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ARTICLE

Adaptive governance in a changing climate situation: exploring a practical approach to manage depleting water resources in Gurgaon, India

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Abstract
Adaptive governance is an emergent form of environmental governance in the face of the complexities and uncertainties associated with climate change. This article highlights its importance in the context of the water sector which has witnessed an impact due to changing scenarios. The key drivers and dimensions in adaptive governance are discussed using a case study in the villages of Haryana. Though there is no 'one size fits all' solution, the study helps to examine the practical tools used to implement adaptive governance. Objective indicators can be complemented to further understand its benefits in a context-specific situation.

Keywords Adaptive governance · Participatory and collaborative approach · Climate change · Ground water · Accountability · Bridging organization

1 Introduction

The impact of climate change is visible in terms of seasonality changes, intensity and frequency of extreme environmental conditions such as droughts, famines and floods. The resulting detrimental effects on economy and development cannot be ignored in various parts of the world. Its impact on water is widely known whether in terms of melting glaciers, water levels, its quality, water loss in soil and plants due to increase in evaporation and transpiration. The world recently witnessed the potential threat of 'ground zero' in South Africa and many more cities predicted to witness this situation in coming years. Though water is a life sustaining source and

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considered as a basic human right, however its governance in view of the climate change is a matter of concern for various policy-makers, implementers, practitioners and researchers. Notwithstanding that it is a critical and limited resource and may even lead to erosion of human population, conflicts and disputes.[1] Pahl-Wostl and Ross[2] have attributed this problem pertaining to water as a governance failure rather than a hydrological base. A consensus has been reached that improving water governance is a solution to the depleting resource especially in the era of climate change and owing to the intricacies of the nature of the issue.

A particular attention is required on the ground water owing to its complex nature and depletion.[3] The traditional centralized or top-down approach is no more appropriate or relevant in the changing scenarios of climate change. According to Foster and Van der Gun,[4] improving groundwater is a long term process, but incremental advances are expected in various countries. Public awareness, their participation, mobilization of political will and required financial support is required to be secured in groundwater governance. While the state parties are expected to exercise this in order to safeguard water for future generations, they are also required to be institutionally responsible, accountable and transparent to ensure good governance. What is missing however is being adaptive in the approach. We address this concern by understanding conceptual knowledge and various approaches to water governance with a focus on adaptive governance. And secondly, we propose a practical approach to implement the adaptive governance in the context of water.

The rest of the paper is organized as follows. The following section discusses the various approaches to water governance. The next section describes the conceptual understanding of adaptive governance. This is followed by a practical tool to implement adaptive water governance using a case study. The paper concludes with a suggestion to strengthen and recognize the role of bridging organizations in adaptive governance to respond to the problem of uncertainties and extreme events.

2 Understanding water governance and various approaches

The term water governance has been characterized by various researchers from their own perspectives of various disciplines. The framework ranges from open welfare, monetary, regulatory to controlling for successful administration of water assets. Proficiency in social, environmental and financial capability is must in water

[1] Arnim Wiek & Kelli Larson, *Water, People, and Sustainability – A Systems Framework for Analyzing and Assessing Water Governance Regimes*, 26 Water Resource Mgmt. 3153 (2012).

[2] Claudia Pahl-Wostl & Andrew Ross, *Finding General Patterns in Complex Water Regimes*, 10 Regional Envt'l Change 261, (2010).

[3] Andrew Ross & Pedro Martinez-Santos, *The challenge of groundwater governance: case studies from Spain and Australia*, 10 Regional Envt'l Change 299 (2010).

[4] Stephen Foster & Jack van der Gun, J., *Groundwater Governance: Key Challenges in Applying the Global Framework for Action*, 24 Hydrogeology J. 749 (2016).

administration.[5] This has been strengthened by Conti and Gupta[6] to use the principles related to these three legs as common terminology while understanding water governance leading to sustainable development goals. Kuzdas explains a broader notion of water governance focusing on the stakeholders involved directly and indirectly with water.[7] Wiek and Larson[8] have documented key principles of sustainability in water governance featuring social-ecological system integrity, water resource efficiency, water for livelihood, collaborative efforts of various stakeholders for socio-ecological civility, equitable distribution of water for inter and intra-generations, collaboration beyond physical boundaries and prevention and mitigation strategies for shortage of water. Thus it is clear that effective water governance requires a holistic, coordinated and comprehensive approach. While collaborating with various stakeholders; the importance of leadership, representatives and legitimacy cannot be ignored.[9] This can be achieved by understanding gaps in policies, objectives, information and capacities.[10]

It must be noted that the water governance must not be confused with government activities or management activities. The difference often cited between water governance and water management is that the governance is the rules or guidelines to ensure how water is allocated while management is concerned with the application of these rules. It is understood that the traditional top-down or command and control approach in water governance is required for effective administration in order to satisfy the requirements of the users. It is also important to maintain the environment quality. However, this approach does not address the instabilities connected with the climate change and thus neglects to address the issue in the shifted contextualized circumstance. There are natural political issues coupled with lack of coordination amongst various departments, feeble functioning and execution, distant realities from grassroots and social treachery.

Another approach is participatory and bottom-up wherein a group of individuals and informal communities work together on water issues. Several such cases have emerged in Andhra Pradesh and Maharashtra. However, such decentralized methodology faces practical issues especially when the group turns out to be just a number with no clear responsibilities and outcomes.[11] Lack of skills and capacities of communities to manage the organization or address the concerns is often a hindrance to the success of this model. This result in losing interest in such structures formed to manage water issues and eventually people are not able to sustain such

[5] Stephen Foster, Hector Garduño, Albert Tuinhof, & Catherine Tovey, Groundwater governance. Conceptual framework for assessment of provisions and needs (2010).

[6] Kristin I. Conti & Joyeeta Gupta, *Global Governance Principles for the Sustainable Development of Groundwater Resources*, 16 J. of Int'l Env't Agreements 849 (2015).

[7] Christopher Kuzdas et al., *Sustainability Appraisal of Water Governance Regimes: The Case of Guanacaste, Costa Rica*, 54 Envtl. Mgmt. 205 (2014).

[8] Weik, *supra* note 1.

[9] Pahl-Wostl, *supra* note 2.

[10] Joyeeta Gupta et al., *Policymakers' Reflections on Water Governance Issues*, 18 Ecology & Soc'y (2013).

[11] Cynthia Morinville & Leila M. Harris, *Participation, Politics and Panaceas: Exploring the Possibilities and Limits of Participatory Urban Water Governance in Accra, Ghana*, 19 Ecology & Soc'y (2014).

organizations. Other areas of concern are lack of funding, information flow and disconnect between the users and the government institutions. Thus sustainable water governance needs better understanding from both conceptual and practical approach.

Privatization in water governance is believed to be another alternative to answer inefficiency and ineffectiveness of top-down and bottom-up approaches. There are a few successes in developed nations but failures have been highlighted in developing countries.[12] There is often a mis-match in technologies adopted by the private companies and what is required at the ground level. Moreover, interests of the water users are often neglected by private companies. There is also an issue of maintenance while the technology is provided at the grassroots and it is often found that the provisions done by companies lie unutilized in dilapidated conditions. Values, ethics and transparency must form an integral part of any form of water governance.[13]

Water governance encompasses legal, regulatory, administrative, institutional, ecological, social, technical and other aspects to address water challenges. Wiek and Larson[14] has provided 'systemic perspective' involving all these cross-cutting domains by understanding cause-effect of each of the activity in a defined geographical unit. It is clear that water governance is multi and inter disciplinary in orientation.[15] Additionally, the dynamics of urban water governance needs to be analyzed by understanding the interplay between various actors in urban water regimes.[16] A paradigm shift is made towards Integrated Water Resource Management (IWRM) which has potential benefits but it may not be perceived as an instant solution due to inherent problems again in uncoordinated, sector-dominated and competitive water governance approaches.[17] Execution of IWRM in itself has institutional barriers and complexities. Green[18] advocates a more flexible and multi-level governance which is adaptive, fosters innovation and facilitates communication between various entities.

3 Characteristics of adaptive governance

The term adaptive governance was coined by Dietz.[19] They proposed inclusive dialogue between water users, nested institutions, mix of market and state based and institutional designs that facilitates learning and exchange of information. It has been argued that the polycentric governance results in higher outputs in environment

[12] Karen Bakker, Privatizing water: Governance failure and the World's Urban Water Crisis (2010).

[13] David Groenfeldt & Jeremy Schmidt, *Ethics and Water Governance*, 18 Ecology & Soc'y (2013).

[14] Weik, *supra* note 1.

[15] Eduardo Araral & Yahua Wang, *Water Governance 2.0: A Review and Second Generation Research Agenda*, 27 Water Resource Mgmt. 3945 (2013).

[16] Maryam Nastar, *What Drives the Urban Water Regime? An Analysis of Water Governance Arrangements in Hyderabad, India*, 19 Ecology & Soc'y (2014).

[17] Racheal A. Mcdonell, *Challenges for integrated water resource management: How do we provide the knowledge to support truly integrated thinking?*, 24 Int'l j. of Water Res. Dev. 131 (2008).

[18] Olivia O. Green et al., *EU Water Governance: Striking the Right Balance between Regulatory Flexibility and Enforcement?*, 18 Ecology & Soc'y (2013).

[19] Thomas Dietz et al., *The Struggle to Govern the Commons*, 302 Science 1907 (2003).

rather than monocentric governance.[20] Adaptive governance is considered essential during periods of abrupt change.[21] This flexible approach helps to cope up with the uncertainty under changing climatic scenarios which is being witnessed these days.[22] Adaptive governance essentially involves various stakeholders to participate in a collaborative manner to manage environment at multiple scales. The literature on adaptive governance represents resilience and provides opportunity for innovation.[23]

Such type of governance seems difficult to implement owing to multi-level governance structures, increase in cost and lack of communication. However, networks developed through cross-linkages helps to mobilize resources and enhance communication.[24] Other issues can be addressed by strong coordination and information flow in all directions. Yet other arguments made in the practical execution of adaptive governance are the engagement of all the stakeholders, building trust amongst them and adopting their learning behaviors. This can be resolved if the material interests of the stakeholders are recognized and addressed. Stakeholder analysis is a powerful tool to understand various actors, their interests, social and political dynamics and the relationships between them.

Meaningful public participation and collaborative measures undertaken can be effective to respond to changing needs.[25] This has many benefits as it enhances transparency and accountability by involving public in planning and decision-making. Quality decisions are taken with consensus as expert opinion is involved thus fostering better relationship, trust and skill development. This however requires effective communication[26] and development of regulatory framework.

Another important in implementation of adaptive governance is the capacity building of all the stakeholders to achieve the desired outputs. Skills and resources are required to anticipate or respond to economic, environmental and social stressors.[27] Informed social change can be brought about by creating co-productive capacities bringing in scientific knowledge and localized knowledge and practices.[28]

[20] Jens Newig & Oliver Fritsch, *Environmental Governance: Participatory, Multi-level – and Effective?*, 19 Envt'l pol'y & governance 197 (2009).

[21] Pahl-Wostl, *supra* note 2.

[22] Anita Foerster, *Developing Purposeful and Adaptive Institutions for Effective Environmental Water Governance*, 25 Water Resource Mgmt. 4005 (2011).

[23] Duan Biggs et al., *Are We Entering an Era of Concatenated Global Crisis?*, 16 Ecology & Soc'y (2011).

[24] Brian C. Chaffin et al., *A Decade of Adaptive Governance Scholarship: Synthesis and Future Directions*, 19 Ecology & Soc'y (2014).

[25] Joshua Roberts & Juan Carlos Sanchez, IUCN: Transboundary Water Governance Adaptation to Climate Change (2014).

[26] Yorck von Korff et al., *Implementing participatory water management: Recent advances in theory, practice and evaluation*, 17 Ecology & Soc'y (2012).

[27] Yvette Bettini et al., *Exploring Institutional Adaptive Capacity in Practice: Examining Water Governance Adaption in Australia*, 20 Ecology & Soc'y (2015).

[28] Lorrae E. van Kerkhoff & Louis Lebel, *Coproductive capacities: rethinking science-governance relations in a diverse world*, 20 Ecology & Soc'y (2015).

To implement adaptive governance, 'how' is the question. In order to reflect upon this, there is a need of more action work to understand the interconnectedness of the dimensions in adaptive governance. We explore a study from Haryana region in India. District Gurugram in the state has substantial water challenges and there is a huge dependence on ground water which is getting depleted due to climate change. The study will be considered as a practical toolbox to understand the concept of adaptive governance. The focus will be on rural areas considering its complexity and multi-faceted characteristics.

4 The location of the study

Out of total usable water, the share of ground water is 433 billion cubic meter per year in India. The rainwater contributes 68% to the country's annual ground water recharge. Climate change is putting a strain on this resource due to change in rainfall patterns. The Central Ground Water Board has found a substantial fall in 76% of Haryana region.[29] Gurgaon district faces major water challenge which is primarily dependent on ground water. The overexploitation of ground water has labeled district under water stressed condition in terms of availability of water in future. The climate of the district may be classified as tropical steppe, semi-arid and hot. The change in climatic condition has resulted in change in the frequency and spread of annual rainfall in the region which is about 596 mm spread over 28 days. The annual replenishable ground water resource in Gurgaon is 23261 ham while net annual groundwater draft is 53927 ham.[30] To ameliorate this gap, the need is to be flexible and adaptive in approach in terms of water governance.

The study is located in the rural setting in District Gurgaon, State of Haryana in India. Two villages, Abheypur and Sehjwas in District Gurgaon have been taken up as the case. Both the villages lie in the Sohna block that occupies eastern part of Gurgaon district in the state of Haryana. The villages are located at foothills of Aravallis and connected by Sohna road to the highway. As mentioned above, it is mainly a semiarid zone. Although the connectivity to highway is good, the transport facility in the village is very poor. The total population of the village Abeypur is reported to be 4164 of which 2211 are males while 1953 are females covering 703 households of the village as per the census of 2011. The Sehjawas village has a population of 2162 of which 1162 are males while 1000 are females with a total of 414 families residing. In Abheypur, village population of children with age 0–6 years is 688 which makes up 16.52% of total population of village while that in Sehjawas is 294 making upto 13.60% of the total population. The literacy rate of Abheypur and Sehjawas is 78.05% and 80.84% respectively with male literacy rate as 87.40% and

[29] Ministry of Water Resources, Government of India, Report of the ground water resource estimation committee (GEC 2015) (2017).

[30] Central Ground Water Board, Government of India, Gurgaon District at a Glance (Feb. 8, 2019, 11:02 AM), http://cgwb.gov.in/District_Profile/Haryana/Gurgaon.pdf.

female literacy rate as 67.81% in Abheypur and 90.43% as male literacy rate and 69.71% of female literacy rate in Sehjawas.

5 Methodology

A qualitative research design is adopted in this study using case study method.[31] The philosophical underpinning of this approach is based on the constructivist paradigm which recognizes the significance of the subjective human perception without rejecting notion of objectivity.[32] Six primary sources of data as established by Yin[33] were used while conducting the case study: documentation, archival records, interviews and focus groups, direct observation, participant observation and physical artifacts. The approach is responsive to stakeholders' needs and local situations. Special emphasis was given to ensure that the information is collected from diverse groups including women, youth and elderly of all caste and income levels.

6 The changing scenario in the villages due to climate change

The impact of climate change on groundwater resources in the villages under study is evident in terms of its influence on precipitation amounts, high rainfall intensity, low groundwater levels, saline intrusion, deep digging of bore-wells and various other indirect impacts. This change is witnessed by the villagers especially the elders who share the situation of water levels in wells and ponds. Ground water is the only source for the villagers for drinking, household and agricultural purposes. Due to low rainfall and resultant impact on the water, residents in both the villages have changed their livelihood practices from agriculture and prefer doing job work in the vicinity in Gurgaon city. The water quality in the area is poor with bacterial contamination and high Total Dissolved Solids (TDS). The villagers use submersible and the water available is at 21 to 27 meters below ground water level. Following the draught in Maharashtra, a feedback was taken from *Gram Panchayat* (local self-government) by Navjyoti India Foundation, a non-government organization working in the area. It was found that the awareness on government water and development schemes was just 2.5 on a scale of 1 to 5. Such small awareness indicate that the prime objective with which these schemes are launched may not be met in reality and may just remain mere adornments on paper. This was followed by meeting with water users in which 70% of the 98 women members from both the villages realize that the water is adequate in their villages for various uses but also accepted the fact that water level has decreased over the years and wells and ponds have dried up. More than half of them shared that they do not participate in water plans. Around

[31] Robert K. Yin, Case Study Research: Design and Methods (1st ed., 1984).

[32] Pamela Baxter & Susan Jack, *Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers*, 13 The Qualitative Rep. 544 (2008).

[33] Robert K. Yin,, Case Study Research: Design and Methods (2nd ed., 1994).

90% were not aware of recharging groundwater. While District Council has been entrusted with providing awareness and capacity building programs, the question emerges if they have required manpower and resources to conduct these sessions directly?

These concerns in uncertainties posed by climate change and lack of awareness amongst the villages led to water movement in the region. The encouragement to harvest and recharge ground water was provided by social processes which were spearheaded by the NGO. The recharge wells and rain roof top harvesting structures, check dams, gabion structures, gully plugs were constructed in both the villages. Ponds were revived which were a mere sewage dumping site. In order to combat the impact of climate change on water, it was realized that there is a dire need to change the approach in governance due to existence of inherent complexities in the villages. Mere construction of recharge structures with the help of experts is not a magical bullet to solve the water governance issue. We below examine the efforts of people from the frameworks of adaptive governance (Table 1).

6.1 Participation and collaboration

One of the key drivers in adaptive governance is the degree of participation of all the stakeholders. The community was engaged starting from planning of the project on watershed and rainwater harvesting using Participatory Rural Appraisal (PRA) techniques. The key persons were identified and mobilized to obtain their consent. The village head man (*Sarpanch*) and other ward members were oriented and resolution was taken on the plan. Women were motivated and mainstreamed in water management. Their role was shifted from mere 'water users' to 'water managers' and they organized themselves to form *Pani Police* (water police). *Pani Police* was a watch group of women who visited door to door to ensure that the water is used efficiently and not wasted. Simultaneously, all the concerned officials at Block level and District administration such as Block Development and Panchayat Officer, Public Health Department, Block Education Officer, District Education Officer, Deputy Commissioner, Additional Deputy Commissioner were informed about the program in writing.

The tools used for communication other than PRA were persuasive communication, instilling the consciousness amongst the community and connecting the local beliefs and traditions with the changing scenario. Reconnaissance survey and transection walk was done by the community to identify the potential sites of water recharge. Special efforts were made to co-opt the community from lower caste and low income groups. Stories were narrated by the elders who shared at various platforms how there have been changes in the rainfall patterns and the visible climate change impacting the ground water level.

Collaboration was done with the organizations and technical experts to support in designing of the recharge structures. The facilities of labs for water quality testing and their resources were accessed to meet the desired objectives in cost effective manner. The students from these institutes were engaged in data collection and awareness drives. Collective decisions were taken to combat the problem of climate

change and its impact on groundwater. The movement additionally had support from corporates, embassies and individuals in terms of finances who wanted to reduce the adverse effects of climate change on these water scarce regions.

6.2 Capacity building and training

After the initial mobilization, focus group meetings and discussions were held with the community members. It was realized that they had limited awareness on the understanding of water issues and the need to recharge the ground water. In the village Sehjawas, the youth group in the first meeting showed their dissent on the construction of check dam as felt that the water will change its course and reach out to other village and they will not be able to avail its benefits. The experts in water sector conducted a session with them and explained the hydrogeology and the movement of water streams below the ground. The understanding of this knowledge led to contribution of youth group in contributing in cash and kind in the construction work and revival of ponds in the village.

Similarly the skills of daily wage labourers and masons were enhanced. The local community was engaged in the construction work thereby employment was generated in both the villages Abheypur and Sehjawas. The village community contributed their voluntary labour in the construction and management which fostered their ownership in the water governance.

So, capacities of all actors were enhanced and efforts directed to equip them to adopt adaptive strategies to changing conditions. The steps adopted in capacity building and training are described as follows (Table 2).

6.3 Scientific and local knowledge

Synthesis of scientific and local knowledge enhances the governance in the context of climate change.[34] This complementary approach builds mutual trust and understanding between various stakeholders. Identifying such opportunities is one of the key dimensions in adaptive governance.

In village Abheypur, there exists a traditional belief wherein the villagers restricted cutting down of trees or its branches in an area called *Dev Bani* (adobe of God). The local community regulated this while designing of check dam by technical experts as they considered that it was a habitat of their ancestors. These protected zones were critical for community to adapt to uncertainty and change. These self-enforced norms by community help to sustain biodiversity in the area and maintaining hydrological cycle. Further, the local community was willing to adapt to scientific knowledge and helped technical experts in identification of ravines based on their experiential knowledge.

[34] Kaitlyn Joanne Rathwell et al., *Bridging knowledge systems to enhance governance of the environmental commons: A typology of settings*, 9 Int'l J. of the Commons 851 (2015).

Table 1 Status of water in village Abheypur and Sehjawas *Source*: Focus group discussions with community

Parameter	Abheypur	Sehjawas
Ground water level	27 mbgl	21 mbgl
No. of government submersible pumps	12	04
No. of private submersibles and borewells (approx.)	450	110
Annual water recharge potential created by NGO	4602.73 kiloliter per year	7775 kiloliter per year

This synergistic approach in mutual learning and knowledge exchange can enable a successful outcome in the context of changes leading to adaptive governance.

6.4 Role of leadership and accountability

A key role in adaptive governance is that of leadership in order to facilitate the flow of information, maintain transparency and ensure sustainability. Key persons who were trained on climate change and effects on water organized themselves into different groups. Separate groups and informal institutions emerged which saw women leaders and youth leaders. They were different from the local government institutions that existed in the villages under Panchayati Raj Institutions. But this polycentric governance played a major role in taking the movement forward. These actors mobilized and generated resources and exchanged information flow in both the villages Abheypur and Sehjawas. It cannot be denied that there exist power relations in the complex societal setting. However, it was possible to navigate through this social and power dynamics through negotiations backed by scientific information, diversification of knowledge base and change in existing norms.

7 Conclusions

There has been an incremental shift on various approaches in water governance to respond to uncertainties and extreme events in the environment. The uncertainties may be due to various reasons such as political, socio-economic, environmental or technical. One major aspect that has evolved and has been highlighted in the review of literature is the need of more flexible and innovative approach to water governance regimes. And hence the concept of 'adaptive governance' has emerged in recent studies.

Participation of all stakeholders and collaboration is paramount in implementing adaptive governance. However, the role of government in the above case was seen to be limited to information sharing and obtaining permissions. A feedback or advisory mechanism can be set up in this network collaboration with the government. This will help to obtain valuable perspective and encouragement from the administrative and regulatory agencies while allowing decision-making at a decentralized level.

Table 2 Steps in capacity building. Adapted from Alberta Water Council (2016)

Steps	Description	Education tools used
Awareness	A basic understanding was given at village level that water issues exist and how it impacts us in the wake of climate change	Street plays, open forum discussions
Knowledge	An increasing holistic understanding of water issue – both quality and quantity, the natural systems and hydrogeology and how it impacts each other	Focus group discussions and exposure trips
Attitude	Behavioral change and appreciation for the concern of water thereby promoting conservation strategies, identifying and understanding the rationale behind local and traditional knowledge	Dialogues
Skills	Technical skills on construction of recharge structures and assembling of biosand filters to address the water quality issue in the villages, management and leadership skills to inculcate ownership	Workshops
Action	Capacity enhancement for personal and collective action	Construction of water recharge structures, assembling of bio-sand filters to promote safe drinking water, awareness and sensitization by community based groups, educational institutes

Alberta Water Council, *Recommendations to improve water literacy in Alberta*, (2016)

Capacity building, training, understanding of scientific and local knowledge form an integral characteristic of adaptive governance which cannot be ignored at community level. The local leadership and polycentric governance has advantages, but unequal power structures cannot be denied. This is where the bridging organization can facilitate social learning and deliberations amongst various actors. These enabling organizations are an essential part in adaptive governance and their roles must be recognized at policy level in changing climate situation.

More research is required to develop objective indicators to investigate the benefits of adaptive governance. This can be beneficial for policy-makers and researchers to develop a new perspective and address the gaps therein.