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Mapping the Policy and Institutional Response to Integrated Water Resource Management in India - A Case Study of Uttar Pradesh

A Status Paper

Shawahiq Siddiqui
Dr. Venkatesh Dutta
Shilpa Chohan
Maria Faridi

Advisory support
Dr. Veena Khanduri

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About the Authors

Shawahiq Siddiqui is an environmental lawyer and Founding Partner of Indian Environment Law Organization (IELO), India's only law firm engaging with all aspects of water governance including the trans-boundary water governance.

Shilpa Chohan is an Advocate, Supreme Court of India and Co-founder of the IELO.

Dr. Venkatesh Dutta is a professor at School of Earth and Environmental Sciences (SEES) Babasaheb Bhimrao Ambedkar University (A Central University).

Maria Faridi, formerly with Ministry of Law and Justice, Government of India, is an Advocate and Consultant with IELO.

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Abbreviations

AWD	Alternate Wetting and Drying
BCM	Billion Cubic Meter
CBA	Capacity Building Agency
CAG	Comptroller and Auditor General
CSR	Corporate Social Responsibility
CWMI	Composite Water Management Index
DSCL	DCM Shriram LTD
DSM	Demand-Side Management
FMISC	Flood Management Information System Centre
FPOs	Farmer's Producer Organizations
GP	Gram Panchayat
GWP	Global Water Partnership
HAM	Hybrid Annuity Model
HHTCs	Household Tap Connections
IA	Implementation Agency
IFC	International Finance Corporation
IWRM	Integrated Water Resources Management
LPO	State Local Partner Organization
MC	Municipal Corporation
MSP	Minimum Support Price
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
NBS	Nature Based Solution
NMCG	National Mission for Clean Ganga
NRW	Non-Revenue Water
NWP	National Water Policy
O&M	Operation and Maintenance
PDS	Public Distribution System
PIM	Participatory Irrigation Management

PPP	Public Private Partnership
R&R	Recognize and Reward
RWS	Rural Water Supply
SEES	School of Earth & Environmental Sciences
SDG's	Sustainable Development Goals
SPV	Special Purpose Vehicle
SRI	System of Rice Intensification
STP	Sewage Treatment Plant
SWP	State Water Policy
SWaRA	State Water Resource Agency
SWaRDAC	State Water Resources Data Analysis Centre
U.P.	Uttar Pradesh
ULB	Urban Local Bodies
UNDP	United Nations Development Program
UNICEF	United Nations International Children's Emergency Fund
UPCB	Uttar Pradesh Pollution Control Board
UPSWP	Uttar Pradesh Water Policy
UPSRLM	Uttar Pradesh State Rural Livelihood Mission
UPWRP	Uttar Pradesh Water Restructuring Project
VWSC	Village Water and Sanitation Committee
WILMI	Water and Land Management Institute
WUA	Water User Association
WUE	Water Use Efficiency
WWF	World-Wide Fund

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Executive Summary

Water in India is increasingly becoming a scarce resource with ever increasing demand for various competing uses. However, its management has seen little transformation over the last five decades. The situation is further complicated in the most populated and agriculture dependent state of the country, Uttar Pradesh (U.P) where water problems accumulate faster than they are resolved thus underlining the urgency to replace hydraulic mission mode driven water supply with a more integrated approach to managing surface and groundwater. The legitimacy for this approach needs to be attained through public participation, and with technical and governance support of the specialized basin level entities which the State Government of Uttar Pradesh is yet to establish.

Coalescence around ideas underpinning Integrated Water Resources Management (IWRM) in India has attained the formal status at the national level under the National Water Policy, 2012, the National Water Mission, 2009; and are promoted through the Composite Water Management Index (CWMI) of the NITI Aayog along with several other policy and planning documents adopted at the national level and continues to form the theoretical basis for water reforms in the country. National progress on IWRM has tended, as a result, to emphasise planning and reforms to policies, laws and institutions. The rolling out of central level schemes and programs such as the Jal Jeevan Mission targeting universal supply of tap water to every household in the country and the Atal Bhujal Yojna (Atal Jal) are seen to be two separate schemes with different objectives and institutional approaches and thus representing disintegrated approach to enhancing access and availability of water resources. The state of U.P has committed far more ambitious targets under the said schemes though it's water policy being outdated and generic, does not reflect the state's vision to carry out water reforms as per the changed circumstances and needs. The fact that the State has carried out certain institutional reforms without having a modern water policy in place also provides an insight into the way the water institutions are functioning in the state. Important to note here is that while the national and the state governments have rolled out yet another series of water supply programs, a dedicated initiative for enhancing water use efficiency is conspicuously missing at all levels of water governance in U.P. These points towards the fact that there is a deficit approach to water governance in the State and calls for a comprehensive scrutiny on planning, institutional strengths and real action on water resources management.

The Sustainable Development Goals (SDGs) are the global targets to which all the countries in the world including India are committed. The SDG 6.5.1 calls for mainstreaming of IWRM by the national and state governments by enabling changes in the water governance to ensure effective, efficient and sustainable water management. Water being a state subject in India, thus water management in U.P needs to be planned from the viewpoint of potential impacts of climate change, adaptation needs and rising energy demands (water-energy-food nexus) for which not much concerted efforts need to be made.

There is also a need for re-evaluation of existing water management strategies in place that have seen political, financial and social investments over a period of many decades in the state and lessons must be learned and used to accelerate the changes needed or readjustments so that the gross efforts lead to improvement in total water availability and efficiency.

The improvement in water governance in U.P must be based on the four practical elements: (i) better policies and laws complemented by the Master Action Plans; (ii) an effective institutional framework; (iii) enhanced use of modern technology and science; and, (iv) sustainable investments in the water infrastructure aimed at enhancing water use efficiency. Collectively, these improvements tend to result in IWRM which is necessary but may not be sufficient over a period of time thus requiring dynamic approach to IWRM led water governance in the State.

Besides the wish list which is between the existing practices and their potential improvement and the desirable IWRM led water governance actions, there are other challenges that relate to the fundamental questions on the utility of IWRM itself. The experts and institutions in U.P and elsewhere in India are striving to interpret and understand IWRM contextually as water being one of the most unevenly distributed natural resource and its uses are extremely diverse not only in the country but in various part of the U.P State and even within districts and villages. Experience suggests that the existing programs and schemes especially that underway, implementation cannot be redesigned altogether and thus will have to be reconciled with IWRM processes and pragmatic problem solving.

The Policy and Legal Framework on water resources management in U.P is a mix of old and new instruments and has strong influence on the planning and management of all programs for the rural and urban areas. The Uttar Pradesh Bhoomi and Jal Sanrakshan Adhiniyam, 1963 (roughly translated as the Land and Water Conservation Act) is perhaps the first legislation of its kind to look at land and water in an integrated manner. The U.P Municipalities Act, 1916, and the U.P Panchayati Raj Act, 1947 and the U.P Water Supply and Sewerage Act, 1975 deal with the decentralized management of water and the role of local bodies in water resources management. The U.P State Water Policy, 1999 is followed by a separate Urban Sanitation Policy, 2009. Contemporary legislation along with these policies are the Uttar Pradesh Participation in Irrigation Management Act, 2009 and the Uttar Pradesh Water Management and Regulatory Commission Act, 2014 (re-enacted 2014)[1].

[1] The Uttar Pradesh Water Management and Regulatory Commission Act, 2008 was enacted on 29.08.08 which came in force in the State on 03.10.2008. The 2008 act was repealed in the year 2012 by the Act No. 330(2)/LXXIX-V-1-13-1(Ka)-9-2012 dated Lucknow, March 28, 2013 and re-enacted in year 2014 by ACT No. 321(2)/LXXIX-V-1-14-1(Ka)2-2014 of Lucknow, March 04, 2014; http://upwamrec.gov.in/background.html

In all, the state has eight dedicated policies and legal instruments dealing with various aspects of water and the institutions entrusted to carry out the functions under these policies and laws are faced with challenges such as isolated planning, implementation laps due to overlaps in he functions of the agencies and complicated flow of funds which results in confusion and delays in planning and execution of works.

The State Water Policy (SWP), 1999 provides a vision for the management of water resources but does not provide effective measures to deal with the new and emerging challenges such as severe groundwater depletion, inefficient use of water especially in irrigation, pollution of rivers and other water bodies and poor water supply infrastructure. Due to these limitations, the SWP, 1999 has been revised and amended and the State Government has launched a new draft of the State Water Policy, 2020[2].

In addition to the desk based review and analysis of the regulatory framework on water, interactions were held with the stakeholders by way of semi-structured interviews. The stakeholders interviewed during the course of this Study have provided insights on the need for an adaptive strategy for IWRM that needs to combine the following five basic elements:

i) Synergising the conflicts and overlaps between various policies and laws on water and land in the state. The land related aspects will require a comprehensive understanding of changing land relations with respect to common property resources such as village ponds, wetlands etc.

ii) A State Water Master Plan on pragmatic solutions to meet water user's priorities at all levels is needed. The Master Plan is required to ensure participatory action on enhancing water availability through traditional knowledge of water harvesting and use of modern technologies.

iii) A Standard Operating Procedure (SOP) to be agreed by the line departments with water as the focus such as agriculture and allied departments, town and country planning, Public Works Department, Transport that involve land use change causing stress on water.

iv) A clear understanding among all the stakeholder departments on what has worked and what did not work in the past.

v) Monitoring and performance evaluation of initiatives to ensure outcomes and accountability.

[2] For the new draft of the State Water Policy, 2020 see:
http://upwamrec.gov.in/downloads/SWP/FINAL_DRAFT_UPSWP2020_August_9_2020.pdf

The stakeholders have viewed that the mainstreaming of SDG 6.5.1 (IWRM) in the State of U.P will need a regulatory and institutional environment that is able to raise the level of ambition for implementation and accelerate the rate of water conservation for making a transition from the current scenario. A new state-of-play is needed in which problems are solved faster than they accumulate. Without this transition, the State is more likely to fall behind on achieving the IWRM and the related SDGs.

Based on the diagnostic policy and institutional analysis, a set of fifteen thematic recommendations under this study on mainstreaming IWRM provide a detailed outline of the areas that are in need of strategic interventions. However, the overall objective of the study was to map the current policy and institutional framework, initiatives and planning in place for mainstreaming the Integrated Water Resource Management (IWRM) at the state level. IWRM is a process for co-ordinated planning and management of water, land and environmental resources. It takes into account the availability of water (surface and groundwater), water use, water quality, environmental and social issues as an integrated approach as a whole to ensure sustainable, equitable and efficient water use[3]. Another key aspect of IWRM is the participation of people in decision making where decisions are decentralised. The stakeholders need to work together to achieve the overall and specific objectives under the IWRM.

The study proposes that foremost, the principle of the unity of hydrological cycle that treats surface and groundwater as one and recognizes their hydrological linkages, is to be taken into account to inform the decision making processes while managing them at the basin level. The other cardinal principle is that the State's water resources are a common heritage of people to be held in public trust by the State Government and its functionaries to ensure that water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner, for the benefit of all persons, and in accordance with the constitutional mandate. This is known as the 'Doctrine of Public Trust'. The inclusion of Doctrine of Public Trust into the water governance at all levels is fundamental to achieving mainstreaming IWRM. This approach is also in conformity with the Draft National Water Framework Bill, 2016 of the Government of India. The other three principles underlining IWRM relate to social equity, economic efficiency and ecological sustainability. The operationalization of these principles should be achieved by harmonisation and coordination of policies and programmes, by mainstreaming IWRM at the basin level planning, convergence, institutional restructuring and coherence, stakeholder participation, regulatory support, financing and private sector participation, effective monitoring and evaluation, progressive adoption and application of science and technology, into a framework for action.

[3] http://cwc.gov.in/sites/default/files/IWRM_Guidelines.pdf

1. The Context: Integrated Water Resources Management (IWRM) in the Global and National perspectives

Globally, it has been realized that water problems faced in the countries are not limited to supply or service delivery and hence can no longer be resolved by the technical water experts and the water Mministries alone. Water has become central to all kinds of economic development and is closely connected with social, environmental and political factors at all levels of governance. In many parts of the world, including India, water problems have already become far too complex due to excessive pollution of large river systems and overexploitation of groundwater. It is being realized that the induced scarcity due to mismanagement of water resources cannot be handled by any one single institution, irrespective of the powers or the resources given to it. Equally important is the fact that water policies and institutions need to be prepared to provide the necessary impetus to achieve the main objective of water resources management in India that is the improved standard and quality of life of people and protection and amelioration of health of the water ecosystems. The challenge lies in achieving this goal in a manner that is socially acceptable and economically efficient.

The challenges and ideas underpinning integrated management of water emerged nearly 60 years ago in the United Nations Water Conference, 1977 wherein the *Mar del Plata* Action Plan was adopted. Since then the global water agenda has not changed much but has been reinforced through the Sustainable Development Goals (SDGs) adopted in 2015. Thus the Action Plan, 1977 followed by the Dublin Principles, 1992 had formed the basis for Integrated Water Resource Management (IWRM). The Dublin Principles provided that water is finite and vulnerable, its development and management should be based on a participatory approach, the women should also play a central role in water management; water has an economic value and its competing uses should be recognized as economic good. These principles were the basis for the call for global action on environment under Agenda 21 in 1992. Though there is a view that the Dublin Conference was only a meeting of experts and its outcome was not binding on Governments, the international significance of the Dublin Conference outcome and Agenda 21 is regarded as a milestone in the progressive development of International Environment Law and International Water Law.

In the year 2000, the Global Water Partnership (GWP) provided a definition of IWRM to mean "*a process which promotes coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.*" Arguably, the definition provided a technical basis to prepare IWRM plans but was vague and unclear for the planning and implementing agencies in most of the countries.

However, by the year 2002, in the World Summit on Sustainable Development many countries had reported the progress on developing IWRM related national policies and plans. IWRM had since then been promoted through many international processes and support programs. However, despite a long evolutionary phase, the global response and the promotion of the concept, it has received mixed responses from governments and experts where it is believed to be an attractive concept without much practical impacts and utility (Biswas, A 2005).

From a country context, often questions on its basic utility remain at the core of implementation challenges for IWRM. In the Indian context, for example, one of the foremost questions is whether IWRM has the potential to address problems faster than they accumulate in climate sensitive environments and whether there is a real case study on the successful demonstration of IWRM as a solution approach? It is also argued that the water-energy-food nexus concept that emerged in Bonn Conference in 2011 in fact presents a replacement for IWRM as it motivates to move beyond water centric approach to looking at the intersection of underlying challenges to water management. Climate change adaptation is understood to provide a similar approach to move beyond the water centric approach.

At the national level, National Water Policy, 2012 strongly promotes IWRM as the foundation of water resources management in India. However, water is a state subject in India and its day to day management is entirely bestowed with the state and local governments. Therefore, any meaningful study and diagnosis that can provide lessons on challenges to IWRM can only be done at the state level. The state of Uttar Pradesh being one of the most densely populated and primarily an agricultural based economy, is faced with serious challenges on water quality and quantity and thus requires a long term strategy and coordinated institutional approach to tackle the existing and emerging water challenges.

2. Background to the Status Paper:

2.1 The review and assessment of water governance in Uttar Pradesh in the past had revealed useful insights:

India Water Partnership is also a Country Water Partnership of GWP (thus also known as "GWP-India) and Indian Environment Law Organization (IELO) had carried out a review and comparative assessment (in 2016) of the state water policies of many states having different demography to assess the synergies and gaps[4] to operationalize the National Water Policy-2012 and U.P State was one amongst them.

[4] http://cwp-india.org/wp-content/uploads/2018/05/Uttar-Pradesh-State-Report-on-Reviewing-and-Examining-State-level-Regulatory-Framework-to-operationalize-NWP-2012.pdf

The objective of review was to map the progress of the state water resource management frameworks and identify the steps needed to align the frameworks with the objectives and the aspirations of the NWP, 2012. The review of the U.P State Water Policy, 1999 had shown that it is not oriented towards the IWRM based approaches and thus needs an overhaul. More importantly, the review also noted that though the State has put in place new regulatory infrastructure namely the Water Management and Regulatory Commission under an Act of 2014 , the Commission was not fully functional due to the inherent overlap of managerial and regulatory functions that the Commission was vested with. Similar issues were noted with the other policies and laws related to land and water in the state. Subsequently, the State government had launched the Phase-II of the Uttar Pradesh Water Restructuring Project (U.PWRP)[5] comprising of six components touching upon various aspects of water governance. The U.PWRP is being implemented with the support from the World Bank and U.P State Irrigation Department is the nodal agency. The key objectives of the UPWRP are to *(i) strengthen the institutional and policy framework for integrated water resources management for the entire state* and *(ii) increase agricultural productivity and water productivity by supporting farmers in targeted irrigation areas*.

The gaps in the existing water policy and legal frameworks revealed by way of the ccomparative aanalysis and the investments made in the water infrastructure improvements in the State indicates that investments may not yield the desired results in the absence of coordinated efforts to mainstream IWRM in Uttar Pradesh. This served as the background for conceiving a stakeholder engagement based Case Study to map the progress, potential and initiatives on IWRM in Uttar Pradesh.

2.2 The NITI Aayog's Composite Water Management Index (CWMI) and the Composite SDG India Index and Performance of Uttar Pradesh:

At the national level, the NITI Aayog launched a Report on "Localizing SDGs in India, 2019" that provides the status with respect to progress on the SDGs including on SDG 6 made by all the states in the country[6]. As per the Composite SDG India Index, the states are categorized into aspirants, performers, frontrunners and achievers based on their overall performance. The state of U.P is under the category of 'aspirants'. Reportedly, U.P has taken the following steps towards achieving the SDGs in the State:

[5] https://projects.worldbank.org/en/projects-operations/project-detail/P122770; https://idup.gov.in/post/en/phase-on-going (2013-2020)
[6] https://www.niti.gov.in/sites/default/files/2020-07/LSDGs_July_8_Web.pdf

No.	Action for SDGs in U.P	Description
I	Nodal departments for SDGs	Identified nodal departments for each of the 16 SDGs
II	Nodal Officers for SDGs	In Uttar Pradesh, the Nodal Officers for each Goal at multiple levels of administration have been trained to raise awareness on issues related to the respective Goals.
III	Task Force on SDGs	The Uttar Pradesh Task Force led by the Chief Secretary has instructed PRIs and ULBs to integrate SDGs in their planning tools.
IV	Training and capacity building on SDGs	In Uttar Pradesh, the Training Wing of the Planning Department and Nodal Departments have been organising capacity building programmes for the officials at the state level, apart from the State Administrative Training Institute.
V	Strategies for reaching out on SDGs	Uttar Pradesh has identified strategies for reaching the vulnerable population for addressing challenges related to poverty, hunger and health.
VI	Communication, Awareness generation and Advocacy on SDGs:	The State's Vision 2030 has 16 goals with a Nodal Department and a Nodal Officer has been designated for each Goal. The Nodal Officer for each Goal is mandated to raise awareness of related departments on issues pertaining to the respective Goals. Nodal Officers have also been identified for every Goal by the State Planning Commission. The Planning Department has been designated as the Nodal Department for working on SDGs. A high-level Task Force, chaired by the Chief Secretary, has been set up to guide progress on SDGs.
VII	Institutional Mechanisms for following 'Whole-of Government' Approach:	The 16 Nodal Departments for the Goals conduct inter-departmental meetings with the 64 Departments that contribute to achievement of SDGs to achieve horizontal policy coherence. The Nodal Departments hold workshops and seminars to promote common understanding and sharing of good practices among the Departments.
VIII	Aligning Local Plan with SDG:	The Task Force led by the Chief Secretary has instructed PRIs and ULBs to integrate SDGs in their planning tools. The Government of Uttar Pradesh has already integrated SDGs in the Gram Panchayat Development Plans.

No.	Action for SDGs in U.P	Description
IX	SDG Monitoring	The State government has identified measurable indicators based on the National Indicator Framework. The Directorate of Economics and Statistics is entrusted with collection, analysis and maintenance of data to be uploaded on a dashboard. The high-level Task Force along with the Planning Department is responsible for overall monitoring on SDGs. A baseline report is currently under preparation.
X	SDG based Budgeting	A three-year Action Plan is being prepared for achieving SDGs. Budgetary requirement for Centrally and State sponsored schemes based on the SDG framework has also been prepared.
XI	Capacity Development	The Training Wing of the Planning Department organises capacity building programmes. Nodal Departments also conduct training programme for State and district level functionaries. Further, District Administration, Divisional Commissioner, and Panchayati Raj Institution (PRI) Departments have been advised to conduct training programmes at the sub-district level.
XII	Strategies for leaving no one behind	Strategies have been identified for reaching the vulnerable population in the several Goals.
XIII	Partnerships	The State Government is partnering with United Nations Development Program (UNDP) and United Nations International Children's Emergency Fund (UNICEF) in preparing the Vision Document. UNICEF is also supporting in capacity building, especially for PRIs while World Wildlife Fund (WWF) is also supporting interventions in the selected districts of U.P.

Earlier, NITI Aayog's Composite Water Management Index (CWMI), 2018 underlined that the state of U.P lagged behind in most of the indicators on CWMI. However, the progress on SDG 6 could not be known either from the rankings of the NITI Aayog or from other reports of the State Government of Uttar Pradesh. This provided a compelling background for undertaking a Study on mapping the progress on IWRM in the state on each of these XIII progress indicators mapped by the NITI Aayog that also apply to SDG 6.

3. Purpose and Scope of the Status Paper on Mapping IWRM in Uttar Pradesh

Water is a state subject in India. In view of the observations of the NITI Aayog on the poor water management scenario in U.P and the findings of the GWP-India in 2016 study, the Status Paper aims at facilitating a better understanding of the water governance in the state of U.P so as to identify and map elements that impede or support achieving IWRM in the state in view of the SDG goals and objectives of the NWP, 2012 and the SDG 6.5.1.

The Status Paper is expected to be used as an information and guidance tool that provides a nuanced understanding of the IWRM and the bottlenecks in achieving the IWRM in the state of U.P. The paper is aimed at improving the application of principles, approaches and strategies involving IWRM so as to overcome critical water management challenges in the State. It can further be used for understanding the role of the stakeholders in various aspects of water management and the allocation of responsibilities. The Status Paper also provides an interesting opportunity for the government and non-government stakeholders to better understand policy and planning processes on water management so as to participate and contribute at the appropriate levels.

Essentially, this Status Paper as a Case Study on IWRM in one of the states in India would serve as an essential information and facilitation tool to aid and assist the comprehensive understanding of the IWRM from the implementation perspective and steps needed to overcome the barriers in achieving the SDG 6.5.1.

4. Introduction

4.1 Water Resources availability in Uttar Pradesh

With eight major river systems and their tributaries fed by glacial melt and monsoon rainfall accounting for nearly 21% of country's available water, Uttar Pradesh (U.P) is considered to have bountiful water resources. However, the State's rich water endowment is unevenly distributed and stressed due to a variety of reasons including a very large population dependent on irrigation for agriculture, rapid urbanization and climate change that threaten the water availability and are likely to widen the demand-supply gap in rural and urban areas. The situation is compounded by severe pollution of the surface and groundwater resulting in very low or no flows in rivers, especially in the lean season. Besides, the mismanagement, inefficient use and lack of unified perspective in the planning and management of water resources further undermine State's water security.

U.P is the most populous state[7] and the fourth[8] largest in terms of the total geographical area in India. It is surrounded by the state of Rajasthan, Haryana, Delhi, Uttarakhand, Bihar, Jharkhand and Madhya Pradesh. In north, the state shares the boundary with the neighboring country Nepal from where numerous major river systems cross into India. The state can be equally divided into three parts namely the Northern Mountains (the Himalayan region and some of the foothills areas in the north), Southern hills plateau (the Vindhya mountains in the south) and the Gangetic Plain. The land in the state consists of fertile Gangetic Plains connecting the north of India to the east. The economy of the state is largely dependent on agriculture that employs 2/3rd of the workforce[9] and there is high percentage of marginal and small land holdings. The share of manufacturing sector in the economy is very small and employs about 7.7% of the work force and contributes 20 per cent of State's income. The combination of ecological and socio-economic factors drives water use and exploitation in the State which is faced with a variety of water management and governance challenges.

4.2 Key Challenges on Water Resources Management in Uttar Pradesh

The existing demand and supply gap as well as the projected trends clearly indicate that the overall increase in water demand will surpass the total availability of water in the State. Thus well defined strategies for ensuring the efficient management of water resources that include an Action Plan for managing the water availability, demand and supply scenarios is clearly warranted. The first step in this direction is to take cognizance of the existing management and governance challenges in the State and identify critical bottlenecks for addressing each of these challenges. Some of the critical challenges that represent the current water scenario in the State include overexploitation of groundwater, land use change, sand mining, unabated pollution of surface and groundwater resources, and rapid increase in demand for water due to population growth in rural and urban areas. Further challenges include unplanned urban growth, changing lifestyles, widening demand-supply gap, reduction in the stream-aquifer interaction along the main stem of the River Ganga and its major tributaries resulting into sharp decline of critical dry season base flow contributions that in turn leads to hydrological imbalances and overall decline in access to water and growing mismatch between demand and supply. The specific challenges on water resources management in U.P are as follows:

[7] Census Data of 2011
[8] Area of states: Ministry of Statistics and Programme Implementation, India
[9] UP SAPCC (undated)

4.2.1 Water availability

The total available water resources in the State are estimated to be about 179 Billion Cubic Meter (BCM). The utilizable water, however, is much less about 118.47 BCM due to various constrains. Currently, the total demand from all users is 105.96 BCM while the total supply is 77.99 BCM, indicating that the demand has already outstripped available water supply[10].

One of the critical aspects of current estimates on availability is that it presents a static estimate and does not take into account inflows from and outflows into riparian States. This underlines the need for better estimates on total water availability by factoring the inflows-outflows component. A comprehensive accounting of estimates and comprehensive identification of challenges and the causes underlying them will lead to a better and informed action oriented planning to address the identified challenges through improved coordination, institutional convergence and increased stakeholders' participation.

4.2.2 Ever rising water demand and the growing deficit: Demand-Side Management is a challenge

Water balance assessments covering the eight river basins of Uttar Pradesh indicate a growing deficit of 32,143 MCM by 2044-45. The Demand Side projections for Uttar Pradesh indicate that in the business as usual scenario, total demand will increase from 105.96 BCM to 125.43 BCM in the year 2044-45. By the same period it is expected that Irrigation demand will increase from 97.8 BCM to 109.46 BCM. Similarly demand for drinking water in the urban areas will increase from 2.85 BCM to 4.68 BCM and in rural areas the demand will increase from 2.67 BCM to 6.11 BCM. Total non-consumptive demand will increase from 7.7% to 12.7% and irrigation demand will reduce from 92.3% to 87.3%. The groundwater assessments for domestic, industrial and irrigation needs of growing population indicate increased ground water exploitation from 27 BCM to 64 BCM by 2025 i.e. requirement of groundwater will be more than double the present level. Due to this, the number of over-exploited blocks (the blocks where the withdrawls are more than recharge) may increase from 14 to 177 by the year 2025[11].

[10] For water availability in Uttar Pradesh see Draft State Water Policy, 2020, Para 3.2, available at http://upwamrec.gov.in/downloads/SWP/FINAL_DRAFT_UPSWP2020_August_9_2020.pdf, Para 3.2

[11] Ibid, see footnote 10

4.2.3 Groundwater overexploitation and mismanagement

Groundwater recharge zones are often blocked and polluted, the wide temporal and spatial variation in availability of water due to changes in the hydrological cycle will likely to exacerbate due to climate change resulting in increase in the incidences of water related disasters such as frequent floods and droughts in the State. From the river basin perspective, environmental health of not only rivers and streams but also of drainage and catchment areas in all the river basins in the State has severely deteriorated due to discharge of untreated industrial, municipal and gynogenic pollutants that needs to be embedded in the basin level water management strategies. The existing water management and fragmented institutional approaches are also the underlying reason as to why there is an incremental deterioration in water quality and quantity in the State.

5. Water Governance Scenario: The regulatory and institutional framework on water resources in Uttar Pradesh

5.1 The Policy and Regulatory Framework

The Uttar Pradesh State Water Policy, 1999 is one of the important instruments outlining the water as 'prime natural resource, a basic human need and a precious asset'. It allocates water for drinking and domestic use as the highest priority. The objectives of the policy are ensuring preservation of the scarce water resources and its optimisation, to bring about qualitative improvement in water resources management and make it participatory, maintaining water quality, both surface and underground and ensuring ecological and environmental balance while developing water resources. The State established Uttar Pradesh Water Management and Regulatory Commission, 2014 with a view to regulate and recommend the tariff for water used for agriculture, industrial, drinking and other purposes and also for levying cess on the land benefited by flood protection and drainage works from the owners of land benefited through appropriate regulatory instruments and according to State Water Policy to assist the State for making policies and execution of the water resources within the State, facilitate and ensure judicious, equitable and sustainable management, allocation and optimal utilization of water resources for ensuring sustainable development of the State and matters connected therewith or incidental thereto.

As per the mandate of Uttar Pradesh Water Management and Regulatory Commission Act, 2014, the water management in the state is being undertaken as per the following policies and legal instruments:

Policies:

- Uttar Pradesh State Water Policy, 1999
- Uttar Pradesh Urban Sanitation Policy, 2009

Laws and Regulations:

- Uttar Pradesh Municipalities Act, 1916
- Uttar Pradesh Panchayati Raj Act, 1947
- Uttar Pradesh Bhoomi Evam Jal Sanrakshan Adhiniyam, 1963
- Uttar Pradesh Water Supply and Sewerage Act, 1975
- The Uttar Pradesh Water Management and Regulatory Commission Act, 2014
- The Uttar Pradesh Participatory Irrigation Management Act, 2009
- Uttar Pradesh Ground Water Act, 2020

The water policy of Uttar Pradesh is over two decades old. Since the U.P State Water Policy, 1999 precedes National Water Policy (NWP) of 2012, some of the principles and approaches contained therein still remain to be harmonized to be in tune with NWP. However, the State Water Policy of Uttar Pradesh acknowledges water as a scarce resource and underlines the need for its planning, development and management to be guided by the state perspectives. The water allocation priorities are broadly classified as (a) Drinking Water, (b) Irrigation (c) Hydro & Thermal Power (d) Agro- industries & nonagricultural industries (e) Navigation and other uses. Given the state's emphasis on agriculture, irrigation is next in water allocation among the priorities.

The regulatory framework on water in the state is more elaborate than many other states having a similar socio-economic context. Water management in the state is carried out on basis of the statutory enactment Acts & Policies such as Uttar Pradesh State Water Policy, Uttar Pradesh Water Supply and Sewerage Act, 1975, U.P. Panchayat Raj Act, 1947, Uttar Pradesh Panchayat Raj (Amendment) Act, 1994, Uttar Pradesh Participation in Irrigation Management Act, 2009, Uttar Pradesh Water Management and Regulatory Commission Act, 2014 , Uttar Pradesh Bhoomi Evam Jal Sanrakshan Adhiniyam, 1963, Uttar Pradesh Municipalities Act, 1916, Uttar Pradesh Urban Sanitation Policy, 2009. The state has recently enacted a Groundwater Act, 2020.

As can be seen most of the legal enactments governing management of water in the state were enacted prior to State Water Policy of Uttar Pradesh, except *The Uttar Pradesh Water Management and Regulatory Commission Act, 2014* . The State Water Policy of Uttar Pradesh outlines need for setting up Tariff Regulatory body and also established the Uttar Pradesh Water Management and Regulatory Commission in line with that, though it needs to be operationalized. Water zoning within the state and the economic activities to be guided and regulated in accordance with such zoning but the way forward to achieve this is not provided in the policy. Similarly, there is emphasis upon regulation of ground water resources so that it does not exceed the recharging possibilities as also to ensure social equity, though regulatory backing for ensuring any measures in this regard is missing.

The emerging challenges of climate change, overexploitation of groundwater and inefficiency in water use are not effectively addressed in the State Water Policy, 1999 and are not covered by any of the regulatory instruments on water in the state. The other instruments attempt to address the issues from a one sided approach which needs to be converged in view of the overall holistic management of water resources in the State.

5.2 The Institutional and Organizational Framework

S.No.	Institutions	Functions
1.	Irrigation and Water Resources Department	Manages a large part of water use in the agriculture through dams, canals, medium and small irrigation and the development of command areas.
2.	Housing and Urban Planning Department	The Department currently has responsibility for Solid Waste and Liquid Wastes Disposal, Storm Water Drainage, Rain Water Harvesting.
3.	Uttar Pradesh Pollution Control Board (UPCB)	It undertakes Water Quality Monitoring Programme to assess the status of pollution in the natural environment. With National Mission for Clean Ganga (NMCG), it is one of the most critical institutions on water pollution in the state.
4.	Barren Land Development Department (Parti Bhumi Vikas Vibhag)	This Department undertakes long-term programs to improve agricultural productivity in areas with a high concentration of sodic lands. It undertakes Integrated Watershed Management Programme to restore the ecological balance by conserving and developing degraded natural resources such as soil, vegetative cover and water.
5.	Forest and Wildlife Management Department	This Department looks after preservation and enhancement of the quality of the natural environment, including water, air and soil quality and implementation of Water (Prevention and Control of Pollution) Act, 1974 and Water (Prevention and Control of Pollution) Cess Act, Rules, 1977-78.
6.	Fisheries Department	This Department has evolved the Fisheries Development Policy-2013 that aims at development of fisheries in lakes, reservoirs, etc.
7.	Department of Rural Development	The mandate of this Department is to provide clean and safe adequate drinking water to the rural habitation, improve the sanitation facilities, and ensure rural water security. Uttar Pradesh State Rural Livelihood Mission (UPSRLM) is a society formed under the aegis of Department of Rural Development to promote and improve livelihoods of the disadvantaged sections of the rural population of the state.
8.	Department of Infrastructure and Industrial Development	This Department functions as the Government arm to formulate and implement industrial and infrastructure development policies and strategies according to the specific needs and objectives of enabling socio-economic development of Uttar Pradesh. One of the sections of the Department specifically deals with water supply & drainage, road, etc. & other infrastructure development works. All the industries and infrastructure works use water and estimation of water requirement is essential for this Department.

S.No.	Institutions	Functions
9.	Uttar Pradesh Jal Nigam (Corporation)	This Corporation (Nigam) was established under the Uttar Pradesh Water Supply and Sewerage Act, 1975 for the development and regulation of water supply and sewerage services in the state.
10.	State Water Resources Agency (SWaRA)	This agency was set up for management, planning and sectoral allocation of Water Resources (both Surface & Ground) to various agencies viz. Drinking Water, Agriculture, Industrial Development, Hydro Power, Transportation, Thermal Power Production, Environmental flow of water in rivers. It works as a Technical Secretariat to the State Water Board.
11.	State Water Resources Data Analysis Center (SWaRDAC)	This Center functions to provide water related data to the State Water Resources Agency (SWaRA) and other Central/State water plans for all river basins of the State.
12.	Water and Land Management Institute (WALMI)	This Institute was started with a view to enhance capacity of various stakeholders in land and water management. The activities of the Institute are; organizing foundation and refresher courses for officials, officers of the Irrigation Department and other stakeholders, such as, farmers, water user associations, local government bodies, officials and officers of Agriculture Department, Command Area Development Authorities and NGOs.
13.	Uttar Pradesh Bhumi Sudhar Nigam (Corporation)	This Nigam is involved in assisting, financing, taking measures for land development, conservation and improvement of soil and water resources.

6. Research Findings and Stakeholder Views on IWRM in Uttar Pradesh under the Study

6.1 Overview

The Case Study revealed that the state is faced with many challenges on water resources management and preventing exploitation of surface and groundwater. The policy and legal framework on water in the State is rendered ineffective due to inconsistencies and the overlaps in the functions of the regulatory agencies. For example, the Water Management and Regulatory Commission established in 2014 is both a manager and regulator for its own activities which are seen as a contradictory functions by other line departments, specially the legacy of departments such as the Department of Irrigation; and the Uttar Pradesh Jal Nigam. The civil society organizations and experts on water resources in U.P have also raised concerns on the policy paralysis in the state, about the intensive water use and lack of water efficiency measures. Importantly, the two national programs vigorously pursued by the state, namely the Atal Bhujal Yojna and the Jal Jeevan Mission are seen with concerns as total water availability is declining while a universal supply

mandate has been launched by the Central Government. As per the experts this is likely to result in further overexploitation of groundwater and diminishing of common property resources such as ponds, Jal kunds, wells that are conserved and managed by the rural people since they have direct dependence on these water bodies etc.

6.2 Methodology

The methodology used for this study was a mix of desk based and action research carried out in four stages. In the first stage, the literature survey comprising of key instruments policies, laws, action plans, annual reports, Comptroller and Auditor General (CAG) of India reports and publically available data were collected and analysed. Collaboration and orientation about the study with the State Local Partner Organization (LPO) i.e, School of Earth & Environmental Sciences (SEES), Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh was also carried out to ensure information and knowledge exchange. Based on the early findings from the literature survey, in the second stage, identification of stakeholders was done based on their role in the water governance at the state level and their potential to contribute to IWRM more specifically. The third stage comprised of the stakeholders' engagement, meetings and interviews wherein nearly 45 key institutions and experts from diverse backgrounds such as policy makers, state water utility managers, practitioners, action oriented NGOs, academicians, data/information managers, representatives from farmer communities, women volunteers and media involved in water governance and IWRM were approached. Based on the responses, nearly 25 interviews were held in the semi-structured format where the experts were encouraged to share their views on issues and challenges on IWRM in Uttar Pradesh and their responses were sought on the formal status and position from the government reports such as the NITI Aayog's Composite Water Management Index and the Composite SDG Index, India and the reported steps taken by the Government of Uttar Pradesh. A few NGOs working at the ground level such the Water Aid were specifically consulted on providing ground level inputs on water scenarios in the State.

At the final stage of the study, a Regional Multi-stakeholders' consultation supported by India Water Partnership (GWP-India) was organized at Lucknow (State capital of Uttar Pradesh) on 27th December, 2021 where experts from other states such as Rajasthan, Chhattisgarh, Odisha, Uttarakhand and Haryana shared their views, lessons and experiences on IWRM.

6.3 Stakeholder's perspectives on IWRM

As discussed above, stakeholders and experts from diverse background were interviewed and encouraged to share conflicts or barriers to achieving IWRM in the state of UP. The inputs and observations of the interviewees have offered useful

insights and lessons that could be used to enhance the understanding the water resources management in the State. Following is an overview of the stakeholders perspectives on the key challenges, the state of U.P is facing for achieving SDG 6.5.1 (IWRM):

6.4 Institutional and Policy Framework

Various stakeholders had diverse views on the existing policy and institutional framework on water management in Uttar Pradesh. A majority of non-government actors have viewed that there is a policy vacuum on IWRM and institutional approaches are inadequate and myopic. It is also viewed that different departments are trying to achieve different objectives of one resource i.e water and unless all the stakeholder departments share some common and linked objectives, it might not be easy to manage water sustainably. Not all the tasks can be performed by the administrative agencies and in certain aspects such as awareness and sensitization, it is found that NGOs have done a better job. Therefore role of non government sector in achieving IWRM becomes pertinent in the context of U.P.

A majority of experts from the Government and outside have also observed that state departments are using different data sets on water and there is inadequate inter-departmental coordination on data sharing and management of water. Water related institutions also lack capacity and skilled resources that impact their performance.

Creation of new institutional mechanism in the State by integrating different water related institutions into larger, more significant organizations like the Ministry of Jal Shakti, Government of India at the State level was welcomed; but, the change in institutional design has not resulted into the change in operational design or water management at the local level. In addition, various stakeholders pointed out that the U.P. Water Management & Regulatory Commission is not functioning effectively. There is an urgent need for an independent water use regulator that allocates water to different users based on availability, levies charges on different users and develops a comprehensive framework for water reuse, the stakeholders had observed.

Identified Governance Challenges for IWRM

- Fragmented planning and inefficient management practices.
- Failure of institutions to co-evolve with emerging water management challenges.
- Degraded water resource management infrastructure leading to inefficiencies.
- Lack of institutional coherence and policy convergence impairing inter-departmental coordination.
- Inter-State, inter-sectoral issues on sharing and allocation of water resources.
- Low public consciousness.
- Lack of public participation and information.
- There is need for strengthening and democratizing water data bank.

The legal framework on water in the state also needs a serious scrutiny. As per the stakeholders' views, the state has enacted a number of Acts and Rules on land and water and some of these laws were enacted pre-independence. A large body of laws, almost each line department having its own law has not resulted in the effective water governance. For example, the Land Resources Department has Uttar Pradesh Bhoomi Evam Jal Sanrakshan Adhiniyam, 1963 that looks at both land and water, the Irrigation Department has the Uttar Pradesh Participatory Irrigation Management Act, 2009, in addition to other irrigation laws and codes such as the Northern India Canal and Drainage Act, 1873. The Rural Development Department has a role in water management as per the U.P Panchayat Raj Act, 1947 and the urban/municipal water is sought to be managed through the Uttar Pradesh Municipalities Act, 1916 and the Uttar Pradesh Water Supply and Sewerage Act, 1975. In addition to sectoral laws, the state has also enacted the Uttar Pradesh Water Management and Regulatory Commission Act, 2008 and the Uttar Pradesh Ground Water Act, 2020, two state wide legislations that have a cross cutting implications on all the sectors of water use. Thus while the legal framework in the state appears well evolved with each sector having its own law, the intersection of these laws has not been thought through, as observed by the stakeholders.

Importantly, water laws in the state do not acknowledge the unity of surface and groundwater and therefore, a separate Groundwater Act has been enacted in 2020 which has again created a room for disintegrated approach to water management in the state. Experts believe that the present legal and institutional set-up in the state is inadequate not due to existence of a law but owning to complete lack of understanding on the source of mismanagement and non-implementation. In this scenario, the experts have viewed that a shift from sectoral approach to basin/sub-basin level approach is necessary for sustainable water management in the state. A section of stakeholders also view that it is extremely difficult to implement functional river basin organizations in the state (or in the country) because of the administrative upheaval it may cause. Thus the IWRM mandate of considering a river basin as a single unit of water governance is not an easy task due to the administrative complexities which are yet to be realised in the state.

In the short-term better coordination between water sector departments and implementing agencies and sub-basin level pilots is a recommended strategy.

A majority of stakeholders have viewed that there is a need to empower existing institutions rather than establishing new ones. A more emphasis is needed to activate and empower Water User Associations (WUAs) created under the Participatory Irrigation Management Act, 2009. The stakeholders cited the effectiveness of WUAs in rebalancing the power imbalances between upstream and downstream agriculturists. Democratizing decisions and enabling communities to make management decisions by themselves with minimal authoritative mandates was deemed to be an effective strategy.

7. Ecological Sustainability and Climate Adaptation

Stakeholders, especially NGOs and academicians were highly engaged in the conversation around sustainability and climate adaptation of water resources.

NGOs highlighted the deteriorating conditions of tributaries, ponds, lakes and catchment areas due to neglect and illegal encroachment, unplanned expansion and municipal oversight as a leading cause of local water scarcity that leads to aggregate water insecurity in the state.

The rejuvenation of water bodies is promoted through several rural and urban schemes and programs but the absence of local participation and ownerships has resulted these renovation drives as seasonal or annual makeovers requiring yearly budgets to clean and upkeep them. Impactful measures such as use of MNREGA to maintain the water bodies in the state has not been through.

It is viewed that pollution is not an uniform problem in rivers, but rather area specific one. Thereby, focus must be diverted towards those areas, which are mostly urban. Industrial discharges into the rivers endanger the river itself, flora and fauna around it, and public health. These pollutants need to be dealt with carefully before they are dumped into the river and not afterwards. Strong mandates and technological interventions that treat discharges and safely dispose them need to be ensured.

All stakeholders expressed their worries regarding the future of rivers and other water bodies in the state with respect to their health.

8. Demand-Side Management

To reduce the demand-supply deficit, stakeholders insights converged around managing the demand for water itself by using broader interventions. Researchers and academicians were particularly emphatic about the need to bring water availability to the forefront on urban planning, crop choice, industrial planning, etc.

Researchers and social workers emphasized the need to redefine development and strongly recommended implementing sustainable use of available water resources in a region when planning the development projects; be the public or private. In practice, this means using policy measures to curb excess water intensive crop growth in the areas with water scarcity. Although a bold step that will require legislative, financial, and community support. For execution this is of paramount importance according to the scholars.

The stakeholders observed that economic value of water is not properly understood and integrated by the implementing agencies and the users. The incentive/penalty mechanisms for elements such as virtual water and water footprint at varying levels of water governance can play a major role in regulating demand.

The failure to prevent excessive water use by the agriculture sector was regarded as the major Demand-Side Management (DSM) failure in the state. A major share of agriculture water use comes from the groundwater. Stakeholders have viewed that this is an area where legislative and welfare programs manifest the conflicts at their best. The state government has brought the state Groundwater Act, 2020 without considering the central laws namely the Indian Easement Act, 1885 and the Indian Property Act, 1865 that allow the landlords to use water beneath his/her land as a chattel or personal property. Thus free electricity to farmers' works as an incentive to pump more water without a cost, thus resulting in excessive groundwater use, Command Area Development and the Ground water regulation are all at cross purposes ensuring continuous overuse of groundwater resources. On the other hand there is no incentive for using less water or water conservation. The policies have not been able to promote conservation over desired water use and behavioural aspects of water mismanagement. Similarly, there are no thoughts around de-incentivising excessive use and exploitation.

9. Water Resources Data Management

An extremely crucial aspect of planning any water management scheme in a region is assessing the health and availability of water resources. Given the large size of the state and the river systems, use of maps and data becomes essential but these are spread into multiple sources, institutions and formats. There is no uniformity in the data set available with various departments. Majority of researchers and government officials alike face significant obstacles in obtaining accurate, reliable, dynamic, and consistent data to base their plans or studies. Fragmented institutional setup with little coordination was cited as the main reason for data disparity. Wherever, data is believed to exist, it is not easily accessible. Not only that the public does not have access to certain information and data, inter-departmental coordination and data management is also a challenge. Technology plays an important role in resource mapping, data aggregation, resource efficiency and can be used to build decision support systems in the areas such as precision agriculture holds a lot of potential. In particular, a common data portal containing data on resource mapping, surplus and deficit areas, river water flow details, rainfall patterns in each area, ground water availability in different areas, canal flow, water bodies, wetlands, ecologically important areas, hotspots, local flora and fauna, etc. is emphasised. This data should be accessible to both government departments and the general public and should be made available in standardised formats making it easy to use. The feasibility of making data available in vernacular languages should be further explored. The Andhra Pradesh Water Resources Atlas is a good example of making data available in vernacular language.

10. Failure to learn from the non-government initiatives and lack of policy-action interface

Ecological sustainability, carrying capacity of rivers and their deteriorating health in the state has emerged as a big concern among the stakeholders. Apart from the pollution in large rivers such as the Ganga that is covered under the National Mission for Clean Ganga (NMCG), the stakeholders have highlighted the alarming situation with respect to the small rivers and water bodies such as Jheels, ponds, tributaries, streams, wetlands, canals that are being lost to pollution and negligence both by the local people and the municipal bodies. Due to this the local water insecurity is likely to increase manifold resulting in cost escalation of water to be made available to all. Jal Jeevan Mission is one effort by the government but will not be sustainable without reviving the ecological health of water ecosystems. The revival of water resources will not be possible without involvement of local people and their ownership in maintaining the health of water systems.

There is no learning of lessons that has happened from the civil society efforts implemented for over a decade[12]. For example, many NGOs have demonstrated small scale pilots in pond rejuvenation, wetland revival and de-siltation using traditional knowledge or basic water filtration methods such as removal of aquatic waste. A few organizations have also introduced concepts such as mini-urban forests using technologies for example; Miyawaki from countries such as Japan. Research work and river health assessments done by organizations like the WWF also recommend certain measures to overcome pollution problems in major river systems. Stakeholders' have viewed that pollution is not a uniform problem in rivers, but rather area specific one. Thereby, focus must be diverted towards those areas, which are mostly urban. Industrial discharges into the rivers endanger the river itself, flora and fauna around it, and public health. Degradation and continual extraction without replenishment has created a critical situation.

11. Training, Capacity building and Awareness

Respondents shared important insights into the significance of knowledge, training, and capacity for IWRM based practices within communities. Stakeholders across backgrounds observed isolated attempts at better water management but very little integration. This was a troublesome factor according to them as there needs to be high quality community engagement for localised solutions to water management.

[12] The organization SayEarth is also involved in greenery projects by creating mini urban forests employing a Japanese technology called Miyawaki in the NCR region of UP. Further, desilting, removal of aquatic waste, installing basic water filtration systems, urban rainwater harvesting, and construction of water catchment areas (baandhs) were some other small scale recommendations made by NGO institutions to create a healthier hydrological system at the village level.

Jal Chaupals as a forum for dialogues on local water resource management in Uttar Pradesh convened by the WaterAid have demonstrated the effectiveness of gathering villages together to discuss and decide the fate of their community water resources. It gives them a direct voice in how their water is used. Intense stakeholder workshops before, during and after the implementation of projects is something that should be worked upon. We need to evolve a framework for this. Awareness, training, capacity building is something that requires urgent attention - sustained campaigns should take place to invoke a sense of ownership among the locals. This can take the form of forming local committees who can deliberate and take decisions at the local level while reporting to a regulating authority.

In addition, festivals such as Van Mahotsav bring a lot of attention and awareness and more such campaigns are required. The cultural significance of water must be emphasised upon to bring about behavioural change. There is a need for a Citizen's charter outlining the role, responsibilities and obligations of different users and stakeholders. This can be used to build awareness.

12. Recommendations and Strategies: Mainstreaming Integrated Water Resource Management (IWRM) in Uttar Pradesh

12.1 Need for equitable and dynamic water allocation for all categories of water uses

Currently, out of the average annual natural flow through rivers of about 161.64 BCM of water, only about 118.47 BCM is utilizable in the State which is allocated among various competing uses. The water availability scenario in the State warrants that all the water resources are allocated judiciously based on the principle of equity and social justice. Prioritization of allocation, however, requires that the principles of water as a common pool resource and water as an economic good are also adhered to so that the value of water is recognized in the management and decision making processes.

A well designed equitable and dynamic water allocation criteria is essential for the IWRM in the state as it will contribute to the achievement of current state water policy and national level policy objectives, including creating mass awareness on social and economic value of water, improved water use efficiency, better environmental outcomes by restoring base flows that are essential for supporting ecosystem services. An equitable and judicious prioritization in water allocation also underlines equitable sharing of risks of shortages among all the sectors of water use. A dynamic water allocation approach, however, provides the flexibility to the State Government to re-prioritize or adjust the allocation based on the change in water use or demands by a category of water users.

A series of strategies and measures are required to augment the water resources in the State. These measures are expected to infuse many changes in the water availability and demand at a basin level that will have positive impact on the competing water uses which is expected to provide the State flexibility in re-prioritizing water use. The equitable and dynamic water allocation criteria is one of the basic strategies to be adopted during planning and management of water resources in the State. However, the dynamic nature of allocation priorities will need to ensure that the existing allocation will be modified based on regional and area specific consideration and scientific analysis. For example, at a basin level, the planning for water allocation for a remote village as per the dynamic criteria would require a consideration on exploring the utilization of local water resources.

Further, the dynamic criteria to be implemented keeping in view the targets and framework under the central schemes such as the *Jal Jeevan Mission* and the *Atal Bhujal Yojna*. Accordingly, the following prioritization is understood to be beneficial in water allocation in the State: (i) Drinking and Domestic Use; (ii) Environmental Flows; (iii) Irrigation; (iv) Thermal and Hydropower; (v) Industries, including agro industries; (vi) Navigation; Recreational, Aesthetic and other uses.

12.2 The River basin to be taken as the hydrological unit for water management in the State - the principle of hydrological unit treating surface and groundwater as one for the successful mainstreaming of IWRM

IWRM broadly rests on the principle of the unit of the hydrological cycle treating surface and groundwater as one and recognizing that these are interlinked. Therefore, the suggested 'strategic paradigm shift' under the IWRM requires that instead of a sectoral approach to managing water such as for agriculture, domestic/urban, environment and industry; a river basin/sub-basin approach should be adopted where the surface water and the corresponding aquifer is taken as a unit for mapping, project planning, climate adaptation and pollution control measures. The basin level planning should take into account as per the present status of development in the delineated basin area relevant for planning a project and strive to ensure optimal conjunctive use of surface and groundwater within the basin where drainage is an integral part of the optimization plan. The planning for water resource projects in the basin should cater to diversified uses within a basin for which the multi-purpose schemes are regarded as a suitable approach. The planning at a basin level should take into account regional imbalances and suitable strategies be devised to overcome them by enhancing augmentation and conservation measures, at a basin/sub-basin level.

12.3 Mapping and Inventorization

Mapping is a prerequisite for any kind of water resources project planning at the basin level. Accordingly, the State government, based on the ecosystem and river basin management approach, should make concerted efforts for mapping and assessment of water quantity & quality and prepare an inventory of all the water resources in a basin that is accessible to all the stakeholders including the

communities. Thus, the mapping of rivers, streams, reservoirs, lakes, *Jheels, Taals, and Kunds,* including those that have diminished is required to be undertaken using appropriate modern technologies such as GIS.

12.4 Qualitative Project Planning

Since an effective project planning is the key to the basin level water management, adequate attention needs to be paid to the quality of planning a project, which is one of the core strategic focuses under the IWRM. The planning must follow a multidisciplinary and integrated approach guided by the common pool resource principle and as far as possible should integrate traditional knowledge on water by involving grassroots level organizations and village level institutions. The planning for large multi-purpose projects should take into account the ecological and livelihood concerns including the considerations for aquatic biodiversity. Capacity building for improving efficiency in planning should be done for all the institutions involved in water management and governance in the State. In case of project planning for urban areas, municipalities and other relevant agencies should be included in the planning process. In order to improve the quality of project planning, a system of benchmarking of efficiency norms is required to be introduced.

12.5 Climate Adaptation

As per the Uttar Pradesh Action Plan on Climate Change (2014)[13], the available projections on climate impacts in Uttar Pradesh indicate an increase in annual rainfall by 15 to 20 percent by the year 2050 as compared to the baseline the increase in the annual rainfall is predicated to be higher by 25 to 35 percent towards 2080. There is also a predicted increase in maximum temperature by 1.8-2.1 degree Celsius by 2050. As a result of climate variations and the changes in the hydrological cycle, the climate sensitivity of agriculture and water in the nine agro climatic zones is very high in Uttar Pradesh; especially the Bundelkhand and Vindhya regions are highly vulnerable to climate change. Due to high vulnerability of these regions, a special climate adaptation program needs to be devised.

[13] http://moef.gov.in/wp-content/uploads/2017/09/SAPCC_UP_final_version_0.pdf

Box 1 : Climate-resilient water management in Bundelkhand and Vindhya regions in Uttar Pradesh

The Bundelkhand and Vindhya regions of Uttar Pradesh are some of the most water-scarce areas in the country. Only around 10% of the rural population in this region has access to piped water supply, negatively affecting the overall economic and social development of its people. Hard rock strata characterize the region, and the hydrogeology, soils and the climatic distribution are directly responsible for the slow agricultural growth and low groundwater porosity. Due to its pattern of erratic rainfall, this region is witnessing contrasting weather conditions – long drought spell and intense monsoon rainfall. An impermeable rocky layer resulting in high runoff of both rainwater and soil further aggravates this. All these challenges result in a severe water crisis in the region. Throughout the region, there has been a major dependence on groundwater consumption and surface water is available in the form of rainfall-generated runoff, which is stored in dams, tanks and other traditional water bodies.

Specific IWRM related policy interventions in these regions could include: (drought proofing strategy and resilience master plan; village level water budgets and water security plans, restoration and rejuvenation of water structures, watershed based soil moisture management, groundwater recharge and program convergence; participatory aquifer management and strengthening systems of community regulation and promotion of drought resilient land use, vegetative and agronomy practices. Programs like MNREGA with CSR could be converged to launch a 3-5 Year drought proofing strategy and action plan for:

- Augmenting surface water storage through rejuvenation of traditional water bodies after systematic identification, mapping and geo-tagging of reservoirs. Participatory community-based maintenance of reservoirs should be promoted.

- Targeting improvements in water retention capacities through effective catchment area treatment.

- Gram Panchayat-level water budgets and water security plans should be prepared for rationalizing water usage, increasing water-use efficiency and promoting participatory micro-level water management.

- Climate smart agriculture practices, integrated farming systems and less water-intensive crops should be promoted through appropriate drip-to-market corridors.

- Facilitation of Artificial Groundwater Recharge in drought-prone blocks by injecting rainwater into the existing subsoil with due care to avoid possibility of aquifer pollution. This will prevent overexploitation of subsoil aquifer and increase water availability during droughts.

Note: *The Government of Uttar Pradesh released a Vision Document for Bundelkhand on Integrated Sustainable Water Management through multi-stakeholder partnerships in November 2018 and a subsequent Strategic Action Plan for multi-stakeholder interventions in Bundelkhand in February 2020.*

12.6 Climate Adaptation in other parts of the State

Climate adaptation in other areas in the State requires a reasonable degree of climate preparedness to deal with water and food insecurity and extreme weather events such as floods and droughts that are often attributed to the State. At the macro level, strategies to deal with climate impacts on water resources include a renewed focus on water security, health of river basins and river ecology from the basin perspective, building resilience for floods and droughts, strategies to deal with urban flooding and storm water and building climate resilient infrastructure. For the implementation of these strategies, the strategic focus as per the IWRM needs to be on supporting and strengthening water stewardship and community capacity building to adapt and mitigate climate impacts through consultative, participatory and scientific management of water resources. Role of innovative means such as the 'cascade approach' is to be actively sought and incentivized, which inter-alia would include revival of traditional water harvesting structures, water bodies and protection, conservation and management of flood plains and urban water bodies. The concerned line departments should include demonstration and pilot projects on climate resilient cropping systems in their annual agenda with clear financial allocations.

While adopting and implementing climate adaptation strategies, the State government should also encourage and facilitate private sector participation to increase the adaptive capacity of the State by creating incentives for sharing best practices adopted by the industries in areas related with climate adaptation such as water use efficiency in agriculture, urban and industrial use, water conservation, pollution management, and recharging. Incentives should be extended for good agricultural practices in the basin catchments and command areas including water use efficiency and organic agriculture that protect consumptive and non-consumptive ecosystem or watershed services. Other incentive-based approaches could be to have a system in place to Recognize and Reward (R&R) water-positive industrial units and processes that demonstrate considerable reduction in water use, recycling, treatment and reuse. Climate adaptation and resilience in the State requires strong civil society participation and partnership in a mission mode for which the role of youth, women, academic and research institutions needs to be promoted through multi-stakeholder platforms. Demand-Side Management and Disaster Risk Reduction mechanisms such as flood forecasting are the other measures that need to be strengthened with a river basin approach.

Box-2: District Climate Resilience Plans in the State

In Uttar Pradesh, the District Climate Resilience Plans have been prepared for Chitrakoot and Jhansi districts in the state. These plans have identified for each of the Districts Climate Resilience priority and accordingly, the actions needed to build resilience and then allocating the implementation of the action plan to be undertaken by the line departments. Some of the climate resilience priorities identified are:

Priority 1: Drinking Water Sufficiency
Priority 2: Agriculture Productivity and Livestock Resilience
Priority 3: Livelihood Options and Income Security
Priority 4: Nutrition and Access to Healthcare
Priority 5: Ecological Balance

12.7 Water Pollution, Water Quality and Health of Water Ecosystems

In Uttar Pradesh, the three major sources of water pollution are municipal sewage, untreated industrial effluents and agriculture run-off that cause serious health concerns for the citizens in the State. In addition to these sources, Geogenic pollutants, such as Arsenic, Fluoride and other heavy metals affect the drinking water quality. At the State level, the Uttar Pradesh State Pollution Control Board (UPPCB) is the nodal institution for the control and abatement of pollution as per the Water (Prevention and Control of Pollution) Act, 1974. However, the responsibility for the protection and management of water ecosystems is spread among the administrative control of various departments in the State. Therefore, the strategic focus under the IWRM is on the health of the water ecosystems that need to be prioritized for preventing deterioration of surface and groundwater quality. All the line departments need to include water quality concerns into their planning and designing of development projects.

12.8 Pollution in the River Ganga and the National Mission on Clean Ganga (NMCG)

Given the widespread pollution of water resources, the strategies to prevent and manage the pollution would require a multi-pronged approach that ensures comprehensive water quality monitoring for determination of the pollution hotspots, reduction in discharge of polluting water into clean water resources, treatment of polluted water before disposal into the environment, recycle and reuse, and maintaining minimum environmental flows. National Mission for Clean Ganga (NMCG), Ministry of Jal Shakti, Government of India is working towards maintaining the minimum flows. This, as per the IWRM is to be achieved by integrating the principle and theme of *Nirmal Dhara* into the institutional functioning of line departments entrusted with control and abatement of domestic, industrial and agricultural pollution. For mitigating domestic pollution, the primary responsibility shall lie with Urban Local Bodies (ULBs) and Gram Panchayats, whereas for industrial pollution, the primary responsibility shall lie with the UPSPCB. The strategies could include a combination of improved standard setting, greater investments, improved technologies, enhanced and reliable monitoring, and improved enforcement and accountability.

For the control and abatement of Geogenic pollution, focus should be on extensive monitoring and mapping for presence of pollutants in the surface and groundwater with the objective to identify and clearly demarcate pollution hotspots. In order to collect reliable data, the quality of the laboratories to be improved. There should be standardisation of standard protocols and reporting formats for the laboratories across the State. The State shall also promote development of alternative sources of water for drinking purposes in the polluted hotspots. Where alternate sources are not available or cannot sufficiently meet the water demand, appropriate treatment of the

polluted ground water as per the regulated water quality standards should be ensured. The State agencies should take appropriate measures for creating awareness about groundwater pollution to dissuade the people from using such water for any potable uses. The State should take up rejuvenation of the aquifers in areas affected by Geogenic pollution by implementing strict limits on groundwater pumping and adopting technological solutions for pollution mitigation.

At the decentralized level, nature based wastewater treatment plants should be incentivised. The State Government should promote and adopt multi-scale sewage treatment technologies, including in-stream treatment, lake side/pond side treatment, and apartment-level treatment. For the centralised treatment of plants, the State Government should parallely ensure completion of sewerage connectivity with construction of Sewage Treatment Plant (STP). Emphasis on low-energy, biological technologies should also be given preference wherever possible.

The qualitative improvement of ULBs in managing and operating the STPs should be ensured by capacity enhancement, technology exposure and by seeking the role of the private sector in building the capacity to ensure water quality and efficiency. As per the mandate under the IWRM, the role of the private sector in wastewater treatment and sewage management is to be actively sought. In all such cases where, STPs are outsourced, the private players must be closely monitored and all their performance should be linked with payment or incentive mechanisms to drive change from poor operating practices to performance based efficient practices.

Environmental flows in rivers must be ensured by integrating the principle and theme of *Aviral Dhara* into various strategies that should focus not only on the quantities of water, especially in the lean season but also ways to maintain monsoon-to-summer variations. The principle has been at the centre of State's official policy position on e-flows in rivers. Ecological needs of all the rivers in the State should be scientifically determined by ensuring that the low and high flow releases are proportional to the natural flow regime, including base flow contribution in the low flow season through regulated groundwater use. After the ecological needs are determined, it is suggested to keep aside a quantum of water for meeting the ecological needs of a river, the challenge will be to manage the water availability in a manner that all rivers have flows as per the principle of *Aviral Dhara.* In order to achieve this, the State Government must take measures to promote judicious and controlled use of ground and surface water. Further, it should ensure conservation of river corridors, water bodies; enhance the storage and carrying capacities of water bodies and water courses and/or associated wetlands, the flood plains, and ecological buffer areas. The areas required for specific aesthetic recreational and/or social needs may be managed to the extent possible in an integrated manner (to balance the flooding, environment and social issues) as per prevalent laws through planned development of the urban areas. A State wide program for the protection of

catchments areas that are within the State administrative limits for all rivers of the State would be useful for restoration of environmental flows. Good practices and success stories on basin/sub basin level should be mainstreamed and special emphasis should be given on maintaining minimum e-flows. With the purpose to achieve the objectives of *Nirmal Dhara* and *Aviral Dhara*, the Polluter Pays principle should be applied on a case-to-case basis.

12.9 Demand Side Management and IWRM

12.9.1 Facilitating Crop Choice

The estimates suggest that the total demand for water in Uttar Pradesh will escalate in the short, medium and the long term unless effective measures for Demand Side Management (DSM) are put in place. The agriculture sector, which uses nearly 92% of State's water out of which more than 80% is groundwater, is completely unregulated. Of the 75 districts in Uttar Pradesh, 34 are overexploited from groundwater abstraction. The water through canals for the *Zaid* (summer crop) remains underutilized as cropping intensity is either non-existent or poor. Another critical challenge is that the cropping in all the regions, including in the water stressed regions of Bundelkhand-Vindhyachal, is done in isolation without considering basin-level demand-supply gaps and the forecasted local agro-climatic data. Another major cause for the excessive use of groundwater in the State is the promotion of shallow boring for agriculture since 1995 that aimed at encouraging farmers to shift from protective irrigation to productive irrigation. This has created unforeseen problems in the water sector and with an easy access to groundwater and promotion of high yielding variety crops, cultivation has shifted to water intensive crops such as paddy and wheat.

In view of the rising water demand in the already water intensive agriculture sector, the IWRM should aim at achieving the twin objectives of realizing the agricultural growth rate set out in the State Agricultural Policy 2013, through increased economic and irrigation water productivity and a reduction of total demand or consumptive water use by agricultural sector (by 1% annually through a combination of various strategies).

12.9.2 Managing Agricultural Water Demand through crop diversification and intervention

In order to effectively manage the rising demand for water in agriculture, a number of strategies have been put in place in the past that need to be integrated into basin level planning from the DSM perspective. However, enhanced efforts are required to improve the situation. Firstly, the productivity and sustainability of farming systems will have to be improved with a focus on irrigation water

productivity (yield produced per unit of irrigation water use). Secondly, concerted effort must be made to engage with the farmers through Panchayats and other forums to move towards shifting the cropping pattern and sowing practices. Other key interventions for managing demand of water for irrigation include a proactive shift towards less water-intensive cropping regime involving shorter duration horticultural crops backed by financial support in the form of interest subventions for short-term crop loans (less than 6 months), distribution of subsidized vegetable seed-kits to the farmers and establishment of logistics hubs on cluster basis. Improved varieties of seeds should be made available to farmers through Farmer's Producer Organizations (FPOs) or other community institutions.

Interventions such as procurement and price-support mechanisms, for instance, Public Distribution System (PDS) should be encouraged to incentivize the farmers who are producing less-water intensive crops. The other strategies such as introducing Good Agricultural Practices in crop-water management, promoting the System of Rice Intensification (SRI), promoting Alternate Wetting and Drying (AWD) and Water-efficient sugarcane innovations should be adopted. Scientifically driven land management practices such as Laser-land levelling and mulching to enhance the slope for adequate drainage and conservation of soil moisture in the field for meeting crop-water management should be applied. Market driven DSM and Public Private Partnership (PPP) for increased adoption of sustainability standards in sugarcane production, will in turn reduce the environmental/water footprint of the crops and to help the farmers earn a higher premium should also be attempted.

12.9.3 Agricultural Water Use Efficiency

Use of On-farm and Off-farm Water Use Efficiency technologies should also be promoted. A few examples include Piped Irrigation Networks for increasing conveyance efficiency and promotion of drip and sprinkler irrigation techniques in horticultural and field crops that would be augmented by water-literacy and extension initiatives of the Departments of Agriculture and Water Resources. This will be complemented by ensuring the source sustainability through Participatory Irrigation Management (PIM). All efforts should be made for promoting and mainstreaming good DSM practices at the decentralized level that demonstrate participation, gender inclusion and community mobilization. A few examples already exist in the State and are presented below.

Box-3: Gender Inclusive IWRM in the State: Learning from the Jal Sahelis of Bundelkhand

Opportunities for women entrepreneurship in water resources management

The Jal Saheli model was initiated in 2005 to revive water harvesting structures and traditional water bodies in Bundelkhand through a community led approach. Since their inception, Jal Sahelis have played a pivotal role in ensuring water availability through small acts of repairing hand pumps, fixing wells and developing work plans for safeguarding water resources. The women in villages work without remuneration as Jal Sahelis and are organised into Pani Panchayats. There are 20-25 women in a single Pani Panchayat and there are 2-4 Jal Sahelis in every village. The Jal Saheli model has been instrumental in not only addressing the issue of water scarcity but also helped empower the women by making them a crucial part of local planning and administration. The Ministry of Jal Shakti, Government of India has also included Jal Saheli's in India's best practices.

Box-4: Meetha Sona Unnati Project – IWRM and Private Sector Participation

Demand-side management through Sustainable Sugarcane Initiative

A consortium of the International Finance Corporation (IFC), Solidaridad, Coca-Cola and other civil society organizations and DCM Shriram LTD (DSCL) in partnership with sugarcane small holder farmers of Uttar Pradesh, has implemented the Meetha Sona Unnati project. This multi-stakeholder initiative is a partnership between a public and private institutions focusing on water saving practices such as trench planting, micro irrigation, laser levelling, organic manuring/vermi-composting, trash mulching and mud-pressing from silt collected. A combination of these practices has helped rejuvenate village ponds, recharge wells, and increase water availability for consumptive uses. The (2016-2017) project has resulted in water savings to the tune of 275 billion litres in three years of implementation and increasing the sugarcane productivity by 20-25%.

Box-5: Setting Incentives Right: Gujarat model in solar cropping

(A success story of Khera District, Gujarat)

Water conservation is better achieved by making incentives right. At Dhundi, in Khera district of Gujarat, farmers are earning more income by fighting climate change. A group of nine small farmers left diesel pumps to go solar pumps under the IWMI-TATA programme. The farmers have installed a solar pump to irrigate their fields. In addition to improved income from agriculture and animal husbandry, they earn extra from selling water to nearby farmers and energy to the power grid. They are also eligible for carbon credit, substituting fossil fuel for pumping. This is a story of rural transformation by setting incentives right and the selling water also discourage over pumping of groundwater. Properly structured, market can also work for the poor.

13. IWRM and Supply Side Management

The supply side management in rural and urban areas in Uttar Pradesh is faced with very different set of challenges and require policy interventions as well as institutional coordination. The IWRM provides for a conceptual and monitoring tool to manage water supply in rural and urban areas in the State.

13.1 Rural Water Supply (RWS)

Efficient management of Rural Water Supply (RWS) to ensure universal access to drinking water through Household Tap Connections (HHTCs) in the country's most populated Sate is a big challenge. The reliable water supply to rural households in U.P is to be provided to a population of about 13.75 crore (2011 census) living in 57,758 Gram Panchayats, 97,942 villages and 2,33,341 habitations. If 40 LPCD of drinking water is provided to each person in rural U.P, on an average, the current water use is estimated to be about 2.0 BCM. There is a further challenge of ensuring service delivery standards. Other critical issues affecting this sub-sector performance are: (i) weak O&M; (ii) source sustainability; (iii) water quality, mainly related to Arsenic, Fluoride, Nitrate and Hardness. The U.P Jal Nigam is responsible for providing infrastructure, through various schemes and the Operations and Maintenance (O&M) is the responsibility of Gram Panchayats and their sub-committees.

The IWRM approach provides for ensuring RWS is in line with the Jal Jeevan Mission (JJM), a national flagship program aimed at providing 100% HHTCs to all rural households by 2024 for ensuring adequate, affordable and sustainable water supply services for all.

The universal access to HHTCs in rural areas in the State will have significant impact on women who will be the main beneficiaries of the JJM. For achievement of this goal in a timely manner, the detailed guidelines issued by the Government of India under the JJM will be followed at the State level. For accelerated extension of the JJM towards the timeframe of 2024, the strategies must aim at providing the impetus to the JJM, that include the following:

- Active participation of Gram Panchayat (GP), Village Water and Sanitation Committee (VWSC), and Gram Sabha to seek local wisdom and community **ownership in designing and building the rural water supply infrastructure**.

- A VWSC should be formed and/or re-activated in every GP for actively participating in planning, execution and O&M phases of the scheme. Such VWSC should have **at least 33% women members and another 33% members from SC/ST/Other Backward Communities to ensure equity**.

- Operation and Maintenance (O&M) plays a key role in ensuring sustainable service delivery. The capacity of GPs/VWSCs and financing are critical to ensure desired O&M standards. Jal Nigam/Zilla Parishads would be required **to adopt appropriate measures to enhance capacity of GPs for improved O&M**.

- Local private sector participation for O&M should be promoted, at least for the schemes that are large and **need higher levels of technical and managerial capacities**.

- The services need to be sustained for at least for the design period of the infrastructure and hence should be **monitored periodically**.

- An appropriate M&E system should be developed to monitor service delivery regularly and the same **should be used for decision making**.

- **Metering should be encouraged in all villages**, starting with large villages that have a population of more than 10,000 people, to encourage water measurement for losses, Non-Revenue Water (NRW) and also for tariff setting, beyond lifeline consumption limits.

- Similarly, all large villages with a population of more than 10,000 people should be provided with decentralized wastewater collection and treatment systems. GPs should be responsible for **O&M of such systems**.

- Source sustainability is crucial for sustainable service delivery. Appropriate **groundwater management measures should be undertaken to ensure source sustainability**.

13.2 Urban Water Supply and Wastewater Management for IWRM

Achieving qualitative Urban Water Supply (UWS) services in the State by adopting various strategies that result in improved supply side management, is one of the strategic focus under the IWRM. The urban population of Uttar Pradesh resides in 653 Urban Local Bodies (ULBs) consisting of 17 Nagar Nigams (Corporations), 198 Nagar Palikas and 438 Nagar Panchayats. By 2031, it is expected that U.P's urban population would grow to be around 35.5% of its total population. The slum population is also expected to grow higher. Some of the specific challenges in the UWS include lack of reliable information on service delivery parameters coupled with high levels of NRW in many ULBs and zero metering. The groundwater exploitation in urban areas is about 5 BCM per annum, which is about 80% of total water supplied. The increased use of groundwater points to higher levels of private bore wells and self-supply, which is largely unregulated. Other challenges include low sewerage network coverage, collection and treatment efficiency, implying a large amount of untreated urban sewage getting disposed into water bodies and/or environment; 95% of industrial water demand is also met by exploiting groundwater.

The strategic focus under the IWRM approach should be to ensure access to safe, affordable and adequate drinking water for all in the urban areas in the State. This should be achieved by way of adopting the following strategies:

13.3 Universal household tap connections and Sewerage Connections: The State Government to ensure 100% HHTC for the supply of drinking water for all urban households, including households within slum areas, through a time bound action plan. The drinking water supplied through HHTCs shall conform to BIS 10500 standards or any other standard prescribed by the GoI/GoUP from time to time.

13.4 Smart Utilities with a Service Delivery Focus: Beyond providing HHTCs to 100% households, the service providers should be capacitated and mandated to achieve desired levels of service delivery. Thus, while the JJM aims at tap connections for every household; the state level schemes should sustain the initiative by technical capacity enhancement of ULBs

13.5 Monitoring and Evaluation: Service delivery should be measured on a regular basis, through appropriate service delivery indicators. Progressively, the GoUP will be required to set specific standards for quantity and other service standards for each region and each type of ULB.

13.6 Metering and enhanced Operation & Maintenance: All ULBs with population more than 1 lakh should be supported to adopt 100% metering, in a phased manner, for regular water audits and also tariff setting and collection. Timely and appropriate O&M is essential to maintain desired service standards. The ULBs are responsible for O&M and their capacities shall be enhanced for this function. Wherever suitable, the ULBs shall be encouraged to use services of 'private sector' through appropriate PPP models. Measures like regular energy and water audits, replacing old pumping and other equipments with more efficient equipments, switching to low-cost power sources should be encouraged and incentivized.

13.7 O&M Financing: The tariff should be telescopic, with a low/nil price for basic consumption which increases thereafter, based on use slabs. The tariffs, other municipal taxes and grants available to ULBs should cover 100% of O&M financing. The ULBs should create a separate budget head for O&M accounts to enable better monitoring of O&M financing.

13.8 Reduced Non-Revenue Water (NRW): Each ULB should prepare a NRW Reduction Plan and achieve gradual reduction of NRW to the levels in a specified time frame. The State Regulatory Commission should set such standards and monitor the same either regularly or from time to time.

13.9 Urban Groundwater Management: Rooftop rainwater harvesting should be made compulsory where technically and financially feasible, the ULBs should shift to using surface water and reduce groundwater exploitation.

13.10 Wastewater Management: The Municipal Corporations and those ULBs in environmental hotspot areas (like Ganga River basin, Hindon River basin, etc.) should be prioritized, followed by others. Decentralized and cost-effective technical solutions should be the first choice. At least 30% of the treated wastewater should be recycled and used for suitable applications by ULBs.

13.11 Citizen Engagement and Accountability: All the concerned agencies should undertake appropriate citizen engagement drives through ward level committees and report progress on various key initiatives through digital and other media.

14 Enhancing Water Availability for Use through Supply Side Measures

The strategic orientation under the IWRM calls for making a conscious shift from 'managing scarcity' to 'managing sustainability'. Hitherto, the water management has been heavily concentrated on hardware and engineering solutions. The IWRM envisages that endeavors should be made to ensure water security and sustainability through measures such as behavioral changes among the water users.

14.1 The Strategic Focus

The strategies for enhancing water available for use should include: Augmenting storage by using Integrated Nature-based Solutions (NbS) that comprise of a wide range of options from landscape level interventions such as Catchment Area Treatment (CAT) focusing on sediment control, water pollution management and protecting integrity of ecosystem or watershed services to storm water treatment and pollution management through constructed urban wetlands NbS also regulate several ecosystem processes, such as productivity, decomposition and nutrient cycling that are important for the functioning of watersheds. NbS can help minimize the pollution load and protect downstream assets such as STPs by managing the pollutant load concentrations. This would ensure groundwater quality management for freshwater supply augmentation; rural areas for drought proofing storage structures, bio-retention units for flood water retention, permeable pavements and storage/retention ponds for storm water management should be mainstreamed. The reuse of treated water confirming to the prescribed standards for augmenting supply to industrial units and irrigating peri-urban agriculture should be promoted. The public participation should also be ensured by incentivizing storm water management in the towns and cities across the State where recurrent flooding is identified as a critical risk to lives and personal property and public infrastructure. Promotion of local innovations by civil society organizations and academic institutions or citizen groups in NbS focusing on water conservation and reuse, storm water mitigation and management, watershed restoration and other sustainable strategies for water quality protection should be facilitated.

15 Sustainable Groundwater Management and IWRM

15.1 The Groundwater Scenario[14]

The State is the largest extractor of groundwater in India accounting for 18.4% of the total national and 4.5% of the total global groundwater extraction (2030 Water Resources Group). The per capita groundwater extraction in the State is 224.97cum compared to a national average of 182.86 cum and a global average of 125.89 cum. Of the 820 Blocks in the State, 91 blocks have been categorized as over-exploited consisting of 82 rural and 9 urban areas, 48 blocks are in the critical zone and 151 blocks are in the semi critical zones of groundwater levels.

[14] The Groundwater Year Book of Uttar Pradesh (2020-2021); http://cgwb.gov.in/Regions/NR/Reports/Year%20Book_CGWB_NR%202020-21.pdf

As per the available data, out of 653 urban bodies, the Municipal water supplied to 622 urban bodies is fully dependent on groundwater. Only in 31 ULBs, the water supply is met from surface water, supplemented by groundwater.

Most of the prominent cities in the State are facing widespread groundwater level decline ranging from 0.5 to 1m per year, which is quite critical and surpasses the threshold of significant annual decline of 20 cm. The Western region of the State has been categorized as having one of the most depleted aquifer systems in the State.

15.2 The deleterious and irreversible impacts of groundwater overexploitation

The multiple problems ranging from over-abstraction and declining water levels to deficient and erratic rainfall, quality hazards affecting potable supplies, sub surface water logging are identified as challenges to be addressed on priority. The critical problems impacting groundwater availability in the State are: 70% of irrigation in the State is dependent on groundwater extraction; the existing cropping pattern is dominated by water intensive crops such as sugarcane and rice. Only 5% of this irrigation is supported by water efficient, micro irrigation techniques like drip and sprinkler, resulting in a strain on the groundwater resources; subsurface water logging in canal commands is converting large areas unproductive, while reduced base flows is also impacting groundwater-dependent ecological flows as well surface storage; groundwater contamination has emerged as a threat for water security. High level/excessive concentrations of various chemical contaminants in groundwater such as Total Dissolved Solids (TDS), Fluoride, Iron, Nitrate, Arsenic contamination, heavy metal toxicity and bacteriological pollution have been found in critical levels affecting groundwater quality in different parts of the State.

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15.3 IWRM based interventions for groundwater management

The strategies for the sustainable management of groundwater comprise of centralized and decentralized approaches. The centralized approach must be complemented with a decentralized participatory management on the ground, while also factoring in the unitary nature of water resources. This should be done using a two-pronged strategy of focusing on centralized and decentralized measures:

Centralized Supply Side Approaches

15.3.1 Aquifer Mapping and Management: Detailed groundwater aquifer mapping should be conducted to the micro-watershed scale by enhancing capacities for Integrated Water Resources Management at all levels (State-District-Gram Panchayat (GP)), through partnerships with knowledge institutions and civil society groups, therefore allowing aquifer-based groundwater management.

15.3.2 *Regulate groundwater:* Usage of groundwater extraction should be regulated as per the Uttar Pradesh Ground Water (Management and Regulation) Act, 2019 with strict restrictions in over-exploited and critical blocks. This should be followed by aquifer-based use and management - notifying separate aquifers for drinking, agriculture, industrial and other users (by decentralized community regulation aided and facilitated by right information)

15.3.3 *Groundwater Recharge should be implemented on an integrated mission mode:* Targeting over-exploited/critical blocks in a time bound manner by adopting a decentralized convergence mode. This should further include adopting approaches to saturate micro watersheds. For large scale artificial groundwater recharge, new technologies based on field driven projects and scientific principles such as *Aquifer Storage and Recovery, Managed Aquifer Recharge, Recharge basin, Radial wells, Infiltration gallery, Large pressure head recharge wells* as appropriate, should be taken up on a pilot basis in both alluvial regions and Bundelkhand-Vindhyachal regions to ascertain the feasibility of such measures and to further replicate successes. Implementation of small recharge and storage structures such as recharge trenches, rain pits, farm ponds, in-situ soil conservation measures, gabion structures, peripheral bunds, *nalla* bunds, check dams and vegetative measures should also be taken up along with the large-scale measures for minimizing surplus run-off.

15.3.4 *Recharging for industrial groundwater use:* All industries should ensure mandatory implementation of rainwater-harvesting and groundwater recharge. Recharge well methods be adopted with due safeguards to avoid groundwater pollution. Submersible pumps should be monitored and regulated for urban and industrial use in overexploited and critical blocks. The polluted effluent of industries should be treated for its maximum re-use and recycle. All industries that exceed water consumption thresholds set by the Regulator through a consultative process, should be required to publish Annual Water Report giving the details of water budgeting, water consumption, water use per unit production, rainwater harvesting, water recycled and fresh-water consumption. The Annual Report should also highlight information with regard to effluents discharged into rivers after treatment and levels of treatment; and the report should be verified by UPPCB and the same shall be required to be put in public domain.

15.3.5 *Tube well Management:* Identification, mapping and reallocation of existing tube wells should be conducted based on water availability and quality in aquifers. Tube well sites may be explored in peri-urban locations. The conjunctive use of surface water should also be promoted. Capping the depth and number of wells sunk in the region and notifying progressive adoption and use of micro-irrigation in water-intensive crops should be pursued. In case of new agricultural tube well connections in semi-critical blocks, adoption of micro-irrigation should be made mandatory.

15.3.6 *Research and Training:* A "Ground Water Research and Training Institute" should be set up to promote research & studies and to train personnel of the State Groundwater Department. Campaigns on water literacy and awareness can be organized by the expert institutes by partnering with institutions and civil society organizations. Focus should also be placed on regionally relevant contents for farmers raising awareness about the economic value of water and the crisis around water resources.

15.3.7 *Convergence with Centrally Sponsored Schemes and Plan approaches:* With an aim to ensure source sustainability of the Central Schemes such as the *Atal Bhujal Yojana* and the *Jal Jeevan Mission* should be dovetailed and integrated with State programs such as micro-watershed programs implemented by the Minor Irrigation, Agriculture, Land Development & Water Resources Department etc.

***Atal Bhujal Yojana* (Atal Jal)**

Atal Bhujal Yojana launched by Government of India has the principal objective to demonstrate community-led sustainable groundwater management which can be taken to scale. Also known as Atal Jal, it is targeted at sustainable groundwater management, mainly through convergence among various on-going schemes with the active involvement of local communities and stakeholders to develop GP-level water budgets and water security plans. Uttar Pradesh is a target State for project implementation of Atal Jal.

Decentralized/Demand-side approaches

15.3.8 *Initiating participatory Gram Panchayat-scale Integrated Water Management Planning, beginning with the Atal Bhujal Yojana (Atal Jal*) - There should be a focus on effective implementation of the Atal Jal in all GPs covered under the Atal Jal to prepare Water Security and Budgeting Plans at the lowest level (GP level) by adopting a Bottom-up Approach (based on the local hydro geological/hydrological and geomorphic settings) by constituting water user associations as contemplated in the scheme.

15.3.9 On its completion, this should be further scaled up by incorporating Local Integrated Water Resources Management (LIWRM) in all GPs of the State in a phased manner starting with over-exploited and critical blocks at the block and district level.

15.3.10 Women-led Self-Help Groups (*Jal Sahelis/ Pani Panchayats*) at the GP level should be formalized with the support from State Rural Livelihoods Mission (SRLM) to make this a long-term sustainable effort. A lead Implementation Agency (IA) and/or a Capacity Building Agency (CBA) should be identified and involved for every district which can build the capacities of the women-led SHGs.

15.3.11 *Increasing Water Use Efficiency (WUE) in Irrigation*: Methods like aligning cropping pattern with natural resource endowments, micro irrigation (drip, sprinkler, etc.), automated irrigation operations, evapo-transpiration reduction, etc., should be encouraged and incentivized.

15.3.12 *Rainwater Harvesting*: In urban areas, roof top rainwater harvesting systems should be made mandatory for buildings along with 'Combined Recharge System' that should be implemented on priority in all urban and peri-urban areas. For rural areas, there should be a focus on systematically identifying, mapping and rejuvenating all traditional water storage structures through a GIS system. It is essential to leverage the *Mahatma Gandhi National Rural Employment Guarantee Scheme* funds wherever possible. This is especially critical and essential for the Bundelkhand and Vindhyan regions.

15.3.13 Recycle and Reuse of water, including return flows, should be the general norm. There should be an incentive for using treated effluents for irrigation, as it would exert lesser pressures on groundwater irrigation.

16 Management of Floods and Droughts

16.1 Floods: The State Context

All the major eight rivers in the State (Ganga, Yamuna, Ramganga, Gomti, Sharda, Ghagra, Rapti and Gandak) bring devastating floods annually and impact millions of lives. About 2.7 million hectares of productive land, other properties and infrastructure are impacted. Estimates suggest that more than 30 percent of the total geographical area in the State is flood prone in 23 districts – 12 districts in the Eastern, Western and Central regions of U.P and rest in the other regions. So far, efforts for flood management mainly consist of 2162 km of marginal embankments, 13825 km drains and 66 town protection works till 2008-09 providing protection to about 1.95 million ha. An effective flood management calls for a holistic approach for structural and non-structural interventions at the basin level. The State is also experiencing frequent episodes of deficient rainfall and droughts, which has affected the surface storage, soil moisture and groundwater recharge. Apart from decline in rainfall, the precipitation pattern has also become highly erratic with frequent extreme rainfall events.

16.2 Recommended Strategies

The strategic shift envisaged under the IWRM approach in flood management is to shift from the 'Reactive mode to Preparedness mode' using latest flood forecasting science and technology and early warning systems, including the capacity building for Community and Impact Based Early Warning Systems. The strategies for managing floods need to include:

16.2.1 Urban Flooding and Storm water Management and Climate resilient water infrastructure:

As the State is rapidly urbanizing and developing, the urban flood management assumes high importance. Effective storm water management is hence a key pillar of urban flood management and water conservation. The storm water should be protected as close to the source as possible, by infiltration to the groundwater where the soil conditions and depth to groundwater permit. If this is not possible, water quality should be protected via in-system approaches before it enters into the receiving water bodies. Re-use of storm water runoff for supplementing water requirements by the household, commercial uses, street landscaping and parklands should be factored into storm water management design and planning. The strategy under the Draft Uttar Pradesh Water Policy, 2020 (UPSWP) emphasizes that every city to strategize 'retain and release', prepare and update drainage maps, analyze

spatial and temporal changes over the years and develop plans to rejuvenate, restore and reconnect drainage systems. The cities are also required to develop flood models using high quality expertise initially for more vulnerable cities by integrating possible scenarios of climate change.

16.2.2 In the medium term the cities need to build resilience and mitigate flood impacts by adopting contextual measures which includes:

- *Retain and release plans and progressively build Sponge Cities by integrating nature based solutions and leverage blue-green- grey infrastructure.*
- *Make flood bypasses and diversion canals.*
- *Construct wetlands and storm water parks.*
- *Design all structures, including recreational areas, utilities, play grounds to be climate resilient and allow storage to reduce peak run-off.*
- *Strengthen resettlement and rehabilitation measures.*

The other strategies for the management of floods include: Promoting a "*Cascade approach*" to incentivize rainwater harvesting, storm water storage, which inter-alia has to include revival of traditional water harvesting structures, water bodies and protection, conservation and management of flood plains and urban water bodies. Water resource resilience in the State should be strengthened by integrating the principles and safeguards of climate resilience in planning and designing of irrigation and water storage-supply infrastructure; Inter-basin transfers after due environmental, economic and social impacts assessment. Flood forecasting is very important for flood preparedness and the services of Flood Management Information System Centre (FMISC) should be expanded extensively across the State linked to forecasting and climate models.

17 Managing Droughts

17.1 The context of Droughts in the State

With spatial and temporal variability, some regions such as Bundelkhand-Vindhyanchal in Uttar Pradesh are often prone to droughts. The risk of drought or drought like situation should be avoided by preparation and planning involving watershed management and rainwater harvesting techniques as well as diversification of livelihoods to improve resilience. Innovative drought management through financial instruments such as insurance may be considered.

17.2 Recommended Strategies

The interventions in the drought prone regions in the state should include drought proofing strategy involving village level water budgets and water security plans, restoration and rejuvenation of water structures, watershed based soil moisture management, groundwater recharge and program convergence; participatory aquifer management and strengthening systems of community regulation and promoting a

drought resilient land use, vegetative and agronomy practices. Programs like MNREGA with CSR could be converged to launch a 3-5 years drought proofing strategy and action plan.

Specific strategies for addressing droughts in the State should include:

- Focus on surface water storage through rejuvenation of traditional water bodies after systematic identification, mapping and geo-tagging of reservoirs. Participatory community-based maintenance of reservoirs should be promoted.

- Targeting improvements in water retention capacities through effective catchment area treatment.

- Preparation of Gram Panchayat-level water budgets and water security plans for rationalizing water usage, increasing water-use efficiency and promoting participatory micro-level water management.

- Promotion of climate smart agriculture practices, integrated farming systems and less water-intensive crops should be through appropriate drip-to-market corridors.

- Facilitation of Artificial Groundwater Recharge in drought-prone blocks by injecting rainwater into the existing subsoil water table with due care to avoid possibility of aquifer pollution. This will prevent overexploitation of subsoil aquifers and increase water availability during droughts.

- Water use efficiency is critical and maximization of drip and sprinkler should be mainstreamed throughout the Vindhyanchal and Bundelkhand regions.

18 Water Pricing and the Role of Private Sector

18.1 Water Pricing

Water pricing is one of the important strategies to attain efficiencies in water use and management. Scientific pricing strategies are also important for sustainability of investments to attract private investments.

18.2 Recommended actions and strategies

Accordingly, following principles and strategies by way of IWRM are suggested to be of strategic value. The major objective of the pricing strategy is to improve the productive efficiency of agencies and utilities, water use efficiency at the users' end, sustainable water resource management and efficient allocation at the supply-side demand to achieve financial sustainability of investments. It will also facilitate an inclusive and progressive pricing regime. Wherever water is targeted and subsidised on considerations of the State, such subsidies will ring fenced and transferred every

year. The system of subsidising, the inefficiencies of the service providers will be dispensed with. The tariff setting will necessarily consider the performance efficiency and utilities' and the need to develop the timeline and action plan to achieve SMART performance benchmarks. The following specific strategies is suggested for adoption.

- In case of water pricing for irrigation purposes, before moving to volumetric determination, rates to be determined based on per irrigation in the area.
- Recycle and reuse of water, after treatment to the specified standards, could be incentivized through a properly planned tariff system, in which there is a cost for the quantity withdrawn, a refund for treated water returned for reuse, and heavy fines for discharge of polluted waters.
- The principle of differential pricing be followed for the pre-emptive uses of water for drinking and sanitation and for ensuring food security and livelihood of the poor. Available water, after meeting the above needs, should increasingly be subjected to pricing on economic principles.
- Heavy under-pricing of electricity leads to wasteful use of both electricity and water. The overexploitation of groundwater should be minimized by regulating the use of electricity for its extraction. Separate electric feeders for pumping groundwater for agricultural use should be considered.
- Public procurement of less water intensive crops like millets in the drought-prone water-stressed regions be taken up by State at reasonable Minimum Support Prices (MSPs), to incentivise willing the farmers for a crop shift from paddy and sugarcane. There should be zero-pricing (cost recovery for an assured basic minimum service of rural water supply in the State). All the households can be provided a metered FHTs. Urban drinking water and sewerage pricing could follow the differential and telescopic tariff system to recover full O&M costs, while protecting the interests of the urban poor. The tariff should be set on a normative and scientific basis taking into account the operational costs and costs of capital.
- Tariff setting both for irrigation and drinking water should be one of the mandates of the Uttar Pradesh Water Management Regulatory Commission.
- Water Users Associations (WUAs) be given statutory powers to collect and share a portion of water charges, manage the volumetric quantum of water allotted to them and maintain the distribution system in their jurisdiction.
- A progressive water tariff structure to be adopted following a normative and transparent manner taking into account the contextual and socio-economic conditions of the State. Water tariff issues for irrigation from surface and

ground water needs to be resolved. The decentralised local governments can be encouraged to recover costs and maintain the assets. In the medium term, capital investments should continue to be dominantly funded and Operation and Maintenance cost to be fully recovered following an appropriate pricing model, protecting the rights of the Scheduled Casts and Scheduled Tribes, the poor and marginalised.

19 Private Sector Participation and IWRM

Currently, water sector financing in the State is fragmented and disorganized. Over 90 percent of the investments are going to finance capital expenditure with a very little for O&M and for asset management, leading to unsustainability of investments and service delivery weaknesses. As such, the State is in a difficult position of maintaining the assets already created and simultaneously expanding service delivery to the unreached and underserved. This should be coupled with poor cost recovery and institutional inefficiencies, that makes it necessary to review the financing architecture.

19.1 Recommended actions and strategies:

The IWRM approach emphasizes on the following strategies to mobilize financing and private sector participation like:

In order to expedite the development of water infrastructure and for improved services in the water sector, the participation of the private sector through PPP model can be actively sought in the planning, financing, development and management of water infrastructure projects and for projects for last-mile delivery. The State needs to enable an ecosystem conducive for private sector participation. It is viewed that with the involvement of private sector through: inclusive business models, innovations in technology, alternate financing mechanisms, management expertise for improved efficiency, improvement in quality and cost effectiveness of water services can be achieved.

For efficient implementation and management of water related infrastructure projects, new financial and implementation models including those that have been piloted by the Central Government and International agencies for example; the Hybrid Annuity Model (HAM), and others, such as performance based contracts, pay for success models, blended finance mechanisms etc. can be pursued as appropriate.

These financial models could be applied to wastewater treatment projects, pumped storage schemes, large lift irrigation schemes, water treatment plants, water distribution systems, wherever feasible. In the case of new water projects, where possible, levy of appropriate user charges or water and sewerage taxes to ensure full recovery of operations and maintenance costs (O&M) and partial recovery of capital costs should be pursued for exploring Build-Operate-Transfer PPP models. There can

be an endeavor to develop wastewater reuse markets, which would also make projects more commercially viable and sustainable in medium to long term. In order to give an impetus to this strategy, the State government intends to draft a '**Wastewater Reuse Policy'**.

For additional investment needs, the State and Urban Local Bodies should explore the feasibility of Municipal Bonds by drawing lessons from wherever such bonds have been floated for water works. In case of a water project serving more than one municipal area, pooled financing mechanism may be considered for issuing the bond and debt servicing;

In order to realize the objectives of securing additional financing for accelerating the improvement and expansion of investment and service delivery in the water sector, setting-up a State level Financial Intermediary as a Special Purpose Vehicle (SPV) may be considered. Such an intermediary agency would leverage resources from international development financial institutions, commercial lending institutions and capital markets. This entity can also work to finance projects, which cannot be financed by an individual local government.

Municipal Bond: Initiative under Process

- In Uttar Pradesh, the Municipal Corporations (MC) of Lucknow and Ghaziabad Nagar Nigam are at an advanced stage in the preparatory process for issuing municipal bonds. While Lucknow (MC) is proposing to use the proceeds of the proposed INR 200 crores bond to finance housing projects and other infrastructures. Ghaziabad is planning to raise about INR 150 crores to finance a wastewater reuse project.

- Ghaziabad Nagar Nigam is raising finances to the tune of INR 234.61 crores Project for upgrading existing 56 MLD Sewage Treatment Plant (STP) at Indirapuram in Ghaziabad District and setting up a new 40 MLD tertiary sewerage treatment plant to supply treated wastewater for use by Sahibabad Industrial Area which includes dyeing and printing, iron and steel, plastics, chemicals and fertilizers, pharmaceuticals and food industries. About 90% of the groundwater is utilized for industrial purpose, which endangers the water table in the area. The proposed project will supply industrial grade tertiary treated STP water to industries where it is feasible to use this quality of water.

20 Institutional Restructuring and Reforms

In order to realize the Vision under the IWRM to transform the State from a water stressed to a water secure State; a new knowledge based transparent and participatory governance and institutional framework that strives for mainstreaming IWRM at all levels of water planning with a basin level approach, is needed. Such a framework also needs to confirm to the people's aspirations of democratization of water governance, wherein their elected representatives are made accountable for water management decisions.

In view of the need for this conscious shift, a new Jal Shakti Mantralaya has been created in Uttar Pradesh and will be restructured based on basin level institutional mechanism consisting of eight basins. As part of this restructuring, the sub-basin level decentralized governance framework will co-opt the three pre-existing institutions. The Water User Associations (WUAs) have been formed under the Uttar Pradesh Participatory Irrigation Management Act, 2009, for managing irrigation water supplied to them within their command areas. The Watershed Committees, registered as societies, formed at village level for active participation during preparation and implementation of watershed projects are also responsible for maintenance of works, post project completion.

The Village Water and Sanitation Committees (VWSCs), formed as sub-committees of Gram Panchayats, for managing drinking water distribution and maintenance of systems have been handed to Gram Panchayats. In addition to this, a fourth institution at the local level would be created. The Village Water Security and Management Committees are proposed to be established in areas outside major and medium project commands. These Village Water Security and Management Committees will be empowered to plan and participate in the development of local IWRM. The Gram Panchayat Ground Water Sub-Committee, Block Panchayat Ground Water Management Committee and District Ground Water Management Committee would be constituted as per Uttar Pradesh Ground Water (Management and Regulation) Act, 2019 and Uttar Pradesh Ground Water (Management and Regulation) Rules, 2020. For the urban areas, Municipal Water Management Committee would be constituted for effective management of groundwater in the State.

21 Conclusions

IWRM is regarded as a guiding formula for solving water related problems which are extremely complex in a large and populous state such as Uttar Pradesh. The National Water Policy, 2012 has embraced IWRM and India's commitment to SDGs including SDG 6 and it can only be fulfilled if states ensure IWRM based water governance. In this paper, the current status of IWRM in the State of Uttar Pradesh through desk research and diagnosis and stakeholder interviews was carried out. The analysis through the lens of policy and legal evolution in the state of Uttar Pradesh using fifteen key dimensions of IWRM that are contextual to water challenges scenario in Uttar Pradesh has enabled a set of early recommendations that can be further deliberated and evolved by the policy and decision makers as well as the non-government stakeholders interested in mainstreaming IWRM.

A thorough review of the policy and legal framework has shown that all the key dimensions of IWRM are not reflected in the existing framework in Uttar Pradesh State and the current schemes are largely sectoral and disjoint from the integrated approach. A few elements that could help in achieving IWRM such as the establishment of SWaRA and the new Jal Shakti Ministry add to the hope in the institutional framework in place. Despite Basins and sub-basins being considered as the spatial unit of water management in the State at the both institutional and project level, the establishment of Basin level Authorities is a far and distant task yet to be accomplished. The State lacks participatory approaches and equity and social dimensions of water management are often ignored in various large water sector projects.

Currently, the six stakeholder departments are dealing with multi-dimensional water challenges in their own ways and share the responsibilities for water management in the State. The lack of a unified vision, fragmented planning and lack of coordination among these departments have been the key concerns for improving water management in the State. The IWRM would fill this gap by providing a unified long term Vision, Guiding Principles and a set of approaches that will be fundamental to the management of all water resources in the State and shall be integrated and applied uniformly by all the line departments for the management of water resources. The Vision of the State under the IWRM is to transform the State from water stressed to a water secure and resilient State. All the water management and governance decisions need to be uniformly guided by this Vision.

A set of fifteen thematic recommendations under this study on mainstreaming IWRM provide a detailed outline of the areas that are in need of strategic interventions. However, the overall objective of the National Water Policy-2012 is to mainstream the Integrated Water Resource Management (IWRM), climate resilience and adaptation into the sector specific policies and decision making processes. IWRM is a process for co-ordinated planning and management of water, land and environmental resources. It takes into account the availability of water (surface and groundwater), water use, water quality, environmental and social issues as an integrated (combined) to ensure sustainable, equitable and efficient use of water resources. Another key aspect of IWRM is the participation of people in decision making where decisions are decentralised. The stakeholders need to work together to achieve the overall and specific objectives under the IWRM.

The realization of Vision and the objectives are guided by the five Principles that underline the overall water resource management strategy under the IWRM. Foremost, the principle of the unity of hydrological cycle that treats surface and groundwater as one and recognizes their hydrological linkages are to be taken into account to inform the decision making processes and while managing them at the basin level. The other cardinal principle is that the State's water resources are a common heritage of people to be held in public trust by the State Government and its functionaries to ensure that water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner, for the benefit of all persons, and in accordance with the constitutional mandate. Inclusion of this principle into the water management in the State will also be in conformity with the Draft National Water Framework Bill, 2016 of the Government of India. The other three principles relate to equity, social justice and good governance, recognizing water an economic good, participatory and consultative approaches, gender sensitive planning and implementation of water resources projects.

The operationalization of these principles will be achieved by harmonisation and coordination of policies and programmes, by mainstreaming IWRM at the basin level planning, convergence, institutional restructuring and coherence, stakeholders participation, regulatory support, financing and private sector participation, effective monitoring and evaluation, progressive adoption and application of science and technology, into a framework for action.

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About the India Water Partnership: IWP is a non-profit organisation with the goal of propagating, promoting and supporting Integrated Water Resources Management in India. It has also been accredited by Global Water Partnership (GWP) with its headquarters at Stockholm, Sweden as Country Water Partnership. IWP Vision is **"**A Water Secure India [with participation of all stakeholders]" and Mission is "Sustainable and Inclusive Water Management at National, Regional, River basin/ Sub-basin and Local Levels in India." IWP works towards water security in India by following the concept of Integrated Water Resources Management (IWRM). It engages in a dispassionate analysis of various water-related issues and steers the policy discourse on social, economic, and ecological issues on a scientific basis.

About the Indian Environment Law Organization: Indian Environment Law Organisation (IELO) is a law firm dedicated to the evolution and progressive development of environment and development laws through. IELO's mission is to make development more inclusive, equitable, sustainable and benign, with committed legal services in the field of natural resource law and environmental law. IELO strives to bring to the fore critical environmental concerns and imperatives so that these are incorporated in the development policies and laws of the country.

IWRM Initiative: The Project "Mainstreaming Integrated Water Resources Management in Uttar Pradesh" sets out beginning of the efforts to map, document, identify and diagnose the policy and institutional impediments for the successful achievement of SDG 6.5 in the national, sub-national and trans-boundary contexts. The Initiative is aimed at locating entry points and approaches that would be helpful in reducing water conflicts and enhance water risk resilience especially among vulnerable communities such as fisher-folks and grazing communities who are often left out of any policy or planning on water infrastructure or distribution. The Project, through intense policy analysis and extensive multi stakeholder surveys and engagements promotes the dialogue and public-policy interface dialogues for the evolution of a roadmap towards equitable IWRM. Through this initiative IWP and IELO intend to cover many more states to understand the critical bottlenecks, best practices and strategic entry points around IWRM in the country to promote learning and exchange.

Feedback and suggestions may be sent to:

Ielo.indialaw@gmail.com
iwpneer@gmail.com