

National Level Workshop
on
Climate Change Impacts in Water,
Sanitation & Health

June 26 -27, 2013

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NIAR
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**National Key Resource Centre (Water & Sanitation)
&
Centre for Climate Change and Environment
National Institute of Administrative Research
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About the Workshop:

Climate change is a phenomenon containing both environmental as well as health dimensions. Water is considered to be the primary medium through which early climate change impacts will be felt by people, ecosystems and economies. Safe and reliable access to clean water and sanitation is crucial for good health. Currently, Water resources are shrinking and per-capita water availability is decreasing. Also, migration to urban areas leading to a stress on infrastructure. With changing patterns of disease, water and food insecurity, dense human settlements, extreme climatic events, population growth and increasing migration, challenges faced by the Water, Sanitation and Hygiene (WASH) Sector have multiplied. Besides, climate change related impacts like melting glaciers, extreme floods and droughts can affect water availability and water quality.

India is considered particularly vulnerable to climate change due to its geographical position and a large rural population having limited or no access to safe drinking water and sanitation. With large sections of the population migrating to urban areas and given weak basic infrastructure- like drainage, sewage disposal, sanitation etc., water contamination and water borne diseases are increasing. The related vulnerabilities can be attributed to factors like Systems, Agents and Institutions and therefore resilience actions are needed around these factors. Government officials working on WASH are likely to face challenges. It is thus crucial to equip Government officers working in the WASH sector with the necessary knowledge and skills to meet the above challenges arising out of climate change.

This workshop was held in the backdrop of the terrible tragedy unfolding in Uttarakhand. However, it also gave context to what is happening due to climate change in places like Uttarakhand. The quantum of rainfall in the state for the first 17 days of June was 440% of the quantum for the same period last year. Estimates are that it will take 3-5 years for the land to recover.

For the last decade, there have been a succession of disasters- landslides, floods- which have changed the landscape of Uttarkashi. The Gazetteer documents that the Gangotri glacier once extended till Bhatwari- in the last century, it has receded 80kms. These are the impacts of climate change. The UNDP-funded **Centre for Climate Change and Environment (CCC&E)**: was established at NIAR with the objective of enhancing capacity of Civil Service and Government officers on Climate Change and Environmental issues.

The three days of the workshop is a short span to come to a definite opinion on the impact of climate change over geological periods of time. Whether there is climate change, or no climate change, there is no doubt that the environment is subject to a great deal of pressure- most of it anthropogenic.

For example, the population pressure on Mussoorie in the last 50 years is unimaginable. This population increase is leading to pressure on water, sanitation, waste management etc. Mussoorie never had a problem with water. The area had lots of springs, and water could easily be brought up. But now, there is unimaginable stress for water. There is the Yamuna close by, but pumping it up from there will cost 180 crores.

For 100 years, nothing had been done to deal with sewage in Mussoorie. A few years ago, the Uttarakhand government created a network of sewers after spending about 60 crores, causing great inconvenience in the town. After that, they realised they cannot work the sewage system due to a lack of water. To get water up, there is a proposal to pump water from the Yamuna costing 180 crores. That is a lot of money to pump up water to flush the sewage down.

Mussoorie was once prized for its cleanliness and now it is a filthy town. The infrastructure of Mussoorie has not grown while the population has grown multiple times. All the garbage is dumped on the hillsides. When the rains come, all the garbage is flushed down via the Agala river to the Yamuna. And then we pump up that dirty water and try to clean it for drinking. This is the kind of situation we are stuck with throughout the country.

Whether climate is changing, whether long term changes are happening is a matter of academic debate. But as a species, are we improving the environment or are we spoiling it? There is plenty of evidence that we are spoiling it.

We as a species need to recreate ourselves and come up with a new way of living- whether it is possible or not. This is because planning and technology will not solve the problem which has its roots in the hunger for power. Solving the environmental problem requires recognising this thirst for power in human beings, acknowledging it, and then seeking out a way to accommodate this while also protecting the environment.

Session 1: Climate Change and WASH

Climate Change and implications for India – Sh. Srinivasan Iyer, Assistant Country Director, UNDP, India

A measure of scepticism is due since everything cannot be attributed to climate change. The current disaster in Uttarakhand is an example of this -we are not doing climate change a service by blaming everything on it. There are an immense range of science disciplines that need to work together to begin understanding this phenomenon.

Climate change is a statistically significant variation in the mean state climate and its variability. for an extended period. Warming of the system is unequivocal, as is melting of snow, and rising global mean sea level. This is due to greenhouse gases and is entirely anthropogenic. This is how this change differs from all else that has happened in the past. Global anthropogenic green house gases have grown significantly with an increase of 70% between 1970 and 2004. CO2 released by fossil fuel use is the significant contributor. Climate change is now proceeding at a rate higher than was predicted in the 1990s. If extrapolated, then the deviation becomes significant. We are thus accelerating towards doom, and this is a sign that the world is not taking it seriously.

It is true that even when India is the third largest emitter of green house gases, per capita emissions are one-third of the average. Thus the 'responsibility' may lie to a greater extent with developed countries. However, looking at impacts, there are significant impacts on health, agriculture, forest, water, coastal areas and biodiversity in India.

THE UNDP recognises that climate change is going to be primarily a development problem. Climate change threatens to halt or reverse human development by the following means:

- reduced agricultural productivity
- heightened water security
- exposure to extreme weather events
- stressed ecosystems
- increased health risks.

These feed each other. For example, for the same meteorological drought, the impact is much more in a stressed ecosystem, for example where groundwater is low, than in a healthy ecosystems.

In aggregate, India is now the third largest emitter of GHG. Most of India's emissions come from electricity, other energy and manufacturing. This differs from developed countries where most are 'lifestyle' emissions.

Why is India more vulnerable than other countries?

- **Dependence on agriculture-** a large proportion of poor people living on the margins of subsistence.
- **Geographical consideration-** people living in the mountains, coastline, forests and flood and drought prone areas, which is nearly all of India.
- **Exposure to climate related disasters-** This is exacerbated by the vulnerabilities in the drinking water and sanitation infrastructure. Also, if rural and poor, there is a minimal part of the income that is not a function of climate, especially the monsoon.

Regional level assessment. A 4X4 assessment of climate change was carried out in India through MoEF and UNDP. The report of the Indian Network for Climate Change Assessment (INCCA) looked at historical trends and imposed a social overlay to predict trends. The report looked at agriculture, water, ecosystems, and health, in the Himalayas, western ghats, coastal areas, and the north-east. It sought to assess impact between 2030 and 2050

Climate: The report predicted temperature rise in a range of 1-4 deg c. It also predicted increased annual precipitation. This will not be uniform, but with lower frequency of rainy days and increased intensity. Evidence of this is already visible. There is far lower rainfall outside the monsoon, and even within the monsoon, there are fewer days of rain. There will be increased risk of storm surges, with lowered frequency and storm surges.

Sea level rise will increase by 1.3mm/year on average. This means that 20 years from now, sewage disposal systems designed will not work. High variability in water yields from 50% increase (in Himalayas) to 50% reduction(in coastal regions and the north east), and variable projections in western ghats is predicted; as is a 10-30% increased risk of floods.

There will also be a sharp fall in land productivity and livestock productivity. Shifting forest borders and species mix will have negative impact on livelihoods and biodiversity.

Human health: Higher morbidity and mortality from heat stress and vector/water borne diseases. This has greater significance in the case of growing urban areas which are heat sinks. There will also be an expanded transmission window for malaria.

Climate Policy:

India is a signatory to the UNFCCC, and plays an active role in its negotiations. India is a votary to the principle of common but differential responsibility. It also accepts its vulnerability. It has ratified the Kyoto Protocol that requires Annex 1 signatories to commit to a time bound and measurable decrease in green house emissions. India is playing a role in keeping the protocol alive in the face of countries dropping out due to economic stress. The Prime Minister's council of Climate change is established, and the 12th 5 year plan has a substantial section that addresses climate change and energy.

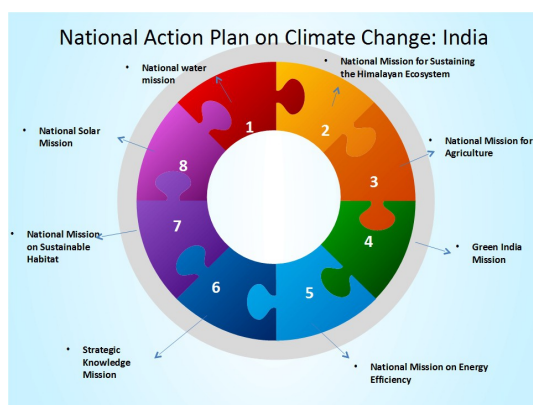


Illustration 1: The eight missions of the NAPCC

NAPCC clarifies that while climate change is a problem, India is not willing to do away with development. In the face of vulnerabilities, India recognises that it is necessary to look at both climate change mitigation and adaptation.

The NAPCC has 8 missions, two of which are primarily towards mitigation. These are the national solar mission and the national mission on energy efficiency. Here the major focus is on industries. This targets several units of identified energy intensive industries, and has given them benchmarks to move towards. It also works at energy efficient appliances and buildings. The others are primarily towards adaptation, of which the national water mission is leading.

Water has been identified as the vector through which climate change impacts will be visible in India. 80% of India's water is for irrigation, which is administered through individuals. This situation is the same for industry and even for domestic use. This means that there are millions of individuals who need the data they need to make informed decisions. The national policy promotes citizen and state action for water conservation. The water mission focuses attention to vulnerable and over-exploited areas. There are also significant opportunities for increasing water efficiency in irrigation and in domestic water. Currently there is a lack of knowledge on the amount of water consumed by cities, the sources of this water, and the losses borne.

The State action plans on climate change decentralize NAPCC objectives into local context. This is an opportunity for people working in the WASH sector.

Climate Change and Water – Dr, RK Rawley, Principal Scientist, AMPRI (CSIR) Bhopal, rkrawley58@gmail.com

The Panch-Ja Abhiyan was launched in Madhya Pradesh for the management of natural resources about 10 years ago. These 5 JAs were Jan, Jal, Jameen, Jungle and Janwar. Of these, the first three can be categorized as natural resources while the latter two are consumers. Within the latter two, Jan or people are bigger consumers and so cause more damage to the environment than Janwar or animals. Earth, or Jameen supports life through several resources which are both on the surface and underground. The forests support all the needs of life for a very large population of the animal kingdom. Even today, tribal communities subsist entirely on the forest. Human greed is the basic cause of climate change. The factors responsible for climate change can be classified as per natural and anthropogenic factors.

Natural factors: Universe with its galaxies and planets, the planets' positions and movements with respect to each other, super moon phenomenon, meteorites and other space debris.

Anthropogenic factors: industrial activities including power sector, automobiles and use of fossil fuels, life style with the use and throw culture, lesser use of manpower and animal power, production of more greenhouse and toxic emissions.

These factors together cause climate change which has changed monsoon movement and precipitation patterns. Water is considered in three parameters, quantity, distribution and quality.

Sanitation surveillance and inspection needs to be carried out for ensuring water quality. This can be tackled by treating pollution done and by also preventing water pollution. Flash floods impact quality and safety of water by increase in pathogens due to organic putrefaction, epidemic diseases, mixing of hazardous, industrial and domestic waste.

Our forests are also under threat, with 41% of our country's forest cover being degraded to some degree. 2000 sq km of forest area was diverted to non-forestry purposes between 2005 and 2008. In addition to this, Rs.100 crores worth of timber is lost every year to forest fires, which also leads to CO₂ emissions. Deforestation has also removed the forests on the western and eastern Ghats, the Vindhya and Satpura ranges and the Aravalli hills. These forests acted as a wind barrier, deforestation has negated this function, thus lessening rainfall. In central India, the average annual rainfall has decreased to 500-750 mm from the 1000-2000 mm of rainfall in the 1950s.

Closed forest is that with more than 60% canopy cover. In 1947, this was 35%. In 1991, the forest remote sensing report showed a forest cover of 18%. Later the definition of closed forest was changed to consider 40% forest canopy, thus yielding a closed forest cover of 25%. These manipulations do not benefit anyone, least of all the environment.

Urbanisation, insufficient infrastructure, lack of sanitation and hygiene, inadequate rainwater harvesting, release of untreated sewage, contamination of groundwater are some of the major challenges facing India. The two crucial and limiting factors that we face in embracing growth are water and energy. Possible solutions to the water crisis are:

- Education and conservation
- 2-line water supply in urban areas
- reclaiming of wastewater
- return to traditional water harvesting methods
- better irrigation technologies
- privatization.

Climate Change and Health - Dr. R.C. Dhiman, environmental epidemiology, National institute of Malaria research, dhimanrc@icmr.org.in

This presentation discusses the potential threat of climate change on health. Bhimtal is reporting lower temperatures in winter; this proves that climate change is not just warming, but change in general. Erratic rainfall, changes in temperatures, sea level rise and melting glaciers are the climate change impacts that affect health. Vector borne diseases are on the increase, as they are spread by insects which are vulnerable to temperatures. As temperatures increase, the disease-spreading insects move towards higher altitudes where they are not previously able to survive. Waterborne diseases are also on the increase due to flood, but there is not enough evidence generated yet. The adverse impact on agriculture will also lead to an increase in malnutrition. Air pollution will also lead to an increase in respiratory diseases.

Work is currently going on in the cases of vector borne diseases, heat stress and eye disease. The problems due to climatic conditions are mortality due to heat/cold waves, cardiovascular diseases, eye diseases, skin disease and disasters. The Uttarakhand disaster will also lead to epidemics- first diarrhoea due to contamination of water, increase in malaria due to stagnation of water.

Challenges for research: Mapping of reduced crop area in the context of malnutrition prone areas is necessary to develop remedial measures to combat malnutrition. The link between pollution level, respiratory diseases and the required impact assessment and remedial measures need to be explored.

Threat of climate change to vector borne diseases: The major vector born diseases are malaria, filariasis, kala-azar, dengue, chikungunya, and japanese encephalitis. Chikungunya and dengue are transmitted by the Aedes mosquito, which breeds in polluted water. This means that with increasing urbanisation these diseases will also increase. Chikungunya had disappeared from the country till it reappeared in 2005. Similarly, the earlier focus of Kala Azar was Bihar and West Bengal, since 1982 it is flaring up in Himachal Pradesh and Uttarakhand (Dhiman et al 2010). This is transmitted by sandfly which moves into deforested areas.

Impact assessments undertaken:

NATCOM 1,2, 3 have studied mortality due to heat waves. Heat stress should define nutritional status and risk factors for mortality. Transmission windows for malaria and dengue have been mapped. In addition to climate, lifestyle, agricultural practices, deforestation, urbanisation etc also influence transmission. This influences projections made for vector borne diseases. For example, better socio-economic conditions in Punjab have practically eliminated malarial outbreaks. On the other hand, provision of water to the arid Thar desert through the Indira Gandhi canal has created optimal breeding conditions for mosquitoes and created malarial attacks.

ICMR is collecting evidence in their field offices in Bhimtal and Assam.



Illustration 2: malaria endemicity in Nainital district

Climate Change and Sanitation - Dr. Anjal Prakash, Saciwaters

What is sanitation: This is the safe collection, storage, treatment and disposal/reuse of human excreta. It also included management of hazardous waster, sewage effluents, industrial waste, solid waste, household waste, and access to improved hygiene practices including menstrual hygiene.
Status of sanitation in India: The joint monitoring program of UNICEF examines sanitation trends in India from 1990 and 2010. 17 states in India have achieved MDG targets while 2 more are scheduled to achieve it before 2015. The last two states- Madhya Pradesh and Orissa- will reach it after 90 years. Poor sanitation is the major source of death in children between 0-14 years.

While some urban toilets are luxury items, other areas are far worse off. Some of the worst toilets include hanging toilets and dry toilets that rely on manual scavengers, as these promote disease rather than prevent it.

The sanitation ladder, which ranks methods based on efficacy and hygiene:

- Open defecation
- Unimproved sanitation facilities: hanging latrines, bucket latrines
- shared sanitation facilities: public toilets
- improved sanitation facilities : flush or pour flush toilet, composting toilet

India is 2nd in the 30 worst nations lacking access to sanitation.

What ails sanitation in India:

- Lack of appropriate technology, rural sanitation is lagging for lack of low cost materials, lack of water, and peoples attitudes in favour of open defecation
- Lack of political will: not part of agenda of political parties
- Lack of finances: sanitation has 25% of allocation as compared to water supply.
- Lack of accountability: No transparency and bureaucratic behaviour.
- sanitation and climate change
- Lack of comprehensive understanding:
- Lack of strategy to deal with urban sanitation: little or no infrastructure, with aging structures even when present.

Better sanitation as mitigation and adaptation to climate change:

Current evidence: New foci of vector borne diseases are increasing due to climate change. For example, dengue in Bhutan and Nepal, Kala azar in Uttarakhand, Assam, and HP, and occurrence of malaria in Uttarakhand all confirm this.

Adaptation tools:

Health education and capacity building should be done to educate communities at the threshold of transmission.

Climate change increases magnitude of disaster. This leads to contamination of water sources which leads to reduced volume of potable water. Disasters also disrupt hygiene practices (ability to access the toilet), cause technological failure, and disrupt sanitation services.

In the coastal region, sanitation infrastructure collapses due to cyclones and tidal flooding. In river basins, floods and water logging cause inundation of sanitation infrastructure and groundwater contamination. Similar impacts may be observed in hilly areas.

Mitigation: Possible strategies include decentralized waste water treatments, sanitation systems with energy, nutrient and water recovery, and use of bio fertiliser.

Adaptation: Possible strategies include drought resistant crops, rainwater harvesting, recycling of water, reduction of physical losses in transporting water, dry toilets in drought hit areas, elevated sludge drying beds and constructed wetlands for flood affected areas.

Session 2: Planning and Adaptation to Climate Change

Adaptation to Climate Change in WASH - Dr. Aidan Cronin, UNICEF India

Disaster, and who is affected and how

Between 2000-2011, there was an increasing trend in the damage caused by disasters. Except 2002, which was a calamitous year, the number of people affected has been more or less constant. The loss to property is now peaking. In Asia too, disaster risk and climate change are increasing. The good news is that case fatality rate of flooding and tropical storms are decreasing. On the other hand, livelihoods implications of disasters are being more severe. Since Asia's population is young, children will feel the force of climate change and not adults. Children are most vulnerable to climate change- with the increase of diarrhoeal disease and malaria, also of food insecurity, malnutrition, extreme events etc. The most severely affected are sub-Saharan Africa, followed closely by Asia and South America. Even without climate change, there are several challenges to health in India- climate change adds another level of challenge.

An UNICEF study examined the efforts the people take to reduce household demands during drought. 49% families said that they will reduce the frequency of bathing and washing.

Where do disaster response and climate change adaptation meet?

Mitigation tries to affect the phenomenon of climate change itself such as by reducing greenhouse gas emissions, while adaptation seeks to affect the consequences of the phenomenon by identifying those who will be hit hardest and helping them develop options. Climate change adaptation encompasses changes to average conditions, while disaster response focuses on extreme events. Similarly, CCA has high political interest and sizeable funding streams, while disaster response is not as much in the limelight.

Climate change and WASH

Most climate change impacts are water related, They manifest itself in spreading disease especially malaria. Reduced rainfall is manifested as increased diarrhoeal disease. Intense local rainfall leads to flooding, groundwater contamination and hence increased diarrhoeal disease and increased malnutrition.

Climate change adaptation and WASH

Adaptation strategies for water and sanitation issues need to look at three critical areas:

addressing water stress and scarcity: rainwater harvesting, (are we doing enough? what scale should we looking at), surface storage of water, aquifer recharge, drilling strategies, how do these fit into policy and DRR planning

for excessive water: flood agriculture, storage, Disaster Risk Reduction planning

for water safety: safe storage, household water treatments, monitoring, rainwater harvesting

In addition, there is a need of communication with communities as to why sanitation and good hygiene is important now and even more in a changing climate.

On-going work

Civil society organisations are mobilizing, the youth climate network is a sign of interest among youth in India, and media is taking leadership and increasing climate coverage. Among state governments, Madhya Pradesh has established a committee on climate change while the government of Karnataka is organising a meeting on WASH and climate change.

Multi hazard vulnerability mapping seeks to bring vulnerabilities and hazards on the same platform considering a series of indices for hazard, base, and sector. This shows the areas that are most at risk and where the disasters will have the highest impact. This tool helps states prioritise and look at the impact now, and in the future.

In the Eco-village concept in Maharashtra, villages began to measure the rain, look at waste management and water quality monitoring, prepare water budgets, etc. This helped rethink communities' awareness about the volumes of water coming in and those being put for various uses. In Delhi, the ministry is working on a drinking water strategy. There are three separate levels that require intervention to ensure safe and sufficient water: the household, the community and the institutional.

Household: safe water knowledge, demand or testing, safe handling and storage, household water treatment systems.

Community: village water safety plan, O&M of sources, don't use unsafe sources.

Institutional: Redressal mechanisms, capacity building, convergence with sanitation, health etc.

We need to think of who we are aiming to reach with these programmes- and we need to aim for the hardest to reach.

Next steps

- Knowledge management , study and evidence build up
- Communication as person to person interaction
- State action plan on climate change needs to have a WASH component
- Climate change is a cross cutting issue that needs constant attention
- Management practices to set a positive role
- Advocacy to policy to implementation to monitoring to impact to advocacy.

Gorakhpur Environmental Action Group works on social change, especially as it concerns livelihoods. They have worked on the poor in rural areas. They are working on Asian Cities on Climate Change Resilience Network, supported by the Rockefeller foundation. Surat, Gorakhpur, and Indore are the cities in India that are part of this programme.

Gorakhpur is in the foothills of Nepal Himalaya, in eastern Uttar Pradesh. The area is flood prone as it is in the Terai with a very low gradient. Unplanned construction and lack of a master plan has aggravated the situation in this flood-prone and low-lying city. The soil fertility and concentration of small farmers has resulted in a high population density in the region.

Studies show that second-tier cities are where most of the migratory population is expected to come to. Climate change has exacerbated inflow of migrants- or climate change refugees. Climate change is increasing the intensity of rainfall. In Gorakhpur, the average maximum temperature is increasing, while average minimum temperature is decreasing.

A vulnerability analysis of Gorakhpur was done along with the other cities. The causes of climate change impact can be classified as Natural causes, which are behavioural issues, policies and political background. These are increasing the vulnerabilities of Gorakhpur which are due to natural causes such as water logging, open drains and lack of an effective solid waste management system. The actions are required at both the mitigation level and at the adaptation level. Unless the citizens insist, elected representatives will not respond. There are three different pillars that provide resilience: physical and ecosystems, institutions, and agents. With the disruption of climate change, these three pillars need to respond. Existing expertise, theories of change, management approaches and monitoring tools already exist in these categories.

Characteristics of these three groups

- Physical and ecosystems: modularity and redundancy, flexibility and diversity, safe failure
- Agents: responsiveness, learn, resourcefulness
- Institutions: Inclusive, informed, adaptable, good governance.

Sharing Urban Resilience Framework: the first step is to understand vulnerability, and then resilience is built (the resilience framework). In Gorakhpur, the infrastructure is weak and the communities are being affected. The question was how to develop a community based process. Community thematic groups were formed to look at various issues, which led up to ward level actions. There are interventions required, and some of these need policy provision. In some cases, the policies are existing, and it needs to be seen what can be done under the existing policies.

Session 3: Integrated water resource management

Be Climate Smart -Bottom up Water Security – M.S. Vaidhyanathan, centre of excellence for change and Dr. B.K Ravichandran, Tamil Nadu agricultural university

This presentation is about a field experiment in about a hundred villages in Tamil Nadu.

Water is the primary climate challenge. Either excess water or less water causes a problem. In India, per capita storage is the lowest across the globe- our aggregate storage only provides 30 days of water security. This can be contrasted with Australia which has 250 days of storage per capita. We have exhausted all potential storage locations.

We are also largely dependent on groundwater. It is predicted that groundwater resources will be totally dry by 2030. The accuracy of this needs to be verified, but it cannot be denied that we are exhausting our groundwater resources while also diminishing its quality.

The Centre for Excellence looks at water in a holistic way, without differentiating between groundwater, surface water or others.

Source sustainability means conserving whatever is available today. CEC promotes water conservation at the user level by creating a water budget. The other issue is how to reduce pollution at the local level. This involves waste management, sewage treatment etc. Water security in a drinking water context is equity, reliability, sustainability, good quality, and affordability. When it comes to irrigation, the effort is to minimise water requirement for irrigation by adoption of technologies, and through choice of crops and agricultural techniques. The effort won second place in the UN water best practices for its 'addressing the behavioural causes of the water crisis at the level of the individual'.

Water management is beset by alienation and animosity between water managers from the government and the villagers. This is exacerbated by the various silos into which water governance and management is split up.

A survey of one lakh people across Tamil Nadu revealed that 95% people believed that water belongs to the government, and it is the government responsibility to provide water. CEC's job was to create convergence and build relationship between the people and the various departments. It was created by the effort of officials from across the water sector. It began when like-minded officials got together to develop strategies to ensure water security. The movement began with individual introspection, which then influenced the organisation. This also changed the way the members of the organisation looked at the community, with a shift in attitude from looking at the villagers as 'beneficiaries' to 'stakeholders'. This then began a joint exploration of what can be done to ensure water security.

The community collaboration focused on strengthening democracy, initiating water dialogues, and delivery of the goals decided upon. The single-window knowledge information centre was initiated, which is a platform where government officials visit a village on a particular day to listen to the villagers. The community change management group consists of members of the panchayat, the water and sanitation committee and other citizens to oversee work done in the village. These experiments were made possible by bringing about individual change, by increasing motivation, and encouraging the voluntary spirit.

This focus on creating behavioural change by extensive training and motivation has created a hundred water secure villages. CEC is now beginning work in one of the driest parts of the state.

Several experiments are being made to examine the impact of climate change on agriculture, especially rice. Farmers are seeing the impact of climate change with erratic and delayed monsoon, and frequent drought.

While India is dependent on groundwater, these resources are rapidly diminishing. Along with deepening water tables, pollution of groundwater is further reducing water availability. Water availability for agriculture is reducing. At the same time, there is a sharp decline in the proportion of lending to water storage projects by the World Bank. In that situation, the only solution is to use available sources effectively. Productivity of water needs to increase. The water crisis can only be met through the irrigation sector, due to the volume of water used. Increasing efficiency must be done with the full involvement of the community.

An increase of 20% in water productivity can be achieved by developing new technologies and agricultural techniques, with a great deal of focus on increasing buy-in from the communities. CEC has developed a process to motivate villagers to increase their water security that has achieved good results.

It begins with a participatory rural appraisal. As part of this process, the village develops an aspirational map of the village that incorporates all that they would like to have. This provides a goal that the village can gradually work towards. The village also creates its own water balance. This includes inflow, groundwater storage, surface storage, domestic requirement, requirement for agriculture and livestock, etc. These water budgets, like the aspirational plan, are documented in the form of a wall mural in a public place. The PRA also includes a village water walk, where villagers tour their area. This increases awareness of problem areas, and frequently increases motivation to redress the issues as well.

The system of rice intensification is one of the key strategies to increase yields by reducing water use. This increases rice yields between 30 to 80 percent while reducing water use by 30 percent. The process incorporates use of much less seed, grid planting, mechanical weeding, alternate wetting and drying. Similar principles are also being used for sugarcane. This saves 27-40% of water and also reduces the amount of seed used. Similarly, techniques such as drip irrigation and use of evaporation-minimising mulches increased crop diversity and agricultural returns.

Multi-sectoral convergence meetings where officials from the agricultural departments come to the villagers and share information. The villagers get information on new techniques and available subsidies.

Himalayan water and climate variability

The change indicators are temperature, precipitation, glacial and ice melt, and sea level rise. The last 150 years, since industrialization began, there has been an increase in population, natural resource exploitation and pollution. Similarly, 2000-2009 is the hottest decade since thermometer records began in 1850. Ice core analyses also proves that the world is experiencing climate change. Precipitation in the mountains has increased by 163mm in the last 25 years, accompanied by a decrease in snowfall. 70-80% of disasters are hydro-meteorological, with most of these concentrated on mountain states. Variability of rainfall is increasing water shortages. Melting glaciers are increasing the occurrence and extent of glacial lakes, making the area more vulnerable to glacial lake outburst floods.

National and State Action plans for climate change. (NAPCC and SAPCC)

NAPCC, released in 2008, aims to provide a strategy for mitigating and adapting to the climate change impacts in India. The SAPCC aims to create an enabling environment for implementation of the national plan while also addressing state priorities. The common framework for the state action plans is based on participatory approach, and ownership in the process and the final plan. These are expected to incorporate regional variations such as vulnerability assessments, climate profiles, identification of mitigation and adaptation strategies, incorporation of financial option, and integrate climate planning into the development of the state.

The national water mission of the NAPCC aims to increase water efficiency by 20%, recycle waste water, use innovative technologies to promote water neutral or water positive technologies, and develop strategies to deal with variability in water. Thus, the NAPCC focuses on:

- Increasing efficiency
- exploring options
- effective management

It also recommends several studies to understand the impact of climate change.

Way forward:

Future strategies developed by the state action plans need to focus on:

- Technological improvement
- capacity building
- reducing water use
- community management

Resilient water resources planning

This rests on water and climate vulnerabilities assessment, as well as studies on hazards, groundwater resources, river water studies and developing capacity of people. It should focus on disaster proofing, climate resilient technologies, rainwater harvesting, catchment area protection and promote water saving technologies. The Swajal project in Uttarakhand realised that water sources were drying up. This necessitated the initiation of a second phase that looked at catchment area protection.

Solid waste management and adequate sanitation considering resilient technologies are also needed. Lack of options for sanitary ware and sewage methods are a major hurdle for the effective implementation of sanitation plans in rural areas. Climate change and disaster protection need to be incorporated into sanitation programmes. Resilient sanitation infrastructure also needs to consider solid waste management, water conservation, and water recycling.

Session 4: Best Practices on Adaptation

Case Studies of climate change adaptation in two situations (floods/water logging and droughts) and Best Practices on Adaptation - Prasad Babu, UNDP, prasad.babu@undp.org

Adaptation and mitigation complement each other. Adaptation can be anticipatory, autonomous, or planned, depending on whether it is based on observation, without conscious thought, or as a result of deliberate policy. Climate change impacts are exacerbated by social changes, especially an increase in population density and the accompanying stress on resources.

Floods and water-logging are due to increased precipitation leading water to enter the interflaves or doabs. This natural process is disrupted by anthropogenic changes such as construction that block the normal drain routes and do not allow the water to drain away when the floods recede. This can be illustrated by observing the road network in the Mahanadi delta of Odisha, which has increased the period of waterlogging from 3 weeks to 4 months effectively ending any chances of a Kharif crop. This story is repeated in the Kosi Megafan in Bihar.

In the Mahanadi delta, communities **renovated a drainage system**. Providing adequate drainage for the flood water has also created an irrigation channel for the rabi crop. Another experiment is the **creation of a floating field** as is practised in areas of Bangladesh. **Protection of drinking water resources**, low pressure ultra-filtration technology, and use of rainwater harvesting has also been implemented by UNDP. **Alternative livelihood opportunities** are also created by introducing pisciculture and flood resilient crops.

Drought is prevalent in several areas in peninsular and western India. Drought affected districts also face groundwater scarcity and low groundwater quality, compounding the problem of drought. Small irrigation infrastructure, artificial recharge, waste water reuse, are proven cost-effective and efficient technologies. In Madhya Pradesh, a pilot project is working on land management and **watershed development** along with improved agricultural techniques such as soil fertility enhancement, and multiple cropping. APFAMGS looked at community based **groundwater management** with success. In Karnool in western AP, farmers have become experts in their groundwater and cropping patterns, and have developed tools for analysis and water budgeting. This has decreased distress migration in the area. In Gujarat and Punjab, the Columbia water center has started an incentive scheme that will reward farmers for **water conservation**. Use of a tensiometer to accurately apply water to crops has also been promoted.

Urban areas over-exploit groundwater resources. This can be combated by treating water using a **decentralised method**, and reusing in industry, domestic areas and for agriculture. A citizens' movement in Bangalore has promoted harvesting of rainwater, using wastewater, and increasing water efficiency.

The following are valuable strategies to increase adaptation to climate change

- Integrated spatial analysis streamlines the mapping of vulnerability by comparing several parameters such as water security, food security and disaster vulnerabilities.
- Incentives are a valuable tool for meeting goals.
- Finally prioritization of investment options using statistical methods is essential to allocate limited funds in a fair and efficient method.

Challenges are acceptance, mechanisation, sustainability, restoration of environmental flows in rivers and groundwater management.

Group Exercise on issues related to climate change and WASH

Community participation in WASH began by understanding what community participation means. It was also understood that it is necessary to have a common goal or interest that the community agrees upon. Equally, it is necessary to resolve past conflicts. Empowerment, ownership, proper representation are other issues that are crucial for participation. The stakeholders include the community, the PHED department, the irrigation department, NGOs or external facilitators. However, external agencies should play a minor role. Ideally, there should be enough drive within the community that the government need only act as a facilitator. Major decisions and choices should be made by the community consisting of local residents of the area.

State action plan on climate change and WASH. It was realised that in most plans and discussions, WASH is a cross cutting issue, while the focus areas are water and urban development. There was debate about whether this is acceptable, or whether WASH needs a separate focus. Vulnerabilities assessment is necessary to develop a plan. However, it is a question of capacity. Capacity building of state officials is necessary to develop a robust plan. It is important to look at vulnerable groups, to identify adaptation and mitigation measures, means of financing these measures, identify structures that are most vulnerable, increase resilience to droughts and floods, and to develop infrastructure to withstand disaster. Water resources, urban issues, and disaster management are issues that are concerned with WASH. While these are managed by different departments, coordination among the sectors is necessary.

Integrated Water Resource Management needs to include villagers. A socio-ecological profile that includes traditional practices and social characteristics needs to be documented. The main aspects for which particular WASH activities need to be planned are effective management of available water resources, household management, awareness generation, improved agricultural practices, recharging, and the conservation of traditional water harvesting practices. Community development funds, conflict management, and gender mainstreaming are all challenges that need to be discussed.

Developing WASH facilities in a village implies working on quantum of drinking water, quality of drinking water, distribution, and sanitation. Decentralised storage of water through rooftop rainwater harvesting, harvesting of surface runoff, and aquifer recharge are necessary. Desilting and maintenance of traditional water harvesting tanks is essential. Use of appropriate technologies such as bank filtration is necessary for safeguarding water quality. Some household level treatment of water such as Chlorine dosing may need to be done. Eliminating open defecation is a must; for safeguarding water resources, a two-pit type latrine (instead of a piped sewer system) needs to be constructed in each household.

GIS as a tool in climate change vulnerability assessment needs to begin with identifying hazards and vulnerabilities. Before making an assessment, it is necessary to understand the data that is available with the agencies. To estimate losses due to disasters, it is necessary to have a database of properties and infrastructure available. Formulae to assess loss and compensation needs to be done on a state by state basis as disasters vary. Data scarcity, reliability of data, parameters to define vulnerability, use of a modelling approach to define this vulnerabilities is needed.

Conclusion: Srinivas Iyer pointed out that there are people from three different sectors, government departments, NGOs, and academic institutions. In this case it will be a valuable learning experience to follow up in a few months time and understand what learnings the participants took back with them and implemented at work.

There is a neglect of WASH infrastructure and systems, in that they are not resilient to disasters. A disaster of any magnitude immediately means that communities lose whatever access to sanitation they have had. There is also a neglect of identifying vulnerabilities to ongoing climate change.

NIAR has a key resource centre on water and sanitation, and a UNDP center on climate change. This workshop brought together both centres. Next is planned a joint workshop on Uttarakhand including the climate change centre and CDM. This is essential because silos are no longer possible. It is becoming more and more difficult to ensure water security for our growing population. This is not to be considered as a one-off engagement. Feedback will help to strengthen the training programmes.



National Institute of Administrative Research
Lal Bahadur Shastri National Academy of Administration
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Two Days National Level Training Workshop on

Climate Change Impacts on Water, Sanitation & Health 26 - 27 June, 2013

Venue : Gyanshila Auditorium, LBSNAA Mussoorie



Appendix 1: Resource Persons Profile:



Srinivasan Iyer is Assistant Country Director and Head, Energy and Environment, UNDP India. He has worked for more than two decades on development and poverty reduction. Since 2000, he has worked with leading international NGOs, DFID and the UNDP. He has worked in several states in India and in Nigeria. He has worked extensively on policy and projects at the national and state levels in areas of natural resource management, clean energy, and water governance. Srinivasan holds an advanced degree in Economics and is formally trained in macroeconomic theory, and development

policy.



Dr. Anjal Prakash is the Executive Director at SaciWATERS, South Asia Consortium for Interdisciplinary Water Resources Studies based at Hyderabad in Southern India. He is also the Project Director of 'Water Security in Peri-Urban South Asia', a project funded by IDRC. He has worked extensively on the issues of groundwater management, gender, natural resource management, and water supply and sanitation. Having advance degree from Tata Institute and Social Sciences (TISS), Mumbai, India and PhD in Social and Environmental Sciences

from Wageningen University, The Netherlands,

Dr. Prakash has been working in the area of policy research, advocacy, capacity building, knowledge development, networking and implementation of large scale environmental development projects. Dr. Prakash is the author of *The Dark Zone: Groundwater Irrigation, Politics and Social Power in North Gujarat*, published by Orient Longman. His recent edited books are - *Interlacing water and health: case studies from South Asia (2012)* by Sage publication and *Water Resources Policies in South Asia (2013)* Rutledge.



Dr Shiraz Wajih is President of Gorakhpur Environmental Action Group- a resource organization working in eastern India on issues related to livelihoods and resilience since 1975. He is also Associate Professor in a University College at Gorakhpur. He has worked on water management, sustainable agriculture for small-marginal and landless farmers, identity and rights of women farmers, poverty and disaster risk reduction, climate change and adaptation both in rural and urban areas. Being a part of Asian Cities on

Climate Change Resilience Network, he is working on Urban Climate Change resilience with special focus on policies, demonstrative models, training and capacity building, microplanning etc. He has led and directed projects supported by agencies like Oxfam, Unicef, IDRC, DFID, Christian Aid, Rockefeller Foundation, Govt of India/UP etc. He has been/is member of Governing Boards of agencies like Oxfam, SPWD, ISET (USA) etc and has been part of various committees constituted by resource agencies/Government.

Mr. Prasad Babu has been working as Project Officer of the AusAID-UNDP Climate Change Adaptation Programme. Prasad Babu has done his Master's degree in Engineering Geosciences from IIT Kanpur, M.Sc.Tech Applied Geology from Andhra University. Prior to joining UNDP, Prasad Babu has worked as a Senior Water and Sanitation IMS specialist at USAID funded project (Water Analysis Innovation, and Systems Program), as Senior Research Engineer, Risk and Insurance at RMSI Pvt Ltd., as Lecturer in Geology and Remote sensing at Royal University of Bhutan. Prasad Babu has also initiated and worked in few other international and national research projects as team coordinator. He has experience in natural hazard risk modelling, post disaster assessment, disaster risk reduction, climate change adaptation, integrated water management, geo-



informatics and allied technologies.



Dr. Aidan Cronin trained as a civil and environmental engineer and holds a Ph.D. in water resources from Queens University Belfast. He has worked in consultancy and then as a Senior Research Fellow at the Robens Centre, University of Surrey, UK where he spent five years researching the impact of anthropogenic activities on water quality in the EU and country settings. He then worked as a Water and Sanitation

developing

advisor at the United Nation High Commissioner for Refugees in their Public Health Section in Geneva, Switzerland where he reviewed the state of water and sanitation globally in refugee camps before joining UNICEF India in 2008. He has managed the UNICEF water and sanitation program in Orissa State, India and in the New Delhi office as the national water advisor. He has published extensively on water and health issues.



K.N. Vajpai is a native of Uttarakhand mountains, he has worked in the Indian Himalayan region, on issues related to environment and climate change. He has been associated with various state and national government agencies, inter-government and multi-lateral agencies, scientific institutions and civil society groups in different managerial capacities. In 2010 he established 'Climate Himalaya' www.chimalaya.org, a widely known pan Himalayan science and policy network on climate change issues. His present work is related to

generating awareness on climate change issues, capacity building and advocating for developing resilience among mountain communities through various adaptation measures in the Himalayan region of Bhutan, India, Nepal and Pakistan. He has over 40 publications on water, environment, climate change and mountain issues, and is an active member of number of national and international scientific environment and climate groups. He can be reached at Vajpai@chimalaya.org and mobile +91-7607481242



Dr. R.C. Dhiman works as Scientist F at the National Institute of Malaria Research, in New Delhi. He has pioneered research studies in India in the field of Climate Change and Health and his key interests are in Climate and Malaria, Remote Sensing, Epidemiology

Appendix 2: List of participants

**Two days National Level Training Workshop on Climate Change Impacts on Water,
Sanitation & Health
(26-27 June, 2013)**

(List of the Participants)

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