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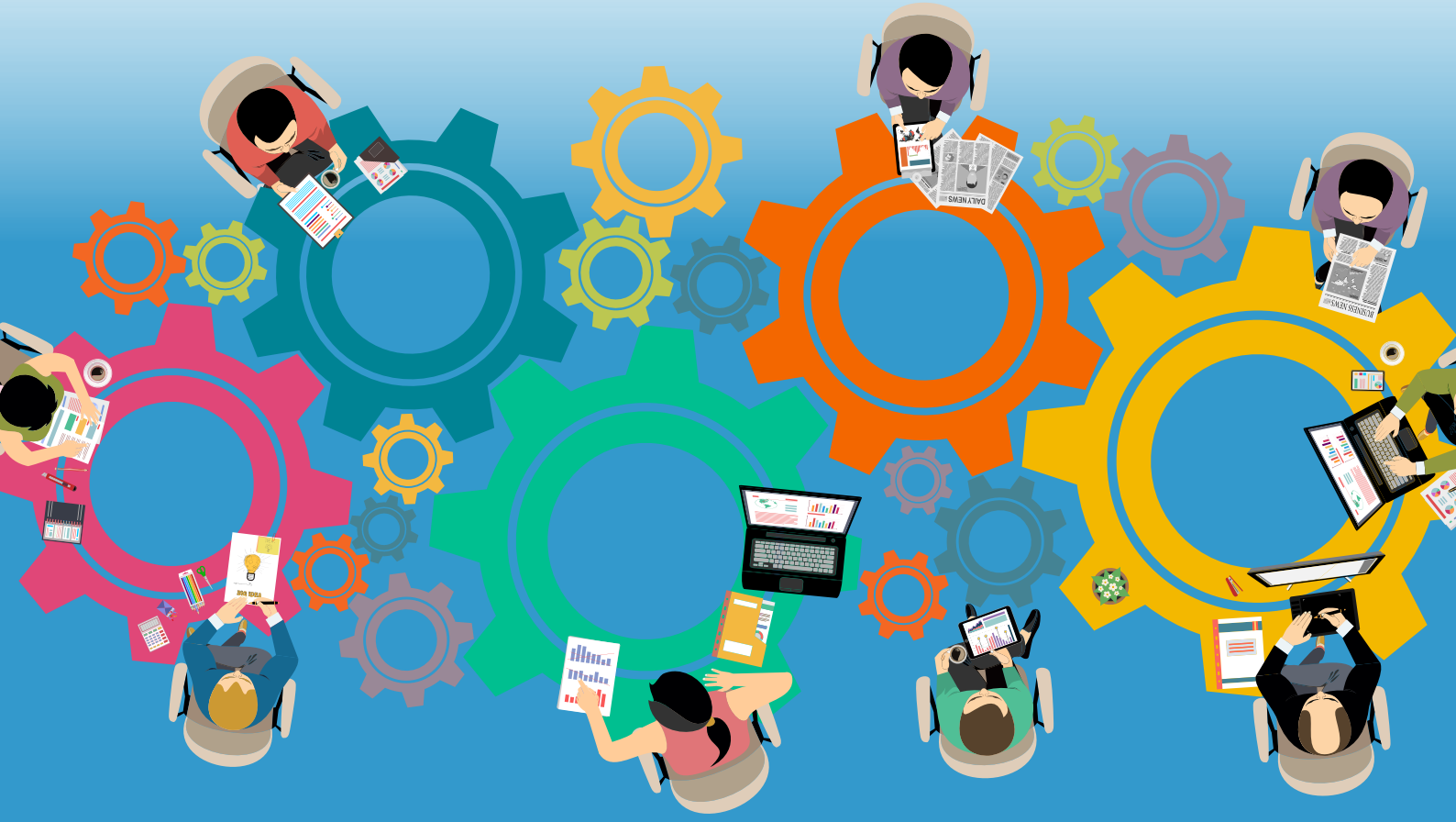
IWMI

IADAPT FRAMEWORK FOR DEVELOPMENT OF CATCHMENT MANAGEMENT PLANS



Title

IAdapt Framework for Development of Catchment Management Plans

Under the Project

Integrated Rural Urban Water Management for Climate Based Adaptations in Indian Cities (IAdapt)

Supported by

International Development Research Centre (IDRC), Canada

Project Consortium

- ICLEI – Local Governments for Sustainability, South Asia
- Athena Infonomics LLC Pvt. Ltd.
- International Water Management Institute (IWMI)
- Indian Institute of Technology, Madras (IITM)

Disclaimer

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Table of Contents

List of Tables

Abbreviations

ACCCRN	-	Asian Cities Climate Change Resilience Network
CMP	-	Catchment Management Plan
GHG	-	Greenhouse Gas
GIS	-	Geographical Information Systems
GoI	-	Government of India
IAdapt	-	Integrated Rural Urban Water Management for Climate Based Adaptations in Indian Cities
IAM	-	Integration Assessment Matrix
IAP	-	ICLEI ACCCRN Process
IITM	-	Indian Institute of Technology, Madras
IPCC	-	Intergovernmental Panel on Climate Change
IUWM	-	Integrated Urban Water Management
IWMI	-	International Water Management Institute
IWRM	-	Integrated Water Resource Management
lpcd	-	Litres per capita per day
MLD	-	Million Litres per Day
NRW	-	Non Revenue Water
RURBAN	-	Rural Urban
TEEB	-	The Economics of Ecosystems and Biodiversity

1. Introduction

Changes in key climate variables, such as temperature, precipitation and humidity, may have significant long term implications on the quality and quantity of water. Besides this, with increasing population and urbanization, there is an immense stress on water utilities.

Protecting water resources and ensuring sustainable supply is one of the priority development agendas in India, both at national and local level. Management and protection of catchments from where the water is drawn and promoting water nexus is at the heart of all smart city and regional planning. With changing climate scenarios and demographic profiles of urban areas, a catchment based approach is needed to ensure that mal-adaptation is avoided. No city or village can be considered in isolation, and therefore, a collaborative approach should be adopted while planning and designing water schemes.

ICLEI – Local Governments for Sustainability, South Asia, in partnership with Athena Infonomics LLC Pvt. Ltd., International Water Management Institute (IWMI) and Indian Institute of Technology, Madras (IITM) under the aegis of Integrated Rural Urban Water Management for Climate Based Adaptations in Indian Cities (IAdapt) Project has developed a framework to prepare catchment level water management plans. The project is funded by International Development Research Centre, Canada (IDRC). The overall objective of the project is to institutionalize climate change adaptation in water resource planning policies by implementing climate adaptive, integrated water management approaches through participatory planning, simple decision support tools and catchment management plans.

To help formulate catchment management plans (CMP), the project has developed the IAdapt Framework Toolkit. The IAdapt Framework is based on the ICLEI Asian Cities Climate Change Resilience Network (ACCCRN) Process or IAP toolkit, the Adopting Integrated Urban Water Management toolkit (AdoptIUWM toolkit) and The Economics of Ecosystems and Biodiversity (TEEB) methodology for ecosystem assessment.

- RURBAN Platform: A Multi-stakeholder platform to bring together stakeholders

- Data acquisition and analysis from the catchment level, regarding the socio-economic, environmental, governance aspects

- Climate scenario assessment, water resource integration scoring, systems assessment, risk assessment and vulnerability assessment

- Resilience interventions and their prioritization
- Decision Support Tool to relook at interventions in an integrated approach

- Catchment Management Plan
- Implementation and monitoring

The Framework is designed to assist rural and urban local governments to come together and formulate catchment level water management plans guided by the principles of integrated water resource management. It promotes an integrated approach to ensuring water security, by looking at the interactions and interdependencies among water, waste water and storm water with other sectors such as health, agriculture, solid waste, industry, etc. It brings together different administrative, planning and regulatory systems by creating a RURBAN platform that includes both rural and urban stakeholders at various levels such as local authorities as well as civil society.

The IAdapt Framework consists of five phases and will assist in developing the Catchment Management Plan for selected catchments in the city-regions. The five phases are:

Phase 1: Engagement Phase

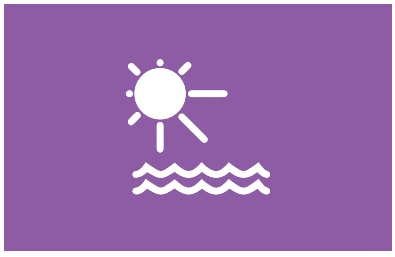
This phase includes formation of the core team and the RURBAN platform and engagements with both entities.

Phase 2: Baseline Assessment

This phase involves collection of socio-economic, environmental and governance data at the catchment level.

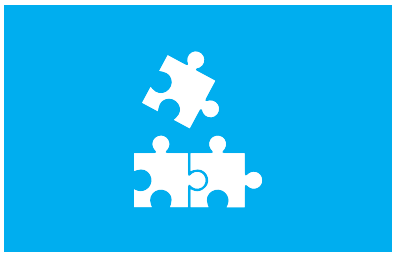
Phase 3: Climate Vulnerability of Water Resources

This phase includes climate scenario assessment, scoring of water resource integration, systems assessment and risk assessment, besides vulnerability assessment. It will help to select the particular sector/ issue for developing integrated solutions for water management.



Phase 4: Solutions Assessment

This phase includes selection of resilience interventions and their prioritisation.



Phase 5: Development of Catchment Management Plan (CMP)

This phase describes the structure of the Catchment Management Plan.

2. Phase 1: Engagement Phase

This phase outlines the institutional mechanisms that need to be established and defines the tools to identify and engage with all stakeholders in rural and urban areas.

2.1. Formation of Core Team

The identification of the core team members is a very crucial step as they will be responsible for driving the process. The core team may consist of representatives from city departments who have responsibilities for, or impact on, development planning, water use, pollution and waste, besides food security, water security, public health and local economic development, as well as infrastructure, and agricultural development. It is important to provide senior management support to the core team, to ensure that staff members working on the IAdapt Framework are directly supported in their day-to-day work by the management.

The core team is not a fixed body and new members can be added as and when required. Given below are a set of suggested responsibilities that the core team should commit to:

- Serve as representatives for their city government's divisions or sectors
- Lead the city government's efforts to participate in the programme
- Attend and participate in workshops to guide the IAdapt Framework implementation
- Ensure the IADAPT Process is followed in its entirety
- Secure the participation of multiple contacts in the city government in the programme
- Support in organising and delivering workshops and stakeholder consultations at different stages of the project, to gather relevant information from them and incorporate their suggestions and inputs as appropriate
- Coordinate the necessary communication and collaboration with all relevant departments and other stakeholders.

Two Project Nodal Officers – urban and rural – for the core team, who can act as the focal point for the process, also need to be identified. The main responsibilities of the Project Nodal Officers would be coordination and smooth execution of the tasks of the core team for implementing the IAdapt Framework. The officers' responsibilities may include:

- Organising meetings of the core team as per the agreed schedule.
- Facilitating communication and consultation with the core team.
- Tracking the progress of the IAdapt Process and informing the core team about completed and upcoming tasks.
- Facilitating data collection from various departments and other sources.
- A list should be prepared as per Table 1 identifying the core team members and their primary roles.

Table 1: IAdapt Core Team

Name	Position	Responsibility

2.2. Formation of RURBAN Platform

The IAdapt core team should formulate a Rural Urban (RURBAN) Platform involving key individuals from the district departments, state departments and officials representing urban and rural authorities, which will be responsible for interactions and discussions on integrated water management strategies and actions. This platform is a larger body who facilitates collaboration and participation from both rural and urban counterparts and prepares the CMP together with the Core Team and provides advisory services to the Core Team.

The RURBAN Platform is an active cross-sectoral network to facilitate inter-agency collaboration and participatory decision making on water management. It consists of decision makers and practitioners from relevant government departments and civil society. This unique platform brings together rural and urban stakeholders to plan for integrated water management.

The RURBAN Platform facilitates

- Exchange of information
- Collaborative Actions
- Formulation and design of plans

The members of the Platform should be identified using the characteristics outlined in Table 2 below.

Table 2: RURBAN Platform

Characteristics of the RURBAN Committee	Government (local, city, block , state)	Local NGOs / CBOs	Academia	Community Representatives	Private Sector	Any other important stakeholder
Has the ability to develop water strategies and actions at the community level						
Has the ability to develop water strategies & actions at the administrative level						
Whose support will be essential to implement water sector-related actions at different levels (e.g. community, city level)						
Those most affected by water related issues						

Once the members of the RURBAN Platform have been identified, an organisational framework needs to be decided upon. This includes formulating a vision and setting the terms and conditions of the Platform.

Vision

The core team along with the RURBAN Platform members should develop a vision, which states how they would like the region to be in the future, regarding water resource management (e.g. in 5 – 10 or 20 years). This vision could be guided by an existing vision statement of the city: first, note the various elements of the desired vision; then, discuss and formulate the Vision Statement. For example: *"By 2030 ….. micro-catchment area would have water infrastructure and systems that ensure the equitable provision of basic service to all and are climate resilient…."*

Terms and conditions of the RURBAN Platform

- The members of the RURBAN Platform shall be appointed for the period of the project duration. A member may resign his/her office by giving at least one month's notice in writing to the committee members, if he/she is completing his/her official term before the conclusion of the project. The core team can appoint a substitute official for the remaining period.
- The RURBAN members will meet at least twice in a year to review and receive updates on the status of the project. Meetings can be rescheduled or reorganised in case of emergency or any unforeseen event.
- A meeting of the RURBAN Platform members may be convened by the state office /district collectorate. The meeting's schedule, time, venue and maximum duration should be determined beforehand.
- At the meeting, the following shall preside -
  - The national and state government representatives
  - Two core team members, representing urban and rural areas
  - Collector or block representative
- The frequency of meetings should be based on the project plan.
- The quorum for the meeting of the RURBAN Platform members shall be at least half of the members of the committee, of whom at least two shall be state officers and at least four will be core team members.
- The nodal officer will be responsible for providing the project updates and status to the RURBAN Platform. The nodal officer can be responsible for ensuring the reporting and thereby monitoring of the project. The report will be finalised after the approval of the RURBAN committee. The comments and suggestions from the committee should be incorporated before the submission of the report.
- Every question or matter for decision or determination at a meeting shall be decided or determined by a majority of votes of the members present. In the event of a tie, the national government representative or state member presiding at the meeting shall have a casting vote.

2.3. Outcomes of Phase 1

- Identification of nodal officers
- Formulation of the core team
- Development of the RURBAN platform

3. Phase 2: Baseline Assessment

The baseline assessment will enable the collection of baseline situational information from the catchment area. It will have generic information from the villages and the parts of the city included in the catchment area. Table 3 provides an exhaustive list of data that should be collected as baseline. The Core Team and Nodal Officers should try to collect as much data from this list as possible.

Table 3: Micro-Catchment Baseline Questionnaire

Category	Unit	Data	Source of Data
Catchment level information			
Number of villages	Number		
Part of city included in the micro-catchment	Area		
Ecosystems / Biodiversity			
Area under green cover	Sq.km		
Types of ecosystems available (wetlands, riverine, forest etc.)	Number / area		
Provisioning services from water resources in the region			
Food: such as support to agro-ecosystems, freshwater systems, forests (wild foods from forests)	Yes/No		
Raw Materials: such as wood, biofuels and plant oils that are directly derived from wild and cultivated plant species	Yes/No		
Freshwater for drinking purposes	Yes/No		
Medicinal Resources: plants used in traditional medicines or as raw materials by the pharmaceutical industry	Yes/No		
Regulating services from water resources in the region			
Local Climate and Air Quality: temperature control, precipitation	Yes/No		
Carbon Sequestration and Storage: through water resources or trees	Yes/No		
Moderation of extreme events such as through wetlands, mangroves, trees	Yes/No		
Wastewater treatment	Yes/No		
Erosion prevention and maintenance of soil fertility	Yes/No		
Pollination	Yes/No		
Habitat or supporting services from water resources in the region			
Habitat for fish or birds that are important locally or as support to ecosystems	Yes/No		
Maintenance of genetic diversity through support to habitats of varied species	Yes/No		
Cultural services from water resources in the region			
Recreation and mental and physical health	Yes/No		
Tourism/economy	Yes/No		
Aesthetic or spiritual benefits	Yes/No		
Agricultural resources			
Total area of agricultural land	Sq.km		
Regional crop seasons	Months		
Primary crop	Names		
Secondary crop	Names		
Contribution to local economy, if possible	Percentage of total GDP		
Contribution to local food requirements, if possible	Percentage		

Category	Unit	Data	Source of Data
Water resources for the catchment			
Number of water bodies	Number, sq.km		
Major source of water supply (village wise)	List		
Classification of water bodies (ponds, lakes, rivers)	Number, sq.km, list		
Depth of groundwater table (village wise)	Metres, list		
Water quality (village wise)	As per pollution control board categories		
Major known water pollutants in micro-catchment	Info from FGDs – consider agricultural fertilisers, pesticides, and industrial effluents, etc.		
Demographics in catchment			
Population			
Total population in micro-catchment (village wise)	Number		
Total population in city			
Sex Ratio (village wise and for city)			
Number of households (village wise)	Number		
Average size of household	Number		
Floating/itinerant population[1]	Number		
Rate of annual inward migration, if possible	Persons/ year		
Rate of annual outbound migration, if possible	Persons/ year		
Employment			
Employment rates (%)	Percentage		
Nature of occupation	List		
Primary occupation	Percentage from list		
Secondary occupation	Percentage from list		
Informal sector[2]: numbers, categories			
Literacy			
Average literacy rate	Percentage		
Vulnerable groups			
Number of slums	Number		
Population living in slums	Number		
Population of minority groups	Number		
Number of Antyodaya Anna Yojana (AAY) families	Number		
Number of Below Poverty Line (BPL) families	Number		
Health			
Total number of deaths from calamities/ extreme climate events/ disasters (number/year) (village wise)	Number/year		
Total number of incidences of water-borne diseases in the city in the previous year (village wise)			
Total number of incidences of vector-borne diseases in the city in the previous year (village wise)			
Existing and proposed schemes or plan for the healthcare system	List		
Land			
Total area of micro-catchment (calculate from map)	Sq.km		
Zoning/ land use	Land use map with area		
Topography	Topographic map with ward/ zone/area		

1. a group of people who reside in a given population for a certain amount of time and for various reasons, but are not generally considered part of the official census count
2. The informal sector or informal economy is that part of an economy that is not taxed, monitored by any form of government or included in any gross national product (GNP), unlike the formal economy

Category	Unit	Data	Source of Data
Infrastructure			
Water supply			
Village Information			
Number of wells/hand pumps/community taps (village wise)			
Number of households (village wise) with piped water supply			
City Information			
Water supply distribution network	Maps to scale, with ward/zone/ area wise breakup; % coverage of network		
Number of authorised residential connections	Number of ward/zone/area wise distribution		
Number of authorised commercial connections	Number of ward/zone/area wise distribution		
Households with piped water supply	Number, percent		
Per capita supply [(total supply in MLDx10,00,000)/ population]	(lpcd)		
Households having water meters	Number, percent		
Taps, hand pumps, tube wells, tankers	Number		
Total amount of water supply (zone wise)	MLD		
Total amount of water demand (zone wise)	MLD		
Total non-revenue water (NRW) / unaccounted for water (UFW) (zone wise)	MLD		
Sources of freshwater for the city	Names and capacity in ML		
Distance from the city for each source	Kms		
Water treatment plant(s)	Number, capacity, location, ward/zone/area covered		
Catchment Information			
Existing and proposed schemes/plans from water supply			
Source of supply in the proposed scheme			
Sewage			
Sewage distribution network	Map with location of pumping stations and STPs and % coverage		
Total length of sewage network pipes	Ward/zone/area wise distribution		
Total length of underground sewage pipes	Kms		
Average age of network pipes	Years		
Volume of wastewater generated per day	MLD		
Volume of wastewater collected	MLD		
Volume of wastewater treated	MLD		
Volume of treated water reused	MLD		
Sewage treatment plant(s)	Number, capacity, location, ward/zone/area covered		
Outfall of main sewer lines	Place , distance from the city		
Level of treatment achieved at outfall (primary, secondary, tertiary)	type of treatment		
Households connected to sewage	Number, percent		
Households with septic tanks	Number, %coverage,		
Process of septage management	Collection, transportation, treatment and disposal process		

Category	Unit	Data	Source of Data
Coverage of pockets of urban poor by sewerage network and/or septic tank provision	Number, percent		
Existing and proposed schemes/plans for sewerage / septic tank or septage management			
Solid Waste Management			
Solid waste generated per day	TPD		
Amount of waste collected	TPD		
Amount of waste treated	TPD		
% of door-to-door collection			
% of waste segregation at the household level			
Solid waste treatment facility	Number, capacity, location, ward/zone/area covered		
Scientific landfills	Number, capacity, location, ward/zone/area covered		
Open dump sites	Number, capacity, location, ward/zone/area covered		
Existing and proposed schemes/plans for SWM			
Stormwater drainage			
Drainage distribution network	Map with ward/zone/area		
Total length of covered network	Kms		
Total length of uncovered network	Kms		
Areas prone to waterlogging in the city	Location, area, coverage in %		
Existing and proposed schemes/plans for drainage			
Governance			
What is the regional environmental plan or policy?	Name, year		
What is the regional disaster management plan or policy?	Name, year		
What is the regional climate change policy or plan?	Name, year		
Any policies, plans, guiding statements that are used to direct actions to reduce energy use and pollution?	Name, year		
What is the regional water management policy or plan?	Name, year		
Is there engagement and collaborative action among rural and urban administrative counterparts?	Yes/No/Partly		

3.1. Outcomes of Phase 2

- Detailed baseline data for the catchment
- Tentative priority sectors that need more exploration

4. Phase 3: Climate Vulnerability of Water Resources

In this phase, the core team, in consultation with the RURBAN Platform members, identify the climate risks to the fragile systems in the catchment. The water balance of the catchment along with the vulnerable areas and vulnerable populations are also assessed here.

4.1. Climate Scenario Assessment

This step helps to collate and analyse climate change data and generate at least one climate exposure scenario, or projection. Ideally, local climate data should be used; however, if this is not available, other sources can be used for conducting the analysis. An in-depth secondary study is conducted to identify how the climate is already changing, as well as how it is expected to change in the future due to changes expected in climatic factors such as average temperature, precipitation, sea-level rise and extreme events in the area.

Climate data collection

For each climate change condition, as much information as possible should be collected and put in the table below:

Table 4: Climate Data Summary

Changing Climate Condition	Assessments	Amount of Expected Change (Include baseline and planning horizon years)	Geographical area	Greenhouse Gas Emissions Scenario	Extent of variability	Level of confidence	Sources
Precipitation Change	Regional Assessments	*Example: 1268±225.2 mm to 1604±175.2 mm*	*Himalayan Region (Western Himalayas constituting of Jammu and Kashmir, Uttarakhand and Himachal Pradesh)*	*A1B scenario, IPCC*	*Overall increase in rainfall. June, July, August, September - 12mm January, February - 5mm October, November and December*	*High*	*4x4 Assessment report by GoI*
	Supplementary Local Assessments						
Temperature Change							
Extreme events							
Sea Level Rise							

Climate Scenario Statements

If there are both regional and local assessments, the data can be analysed to determine whether there is a consistent set of projections. If the results for a particular 'changing climate condition' are consistent for both the regional and local assessments, a single Climate Scenario Summary Statement can be written for that climate condition. However, if there are significant variations in the projections, you may need to develop two separate Climate Scenario Summary Statements for each of the assessments. Some specialist assistance may also be required for this process.

A Scenario Statements can be framed in the following manner:

"There is a... **<insert information from 'level of confidence'>**... degree of certainty of a...**<insert information from 'amount of expected change' i.e. the range>**... change in the...**<insert information from 'changing climate condition'>**...in the...**<insert information from 'geographical area'>**...by the year...**<insert information on the planning horizon year from 'amount of expected change' column>**. The projected change is expected to...**<insert information from 'extent of variability'>**."

The summary statements can be noted down in the table below.

Table 5: Summary of Climate Scenario Statements

Changing Climate Conditions	Assessments	Climate Scenario Summary Statements
Precipitation Change	Regional Assessments	
	Supplementary Local Assessments	
Temperature Change		
Extreme events		
Sea Level Rise		

From the scenario statements, the major climate risks for the catchment should be identified and listed by the team for use in subsequent steps.

4.2. Water Balancing

The core team will undertake the Water Balance Exercise. The water balance exercise identifies the demand-supply gap and helps to demonstrate alternative pathways to reduce this gap. It helps the catchment to move towards a demand-supply balanced approach without any additional water abstraction. Since Indian cities face issues related to water scarcity in summer, summer water balance is an additional indicator to be assessed for the water balance exercise.

The exercise has three steps:

1. The core team collects data for demand and supply related to existing scenarios of water sectors. The existing demand of water can be calculated on an average from the population and other bulk uses of water in the catchment – agriculture, industries, etc. The existing supply of water can be assessed from a random sample survey of the population in the catchment and other data that is available with the state water resource department or Groundwater Board.
   - Water demand urban areas: total population *135 lpcd[3]
   - Water demand rural areas: Total population *40 lpcd[3]

3. http://cgwa-noc.gov.in/LandingPage/Guidlines/NBC2016WatRequirement.pdf

2. The demand supply gap will be calculated for future population scenarios based on future population estimates. For sections where data is not available, realistic estimates can be used. Future population can be calculated as follows (arithmetic method):
   Average rate of change of population with respect to time, C = dP/dt, where dP is the change in population and dt is the change in time. Population after nth decade will be Pn= P + n.C (1) Where, Pn is the population after 'n' decades and 'P' is present population.
3. The core team will assess the existing and future demand-supply gap and add the information in Table 6.

Table 6: Water Balance: Existing and Future Demand-Supply Gap

Parameter	Value (MLD)	
	Existing Scenario	Future Scenarios
Household Supply		
Total water supply		
Total water demand		
Demand and supply gap		
Alternative water use		
Supply for bulk uses		
Demand for bulk uses		
Demand-supply gap for bulk uses		
Total demand-supply bulk gap		
Summer water supply		
Summer water demand		
Summer: demand-supply gap		

Once the demand and supply gap is known, there is a need to look at options to reduce this gap using the principles of IWRM so as to achieve water balance in the catchment. The IWRM principles demand that the demand-supply gap be reduced using alternate approaches/options to meet the increasing water demand, without resorting to additional abstraction. Future scenarios need to be assessed to enable a transition from addressing demand-supply gaps to achieving demand-supply balance. Six key approaches for achieving the balance are:

1. Wastewater reuse
2. Stormwater reuse/recharge
3. NRW loss reduction
4. Per capita supply reduction
5. Revival of traditional practices (for water conservation) and local water bodies
6. Service provision, particularly to poor and marginalised

After using these key approaches for integration, the reduction in the demand and supply gap will provide us the Integration Value. These values can be used to calculate the demand-supply balance (refer Table 7).

Table 7: Water Balance: Demand-Supply Balance

Parameters	Business as Usual Scenario Value (MLD)	After Integration Value (MLD)	Business as Usual Scenario Value (MLD)	After Integration Value (MLD)
	Existing Scenario		Future Scenario	
Total supply available for household use				
Total supply available for bulk uses				
Demand-supply balance: household supply				
Demand-supply balance: bulk uses				
Total demand-supply balance				

Example

Water supply
A. Drinking: 30 MLD
B. Industries: 40 MLD
C. Green area/parks: 20 MLD
Total Water Supply, S: A+B+C = 90 MLD

Water demand
Population, P: 10000
Per capita consumption, C: 120 lpcd
Total Water Demand, D: PxC = 12000000 = 120 MLD

Water Supply Demand Gap: D-S = 30 MLD

Scenario after intervention
Integration solution of IUWM Approach: Wastewater reuse
Available water for reuse after treatment: 20 MLD
Integration Value is 20 MLD

Total water supply = water supply+ integration value: 90 + 20=110 MLD
Demand: 120 MLD
Water Supply Demand Gap: 10 MLD

Thus there is a reduction of 20 MLD in the supply demand gap.

4.3. Identification of Focus Sectors and Issues

For integrated water management, an analysis of water and its allied sectors is needed to understand existing situation and improvement needs. This can be done using the Integration Assessment Matrix (IAM). It is a self-assessment tool that contains questions, based on principles of IWRM, to assess the existing status of integration of water and allied sectors. It assesses the different water sources and uses in the micro-catchment and identifies whether different quality of water is used for different uses. The tool provides different indicator questions that tries to estimate the level of integration among water and its allied sectors. For each indicator question, possible responses are selected based on the situation in the catchment. Each possible response has been given a score in the matrix and the sum total of these scores give the total integration score.

The core team should discuss and assign a score to each indicator, based on the options best suited to the catchment. For indicators where accurate data is not available, the core team can use broad estimates that best depict the existing situation. The matrix is given in Table 9.

This tool will give:

a. Existing status of integration through an integration score for the catchment, which is a measurement of the extent to which different quality of water is used for different uses. This score should be compared with the Scoring Table below to get the existing status of integration across water sectors in the catchment.

Table 8: Scoring Table

Score	Status
Above 30	Excellent
Between 25-30	Good
Between 20 – 25	Average
Between 15 – 20	Poor
Less than 15	Critical

b. Strengths, Weaknesses and Quick Improvement Areas: The tool shows that:
   - All indicators with a high score are the strengths of the catchment.
   - Indicators with a medium score are the quick improvement areas, where with minimal intervention, improvements in the level of integration can be made.
   - Indicators with a low score would correspond to weaknesses of the catchment. These are critical areas that the city should focus on.

c. Focus issue based on Integration Assessment Matrix: The tool will indicate the issue/s that score low that should be addressed by the city on priority basis.

Table 9: Integration Assessment Matrix

Sr. No	Integration Indicators	Criteria Scoring		
		Criteria/sub criteria	Scale	Selected Score
1	Location of major water source(s) in the micro catchment	Main source(s) within micro-catchment boundary	3	
		Main source(s) located at district level	2	
		Main source(s) located outside district	1	
2	Existing participatory process for integration of water sectors	All stakeholders and water sector departments are involved throughout planning and implementation (through stakeholder consultations)	3	
		No direct stakeholder involvement, comments invited after preparation of final plan	2	
		No involvement, plans prepared internally by government departments	1	
3	Water portfolio for supply	Practicing Reuse, Recycle and Recharge - Traditional rainwater harvesting (RWH) structures and systems or new policies to recycle reuse	3	
		Water security plans using different sources of water (groundwater, surface water, pond)	2	
		No plan for water security, but supplies assured through single source (for next 10 to 20 years)	1	
4	Water pollution	Water quality (surface and groundwater) within permissible limits	2	
		Polluted pockets are being confined; no mitigation plan/ measures yet	1	
		Critical level of surface water pollution (Coliform, BOD, DO level, eutrophication, etc.) and critical level of groundwater pollution (fluoride, arsenic, etc.) – no plans for mitigation	0	

Sr. No	Integration Indicators	Criteria Scoring		
		Criteria/sub criteria	Scale	Selected Score
5	Link between water and energy	Link is realised and measures are taken (like use of renewable energy, energy efficiency, land use etc.)	2	
		Link is realised but measures are not taken	1	
		Link not recognised and no measures are planned	0	
6	Climate change and water resources	Impacts of climate change on water resources are recognised and adaptation measures are taken up	2	
		Need is recognised but no measures being taken	1	
		Need is recognised but no measures being taken	0	
7	Instances of water or vector-borne diseases (malaria, typhoid, jaundice, hepatitis, etc.	Not common	2	
		Occasional occurrence in some areas	1	
		Water-borne diseases leading to fatality and outbreak of epidemic in recent past	0	
8	Capacity (skills, resources, awareness, willingness) of administrative staff and other stakeholders	Capacity-related constraints are limited, addressed regularly	2	
		Addressed only in extreme cases	1	
		Capacity-related constraints not addressed at all	0	
9	Solid Waste Management	Segregated waste collection, treatment and disposal available; no impact on water quality or drainage	3	
		Simple collection without segregation, treatment and disposal available; low impact on water quality or drainage	2	
		Simple collection without segregation, no treatment, only disposal; medium impact on water quality or drainage	1	
		Open dumping, without collection or treatment; high impact on water quality or drainage	0	
10	Wastewater	Treatment system available to treat wastewater at least to secondary level, and septage management system available	3	
		Part sewer connection, and/or septage management available	2	
		No sewer connection, and septage management available	1	
		No sewers and no septage, link to open or natural drains	0	
11	Stormwater	Waterlogging due to encroachment of natural drains is frequent	1	
		Waterlogging due to encroachment of natural drains is infrequent	3	
12	Ecosystems	More than 50% green cover and supports at least 3 types of ecosystem services	4	
		Between 35-50% green cover and supports at least 2 types of ecosystem services	3	
		Between 20-35% green cover and supports at least 2 types of ecosystem services	2	
		Less than 20% green cover and supports 1 or no ecosystem service	1	
	Total Score			

The core team should prepare a summary sheet from the integration assessment matrix as per Table 10.

Table 10: Summary Sheet for Integration Assessment Matrix

Total Score	
Existing status of integration in the city (Excellent, Good, Average, Poor, Critical)	
Weaknesses	
Strengths	
Quick Improvement Areas	
Focus systems	

4.4. Fragile Systems Assessment

This exercise helps to analyse the fragile systems that have been identified through Table 10 as the focus issues or weaknesses or quick improvement areas. The systems may include 'core systems', such as water and food, essential for survival, and 'secondary systems' such as education and social services, which rely on the core services. This step helps to do the following:

1. Analyse of fragile systems i.e. the systems or services that are already weak or under great pressure, by looking at them through a water lens.
2. Assess the impact of climate change on these fragile systems.

The fragility of these systems are identified in terms of the characteristics of resilient systems - flexibility and diversity, redundancy and safe failure. This information can be obtained largely from the baseline questionnaire that collects information on these systems and through discussions in meetings with the RURBAN Platform and core team members.

Flexibility and Diversity – whether the sector is able to provide a mix of multiple options, so that key assets and functions are distributed or decentralised, and not all affected by a single event, and can function under a variety of conditions.

Example: A variety of water sources are used for water supply, rather than one centralised water treatment facility.

Redundancy – whether the system has alternatives / back-up systems / contingency plans, capacity for contingency situations, multiple pathways and options for service delivery in case one or several options fail.

Example: If the water treatment facility fails, tankers can be used to provide water for essential services.

Safe Failure – whether the system has the ability to absorb sudden shocks or slow onset stress so as to avoid catastrophic failure.

Example: Dikes are designed so that if their capacity is exceeded, they fail in predictable ways, channelling flooding away from populated areas.

The systems are also analysed in terms of the impacts of this fragility on other systems and services and the overall responsibility of these systems. The information is then collated to formulate a Fragility Statement for the system to define concisely why the system is considered fragile in the catchment.

Table 11: Fragile Systems Assessment

System	Why is it critical or fragile?	What are the existing and anticipated problems caused by the fragility of this system?	Responsibility	Fragility Statement
Example: Water Supply	*Flexibility & Diversity: Traditional water sources have been lost due to urbanisation and the city depends on centralized pumping systems that transport water from significant distances to the city. Supply cannot meet the growing demand* *Redundancy: Alternatives usually include water supplied by tankers (trucks). This is an expensive and polluting fallback option* *Safe failure: in case of a disruption in water supply, individual households have to fend for themselves.*	■ *Disruption of water supply to citizens* ■ *Additional financial burden on individual households to purchase water from water tankers* ■ *Increased pollution and emissions from the plying of water tankers*	*Shared with the Irrigation & Public Health Department*	*The water supply system in the city is old and largely dependent on transporting water over large distances, whereby even minor disruptions cause significant shortages in the city in the face of an ever growing demand; alternatives are not cost effective or sustainable*

To assess the impacts of climate change on the fragile systems identified in the table above, the core team should develop a Climate Fragility Statement for each fragile system. To do this, the core team should look at the climate risks (identified through the climate scenario assessment in Table 5) and consider the possible impacts of such risks on the fragility of these systems. This should be outlined in Table 12.

Table 12: Climate Fragility Statements

Urban System	Fragility Statement	Climate fragility statement	Climate fragility statement
		Climate Risk 1: increased precipitation	Climate Risk 2: Increased temperatures
Example: Water Supply	*The water supply system in the city is old and largely dependent on transporting water over large distances, whereby even minor disruptions cause significant shortages in the city in the face of an ever-growing demand; alternatives are not cost-effective or sustainable*	*Increased precipitation disrupts / damages water supply infrastructure*	*Increased temperatures will lead to increased demand for water, thereby posing additional stress on the supply system*

4.5. Risk Assessment of Climate Fragility Statements

After the climate fragility statements for the fragile systems are identified, these should be prioritised on the basis of the likelihood of its occurrence and the consequence, if such a risk occurs. It is recommended that the core team conducts a workshop to assess the risk status. It is important to incorporate the views of all stakeholder groups as well. The Risk Assessment exercise should be undertaken jointly with the stakeholders as part of a consultation process through group exercises in the workshop. Every group can present their results and debate and finalise together the final scores of the exercise.

To assess the climate risks, the core team needs to score the likelihood and consequence of each climate fragility statement of each of the systems.

The likelihood of each risk can be assigned a score from 1 to 5 as per the table below. It is recommended that you refer back to the 'Level of Confidence' that has been assigned to each of the identified climate change conditions in Table No 4, which indicates whether the likelihood of occurrence is higher or lower.

Table 13: Likelihood Rating and Scoring

Likelihood Rating	Description	Score
Almost certain	Is highly likely to occur, could occur several times per year; Likelihood probably greater than 50%	5
Likely	Reasonable likelihood, may arise once per year; Likelihood 50-50 chance	4
Possible	May occur, perhaps once in 10 years; Likelihood less than 50%, but still quite high	3
Unlikely	Unlikely but should still be considered, may arise once in 10 to 25 years	2
Rare	Likelihood probability significantly greater than zero. Unlikely in foreseeable future – negligible probability	1

Next, for each climate risk, assess the consequence or impact, if the risk does occur. Consequences can be assigned a score from 1 to 5, where 5 is Catastrophic and 1 is Insignificant. Table 14 shows how to assess the different consequence rating, using "Impact on the System" and "Impact on the City Government" as measures. It is necessary to consider the impacts on both, the system as well as the poor and vulnerable, while deciding on the consequence ratings.

Table 14: Table 14: Consequence Rating and Scoring

Consequence Rating	Impact on System	Impact on poor and vulnerable and city government	Score
Catastrophic	System fails completely and is unable to deliver critical services; may lead to failure of other connected systems	Severe impact on poor and vulnerable groups in the city, leading to situations of extreme destitution	5
Major	Serious impact on the system's ability to deliver critical services; however, not a complete system failure	Loss of confidence and criticism in city government; ability to achieve city vision and mission seriously affected Significant impact on poor and vulnerable groups in the city that seriously affects their lives and livelihoods	4
Moderate	System experiences significant problems, but still able to deliver some degree of service	Moderate impact on the lives and livelihoods of the poor and vulnerable groups in the city	3
Minor	Some minor problems experienced, reducing effective service delivery, possibly affecting certain other systems or groups	Minor impact on the lives and livelihoods of the poor and vulnerable groups in the city	2
Insignificant	Minimal impact on system – may require some review or repair, but still able to function	Minimal impact on the lives and livelihoods of the poor and vulnerable groups in the city	1

The likelihood and consequence scores can be multiplied to get the Risk Score. The Risk Score can be compared to the Risk Matrix (see Table 15) to assess the Risk Status. This can be outlined in Table 16.

Risk Score = Likelihood x Consequence

Table 15: Risk Matrix

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Medium (RS=5)	Medium (RS=10)	High (RS=15)	Extreme (RS=20)	Extreme (RS=25)
Likely	Low (RS=4)	Medium (RS=8)	High (RS=12)	High (RS=16)	Extreme (RS=20)
Possible	Low (RS=3)	Medium (RS=6)	Medium (RS=9)	High (RS=12)	High (RS=15)
Unlikely	Low (RS=2)	Low (RS=4)	Medium (RS=6)	Medium (RS=8)	Medium (RS=10)
Rare	Low (RS=1)	Low (RS=2)	Low (RS=3)	Low (RS=4)	Medium (RS=5)

RS=Risk Score

Table 16: Prioritisation of Climate Risks

Climate Risk Statements	Likelihood	Consequence	Risk Score (Likelihood X Consequence)	Risk Status
Increased precipitation disrupts/ damages water supply infrastructure	4	4	16	High

The climate risk statements with high or extreme risks should be given priority during the solutions assessment in the later stages.

4.6. Vulnerability Assessment

In a workshop conducted by the core team with the RURBAN Platform members, vulnerability assessment should be carried out for the region, to identify the areas prone to the climate risks identified above and the social groups/communities/ stakeholders who are impacted by these risks in these areas.

Maps showing the distribution of the high priority climate risks across the catchment area are produced. This can be done using hard copies of the catchment map showing different village boundaries and city wards. Different colours representing different climate risk statements can be put in the areas that the core team perceives to be at greatest risk. The vulnerable areas for each sector can be identified on separate maps. Superimposing all the maps will create the vulnerability hotspot map indicating which area is vulnerable to most issues so that interventions can be targeted to these areas.

The core team should then identify the actors (i.e. individuals, households and public/private sector organisations) that can play a critical role towards building urban resilience. Their ability to contribute to water resilience is broadly dependent on the following three key capacities:

a. **Capacity to organise and respond** – whether the actor has the capacity to organise and re-organise in response to threat or disruption.

b. **Access to Resources** – whether the actor has access to the resources necessary to respond to stress (manpower, technology, funds).

c. **Access to information** – whether the actor can avail data and information necessary to develop effective plans and actions and to improve responses to disruptions.

The combination of these three characteristics would help to determine the adaptive capacity of each of the urban actors.

Adaptive Capacity Score = Capacity to organise and respond x Access to Resources x Access to Information

Table 17: Actors' Capacities Rating and Scoring

Key Capacities of Actors	Score
Capacity to Organise and Respond - in response to threat or disruption	
Low capacity	1
Medium capacity	2
High capacity	3
Access to Resources - necessary to respond (manpower, technology, funds)	
Low access	1
Medium access	2
High access	3
Access to Information – to develop effective plans for better responses to disruptions	
Low access	1
Medium access	2
High access	3

Table 18: Levels of Adaptive Capacity of Urban Actors

Adaptive Capacity Score	Level of Adaptive Capacity
1-8	Low
9-17	Medium
18-27	High

Adaptive Capacity Score for each actor is obtained by multiplying the scores allocated to each of the 3 characteristics. Actors having a 'Low' or 'Medium' level of adaptive capacity would be those that would need to be specifically targeted in the actions (or resilience strategies) that are undertaken in the catchment management plan. Actors with a 'High' level of adaptive capacity can be engaged in the proposed actions as they have the capacity to effectively respond to the impacts of the fragile systems. The information can be listed in Table 19.

Table 19: Actor Analysis

Climate Fragility Statements	Area/ward/ village	Actors	Capacity to Organise & Respond (A)	Resources (B)	Access to Information (C)	Adaptive Capacity Score (A)*(B)*(C)	Supporting Notes
Example: Contamination of water supply due to flooding made worse by lack of alternative sources	*Village Name*	*Slum dwellers*	*1*	*1*	*1*	*1 (low)*	*Dependent on shallow aquifers that are easily contaminated; access to water tankers too expensive; no information on water purification techniques*
		Private Sector	*2*	*3*	*2*	*12 (medium)*	
		RWA	*2*	*2*	*1*	*4 (low)*	
		Water Authority	*2*	*3*	*3*	*18 (High)*	
		NGO	*2*	*1*	*3*	*6 (low)*	

4.7. Outcomes of Phase 3

- Water balance of the catchment
- Climate scenarios and climate risks to the catchment
- List of fragile sectors in the catchment
- Vulnerable areas in the catchment
- Vulnerable populations in the catchment

5. Phase 4: Solutions Assessment

In this phase, the core team will use the information and analysis from Phases 2 and 3 to develop a list of possible interventions that will support integrated water resource management. These interventions will be screened and prioritised, linked to existing city plans, and assembled into a Catchment Management Plan.

5.1. Identification of Interventions for Catchment Water Resources

This step should be conducted by the core team and verified by the RURBAN Platform. All the climate fragility statements should be listed along with their vulnerable areas (villages, or city wards) and vulnerable actors (social groups) as identified through above exercises. Based on these, interventions and solutions will be identified and listed in Table 20. While selecting the interventions, it is important to remember to:

- Focus on the most vulnerable groups, sectors, neighbourhoods
- Develop measures to address current issues and to prevent future problems
- Aim for a mix of "hard" (e.g. infrastructure related) and "soft" (e.g. policy changes, capacity building) solutions
- Consider links with other existing plans and processes to facilitate implementation of the Catchment Management Plan.

Table 20: List of Interventions

Climate Fragility Statements	Vulnerable Sectors	Urban Actors		Micro-Catchment Solutions
		Vulnerable Actors	Supporting Actors	
Example: Contamination of water supply due to flooding made worse by lack of alternative sources	*Water, wastewater etc.*	■ *Slum Dwellers* ■ *Resident Welfare Association* ■ *NGOs*	■ *Private sector* ■ *Water Authority*	■ *Rooftop water harvesting and safe storage* ■ *Capacity building on hygiene and sanitation* ■ *Provision of low-cost, effective water purifiers*

5.2. Prioritisation of Interventions and Solutions

Once the interventions are selected, they are first assessed for their contributions to climate resilience using a set of resilience indicators and their contribution to integrated water management through a set of integration indicators. They are then assessed for their feasibility and impact.

The resilience indicators to be used for assessing the selected interventions include:

- **Redundancy:** The intervention should support redundancy and enable the system to work in a variety of ways. A resilient system can function and achieve results through multiple paths, so that if one path fails, the others still function. In contrast, a "single best solution" is not resilient because if this single option fails, the system collapses. Back-up systems, or decentralised nodes for service delivery in a linked network, are preferable.

- **Flexibility and diversity:** The intervention should enable the system to function in different conditions and work in spite of climate stresses and shocks. Essential systems should be able to work under a variety of conditions and not be rigid or designed only for one specific situation.
- **Re-organisation and responsiveness:** Under extreme conditions, the intervention should enable the systems to respond and change to meet unexpected shocks. This requires access to different kinds of resources (information, skills, equipment, knowledge and experience) and high level of coordination among departments.
- **Access to information:** The interventions should enable the system to measure all impacts of climate change. Resilient systems have mechanisms to learn from and build on experience, so that past mistakes are not repeated and lessons from other cities can be integrated into planning. This requires procedures for monitoring and evaluating that can be shared among different departments.

The contribution of the interventions to the principles of IWRM are also assessed to analyse their priority for the region. The primary concepts of IWRM are considered:

- **Consider all parts of the water cycle:** Whether the intervention helps to include different sources and forms of water into the water resources for the region.
- **Consider various requirements for water:** Whether the intervention helps to assign different quality of water for different uses.
- **Consider the local context:** Whether the intervention is locally relevant and addresses pertinent local issues
- **Considers requirement of various stakeholders:** Whether the intervention addresses requirements of different stakeholders in the region.

The core team should count and calculate the number of instances when these indicators are addressed (i.e., marked Yes). The overall prioritization score is calculated as per the number of instances where "Yes" occurs. The score is ranked as low, medium, average or high based on the rating given below:

- if yes occurs 1-2 times then the score is **"Low"**
- if yes occurs 3-4 times then the score is **"Medium"**
- if yes occurs 5-6 times then the score is **"Average"**
- if yes occurs 7-8 times then the score is **"High"**

Table 21: Prioritising resilience interventions – Example and exercise

Interventions and Solutions	Resilience Indicators (yes/no)				IWRM Indicators (yes/no)				Overall Prioritisation Score
	Redundancy	Flexibility	Responsiveness/Re-organisation	Access to Information	Considers all parts of the water cycle	Considers various requirements for water	Considers the local context	Considers requirement of various stakeholders	1-2 yes – Low 3-4 yes – Medium 5-6 yes – average 7-8 yes – High
Example: Roof-top water harvesting to be made mandatory to deal with water stress due to anticipated increase in temperatures and decrease in precipitation	*Yes Supports a higher degree of self-sufficiency at the household level*	*Yes System allows for water to be channelised towards recharging groundwater as well*	*Yes In case of shutdown of the city's water supply system, households have stored rainwater for use*	*No City helplines exist, but responsibility lies with individual households*	*Yes Considers rainwater as a resource*	*Yes Assigns different quality of water to different uses*	*Yes Addresses local water scarcity*	*Yes All stake-holders can benefit*	*7*

Apart from building resilience, interventions should be checked for their feasibility and expected impact.

Feasibility can be assessed using the following criteria:

- **Technical:** The region has the necessary technical expertise to implement the project, or can access the required skills; the project is implementable, realistic and suitable to the local conditions.
- **Political:** The intervention will be seen as acceptable to city leaders and the community, and is consistent with the city's values and vision.
- **Financial:** The cost is within the capacity of the region, or the region will be able to access the required funds from the state or the central government, and the anticipated benefits of the action will justify the cost; any low hanging fruits that can be implemented quickly with minimal efforts and costs.

Impact can be assessed using:

- **Timeframe:** most actions should be completable within a short or medium timeframe.
- **Criticality or overall impact:** The proposed intervention should have a significant and measurable impact on the targeted climate risk

For each of these parameters, the core team should discuss and decide a scoring, such as low or medium or high for each intervention or solution. On the basis of these scores, a prioritised list of interventions and solutions will be developed for the catchment. The information should be listed in Table 22.

Table 22: Feasibility and Impact

Interventions and Solutions	Feasibility			Impact – Timeframe	Impact - Criticality
	Technical (high/ medium/ low)	Political (high/medium/ low)	Financial (high/medium/ low)	(short/medium/ long term)	(high/medium/ low)
Example: Roof-top water harvesting to be made mandatory to deal with water stress due to anticipated increase in temperatures and decrease in precipitation	*High (technology is easily available)*	*Medium (would require a change in building by- laws and building codes)*	*High (not an expensive option to implement with substantial results)*	*Short term (can be completed in a short time)*	*High (Can help to deal with water stress areas with immediate focus)*

5.3. Verification and Ratification

The interventions and solutions selected should be discussed in the RURBAN Platform to get their opinions and suggestions. Once they are discussed and ratified by the RURBAN Platform they can be integrated into the Catchment Management Plan for implementation and eventual evaluation. The District Collector and the Municipal Commissioner should be present in the meeting to discuss potential immediate actions.

5.4. Outcomes of Phase 4

- List of interventions for catchment water resources.
- Scoring and prioritisation of the interventions on the basis of resilience and IWRM principles.
- Feasibility and impact assessment of the prioritised interventions.
- Ratification by the RURBAN platform.
- Quick win projects selected from the list of interventions.

6. Phase 5: Catchment Management Plan (CMP) Formulation

This is the final phase which helps to collate all information from previous phases to develop the catchment management plan. A monitoring tool is also provided to facilitate implementation and regular evaluation of the plan.

6.1. Structure of the Catchment Management Plan (CMP)

The catchment management plan (CMP) should be developed while keeping in mind the overall fragility and vulnerability of the resources and the community. A typical structure of the integrated catchment management plan consists of the following sections:

Introduction: This section introduces the concept of integrated water resource management (IWRM, IUWM), the rationale of conducting a catchment management and reasons of adopting integrated approaches to assess the vulnerability to climate change. Methodology and approaches used to develop catchment management plan are also defined here.

1. What are the IUWM and IWRM principles applied to the catchment?
2. Benefits of adopting these approaches while developing catchment management plan, including the socio- economic and environmental benefits for the catchment.
3. Methodology of assessment
    a. Explanation of the different steps of the IAdapt Framework followed.
    b. Possible annexes and tools
        i. List of members of RURBAN Platform;
        ii. List of members of core team;
        iii. Public communications from the core team (for instance, minutes of meeting, newspaper cuttings, memos, etc).

Catchment profile: This section describes the nature and existing situation of the catchment for which the management plan is being developed and could have the following information:

- **Location of the catchment:** This will include the information about the main rivers and their tributaries and basins, information on area, number of water sources within the catchment and potential of the catchment area, location, number and capacity of dams within the catchment etc.
- **Demography:** This will include:
    a. Number of villages and urban centers;
    b. Population data – general v/s urban poor;
    c. Population projections.
- **Socio-economic profile:** This will include:
    a. Information on population, number of households, number of slums, marginalized groups, urban poor;
    b. Information on economic profile of the population, major livelihood activities and other development activities within the catchment;
    c. Urbanization pattern and percentage.

- **Climate pattern and geomorphology of the catchment:** This will include
  a. General climatic pattern of the city.
  b. Seasonal information on temperature, precipitation.
  c. Information on soil, slope and forest cover.
  d. Past events in the catchment – droughts, floods, cyclones etc.
     i. Date of occurrence of event;
     ii. Details of the event (for instance, reasons of occurrence of the event, details of the event);
     iii. Impacts of the event on life and livelihood of the citizens, urban systems, and environment;
     iv. Measures undertaken by the city or regional government to mitigate impacts of the event;
     v. Actions or measures undertaken by the city or regional government to address such occurrences in future, if any.

Integrated catchment management plan: This section provides information of the entire methodology of using the IAdapt Framework to develop the catchment management plan.

1. **Engagement phase:** This section describes the engagement with various stakeholders from rural and urban areas within the catchments to discuss the issues, develop strategies to overcome the challenges and implement best possible solutions. It should define:
   a. Formation of core teams from representatives of city departments who have responsibilities for, or an impact on, development planning, water use, pollution, waste, food security, water security, public health, local economic development, infrastructure, and agricultural development.
   b. Identification of Project Nodal Officer at the rural and urban level who can be the focal point for the process in the city.
   c. Formation of RURBAN platform for advice, discussion and prioritization of strategies identified by the core team and state officials. It should involve key individuals from the district departments, core team member and officials from State departments and Ministries representing urban and rural authorities.

2. **Baseline assessment:** This section outlines all data and information collected at the catchment level on water resources (water availability, water supply and water management), waste water, storm water and solid waste. All data collected on demography, including population characteristics and composition, health, exposure to disasters, as well as information on bio diversity and ecosystem services of various resources within the catchment is presented. Ongoing or proposed policies and programmes for water management at catchment level is also outlined.

3. **Assessing the climate vulnerability:** The water balance for the catchment is presented in this section, presenting the current and future stress on water resources due to urbanization, population growth and other economic development activities. Information from the integration matrix, information on the climate scenarios, data on the fragile systems, their climate risks and vulnerability, hotspot maps prepared and actors identified are presented in this section.

4. **Solution assessment:** The list of solutions or interventions prepared to combat vulnerability of the fragile sectors are outlined in this section. The interventions are presented along with their resilience and IWRM integration priorities, their technical, financial and political feasibility and their criticality and timeframe are outlined. This section should also outline any financing sources that may be available for the implementation of the interventions.

5. **Monitoring and evaluation framework:** This section outlines the monitoring and evaluation processes for the CMP implementation. The RURBAN committee will ensure a regular monitoring of the CMP and will monitor the effectiveness of the plans in achieving their stated objectives and delivering the outcomes.

6.2. Monitoring and Evaluation

Monitoring and evaluation processes is vital to successful implementation of the CMP. It helps to ensure that the plan is implemented and keeps a record of all targets achieved. Ideally the RURBAN Platform will ensure a regular monitoring of the catchment management plan and will monitor the effectiveness of the plans in achieving their stated objectives and delivering the outcomes. A monitoring procedure should be developed based on reporting on the implementation of the interventions and updated at regular intervals. The framework should identify the individual with responsibility of monitoring, the methods to be used for monitoring, and the frequency of monitoring of all the activities implemented. The monitoring framework is given in Table 23.

Table 23: Monitoring Framework

Intervention	Implementing Agency	Indicator	Responsibility of monitoring	Method/ tool of monitoring	Frequency of monitoring

Once the CMP implementation begins, annual discussion with the core team and RURBAN Platform members will help to understand the impact and effect of the implementation. Any updates to the CMP based on its implementation and changing targets/outcomes, should be recorded by the core team. The implementation monitoring table is given in Table 24.

Table 24: CMP Implementation Monitoring Table

Status of Implementation of the CMP				
Phase	Outcome	Responsibility	Methodology/tools	Status

6.3. Outcome of Phase 5

- Catchment management plan with monitoring framework

7. Conclusion

The IAdapt Framework is an indicative process for developing a catchment management plan in a manner that responds to both climate challenges and water issues of the catchment. This is a flexible tool and may be adapted to suit the requirements of a large number of cities and local governments and provides a step by step guidance to develop the catchment management plan. As one works through the process, it may be discovered that there are issues and groups of stakeholders that were not identified initially. There will be points where there is a need to consult external groups and points where there is a need to report back to the regional decision makers. It is therefore essential that the engagement decisions taken as per the Framework are reviewed regularly and updated.

The prime purpose of the Catchment Management Plan or CMP developed through the IAdapt Framwork is to assist local authorities with their own water management planning and execution, with focus on the climate impacts on this sector. The CMP will provide the necessary documentation to demonstrate the planning process followed by the local authorities. In order to ensure that the CMP is judged of good quality, it should have the following characteristics:

- The CMP must showcase the engagement at rural and urban levels through the formalized RURBAN Platform
- The CMP must consider future climate scenarios and climate vulnerability of water and its allied sectors.
- The CMP must consider current and future demands on water from both urban and rural users.
- The CMP must identify a mix of hard and soft interventions, long term and short term interventions and prioritise them
- The CMP must promote future sustainability and resilience and fulfil the "Do No Harm" principle
- The CMP must include mechanisms for integration with other regional development plans and include a component of monitoring and reporting

It must be mentioned here that the development of the Catchment Management Plan is only the beginning of a long way towards a water resilient future for the region. The Framework outlines means of monitoring and evaluation of the plan and these may be employed along with the local authorities own monitoring processes to assess the success of implementation of the plan and achievement of water resilience in the region.

NOTES

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