Urban Climate Change Resilience

POLICY BRIEF 4

Water Security Resilience against Climate Change

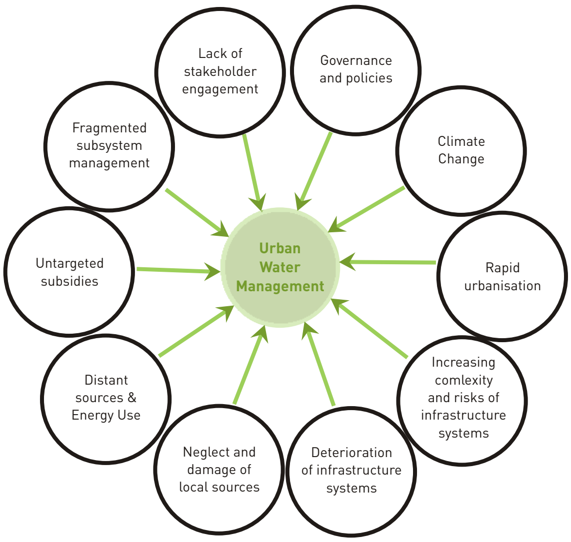
KEY MESSAGES

- The urban population growth, inter-sectoral competition over water resources and climate change are expected roll out concurrently, amplifying water scarcity, energy and treatment costs and health issues in urban areas. Improving efficiency and reducing climate change related risks would be possible through integrated management of water, sewage, solid wastes and storm water management across household to city scales.
- Lack of recognition of local resources in urban water management precludes possibility of improving resilience of urban water systems against energy and resource perturbations. Rainwater and sewage should be seen as resources rather than a problem in urban systems. All local resources should be carefully managed to build resilience against climate change as well as energy challenges.
- The data & information on urban water sector is weak, which limits possibility of improving management. Metering is a challenge in intermittent supply systems and cost managing the metered distribution systems is often higher than the revenues with high subsidy context. Enabling environment for resilience building would require developing & improving access to information on future scenarios, engagement and capacity building of multiple stakeholders across scales as well as new policies.
- Multi-scale water budgeting for each city should be first step in urban water management. It should include all local resources, imported water and waste water that can be potentially recycled. Spatially explicit database of resources, demand and supply, infrastructure and service levels for each city and its catchment area is necessary and this database should be annually updated for better management.
- There are several proven soft paths for improving efficiency of water use through reducing leakage losses, demand focussed end use as well as conjunctive management of local resources (e.g. rainwater, ground water) along with centralised supply.
- Current planning, legislation and management mechanisms need to be transformed towards integrated management of water through collaborative management by multiple stakeholders across scales to achieve efficiency and desired health outcomes. Policy space should be provided to enable such management process.
- Decentralised water management should be emphasised by empowering and devolving the responsibilities to formal and informal institutions, especially in urban peripheries. Nurturing, Information access and capacity building and monitoring support would be necessary to empower these institutions.

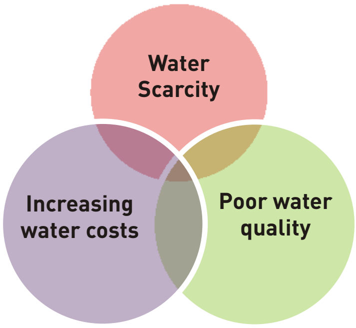
Most of the cities are facing water scarcities and piped water supplies cover only about three fourths of the population. Intermittent supplies and lack of coverage has resulted in significant proportion of users opting for household/building level self-supplies including groundwater use, storage and filtration systems and tankers.

1 CURRRENT STATUS OF THE PROBLEM

Indian urban water systems face multiple challenges arising out of urban growth, insufficient coverage, deteriorating infrastructure, fragmented management, competition from other stakeholders, untargeted subsidies etc. The figure presents overview of challenges facing the urban water sector.



Most cities across India have intermittent water supply and the peripheral areas are often not served. Most of the underground infrastructure is old and decrepit resulting in high leakage losses. The local resources in various levels of neglect due to pollution and over-extraction. Due to growing water crisis, cities are resorting to new capital works based on distant water sources, while not giving priority in addressing the high leakage losses as well as well as local resources.



At the user end, three most important challenges are water scarcity, water quality and increasing costs of water. As these challenges grow, people seek affordable solutions and households have to resort to measures like self-supply through private wells, large storage systems and household level filtration systems. The self-supply through groundwater use has resulted in groundwater decline in most cities. The degradation of local sources and groundwater decline has reduced the buffer against droughts and seasonal water scarcity, especially in hard rock regions.

2 CLIMATE CHANGE CHALLENGE

Urbanisation and Climate change are expected to roll out concurrently in different ways across the country. The temperature increase is expected to amplify the urban heat island effect and also can increase water demand for domestic use as well as space cooling. Increasing minimum temperatures can increase viability period of disease vectors. In cities with poor drainage and sewerage, the changes in viability periods of disease vectors can increase vector and water borne disease incidence.

In most regions in India, rainfall is expected to increase marginally, number of rainy days is expected to reduce along with few heavy rainfall events. The drought frequency may change significantly, impacting water resources and agriculture across years. With the continued urbanisation, the point demands for water resources are continuing to grow. The climate change is likely to be amplified in the water environment, reducing the reliability of existing water sources during droughts and increasing frequency of urban floods. Even with no change in urban population, the cities may have to explore new water resources (or conjunctive management of local and piped water supply) under such a scenario.

The water quality is expected to deteriorate with surface water bodies unable to withstand dumping of partially treated waste water upstream as well as leaking sewers within the city. Increased temperature is also likely to result in increased algal and weed growth in the rivers resulting in additional costs of water treatment. If the sewage and solid waste management is not improved, transmission of waterborne diseases can affect increasing proportion of urban population, while waterlogging and storage systems can increase habitats for disease vectors.

The coastal regions are likely to suffer from saline water intrusion in to estuaries and aquifers. Building resilience against water scarcity and climate change includes soft options to reduce water footprints, recycling as well as conservation of local resources. To be effective, these measures need to be practiced at various scales starting from household upwards and therefore require engagement of multiple stakeholders as well as interventions at multiple scales.

3 PROBLEM HISTORY

Most of the cities grew around perennial sources of water, since pumping technology was not widely available until last century. Advent of centralised urban water systems in the last Century resulted in neglect of local resources. Household level Wells and shallow tube-well based hand pump systems were common in riverine cities across Indogangetic plains. Sewerage system was only partially laid and managed poorly. The cities started expanding rapidly in later part of the last Century, with utilities unable to extend the water distribution networks to peripheral areas. In later part of the last century, water scarcity became widespread and borewell and submersible pump, PVC pipes and tank technologies became cheap and affordable and easily retrofittable in existing buildings. With these, households facing intermittent supply expanded their water portfolio by adopting self-supply to overcome scarcities. In Early 21st century, household level RO and UV filtration systems became affordable and private sector was able to provide satisfactory services to manage them. Now with the whole suite of household scale technologies available, most of the middle and upper socio-economic groups built household level water systems, thereby getting 24X7 water supply even with intermittent supply from the city water supply system. Since water was no longer a constraint in areas not connected to city water supply, these technologies also catalysed faster peripheral growth.

Prior to 74th Amendment, the city water utilities were managed by the state government departments with the ULBs having no power over management of water supplies. Focus of improvements in water supply and sewerage was limited to creation of new assets rather than improving efficiency of existing assets. The cities did not have autonomy and water supply is seen as the responsibility of the state governments. This resulted in externalisation of drinking water issues by the residents and neglect of local resources. The devolution of the water related function without building technical and managerial capacity within the ULBs has resulted in further deterioration of water supply systems. Also, with no control over the water resources beyond their boundaries, their reliance on state government remained and would continue to grow. As the state departments were managing water supplies with access to state's water resources, centralised piped water supply was considered as panacea for achieving economies of scale in water supply sector.

4 ROOT CAUSES

The root causes of water insecurity lies in:

Growing Demand, supply gaps

- Increasing reliance on large and often distant resources and neglect of local resources
- Fragmented management of potable water, sewerage, storm water and solid waste management
- Lack of investments on maintenance of distribution systems, formalisation of local source management, recycling
- Growing demands and lack of integration of peripheral growth
- Shrinking resource base and lack of information on resource behaviour & risk on water resources

Planning issues

- Information in water supply, sewerage and storm drainage is insufficient to plan and manage
- Existing land use based urban development rules restricting options for change
- Lack of integration of water resource assessment and management issues in urban planning
- Poor information on possible climate change impacts

Institutional issues

- Fragmented mandates and roles of different departments at various levels (ULBs, State and National governments)as well as between water supply, sewerage, storm drainage and solid waste management
- Lack of engagement of cross-scalar and cross-sectoral stakeholders in planning and management of water
- Poor management and financial health of ULBs

5 OPTIONS FOR URBAN WATER MANAGEMENT

The Integrated urban Water Management (IWM) provides a framework for management of scarce water resources in urban environments. This framework emphasises on improving water efficiency through a. integrating management of water supply, sewerage, storm water drainage and solid waste through multi-stakeholder engagement and collaborative management across scales. In data scarce environment with limited autonomy and capacity of the ULBs, collection, analysis & free access to information, technologies, as well as institutional changes are necessary before initiating IUWM.

Integrating Subsystems

Cities require high resource flows to function efficiently due to high density of population and water intensive economic activities. Water scarcity and urban flood risks arise from various interlinked factors. Water in all forms behaves as a single system, while water supply, sewerage, drainage and solid waste are managed as though they are independent entities. Poor integration of these subsystems result in increased risks of water scarcity, pollution of local and regional water resources, floods and water and vector borne diseases.

These four subsystems can be integrated to reduce the inefficiencies, prevent wastage of resources, and avoid fragmentation /overlapping of planning and decision making. For example, decentralised treatment of sewage can create low quality water suitable for gardening, construction and flushing use, which can reduce per capita demand by nearly 50%. Also, improvement of sewerage systems can reduce pollutant loads reaching the aquifers as well as overflowing through storm water drainage in to water bodies. Similarly, rainwater harvesting can increase local ground water resources and can dilute pollutant loads in aquifers. Better solid waste management can reduce pollutant loads on lakes and water bodies and also can reduce floods due to choking of sewerage and storm water drainage.

Integrating these subsystems would require subcomponents from building to city scales to integrate the system. Unfortunately such data is unavailable and urban water planning is done with gross estimates. Since most cities have limited or absence of metering, such data may have to be built with sample studies and database needs to be built up over time.

Soft paths to water management

Water is currently managed as though it is an infinite resource and could be tapped by increasing water foot prints. The climate change related water scarcity can only be managed through reducing reliance on single or small number of large resources and increasing efficiency of the systems.

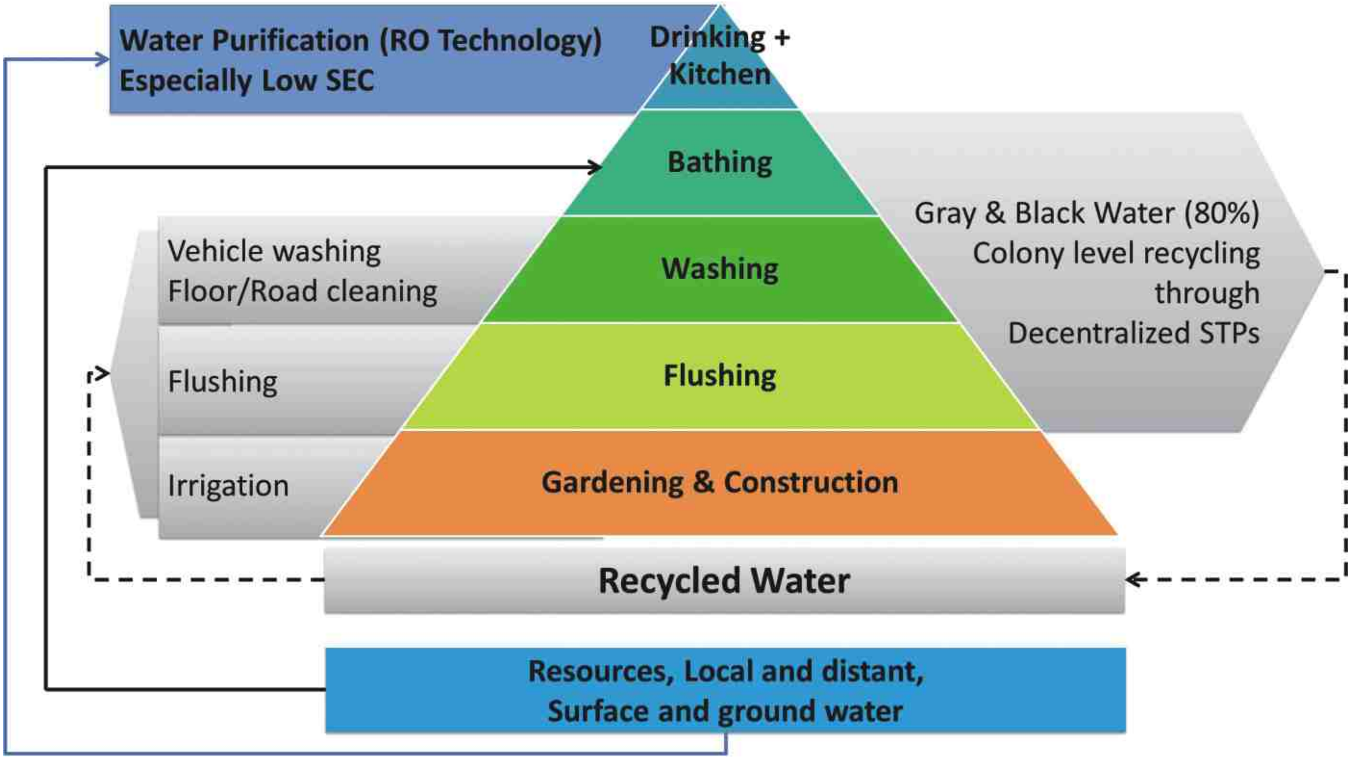
Comparison of different sources of existing and potential, local and distant sources are not done, since the cities can get water allocated from their state governments. In India, most of the regional water resources are already being used by other users, and distant source based water supply systems have started creating violent conflicts and these are expected to grow as cities search for distant water sources to augment supply. Also energy consumption and costs are going to increase for accessing distant resources.

Most of the cities across India face high leakage losses from decrepit distribution systems, often as high as 50% or more, while modern distribution systems can reduce the losses to less than 15%. Many cities can first invest on loss reduction before investing on new infrastructure from more distant resources.

Conjunctive water management

While the cities have been investing on distant sources, the local water resources have degraded due to over exploitation from self-supply, reduced recharge due to increased impervious areas, pollution from leaking sewerage as well as encroachment of water bodies. Increasing recharge, as well as use of rainwater harvesting can reduce the demand of treated water from external sources. Similarly, the recycling offers options to reduce the demand from external sources as well as reduce water costs.

Already the multitudes of users at various scales have learnt to conjunctively manage ground water along with piped supply. Formalising these informal arrangements & monitoring the resource status and quality is essential. Since most of these sources are distributed over space & of different capacities, they can be best managed by collaborative management between users a& the ULBs or devolving the systems to meso-scale institutions like resident welfare association & ward committees. These have to be explored before augmentation works are taken up.



Conservation of local resources

Local resources, especially the groundwater can provide buffer capacity during droughts and failure of distant source based systems. These can potentially serve as emergency supplies during droughts. Decrepit and partial sewerage network as well as inadequate solid waste management has resulted in pollution and siltation of water bodies as well as groundwater pollution. As a result, local resources have been damaged especially in core city and lag in extension of water infrastructure and services are resulting in overexploitation in peripheral areas. The efforts to manage local bodies so far has been restricted to prevention of encroachment, and monitoring of aquifers on regional scales. The regulatory interventions in groundwater management have been bogged by lack of staff as well as tools for management. Monitoring of water quality and flow the local water resources is necessary first step in managing the local resources.

Network integrated planning

The urban planning in India has been focussed mainly on land use planning. As the cities expand and urban systems become more complex, efficiency of urban metabolism would be increasingly dependent on of water, sewerage, storm water, and road and communication networks. While the population densities are expected to increase in city cores by compact growth, the capacities of existing networks need to be augmented. The peripheral growth needs to incorporate network based planning concepts. Also, most of the urban growth is expected to occur in medium sized cities with limited infrastructure. Network based planning holds potential to improve resource use efficiency in these cities.

Multi-Stakeholder engagement

While the users consider the water supply as the duty of the local body, the ULBs were unable to provide adequate supply due to capacity and financial constraints. With growing water insecurity, the middle and upper class households have opted for augmentation of limited supply by self-supply through borewells and also through tankers. Private storage systems have further amplified the disparity between those who are connected and rest of the population. The households with self-supply systems have limited stake in ensuring satisfactory performance of the centralised supply, while the rest are forced to bear the brunt of the water scarcity.

The water management under constrained resource context would need decentralised management of local resources and integrating them with centralised supply. Rain water, ground water and recycling of treated waste water can be best managed at building to colony levels. Involvement of these stakeholders is crucial to achieve maximum efficiency at these scales. Resident welfare associations and local informal institutions need to be engaged and empowered to take responsibility in managing these resources optimally. Access to information, technologies and skilled manpower to manage these systems would be necessary along with incentives to enable these.

Financial viability

Water is considered as public good and urban local bodies were mandated to provide drinking water. Untargeted subsidies and low tariffs impacted the financial health of water utilities, which impacted maintenance of the systems. With low water tariffs, there were no incentives to measure the use as well as manage finances. Poor financial health of urban local bodies resulted in lag between growing demand and expansion of water supply infrastructure. High leakage losses, poor collection of user charges and theft have resulted in high non-revenue water, which is worsened by low water tariff.

Decentralised management and transfer of some responsibilities to meso-level institutions like Resident welfare association and trade associations can provide options for improving water supplies. With ULBs providing bulk supply to these institutions(wherever feasible), the metering and monitoring costs can be significantly reduced and ULBs can focus on managing the centralised systems of water supply, sewerage, storm water drainage and solid waste and encourage/support bulk users to optimise the use of local resources effectively.

Peripheral growth

The autonomous city expansion through urban sprawls are managed by many private real estate agencies and City development authorities. High land values have resulted in encroaching of natural water bodies as well as drainage lines. With multitudes of real estate developers catalysing urban expansion, the drainage lines are often blocked by construction. The urban development plans and cadastral maps often have not allocated land for drainage, and sewage treatment in most city peripheries. The increase in paved areas have caused changed the hydrology resulting increasing runoffs with inadequate drainage, resulting in increasing frequency of water logging and urban floods. The peripheral areas undergoing rapid development offer opportunities to incorporate integrated water management principles that can be replicated in core areas later.

6 POLICY IMPLICATIONS

Climate change resilience for urban water management essentially centre on

- Optimal use of resources in the context of changing resource situations,
- Creating sufficient redundancy through multi-scale options for managing scarcities and
- Mitigation of hydro-meteorological risks amplified by climate change.

These can be achieved by policies for enabling multi-scale, multi-stakeholder options to strengthen cross-scalar linkages.

Ecologically sustainable water management: Climate, water resources and water demands are undergoing rapid change. Current policies are unable to deal with these changes as evidenced by poor coverage and wastage and damage of resources downstream. Since urban systems lie within basin level ecological systems, the sustenance of cities depend on the ecological health of its neighborhood and basin.

Even though national water policy states that the drinking water accorded top priority, there are a variety of other sectors already dependent on the water resources. With demands for food, industrial products and energy grows, the water use in other sectors are going to increase. Also, pollution form these sectors are expected to grow and the river systems would be unable to sustain ecological flows necessary.

In growing scarcity environment-impacted further by climate change linked variability, shift from exploitation of water resources to optimising use efficiency and maintaining ecological health of the water system is urgently necessary. Such a paradigm shift would require urban water policies informed by context, scenarios of growth and climate change impacts and minimum ecological flow requirements. Unless these shifts take place, over-extraction, and pollution can irreversibly damage the water system and ability of ecosystems to absorb and metabolise wastes. As the urban population grows, water policies need to be integrated with basin level water management policies.

Managing Water as finite resource: Water has been managed as though it is an infinite resource. Excessive focus on economies of scale resulted in opting for large centralised systems, ignoring local resources and decentralised management. A holistic approach including local as well as distant resources and potential reuse options should be included in urban water policy. Cross-scalar linkages at various levels ranging from households to basin scale need to be understood and incorporated in urban planning.

Urban planning: The urban planning and master planning process is centred on land use without integrating water resources and hydro-meteorological risks as well as critical networks necessary for efficient urban metabolism. Urban water system is essentially network based and therefore water supply, sewerage and storm water drainage and road networks should be integrated in urban planning process.

Institutional environment: The water resources are developed and managed by the states (by multiple states in case of interstate rivers). The ULBs have to depend on state departments to access resources beyond the city limits. Different roles of water cycle management are fragmented and overlapped between different utilities and departments. The water supply and sewerage is often managed by autonomous boards in many cities, while the drainage is managed by the ULBs. In others, the state government departments are responsible for capital works and they are handed over to the ULBs for operations and maintenance.

In the cities, water is managed by multiple stakeholders spread across scales encompassing households, colonies, industries and commercial users. The multiple stakeholders ranging from households, resident welfare associations and ward level committees (where they exist) have no voice or responsibility over water management. A major shift from centralised utilities to multi-scale, multi-stakeholder led planning and management is necessary as the resources are contested between sectors and resource scarcity is increasingly experienced. Policies to give voice, choice and roles to the stakeholders to enable multi-stakeholder engagement and institutional platforms for engagement are necessary.

Risk mitigation: Climate change is expected to increase temperatures, amplify uncertainties in precipitation and water yields. Also, the flood and waterlogging risks are expected to increase due to encroachment in to high risk areas as well as water bodies as well as constructed areas. In coastal areas, the risks of cyclones and sea level rise as well as saline water intrusion will be major issues. Current urban planning processes have ignored these issues and there are no explicit policies for managing these changes and risks. Disaster risk mitigation is only recently brought in to urban policy debate. Explicit polices to mitigate and manage risks are necessary.

7 POLICY RECOMMENDATIONS

Information for decision making

Urban water planning should be informed by spatially explicit water management information systems. Cities should be supported to develop the water information system, which may be made accessible to all stakeholders and users. Financing of water projects and expansion works may be informed by the water information system. The Water information system should include:

City and local levels

- Water supply, sewerage and storm water drainage networks as well as water bodies
- Flood zones
- Current coverage of city water supply as well as self-supply arrangements
- Local surface and groundwater resources and their status
- Assessment of currently unused resources like rainwater and treated waste water
- Demand for different end uses and their quality criteria as well as projected use based on end uses
- Current self-supply arrangements and estimates of use.
- Unaccounted for water at various scales
- Situation analysis of water supply, demand, resources and their variability across seasons
- Scenarios of urban growth and urban water demand
- Capital and O&M costs and utility finances
- Institutional arrangements
- List of Technological options for various scales

Basin level

- basin level resource assessment and impacts of climate change
- Existing water rights across users, their current demand and demand growth scenarios
- Traditional users and other stakeholders' profile,
- Demand for Ecological flows
- Basin level pollution status and scenarios of change
- Interstate water sharing issues

Integrated resource management

- The urban water planning should include both local and distant resources as well as rainwater and treated waste water. Conjunctive water management framework based on demand focussed end use should be adopted to reduce demand on potable water from distant sources. Each city should be supported to develop a monitoring system, which can be incorporated in water information systems.

- Each city should develop a policy for conservation of local resources. Conservation and monitoring plan should be developed. Principle of zero pollution discharge to local sources should be adopted to conserve local water sources. Point and non-point sources of pollution as well as over-exploitation should be monitored and incentive/disincentive structure for preventing their degradation should be developed and enforced.
- Rainwater harvesting and recycling of water should be made mandatory at building and colony levels (if not already existing), which should be monitored. In-situ sewage treatment and recycling should be made compulsory for peripheral areas and large colonies and institutional users. Water markets may be formed for low quality water for non-potable recycled water.

Urban Planning and land use

- Urban planning should include water supply, sewerage, storm water networks and they should be integrated with roads and other essential service networks to enable maximum use of rainwater and retain network integrity during disasters. Storm water network outlets in coastal areas should incorporate sea level rise issues.
- Flood zonation as well as sea level rise zones should be done incorporating climate change scenarios a separate land use category of no construction zone included into land use plans. Also separate space should be allocated for water and wastewater treatment purposes in each colony/neighborhood level.

Skill development and services

- Microenterprises may be formed and skill development for managing decentralised water systems and water bodies may be done to expand livelihood options for masons, plumbers and sanitary workers. The ULB should provide certification for such workers and micro-enterprises.
- Formalisation of self-supply arrangements and informal water markets may be done and monitored.

Stakeholder engagement

- The stakeholders across different scales should be encouraged to take up responsibilities of water management and maintenance in their areas. Formation of Stakeholder groups at various scales should be done wherever they exist. In other areas, stakeholder groups may be formed, supported and empowered to take on responsibilities of development and management of local resources. Incentives for best practices in water savings, recycling and local water resource management may be initiated.
- As far as possible, the distribution responsibilities should be devolved to these groups and the ULBs should provide bulk water supply and monitoring. This can be possible starting with colonies and large buildings

Utility capacity development

- The capacity of ULBs may be developed to understand and use climate information, water resource estimation, conjunctive water management, integrated urban water management and monitoring.

Risk mitigation and management

- Contingency plans for slow and rapid hydro-meteorological extremes

Policy Brief Overview

Asian Cities Climate Change Resilience Network (ACCCRN) is a network of cities in India, Indonesia, Thailand, Philippines, Bangladesh and Vietnam, experimenting with a range of activities that will collectively improve the ability of the cities to withstand, to prepare for, and to recover from the projected impacts of climate change. One of the key intervention focuses to build policy debate around UCCR. Policy makers seek evidence-based guidance as a foundation for decision-making. ACCCRN India partners have been working with cities in India since 2008 and it highlights sound practices, demonstration projects and interventions on building resilience to climate change.

It was recognized to tap the knowledge and develop evidence-based Policy Briefs to address the needs of the decision makers at the level of the national/state and city government on UCCR. In the period 2013-2014, ACCCRN India is producing a series of UCCR policy guidance briefs. For a complete list of reports, case studies, policy briefs, please visit www.acccrn.org

References

Policy and Operational Framework for Integrated Management of Estuarine, Coastal and Marine Environments in Canada http://www.dfo-mpo.gc.ca/oceans/publications/cosframework-cadresoc/page04-eng.asp

SWITCH in the City: putting urban water management to the test http://www.irc.nl/page/66812

Per capita water availability http://pib.nic.in/newsite/erelease.aspx?relid=82676

CPCB 2009, Status of Water Supply, Wastewater Generation and Treatment in Class-1 cities and Class-II towns of India

Report of the Committee on Slum Statistics / Census, Ministry of Housing and Urban Poverty Alleviation, National Buildings Organization, New Delhi (2010) http://mhupa.gov.in/W_new/Slum_Report_NBO.pdf

India 2025 – Environment http://planningcommission.gov.in/reports/sereport/ser/vision2025/env2025.doc.

This Policy Brief is written by:

TARU Leading Edge

www.taru.co.in

Telephone +91 124 2560424

Email (ACCCRN Focal point): gkbhat@taru.org

Kanadiya Community Handpump