern for ecological concern dates back to thousands of years.

Many participants stressed the fact that our ancestors have provided us with ways and means of preserving the nature and of leading sustainable life styles. The society has to decide whether to study and adopt them OR continue to face the threats of CC.

*Agnihotra* is a special fire performed exactly at the time of sunrise and sunset in a copper pyramid. It comes from ancient Vedic Knowledge. Agnihotra is said to purify the environment and especially it has been found to have profound impact in mitigating water pollution problem. One such study shows that water will be purified if it is kept in a room where Agnihotra is regularly performed. Water purification also happens if water bottles are kept inside a Faraday Cage in the Agnihotra room. These results suggest that Agnihotra creates an energy field beyond the electromagnetic field which has profound impact.

*(Effect of Agnihotra energy field on water purification; Ulrich Berk & Shailendra Sharma; Indian Journal of Traditional Knowledge Vol. 1 (1), January 2015, pp. 63-68)*

### **“Sacred Plants of India: Marvellous lucidity of Puranic facts”**

The book, “Sacred Plants of India” by Nanditha Krishna and M Amrithalingam throws light on many sacred plants which were worshipped and preserved in our culture. The book has taxonomical details, mythological notes and lists trees that have mysterious potency of more than 80 sacred plants. Even if the modern society does not subscribe to the view of worshipping such plants/trees, the ecological importance of preserving is becoming increasing evident in the context of Climate Change. It is interesting that our ancestors did so many things admirable in preserving the pristine environment they had inherited from their ancestors without writing truckloads of books on Climate Change. Thus, the book gives unified plant information on history, mythology, science and medicine. The logical precision of information is laudable. The present discourses on ecology, the debate on carbon credit, the dangers of deforestation, the issue of clean energy — all have their oblique references in Indian plant mythology. The benefits of walking around a Peepal tree, or a Tulsi plant, sleeping under a sacred tree, all point to the same: We need to preserve the forests. The Indian belief that all the plants are abodes of the divine personality itself is enough to substantiate the point that our concern for ecological concern dates back to thousands of years.

*<http://mitramaadhyama.co.in/archives/3249>; accessed on 10.5.2015*

***It was a matter of consolation to know that many communities and individuals have retained some of the traditional knowledge. The present day society would do well to study such practices, and implement them wherever feasible.***

### **References**

- “Exploring the Role of Traditional Ecological Knowledge in Climate Change Initiatives”  
([http://www.fs.fed.us/pnw/pubs/pnw\\_gtr879.pdf](http://www.fs.fed.us/pnw/pubs/pnw_gtr879.pdf)); accessed on 10.5.2015
- “Sustainable Development and Protection of Environment: by Prof. M.A. Lakshmithathachar provides a high level indication of such traditional knowledge.  
(<https://kspcb.wordpress.com/2015/05/06/sustainable-development-and-protection-of-environment-prof-m-a-lakshmithathachar/>); accessed on 10.5.2015

### **8.18 KSPCB issues**

Many initiatives of KSPCB, including the huge efforts behind organizing public consultations associated with the present study report, the programme on Parisara Mitra Schools, various out reach programmes were appreciated by the participants.

In most of the public consultation meetings the critical role of KSPCB in the overall upkeep of the environment was stressed by the participants. While some participants wrongly held KSPCB responsible for all the environmental problems, without appreciating the limits of various mandates of the relevant Acts, it was evident that people wanted a much larger and vastly more important role for KSPCB in arresting

the run away status of pollution of land, water and air. Many considered KSPCB as the most appropriate agency to be entrusted with a lead role to co-ordinate all the actions needed to mitigate the Climate Change in the state.

Since KSPCB is mandated by the relevant Acts to control the pollution of air, water and land, and since these three are also the primary cause of global warming, it seems appropriate for the STATE to consider making KSPCB as the nodal agency for implementing the state action plan on climate change. For that to happen the agency will need lot more powers and resources at its disposal. As far as capacity building is concerned, it would be rather easy with this agency than with any other agency of the Government because of the vast base of highly qualified staff in it. Since KSPCB has offices in all districts, and is working closely with many departments of the State Government its offices at district places seem to be in an ideal position to act as rallying points for all climate change related activities.

Participants also wanted KSPCB to be a role model for other Government agencies in optimising the usage of natural resources such as water, land, energy etc. through measures such as rain water harvesting, energy efficient buildings, tree planting etc. in all its activities including its buildings.

There was also a mandate from the State Government to KSPCB to provide additional focus to three action points pertaining to the specific role being discharged by KSPCB as follows:

- Promoting treatment plants at point source, and CETPs for cluster of small scale industries
- Data on type and amount of Hazardous Chemicals released by different sectors
- Research on implementation of advanced technology to reduce pollutants entering the sea.

Discussion with the Climate Change cell of KSPCB revealed the compilation of relevant information as in **Annexure 13**.

### **8.19 Other issues of importance from the perspective of state action plan**

- In most of the public consultation meetings participants raised very many relevant issues of hue importance in mitigation and adaption to the CC, but which could not be included in any of the heading discussed above.
- The issues such as strategising and adapting to CC; social and technical issues in CC; studies, data base and modeling on CC in Indian context; civil society participation etc. are all important from the perspective of state action plan. Hence they are listed under a separate group.

## Chapter 9

# Best Practices and Conclusions



### 9.1 Best Practices

While it is necessary to take a long term view of various policies and practices at the societal level in order to mitigate and Climate Change, in the short term it has become critical to study the best practices already in vogue around the world, and carefully consider to implement those which are relevant to our state's requirements at an early date.

In the context of Climate Change there is a vast amount of literature and statistics indicating best practices in various sectors of the economy, at least in today's context. Such practices can be modified to suit an individual scenario, or there may be better practices in the future.

There are very many good examples of bio-waste management for energy production and rainwater harvesting in our own state, as in **Annexure 14**. It is both in the short term and long term interest of the state that every one of such best practices are studied in detail, and adopted widely with suitable modifications, if necessary.

The following are some of such best practices which can be considered for adoption in the state.



**Table 15: Best Practices for addressing Climate Change threats**

1. Making eco-friendly toilets	<a href="http://bit.ly/1An1REE">http://bit.ly/1An1REE</a> ; accessed on 10.5.2015
2. Eco-friendly technologies fetch better results in rice production	<a href="http://bit.ly/1bWOyjn">http://bit.ly/1bWOyjn</a> ; accessed on 10.5.2015
3. 'Zero Garbage Kitchen' – Adama Chetana, Bangalore	<a href="http://www.adamyachetana.org/green-life/zero-garbage-kitchen/">http://www.adamyachetana.org/green-life/zero-garbage-kitchen/</a> ; accessed on 10.5.2015
4. Greenpeace's Take Charge	"Taking Charge"; GreenPeace India: <a href="http://www.greenpeaceindia.org">www.greenpeaceindia.org</a> ; accessed on 10.5.2015
5. No vehicle zones in CBD of London	<a href="http://en.wikipedia.org/wiki/London_congestion_charge">http://en.wikipedia.org/wiki/London_congestion_charge</a> ; accessed on 10.5.2015 <a href="http://www.london.gov.uk/sites/default/files/londons-cbd-jan08.pdf">http://www.london.gov.uk/sites/default/files/londons-cbd-jan08.pdf</a> ; accessed on 10.5.2015
6. Sacred forests	<a href="http://bit.ly/1FI0z7g">http://bit.ly/1FI0z7g</a> ; accessed on 10.5.2015 <a href="http://www.ces.iisc.ernet.in/biodiversity/sahyadri_enews/newsletter/issue32/article1.htm">http://www.ces.iisc.ernet.in/biodiversity/sahyadri_enews/newsletter/issue32/article1.htm</a> ; accessed on 10.5.2015 <a href="http://bit.ly/1KskDxG">http://bit.ly/1KskDxG</a> accessed on 10.5.2015 <a href="http://bit.ly/1KskDxG">http://bit.ly/1KskDxG</a> accessed on 10.5.2015
7. Germany's example in Renewable Energy	<a href="http://energytransition.de/">http://energytransition.de/</a> ; accessed on 10.5.2015 <a href="http://in.boell.org/2015/03/17/energy-transition-india-exploring-german-energiewende">http://in.boell.org/2015/03/17/energy-transition-india-exploring-german-energiewende</a> ; accessed on 10.5.2015
8. Solar Water Pumps for agriculture	Solar Irrigation Pumps - Farmers' Experience and State Policy in Rajasthan Economic & Political Weekly, March 8, 2014 <a href="http://Shaktifoundation.in/wp-content/uploads/2014/02/feasibility-analysis-for-solar-High-Res-1.pdf">http://Shaktifoundation.in/wp-content/uploads/2014/02/feasibility-analysis-for-solar-High-Res-1.pdf</a> ; accessed on 10.5.2015
9. An integrated approach to meet the energy demand of a district – case study on Shimoga district	"Selection Of Sustainable Energy Technologies Based On Energy Availability-Consumption Pattern: A Region Specific Analysis [Shivamogga]"; H.B. Suresh , Sreepathi. L.K2, J.N.N. College of engineering. Shivamogga. Karnataka. India <a href="http://bit.ly/1G2EhPQ">http://bit.ly/1G2EhPQ</a> ; accessed on 10.5.2015
10. Making the existing automobiles more efficient	Global Solutions To Reduce Pollution From Over One Billion Air Breathing Petrol & Diesel Engines in use across the World <a href="http://bit.ly/1Fcr7cd">http://bit.ly/1Fcr7cd</a> ; accessed on 10.5.2015
11. Harnessing roof top SPV systems	a good example of KSCA cricket stadium in Bangalore commissioning 400 kW solar power system on its roof
12. Renewable Energy & Sustainable Technologies	<a href="http://www.niecrest.in/">http://www.niecrest.in/</a> ; accessed on 10.5.2015

## 9.2 Conclusions

In the backdrop of the fact that about 2,000 people from diverse backgrounds in the state such as teachers, college Professors, doctors, engineers, NGOs, State Government employees, college students, women, activists, industrialists, farmers and others participated in the public consultations, and about 1,000 people have expressed their views on the kind of developmental plan for the state, it is reasonable

to assume that these recommendations truly reflect the public's aspirations to the extent feasible under the circumstances. Hence these recommendations should be considered objectively for implementation with all the seriousness they deserve.

Participants seem to fully accept the view of IPCC that Climate Change is set to inflict "severe, widespread, and irreversible impacts" on people and the natural world unless carbon emissions are cut sharply and rapidly.

Among the people who attended the public consultation meetings, there was a sort of unanimity that the implications of Climate Change are so huge and so important for all sections of our state that we cannot afford to continue to ignore the urgency to develop and implement an appropriate action plan to mitigate and adapt.

The STATE has no option but to take resolute steps to 'mitigate' and 'adapt'. Anything less than a fully committed and comprehensive action plan should not be acceptable.

The level of awareness and interest among the general population of the state on the issues of Climate Change can be termed as very low, and should be a cause of serious concern because such a status will seriously hinder the much needed efforts to mitigate and adapt.

The deleterious impacts of CC are projected to affect every sector of our economy. Sectoral considerations and holistic approach to the overall welfare of the society will demand that specific action plan with clearly identified targets and accountability should be developed for each sector and each taluka / district, and implemented through active participation of various stake holders at all levels.

The existing Acts and regulations alone, if implemented diligently, can address most of the serious CC issues impacting our communities. Suitable modifications to these Acts and rules will provide the necessary additional tools to address the multiple crises confronting our communities.

The initiative of the State Government to seek feedback from the public on state' action plan and the well organized efforts of KSPCB to make this initiative effective have attracted a lot of appreciation from the public. Various departments and agencies of the State Government should embark on similar public consultation process reaching to all talukas and all sections of the society in order to develop a people centric action plan for the state.

Public have felt that such an initiative should be escalated to the level of a serious awareness campaign on all related issues of CC at the societal level. State Government officials and people's representatives should receive maximum and priority attention from such an awareness campaign because of their role as change agents.

There is a critical need for the society to deliberate objectively on all the overarching developmental policies at the societal level and to take principled stand to mitigate and adapt to CC.

Water stressed characteristic of the state should determine the developmental pathway for the overall economic development of the state in general, and for agriculture and industries in particular. Sustainable agricultural, horticultural and animal husbandry practices should become a fundamental approach from CC perspective.

The forests of the state, almost all of which are in WGs, and which are among the eight hottest of biodiversity hotspots in the world, are critical for the long term welfare of the state, and hence must be protected and enhanced at any cost, because no cost is too high in this regard as compared to the criticality of the same.

The absence of any kind of fossil fuel reserve and the huge potential for RE in the state should define the energy pathway for the state. An integrated approach consisting of suitable measures for highest possible

efficiencies, optimal demand side management, responsible energy conservation and widespread usage of distributed RE sources has become critical to meet the growing energy demand of the state.

Industrialisation, urbanisation and rural development should be considered in a holistic manner keeping their huge relevance to CC and the overall welfare of the state in proper perspective.

Air pollution associated with the large number of vehicles in operation, and water pollution associated with chemical contamination cannot be ignored any longer, and hence should be addressed with adequate pollution control measures on a war footing.

Traditional knowledge and the role of women in mitigation and adaptation should receive the attention they richly deserve.

A coordinating agency, preferably a standing committee of responsible officers, domain experts, credible NGOs and committed individuals, directly reporting to the Chief Minister should oversee the development of a comprehensive state action plan and implementation of the same on a continuous basis.

Keeping in view the fact that KSPCB is already entrusted with the administration of Air Act, Water Act, and Environmental Protection Act in the state, it should be considered to be nominated as the coordinating agency for the implementation of state's action plan on CC. It should be provided with necessary authorities (through legal support if needed) and resources. The staff vacancies in KSPCB, which are considered to be the highest among SPCBs in the country, should be filled urgently and the staff strength should be further enhanced for effective administration of the relevant Acts.

It may appear that the initiatives such as NAPCC, KSAPCC, Carbon Tax etc. by successive governments will be able to address all the concerns on Climate Change. But a rational analysis of the ground realities in the state in particular, and in the country in general, will give raise to serious doubts whether these policies will make any considerable impact on the total GHG emissions without concerted follow up actions. With the so called carbon tax has the consumption of fossil fuels been reduced in absolute terms? It is not evident: more and more vehicles are coming on to the road; more and more petrol bunks are being opened; successive governments are spending lots of money in widening the roads, building fly-overs, express ways, reducing/ eliminating foot paths etc. which are all only to facilitate more vehicles. Vast increase in air travels is being reported and there are plans to build more airports. One will have difficulty to understand in what way all these are positive steps in combating the CC?

Has there been reduction in coal consumption? It is impossible to say so. A large number of coal power plants are being planned / implemented. Coal is being imported in increasing quantities. Some coal power plants are being built entirely dependent on imported coal. Very many additional coal mines are being permitted (moves to auction about 210 coal mines are underway). Where are all these coal mines? Most of them are below thick tropical forests of very high ecological value to the global climate and of huge socio-economic value to the local tribal populations. A coal consumption reduction scenario cannot be foreseen in the near future. In such a context how can the carbon tax help CC? Those people who are rich seem to be ready to pay any price for the continued access to fossil fuels.

A highly effective carbon sink are our tropical forests. But they are under all sorts of pressure to be diverted to non-forestry purposes, including the proposed coal mines. So are the diversions of agricultural/ horticultural lands, which have been sequestering carbon for ages. The urbanisation, which is a substantial contributor to GHG emissions, is galloping away. And the usage of chemicals in all walks of life is increasing phenomenally. In such a scenario it is impossible to project any drop in the total GHG emissions of the state/country.

A rational analysis of all the relevant issues, in the backdrop of people's recommendations, would reveal that a credible CC policy in the country/ state will need clear and committed statement on the following

requirements:

- that it proposes to reduce the energy reliance on coal by certain percentage by 2025, 2040, 2050 etc. w.r.t the base year of, say, 2000
- that it proposes to reduce the consumption of petroleum products by certain percentage by 2025, 2040, 2050 etc. w.r.t the base year of, say, 2000
- that it will stop diverting the existing forests until the forest policy target of 33% of the land cover is reached again; and that it will take effective measures to increase the forest cover area by at least by 0.5% every year for the next 30 years
- that the chemicals used in agriculture will be gradually reduced so as to make our agriculture completely sustainable /organic by 2040/50
- that a minimum 75% of our electricity needs will be met by new and renewable energy sources by 2050
- that it will take all possible measures to reduce the urbanisation, and keep the urban population to less than, say 30% by 2040/50.

The overarching principles behind the recommendations of the public can be said to be generally consistent with those advocated by many credible / influential sections of the globe such as UN, UNEP, FAO, World Bank, etc. and even by India's own National Action Plan on Climate Change. Also it is not difficult to see how the letter and spirit of the Constitution of the country, and various Acts of the Parliament such as Air Act, Water Act, Environmental Protection Act, the Forest Conservation Act and the Wild Life Protection Act etc. seek the implementation of such recommendations.

The public were clearly of the demand that the state must not only focus on the welfare of the present generation, but also must not do anything to jeopardize the true welfare of the future generations. This is possible only if the state takes care not to succumb to the demand by a tiny section of the society for unsustainable harnessing of our natural resources.

In summary, it can be said with a high degree of confidence that, if these recommendations are converted into credible state action plan after due diligence consultation with the concerned stake holders and effectively implemented, they will lead to satisfactory 'mitigation' and 'adaptation' w.r.t. the looming Climate Change.

*Broken land for a broken future?*



### List of public consultation meetings

	Date	Place	Venue	Districts covered / stakeholders
1	28.1.2015	Mysore	Institution of Engineers	Mysore, Chamaraja Nagar and Mandya
2	29.1.2015	Madikeri	Coorg International Hotel	Coorg and Hassan
3	6.2.2015	Mangalore	Office of DC	Dakshina Kannada, Udupi and Chickamagaluru
4	7.2.2015	Karwar	District Science centre	Uttara Kannada and Haveri
5	9.2.2015	Sirsi	M.M College	Sirsi area
6	20.2.201	Bellary	Rao Bahaddur Mahabaleshappa College of Engineering	Bellary, Raichuru and Koppala
7	21.2.2015	Gulberga	District Science Centre	Gulberga, Bidar and Yadgir
8	22.2.2015	Vijayapura,	ZP Convention Hall	Vijayapura and Bagalakote
9	27.2.2015	Shivamoga	JNNCSEminar Hall	Shivamoga and Davanagere
10	28.2.2015	Tumkur	DIET Seminar Hall	Tumkar and Chitradurga
11	12.3.2015	Dharwad	Regional Science Centre	Dharwad and Gadag
12	13.3.2015	Belgaum	Foundry Association Convention Hall	Belgaum
13	24.3.2015	Bengaluru	KSPCB Seminar hall	Bengaluru Urban,
14	25.3.2015	Bengaluru	KSPCB Seminar hall	KSPCB staff members
15	26.3.2015	Bengaluru	KSPCB Seminar hall	Bengaluru rural, Ramanagara, Ckikka- Ballapura and Kolar
16	7.4.2015	Bengaluru	KSPCB Seminar hall	Women's perspective
17	8.4.2015	Bengaluru	Nisarga Bhavan premises	KSPCB C & D group of Nisarga Bhavan on Womens perspective
18	9.4.2015	Bengaluru	Nisarga Bhavan premises	KSPCB C & D group of Nisarga Bhavan on Womens perspective
19	10.4.2015	Mysore	MGP premises	Women's perspective
20	13.4.2015	Bengaluru	Ashwatha Katte, AGS Layout, Subramanyapura post	Women of AGS Layout, Womens perspective
21	5.5.2015	Bengaluru	KSPCB Seminar hall	Departments of Energy, Industries, agriculture and water resources

### Power Project Proposals in Karnataka

(Various stages of planning & implementation as in 2009)

Project	Capacity	Fuel	Comments / concerns
1. Richur Thermal Power Station (RTPS): extension	1*250 MW + 2*500 MW	Coal	Coal shortage already being experienced; additional quantity of water can be a serious issue for the dry region; already listed as a highly polluted region by Ministry of Environment & Forests (MoEF)
2. Yeramarus, near Raichur	2*500 MW	Coal	How are we going to get huge quantities of coal and fresh water for these additional coal power plants? Land acquisition is already facing strong opposition in different parts of the state.
3, Edlapura, near Raichur	1*500 MW	Coal	How are we going to get huge quantities of coal and fresh water for these additional coal power plants? Land acquisition is already facing strong opposition in different parts of the state.
4, Kudigi, near Bijapur	5*800 MW	Coal	UMPP by NTPC?; Imported coal? Will water supply from Almatti reservoir affect the water supply to the region?
5. Yadgir Thermal Power Project near Gulbarga	2* 500 MW	Coal	How are we going to get huge quantities of coal and fresh water for these additional coal power plants? Land acquisition is already facing strong opposition in different parts of the state.
6. Nandikur Power Project, near Udupi	2*660 MW ?	Coal	Already commissioned. Reports on proposal for expansion.
7. Gundia hydel project near, Sakaleshapur	2*200 MW	Water	Can we afford to loose thick rain forest of about 1000 acres?
8. Tadadi gas power project near Gokarna	3*800 MW ?	Gas	How are we going to get huge quantities of coal and fresh water for these additional coal power plants? Land acquisition is already facing strong opposition in different parts of the state.
9. Bellary Super Thermal Power; Extension	2*500 MW	Coal	How are we going to get huge quantities of coal and fresh water for these additional coal power plants? Land acquisition is already facing strong opposition in different parts of the state.

10. Varahi hydel project – Stage II	2 * 115 MW	Water	Not much of a serious concern unless more land area (of forest and agricultural fields) is planned for submersion.
11. Kuduthini Thermal Power, near Bellary	3* 500 MW	Coal	How are we going to get huge quantities of coal and fresh water for these additional coal power plants? Land acquisition is already facing strong opposition in different parts of the state.
12. Kalgurki Thermal Power	3* 500 MW	Coal	How are we going to get huge quantities of coal and fresh water for these additional coal power plants? Land acquisition is already facing strong opposition in different parts of the state.
13. Annechakanahally Thermal power, near Hassan	3*500 MW	Coal	How are we going to get huge quantities of coal and fresh water for these additional coal power plants? Land acquisition is already facing strong opposition in different parts of the state.
14. Bhoruka Power Corporation, Gulberga	2*300 MW	Coal	Private sector proposal seeking coal linkages
15. JSW Energy Ltd, Toranagallu, Bellary	2*130 MW	Coal	Private sector proposal seeking coal linkages
16. JSW Energy Ltd, Toranagallu, Bellary	2*300 MW	Coal	Private sector proposal seeking coal linkages
17. Atlas Power India Pvt Ltd.; Yadgir, Glubarga	2*660 MW	Coal	Private sector proposal seeking coal linkages
18. Jewargi Power Ltd, Jewargi, Gulbarga	2*660 MW	Coal	Private sector proposal seeking coal linkages
19. M/S Power Company of Karnataka, Ghataprabha, Belgaum	2*660 MW	Coal	Private sector proposal seeking coal linkages
<b>Grand Total</b>	<b>23,020 MW</b>		<b>21,550 MW of coal power</b>

Note: (a) There are also few proposals for captive power plants of small and medium sizes.

(b) List from KPCL website and Ministry of coal

## Transcript of news paper report in Deccan Herald of 9 September 2008

<http://archive.deccanherald.com/Content/Sep92008/state2008090988970.asp>

### State-C'garh script powerful history

From Jagadish Angadi, DH News Service, Raipur:

**Karnataka and Chhattisgarh on Monday set a classic example of inter-state co-operation in a federal set-up by inking a Memorandum of Understanding (MoU), allowing the former to set up a pit-head thermal power plant in the latter.**

**The 1200 MW power plant will come up at Godhna in Janghir district of Chhattisgarh.**

The land acquisition and such other formalities will be completed by the Chhattisgarh government, while the Karnataka government has agreed to implement the best rehabilitation, remuneration and resettlement package for those who sacrifice their lands.

Principal Secretary, Department of Energy K Jairaj and KPCL MD S M Jaamdar, on behalf of the State, exchanged files of the MoU with their Chhattisgarh counterparts symbolizing the signing of the MoU at Raipur.

Speaking on the occasion, Chief Minister B S Yeddyurappa termed the MoU as a major milestone in the history of power generation in the country as well as Karnataka.

The chief minister pointed out that Karnataka is experiencing acute shortage of power. Currently, it has a total installed capacity of around 8,930 MW, as against the demand of 9,000 MW. It is estimated that by the end of the Eleventh Plan, the energy demand in the State would increase to 11,000 MW and by the end of Twelfth Plan, it will further increase to 13,092 MW. Hence, the BJP government has given primacy for enhancing the generation capacity, he stressed.

He said: "The government has embarked upon an ambitious plan of adding another 10,000 MW of power before the end of Twelfth Plan. As much as 5,000 MW would be achieved in the next four years during the Eleventh Plan itself. The State has exhausted most of its hydel potential. At present, the State is producing the highest quantum of hydro-electric power in the country which is more than 55 per cent of its total supply."

The chief minister justified the MoU stating that transporting coal from other states is very costly. The transportation expenditure turns out to be four times the cost of coal. It is therefore not economical to locate the thermal power stations in the State. If power is produced at the pit-head, the cost of power will come down by 30 to 40 per cent.

"It is a small beginning in the cooperation and collaboration for development between Chhattisgarh and Karnataka. The State will help Chhattisgarh in fields like IT, BT, higher education, medical education and silk technology," he added.

Cheaper coal

The proposed pit-head thermal power plant will produce approximately 1200 MW. It will use coal from nearby coalfields making energy cheaper. It will also save the fuel which would have been spent for transporting about 60 lakh tonnes of coal from Chhattisgarh to Karnataka. More than half of the human resources will be recruited from Chhattisgarh. The State is also contemplating developing captive mines in Chhattisgarh, Yeddyurappa said.

Chhattisgarh Chief Minister Raman Singh stressed the importance of inter-state co-operation in a federal structure.

"We have made the beginning. The state was planning to enter into an MoU with the Delhi government, but Karnataka succeeded in clinching the deal. The State would seek the help of Karnataka in developing IT, BT, higher education, medicine and health sectors. We stand together now and will continue to remain so."

Karnataka Ministers V S Acharya and G Karunakara Reddy were present.



### “The coal curse’

## India’s first-ever environmental rating of coal-based power plants finds the sector’s performance to be way below global benchmarks

*<http://bit.ly/1DMStsx> (accessed on 6.5.2015)*

India is the fifth largest producer and consumer of electricity in the world with the total production coming up to 1,006 terawatt hours. Electricity demand is set to rise in the country and the capacity of coal-fired plants is projected to double between 2012 and 2022. This is a matter of concern, as a recent two-year study by New Delhi-based Centre for Science and Environment (CSE) has reported that coal-based power plants run on inefficient technology, don’t meet even the lenient regulations and are a major source of pollution.

The performance of these plants is way below the global benchmark, with immense scope for improvement. The study, Heat on Power, done under CSE’s Green Rating Project (GRP), is the first of its kind rating of coal power sector in India in terms of their environmental performance and compliance. “Given the rapid increase in coal-based power projected by the government, stress on precious resources like water and land will increase and air and water pollution will worsen, unless corrective measures are taken by the industry and policy makers,” said Sunita Narain, director general of CSE during the release of ratings in New Delhi.

### Water guzzlers

“The thermal power industry in India annually draws about 22 million cubic metres of water, which is equal to over half of India’s total domestic water needs,” said Chandra Bhushan, CSE’s deputy director during a round table organised at Mumbai. Over 70 percent of the total freshwater withdrawal by industrial sector in the country is by these plants, which are also water inefficient. As against the global best of 1.6 m<sup>3</sup>/MWh of water use, the average water use by coal-based power plants in India is 4 m<sup>3</sup>/MWh.

Apart from being water guzzlers, coal-fired power plants are also a source of high air pollution. Almost 70 per cent of total coal consumed in India is by this sector. Since they burn coal inefficiently, they spew out toxins. Of the total industrial sector pollution in the country, coal-fired power plants are responsible for 60 per cent of particulate matter (PM) emissions, 45-50 per cent of sulphur dioxide (SO<sub>2</sub>) emissions, 30 per cent of nitrogen oxide (NO<sub>x</sub>) emissions, and more than 80 per cent of mercury emissions.

The GRP team started the study in early 2012 covering 47 coal-and lignite-based thermal power plants spread across 16 states with a total capacity of 54 gigawatts. In order to assess the plants, the research team considered only the generation phase, i.e., from the entry of coal inside the plant boundary till the generation of electricity. Several parameters were considered and assigned weightage. These include energy, air pollution, water use, ash handling, water pollution, etc.

Of the 47 power plants rated, four plants made it to the Three Leaves category, scoring between 40 and 60 per cent. Seven companies got Two Leaves (30-40 per cent), and 16 One Leaf (20-30 per cent). Twenty plants got less than 20 per cent score. The performance of NTPC Ltd., which refused to disclose data to the GRP team, was found to be below par (16-28 per cent).

CSE found almost two-third of the surveyed plants to be clearly violating the lax PM standard of 150-350 milligrams per normal cubic metre (mg/Nm<sup>3</sup>) for existing plants. The future coal-fired power plants in the country have to follow 50 mg/Nm<sup>3</sup>, which is still lenient than China and the US, who follow a PM standard

of 20-30 mg/Nm<sup>3</sup> and 10-50 mg/Nm<sup>3</sup> respectively. These countries also regulate other pollutants, like SO<sub>2</sub>, NO<sub>x</sub> and mercury from the coal-fired power plants. However, in India there are no standards for these toxic pollutants.

Coal-fired power plants in India are also not land efficient. On the basis of environmental clearance granted, CSE has calculated that till February this year, 2.85 lakh hectares (ha) of land has been diverted for such projects. Of this 0.75 lakh ha is for the plant sites and 2.1 lakh ha is for the coal mines, which includes 46,719 ha of forest land.

The Central Electricity Authority suggests using 0.44 ha land per MW capacity. But, CSE assessment shows that Indian coal plants are using an average of 0.72 ha per MW, of which over 40 per cent is used for disposing ash. At present, more than a billion tonne of ash is lying unused in ash ponds across the country. Indian coal-fired power plants lag behind in energy efficiency too. Poor efficiency means burning extra coal to generate the same amount of power. Take the case of China, where plant efficiency is 35.7 per cent. In the US and Japan, it is 35.8 per cent and 40.5 per cent respectively. But, average efficiency of Indian coal-fired power plant is only 32.8 per cent. CSE's survey found Tata Power's 4,000 MW plant at Mundra in Gujarat to be the most efficient plant (38.1 per cent) and JSEB, Patratu to be least efficient (21.4 per cent). Low efficiency is also directly related to high CO<sub>2</sub> emissions. CSE's study found the average emission rate of Indian plants to be 1.08 tonne CO<sub>2</sub>/MWh, which is seven per cent higher than the global average and 14 per cent higher than China's.

### **Smarter solutions**

As per the list of proposed coal-fired power plants in India, a number of these projects are coming up in clusters. This means, local pollution levels are going to rise in the future. According to J P Deb Roy, vice president of JSW Energy Ltd, the need of the hour is to increase efficiency of the installed capacity, rather than blindly setting up new coal-fired power plants. Bhushan claims that strict standards for PM, SO<sub>2</sub>, NO<sub>x</sub> and mercury must be set in the country and all new capacity additions should be based on the tighter norms. Coal-based plants should also use resources (land, water, coal, etc) efficiently.

Environmental cost must be built into the project cost of coal-fired power plants. Such a calculation may lead to an increase (20-25 percent) in capex (capital expenditure) and O&M costs (and eventually consumer tariffs); but, it will also lead India's thermal power sector to the global best. Are we ready for it?

### Comparison of electricity technologies in a matrix form

Technology	Positives	Concerns	a) Ranking b) Suitability to Karnataka
<b>CONVENTIONAL TECHNOLOGIES</b>			
<b>Coal</b>	Fairly mature technology; all weather and reliable source of electricity ; suitable for base loads; has been main source for many decades	Pressure on land, water and minerals; fast depleting fuel source; social and environmental concerns; ever increasing costs and supply risks; global warming concerns; disposal of ash; pollution of land, water and air.	a) Lowest Rank b)Least Suitable
<b>Natural Gas</b>	Much less pollutants and GHG concerns; suitable for peak loading because of its ability to start and stop quickly; can be considered as a link fuel between coal based power era and renewable energy era.	No large reserves; huge import dependence;  fracking has huge global warming concerns; needs a lot of fresh water; pollution of land and water	a)Lower Rank b) Not Feasible
<b>Dam based hydro</b>	Clean source of electricity;operational costs are very small; best suited for quick start, stop or varying loads; can be a part of multipurpose dams; considered a renewable energy source	Many social and environmental concerns; Methane as highly potent GHG; location specific and largely away from load centres; mostly in hilly terrains; need long transmission lines; much larger construction time; vastly impacted by the vagaries of rainfall; likely to be impacted by the climate change impacts.	a) Low Rank b) Not much potential
<b>Mini/micro hydro</b>	Has least costs on social and environmental grounds; highly suitable for hilly terrains; can complement photovoltaic solar energy systems during winter/ rainy seasons	Not suitable for grid based operations; due to absence of storage reliability can be low	a) Good Rank b) Not much potential
<b>Nuclear</b>	No GHGs during its operation; Low operational costs; highly suited for base load operations	Capital costs and risks are very high; huge threat of accidents and radiation; spent fuels have remained a serious issue and can have dangerous levels of radiation for thousands of years; not enjoyed popular support	a) Lowest Rank b) Least Suitable
<b>NEW AND RENEWABLE TECHNOLOGIES</b>			

<b>Solar</b>	Clean, green and renewable; most suitable at consumer's premises; no pressure on land and water; minimum pollution loading; fast declining prices; gaining lot of support ; low operational costs	Per MW Capital costs are considered high; suitable only during sun-shine hours; intermittency is a serious issue; may need back up or storage in many applications	a) Highest Rank b) Highly Suitable
<b>Wind</b>	Clean, green and renewable; minimum pollution loading; fast declining prices; gaining lot of support ; low operational costs	Intermittency is a serious issue; may need back up or storage in many applications; location specific; can leave considerable foot print on environment	a) Highest Rank b) Highly Suitable
<b>Bio-mass</b>	Clean, green and renewable; Highly suitable where large quantities of agricultural and plant wastes are available; suitable to rural areas where electricity has not reached; bio-energy has been in use in India for thousands of years; low costs and environmental foot print.	Unregulated usage can lead to food security issues; bio-electricity production is relatively new, and may not be seen as a mature technology	a) High Rank b) Highly Suitable
<b>Geo-thermal</b>	Clean, green and renewable; cost effective and reliable; has been in usage in New Zealand an Iceland for decades	Location specific; historically limited to areas near tectonic plate boundaries	a) High Rank b) Suitability to be studied
<b>Ocean energy</b>	Has huge potential for the long Indian coast; can have very low operational costs	Not a mature and widely used technology; can have impact on marine creatures; needs more of R&D spending	a) High Rank b) Suitability to be studied
<b>T &amp; D SYSTEM</b>			
<b>Integrated Network</b>	Has come to be known as essential; needed in case of large size power plants; has been very popular	Complexity and risk of failures growing; has not met the needs of rural areas in India; has social and environmental footprint; increasing costs; land acquisition is an issue; prone for natural calamities such as flood and storms	a) High Rank b) Needed with modifications
<b>Micro/Smart Grid</b>	Most suitable for smaller / rural communities; provides local control; low capital and operational costs; highly suitable for distributed REs; has nil or very low social and environmental footprint; much easier to manage;	Emerging technology; will need very advanced protection and communication technologies; stake holders have to exercise much higher operational discipline	a) Highest Rank b) Essential and suitable

(Source: Compiled from various sources)

### Staff strength position in various state Pollution Control Boards

(Source : CSE(2015)

#### Staffing position of State Boards.

State	Estimated number of polluting units	Sanctioned Staff strength	Staff in position	Number of technical staff in position	Number of vacancies
1	2	3	4	5	6
Andhra Pradesh	7521	355	234	88	121
Arunachal Pradesh	*	0	0	0	0
Assam	*	204	197	93	7
Bihar	1663	277	261	171	16
Goa	248	24	13	4	11
Gujarat	7337	572	491	257	81
Haryana	2085	258	179	45	79
Himachal Pradesh	226	119	100	26	19
Jammu Kashmir	*	467	54	15	413
Karnataka	3267	725	254	146	471
Kerala	848	253	244	121	9
Madhya Pradesh	2687	541	589	255	-48
Maharashtra	9035	765	632	292	133
Manipur	*	61	13	8	48
Meghalaya	*	72	30	12	42
Mizoram	*	11	8	1	3
Orissa	1045	220	160	61	60
Punjab	3706	232	106	86	126
Rajasthan	2265	225	206	88	19
Sikkim	*	4	4	4	0
Tamil Nadu	8151	931	696	295	235
Tripura	*	9	8	6	1
Uttar Pradesh	6441	752	549	199	203
West Bengal	3414	181	143	85	38

\* Not estimated.

### The status of industries and organisations in Karnataka being monitored by KSPCB as on 31-03-2014

(Source: KSPCB AR 2013-14)

Sl. No.	Particulars	Category	Total no. of Units as on 31.3.2014	Operating	Closed	Yet To Commission
i)	Number of Industries	Red	7186	3572	2718	896
		Orange	7343	4515	1908	920
		Green	19729	13094	3881	2754
ii)	Number of Stone crushers	Red	3091	1566	1284	241
iii)	DG sets installed in Telephone towers	Green	11369	11238	95	36
iv)	Number of Local body	Red	215	214	01	00
v)	Number of Layouts (10 acres and above)	Green	1733	28	3	1702
vi)	Number of Infrastructure projects (Apartment, education institutions, commercial establishments, etc.,)	Orange	1259	369	03	887
		Green	1918	731	38	1149
vii)	Number of Hospitality organizations (Hotels, Resorts etc.) a. Hotels(3 Star and above) and Hotels having 100 rooms and above	Red	112	80	3	29
	b. Hotels (<3 Star) or hotels having >20 rooms and < 100 rooms	Orange	255	187	17	51
	c. Holiday resorts/Jungle Resorts/ Beach Resorts	Green	1213	1002	133	78
viii)	Number of Hospital /HCEs	Red	23240	22609	521	110
ix)	Number of Mines	Red	755	184	438	133
x)	Number of Coffee estates	Green	2595	2486	107	02
xi)	Number of others -banks, kalyanmantap, office complex, office, Association, etc having DG set as air pollution source	Red	10	08	0	02
		Green	965	812	95	58
<b>TOTAL</b>			<b>82988</b>	<b>62695</b>	<b>11245</b>	<b>9048</b>

### Summary Of Pollution Control Status Of 17-Categories Of Industries In Karnataka As On 31.03.2014

Source: KSPCB AR 2013-14

Category	Total No.	OPRS	OPRNS	UCLO	UCLB
Aluminium	1	1			
Copper Smelter					
Zinc Smelter					
Bulk Drug & Pharmaceutical	80	55	16	9	
Chloro Alkali	1	1			
Cement	28	24	2	1	1
Petrochemicals	1	1			
Dyes & Dye Intermediates	3	2		1	
Fertilizer	3	3			
Integrated Iron & Steel	1	1			
Oil Refinery	1	1			
Pesticides	1	1			
Pulp & Paper	3	2	1		
Sugar	22	12	2	8	
Distillery	24	17	3	4	
Tannery	2			2	
Thermal Power	11	11			
Sugar and Co-generation	32	28	4		
Sugar, Co-generation and Distillery	16	15	1		
<b>TOTAL</b>	<b>230</b>	<b>175</b>	<b>29</b>	<b>25</b>	<b>1</b>

#### Note :

- OPRSThe industry is complying with pollution control norms
- OPRNSThe industry is not complying with all pollution control norms
- UCLOIndustry has closed on its own
- UCLBIndustry has been closed by the Board

### Abstract of CETPs in Karnataka

Source: KSPCB AR 2013-14

Sl. No.	Name and Location of the CETP	Capacity	Working/ Not Working
1	M/s. C.E.T. Plant Malur Pvt. Ltd., Plot No. 64 & 65, KIADB Indl. Area, Malur Taluk, Kolar Dist.	140 KLD	Working
2	M/s. Lidkar Tannery Enviro Control System Ltd (CETP), Tannery road, K.G Halli, B'lore-45.	01 MLD	Working
3	M/s. Eco Green Solutions, 48 A4, KIADB Indl Area, Doddaballapura, Bangalore Rural Dist	50 KLD	Working
4	CETP of KIADB located at Apparel Park, Doddaballapura, Bangalore Rural Dist	05 KLD	Working
5	CETP (Fish Meal & Oil Manufacturers Association), Kotepura, Ullal, Mangalore Taluk, DK District.	600 KLD	Working
6	M/s. Govind Solvents (P) Ltd, No.19 (P)-22, Kunigal Industrial Area, Tumkur Dist.	75 KLD	Working
7	M/s. Pai & Pai Chemicals, Plot No.29/A, 1st Phase, KIADB Industrial Area, Kumbalagodu, Kengeri Hobli, Bangalore-560074.	300 KLD	Working
8	M/s. Pai & Pai Chemicals (I) Pvt. Ltd., Plot No. 25-D, 1st Phase, Kumbalagodu, Kengeri Hobli, Bangalore-560074.	40 KLD	Working
9	M/s. VIWA Eco-Club CETP, Opp. Shed No.B-5 & 6, Veerasandra Industrial Estate, Hosur Road, Anekal taluk, Bangalore-560100	20 KLD	Working
10	Bangalore Golf Club, No.2, Sankey Road, High Grounds, Bangalore - 560 001.	01 MLD	Not Working
11	Tekkotte Rice Mill Owners, Sy.No. 213/5, Kedoor Village, Kundapur Taluk, Udupi.	30 KLD	Not Working



### Status of power plants with respect to utilization of fly ash generated

Source: KSPCB AR 2013-14

Sl. No	Name & Address of the unit	Power Generating Capacity [MW]	Quantity of fly ash generated in MTA	Percent Utilized	Remarks
1	Vasavadatta Cements, Sedam, Gulbarga Dist.	61.2 (Captive)	175000	100	Used for cement making
2	Rajashree Cements, Malkhed, Gulbarga Dist.	58.2 (Captive)	133888	100	Used for cement making
3	ACC Ltd., (Previously Tata Power Corp. Ltd,) Wadi, Gulbarga Dist.	75 (Captive)	315000	100	Used for cement making
4	Grasim Industries Ltd, Kumarapatnam, Haveri.	10 (Captive)	44825	100	Sent to brick manufacturers and cement industries
5	Raichur Thermal Power Station, Raichur.	7x210 and 1x250	1630957	50	Supplied to cement industries, brick manufacturing and tile industries.
6	Bellary Thermal Power Plant.	1x500	539447	71	Supplied to cement industries
		1X500	168643	8.4	Supplied to cement industries
7	Udupi Power Corporation Ltd., Panambur, Mangalore.	2x600	1075360	99.5	Secondary utilization
8	JSW Energy Limited, Thoranagallu, Bellary Dist.	2x130	62181	100	Supplied to cement industry, brick units and used for slime pond bund construction.
9	JSW Energy Ltd, Thoranagallu, Bellary Dist.	2 x 300	171576	99.3	Supplied to cement industries and used for slime pond bund construction.
10	West Coast Paper Mills, Dandeli, U.K.District.	70.3	78000	90.0	Sent to cement & brick manufacturers
11	Gulbarga Power Pvt.Ltd. Chatrasala village, Chincholi Taluk, Gulbarga District	30	30000	100	Used for cement making
12	Himatsingka Linens, Plot No. 1, SEZ, KIADB Industrial Area, Hanumanthapura Post, Hassan	12.5	5250	Negligible	Sent to brick manufacturers
	<b>TOTAL</b>		<b>44,12,127</b>		

### Greening Initiatives In Industries And Industrial Areas During 2013-14

(Source: KSPCB AR 2013-14)

Sl. No.	Regional Office	Number of trees planted during 2013-14	Sl. No.	Regional Office	Number of trees planted during 2013-14
1	Anekal	1100	18	Davangere	5000
2	Bommanahalli	200	19	Nelamangala	5000
3	Bangalore City South	900	20	Dharwad	50000
4	Sarjapura	10500	21	Belgaum	39000
5	Hoskote	5000	22	Chikkodi	223031
6	Udupi	117500	23	Chitradurga	111300
7	Mangalore	101792	24	Bagalkot	120000
8	Karwar	2500	25	Bijapur	5000
9	Ramanagaram	243560	26	Haveri	5500
10	Shimoga	30000	27	Gadag	50000
11	Chikkaballapura	12000	28	Yadgir	10500
12	Kolar	14600	29	Chamarajanagar	500
13	Bellary	35100	30	Hassan	2000
14	Raichur	2000	31	Mandya	4000
15	Tumkur	4000	32	Mysore (Urban)	28000
16	Bidar	3000	33	Mysore (Rural)	10000
17	Koppal	84500	<b>TOTAL</b>		<b>13,37,083</b>

## Widening Roads – Are There Wider Issues?

By Dr. S.G.Vombatkere

The recent opposition to widening of Irwin Road from residents of the locality has been viewed as obstructive to development by officialdom. This opposition is stated to be based on several points, including (#) loss of land with built-property, (#) loss of residence and/or livelihood, (#) increased air and noise pollution with increased volume of traffic with widened road, (#) restriction of movement on densely populated and busy feeder roads, (#) lowered economic activity all along the extent of the widened road, and (#) reduced pedestrian safety as traffic density increases in an already densely populated area.

The opposition concerns Irwin Road in the heart of our City. But with roads being widened all over the City, and a growing body of opinion that road-widening is merely a short term solution for traffic congestion, the connected issues need more comprehensive discussion.

### Widening roads

Today, confronted with traffic congestion, city planners resort to vehicle-centric widening the carriageway of roads to create more space for vehicular traffic by reducing or removing footpaths. But, with drivers choosing the widened road for easier movement and a rapidly growing vehicle population, congestion again becomes a problem in a few months or a year at most.

In this connection, it is worth reading what the Union Ministry of Urban Development's National Urban Transport Policy (NUTP) speaks: "The Central Government would [therefore] encourage measures that allocate road space on a more equitable basis, with people as its focus. This can be achieved by reserving lanes and corridors exclusively for public transport and non-motorized modes of travel". Also: "It is well known that public transport occupies less road space and causes less pollution per passenger-kilometre than personal vehicles. As such, public transport is a more sustainable form of transport". Thus, official wisdom based on justice and equity, makes a strong case for public transport, which should be understood easily by city planners.

However, widening of roads to facilitate vehicular traffic also brings pedestrian safety and convenience into sharp focus – reducing or removing footpaths forces people to walk on the carriageway. This has a double negative effect – people are at risk of being hit by a motor vehicle besides being otherwise inconvenienced, and vehicle drivers slow down to avoid accident, leading to congestion and defeating the purpose of road-widening. The sustainability of road-widening is therefore questionable.

### Pedestrians' rights

The NUTP speaks thus on road space: "At present, road space gets allocated to whichever vehicle occupies it first. The focus is therefore the vehicle and not people. The result is that a bus carrying 40 people is allocated only two-and-a-half times the road space that is allocated to a car carrying only one or two persons. In this process, the lower income groups have effectively ended up paying, in terms of higher travel time and higher travel costs, for the disproportionate space allocated to personal vehicles". It goes on to say: "Users of non motorized modes have tended to be squeezed out of the roads on account of serious threats to their safety". Here again we see NUTP articulating the Constitutional values of justice, equity and right to life, even while noting that walking and bicycling are the most environment friendly modes of transport. It is unfortunate that these very modes face threat from motor traffic.

Especially where roads have been widened, footpaths are a veritable obstacle course for the pedestrian to negotiate uneven surfaces, and dodge between trees, electric power poles, parked vehicles, driveways of buildings, building material, building debris, garbage heaps and roadside vendors. She also has to get off the footpath onto the road and back again onto the footpath. Today, the pedestrian is exposed to risk of life or limb by getting hit by a motor vehicle besides the health risk from inhaling exhaust gases from passing vehicles and even from parked vehicles with the engine running for air-conditioning. There is no need to provide photographs to demonstrate these hazards, which everybody understands, perhaps excepting planners.

### **Planning for justice and equity**

Our City as a whole belongs to all its citizens, and its roads (consisting of footpaths, side drains and carriageway) belong equally to everybody regardless of religion, caste, sex or socioeconomic status. Convention, which also has the sanction of law, dictates that faster traffic moves in the carriageway and slower traffic uses the side of the road, while pedestrians use the footpath. Good sense therefore dictates that pedestrians should not step onto the carriageway except when they need to cross the road.

It is therefore the duty of planners to provide adequate footpaths, with trees to provide shade for pedestrians and also absorb some of the vehicle exhaust emissions. This, rather than widening the carriageway to provide short-term relief to traffic congestion, would make our City

more people-centric. It would also encourage tourism in our heritage city.

This is not a narrow pedestrian-versus-motorist issue concerning road-widening, but a much larger issue. Mysuru, like any other city, needs an integrated public transport system, which can provide cheaper, more convenient and safer movement, and motivate people to substantially reduce use of personal transport. Such an approach will also be in accordance with NUTP and the constitutional principles of justice and equity, and also be sustainable in the long-term.

The City elders and the MLAs and MP might like to reconsider road-widening in the light of the foregoing arguments, to provide the greatest good of the greatest number which, in any case, is their sworn duty. Diverting funds sanctioned for road-widening to a wider public cause can also be politically gainful.

## Activities Pertaining To KSPCB In Respect Of KSAPCC

Action	State Coordinator	Collaborator	5 year budget in lack rupees	Activities to be taken up	Physical target+ Goals	Available funding under the state + other existing schemes	Addi tional require- ment	Remarks
<b>4. Coastal Zone Management:</b>								
Promoting of treatment at point source and	KSPCB	--	Budget require- ment - individual treatment plants by concerned industries	<ol style="list-style-type: none"> <li>1. Providing ETP by the individual industry is a mandatory requirement.</li> <li>2. Inspection and Monitoring of these ETPs is being carried out regularly by the Board after establishment of ETPs by industries as per the monitoring frequency for Red, Orange &amp; Green categories quarterly, half yearly &amp; yearly respectively.</li> </ol>	As and when CFEs are issued a condition to establish individual ETP is stipulated and CFEs are issued only after establishment of ETP.	The budget cost has to be met by the individual industries.	--	--
CETPs for cluster of small scale industries (refer explanation at KSAPCC)			Budget require- ment - CETP promoters	<ol style="list-style-type: none"> <li>1. One CETP is in operation for the effluents generated from cluster of fish processing activities which is established by M/s. Fish Meal &amp; Oil Manufacturers Association at Kotepura, Ullal, Mangalore Taluk, DK District.</li> <li>2. Presently, there is no scope for CETP for other area/cluster.</li> </ol>	Completed.	There is a provision of subsidy scheme from both the State and Central Government to promote CETPs.	--	<input type="checkbox"/> An attempt is made to pursue with the fish processing industries to adopt zero liquid discharge technologies which will also address the problem of odour nuisance. <input type="checkbox"/> Besides this, the individual industries in the cluster have been encouraged to provide advanced treatment systems such as MEE so as to recover the by-products and to adopt zero liquid discharge.
Data on type and amount of hazardous chemicals released by sector.	KSPCB	-	Internal resource of the Board.	<ol style="list-style-type: none"> <li>1. Inventorization on release of hazardous chemical is being taken up.</li> </ol>	--	Nil	Nil	--

<p>Research on the implementation of advance treatment technology to reduce pollutants entering the sea.</p>	KSPCB	-	Internal resource of the Board.	<p>1. By and large all the industries have provided latest advanced technology for treatment and disposal of effluent by new units.</p> <p>2. In case of existing industries they have been directed to switch over to new technologies as and when the advanced technologies are available so as to minimize environmental pollution.</p> <p>3. With the improvement in technology, MRPL, Mangalore has achieved 70% recycling of treated effluent in Phase-I &amp; II and similar provision is made in Phase-III. MCF is completely recycling the treated effluent and has achieved zero discharge.</p> <p>4. In sectors like pharmaceuticals zero discharge technologies are being adopted for new units, oil units are also slowly switching over to zero discharge concept.</p> <p>5. Caustic soda industry namely M/s. Aditya Birla Chemicals at Binaga, Karwar (Old name M/s. Solaris Chemicals) have changed over the technology from mercury based technology to Membrane based technology by this toxic effluent handling is dispensed with.</p> <p><input type="checkbox"/> Further, R&amp;D work if required will be examined.</p>	--	Nil	Nil	-
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**Note:**

- Local bodies have to establish STPs to treat and discharge sewage generated. For which UDD and DMA departments have to expedite.

### List of Major Organic/Kitchen Waste Biogas Plants Implemented/Installed by NIE-CREST, Mysore

#### Fuel Efficient Biomass Stoves

SI No.	Name of the Institute
1	Sri Chamundeshwari Temple, Chamundi Hills, Mysore
2	Raghavendraswamy Mutt, Mantralayam, Kurnool, Andhra Pradesh
3	BR Hills, VGKK, Chamarajanagar
4	P&V Engg., Aizawl, Mizoram
5	Santana Ganapathy Temple, Gundlupet
6	Gramabharathi Vidya Samsthe, KR Pet
7	JSS, Suttur
8	More than 1000 stoves in villages

#### Rain Water Harvesting: List of Major projects implemented at institute/community level

SI No.	Name of the Institute
1	Mysore Palace
2	Administrative Training Institute
3	Karnataka State Industries Corporation
4	Postal Training Centre, Mysore
5	GSS Herbal Habitat, Mysore
6	Bapuji Layout, Mysore
7	Raghavendraswami Mutt, Jayalakshmpuram, Mysore
8	Sri. Maheshwari Beverages, Nanjangud
9	Raitha Santhe, Mysore

#### List of Major projects implemented at residential level

1	Sri. Sampath Iyengar, Lakshmpuram
2	Sri. Sreepada Rao, Ramakrishnanagar
3	Sri. S Shamsundar, JP Nagar
4	Dr. GM Kumar, Kuvempunagar
5	Dr. Prakash, Datagalli
6	Smt. Sharadamba, Vidyaranyapuram
7	Smt. Vasumathi, Vidyaranyapuram
8	Dr. Bhuvaneshwar, Somanathanagar

9	Smt. Savithri Gopinath,
10	Smt. Sujatha, Vijaynagar
11	Mr. Lakshminarasimhayya, Vijaynagar
12	Mr. Devaraj, Rajarajeshwarinagar
13	Antipoaching camp, Anechoukur, Thitimathi Range
14	Mr. Simha, Srirampur
15	Kanana-Ecofriendly and Sustainable Farm, Baradanapura

### List of Major Organic/Kitchen Waste Biogas Plants Implemented/Installed by NIE-CREST, Mysore

Sl No.	Details	District	Capacity (kg/day)	No.s
1	Mysore Zoo	Mysore	1500	1
2	Oxygen Acres, Chikkahalli	Mysore	1000	1
3	Administrative Training Institute	Mysore	100	1
4	Pothnal Church	Raichur	100	1
5	Bapuji Institute of Engineering and Technology	Davanagere	100	1
6	Karnataka State Women's University	Bijapur	100	1
7	Sri Srikanteshwaraswamy Temple, Nanjangud	Mysore	100	1
8	Postal Training Centre	Mysore	60	1
9	Sri Chamundeshwari Temple, Chamundi Hills	Mysore	50	1
10	Jawahar Navodaya Vidyalaya	Chamarajanagar	25	1
11	P & V Engineering, Aizawl	Mizoram	20	1
12	Mrs. Suma Shamsundar's Residence	Mysore	1 to 5	1
13	Agriculture Office – Port Blair	Andaman & Nicobar	1 to 5	1
14	Anna University of Technology, Thirukuvalai Campus	Trichy	1 to 5	1
15	The National Institute of Engineering, Mysore	Mysore	1 to 5	2
16	The National Institute of Engineering, Mysore	Mysore	5 to 10	1
17	ALN Rao Ayurvedic Medical College	Koppa	25	1
18	K R Hospital	Mysore	25	1
19	Karnataka State Pollution Control Board	Mysore	1 to 5	1
20	GP Gumbagola Village	Dharwad	1 to 5	1
21	Belamagi GP	Gulbarga	1 to 5	20
22	Nagamangala and Krishnarajpet Taluk	Mandya	1 to 5	19
23	Hindustan Unilever Ltd.	Mysore	1 to 5	1
24	B C M Hostel, Gundlupet	Chamarajanagar	10 to 15	1
25	Government Diploma College	Chamarajanagar	10 to 15	1
More than 100 plants of capacity 1 to 5 kg per day installed at various places				



## Photographs of biogas plants installed by NIE-CREST



Prefabricated- Mild Steel Kitchen Waste Biogas plant of capacity 50kg per day at Sri Chamundeshwari Temple, Chamundi Hills, Mysore



1500 kg.day input biogas plant at Mysuru Zoo.



Kitchen waste Biogas Plant of 100 Kg/day implemented by NIE-CREST

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## Karnataka State Pollution Control Board

### Recommendations to State Action Plan on Climate Change

Based on state wide public consultations and internal studies

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