AGRICULTURAL WATER GOVERNANCE: SUSTAINABLE PRACTICES AND STRATEGIES

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PREFACE

Scarcity of water is chief amongst the several challenges faced on a global context, as inherently the said natural resource contributes to domestic usage, irrigation, agricultural productivity and is critical for ensuring food security. Irrigation techniques depend significantly on the availability of water, and there are diverse practices fostered, strengthened and promoted by local communities. As per a press release by the Press Information Bureau, Government of India in August 2021, the contribution of the Agricultural Sector to India's GDP has been pivotal, despite the outbreak of Covid-19, accounting to 20.2 percent of the Total Gross Value Added.

The federal structure of the Indian administration leaves the governance of Agriculture and Water subject-matters of its various regional provinces or States. Nevertheless, the Central Government has been on its toes to supplement the State Governments through various initiatives such as Micro Irrigation Fund, Long Term Irrigation Fund, besides several others. Water being a core component in all agricultural activities, it should be a focal point of legal and policy research. Given the extant regulatory structures, diverse topography across the country, coming up with a comprehensive law and policy framework is cumbersome, and as such this research is directed to fulfill such objectives.

The Agri-Consortia Research Platform on Water (Agri -CRPW) granted a five-year project to the Centre for Environmental Law, Education, Research and Advocacy, (CEERA), National Law School of India University (NLSIU) on 'Discussion on Water Governance and Policy' connected with areas of Institutional and Market Innovations Governing Sustainable Use of Agriculture Water. Under the aegis, CEERA has aimed at coming up with legal discourse on means in which water use efficiency in India can imbibe from various best models. By delving into the water laws that exist at the state level, a comparative analysis has been carried out to detail the existing legal regime. This book published as one of the deliverables under the project seeks to empower institutions to increase efficiency in service delivery; fostering effective management, distribution and sustainable use of water resources.

The project has multiple objectives which include evaluating regulations, laws, rules of State and Central Governments governing water resources with respect to institutional innovations for sustainable use of water resource. Under this project, CEERA, NLSIU has studied the Cauvery Dispute, the legal and policy framework at the Central level and in twelve states *viz.* Karnataka, Odisha, Madhya Pradesh, Gujarat, Rajasthan, Maharashtra, Andhra Pradesh, Uttar Pradesh, Punjab, Uttarakhand, Kerala and West Bengal. The outcome of this was a comparative analysis, highlighting the commonalities, benefits and lacunae in the regulatory framework of water management.

CEERA hosted two in-person consultative workshops and owing to the COVID-19 pandemic, one online national seminar was organised. The two consultative workshops were hosted by CEERA, NLSIU in collaboration with Jagadguru Sri Shivarathreeshwara (JSS) Law College, Mysore on 24th March, 2021 and Vasudev Mahadeva (VM) Salgaocar Law College, Panaji on 31st March, 2021. The National Seminar was conducted online by CEERA-NLSIU in collaboration with ICAR-IIWM, Bhubaneswar, and UAS, GKVK, Bengaluru on 26thMarch, 2021. All the three events saw enthusiastic participation from various stakeholders and deliberations were made on various aspects of agricultural water use law and policies. This book includes various papers presented by resource persons in the aforesaid events.

As a pre-cursor to this book, CEERA, NLSIU had published a book titled "A Primer on Agricultural Water Use Law in India" in December 2020. And it gives us immense pleasure to publish another research outcome on the scantily researched area of Agricultural Water Use Law and Policy. This book is divided into five parts.

The first Part includes six research contributions on the theme *Analysis of Water Conservation Policies in Various Jurisdictions*. The authors of the articles under this section have presented an overview of the traditional irrigation systems in Dakshina Kannada, Udupi and Kasargod; an analysis of the Jammu & Kashmir Water Resources (Regulation and Management) Act, 2010; a Goan and Karnataka perspective along with surface water quality for irrigation and water use in peri-urban areas.

The second Part of the book comprising of two research contributions focuses on the theme *- Use of Technology in Water Conservation and Usage*. The authors in this section have analysed the Flexi-Check Dam technology for Water Conservation and Efficient Use for Agriculture and the Impact of Treated Sewage Water on Farm Economy in Kolar District, Karnataka.

The third Part of the book is on the theme *- Indian Legal Framework on Regulation of Water Conservation and Resolution of Disputes* and has eight research contributions. In this section the authors have examined the water quality in agriculture in terms of land use patterns and have also analysed the policies related to the same. Furthermore, a constitutional perspective in terms of food security and the use of water has also been analysed. Role of panchayats in implementation of water policies and schemes in the agriculture sector along with an examination of the irrigations laws have been spoken about. The interstate water disputes in India have been looked at in terms of their recent developments; and, also from a conservationist point of view and management of ground water crisis in the country has also been explored.

The fourth Part of the book is on *Water Policy for the Agricultural Sector in Light of Climate Change* comprising of three research contributions focuses on climate change, sustainable water management and agricultural sector and policies in India related to the same are explored. A brief analysis of the policy related to rainwater harvesting is also addressed by the authors.

The last Part of the book has two research contributions on the areas of *Economic Evaluation of the Efficiency of Water Projects,* wherein the authors have specifically made an economic analysis of water productivity and efficiency and energy costs in Godavari command area and Ramthal Project in Karnataka.

Coming up with a book on these research areas involved an engaging discourse with various stakeholders and the outcome is owed to a concerted team effort. In this regard, we would profusely thank all the institutions involved in the project, *viz.,* **Indian Council of Agricultural Research – Indian Institute of Water Management, Bhubaneswar** and the **Department of Agricultural Economics, University of Agricultural Sciences, Bengaluru**. In particular we would like to thank **Dr. Atmaram Mishra, Director, ICAR-IIWM, Dr. S. K. Jena, Principal Scientist, ICAR-IIWM** and **Dr. P. S. Srikantha Murthy, Professor, UAS, Bengaluru** for their collaborations.

We would also like to extend our sincere gratitude to the **University of Agricultural Sciences, GKVK, Bengaluru, JSS Law College, Mysore and V.M. Salgaocar College of Law, Goa** for their support and extensive co-operation in organising the consultative workshops on **"Agricultural Water Use Law, Policy and Management in India"**.We specially acknowledge the support and cooperation extended by **Dr. Nataraju S., Principal, JSS Law College, Mysore** and **Dr. Shaber Ali Gandaman, Officiating Principal, V.M. Salgaocar College of Law, Panaji.**

We acknowledge the rich insights of all the Resource Persons and stakeholders for their active participation and their contributions to the deliberations under the Project and for their invaluable contributions towards this publication, who include **Dr. P. Ishwara Bhat, Akhila Basalalli, Nayashree Bhosge, Dr. Arvind Jasrotia, Kartika Bakshi, Dr. G. Shaber Ali, Dr. Kim Couto, Dr. Shilpa M.L., Seemakowsar. N., Dr. Priyanka Jamwal, Dr. Sharachandra Lele, Dr. Susanta Kumar Jena, Dr. P. S. Brahmanand, N. Ramesh, Dr. Jagannath Olekar, Dr. Vani Kesari, Dr. C.N. Manjappa, Dr. Manjunatha C.S., Dr. Nataraju S., Dr. N. Sathish Gowda, Dr. Uday Shankar, Dr. G.B. Reddy, Dr. S.B. Md. Irfan Ali Abbas, Dr. Misha Bahmani, Yashdeep Lakra, Aditi Tripathi, Omkareshwar Pathak, Dr. Yogendra Kumar Srivastava, Vidya Ann Jacob, Ishita Das, Banda Sainath and M. Shivashankar Hugar.**

We would like to acknowledge the efforts of the research team at CEERA - **Madhubanti Sadhya, Rohith Kamath, Raghav Parthasarathy, Vikas Gahlot, Geethanjali K.V.** and **Lianne D'Souza,** who have supported in organizing the workshops and also in putting together this book.

October, 2021

Prof. (Dr.) M. K. Ramesh
Prof. (Dr.) Sairam Bhat

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39. S. Jagannath v. Union of India, (1997 7) 2 SCC 87 (A.P).
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41. Special Reference No. 1 of 2001, In re 6 (II). 34 (2004) 2 SCC 489.

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54. The Punjab Termination of Agreement Act, 2004, In re, (2017) 1 SCC 121.

55. The State of Karnataka & Ors., v. State of Tamil Nadu & Ors., (2018) 4 SCC 1.

56. Vellore Citizens Welfare Forum v. Union of India, (1996) 5 SCC 647.

57. Vishala Kochi Kudivella Samarkshana Samithi v. State of Kerala, 2006 (1) KLT 919.

58. Wasim Ahmed Khan v. Government of Andhra Pradesh, 2002 (5) ALT 526.

PART I

Analysis of Water Conservation Policies in Various Jurisdictions

Chapter 1
A Study of Kattas as Traditional Irrigation Systems in the Districts of Dakshina Kannada, Udupi and Kasaragod

Dr. P. Ishwara Bhat* Akhila Basalalli Nayashree Bhosge*****

Abstract

The paper in emphasizing the need for revival of traditional irrigation systems, studies the efficacy of Kattas (temporary check dam) as a reliable means of irrigation in the districts of Dakshina Kannada, Udupi of Karnataka and Kasaragod of Kerala. Kattas being temporary structures with barricade/bunds across the rivers or streams not only store water for community irrigation during summer season but also play a pivotal role in sustenance and maintenance of ecological balance by retaining moisture and increasing ground and surface water level. The empirical data indicates a few challenges associated with the traditional Kattas for which there has been a

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Sri H.P. Jayaprakash et. al., Ground Water Year Book of Karnataka, 2016-17, Govt. of India, Ministry of Water Resources, River Development & Ganga Rejuvenation, Central Ground Water Board, Bangalore, October 2017, *Also See* P. Ishwara Bhat, et. al., 'Karnataka', in Groundwater Law and Management in India From an Elitist to an Egalitarian Paradigm, Khan Sarfaraz, Puthucherril Tony, Paul Sanu (Eds.), Springer, 2021

great demand by farmers for government support in terms of finance and technical aid. The paper examines the response by the Governments of Kerala and Karnataka through several schemes and programs, prominent of which is the construction of Vented Dams (VDs). Highlighting the disadvantages of the VDs, the paper makes a comparative analysis between Kattas and VDs on parameters of being eco-friendly, disaster resistant, community led and fairly accountable. It further suggests that the regulated use of Kattas with the Government intervention and community participation increases their efficacy making them a reliant irrigation system in the districts of Dakshina Kannada, Udupi and Kasargod.

Keywords: *Katta, Vented Dams, Traditional Irrigation Systems, Water Conservation, Community Participation.*

The emphasis on traditional and alternative forms of irrigation and their revival is of great importance given the rampant water crisis in the country. The need for the revival of traditional forms of irrigation is strongly felt across Karnataka as it appears to be the viable solution to the alarming crisis. The Ground Water Year Book of Karnataka has recorded a fall in water levels in 70 percent of wells in the decade 2006- 2015 and agricultural use of the groundwater largely attributes to such depletion. There have been persistent efforts at all levels to conserve water for instance, the Ministry of Jal Shakti has stressed on the importance of rainwater harvesting, renovation of traditional water bodies and tanks, reuse and recharge structures and afforestation;[1] Prime Minister in the recent Mann Ki Baat has initiated a new 100 days campaign 'catch the rain'.[2] The National Water Policies,[3] and Karnataka State Water Policy, 2019[4] further encourage the revival of traditional water harvesting systems to solve the problem of water crisis. Such water conservation drives have provided impetus for the reversion to traditional forms of irrigation as a viable and alternative model. The paper explores the Kattas (temporary check dam) as reliable traditional irrigation model of Coastal Karnataka and vouches for their efficacy. These are classical irrigation structure predominately found in the districts of Dakshina Kannada, Udupi and Uttara Kannada of Karnataka and Kasaragod of Kerala.

1 http://164.100.68.78/gwh/GWH_Home.aspx accessed on 8/3/2021

2 https://www.pmindia.gov.in/en/news_updates/pms-address-in-the-21st-episode-of-mann-ki-baat-2-0/ accessed on 8/3/2021

3 National Water Policy, 2002, National Water Policy, 2012 & Section 7 Draft National Water Framework Bill, 2016.

4 KJA Task Group, Government of Karnataka, Karnataka State Water Policy, 2019, p. 187

Traditional Kattas

Kattas (temporary check dam) are temporary structures in the form of bunds constructed across the rivers, tributaries of the rivers and streams. The Kattas/ seasonal bunds or barricades are designed to store running water from streams or rivers for community irrigation during Rabi and summer season. They are significant means of water conservation as they hold back flowing water and let excess water flow. Traditional Kattas are mostly community irrigation system where their construction, maintenance and repair are managed by the community.

The construction of these structures requires enormous amounts of traditional skill and knowledge as the task of building a Katta begins from identification of a suitable location, processing the raw material into construction materials and ends with building barricade without breaches or leakages. Generally, the site selected for construction of Katta would be in a bottle-neck shape landform.[5] Usually, the construction takes place at the end of November or beginning of December to avoid flood and water scarcity. The traditional Kattas are mostly constructed with locally available materials like stone, mud, wild creepers, wooden poles and soil. A foundation is first constructed using locally available soil or if granite rock exists then it serves as the foundation. The barricade/bund to obstruct the water flow is constructed using stones and sticky mud. A small outlet called 'Maadu'[6](diversion channel) is left open in barricade/bund to allow the water to flow until construction of Katta is complete. After the construction is complete, 'Maadu' is closed for the water to collect. One of the remarkable features of construction is the preparation of sticky mud to bind stones in the barricade. The preparation of the sticky mud takes about a week's time as it involves kneading of the muddy mixture by feet until it gets sticky and letting it to ferment for about 3-4 days so that it acts as an adhesive to the stones while constructing the barricade/bund. To protect the slimy texture of the mud from getting evaporated, banana or areca dried leaves are used as coating agents.[7] The process of applying such mixture to the stones is a skill whereby the continuous kneading of mud by feet fills the gaps between the stones. Hence, the construction of a Katta requires enormous skill and indigenous knowledge of appropriate place, time, process and materials. However, a few innovations to the traditional design have been brought about to increase the longevity of the structures and reduce manual labour like construction using concrete

5 Chandrashekhar Yethadka, Sarani Katta Ulisikonda Yethadka, ed. by Shree Padre & Dr. Varanashi Krishnamurthy, *Kattagalu Anushodhane Mattu Varanashi Madari,* Varanashi Research Foundation & Arghyam Trust, May 2008, pp.44-50

6 *Ibid* p. 45

7 *Ibid* p. 46

planks, fibre plastic planks, sandbags,[8] lining plastic sheet to the tank, micro ring to check dam[9] in place of stones and mud to prevent washing away of barrages.[10] There have been innovations by farmers to the traditional Kattas with the use of HDPE sheet, iron sheet[11], Silpaulin sheet,[12] concwood, bison-sheet, convex sheets, and micro-ring check dams. Once the Katta is formed, the 'water spread' lasting for several months over the long basin of the stream which has rocky fissures facilitate the percolation of water into the soil effectively rejuvenating the groundwater.

The Kattas have multiple benefits not just for farmers but they are also the most effective means of rain water conservation in the Coastal Karnataka. The water from the Kattas is used for the purpose of irrigating the agricultural lands, it also provides water for the cattle and other domestic needs. The Kattas recharge water-bodies like tanks (hondas) and open wells in the surrounding areas. Another remarkable benefit of Kattas is that it recharges the water source that is located in an elevated place. Water flows from downward Katta to water sources at higher altitude due to 'capillary action.'[13] The unique construction of Kattas facilitates the percolation of water sideways and to surface thereby enhancing the retention of moisture in the surrounding areas. The birds, animals and aquatic species also benefit from Kattas adding to their ecological significance. Since these structures are of great importance due to their multiple and varied benefits, the emphasis for their revival becomes all the more relevant.

Despite Kattas being remarkable structures, they are not without challenges. The desirability of Kattas has reduced over the years due to some of the problems that grapple them. Firstly, the breach in the walls or embankments poses threat to the stability of the Katta. The very purpose of constructing Kattas gets compromised if there is any leakage because of breach. The construction has to be re-started if the problem has to be addressed.[14] The second challenge arises in the event of multiple beneficiaries of Katta when a few of them are reluctant to share the cost arising out of its construction and maintenance. The empirical data collected after interviewing one of the beneficiaries of Nereppady stream Katta reveals

8 Apa Balaga, *Hosa Aase Chigurisida Sudharita Katta,* Adike Patrike, June 2019, pp. 15 & 16.

9 Raviprasad Kamila, *Old 'Kattas' make a comeback as mini check dam,* The Hindu, Mar. 20, 2017 https://www.thehindu.com/news/cities/Mangalore/old-kattas-make-a-comeback-as-mini-check-dams/article17533135.ece

10 Karant, *Neer Nemmadige Katta Kattona,* Adike Patrike, August 2017, pp. 18 & 19.

11 Karant, *Marike Tagadina Katta,* Adike Patrike, January 2018, pp. 18-20.

12 *Supra* note 6, p. 46

13 Shree Padre, *Rain Water Harvesting,* Alter Media, pp. 34 & 35.

14 Ravishankar Doddamani, *Katta : Samasyegalu, Parihaargalu,* ed. by Shree Padre & Dr. Varanashi Krishnamurthy, *Kattagalu Anushodhane Mattu Varanashi Madari,* Varanashi Research Foundation & Arghyam Trust, May 2008, pp.91-99.

the reluctance of few among the seven beneficiaries to share the cost of the expenses.[15] It is basic tenet that the law does not support unjust enrichment of one at the cost of another. Hence the beneficiaries using Katta water are obligated to share the cost of the expenses arising out of construction and maintenance. Thirdly, the Kattas are often under the threat of crab attack, i.e. the crabs gnaw mud from the barricades/bunds thereby loosening the structures. In order to prevent such attacks from the crabs Copper Sulphate is mixed with the mud while constructing Kattas.[16] Fourthly, the construction of Kattas requires skilled labour and there has been a decrease in the availability of skilled labour over the years.[17] There have been instances where only with the intention of providing employment, a few of the women labourers were assigned for the construction of Kattas under the MGNREGA. This proved to be futile since the women labourers had neither any training to construct Kattas nor did they have any knowledge of the same.[18] Fifthly, the other set of problem faced during the construction of Kattas is the insufficiency of local construction material. The local material is to be transported from different places making the construction process far more tedious than it already is. Finally, there is excess reliance on groundwater as an alternative to the Kattas appears to the local communities as an easier means of irrigation. With the insufficiency of material, skilled labour, construction material and the reduced community participation, the shift from the use of water from traditional Kattas towards groundwater is evident.

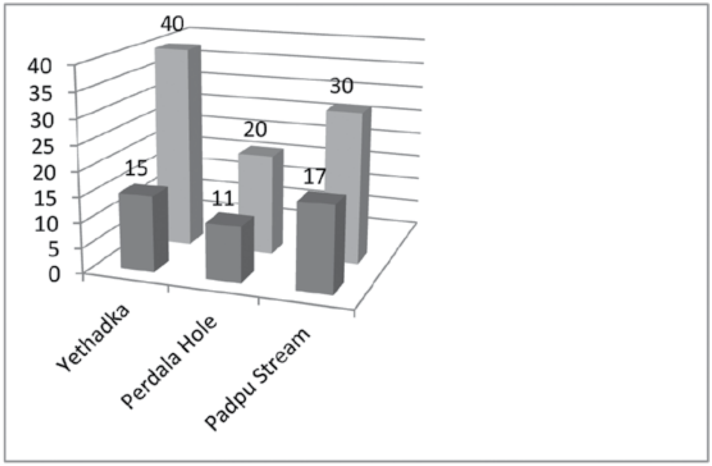
There has been a significant decline in the number of Kattas for reasons such as shifting trends of cultivation from paddy to commercial crops, use of ground water and construction of Vented Dams in the place of traditional Kattas. For instance, in Udupi especially the talukas of Karkala, Byndoor, Kundapur and Kapu have a marked decline of traditional Kattas. The charts below further the argument.

15 *Also see* Shree Padre, *Kattas and Madakas: Decline of traditional water conservation methods*, Down to Earth, 27 Feb 2020

16 *Also see* Jadadeeshchandra K., *Katta Katti Nodi,* Adike Patrike, November 2019, pp. 36 & 37.

17 Anitha Pailoor, *Water Conservation: Kattas in the coast,* Deccan Herald, 28 Nov. 2020

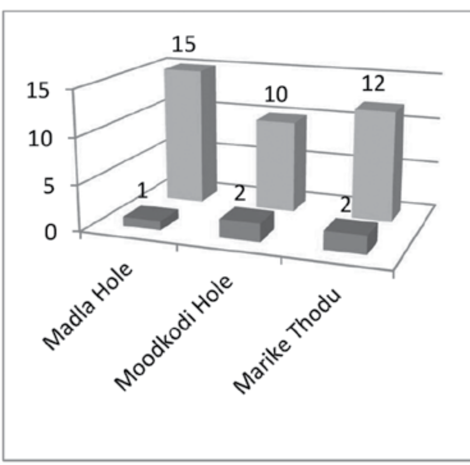
18 Interview with farmers at Yethadka



Decline in Traditional Kattas

Figure 1 Katta in Kasaragod District

x-axis indicates name of streams; y-axis indicates no. of Kattas constructed in 2020-2021, and no. of traditional Kattas constructed 50 + years ago.



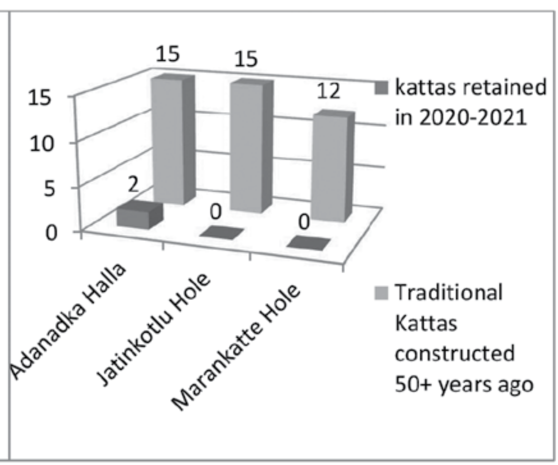


Figure 2 Kattas in DK Dist.

Figure 3 Kattas in Udupi District

1. Yethadka has retained 35-40% of Kattas.
2. Dakshina Kannada District has seen increased number of farmer innovated Kattas [19] as compared to Kasargod and Udupi.

19 For ex. two Kattas retained in Marike thodu (stream), both are farmer innovated Kattas i.e., one

3. With increase in VDs, there has been decrease in Traditional kattas in Udupi& DK Districts.

4. VD are not constructed in small streams, farmers irrigating from these streams constructed Katta[20] which are tiny check dams across the drainage channel. These are inexpensive and can be constructed in a day using areca trunk, soil and plastic sheet.

While exploring the ways to meet the challenges associated with Kattas, the interviews from the framers suggested that support by the Governments and their departments in terms of financial and technical assistance would be the way forward. Since the study is focused on the districts of Dakshina Kannada and Udupi of Karnataka and Kasargod of Kerala, the responses from the two State Governments are evaluated and a comparative assessment is made on the basis of incentives provided in support of traditional Kattas.

Responses from Governments of Kerala and Karnataka

Kerala

Kerala Government has launched several schemes for the retention of traditional Kattas and construction of new Vented Dams (VDs). The VDs are the modernized concrete structures with similar function and roles as Katta. Few of the efforts by Kerala Government are as follows:

1. Minor Irrigation (MI), Kasaragod

The MI department has constructed 263 Vented Cross Bars (VCBs) in 6 divisions of Kasaragod under the Haritha Keralam Mission[21] VCBs are generally designed in discharge areas where direct irrigation is not feasible from the streams. Vented Cross Bars are constructed across the steams with reinforced cement concrete on an average height of 2.5 m above bed level, a minimum of 2 vents and provision of wooden shutters to discharge the flood water and silt load carried during the monsoon seasons.[22] The Haritha Keralam Mission has also ensured cleanliness of streams/ rivers to curb water pollution, cleanliness drives have been initiated

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micro-ring check dam & another steel sheets Kattas, which are far more sustainable than traditional Kattas, sandbag Kattas and VDs. *See https://www.civilsocietyonline.com/rural-reporter/the-new-check-dams-of-puttur/*

20 Shree Padre, *Put in the Water, Take out the Guarantee,* India Together, 02 Dec. 2008 http://www.indiatogether.org/photo/2002/rwhpadre.htm

21 As per data available till 2014, collected from MI Department, Kerala.

22 http://www.irrigation.kerala.gov.in/index.php/infrastructure/other-mi-structures

with the help of the local self-government institutions. [23] The Irrigation Department has undertaken construction of seven check dams from 2010-2020.[24]

2. Kasargod Development Package (KDP)

The Government launched a special developmental programme for the district, known as 'Kasaragod Development Package' which was started in the year 2013-14[25]. About five rubber check dams (RCD) have been sanctioned by Kasaragod Development Package in 2019-20 and Rupees 2.43 crores has been granted for the same.[26] Rubber check dam or flexible check dam is an inflatable structure built across a stream used for water conservation, flood control and regulating flow of water in the stream. When RCD is inflated, it serves as a check dam/ weir. When RCD is deflated, it functions as a flood mitigation device and sediment flushing. The head or height of RCD is variable. According to the requirement, its height can be increased or decreased[27]. The components of a rubber dam include a concrete base and side walls. Its dimension varies from a width of 1 meter to 100 m, and height of 0.5 m to 5m. KDP's water conservation project has launched construction of 900 micro ring check dams.[28] It has also initiated projects for construction of 16 check dams, 72 VCBs and renovation of 18 VCBs since 2014-2021 costing Rs. 11247.21 lakhs[29].

3. Local Bodies

Kerala Government has also initiated schemes to promote construction of traditional Kattas, for example, a few gram panchayats had sanctioned 50% of construction costs for ten years between 2005- 2015[30]; Rs. 8000/- was sanctioned under 9th Five Year Plan;[31] Rs. 4000/- was sanctioned to Karimbila panchayat from 2008 to 2016; and 120 MGNREGA women laborers were assisting in construction of Kattas (MGNREGA scheme for construction of Kattas was discontinued three years ago as the scheme was implemented for construction work which was permanent in nature, construction of Kattas being of temporary in nature, MGNREGA scheme was discontinued)[32].

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23 http://haritham.kerala.gov.in/ininjan-ozhukatte/

24 Data collected from Irrigation Department

25 http://www.kasaragodpackage.com/index.php#about

26 http://www.kasaragodpackage.com/projects.php

27 Jena, Design and Development of Rubber Dams for Watersheds

28 SP, *Kasaragodina Ananya 'Ring Thadegottu',* Adike Patrike, July 2020 pp 26 & 27.

29 Data collected from Kasargod Development Package, Kasargod, *Also see* Shree Padre, *Rubber Anekattua,* Adike Patrike, March 2020, pp 5 -10

30 Field interview with farmers at Perdala Kattas

31 Five Year Plan from 1997 to 2002, Field interview with farmers at Perdala Kattas

32 Field interview with farmers at Yethadka, Kasaragod

The P. Prabhakaran Commission[33] was appointed to study the scope for development needs of Kasaragod especially in the light of its overall backwardness. The Commission was set up 25 years after the formation of Kasaragod. Addressing the over-extraction of groundwater, the Commission made the following observation as "problems faced due to over exploitation of groundwater can be resolved by striking a balance between drawal of ground water and its recharge. Water requirement for drinking, irrigation, etc. can be met to a large extent by adopting new approaches for optimum conservation of surface water. Over utilization of ground water and under- utilization of surface water potential are problems that call for immediate attention. Surface water which wastefully drains in to the sea is enough to take care of our drinking water and irrigation needs. Check dams should be constructed in major rivers at regular intervals to facilitate recharging of ground water."[34] The approach of Kerala Government is inclined towards revival of Kattas and construction of new VDs. Several incentives have been provided for construction of Kattas and Gram Panchayats have played an active role in disbursing the sanctioned amount. Kerala has also experimented with different designs and structures of VCB's.[35] However, viewed from the angle of the cost-benefit analysis, inclusive of construction, monitoring, maintenance, repair and renovation of VCBs , it was observed during field study at Kasaragod that despite the large number of schemes they were not implemented in letter and spirit.[36] The Report attributes these reasons for such predicament: (i) a lack of co-ordination in the functioning of Agriculture and Irrigation Departments which reduces the effectiveness of irrigation schemes; (2) low level of participation of farmers in the implementation of schemes for the development of irrigation facilities, and; (3) lack of arrangements to involve local people in the maintenance of the assets created as part of irrigation development on a sustainable basis resulting in poor efficiency.[37]

33 P. Prabhakarn Commission Report available at http://www.kasaragodpackage.com/index.php https://cdn.s3waas.gov.in/s38dd48d6a2e2cad213179a3992c0be53c/uploads/2018/05/2018050942.pdf

34 *Ibid*, p. 297

35 The Government bodies have also recognized the efforts of local farmers. For instance, Mini ring check dams was innovated by farmer from Dakshina Kannada District., this has been studied & is being scaled by KDP, Raviprasad Kamila, *Old 'Kattas' makea comeback as mini check dam,* The Hindu, Mar. 20, 2017 https://www.thehindu.com/news/cities/Mangalore/old-kattas-make-a-comeback-as-mini-check-dams/article17533135.ece

36 Field interview with farmers at Yethadka

37 Dr. P. Prabhkaran Commission Report, Report on the development of Kasargod District, October 2012, p. 51.

Karnataka

The Government of Karnataka has mostly constructed Vented Dams (VDs) in the districts of Dakshina Kannada and Udupi. The Dakshina Kannada district has seven major rivers[38] while Udupi has six.[39] Several departments and ministries, such as Minor Irrigation Department, Panchayat Raj Engineering Department and Agriculture Department have launched schemes such as Paschim Vahini[40], PMKSY-WD,[41] PMKSY-OI,[42] WDDP[43] and MGNREGA[44] for the construction of VDs. Some of the department-wise figures are as follows:

a) Minor Irrigation Department

Under Paschimvahini Scheme, 212 VDs from 2010-2020 have been completed by Minor Irrigation Department in DK District. The total funds allocated during the period of 2009-2021 to Dakshina Kannada is Rs. 54,035.31 lakhs of which A&P NABARD has funded Rs. 2659.5 lakhs, A&P has allocated Rs. 29905.75 lakhs and Pashimvahini has allocated Rs. 18811.06 lakhs.[45] The expenditure incurred for the construction of VD varies from Rs. 15 lakhs to Rs. 4670 lakhs depending on the size.[46] Minor Irrigation Department also provides storage sheds to store planks and looks after regular maintenance of the Vented Dam[47].

b) Agriculture Department

The PMKSY and Watershed Development (PMKSY-WD) is a Central Government Scheme which is implemented at State Level. Under this scheme, 60% funds were sanctioned by Central Government and 40% funds from State Government. Integrated Watershed Management Programme (IWMP) is another such scheme for soil and water conservation implemented by Department of Land Resources. In the year 2009-2010, VI batches of projects were sanctioned by Central Government. In the year 2017-18, Watershed Development for Drought Proofing (WDDP) consisting of ridge-to-valley scheme was

38 Major Rivers are-Netravathi, Kumardhara and Gowri, Gurupura, Nandini, Shambhavi, and Phalguni,. as per Data collected from Minor Irrigation Department, Dakshina Kannada District.

39 Major Rivers are-Seetanadi, Swarnanadi, Shambhavi, Chakra, Varahi & Gangolli *See* PMKSY, Udupi District, District Irrigation Project, 2016, p. 22.

40 Data collected from Minor Irrigation Department, Dakshina Kannada District

41 Data collected from Agriculture Department, Dakshina Kannada District.

42 *Ibid*.

43 *Ibid*.

44 Data collected from Zilla Panchayat Office, Dakshina Kannada District.

45 Data collected from Minor Irrigation Department, Dakshina Kannada District.

46 Data collected from Zilla Panchayat Office, Dakshina Kannada District.

47 Data collected from MI Department, Dakshina Kannada District.

introduced by Agriculture Department, DK District. Important components of these programmes are- construction of Vented Dams, nala bunds, gowkatte, and krishi Honda. About 806 VDs have been completed by Agriculture Dept., DK Dist. and amount allocated for construction of VD is Rs. 39062 lakhs.[48] The capacity building training programmes are conducted where the user group, self- help groups and watershed committee members led by Assistant Agricultural Officer and President of Gram Panchayat are trained. About 638 VDs have been constructed by the Agriculture Department, Udupi District under PMKSY-WD, PMKSY-IO and WDDP Schemes and Rs. 1,969.81 lakhs were sanctioned for the same.[49]

c) Zilla Panchayat

The DK District under MGNREGA has constructed 125 VD in the past three years and Rs. 3.53 Crores has been expended. The VDs constructed under this scheme have width between 2m to 5m, and store water between 1200m^3 to 2900m^3. The Panchayat Raj Engineering Department (PRED), Udupi Dist. has constructed 548 VD.[50]

From the evaluation of the data, it may be evidently observed that the response by the Karnataka Government has been the construction of VDs through several schemes and enormous funds. Whereas, the Kerala Government though has launched many projects for the construction of VDs, it has nevertheless taken efforts to sustain traditional Kattas and has experimented with new innovation to Kattas.

Critical Evaluation of the Vented Dams

The VDs are seen more as a solution to the problem that traditional Kattas face. The concrete -based checked dam/ vented cross bars are projected as way out of the traditional Kattas. However, when the VDs were critically evaluated for their efficiency in water conservation and retention, channelization of stored water, longevity of the structures, cost efficacy and desirability among the users, the following inferences were made after examining the data gathered from the government authorities and interviews of the users.

1. Vented dams are constructed using concrete structures, the retaining walls and the vents are permanent structures which obstructs the flow of water permanently unlike traditional Kattas that are dismantled post-monsoon. The semi- permanent

48 Data collected from Agriculture Department, Dakshina Kannada District.
49 Data collected from Agriculture Department, Udupi District.
50 Data collected from Zilla Panchayat Office, Dakshina Kannada District.

concrete structures block 30% natural flow over the year.[51] The general norm is that the obstruction has to be reasonable and must not hinder the natural flow.

2. VDs lacked structures/channels that facilitate the flow of excess water, thereby resulting in artificial floods. A few instances of which are during August 2019 floods, the embankments of 87 vented dams were damaged causing a loss of Rs 35.77 crore.[52] There had been blockage due to fallen tree branches and garbage.[53] During September-October 2020 floods, at Kukkuje Village, Karkala Taluka, a VD was damaged as a result of which the surrounding agricultural plantations were damaged because of artificial flooding.[54] Many bridges in Udupi and DK Districts also were damaged during 2020 floods. A VD constructed at Palimar, Kapu Taluk, Udupi District has created huge agricultural loss upto 100 acres due to standing waters stored in this VD, and lack of channels to drain excess water.[55] The work of this VD was completed on 17th June, 2020 with the budget of Rs. 650.00 lakhs and consists of 30 Vents. There is another VD located just 50 m ahead that was built earlier and is defunct now. Further, there is another bridge 50 m ahead of these two VDs making three concrete structures in a row. As a response to flood, an inter-Ministerial Central Team was appointed to assess the damages caused by flood.[56] However, repair work is in progress and the emergency support came from the local people. The Udupi District Disaster Management Plan 2019-2020 provides for-Inspection of damage prone roads, bridges, check dams, causeways,[57] preparedness by alerting officers on the dam site,[58] forewarning settlements in the downstream, evacuation, coordination with other dam authorities.[59] However, Disaster Management Plans with respect to VDs specifically require detailed guidelines and better planning for the dam safety, keeping in view the havoc caused by the artificial floods.

3. A few of the Government constructed VDs have been inefficient to store water. The planks that are to be used in summer to stop flowing water are dysfunctional, and

51 Shivanand Kalave, Neernyamadige Shatmanad Mannina Vidya, in Kattagalu-Anushodha-negalu mattu Varanashi maadari, Varanashi Research Foundation and Arghyam Trust, May 2008, p. 24.

52 https://www.deccanchronicle.com/nation/current-affairs/260819/mangaluru-vented-dams-gone-farmers-worried.html accessed on 10/11/2020.

53 *Ibid*.

54 Data Collected from Disaster Management Department, Udupi.

55 Field Visit to Palimar VD and farmers interview.

56 https://timesofindia.indiatimes.com/city/mangaluru/karnataka-3-member-central-team-visits-flood-hit-udupi-dakshina-kannada/articleshow/65786996.cms accessed on 10/03/2021.

57 8.1.12 Udupi District Disaster Management Plan 2019-2020.

58 8.2.6 Udupi District Disaster Management Plan 2019-2020.

59 8.2.6 Udupi District Disaster Management Plan 2019-2020.

has resulted in the growth of weeds obstructing the flow of the stream in the rainy season.[60] The rainwater flooding to the adjacent agricultural lands has wrecked the crops. Due to fear of crop loss, the farmers have destroyed VDs in Yellapur, Sirsi[61].

4. Flawed site selection is a significant cause for breach in the structures and leakages. Leakages in the foundation of the structure or vents or VDs which have become defunct due to other reasons, such structures are being simply abandoned and not used for anything. Shree Padre strongly opines that the Authorities have to repair such abandoned structures and make them useful rather than constructing the new ones.[62] The interviews of the local farmers at Moodkodi village,[63] suggested that VD was constructed in that location simply because it was easy to approach and transport the construction materials. However, that VD had failed to store water due to leakage in foundation and the site selection was based on ease of transportation. The farmer had to incur expenses and repair VD and had to use iron shutters to prevent leakages[64]. Bengav Bandhara, Sirsi, which was constructed in 1993 is another example for failed VD due to selection of site based on transportation of stones and cement trucks[65].

5. There has been heavy reliance on the Government's expert knowledge base resulting in reduced community participation and disregard to the traditional knowledge. The Government sponsored projects lack local farmer's participation for instance initially, watershed programmes had no component of Kattas.[66] Shivanand Kalave argues that lack of building trust during site selection, construction and execution of project has made these concrete structures mere museum pieces and crores of rupees spent on construction of these structures have become unusable.[67] He further draws attention to water bodies such as bunds, tanks, wells built by farmers are flourishing because of elders' wisdom in terms of water conservation and culture of societal co-operation. The villages in Bhatkal are cited as examples for achieving water conservation in agriculture based solely on the understanding of the nature of water.[68] Shree Padre proposes that the watershed projects should take into confidence all the stakeholders

60 *Supra* note 52.

61 *Supra* note 52, p. 23.

62 Interview conducted during field visit.

63 Venooru Gram Panchayat, Belthangady Taluk, DK District.

64 *Ibid*.

65 Shivanand Kalave, Halligalige 'Bandhara'gala koduge enthahdu? , ed. by Shree Padre & Dr. Varanashi Krishnamurthy, *Kattagalu Anushodhane Mattu Varanashi Madari,* Varanashi Research Foundation & Arghyam Trust, May 2008, p. 35.

66 As pointed out by Shree Padre during the Interview

67 *Supra* note 52, pp.20 & 21.

68 *Supra* note 52, p.29.

since the local farmers have wisdom and experience in water conservation practices and their knowledge and expertise has to be utilized from the initial stages of project.[69]

6. There have been noted procedural delays in laying and removing barricades since the tenders have to be floated for laying and removing the planks. During data gathering, the farmers at the Udupi District expressed that they cannot lay/remove the planks themselves because one FRP sheet weighs around 50 kg and have to be laid/removed using earth movers. They have also revealed that the delay in laying planks has defeated the purpose of VD altogether, and at times the planks are not laid at all. [70] Additionally, the insufficiency of planks has also posed a problem to the farmers of Udupi District. Due to a smaller number of planks, there is a marked decrease in storage of flowing water. In one of VDs of Palimar Village, Kapu Taluka, Udupi District planks have not been laid in the last ten years. Wooden planks last only for two years whereas FRP sheets have long span but they are not affordable by local farmers making them dependent on MI Department for shuttering materials.

7. Difficulties persist while attempting to address these challenges because of scattered jurisdictions. The authorities claiming that the VDs not falling within their jurisdiction for the repair and maintenance has left most of the VDs futile. The jurisdiction is often disputed regarding undertaking the obligations of the VDs by the Gram Panchayats, Public Works Department, Minor Irrigation Department and Agriculture Department. Scattered jurisdiction, fragmented responsibilities and lack of co-ordination between concerned agencies poses a serious problem that remains unaddressed.

Questioning the cost effectiveness of VDs, the paper compares the VD with Katta and farmer innovated micro-ring check dam.[71] Though the VD (in the following table) irrigates larger area, the cost of construction is 30 times more than that of a traditional Katta and 20 times than that of a farmer innovated Micro-ring Check Dam. The observation is tabulated as follows:

69 Interview with Shree Padre.

70 Interview with farmers at Kervashe, Karkala Taluq, Udupi.

71 Four beneficiaries at Kodungai river, DK Dist., voluntarily joined together to design concrete VD with galvanized iron sheets as shutters on an abandoned bridge. Shuttering is carried out through Cranes. KDP Special Officer has remarked that this model is very effective and that the difference in government estimates & the costs incurred by locals for the same structure is huge. *See* Shree Padre, *With dream dam farmers show what is possible,* Civil Society, Feb 28, 2020 https://www.civilsocietyonline.com/rural-reporter/with-dream-dam-farmers-show-what-is-possible/

Legal Dimensions of Riparian Rights and Kattas

The Indian Constitution, pursuant to Article 21 has expanded dimensions of right to life to include ‘right to wholesome environment’ i.e., the right to have access to pollution -free water and air for the enjoyment of life. The Judiciary has played a pro-active role in providing varied and vast interpretations to the right. For instance, the Court in *Subhash Kumar v. State of Bihar*[72] highlighting the requirement of clean and pure water and air for a healthy and quality existence, entitles the recourse under Article 32 for furtherance of such right. The Court reiterating the importance of quality of water in *Narmada Bachao Andolan v. Union of India*[73] resorted to the United Nations Water Conference 1977[74] and held that “water is the basic need for the survival of human beings and is part of the right to life and human rights as enshrined in Article 21 and can be served only by providing source of water where there is none.”[75] Further, Supreme Court in the recent decision of *suo moto* petition ‘*Remediation of Polluted Rivers’* and subsequent *Delhi Jal Board v. State of Haryana*[76] looking into the consequence on increasing ammonia in the river water because of pollution, held that ‘the right to clean environment and further, pollution free water has been protected under the broad rubric of the right to life guaranteed under Article 21.”[77] It further explained the importance of Articles 47, 48A and 243W towards the realization of right to clean water.

72 AIR 1991 SC 420.

73 (2000) 10 SCC 664.

74 All people, whatever their stage of development and their social and economic conditions, have the right to have access to drinking water in quantum and of a quality equal to their basic needs. See United Nations Water Conference 1977.

75 *Supra* note 74 para 274.

76 Writ Pettion (Civil) No. 8/2021. Para 15 of the case directs the registration of *suo moto* writ petition (civil) with regard to ‘Remediation of Polluted River’.

77 *Ibid*. para 5.

These articulations of Article 21 by the Supreme Court extend to Kattas and has two-fold manifestations (a) it vests the users of Kattas/stream with a positive right to have access to clean water; (b) imposes an obligation not to pollute the water of the stream/Kattas or cause obstruction to others from having access to water.

Article 39 (b) provides that the State shall direct its policy towards securing the ownership and control of the material resources of the community and distributed in manner best to subserve the common good. With the inclusive interpretation of 'material resources' to cover water resources, there arises a duty on the state to ensure that water is equitably distributed among the beneficiaries. The right to flowing water of rivers/streams is described as a right *'publici juris'* a right of public.[78] This idea of distributive justice resonates with the rights of riparian owners. The riparian owners both upper and lower are entitled to equitable share of water. This unveils the dilemma of the lower riparian owner, their access to water when Kattas are constructed across the stream by upper riparian owners. When the Court encountered with such situations, for instance in *Ram Bhatta and others v. Krishna Bhatta and others,*[79] it held that the riparian proprietor has no right to interrupt the regular flow of the stream, if he thereby interferes with the lawful use of the water by other proprietors and inflicts upon them a sensible injury.[80] Similarly, in *State of Bombay v. Laxman Sakharan Pimpakar and others*[81] the Court laid down guidelines protecting the rights of the lower riparian owners by holding that upper riparian owners cannot obstruct water *ad libitum* for it is conditioned by the right of similar riparian owners who have co-extensive rights to the water of the stream.[82] But for a few decisions on riparian rights associated with Kattas,

78 *Re: Cauvery Water Dispute Tribunal*, AIR1992 SC 522.

79 1962 KLJ 45.

80 Every riparian proprietor has a right to the use of stream for any purpose what may be deemed the extraordinary use of it, provided he does not thereby interfere with the rights of other proprietors, either above or below him. Subject to this condition, he may dam up the stream for the purpose of a mill, or divert the water for the purpose of irrigation. But he has no right to interrupt the regular flow of the stream, if he thereby interferes with the lawful use of the water by other proprietors and inflicts upon them a sensible injury. *Ibid* para 10 p 5-6.

81 AIR 1960 Bom 490.

82 The Court laid down the following principles (1)A riparian owner, in the exercise of his right to use the water of the stream for or extra-ordinary purposes, such as agriculture, can impound and divert water to irrigate his land adjacent to the stream.(2)The right is not an absolute or exclusive right. He cannot abstract water ad libitum for his right is conditioned buy the similar right of other riparian owners who have coextensive the water of the stream. It is limited but only by rights of persons in similar position having lands abutting both sides of the stream. The crucial condition is that the user of the stream by him must be a reasonable use and not capricious or such as wood inflict sensible injury on others similarly situated.(3)This standard or reasonableness applies to the volume of water that he can divert, to the purpose for which he can utilise it as also to the mode or method that he may adopt for impounding and channeling such water.(4)There is no rule exclusive or inclusive

the area is largely left unattended and requires a regulatory mechanism.

The Way Forward

In conclusion the paper addresses the challenges that the users of the Traditional Kattas and VDs are facing with a few recommendations. Firstly, there has to be a well- structured post intervention map that lays down the responsibilities and obligations of the stakeholders. The rationale is that the project should not be abandoned by the government once the construction is completed. There has to be well defined framework of the work, repair, monitoring and maintenance that has to be included within the project so as to avoid the conflict of scattered jurisdiction. This also ensures the timely laying/ removing the planks thereby increasing the utility of the Katta/VDs.

Secondly, the Water Users Associations have to be strengthened to (a) obtain a better collective bargaining capacity against the authorities to enhance the maintenance of VDs; (b) to ensure that there is efficient and equitable supply and distribution of water from the VDs/Kattas; and (c) to amicably resolve disputes.

Thirdly, the paper stresses on the strict contractual arrangements between the users of Kattas to ensure the proportionate cost and benefit sharing. The strict terms of contract checks the unjust enrichment of those beneficiaries who use the water of Kattas but are unwilling to share the annual maintenance cost.

Fourthly, the general absence of contract spelling out the rights and obligation of stream users has given rise to the violation of riparian rights. The solution is two-folded action, one by the users of streams to have specific contract ensuring that there is no overstepping of the condition laid down by the precedents, thereby protecting riparian rights of lower

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which defines the mode or specific methods or manner of diverting that water for that must depend on a variety of factors including for instance geographical and natural features of the lands of the riparian owners upstream and downstream, the Terrain and the magnitude of the steam.(5)A normal and usual mode or method of diverting water adopted in many parts of the country and more so in rocky or hilly Terence is that of putting up in the stream Kaccha or Pakka Bandharas (dams). In case of such terrains principally in higher reaches of a small river or rivulet this is the most practicable and economical method and it is too late in the day Nau to throw doubt on the reasonableness of this ancient system. It is incidental to the right itself. But the Bandharas must be such that they permit the flow of the water down stream and without diverting the natural course of the stream.(6)The riparian rights of lower owners is to have the water of the stream transmitted to them continuously and in a manner which does not materially affect their enjoyment on the right. An upper riparian who puts up Bandhara must, therefore, take care to see that the stream continues to flow without interruption and without any substantial diminution in volume. Ibid, para 11 pp.7-8.

regions and the intervention by authorities through monitoring the use. There might also be pragmatic solutions like enabling the lower riparian owners to construct a check dam/ Katta prior to the construction by the upper riparian owner so that sufficient water is stored before the water flow diminishes. In cases of conflict, the contracts must specify the dispute resolution clause specifying conciliation or arbitration as efficient and speedy means of disposal.

Fifthly, there has to be revival of the role of Neeruganti,[83] by nominating a person who will be in-charge of distributing and allocating equal shares of water among the beneficiaries. This arrangement is the step towards distributive justice.

Sixthly, the paper recommends that the projects concerning VDs have to be placed in the public domain to necessitate proper impact assessment and public hearing. This provides the required platform for the public to deliberate upon the consequences of the project. This also provides for an opportunity to include the local communities to participate in the projects.

Finally, the paper emphasis on the importance of community led participation in making these irrigation systems successful. There have been a few mass movement led by youth groups[84], NGOs, journalists and activists to sustain the practice of Kattas. The initiative by Varanashi Development and Research Foundation[85], campaign led by Zilla Panchayat Member Dharnendra Kumar[86], *shramadan* activities by NSS Volunteers, activism by journalists like Shree Padre, Chandrashekar Yethadka, and Shivanand Kalave are examples that illustrate the importance of traditional Kattas to the local communities. Though these movements are not against the construction of VDs, they nevertheless symbolize the importance of community participation and sentiment in making the structures successful. The VDs devoid of these elements make them elitist and less popular among masses.

83 *Neeruganti* is a person appointed by the community to manage water in a just and equitable manner. The key functions of the *neeruganti* were to- ensure uniform supply of water to all fields in the command area; determine the type of crop to be grown based upon the water available; decide on the dates and times for supply of water; maintenance and repair of waterbodies, etc. *See* Dr. S.T. Somashekara Reddy, *Water Management- the neeruganti way,* ed. By Sandhya Iyengar, 'Waternama', Communication for Development and Learning, Bangalore, 2007, p.15.

84 Bhashya Laxmi P et. al., Improvement of Groundwater by replacement of earthen Kattas by Bison Panel Sheet Katta System, International Journal of Advances in Mechanical and Civil Engineering, Vol-5, Issue 2, Apr. 2018.

85 Varanashi Foundation experimented and developed an innovative cost saving and less labour intensive method. VF conducts field visits, technology demonstrations and workshops to disseminate this practice. *See* Krishna Moorthy and Ashwini K. M, 'Water Harvesting The Varanashi Story' www.varanashi.com accessed on 30/10/2020.

86 Sri. Dharnendra Kumar, Zilla Panchayat Member is on a Mission to revive Kattas. He led the construction of 50 Kattas across Falguni river with the help of NSS volunteers. *See* Shree Padre, Holethodugale Nilli! Dharnendra Katta Chalaka, Adike Patrike, April 2020, p.5-12.

Chapter 2
Jammu & Kashmir Water Resources (Regulation and Management) Act, 2010: An Analytical Snapshot with Special Reference to Irrigation Facilities

Dr. Arvind Jasrotia* Kartika Bakshi**

Abstract

A succinct warning regarding effective water resources management has long been issued during the International Conference on Water and Environment in Ireland in January 1992. However, the issue has taken a critical turn in the last few years when viewed from different perspectives of accessibility, affordability and availability of water for various human and non-human uses. One such area that has largely been unaddressed and regulated by uniform policies is the regulation and management of irrigation water for food security, i.e., agriculture production. For the present analysis, an effort has been made to know whether such facilities are sufficient to cater for the demands of the growing population vis a vis crop production and understand how such facilities became the subject matter of encroachments in the recent past in the territory of J&K. Further, it is important to understand that J&K has always been divided into areas deemed as "Kandi and non-Kandi" depending upon the availability of water in the region but the J&K Water Resources (Regulation and Management) Act, 2010 has taken a linear approach and attempts to develop a one glove fits all solution that seems unfeasible. Therefore, against the above backdrop, an effort has been made to critically analyze the provisions of the legislation described

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above and suggest possible solutions for making its objectives productive in the real sense.

Keywords: *J&K Water Resources Act, 2010, Irrigation, Food Security, Kandi.*

Introduction

J&K is considered a paradise on earth with ample water resources such as lakes, rivers, and glaciers besides groundwater. The main rivers that flow through the State are Jhelum, Chenab, Indus and Tawi. J&K is essentially a mountainous state in which only about 30 per cent of the reporting area is under cultivation. Agriculture is the mainstay of the people as it provides employment, directly or indirectly, to about 70 per cent of the workforce.[1] It contributes about 65 per cent of the state revenue, which explains the State's overdependence on agriculture.[2]

The scorching heat in the plain of Jammu Division and the uncertainty caused due to the summer monsoon in the Valley of Kashmir compel the farmers to irrigate their Kharif and Rabi crops frequently to get an excellent agricultural return. The farmers are pretty conscious of the significance of irrigation to increase yield and productivity in agricultural production. It can be reflected in the eagerness with which some of the Kuls (canals) were constructed by the cultivators in the past. After independence, several irrigation projects have been envisaged and completed, due to which the area under Irrigation has increased significantly. The significant irrigation sources in the State are canals, wells, tanks and others. Canals alone account for about 94 per cent of the total area irrigated, while the remaining about 6 per cent was irrigated by wells, tanks and other sources.[3]

The increasing depletion of water resources vis a vis least priority accorded to irrigation facilities has led to the realization that existing rules concerning the use of water resources were unadopted to a situation of scarcity. Legislative interventions concerning the use of water resources for irrigation facilities are significant for two main reasons. Firstly, from a legal standpoint, they constitute a major organized attempt at redrawing the rules concerning control and use of water resources, which is still otherwise based mainly on

1 Ouffee Maqbool and Fozia Jan, *The Agricultural Sector of Kashmir: Between Growth and Mismanagement*, 5(5) ARJASR, 341, 342 (2017).

2 *Agriculture in Jammu and Kashmir*, Your Article Library (April 5, 2021), https://www.yourarticlelibrary.com/essay/agriculture-in-jammu-and-kashmir-explained-with-map-and-statistics/41650.

3 *Irrigation: Irrigation in Kashmir, Jammu and Ladakh Division,* Your Article Library (April 5, 2021), https://www.yourarticlelibrary.com/essay/irrigation-irrigation-in-kashmir-jammu-and-ladakh-division.

common law principles. Secondly, they constitute a response to the fact that over time, canal irrigation has become the most crucial source of water supply in rural areas and supports a significant chunk of agricultural production. This strengthens the case for ensuring the sustainable use of water through irrigation facilities. One of the essential consequences of setting up water regulatory authorities in different states concerns the strengthened control over water resources.

Their main aim is to regulate and apportion entitlements to use water between different recognized categories of users. Despite this, the division of tasks between various state actors and levels are not clear. Further, water policy is pushed in several different directions, reflecting the specifics of the current situation, such as its complex administrative structure, overlapping and sometimes contradictory rights, vastly different endowments in water resources in different regions, and difficulties in allocating water in the most socially and economically appropriate manner. Drinking water supply, environmental dimensions of water conservation, water infrastructure for irrigation and flood control, and groundwater regulation are the critical area where water laws and policies have tried to regulate accessibility, affordability, availability and preservation of water in both the short term and long term, to ensure the sustainability of human uses. Considering that water is central to livelihoods, particularly agriculture which remains the primary sector in terms of individual livelihoods, laws and policies concerning infrastructure for Irrigation have been devised in different states. For the present analysis, one such legislation viz., Jammu and Kashmir Water Resources (Regulation and Management) Act, 2010, has been enacted to ensure the reasonable and optimum utilization of the water resources has been discussed. However, the main aim is to analyze relevant provisions of the legislation mentioned above towards strengthening existing irrigation infrastructure to augment agricultural production and suggest remedial measures towards building a robust irrigation infrastructure.

Water Law and Policy: Conceptual Underpinnings

Water is at the heart of agriculture. The availability of water makes it possible to grow crops and raise livestock. Agricultural water use, in turn, is at the heart of discussions involving water law and policy. Although water is one of our most plentiful resources, there is often not the correct quantity of the right quality of water in the right place at the right time to satisfy demand. Consequently, there is keen competition among water users, including agriculture, municipalities, industry, recreational users, and conservationists. Water used in agricultural production is usually sourced from surface waters, such as rivers, lakes, streams, ponds, or groundwater stored in aquifers. In some circumstances, agricultural water is also harvested directly from rainfall and stored in above or below-ground cisterns.[4]

Traditionally, water resources management has focused on surface water or groundwater as if they were separate entities. Although water is part of a connected system, it tends to be regulated based upon its source. Even within the category of surface water, water regulations can vary depending on whether the surface water is perennial, ephemeral, or human-made.

Broadly, water law can generally be divided into two substantive areas: rights to use water and means to curtail water pollution. More specifically, water law concerns:

i. The balance between public rights and private rights to use water.

ii. The relative rights of individual water users.

iii. Water quality and the regulation of discharges to water.

The states generally govern water allocation, with each State having its regulatory system with very little central intervention. The primary entry in the Constitution relating to Water is in the State List. It brings water including water supplies, irrigation and canals, drainage and embankments, water storage and water power under state list.[5] On the other hand, water quality is governed mainly by the Central Act, primarily the Water (Prevention and Control of Pollution) Act, 1974.

At this juncture, it is essential to mention that the states shall develop and continue to revise legal and regulatory schemes to prioritize and clarify the relative rights of competing water users. Here the observation made in the forward to the 5th edition of David H. Getches' *Water Law in a Nutshell,* deserves special mention:

> *"A decision to use water for a particular purpose can have far-reaching impacts. For instance, transporting water from a rural area across a mountain range to a city may sustain the city's population. Still, it may also force a decline in agricultural productivity and the farming community built on it, facilitate more rapid growth in the importing city, prevent future development of the exporting rural area, curtail recreational opportunities, make sewage treatment more difficult as a stream flows to dilute wastewater discharge are diminished, deprive the exporting area of groundwater recharge, and cause ecological changes in both areas. Balancing these*

4 *Water Law: An Overview* The National Agricultural Law Centre (July 5, 2021), https://nationalaglawcenter.org/overview/water-law/.

5 India Const. Seventh Schedule, Entry 17, List II.

> *conflicting interests and demands is made ever more complex, challenging, and essential in the face of chronic drought cycles intensified by climate change."*

The right to the use of surface water for Irrigation is generally governed by state law. Three different use allocation systems are in vogue to determine the rights of private persons in the water. The first is the riparian doctrine.[6] The second is the system of prior appropriation[7] or "first-in-time, first-in-right," and thirdly hybrid system, which contains parts of both the prior appropriation and the riparian systems doctrines.

A close look through the water governance in different states viz., Maharashtra, Gujarat, Andhra Pradesh and Rajasthan highlights no consistency in water allocation approach. Under Participatory Irrigation Management which largely provisions for the command area farmers, the riparian doctrine seems to be a dominant principle. We see the doctrine of prior appropriation being used to allocate water for large cities like Mumbai, Bengaluru, etc. - the doctrine is historically based on a "first in time, first in right" philosophy whereby supply is theoretically subject to a priority order. In the case of industrial water allocations or for drinking water, it seems to be the non-priority permit doctrine that operates on the allocation of entitlements granted at the government's discretion. The resource itself is nationalized by vesting the control it in State Government water authorities. Property rights in resources exist either under state property regime (where the secure claim rests with Government) or private property regime (claim rests with individual or corporation) or common property regime (individuals have claims on collective goods as members of an organized group) or open access (or no property with no secure claims).[8] The essential requirement for any property regime is an authority system (for example, Central or State Governments/panchayats/resource development committees/user groups/water user associations) to guarantee the security of expectations for the rights holders (resource users). When the authority system breaks down, a particular resource regime starts degenerating. Under such a situation, new institutional arrangements are used to define

6 Riparianism limits the use of water to only those landowners with riparian land. In order to be classified as a riparian landowner, the landowner must own the parcel of land adjacent to the watercourse, i.e. a river, stream, lake, or pond, from which the landowner plans to use the water. Even then, the water may only be put to a reasonable use.

7 The prior appropriation system is based on priority. The most senior appropriator has the highest priority and can defeat all other less senior appropriators in times of shortages. Unlike riparianism, there is no requirement that a senior appropriator use less water in times of a shortage. Water users can take in order of their respective priorities, with each user taking their full appropriative right until the water is gone.

8 D.W. Bromley, *Environment and Economy: Property Rights and Public Policy*, 42 American Journal of Agricultural Economics, 836, 837 (1991).

the resource regimes over natural resources. The authority system protects the interests of those (resource users) holding the rights under a particular regime.[9]

Irrigation Management in J&K

Irrigation plays a pivotal role in the agriculture sector of the J&K economy. The State does not receive rain throughout the year. In the Jammu region, temperature conditions favour the cultivation of crops throughout the year. Due to the non-availability of water in the region, the agricultural yield is comparatively less. The rainy season provides sufficient water from July to September. In Kashmir valley, it rains mainly in winter when the temperature is too low for plant growth. When the temperature begins to rise in May and onwards, the rainfall decreases, and except for some showers of rain in July-August, most of the growing season remains dry. The farmers always require sufficient water supply for this field; therefore, they depend mostly upon canals for irrigation. The snow-fed streams running down the mountains' slopes make it very easy for the farmers to construct small canals or pools. In this view, 60% of the land in the valley is irrigated.

The net sown area in the State during 2013-14 was 741 thousand hectares, whereas the gross area sown (total area sown under different crops) was 1160 thousand hectares. The mode of irrigating the crops is through the canals. About 89 per cent of the net areas irrigated is irrigated through canals while tanks, tube wells and other means are also used[10]. The major irrigation canals in Jammu division include Ranbir Singh Canal[11], New Partap Canal[12] and Kathua Canal, while Martand Canal[13] and Zainagir Canal[14] are the major

9 D.K.Marothia, *Agricultural Technology and Environmental Quality: An Institutional Perspective,* 52 Int. J. Agric. Econ., 473-487 (1997).

10 J&K SLBC, http://www.jkslbc.com/Irrigation.php (last visited July 5, 2021)

11 The Ranbir Singh Canal has been taken out of the left bank of River Chenab and its head-works lies at Akhnoor. Passing southwards, it has been taken across the Tawi River with the help of an aqueduct. The productive plains of Jammu and Ranbir Singhpura are under its command. Its canal and command area is over one lakh acres; this canal and its distribution have helped appreciably in the adoption of High Yielding Varieties of rice and wheat in the Jammu Plain, especially in the Tehsil of Ranbir Singhpura.

12 Taken out from the right bank of the Chenab river at Akhnoor, the Chenab Canal has a total length of 36 km. About 20,000 acres of Akhnoor Tehsil are under its command. It provides water to rice, wheat, oilseeds, orchards, fodder and vegetable of the command area.

13 It has been taken off from the left bank of the Liddar River. Its head-works lies at Ganeshpur. The total length of the canal is about 50 km which commands about 9500 acres of land.

14 This canal has been excavated from the bank of the Madhumati River- a left-hand tributary of the Jhelum. The canal has been constructed along the northern side of the Wular Lake through Sopore and Zainagir. It provides water to the paddy fields and apple orchards of Baramulla district. The total area under its command is about 13,500 acres.

irrigation canals in the Kashmir division. Since a large chunk of the Kandi belt lies in the upstream and downstream side of Jammu Pathankot National Highway road between Ravi River and Tawi Rivers which is partially cultivated and at the mercy of rain gods. To provide assured Irrigation to about 1,50,000 acres of land from waters of river Ravi and Tawi, the Government of J&K formulated Ravi Tawi Irrigation Complex as a composite project comprising of Ravi Canal and Tawi Canal.[15] In intermediate and hilly regions of the Jammu division, the traditional community constructed and managed irrigation channels are used to provide sustainability to water conservation efforts and existing farming systems. These are locally known as kools, and the system of Irrigation is known as the kool system.[16]

Despite efforts by state governments, as mentioned earlier, a slight decrease from 325.08 thousand hectares in 2012-13 to 323.26 thousand hectares was witnessed in the net area irrigated during the year 2013-14. However, when the figures of the net area irrigated for the year 2013-14 is compared with that of 1974-75, one observes an increase of only 30 thousand hectares in the irrigation potential utilized over more than three decades.[17] Further, the irrigation projects are classified into three categories viz., major, medium and minor. A project with a cultivable command area (CCA) of more than 10,000 hectares is termed a major project. A project with a CCA of less than 10,000 hectares but more than 2,000 hectares is termed as medium projects, and those which have a CCA of 2,000 hectares or less are known as minor projects. Minor irrigation projects have both surface and groundwater as their sources, while major and medium projects mainly exploit surface water resources. In the State, irrigation potential is created under funding through Accelerated Irrigation Benefit Programme, Border Area Development Programme and State Sector/District Sector schemes (including NABARD loan assistance).[18]

The J&K State Water Resources Regulatory Authority[19] (hereinafter called 'SWRRA') under the J&K Water Resources (Regulation and Management) Act, 2010 (hereinafter called 'J&K Water Resources Act, 2010) has been set up to ensure judicious and optimum utilization of water resources of the State, i.e. surface/groundwater as per Water Policy as well as push ahead of the reforms in the water sector. Under the Act, water tariff system and water usage charges for different uses of water has been stipulated, thereby effectively kick-starting the much-awaited water reforms process.[20]

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15 RTIC-Jammu, http://rticjammu.in/ (last visited April 5, 2021).

16 P.S. Slathia Et. Al., *Traditional water conveyance modes, their management and use in Udhampur district of Jammu and Kashmir,* 15 Indian J. Tradit. Knowl., 503-508 (2016).

17 *Supra* note 10.

18 *Ibid*.

19 Jammu and Kashmir Water Resources (Regulation and Management) Act, 2010, § 139, No. 21, Acts of Parliament, 2010.

20 *Ibid.* § 145(d).

The Act stipulates that every water source in the State is, and shall remain, the property of the Government and any proprietary ownership, or any riparian or usage right, on such water resources vested in any individual, group of individuals or any other body, corporation, company, society or community shall, from the date of commencement of the Act, shall be deemed to have been terminated and vested with the Government. Further, no person shall use any water from any source (surface or ground) or collect or extract any material from such water sources except under the Act's provisions.[21] Chapter IV of the Act comprehensively deals with Irrigation and flood control.

Since irrigation and drainage are the backbones of irrigated agriculture and food security, the smooth running, maintenance and operation system of irrigation infrastructure, it is reliable functioning throughout the entire period of its use is essential. Accordingly, the J&K Water Resources Act and water policy and plan provide for the management, extension, and improvement in irrigation facilities and focus on efficiency in water utilization for crop production to increase productivity in the agriculture sector.

Salient Features of the Act vis a vis Irrigation Facilities

a. Construction and maintenance of irrigation works:

Whenever it appears necessary to the Government that water received from any water source, including any natural collection of still or groundwater whether by percolation, regeneration, release or otherwise, should be applied or used for any existing or projected irrigation work or the regulation, supply or storage of water, the Government may, by notification, declare that the said water shall be so applied or used.[22] For carrying out the above purpose, the Act authorizes Assistant Executive Engineer the powers of entry on notified premises or any land or remove any obstruction or close any channel or do other things necessary for such application or use of the said water.[23] He also has the power to enter and survey any projected irrigation work or its construction or with the maintenance of an existing irrigation work or with the application or use of the water of any irrigation work to regulate, supply, or store water.[24] He is authorized to enter upon land, building etc., for inspection.[25]In case of occurrence, or apprehension, of an accident to an irrigation work or flood control work, the Assistant Executive Engineer concerned can enter into

21 *Ibid.* § 3.
22 *Ibid.* § 24.
23 *Ibid.* § 25.
24 *Ibid.* § 26.
25 *Ibid.* § 27.

any immovable property in the vicinity of such Irrigation or flood control work as may be required for repairs and to prevent accidents.[26]

If the Government is satisfied that any land is required for the construction of an irrigation work excluding watercourses, field channels, and field drains, or for the maintenance, improvement or extension of existing irrigation work, the Government may acquire the land following the provisions of the State Land Acquisition Act, Samvat 1990.[27]

b. Water Channels and Field Channels:

The Executive Engineer concerned may, on his motion or an application made by owners or occupiers of any land or field, prepare or cause to be prepared a draft scheme to provide for all or any of the matters, namely[28]:-

i. construction, alteration, extension and realignment of any water channel, or any existing water channel constructed or maintained by any owner or occupier;
ii. re-allotment of areas served by one watercourse to another;
iii. the lining of any water channel;
iv. occupation of land for the deposit of soil gathered from clearance of any water channel;
v. any other matter which is necessary for proper maintenance and distribution of the supply of water from a watercourse.

The aforesaid scheme needs to be publicised for inviting objections and suggestions within thirty days from the date of its publication. The prescribed authority, Executive engineer or Superintendent engineer, shall either approve or revise the scheme respectively and publish the same.[29] The Executive Engineer shall direct the owners, occupiers or beneficiaries to take over and maintain the water channel on the execution of the scheme. If any owner or occupier or beneficiary fails to comply with this direction, the Executive engineer shall make arrangements for maintenance of the water channel at the cost of such owners or occupiers or beneficiaries in proportion to the cultivable commanded area under the scheme held by them. Further, to deal with the cases of encroachment, demolition or obstruction for the protection of water or field channels, the person affected may apply to the Assistant Executive engineer for directing the restoration of the concerned water or field channel to its original condition.[30]

26 *Ibid.* § 28.
27 *Ibid.* § 31.
28 *Ibid.* § 32.
29 *Ibid.* § 33.
30 *Ibid.* § 38.

In order to augment irrigation potential, field channels can be constructed whenever it appears reasonable to the Assistant Executive Engineer either on his own motion or on the application of an owner or occupier or beneficiary. Accordingly, he can cause to be served on the owner or occupier, or beneficiary concerned notice containing the exact location of sluices or outlets on the irrigation works and specifying the area of irrigable land to be served by the same and direct them to construct such field channels at their own cost within a specified time which shall not be more than three months from the date of issue of the notice.

In case, the owner or occupier or beneficiary fails to construct the field channels in his land as directed by the Assistant Executive Engineer within the time specified, the Assistant Executive Engineer may, after giving the owner or occupier a reasonable opportunity of being heard, construct the field channels at the cost of the Government and recover the cost plus 15% of the actual cost pro-rata from such owner or occupier or beneficiary, as the case may be.[31]

c. Drainage and Prevention of waterlogging

Whenever it appears to the Government that injury or damage to any land has arisen or may arise from the encroachment upon any irrigation or flood control work, the Government may, by notification, prohibit, within limits to be defined in such notification, or may order the removal of, such encroachment.[32] After the notification mentioned above, the Executive Engineer may issue an order to the person causing or having control over any such encroachment to remove such encroachment within a time to be specified in the order. Suppose within the time so specified, such person does not comply with the order, in that case, the Executive Engineer may remove the encroachment with the assistance of the police force and recover the expenses involved in such removal from the person concerned.[33]

Whenever it appears to the Government that any drainage work, excluding field drain, is necessary for the interest of public health or improvement of any land, or for the proper cultivation or Irrigation thereof, or protection from floods and other accumulation of water or harmful salts or for prevention of erosion by a water source, the Government may, by notification, declare that the drainage work shall be constructed after a day to be specified in the said notification not earlier than three months from the date thereof.[34]

31 *Ibid.* § 48.
32 *Ibid.* § 52.
33 *Ibid.* § 53.
34 *Ibid.* § 54.

Similarly, an executive engineer may cause a scheme for field drains to be drawn up, which among other things, includes realignment of the proposed field drain or realignment of the existing field drain, as the case may be.[35]

d. Regulation of water supply from irrigation works:

After making the requisite inquiry, an Assistant Executive Engineer may regulate in respect of any irrigation work for each year or part thereof or for a specified term of years at a time, as circumstances may require, the[36]

i. time for letting out water for Irrigation;
ii. period of supply;
iii. quantity of supply; and
iv. areas to be supplied at different times.

Besides regulation of irrigation of water supply for irrigation works under a provision mentioned above,[37] any person desiring to have a supply of water from an irrigation work for irrigating land shall make a written application to that effect to the Assistant Executive Engineer concerned and he may, if in his opinion, such supply can be made without detriment to the supply of water to lands to which supply of water is regulated under the provision as mentioned earlier, order the supply of water for a period not exceeding six years subject to such conditions as may be mentioned in such order. The water charges for the use of water for temporary cultivation shall be the regular water usage charges. If the occupier, owner or beneficiary of such land applies for the supply of water being made permanent, i.e., beyond six successive years of supply, his application, with the opinion of the Assistant Executive Engineer, shall be forwarded to the Executive Engineer concerned who shall take steps to include the land in the area to which supply of water is regulated by section 57.[38]

Further, the supply of water to any watercourse or field channel or to any person who is entitled to such supply shall be stopped[39]

i. whenever it is necessary to stop supply for maintenance of an irrigation work or execution of any work ordered by the competent authority;

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35 *Ibid.* § 55.
36 *Ibid.* § 57.
37 *Ibid.*
38 *Ibid.* § 58.
39 *Ibid.* § 59.

ii. whenever any field channel by which such supply is received is not maintained in such repair as to prevent the wasteful escape of water thereof;
iii. whenever it is necessary to do so to supply water in rotation to the legitimate demands of other persons entitled to water;
iv. whenever it may be necessary to do so to prevent the wastage or misuse of water;
v. within the periods fixed from time to time by the Assistant Executive Engineer of which due notice shall be given;
vi. whenever there is a decrease in the supply of water in the irrigation work due to any natural or seasonal cause and so long as it is necessary to do so; and
vii. for any reasons beyond the Department's control.

The Act also stipulates that the sale or subletting of the right to use water for irrigation work is not allowed for purposes other than irrigation.[40] When water from an irrigation work is provided for the irrigation of one or more crops only, the right to use such water shall be deemed to continue only until such crop or crops shall come into maturity.[41]

The competent authorities are even empowered to prescribe the crop to be grown under the irrigation area. It provides that where the executive engineer is satisfied that for better cultivation of lands, or better production of crops, or for preservation and proper utilization of water resources or any irrigation work, it is necessary to identify the kind of crops that should be sown on lands under the irrigable command of an irrigation work or any part thereof, he may, with the accord of the Chief Agriculture Officer concerned, by order in writing, making a declaration to that effect. Such a declaration shall be given wide publicity in such manner as the Executive Engineer may think fit. The Assistant Executive Engineer, thereupon by order, regulates the supply of water from the irrigation work for sowing, planting or growing such crops during the periods specified in the order. Hereafter no person shall sow, plant or grow or allow to be sown, planted or grown any crop other than the crop specified in such notice on any land under the irrigable command of the irrigation work or part thereof specified in such notice and during the periods specified therein.[42]

In the larger public interest, the Government may direct the competent authorities under the Act to prepare small schemes for irrigating lands not exceeding 100 hectares or such area as may be prescribed for the supply of water from an irrigation work to such lands and

40 *Ibid.* § 60.
41 *Ibid.* § 61.
42 *Ibid.* § 62.

after that handover the management of the scheme and distribution of water from there to the Water Committee.[43]

Section 64 of the Act deals with the constitution and functions of the Water Committees.[44] The water committee shall manage the irrigation work and ensure proper allocation of water to the lands included in the scheme. Section 64 (f) provides that the water committee has to assist the assistant executive engineer in detecting and preventing encroachment on irrigation work and on the lands appurtenant to it to prevent damage to the irrigation work and repair any damage caused to the irrigation system. The penalty that may be imposed under the Clause mentioned above shall consist of fine, not exceeding rupees five thousand. Most importantly, the Government also has the power to suspend and supersede the water committee if it believes that these committees have persistently made default in the performance of the functions conferred on it under the Act, or circumstances exist which renders it necessary in the public interest so to do.[45]

e. Safety of Irrigation Works

For ensuring the smooth functioning of the irrigation system, the Act forbids the general public not to interfere with any irrigation or hydraulic work, construct an earthen or masonry bund or weir on any channel or stream, flowing upstream or downstream of any irrigation work or perform or undertake any excavation activity within the vicinity of any irrigation or hydraulic work. Further, no person shall raise any residential, commercial or industrial building or unit in the vicinity of any irrigation or hydraulic work without prior permission from the prescribed authority.[46]

The Act empowers the assistant executive engineer to remove any interference or encroachment upon any irrigation or hydraulic work at the expense of the defaulter and take such other action as necessary, including the recovery of expenses incurred on removing such interference or encroachment. The concerned authority may seek the assistance of the police force for the removal of such interference or encroachment.[47] Section 68 of the Act obligates every person whose water storage tank or reservoir or any other storage device is situated in the vicinity of any irrigation work.

43 *Ibid.* § 63.
44 *Ibid.*
45 *Ibid.* § 65.
46 *Ibid.* § 66.
47 *Ibid.* § 67.

Every person whose water storage tank or reservoir or any other storage device is situated in the vicinity of any irrigation work has to maintain such tank, reservoir or device in a safe and efficient condition. The Act also prohibits every person, without the prior permission of the Assistant Executive Engineer, to conduct any operation requiring the use of any explosives within such distance from the boundaries of irrigation work, as may be specified.[48]

Further, fishing and plying of boats in a reservoir, pond, tank, or across and along a river, stream, nallah, canal, watercourse or channel maintained or controlled by the Government without permission is not allowed.[49] Section 72 of the Act prohibits any person subject to any permission accorded by the Executive Engineer to abstract water from irrigation work by installing a pump set or other electrical or mechanical device.

The Act forbids every person from polluting or discharging any sewage or industrial effluent in the water of any irrigation work which may deteriorate the quality of water or give rise to the growth of any weeds in, or cause an injury to, any irrigation work.[50]

The Act also regulates water usage of any water source to a user by the installation of a unit except under a licence issued by the licensing authority.[51]

Chapter XII of the Act deals with offences and penalties for contravening any provisions of the Act. Section 156[52] to 158 specially enshrines various offences and their penalties for Irrigation or hydraulic works.

Furthermore, the Water Policy and Plan and regulations[53] issued by the J&K Water Resources Regulatory Authority under this Act extensively elaborate the extension and improvement of existing irrigation facilities in the Union Territory of J&K.

48 *Ibid.* § 69.
49 *Ibid.* § 70.
50 *Ibid.* § 74.
51 *Ibid.* § 90.
52 *Ibid.* § 156.
53 Water Resources Regulatory Authority (Guidelines on Selection of Water Sources and for ensuring availability of Water for the Water Supply Irrigation Systems) Regulations, 2018; State Water Resources Regulatory Authority (Manner and Guidelines to Ensure Smooth, Uninterrupted and Leakage free Supply of Water to Farmers) Regulations, 2018.

Problems and Prescriptions for Change

a. Administrative apathy:

On numerous occasions[54], the Division Bench of the State High Court passed directions for strict adherence to the provisions of the law, including preparation of State Water Policy and Plan. This process took an unreasonably long time, and finally State Cabinet, on October 23, 2017, approved Water Policy and Plan. Even after eight months of the approval above, no discussion between J&K Water Resources Management Authority, senior functionaries of the PHE, Irrigation and Flood Control Department and Department of Forest, Ecology and Environment has been initiated to chalk out the strategy for effective implementation of the policy.[55]

As defined under Clause (zw) of Section 4, one of the objectives of the enactment are the imposition of the complete ban on encroachment of water bodies, wetlands, watercourses, and reclamation of such water bodies wetlands and watercourses. In *Balbir Singh vs State of J&K & Ors,*[56] it is contended that even after the enactment of the J&K Water Resources Act, the State Water Resources Regulatory Authority has not been stopping the encroachments of such lands, nor any action as contemplated under the aforesaid Act is being taken. The Court, while passing interim direction as to maintain status quo in respect of further construction in the areas of a water body also directed the Government to frame State Water Policy and Plan/Scheme under the Act for safety, prevention and restoration of wetlands, flood channels, marshland as well as lands recorded as khads in the revenue record. It also directs authorities to take stringent and practical measures to preserve the sanctity of river Tawi from being polluted by the waste and toxic water emanating from authorized/unauthorized colonies alongside the concerned river.

Another case of official slackness comes into light when residents of lower Barnai seek the intervention of the High Court[57] to issue a writ of mandamus commanding the respondents to exercise their statutory duties under the Jammu and Kashmir Land Revenue Act read with the provision of Jammu and Kashmir Water Resources Regulation and Management Act, 2010. The issue pertains to removal of illegal and unauthorized encroachment made by several encroachers who have forcibly and illegally raised the construction over the

54 Balbir Singh & Ors. v. State of J&K & Ors, 2016 (1) JKJ 65; Gulab Chand & Anr. v. State of J&K & Ors on 6 August, 2014.

55 Notified 8 months back, implementation of J&K State Water Policy yet to begin, Daily Excelsior, July 2,2018

56 Balbir Singh v. State of J&K & Ors , 2016 (1) JKJ 65.

57 Inhabitants of Village Lower Barnai v. State of J&K and others on 28th December, 2019.

Gair Mumkin Choi/Nallah (Water Bodies) situated at Village Lower Barnai, Tehsil Jammu (North), Jammu. The Court directed to restore the position as it exists before encroachment of Choi/Nallah for the natural flow of water which has a catchment area of 17 kanal 14 marla.

Such lackadaisical attitude shows the seriousness of law enforcement agencies towards the conservation and judicious use of water bodies in the region. Thus, a robust control mechanism in the form of fixing accountability of derelict functionaries is must to ensure efficiency in administrative actions and decisions.

b. Top-down approach:

Farmers' participation in irrigation management is crucial at every step because those potentially affected by the decision must be considered. The Act places more reliance on departmental machinery by entrusting nearly all the functions related to Irrigation works to Assistant Executive Engineer, Executive Engineer and Superintendent Engineer. Moreover, local bodies must be brought on board while deciding water tariff under this Act. It is pertinent to mention that the Draft State Water Policy and Plan 2016-17 also highlighted this fact that the public agencies in charge of taking water related decisions tend to take these on their own without consultation with stakeholders, often resulting in poor and unreliable services characterised by inequities of various kinds.

c. Regulatory mechanism under the Act:

The J&K Water Resource Regulatory Authority consists of a Chairperson and not more than three members. The Government shall appoint them on the recommendations of a selection committee.[58] The Selection Committee comprises the Chief Secretary, Administrative Secretary (PHE/I&FC Department), Administrative Secretary (Planning & Dev. Deptt.), Administrative Secretary (Finance Deptt.), Administrative Secretary (Law Deptt.). The purely bureaucratic composition of the Selection Committee impedes the creation of a genuinely apolitical authority. In practice, there exists a close link between the Government and the authority.

Additionally, there was no authority in place from 2015 to 2017. Further, against the sanctioned strength of 19 officers, only 12 has been filled.[59] Even now, the authority is functioning only with a Chairperson appointed for the last one and a half years.[60]

58 Jammu and Kashmir Water Resources (Regulation and Management) Act, 2010, § 139, 141(1), No. 21, Acts of Parliament, 2010.

59 J&K Water Resources Regulatory Authority, http://jkswrra.nic.in/lo.html (last visited April 10, 2021).

60 Shri G.S. Jha has taken over as Chairperson w.e.f. 27.10.2020.

Hence it is imperative to fill the vacant positions as and when vacancy arises so that the normal functioning of the authority shall not suffer.

d. Environmental Sustainability:

No doubt the J&K Water Resources Act mandates the authority to promote sustainable water conservation and management practices; it is insufficient given the impending environmental concerns related to water resources projects. Thus elaborate provisions and guidelines must be in place to mitigate any environmental concerns and ensure sustainable development. It entails integrated and multi-disciplinary approach to planning, formulation, clearance, implementation and monitoring of irrigation projects and schemes.

e. Interdisciplinary approach and coordination:

The Act envisages multi-stakeholders involvement for implementing this Act viz., Irrigation and Flood Control Department, Department of Forest, Ecology & Environment; PHE, Revenue Department and State Pollution Control Board. Further, managing water resources requires knowledge of the relevant physical sciences and technology. Experience, however, reveals that the lack of coordination is primarily responsible for the poor implementation of this Act. Therefore, what is required at this juncture is the appropriate expertise on an individual level and efficient coordination between different agencies to translate the intended objectives of this legislation.

Conclusion

To sum up, it can be concluded that no doubt the legislature has painted a rainbow of rights to ensure judicious, equitable and sustainable management, allocation and utilization of water resources for irrigation purposes but due to administrative slackness, poor coordination and defiance of some persons who are otherwise duty-bound to translate the legislative intendment into reality, the intended objectives under the Act get eclipsed under dark clouds of insensitivity. Prevention of encroachment, obstruction or demolition on existing water bodies and field channels must be viewed seriously. Further systematic problem identification is necessary to understand the requirements of a particular area to determine the barriers involved in improving irrigation management and better agricultural production. It is particularly crucial to address the need of Kandi areas in Jammu region. Promotion of the consciousness to conserve water is to be done through education, awareness building, regulation, incentives and disincentives can address wastage and inefficient use of water. Most notably, involvement of users, farmers, local bodies and voluntary organisations in various aspects of planning, design, development and management of water resources schemes and plans can effectively mitigate the widening gap between irrigation potential created and utilized.

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Chapter 3
Agricultural Water Law and Policy: Goan Perspective

Dr. G. Shaber Ali* Dr. Kim Couto**

"The earth, the land and the water are not an inheritance from our forefathers but on loan from our children. So, we have to handover to them at least as it was handed over to us."

Mahatma Gandhi[1]

Abstract

Water is one of the most important natural resources for all the living organisms on this earth including agricultural activities. Agriculture is one of the most important sectors that provides sustenance to the human beings on this earth. Water on this earth is scare, hence there is a need to preserve, conserve and save the water for future generations. For this purpose, we need to have proper law, policy and management of water resources. In this article an attempt is made to look into the Central Water Policy and the role played by the State of Goa in adopting similar policy for water preservation. This article starts with an introduction about the importance of water, its use and need to control water misuse. This article is mainly divided in to five parts. First part deals with the colonial regulations made by the Portuguese rulers in Goa, second part deals with the post-colonial period regulations incorporated with regards to water conservation, preservation, and the third part is concerned with National Water Policies introduced from time to time by the Central Government in 1987, 2002, 2012 and 2021 and Goa State water policies introduced to comply with

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1 Newman, J. (2011). Green Ethics and Philosophy: An A-to-Z Guide (Vol. 8). Sage.

Central water policies and its advantages for the State. Fourth Part deals with Goa State Water Policy. Goa State made draft water policies in 2000, 2011 and 2015. Unfortunately till today there is no regulation in this regard, it is high time for the State of Goa to have a policy as soon as possible to keep pace with new challenges in the word in the matters relating to natural resources like water and environment, climate change and global warming. The article concludes in the Fifth Part with observations, stating the urgent need to introduce the Goa State Water Policy.

Keywords: *Water Policy, Ground water, Irrigation, Water bodies.*

Introduction

Water is one of the most important elements available for the survival of the living creatures, including human beings on this earth. Though 3/4th of the earth is covered with water, only a very miniscule fraction is fresh water and available for utilization of mankind. The water on the Earth is in the form of salty water (sea water), frozen water or river water. From which 97% of water is sea water and 3% of water is in form of pure or fresh water and from that 3%, 2% is the water frozen on the poles of the Earth that is North and South poles, then only 1% fresh water is usable which may be in flowing rivers or lakes or ponds or such flowing water.[2]

Water is one of the most precious gifts of the nature to living organisms on this earth. Mankind has been using water since its appearance on earth. Civilizations grew and prospered in the proximity of water. It is a scarce resource and is fundamental to life, livelihood, food security and sustainable development. It is our responsibility to protect, conserve and preserve the natural resource for the future generations. Though quantity of water is more on this earth, still we face water crisis during summer seasons.

Water is used in a multitude of human activities such as agriculture, industry, domestic, and most for drinking. Apart from human consumption, water is essential for animal and plant life on the earth, importantly for drinking. Water is distributed geographically, so it needs costly infrastructure for transportation and it is difficult to store, for human consumption without expensive treatment. Other problems related to water include waterlogging and flooding.[3]

2 https://www.quora.com/ What is the percentage of fresh water on Earth-1 visited on 11th May 2021.

3 Masood Ahmed and Eduardo Araral, Water Governance in India: Evidence on water Law, Policy, and Administration for Eight Indian States, (2019, Lee Kaun School of Public Policy, National University of Singapore, Singapore)

India's long history can be traced back to the Indus Valley Civilization that developed on the banks of the river Indus. India is a subcontinent surrounded by the Himalayas in the North and three sides by the sea on the west, the south, and the east. India is criss-crossed by 12 major river systems. About 85% of the available water is used for agricultural purposes, 8% for domestic purposes and 5% for industry (FAO Aquastats 2003).[4]

The present article is divided into five parts. In the first part the author delineates the water policy and legislative provisions during the colonial era. In the second part, various laws and the water policy adopted during the post-colonial period have been analysed and discussed. In the third part water policy introduced by the Central Government has been examined. The fourth part deals with Goa State water policy. The article concludes in the fifth part with observations, stating about the immediate necessity to introduce the Goa State Water Policy.

First let us start with role of Portuguese in making water regulations and policy to deal with agricultural water during the colonial period in Goa.

1. Water Regulations in Goa in the Colonial Period

Goa having a strategic location in the Indian sub -continent and easy accessibility to the sea and rivers, became the principal point of entry for the Portuguese. In the early period of their setting foot on Goan soil, the Portuguese colonial masters were initially keen on monopolising trade by means of the sea route which had been discovered by Vasco da Gama in 1898. Interestingly, at the behest of the Portuguese Government, a strategy which came to be known as the Blue Water Policy was devised. By this policy, the erstwhile Portuguese Viceroy Francisco Almeida demanded all-out efforts to maintain Portuguese supremacy at sea instead of building a territorial empire. By this, he envisioned Portugal as a powerful nation having control of the Indian Ocean.[5]

One finds that the Portuguese made specific regulations and laws to govern their colonial empire overseas. But certain general laws such as the Portuguese Civil Code of 1867 (hereinafter referred to as Code) were extended in their application to the Portuguese territories in India including Goa which was conquered by the Portuguese.[6] The application

4 Philippe Cullet and Joyeeta Gupta, *India : Evolution of Water Law and Policy*, in Joseph W. Dellapenna & Joyeeta Gupta eds, The Evolution of the Law and Policies of Water (2009, Dordrecht: Springer Academic Publisher).

5 Available at https://andedge.com/portuguese-trade-in-india/last accessed on 15/5/2021.

6 *See* Article 1and 3 of Law dated 18th November, 1869 Extending the Civil Code to the Overseas Provinces available at https://www.indiacode.nic.in/bitstream/123456789/8312/1/ocrpor tuguese

of the Code with special reference to three areas of provisions dealing with Navigable Natural Water Bodies, Non-Navigable water Bodies, spring and water resources and provisions in relation to rain water and flood water is verified as follows:

a. Code Provisions on Navigable Natural Water Bodies

The provisions of the Portuguese Civil Code from Articles 431 to 464 dealt with rights and obligations with respect to natural water bodies and other water works. These provisions in the first place recognise the rights of the public to use public waters and navigable and floatable waters.[7] However, these rights were not unfettered.[8] The Code stipulated that such use should be without prejudice to the interest of navigation or floating operations. It further laid down that in case any dispute arose between the general interest of navigation and interest of agriculture or industry the same would have to be resolved administratively. It further restricted any permanent construction work in the water body without prior permission of the competent administrative authorities.

b. Code Provisions on Non -Navigable Natural Water Bodies

Articles 434 to 443 dealt with the rights in respect of water bodies which are neither navigable nor floatable such as water courses passing through properties. The rights and liabilities of the owners of properties through which such water bodies passed and the neighbouring properties are set out in these Articles. These Articles spelt out the rights to use the waters from such bodies by the owner of the property through which it passes and the rights of the owner of the neighbouring property in respect of the said water body. These provisions lay down that the owner in possession of properties which are crossed by a water course which are neither navigable nor floatable can use the waters for the benefit of their properties without causing damage to the adjoining properties and without altering the point of exit of the water body.[9] The owner of the property through which the water course crosses has a right to alter the river bed or channel thereof but subject to the same conditions imposed for the use of the water of such water bodies.

The manner of sharing of waters by owners of adjoining properties through which the water course passes, is also set out in detail in the Code.[10] Among other aspects, it lays that

civilcode.pdflast accessed on 13/5/2021.

7 Portuguese Civil Code, 1867, Article 431.

8 *Ibid.* Art. 432 and 433.

9 *Ibid*. Art. 434.

10 *Ibid*. Art. 436.

each of the adjoining owners shall have the right to use part of the waters proportionate to the need of his property. The Code prohibits the landowners adjoining the water course from preventing their neighbours to use water for domestic purposes. However, this right would cease when the public fountain is constructed and the said neighbours have the water they need without much difficulty or much inconvenience.[11]

The Code also provided for prevention of pollution and obstruction of water courses where it is laid down that in case of excess water, the owner of the property in which it is cannot pollute the same so as to make it unpotable or unusable for other persons having right to use the same. Similarly, the owner cannot obstruct the free flow of water by creating any obstacle in the water course. Breach of any of any of the above obligations entailed recovery of costs of cleansing work and conservation as well as imposition of fines and payment of damages.

c. Code Provisions on Springs and Water Sources

Articles 444 to 452 deals with springs and water sources. Accordingly, an owner is entitled to the free use of the spring water in his property except when third parties have acquired rights to the same. Further, if the spring waters were medicinal waters their use was regulated administratively.[12] The owner of any source of water cannot change the customary course thereof if inhabitants of the locality were using the same. He could however demand compensation for such use if the use was without just title. The owner of a land could search for water in his property by digging wells, mines or other excavations without prejudicing the rights of third persons over the waters of such properties.[13] It was also permissible for a person to dig a well in public or municipal land with prior permission of the administrative or municipal authorities.

d. Code Provisions on Rainwater and Flood waters

The Code also made provisions with regard to the enjoyment of rainwater and flood waters. A landowner could freely enjoy the rainwater which fell directly on to his land. However, he could not divert the natural flow of such waters to the land of another, without their express consent.[14] Articles 456 to 464 dealt with canals and private aqueducts. The Code

11 *Ibid*. Art. 440.

12 *Ibid.* Arts. 444 and 445.

13 *Ibid.* Art. 450.

14 *Ibid.* Art. 454.

laid down that any person can canalise underground or surface water to flow over his property for the purpose of agriculture, farming, orchards, kitchen gardens etc. Aqueducts were mandated to be maintained and the owners of adjoining property though which the aqueduct passes were entitled to whatever natural growth occurred on the embankments but could not object to the repair and inspection of the aqueducts.[15] The Code also provided that the owner of the servient property could ask to relocate the aqueduct within their own property if it was beneficial to therm. The water of the aqueduct was not solely for the use of the owner but also for owners of adjoining properties who would have to bear a proportionate share of the expenditure incurred to canalise and maintain the aqueduct.[16] The Code also made the provisions relating to aqueducts applicable to waters flowing from ditches, artificial conduits, trenches, drains furrows and other modes of drainage. Articles463 and 464 dealt with the enjoyment of water taken into private properties from rivers by the erection of catchment works, dams or similar works.

A perusal of the various provisions discussed above, demonstrate that the Code recognised the rights of parties to the use of existing water sources. It also regulated the maintenance of existing water sources without touching upon aspects such as the augmentation of such sources.

2. Post -Colonial Period

Goa on being liberated from Portuguese rule in 1961, the integration of Goa into the Indian Union resulted in most Indian laws being made applicable to the territory of Goa.[17] Besides, the Legislature of the erstwhile Union Territory of Goa, Daman and Diu also enacted legislations for the territory. Law was made recognising the terms of tenancy, rights and obligations of tenants of agricultural lands in Goa. Laws were also made with regard to collection of land revenue and for the creation of various authorities such as the Mamlatdar with important functions under each of the specific legislations. After liberation, provisions were made to deal with Agricultural tenancy, water resources and irrigation.

a. Relevant Provisions on Agricultural Water under The Goa, Daman and Diu Agricultural Tenancy Act, 1964

The Goa, Daman and Diu Agricultural Tenancy Act, 1964 extending to the State of Goa and Union Territories of Daman & Diu was brought into force on 16th December 1964. Chapter

15 *Ibid.* Arts.456-458.

16 *Ibid.* Arts. 458,459.460.

17 The Goa Daman and Diu (Laws) Regulation, 1962 and The Goa Daman and Diu (Laws) No.2 Regulation, 1963.

V of the said Act deals with the Tenant's right to operate sluice gates. As per this provision, the tenant is entitled to operate the sluice gates if these exist for the purpose of regulating the supply of water or for the purpose of irrigation of land. He has also the right to fisheries in the vicinity of the sluice gates.[18] The Act makes the tenant liable to pay rent to the landlord and obliges him to maintain the sluice gate. The Act further mentions that if the tenant desires to take water for agriculture from a water source away from the property and by constructing a channel through an adjoining property, he can do so after arriving at an agreement with the owner of the adjoining property or if no such agreement is arrived at, he may make an application to the Mamlatdar to do so.[19] The procedure to be followed by the Mamlatdar in dealing with such applications is set out in subsection (2) of section 39 itself. Section 42 lays down that if there is surplus water in a water course, such surplus water can be used by an adjoining neighbour by payment of rates agreed to between the parties. If no agreement is arrived, it will be decided by the Mamlatdar. The Act also lays down the manner of discharge of joint responsibilities by tenants in section 42 -A of the same Act.

b. Relevant provisions on the use of sources of water under the Goa, Daman and Diu Mamlatdars Court Act, 1966

The Mamlatdar, under the Goa, Daman and Diu Mamlatdar's Court Act,1966 has powers to remove or cause to be removed any impediment to the natural or customary flow in a channel or surface water used for agriculture, trees or other crops. The Mamlatdar also has powers to bestow the use of water of any well, tank reservoir canal or water course whether natural or artificial used for agricultural purpose to any person who has been dispossessed or deprived thereof. The Mamlatdar further has the power to restore any right to use or take water for the purpose of irrigation or domestic use of which any person has been deprived otherwise than under the due authority of law.[20]

c. Relevant provisions on water use under the Goa, Daman and Diu Land Revenue Code, 1968

The Goa, Daman and Diu Land Revenue Code,1968, was enacted to consolidate and amend the Law relating to Land and Land Revenue. As per section 80 of the Code, any occupier of land who makes use of water from an irrigation system is required to pay additional land revenue for the additional advantages accrued from the water thus received.

18 Goa, Daman and Diu Agricultural Tenancy Act,1964, Section 38(1).
19 *Ibid*. Section 38(2).
20 Goa, Daman and Diu Mamlatdars Court Act,1966, Section 4 (a),(b),and (g).

From the discussion above, it is evident that the legislations aforementioned, contain provisions which incidentally deal with water for agricultural purposes. In addition, one finds specific legislations enacted by the State of Goa concerning surface water resources and ground water resources.

d. Relevant provisions of The Goa, Daman and Diu Irrigation Act,1973

The Goa, Daman and Diu Irrigation Act, was enacted in the year 1973. The purpose of its enactment is to make provision primarily, for the construction, maintenance and regulation of Canals and for the supply of water therefrom and matters pertaining to irrigation, among other things. The Act provides for inspection and regulation of water supply upon land, building or water course by a Canal officer for the purpose of inspecting and regulating the use of water.[21] Canal Officers is empowered to enter upon land to carry out maintenance works on the canal. Power to Government to execute drainage works for the purpose of improvement of proper cultivation or irrigation of land, and protection from floods or accumulated waters or from erosion by a river, is also provided for under the Act. Where the Canal Officer opines that a water course is to be constructed for the supply of water for cultivation, he can determine the suitable alignment for the water course and Collector can acquire land for such purpose.[22] The Act gives powers to the Canal Officer to determine the time for supplying water for irrigation, the period, quantity and area of supply of water from the canal. The Canal Officer also has the powers to stop supply of water as laid down in Section 22 in certain circumstances. Provision with respect to construction and maintenance of canals are also set out in the Act. There are other provisions which deal with allied aspects such as imposition and collection of irrigation cess. In all the Act is both regulatory and fiscal in nature.

Goa has also enacted exclusive legislations to provide for accelerated increase in agricultural and allied production in the State of Goa, through a programme of comprehensive and systematic development of command areas on scientific and modern lines, comprising measures for optimum use of land and water, prevention of land erosion and water logging, improvement of soil fertility and regulation of cropping pattern, and for proper maintenance and upkeep of irrigation systems in the State of Goa for ensuring maximum benefits to the cultivators under the command areas and for matters connected therewith.[23]

21 Goa, Daman and Diu Irrigation Act, Section 7.
22 *Ibid*. Sections 15 and 16.
23 The Goa Command Area Development Act, 1997.

3. National Water Policy:

Government of India had adopted the **National Water Policy (NWP) in 1987** which was updated in 1998 due to the various issues and challenges that emerged. The NWP aimed to give an encouragement to the protection, development and regulation of this precious resource, i.e. water.[24]

a). National Water Policy 1987:

The National Water Policy, 1987 was the first document to recognise water as resource of national importance, that requires water management at national level. This policy recognised the importance of drinking water, recycling and reuse of water resources and preservation for ecological balance. The main objectives of this policy were allocation of water for drinking purpose and also allocation for irrigations. The policy creates a frame work for the management of water resources at national level as well as State level.[25]

b). National Water Policy 2002:

Due to changes during 1990's in India's socio-economic makeup and large number of investments, it was felt that there was a need to create a new National Water Policy. The National Water Resource Council began its work and introduced the National Water Policy, 2002.

The policy provides for the setting up of suitable river basin organisations for the planned construction and maintenance of the river basins as a whole or sub-basin. The main reforms proposed under the policy are in the farming, manufacturing and domestic industries. The goal was to improve water usage, rain water harvesting, drainage system, elimination of subsidies, deter pollution and National River Connection project in the agricultural sector.[26]

Under this policy the Water Resources Management Plan should be participatory in different areas of planning, architecture and production and management of water supply schemes.

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24 https://goawrd.gov.in/content/State-Water-Policy-Draft visited on 12th March 2021.

25 Ramesh MK and Sairam Bhat, *A Primer on Agricultural Water use Law in India, (*2020, CEERA, NLSIU, Bangalore) at 18 - 20.

26 *Ibid*. at 20-22.

Government of India due to the changing scenarios of growing population, impacts of climate change, water utilization being under strain, increase in water and water related conflicts, etc circulated the National Policy 2012 with a view to take cognizance of the existing situation and propose a framework for creating a system of laws and institutions and adopting a plan of action with a unified national perspective. The same was adopted by the National Water Board in 2012.

c). National Water Policy 2012

To deal with the above issues, the National Water Policy 2012, was circulated with a view to take cognizance of the existing situation and propose a framework for creating a system of laws and institutions and adopting a plan of action with a unified national perspective. The policy mentions the present scenario of water resources and their management in India.[27]

Each State should set up a water regulatory authority to repair and control the water tariff in accordance with the principles set out in this policy. The authority is empowered to resolve water disputes if it is called upon to do so. It also states that the States have the ability to set down effective policies, laws and regulations on water, further state can delegate the required authority to the lower levels of governance to deal with local water issues.[28]

This policy once again reiterated the idea of community-based water protection that has to be institutionalised and improved. Water supply initiatives are to be interdisciplinary in nature, social, environmental issues, and techno economic concerns should be discussed with the affected families. Need to reduce the gap between urban and rural areas in dealing with water resources. The 2012 Policy also dealt with water pollution, desalination, sewage issues, hydropower projects, and industrial development.[29]

Water policies have been continuously and consistently revised to bring harmony and sustainability in allocation, distribution of water resources. The Central Government has prepared a **Draft National Water Policy, 2020** mainly dealing with two important aspects that is sustainable development and respect for environment. It is hoped that this policy may come into effect in the year 2021.

To supplement the National Water Policy, to bring out the state specific issues and for the

27 Ministry of Jal Shakti, National Water Policy, 2012, http://mowr.gov.in/policies-guideline/policies/national-water Policy visited on 12th March 2021.

28 *Supra* note. 25 at. 24-25.

29 *Ibid* at. 26.

purpose of remodelling the existing laws/rules there is also an ardent need to adopt the State Water Policy 2015 which would supplement the National Water Policy as well bring out the various aspects of protection, development and regulation of the water resources in the State of Goa.

4. Goa State Water Policy

It is a popular belief that Lord Parashurama shot an arrow into the sea and asked the Sea God Varuna to retreat till the point where the arrow had struck. Lord Varuna obliged ...thus creating the land of Goa.[30] Goa, the smallest State in the Indian Union has been blessed abundantly with water and land resources. Situated on the western coast of the country, the State receives copious rainfall from the south west monsoons.

Water is a State subject and there is a necessity to lead the way for essential legislation on water governance in the State to deal with the local water situation. The State has enacted two Acts,[31] with the changing scenario, there is an ardent need to make necessary amendments in the existing Acts and draft new acts to plan, manage and regulate utilization of water resources in the basin in the State.

Government of Goa adopted the State Water Policy which encompassed the site specific issues of the State. As per changing conditions in society there is need to make necessary amendments in the existing Acts and draft new acts, to plan, manage and regulate utilization of water resources in the basin with in the State. As per the NWP for the protection, development and regulation of water, the Government of Goa adopted the State Water Policy which encompassed the site specific issues of the State.

a. Goa State Water Policy, 2000

In the year 2000, the State of Goa brought out its Water Policy founded on the distinctive features of the water resource scenario in the State. Goa has 9 rivers and 49 tributaries which are perennial water bodies. Out of 9 rivers, 6 rivers originate and flow with in the State boundaries, out of three Terekhol, Chapora originate in Maharashtra and Mandovi originates in Karnataka State. However, on account of quick drainage due to steep slope, porous substratum, deforestation in high ranges, non-uniform distribution of rainfall

30 Available at https://www.currentresults.com/Weather/India/average-yearly-precipitation.php last accessed on 23/5/2021.

31 Goa Irrigation Act, 1973 for regulation of surface water resources and Goa Ground Water Regulation Act, 2002 for regulation of ground water resources.

etc. the rivers tend to go dry during summer months and the level of ground water declines.[32]

The Policy of 2000 has several objectives: In the first place, the Policy aims at the preparation of an Integrated Master Plan for Water Resources Development for the State of Goa consisting among other things, of an Integrated River Basin Development Plan having due regard to the environmental and socio-economic impacts. Secondly, it seeks to assign topmost priority to drinking water schemes. Next, it aims at making suitable provision for drinking water supply in existing and future irrigation and hydel schemes. The regulation of uncontrolled extraction of sand from river beds in consultation with the concerned agencies and the need for adequate protective measures against the damage caused by mining activities, were the among the other significant objectives. The Policy also explores the possibility of using mining pits for storing water for ground water recharging needs. Educating people and creating awareness about pollution of surface and ground water and the need for controlling it forms a part of the objectives. The avoidance as far as possible, of any large-scale submergence and displacement of human habitations while taking surface water schemes is envisioned. The Policy also endeavours to locate the schemes for water supply for domestic use higher up in the river basin where there are no mines, industries polluting the sources of water, and to create state level central facilities for collection, processing and storage of hydro-meteorological data.[33]

The Policy also recommended the need for measures in advance such as the construction of *bandharas* on all important rivulets to prevent potential sea level rise and other effects of global warming. The Policy also states that the ground water development should be undertaken with caution and resorted to only where it is inevitable. It also stipulated the need for conservation, development and management of traditional techniques of construction of bunds for the protection of the Khazan lands. The Policy envisages two types of strategies to arrest and conserve water; The short-term strategies would include drip irrigation, desilting of pans and ponds and other water saving mechanisms. The long-term strategies would include adoption of large-scale soil and water conservation methods, control over deforestation and promotion of afforestation. Emphasis is also laid on the preservation of fresh water bodies and judicious ground water development.

32 Review of State Water Policy of Goa in line with National Water Policy 2012 with regard to climate change available at https://cwp-india.org/wp-content/uploads/2018/03/Report-of-Review-of-Goa-Water-Policy-with- respect-to-NWP-2012.pdf last accessed on 13/5/2021.

33 *Supra* note 6 at p.15-16.

In the State of Goa cropping pattern, land use, hydrological status and environmental needs of the State are completely different from that of other states. Goa has a good network of inland water ways. It has a large number of manmade and natural freshwater lakes, tanks, ponds including temple ponds and backwater bodies. This has great potential for inland fisheries as well as for aquatic sports facilities.[34] A Water Resources Control Board will be notified to co-ordinate all the activities of the State Water Policy 2000

After going through the Water Policy 2000, let us understand the provisions of Goa Ground Water Regulations Act, 2002.

Relevant provisions of the Goa Ground Water Regulation Act, 2002

The next important legislation needing consideration is the Goa Ground Water Regulation Act, 2002. This Act was enacted to regulate and control the development of ground water resources. It is heartening to note that the State of Goa was one of the first States to implement the Ground Water Regulation Act. For the purpose of implementation of the Act, the whole State has been declared as a scheduled area. The Act among other things also establishes Ground Water Officers (GWO) for each district and a Ground Water Cell which has been notified under the Act.

The first task required to be undertaken under this Act is to identify and notify areas with water scarcity and over exploitation of ground water resources. It provides for the registration of all existing wells within a scheduled area with GWO. It prohibits the sinking of new wells in the scheduled area without the permission of the GWO. In this manner, the use of ground water in scheduled areas which are over exploited areas is sought to be regulated. The Act prohibits the transportation of ground water from a source in a scheduled area of more than 30,000 litres annually without due permission of the GWO. While granting or refusing permission the GWO has to consider the purpose for which the water has to be used, the existence of other competitive users, the existence of other wells in the locality, availably of groundwater, long term ground water behaviour etc. The Act also makes similar provisions for protective measures in respect of water scarcity areas.

When an existing well is found to be adversely affecting any other public drinking water source, the GWO may order the owner to stop drawing water from the well and close or seal the same. The Act confers various powers on the GWO to enforce the regulated use

34 Committee formed for working on new State Water Policy, *Herald, Daily News Paper*, Panaji, 2nd January 2021.

of ground water. The Act imposes penalties on defaulters which are penal and punitive in nature and which range from fines to imprisonment.[35] It also has provisions regarding the requisition of wells. Section 23 of the Act lays down protective measures for public drinking water sources and existing ground waters in non-scheduled areas.

The *Obras Publicas* (Public Works) was entrusted with the responsibility of ensuring water supply under the Portuguese regime. After the re-organisation of the earlier composite Public Works Department (PWD), the Irrigation Department was set up as per Government Notification No.7/17/1/80 WET, dated 25/6/1981 which started functioning as an independent Department with effect from 1/7/1981.[36]

Keeping in mind the State water policy and irrigation for conservation of agricultural land, prevention of sale of agricultural land to non-agriculturists, imposing standards of cultivation of agricultural land, contract farming and establishment of co-operative farms and farming estates, etc[37], the Law Commission of Goa prepared a comprehensive Draft Bill known as '**The Goa Land and Water Bodies (Conservation and Management) Bill, 2011'.**

The salient features of this Bill are:

a. Conservation of Agricultural Land and Water Bodies on the lines of Conservation of Forest, Heritage sites and buildings, etc.
b. Conservation and management of water bodies
c. The Bill was proposed because of large scale urbanization at the cost of fertile lands in Goa.
d. Irrigation facilities were provided through micro and medium irrigation schemes.

Though the Bill does not completely deal with water policy, one of the aspects of the Bill was water bodies and its conservation. For the purpose of irrigation and agricultural needs the Government of Goa introduced water schemes to manage three dams that is Tillari, Anjune and Salauli. The Bill was never made into a law for the purpose of implementation,

It is noteworthy that the State Water Policy has several aspects which correspond to the National Water Policy of 2012. However, certain key features present in the NWP of 2012 are absent in the State Policy. Some of these are the avoidance of wastage of water, increasing the efficiency of water use, management of groundwater as a community pool resource

35 Goa Groundwater Regulations Act, 2002.
36 Available at https://goawrd.gov.in/administration/about-the-department last accessed on 21/5/2021.
37 http://goalawcommission.gov.in/reports/report18.pdf visited on 12th May 2021.

held by the State as public trust doctrine.[38] The Goa State Water Policy also includes certain climate change related aspects which are not evident in the National Water Policy of 2012.[39]

b. Draft Goa State Water Policy, 2015

In order to highlight the specific issues as regards the protection, development and regulation of water resources in the State of Goa and also for the purpose of supplementing the NWP 2012, the need was felt to adopt the Draft Goa State Water Policy 2015. The new Policy is currently in the Draft form. The Draft Policy aims at covering the planning, management and regulation of the utilization of water resources in the basins in the State.[40] Besides this, it was also prepared to bring out the various aspects of protection, development and regulation of the water resources in the State of Goa. The object of draft policy was to alleviate water shortage issues in Goa, the Government planned to revise the earlier policy to make it adaptable to the current situation. A committee was constituted to revise the State Water Policy by taking note of the draft State Water Policy 2015. The policy was revised taking into consideration the suggestions received from the public and other stakeholders that are already in the possession of the Water Resources Department.[41] Some of the key areas of the Draft Water Policy mentioned among others are a) Creation of a hydrological database b) Adaptation to climate change c) Enhancing Water that is available for use c) Ground water d) Water Pricing e) Conservation of water f) Water supply and sanitation g) Strategies for better management of resources h) flood and drought management i) research and training j) institutional arrangements.

a) **Creation of a hydrological database**: The Draft Policy seeks to create a water resources database for the purpose of making it available for organisations involved in planning and designing various development projects. Making data available regarding various water related matters such as rainfall, surface water, ground water, water quality, water extraction and use and irrigation, etc. to facilitate development of database for decision making in water management is also part of this policy.

b) **Adaptation to climate change:** The Draft Policy envisions that due to climate change there would be variability in water resources and therefore it is necessary to mitigate these effects on the community by adopting measures for water storage in ponds, lakes, rivers etc. and also revive traditional water harvesting structures and bodies.

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38 *Ibid*. p.17.

39 In the Goa State Water Policy, stress is laid on taking measures to mitigate the effects of global warming and the expected rise in sea water level.

40 Available at https://goawrd.gov.in/content/State-Water-Policy-Draft last accessed on 18/5/2021.

41 *Ibid.*

c) **Enhancing water that is available for use**: To augment water available for use, the Draft Policy envisages the use of better water management practices and strategies. It recommends renovation, restoration and rejuvenation of fresh water bodies and water saving techniques like drip and sprinkler irrigation, recycling of water for non-consumptive uses etc.

d) **Ground water**: Various regulatory and protective measures to control the use of groundwater have been addressed through the State Ground Water Policy. Registration of all groundwater structures, the metering and charging of withdrawals for commercial, industrial and mining uses, registration of water transportation carriers, and issuance of passes for these carriers, stringent action against the violators are some of the measures envisaged thereunder. Measures to ensure the quality of groundwater and mechanisms to encourage recharge of groundwater resources as well as the periodical monitoring of groundwater levels have been addressed in the policy. It may be noted that there is a Ground Water Policy 2015 which has been separately notified but forms a part of the overall State Water Policy.

e) **Water pricing**: This aspect is dealt with in the Policy where it suggests the formation of a water regulatory authority and fixation of water charges on volumetric basis wherever possible as well as the need to review the same periodically.

g) **Conservation of Water**: The Policy outlines the need for everyone to protect and conserve the rivers, river corridors, water bodies in the State. Water bodies in the vicinity of urban areas should be regulated to avoid pollution and contamination. Such bodies require to be periodically checked and stringent action taken against the polluters. Quality of water and particularly of ground water, should be monitored and maintained.

h) **Flood and Drought**: The Policy requires the formulation of different agricultural strategies for improvement of soil water productivity to manage droughts. The Policy also recommends that flood forecasting should be envisaged using real time data acquisition systems and linked to forecasting models. Community based action plans to tackle/mitigate flood-drought situations should also be undertaken.

i) **Water supply and Sanitation**: The Policy makes provisions regarding domestic water supply and sewerage treatment. The former should be mainly dependent on surface water supply. As regards the latter, efforts should be made to utilize the re-used water for non-consumptive purpose. Efforts are required to be made to supply industries with raw water or reused water so that the drinking water systems in the State are not overburdened.

j) **Research and training needs**: The Policy lays emphasis on the need for continuing research and advancement in technology to address issues in the water sector in a scientific manner. Innovations in the water sector should be recognised and appreciated.

k) **Institutional arrangements to implement the State Water Policy**: The Policy envisages the notification of a Water Resources Control Board to co-ordinate all the activities of the State Water Policy.

On a perusal of the above, one finds that the Draft Water Policy of 2015, is in several ways an improved version of the State Water Policy of 2000.[42] However, there is need for including crucial aspects in the Policy some of which are crop and plant selection based on their water consumption, promotion of traditional organic agricultural practices which require less water, proper implementation of the ground water policy, emphasis on water use efficiency, involvement of stakeholders in the formulation of the policy, among other aspects.

The State Water Policy of 2000 does address various key issues to counter the adverse effects of climate change and recommends some measures to protect the degradation of this precious resource keeping in mind the special water resource scenario in the State. However, it lacks reference to some significant aspects which are sought to be addressed in the State Water Policy of 2015, which is currently in draft form. It is imperative that water issues in the State such as the declining water supply and the deteriorating quality of water be suitably addressed urgently.

Even after six years the Goa Government has failed to implement the State Water Policy 2015, drafted to alleviate water shortage issues in Goa. The Government is set to revise the policy to make it adaptable to the current scenario. A Committee under retired Central service officer Chetan Pandit has been constituted to revise the State Water Policy by taking note of the draft State Water Policy 2015. The policy has to be revised taking into consideration the suggestions received from the public and other stakeholders which are already in the possession of the Water Resources Department.

42 Available at https://cwp-india.org/wp-content/uploads/2018/03/Report-of-Review-of-Goa-Water-Policy-with-respect-to-NWP-2012.pdf at p.5, last accessed on 14/5/2021.

Conclusion:

At present, India is facing a decrease in available water resources that has implications on India's agricultural sector. State of Goa is also experiencing water stress. Improvement of policies, strategies and regulatory measures to prevent the water misuse should be taken into consideration. Awareness and orientation of water users in the agriculture sector to switch to more water efficient production methods can help the country against water scarcity. Moreover, enforcement of best practices can help present policy makers and planners to enhance governance structures.[43]

India is not a water rich country and is further challenged due to negative impacts of climate change; enormous wastage owing partly to poor management and distorted water pricing policies. The Northern Ganga River Basin has abundant water resources, whereas the Southern River Basin has few, but with high levels of pollution in ground water and surface water. Increase in population and changing lifestyles has increased demand for water (largely for irrigation) in both urban and rural areas.

Water overuse can cause water shortage, often occurs in areas of irrigation, agriculture, and harms the environment in several ways including increased salinity, nutrient pollution, and the degradation and loss of flood plains and wetlands.[44]

"Goa has a lot of constraints for utilisation of the water resources, with rivers prone to tidal variations up to 40km inland," the water policy said. The document recommended formation of a Water Board for Goa, which would approve all major state and private projects after studying its impact on water resources.[45] In spite of a heavy annual rainfall (higher than the national average), rivers have very little water flowing for half of the year. Summer months due to factors such as quick drainage due to steep slope, porous substratum, deforestation in high ranges, non-uniform distribution of rainfall etc.[46]

The State of Goa is hydrologically land locked. It has a large number of manmade and natural freshwater lakes, tanks, ponds including temple ponds and backwater bodies. The cropping pattern, land use, hydrological conditions and environmental needs of the State

43 Dr. Vibha Dhawan, Water and Agriculture in India, Background paper for the South Asia expert panel during Global Forum for Food and Agriculture (GFFA) 2017, with support from Federal Ministry of Food and Agriculture, Germany, at. 24.

44 *Ibid.*

45 Gauree Malkarnekar, "As Goa thirsts, state's water policy remains paper tiger", *Times of India*, Daily News Paper, (Panaji) 5th June 2019.

46 https://goawrd.gov.in/content/State-Water-Policy-Draft visited on 12th March 2021.

of Goa are distinctly different from that of the country as a whole thus creating the need for a State Water Policy.[47]

Further, there is a need to increase water storage in ponds, lakes, rivers, ground water, small or large reservoirs, revival of traditional water harvesting structures and bodies, adaptation of better demand management like adoption of better cropping patterns, water application techniques, sprinkler and drip irrigation.

It is clear from the foregoing discussion that the contemporary legal regime for the protection and regulation of the water resource and its use in the State of Goa is inadequate and far from satisfactory.

Keeping in mind the above factors and necessity in management of water resources in the State of Goa there is an immediate need to create a State Water Policy. It is high time for the State to make water policy as per the changing conditions in our society. No time may be wasted to bring in a more comprehensive law regulating water which would ensure among other things, water security for the people of the State of Goa.

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47 *Ibid.*

Chapter 4
Law and Policies on Ground Water Management in Karnataka: An Analysis

Dr. Shilpa M. L.*

Abstract

India is primarily an agricultural country and thus ensuring supply of sufficient water for irrigation purposes is a matter of importance. The two sources of irrigation available in our country are surface water and ground water. Agriculture being the main occupation of the people of India, ground water accounts for more than forty percent of the total irrigated area. Unfortunately, thirty percent development of ground water has attained utility and the remaining seventy percent of the available potential still remains to be developed for the further usage. This excessive unregulated extraction and deteriorating quality of this freshwater resource have resulted in water scarcity. Consequently, the prevailing rules and regulations on water resources in India focus mainly on pollution control and its utilization.

The legal instruments governing water as a subject matter are applicable only to surface water whereas the legal regulations pertaining to ground water are put to darkness.[1] Even though certain legislations on ground water have been formulated by different States it is just piece meal and fails to address the issues effectively. Ground water is the primary source of drinking water and its nexus with the right to safe drinking water as a fundamental right is indispensable. Apparently, the conservation, protection and management of ground water forms the basic human right and fundamental right as well. Therefore, water being the main source of life and limb of human concerns for production and protection, effective implementation of existing

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1 *Philippe Cullet, Water Law, Poverty and Development, (1st edn, OUP 2009) p.126*

laws in this regard is the need of the hour. In this milieu, the author in the present paper makes an attempt to know workability of the provisions of law particularly in the State of Karnataka and tries to assess the lacunae in implementation by providing workable solutions.

***Keywords**: Ground water, Human Rights, Fundamental Rights, Lacunae, Agriculture, Conservation, Life, Management, Karnataka, Protection, Resources.*

Introduction

Ground water seeps through different zones from side-to-side rocks and soil and is stored beneath the ground. It is always stored in rocks which are known to be aquifers made up of gravels, sand, sandstone or limestone. The area where water fills the aquifer is called saturated zone. The depth from the surface at which ground water is found is called water table. Heavy rain causes the water table to mount and equally the drawing out of ground water can cause the level to decrease.

Since a very long time, human beings have obtained much of their basic requirements through good quality water from ground water resources. The surface manifestation of underground water has played an elementary role in human settlement and social development. Due to the expansion of cities and towns there is an escalating use of ground water as the urban dwellers depend more on open wells, bore wells and spring sources. Ground water also contributes more towards irrigation as agriculture requires ground water for high productivity of crops. The exploitation of ground water resources for human need takes back to the earlier civilization, but substantial resources development has been basically of the present epoch. The quick expansion in ground water exploitation occurred during 1950 to 1975 due to industrialization. However, it is believed by the experts that India is fast moving towards a crisis of ground water overuse and contamination.[2]

Nonetheless, ground water received low attention than that of surface water in policy framework. Inadequate legislative policies, institutional set-up and non-implementation of available provisions of law have made the author to throw light on the existing piece meal legislations and also the researcher tries to bring about the way in which the public and private interest have balanced and involved in decision making and management process in addressing the issues of ground water management in the State of Karnataka.

2 Himanshu Kulkarni, Mihir Shah, P.S. and Vijay Shankar, 'Shaping the contours of ground water governance in India', November 25, 2014, http://ac.els-cdn.com/S2214581814000469/1-s2.0-S2214581814000469-main.pdf? _tid

Importance of Underground Water

The use of ground water has significantly played an immense role in the economic development, standard of living and in protecting the environment**.** Despite the fact that there have been millions of private wells, there is a huge exploitation of ground water over the past five decades due to several factors such as poor public irrigation and poor service delivery from public water supply system which impelled the farmers to have their own private irrigation system, modern pump technologies which helps in frequent pumping of water from the ground, continuous pumping of ground water from aquifers where it does not have enough time to reload itself and the government electricity subsidies.

Ground water is one of the natural and most important resources of a nation. Every living organism on the earth requires water as its primary requisite. The extraction rate of underground water is greater than that of the recharge rate[3] It is believed that India is fast moving towards a predicament of ground water overuse and contamination.[4]Likewise, with reference to the State of Karnataka, ground water is under severe exploitation due to the over usage and of irregular planning which is most profound and an sustainable irrevocable challenge to the state of Karnataka. Additionally, the current status of the monitoring and administration of ground water depletion is not systematically reviewed on account of lack of proper mechanism. The technical capacity of the institutions both at national and state level is totally weak and also there is inadequate human resource/ manpower to undertake the tasks required for groundwater management and protection. There is an institutional vacuum within the state, which needs to be filled.

Reasons for the Ground Water Crisis in the State of Karnataka

In the present scenario there has been a significant change in demography, economical diversity and agricultural patterns, which has increased the demand for ground water in the State of Karnataka. Expanding irrigation and urbanization have greater impact on the diminishing situation of underground water in the State. There is also a growing disquiet on the deterioration of ground water quality due to geogenic and anthropogenic activities. Highly concentrated fluorides, nitrates, iron, arsenic are also mixed with the underground water which leads to the acute contamination of ground water.

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3 Suresh Kumar, A.Raizada and Hrittick Biswas, "*Ground Water Extraction in Karnataka and its Long Term Implications*", India Journal of Economics and Development, Volume 12, No.4:615-628, October-December, 2016, DOI: 10.5958/2322-0430.2016.00185.2

4 *Ibid.*

The pollution of ground water occurs due to human and animals wastes, application of fertilizers which resulted in the high level of nitrates and potassium in the ground water.[5]There are many unique advantages of ground water to farmers, industries, residential purposes as well as for public purposes and also to other drivers of the ground water who are at play and which need to be scientifically and legally addressed.

Some of the reasons for the deterioration of ground water are:

1. **Production of cheap drilling, pumps, and electricity:** The recent policies in the State of Karnataka whereby all the new Irrigation Pump IP connections must use certain standards such as 'Bureau of Energy Efficiency (BEE) standard Efficient Pump Sets' by replacing the old inefficient IP sets are some of the pilot scale initiatives which prompt the farmers to undertake borewell drillings and many other work efficiently. Some of the initiatives are **a)** Water Energy Nexus (WENEXA) project **b)** Nippani and Byadgi Project, **c)** Malavalli Project. While these policies have gains for some, they are fraught with certain drawbacks. These policies gain positive response to some, but have many drawbacks. There are number of unknown and unauthorized IP connections and the Revenue Register (RR) number for the IP sets are absent in some cases especially in rural areas. In most of the cases multiple pumps will have the same RR number plates. Such unauthorized use may yield the farmers by depleting the ground water to the core.[6]

2. **Demands of urbanizing population and Industries:** Urbanization and industrialization have led to hysterical growth of cities in the state; the water resources continue to be insufficient to meet the needs of the urban population. Water markets and water contamination are on the mount, mainly in the rapidly growing cities of Karnataka. Pipe water supply covers only a portion of total domestic water consumption in the urban areas of Karnataka State particularly Bangalore. To cope with the differences, people make use of both surface water and ground water, basically from private bore wells, tankers and bottled water because there is no regulation or monitoring of this private self-supply. There is

5 Ministry of Water Resources, Groundwater Resource Estimation Methodology, (Report of the Groundwater Resource Estimation Committee, 2009) para 2.4 < http://cgwb.gov.in/documents/gec97.pdf> accessed on 23 November 2015.

6 Centre for Study of Science, Technology and Policy (CSTEP), Energy Department, Planning Department, Government of Karnataka, August, 2018.

large uncertainty in the total consumption of domestic water.[7] Bangalore Water Supply and Sewerage Board (BWSSB) is an organization responsible for providing water supply and sewerage system and it has implemented Cauvery Water Supply Schemes in 4 stages owing to the scarcity of water due to the dried up sources, BWSSB supplies water through tube wells. The distribution system within the city has been affected by corrosion of pipes. The expansion of core areas of Bangalore which has extended and reached the outskirts have been included into the city limits. These outskirts which were once villages are thickly populated and less equipped with basic facilities. Therefore, the developing areas face great problem without full coverage of surface water supply and inevitably depend on ground water as an alternative which is again a problem towards ground water depletion.[8] Out of total 274 Unban Local Bodies which are covered under the Karnataka Urban Water Supply and Drainage Board, maximum area depends on groundwater rather than river water. In addition, maintenance, poor distribution system has also added to the problem.[9]

3. **Agricultural Requirements in Arid and Semiarid Areas:** Compared to other regions the Arid and Semi-Arid regions have limited natural water resources. Due to the lack of surface water, ground water is the main source for agricultural and domestic purposes. The ground water in theses region is over exploited due to increased population growth and excessive agricultural purposes.[10] In many arid and semiarid regions ground water has been withdrawn at rates far in excess of recharge, leading to ground water 'mining', which results in the decline of water level and increasing pumping costs. Indirectly, this affects the environment by land subsidence, water quality degradation and reduces ground water discharge resulting in acute loss of habitat and bio-diversity.

4. **Difficulty of rural population besieged to survive:** Due to the introduction of several water intensive crops in the State of Karnataka, the ground water level has come down owing to the over pumping of ground water for irrigation purposes.

7 Vishal K. Mehta, Muddu Sekhar and Deepak Malghan, 'Gorund Water Impact of Water Consumption Pattern in Bengaluru, India, JGWR (ISSN:2321-4783), Vol.2, Issue 1, June 2013, AGGS Publications, India.

8 K.V.Raju, S.Manasi, N.Latha, 'Emerging Ground Water Crisis in Urban Areas-A Case Study of Ward No.39, Bangalore City, Institute for Social and Economic Changes, 2008.

9 Press Release, Karnataka Urban Water Supply and Drainage Board November 19, 2020.

10 Biswajit Das, Sunil Kumar Singh, 'Ground Water Potential Zone Mapping of Semi-Arid Region of Kalburgi and Yadgir Districts of North Karnataka : A Geospatial Analysis Approach', International Journal of Current Research, Vol.8, Issue-03, pp.28807, March, 2016.

The rural population which depends on ground water for drinking and for other domestic purpose suffers from scarcity of water largely due to the over exploitation of ground water and lack of safe drinking water facilities.[11] In Karnataka, out of 176 taluks, 45 taluks fall under the category of over-exploited groundwater, 26 under semi-critical category. Only 97 taluks of Karnataka are considered to be safe. As per the estimation 85% of the rural population depends on ground water for their survival.[12]

5. **Subsidies made available to the farmers to start bore wells and pumps:** There are many schemes and policies made available to the farmers under Ganga Kalyana Scheme[13], Karnataka Surya Raitha Scheme etc., where irrigation facilities are provided like Individual Borewell Scheme, Life Irrigation Scheme, Open Well Scheme etc., The State Government also replaced the water system pump sets with sun based water pumps to create excess energy. Even though these schemes provide required irrigation facilities to the farmers, it is a bane to the ground water sources. These schemes and policy decisions to provide free subsidized bore well and electricity has become a key driver for widespread groundwater exploitation. The Karnataka ground water depletion has forced the farmers to drill upto depth of 200 to 300 meters which inturn causes severe ground water crisis.

Methods to Improve or Recharge Ground Water System in India

The main water sources in the State of Karnataka are canals, tanks, wells, tubes, lift irrigation etc., Karnataka State is pointed to be an over-exploited region when it comes to ground water.[14] The Ministry of Water Resources, River Development & Ganga Rejuvenation, has also stated that Karnataka is one among the 9 States where ground water has reached a critical stage. The need to address the issue of water scarcity in Karnataka due to the contaminated ground water quality which impact human health is the need of the hour.[15]

11 M.A.Siraj, Deccan Herald, 'Ground Water Reaching Dangerous Level' 23rd March, 2020, https://www.deccanherald.com/opinion/in-perspective/free-trade-zones-in-andaman-a-mindless-proposal-970436.html.

12 According to D.Subburaj, Regional Director, Central Ground Water Board of Karnataka.

13 Karnataka Minorities Development Corporation Limited, Government of Karnataka, http://kmdc.karnataka.gov.in/info-2/KMDC+SCHEMES/GANGAL+KALYANA+SCCHEMES/en

14 "Ground Water Year Book-India 2019-20" Central Ground Water Board, Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga Rejuvenation, Government of India, Faraidabad.

15 G.B.Ramesh, G.B.Lokesh and Kashinatha Dandoti, 'Groundwater Regulation and Management Practices in Karnataka-Status and Challenges', International Journal of Current Microbiology and Applied Sciences, ISSN: 2319-7706, Special Issue-7, pp.807-815.

In this perspective, the Government of India, in order to improve the depleting ground water level has laid down certain guidelines on artificial recharge to ground water. These guidelines provides planning of artificial recharge projects, techniques and designs and also the monitoring mechanism for artificial projects in order to enhance the sustainable yield in areas where over-development has exhausted the aquifer and to improve the quality of existing ground water through dilution. The artificial recharge also helps in conserving and storing excess water for future requirements. The basic purpose of artificial recharge of ground water is to ensure supplies from aquifers depleted due to excessive ground water usage.[16] Various artificial techniques have been successful throughout India except Karnataka coastal zone and Saurashtra due to the extreme intake of the aquifer and its connection to the sea which means that less water is available for harvest than is injected. In certain circumstances where channels are used for ground water recharge, 'multiple use' benefits have also been achieved.[17] The Atal Bhujal Yojana (Atal Jal) , a Central Government scheme has also played a vital role to increase the capacity of ground water resources.[18]

The over-exploitation of ground water not only reduces the future availability but also declines base flows in all the major river basins. As the ground water level declines, soon the minor irrigation tanks in the State of Karnataka starts drying up. In this background, the Karnataka State Water Policy, 2019, is also considered to be one of the policies which is in the way of improving productivity and sustainability of farming system by reducing water use and also making changes in the incentive shift from rice and sugarcane to less water-intensive millets and pulses. The policy recommendations also owe towards improving the irrigation efficiency and also in the expansion of irrigated area Integrated Management of Groundwater, watersheds and Minor Irrigation Tanks outside the Major or medium command areas.[19]

'A man in an imagination is like a bird without wings.' In the same way, policies and schemes without proper enforcement is of waste. Institutions encompass not only rules and norms but also rules in utilizing it or institutional planning. In effect, the implementation and

16 Guide on Artificial Recharge to Ground Water, Central Ground Water Board, Ministry of Water Resources, New Delhi, May, 2020.

17 Ramaswamy Sakthivadivel, 'The Groundwater Recharge Movement in India', 33First East Street, Kamarajanagar,Thiruvanmiyur,Chennai-600041,India.https://www.iwmi.cgiar.org/Publications/CABI_Publications /CA_CABI_Series/Ground_Water/protected/Giordano _1845931726-Chapter10.pdf

18 'Atal Bhujal Yojana' (Atal Jal', Ministry of Jal Shakti, Department of Water Resources, River Development & Ganga Rejuvenation.

19 Karnataka State Water Policy, 2019, Karnataka Jnana Aayoga (Karnataka Knowledge Commission), Government of Karnataka June, 2019.

enforcement of ground water laws have to be propped up by the society. The involvement of ground water users in ground water management system is a necessary condition for enforcement mechanism.

Legal Regulations of Ground Water Management in India-with special Reference to Karnataka

The common law principles are applied in India to access water, mostly by linking access to water with control over the land. The over exploitation and the pollution problems threatening groundwater availability and quality in the State of Karnataka require effective legal frameworks for the efficient management of groundwater which is the need of the hour. The right to groundwater in India is a concomitant right of the rights of the owner over his/her land. The land owners have the right to dig wells in their land according to their desire and also have the right to extract as much ground water they require in excess. Therefore, the right to groundwater is considered to be as an integral part of right to ownership. In this milieu there are many legislations, policies and programmes laid down for addressing the issues of ground water which have been mentioned below:

1. **The Indian Easement Act, 1882**: The Act imposes certain restrictions on such rights by way of easements.[20] It states that the right to underground water not passing in a defined channel cannot be acquired by prescription.[21] The Act also makes clear that the right of every owner of the land to collect and dispose within his limits under the land that does not pass in a defined channel can be restricted through easement.[22]More specifically, the Easement Law recognizes the right to ground water as a right attached to the land and can be restricted by easement.

2. **The Water (Prevention and Control of Pollution) Amendment Act, 1988:** In addition to groundwater depletion, groundwater pollution is also one of the legal concerns to curtail the contamination. The Act prohibits the discharge of sewage or trade effluents into a stream or well or sewer or on land without the previous consent of the state pollution control board.[23] Therefore, dumping of wastes and other chemical effluents have come under the regulatory jurisdiction of Pollution Control Board.

20 Sec.7 of the Indian Easement Act, 1882

21 *Ibid*, Sec. 7(d)

22 Sec.7(g) of the Indian Easement Act, 1882

23 Section 25 of the Water Act as substituted by The Water (Prevention and Control of Pollution) Amendment Act, 1988

3. **The Environment Protection Act, 1986:** The rules and the notifications under the Act such as the Coastal Regulation Zone Notification, 2011-prohibits the ground water withdrawal within 200 meters of high tide line and the Hazardous Waste (Management and Handling) Rules, 1989 have also conferred on pollution control boards, the power to grant authorization for the activities connected with disposal of hazardous wastes on ground water. Unfortunately, these rules are silent on the question of whether the board should consider the effects of hazardous waste on ground water prior to authorizing permission for disposal in a particular locality.[24]

By considering the Constitutional scheme of legislative powers on water, the State of Karnataka has formulated ground water conservation legislation. The laws governing ground water in the State are;

Karnataka Ground Water (Regulation for Protection of Sources of Drinking Water) Act, 1999[25]: The Act regulates the exploitation of ground water for the protection of public sources of drinking water and matters connected therewith.

Karnataka Groundwater (Regulation and Control of Development and Management) Act, 2011: The substantive provisions of the Act applies only in the notified areas. The Act regulates three main aspects of ground water abstraction

a. Drilling companies to register themselves and their machineries before June, 2013;
b. Anyone aiming to dig or drill a new borewell is required to seek prior permission from the authority;
c. Owners of all existing types of wells were to apply for grant of registration before the end of March, 2013.

But unfortunately, the law does not apply to deepening of existing wells, which is a wide spread practice. For instance, the rich farmers can deepen their wells by spending more money while poor farmers are forced to stop cultivation. Therefore, in order to protect the small-scale farmers and also to conserve groundwater for better agricultural economy, over exploitation of ground water should be controlled. The Act does not mandate quantum of water for a particular use and it does not specify any penalty for wastage of water and incentives for water use efficiency.

24 P.Leelakrishna, Environmental Law in India, (3rd edition, Lexis Nexis) 2012, P.169
25 Act No.44 of 2003.

Guidelines to Regulate and Control Ground Water Extraction in India, 2020[26]: In pursuance of the direction of Hon'ble National Green Tribunal and the powers conferred thereupon,[27] the Department of Water Resources, River Development & Ganga Rejuvenation has notified the guidelines to regulate and control groundwater extraction in the country.[28] The Groundwater abstraction in States/ UTs continues to regulate by Central Ground Water Authority. Wherever the States/UTs have come out with their own groundwater abstraction guidelines, the provisions of CGWA guidelines will prevail. The States will have liberty to suggest additional conditions on the local hydro-geological situations and the same shall be reviewed by CGWA.

Consequently, the new or existing industries looking for expansion, infrastructure projects and mining projects abstracting ground water which require to seek No Objection Certificate from CGWA or the concerned SGWA can go on with the entire process through online web-based application system.[29]

The Karnataka Ground Water (Regulation and Control of Development and Management) Rules, 2012: Theses rules are framed in exercise of the power conferred by Section.38 of the Karnataka Ground Water (Regulation and Control of Development and Management) Act, 2011. Accordingly, the Government of Karnataka makes rules with reference to the registration of existing users in the notified, registration of drilling areas, utilization and operation of authority funds, annual report of the authority, recovery of dues as arrears of land revenue, rain water harvesting and ground water recharge where the authority identifies worthy areas and give direction to the local authority, to implement the rain water harvesting structures only in the recharge worthy areas. The person who requires permission for the construction of well or borewell shall comply with the technical opinion rendered by the concerned technical officer of the Authority.

All the users who extract and use groundwater in Karnataka come under the purview of the law.

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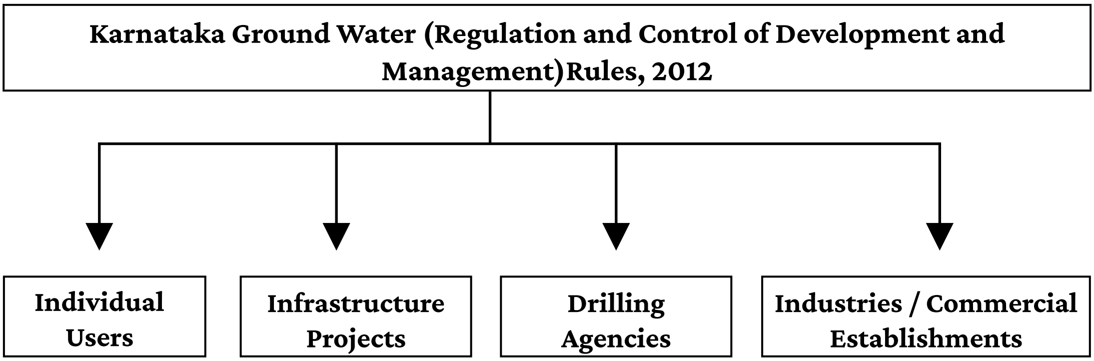
26 Ministry of Jal Shakti (Department Of Water Resources, River Development And Ganga Rejuvenation) (Central Ground Water Authority) Notification, New Delhi, the 24th September, 2020.

27 Section 3 (3) R/W/S 5 of the Environment (Protection) Act, 1986 (29 of 1986).

28 Ministry of Jal Shakti, notification vide S.O. 6140 (E), dated the 12th December, 2018.

29 Exemptions from seeking No Objection Certificate for Groundwater extraction:: (i) Individual domestic consumers in both rural and urban areas for drinking water and domestic uses. (ii) Rural drinking water supply schemes. (iii) Armed Forces Establishments and Central Armed Police Forces establishments in both rural and urban areas. (iv) Agricultural activities. (v) Micro and small Enterprises drawing ground water less than 10 cum/day.



The Karnataka Groundwater Authority, after consultation with various expert bodies is of the opinion that it is necessary in the public interest to regulate the extraction or the use of Ground Water in any area. Consequently, the Authority has declared areas "Notified" based on the groundwater availability and extraction in the given region. As per the notification issued by the Karnataka Groundwater Authority and signed by Member Secretary, Department of Mines and Geology, the areas declared as "Notified Areas" are required to take permit before digging bore wells.

The industries, commercial establishments or other users are required to install water measuring devices i.e., ISI Specification and furnish the information about the total quantity of groundwater extraction to the authority. Every drilling agency has to furnish information regarding the date, location and number of bore wells drilled with depth, casing and yield of each bore well every month to the concerned Authority at each district.

This below table is as per the Rules laid down under The Karnataka Ground Water (Regulation and Control of Development and Management) Rules, 2012.

Consumer	Purpose	Application Form (New User)	Application Form (Existing User)	Processing Fee	Supporting Documents and Conditions
Individual	Drinking or Agriculture	Form-1A	Form-4	Rs.50/-	Khata Certificate and Survey Number of that property, Address Proof, Ownership of Property including Tax paid receipts issued by the local Authority or Record of Right (RTC maintained under the Karnataka Land Revenue Act, 1964) pertaining to the property

Commercial Establish-ment or Industries	Industrial, Commercial or entertain-ment Use	Form-1B	Form-4	Rs.500/-	Documents from competent authority for the establishment
Drilling Agencies	Business	Form-6		Rs. 5000/-	**1**.Must have a compressor of the drilling rig with minimum capacity of 900/200 PSI **2**. Must possess a machinery to drill a bore well of diameter of minimum of 152mm. **3**. Must have appointed driller having minimum qualifications of Diploma in Mechanical Engineering with 3years experience in well drilling in hard rock terrain to undertake, drilling or digging operation and extraction of groundwater.

According to the Rules laid down, it is mandatory to apply for a permit to dig new bore wells, and also register the existing bore wells in the 'notified' areas. But, ever since the enforcement of the Rules, very few have bothered to register or obtain for new bore wells. The idea behind registering existing bore wells is to account for the recharge and discharge rate. But the Authority continues to give permission for digging new bore wells which is very relentless inappropriate.

Nevertheless, the Central Government has framed model framework for the States to adopt the rules, regulations and guidelines but there is no cohesive arrangement on all the State Legislations. But that very framework has undergone revision and the major drawback is that most of these legislations are applicable to particular notified areas. Even though there are many institutional and organizational set ups on water management[30] the groundwater legislative framework as it prevails today in our country is firmly an indefensible scaffold on natural resources. This embodies an instrumental canopy towards ground water management.

30 Water Resources Development Organisation, Command Area Development Authorities, Department of Minor Irrigation, Department of Mines and Geology (Groundwater wing), Watershed Development Department (Department of Agriculture), Karnataka State Natural Disaster Monitoring Centre (Erstwhile Drought Monitoring Cell) and Karnataka Regional Remote Sensing Centre. (Department of IT and S & T).

Water as a Subject Matter under the Constitution of India

The Constitutional framework on distribution of legislative power between the Centre and the States in India is reflected in Article 246 of the Constitution of India.[31] Accordingly, the Parliament is empowered to legislate on entries List-1 of the Union List and State legislature have the power to legislate with respect to subject in List-II. Both the Parliament and the State Legislatures are empowered to enact with respect to the entries in List III i.e., the Concurrent List. The legislative capacity on 'water' is based on Entry 17[32] of the State List and Entry 56[33] of the Union List with respect to Seventh Schedule of the Constitution of India.

Right to Water being a matter of universal survivor right has nowhere been mentioned in the Indian Constitution expressly. But water is considered to be an integral part of Article 21 of the Constitution of India. The Constitution divides the rights into Fundamental Rights including Civil and Political Rights, and Directive Principles of State Policy[34] including economic, social and cultural rights. Though both the rights are constitutionally documented, only fundamental rights under Article 14 and 15 are directly justiciable.[35]

Judicial Response to Conservation of Ground Water in India

The administrative enforcement of the existing rules and regulations is the need for increased justiciability. Judiciary enables individuals to seek remedies and hold their government accountable, transparent and responsible. If the right of an individual is violated then the government becomes answerable for not fulfilling the responsibilities, which identifies access to water as an elementary form of human right.

In *Attakoya Thangal* v. *Union of India*[36]*, the High Court of Kerala has held that the groundwater resources in the Lakshadweep Islands were endangered by saline intrusion, due to undue*

31 The Constitution of India, 1950, Art. 246.

32 "Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to the provisions of Entry 56 of List-I."

33 "Regulation and development of inter-state rivers and river valleys to the extent to which such regulation and development under the control of the Union are declared by Parliament by law to be expedient in the public interest."

34 "The Directive Principles provide that "[t]he State shall strive to promote the welfare of the people by securing and protecting as effectively as it may a social order in which justice, social, economic and political, shall inform all the institutions of the national life."

35 C. Raj Kumar, Human Rights Implications of National Security Laws in India: Combating Terrorism While Perserving Civil Liberties, 33 Denv. J. Int'l L. & Pol'y 195 (2005).

36 AIR 1990 (1KLT 580)

groundwater pumping by rich farmers. Residents argued that their right to life and livelihood was threatened by this private ordering, since the excessive pumping threatened a significant universal resource, and as a result, they were granted relief under Article 21[37] *of the Indian Constitution. This particular decision apparently made the right to water a fundamental right.*

In R.Anjaneya Reddy v. *State of Karnataka,*[38] the Supreme Court restrained the Karnataka government from pumping secondary treated water from its sewage treatment plants in Bangalore into irrigation tanks in Kolar District for recharging the ground water table after taking note of a report claiming that the water was contaminated. The High Court failed to appreciate that the right to safe drinking water is a fundamental right under Article 21 of the Constitution of India and by supplying water containing hard metals and pollutants harmful to living beings, a large population of Kolar, Chikkaballapur and Bangalore Rural Districts are deprived of their fundamental rights. With this background, the Supreme Court has granted a stay order and a direction to the State Government to stop pumping secondary treated water from its sewage treatment plant (STPs) into the Minor Tanks of Kolar District.

In *K.M.Hiriyannappa* v. *State of Karnataka*[39]*, the Hon'ble High Court of Karnataka held that the ground water is not a captive resource of the land owner. It flows like the river beneath the surface. Accordingly, the owner of a particular land claiming as his right*[40]*by putting modern equipment to draw water, which ultimately deprives public at large. Hence, the mandate underSec.3*[41] *has to be implemented in its full spirit to save the public, poor and disadvantaged and to keep the environment and livestock safe. The Hon'ble High Court held that the Act should be understood in proper perspective that every bore well, lorry or truck shall take permission from the competent authority before proceeding to sink a bore well in anybody's land. It should be in the form of licence to move to sink a bore well.*

In State of West Bengal v. *Kesoram Industries*[42], the Hon'ble Supreme Court restricted the power of the State to grant any right in relation to deep underground water. The Court held that the deep underground water belongs to the State in the sense that doctrine of Public Trust extends thereto. The holder of the land may have only a right of user and cannot take any action or do any deeds, where the right of others is affected.

37 "No person shall be deprived of his life or personal liberty except according to procedure established by law."

38 WP.No.27288 of 2019 (GM-RES) PIL.

39 WP.No.2503 of 2009 (GM).

40 The Indian Easement Act, 1882.

41 *The Karnataka Ground Water (Regulation for Protection of Source of Drinking Water) Act, 1999.*

42 AIR (2004) 10 SCC 201.

The stand of Indian judiciary over the issues pertaining to groundwater is not comprehensive in the contemporary situation. In the absence of clear laws, rules and regulations to guide the Courts, the judgments are not giving satisfactory result to the public at large. Due to the contradictory judgments, there is no stability, certainty or uniformity in the verdicts. Therefore, in order to make public believe in the justice system 'justice should not only be done but should be manifestly and undoubtedly seen to be done'.

Conclusion

As the population of a country increases, demand for water will also increase and the need for managing and planning water management and water supply system will also pile up. Ground water management can be a possible positive approach only if the people, the State and the political system proceed with clean hands, without selfish motives in their approach.

In the meanwhile, unauthorized use of irrigation water, excess usage of water by farmers and pumping of water from canals are depriving the small scale farmers with their due share of water. NGOs should come forward to join their hands with Local-Self Government. There should be open seminars conducted in villages and areas where there is a requirement to create awareness among the people in protecting and utilizing ground water in the State of Karnataka. The legislations have failed to address the issues regarding underground water management in agriculture zone, which is the backbone of the people of Karnataka. Hence, it is the need of the hour to have provisions with respect to agricultural sector. The authorities should have proper co-ordination for the effective implementation of the provisions of law. And most importantly there is a need to formulate a State Water Policy, which will comprehensively address the overall prospective development of the State. The existing legislations and policies which have been formulated have to be implemented in letter and spirit, in the interest of present and future generation.

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Chapter 5
Impact of WUCs on Efficiency of Irrigation Water Use in Bhadra Command Area

Seemakowsar N.* Dr. P. S. Srikantha Murthy**

Abstract

Water is a crucial input to agricultural production on which the sustenance of farmers' income is dependent. A proper water management mechanism has to be developed for its sustainable use. Water users' cooperatives (WUCs) is one such irrigation water management institution which will create a sense of belongingness with irrigation water resource among the farmers. The present study was undertaken in the Bhadra Command area. Four villages of Bhadravathi taluk were selected, two having active WUCs and the other two having flaccid WUCs. The results showed that there exists equity in distribution of canal water in areas under active WUCs, whereas, in areas under flaccid WUCs the farmers suffered inequity in the distribution of canal water. For the cropping systems a) arecanut, b) arecanut + coconut, c) arecanut + coconut + banana, d) paddy and e) sugarcane, the economic water use efficiency was higher in active WUCs (Rs.1,634, Rs.1,786, Rs.1,826, Rs.101 and Rs.75, respectively) than in the flaccid WUCs (Rs.1,122, Rs.1,185, Rs.1,374, Rs.93 and Rs.57, respectively). These results of the study emphasize the need for government intervention to activate flaccid WUCs to achieve equitable distribution of canal water, improve economic efficiency of irrigation water and realize higher net returns.

Keywords: *Active WUCs, Flaccid WUCs, Equity in water distribution, Economic water use efficiency, Physical water use efficiency.*

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Introduction

Irrigation water scarcity is the utmost constraint faced by a large number of farmers in India. It is the crucial input to agricultural production on which the sustenance of the farmers is completely dependent. It is considered as a public good in the living world, where all free-rides on it are leading to its irreversible loss. An efficient water management mechanism has to be developed for its sustainable use. Water users' co-operatives is one such water management technique which will create a sense of ownership on irrigation water resource among the farmers. Each WUC has set its own rules and regulations for managing, operating and distributing water. Lack of collective action and the problem of free riding have led to defunct of few WUCs questioning the equity in the distribution of canal water. Hence, it is necessary to form new WUCs or to rejuvenate the existing WUCs to ensure equity in distribution of canal water for irrigation. The present study, funded by ICAR-IIWM, Bhubaneswar under the Agri-Consortia Research Platform on Water, investigated the economic water use efficiency of canal irrigation and equity in distribution of irrigation water under active and flaccid water users' co-operatives in the Bhadra command area, falling under Southern Transition Zone of Karnataka. In this context, it was hypothesized that,

1. Distribution of irrigation water to the farms is more equitable along canals having active Water Users' Co-operatives.
2. Efficiency of irrigation water use is higher in the farms of farmer-members of active Water Users' Co-operatives.

Methodology

Study Area and Sampling

The study was carried out in the Southern Transition Zone of Karnataka during the agriculture year 2018-19. There are Four water users' co-operatives at Bhadravathi taluk of southern transition zone. Kagekodamagge and Dananayakapura are the two villages in the Bhadra command area which have active WUCs managed by farmers through collective action ensuring equity in distribution of canal water. Along the irrigation canals in these two villages water is first released to the tail end farmers and finally to head-reach farmers. Each farmer is provided with irrigation for five hours. Farmers are being charged Rs.100 per acre per year to meet out the operation and maintenance expenditure. Whereas, in Tiplapura and Sriramanagara villages which have flaccid WUCs, irrigation water is normally released from head-reach to tail-end farmers. Farmers in the tail-end do not get water indicating non-equity in distribution of irrigation water, leading to conflicts among farmers.[1] In these two villages no water charges are collected from the farmers. And tail-end farmers have to depend more on ground water compared to head reach farmers. Whereas in case of active WUCs both head-reach and tail-end farmers are conjunctively using surface and ground water.

Thirty sample farmers were selected randomly in each WUCs. Totally data was collected from 120 sample farmers for the research problem identified. Distance of the channel was divided into half and was demarcated as head and tail reach.

Economic and Physical Water Use Efficiency

Resources being scarce and the opportunity for development and adoption of superior technologies are competitive; therefore, efficient use of such scarce resource matters a lot.[2] There are two types of water use efficiencies, namely, physical water use efficiency and economic water use efficiency (WUE) which are calculated as follows—

$$\text{Economic WUE} = \frac{\text{Net returns (Rs.)}}{\textit{water used in acre inches}}$$

$$\text{Physical WUE} = \frac{\text{Output (q)}}{\textit{water used in acre inches}}$$

Quantification of Irrigation Water from Surface Water Irrigation and Groundwater Irrigation

a. Surface water

   Quantity of water = Number of irrigations × Depth of irrigation (cm) × Area of irrigation(ha)

b. Ground water

   Water meter was used to estimate the discharge or yield of water from borewells in some randomly selected farms, to cross check with the yield of water as perceived by

1 Suresh, E., *Economic analysis of cropping systems under tank irrigation in Northern Karnataka* M. Sc. (Agri.), Thesis (Unpub.), University of Agricultural Sciences, Dharwad (2010).

2 Ashok, M. T., *Economic analysis of conjunctive use of irrigation water in Malaprabha command area of Karnataka, M. Sc. (Agri.), Thesis* (*Unpub.*), Univ. Agric. Sci., Bengaluru (2018).

the farmers. Here, 1 inch =1000 GPH, 2 inches = 2000 GPH, 3 inches = 3000 GPH, and so on.[3] Following formula was used to estimate the groundwater yield from bore well,

$$\text{Water yield fraom BW} = \frac{\{\text{Water discharge by the well in GPH across all seasons* Number of hours pump put on across all seasons}\}}{22611}$$

Where, 1 GPH=22611 ha cm

Cost of Irrigation Water Using Natural Resource Economic Concept

a. Surface water

The price of surface water according to natural resource economic concept as reported by Nagaraj *et al.*[4] was Rs.12 per acre inch in 2002 and the same was compounded at an interest rate of 2 per cent to derive the present cost. The cost of surface water per acre inch was worked out to Rs.16.80 for the study year 2019.

b. Groundwater

1. Variable cost of groundwater irrigation

The variable cost of groundwater was estimated by adding operation and maintenance cost of the borewell with the amortized investment on drilling and casing of bore wells over the subsistence or economic life of the borewell/s (whichever is relevant for the specific bore well). The variable cost thus obtained was divided by the volume of groundwater extracted during the study year (2018), to obtain the variable cost of groundwater per acre inch.

2. Fixed cost of groundwater irrigation

The fixed cost of groundwater was obtained by amortizing the investment on irrigation pump sets, pump house, electrification charges, investment on pipe line, drip irrigation, sprinkler irrigation system, storage structures if any and investment on other accessories for a period of ten years. Fixed cost of groundwater per acre inch was obtained by dividing the amortized fixed investment by the volume of groundwater extracted during the study period.

3 Kiran Patil, *An implication of groundwater institutions on reducing negative externality, enhancing economic efficiency and welfare in Karnataka* 70 Indian J. Agric. Econ. 292 (2015).

4 N. Nagaraj, et. al., *Pricing of irrigation water in Cauvery basin* 5 Economic and Political Weekly 181 (2002).

Results and Discussion

Economic Water Use Efficiency

The economic water use efficiency can be defined as net returns per ha cm of water used.[5] Results of the economic efficiency in water use are presented in Table 1.

Table 1: Economic water use efficiency of farms under active and flaccid water users' co-operatives

Sl. No.	Crop	Net returns per ha (Rs.)	Water used in ha cm	Water use efficiency (Rs. /ha cm)
Active water users' co-operatives (n=60)				
1	Areca	6,45,094	394.81	1,634
2	Areca + coconut	7,07,192	396.00	1,786
3	Areca + coconut + banana	8,08,093	442.58	1,826
4	Paddy	8,166	81.06	101
5	Sugarcane	54,931	734.35	75
Flaccid water users' co-operatives (n=60)				
1	Areca	4,26,072	379.9	1,122
2	Areca + coconut	4,50,459	380	1,185
3	Areca + coconut + banana	5,28,057	384.42	1,374
4	Paddy	7,284	78.14	93
5	Sugarcane	39,740	692.21	57

The net returns per ha cm of water used in Arecanut, Arecanut+Coconut and Arecanut+Coconut+ Banana cropping systems were higher in areas under active water users' co-operatives (Rs.1,634, Rs.1,786 and Rs.1,826 per ha cm, respectively) than in the areas under flaccid water users' co-operatives (Rs.1,121, Rs.1,185 and Rs.1,374 per ha cm, respectively).

Even in case of paddy and sugarcane crops, economic water use efficiency was higher in farms under active WUCs (Rs.101 and Rs.75 per ha cm, respectively) than in farms under flaccid WUCs (Rs.93 and Rs.57 per ha cm, respectively). The higher economic water use efficiency of farms under active WUCs can be attributed to higher net returns realised by all farmers along the canal due to sufficient water availability to each farmer from head-reach

5 M. G.Chandrakanth, *Economic benefits from micro irrigation for dry land crops in Karnataka* 68 Indian J. Agric. Econ. 338 (2013).

to tail-end, where as in case of flaccid WUCs there was an insufficient water supply to tail-end farmers resulting in lower net returns.

Table 2: Comparison of Economic Water use Efficiency of Head-Reach and tail-end Farmers under Active and Flaccid Water users' Co-operatives

Sl. No.	Active water users' co-operatives			Flaccid water users' co-operatives		
	Head- reach (Rs. per ha cm)	Tail-end (Rs. per ha cm)	Percent difference	Head- reach (Rs. per ha cm)	Tail-end (Rs. per ha cm)	Percent difference
A	1,172.54	1,114.62	5.20	744.14	919.18	19.04
A+C	1,268.74	1,216.46	4.30	792.43	951.59	16.73
A+C+B	1,299.68	1,224.07	6.18	641.08	973.51	34.15

Note: A- arecanut; A+C- arecanut + coconut; A+C+B- arecanut + coconut + banana

Comparison of economic water use efficiency of head-reach and tail-end farmers under active and flaccid water users' co-operatives is presented in the Table 2. The economic water use efficiency of head-reach farmers, under active WUCs, was higher by 5.20 per cent for arecanut sole crop, 4.30 per cent for arecanut+coconut and 6.18 per cent for arecanut+coconut+banana cropping system, when compared to that of the tail-end farmers. Where as in case of farms under flaccid water users' co-operatives, the economic water use efficiency of head-reach farmers was higher by 19.04 per cent for arecanut sole crop, 16.73 per cent for arecanut+coconut and 34.15 per cent for arecanut+coconut+banana cropping system, when compared to that of the tail-end farmers. Lesser difference in the economic water use efficiencies between head-reach and tail-end farmers under active WUCs is due to equitable distribution of irrigation water. The higher economic water use efficiency of tail-end farmers when compared to that of head-reach farmers, under flaccid WUCs, can be attributed to lesser water wastage done by the tail-end farmers, since they get very less volume of cheaper canal water and their dependency on costlier ground water is high. Whereas the head-reach farmers, under flaccid WUCs receive abundant canal water which is priced low and their dependence on costlier ground water is minimal.

Physical Water-Use Efficiency

Technical efficiency or physical water use efficiency can be measured as output per ha cm of the water used. Results of the economic efficiency in water use analysis are presented in Table 3.

Table 3: Physical Water Use Efficiency of Farms Under Active and Flaccid Water Users' Co-operatives

Sl. No.	Crop	Active water users' co-operatives (n=60)			Flaccid water users' co-operatives (n=60)		
		Output (q)	Water used in ha cm	Water use efficiency (q per ha cm)	Output (q)	Water used in ha cm	Water use efficiency (q per ha cm)
1	A	388.05	394.81	0.98	260.99	379.90	0.69
2	A+C	399.75	396.00	1.01	265.89	380.00	0.70
3	A+C+B	509.39	442.58	1.15	323.97	384.42	0.84
4	Paddy	40.06	81.06	0.49	17.07	78.14	0.22
5	Sugarcane	316.46	734.35	0.43	232.54	692.21	0.34

Note:
- Yield of coconut was converted to copra unit (1000 nuts = 1.25q of copra) to assess the water use efficiency
- Arecanut; A+C- Arecanut + coconut; A+C+B- Arecanut + coconut + banana In farms under active WUCs, 0.98 q of arecanut, 1.01 q of arecanut+coconut and 1.15

While q of arecanut+coconut+banana was produced per ha cm of water, in farms under flaccid WUCs 0.69 q of arecanut, 0.70 q of arecanut+coconut and 0.84 q of arecanut+coconut+banana was produced per ha cm of water. Even in case of paddy and sugarcane crops, physical water use efficiency was higher in areas under active WUCs (Rs.0.49 and Rs.0.43 q per ha cm, respectively) than in areas under flaccid WUCs (Rs.0.22 and Rs.0.34 q per ha cm, respectively).

Both economic and physical water use efficiencies were higher in farms under active WUCs than in farms under flaccid WUCs leading to acceptance of the hypothesis that, economic efficiency of irrigation water use is higher in the farms of farmer-members of active WUCs was accepted. The results are in line with that of the study conducted by Ravi., S.C.[6] The difference in economic and physical water use efficiencies between active and flaccid WUCs can be attributed to low level of yield and net returns obtained by the tail-end farmers in flaccid WUCs, because of inequity in water distribution. When the averages of net returns and yield were worked out considering both head-reach and tail-end farmers,

6 S.C. Ravi, *Role of institutions, technologies, markets and governance in irrigation tank management in central dry zone of Karnataka - an economic analysis*. University of Agricultural Sciences, GKVK (2018).

these averages were higher for farmers in active WUCs than that in flaccid WUCs.

Table 4: Comparison of Physical Water Use Efficiency of head reach and tail end farmers Under Active and Flaccid Water Users' Co-operatives

Sl. No.	Active water users' co-operatives			Flaccid water users' co-operatives		
	Head reach (q per ha cm)	Tail end (q per ha cm)	Percent difference	Head reach (q per ha cm)	Tail end (q per ha cm)	Percent difference
A	0.97	0.96	1.04	0.73	0.68	7.35
A+C	1.00	1.01	0.99	0.75	0.69	8.70
A+C+B	1.12	1.11	0.90	0.76	0.72	5.56

Note: A- Arecanut; A+C- Arecanut + coconut; A+C+B- Arecanut + coconut + banana

There was not much difference in physical water use efficiency between head-reach and tail-end farms under active WUCs 1.04, 0.99, 0.90 per cent differences among A, A+C, A+C+B cropping systems, respectively.

While in farms under flaccid WUCs, physical water use efficiency of head-reach farms was higher by 7.35 per cent for arecanut sole crop, 8.70 per cent for arecanut+coconut and 5.56 per cent for arecanut+coconut+banana cropping systems, because of higher yield in head-reach farms due to more water availability compared to farms in tail-end regions of flaccid WUCs.

Difference in net returns realized by the farmers under areas of active and flaccid water users' co-operatives

From the Table 5 it is clear that the net returns per ha in arecanut, arecanut+coconut, arecanut+coconut+banana, paddy and sugarcane cultivation was higher in areas under active water users' co-operatives to an extent of 51.40 per cent, 56.99 per cent, 53.03 per cent, 12.11 per cent and 38.23 per cent, respectively, than in areas under flaccid water users' co-operatives.

Table 5: Comparison of Net Returns per HA in Farms Under Active Water Users' Co-operatives and Flaccid Water Users' Co-operatives

Sl. No.	Crop	Net returns per ha in Active water users' co-operatives (Rs.)	Net returns per ha in Flaccid water users' co-operatives (Rs.)	Percent difference in net returns
1	Arecanut	6,45,094	4,26,072	51.40
2	Arecanut+coconut	7,07,192	4,50,459	56.99
3	Arecanut+coconut +banana	8,08,093	5,28,057	53.03
4	Paddy	8,166	7,284	12.11
5	Sugarcane	54,931	39,740	38.23

This was because, the farmers in the tail-end region were deprived of the availability of proportionately equal volume of canal water in case of farms under flaccid water users' co-operatives, which resulted in lower returns. Whereas, in case of farms under active water users' co-operatives, the water was equitably distributed between the head-reach and tail-end farms resulting in higher returns for farmers in both head-reach and tail-end regions.

Thus, active water users' co-operatives ensuring equity in distribution of water among all the users are the need of the hour. The hypothesis that, the Water Users' Co-operatives have contributed significantly to enhance returns through their interventions was accepted. The results are in line with results of the study conducted by Arun et.al.[7]

Conclusion

Higher physical as well as economic efficiencies of water use all along the canals, higher net returns in all the cropping systems in the villages where WUCs have been active in management of irrigation water distribution, as compared to that in villages, where WUCs have been inactive, conclusively stresses the urgency for activating all the WUCs in all the command areas of the state to ensure optimal utilization of scarce water use which is fast depleting.

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7 G. Arun, *Canal irrigation management through water users' associations and its impact on efficiency, equity and reliability in water use in Tamil Nadu* Agric 25 Econ. Res. Rev. 419 (2012).

Chapter 6
Regulating Surface Water Quality for Irrigation Water Use in Peri-Urban Areas

Dr. Priyanka Jamwal* Dr. Sharachchandra Lele**

Abstract

Urban areas are zones that create a convergence of wastewater streams and surface water bodies. Both industrial and domestic wastewater flows become part of natural flows in streams and rivers originating in or flowing through urban areas. These mixed flows are monitored based on water quality criteria to determine their suitability for different human uses of water. Due to gaps in the way these criteria have been specified, however, many peri-urban lakes and rivers get designated as class E (i.e., fit for irrigation) although they have high levels of certain toxic contaminants. Exposure to such contaminants poses a significant risk to human and environmental health. Furthermore, monitoring protocols that do not factor in the temporal variability of contaminants further increases the chances of mis-classifying these water bodies as fit for irrigation. To illustrate this problem, we present the Vrishabhavathy River (V-river) case in Bengaluru that highlights the gaps in our existing water quality criteria and monitoring framework. To prevent such risk, we recommend expanding the existing criteria and improving the monitoring protocols.

Keywords: *peri-urban, wastewater reuse, water pollution, irrigation, heavy metals*

Introduction

India is facing two simultaneous problems in the water sector: scarcity and pollution. Much

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attention is focused on scarcity, since it affects live and livelihoods across the country. Indeed, rapidly declining groundwater levels pose a risk to the sustenance of agriculture and livelihoods.[1] At the same time, according to the recent report by the Central Pollution Control Board (CPCB), around 70 % of surface water bodies in India are also contaminated.[2]

While most of the regions across India witness water scarcity, certain areas, especially the peri-urban areas located downstream of urbanized catchments, receive a consistent supply of water/wastewater throughout the year. The water flowing in these 'perennial' urban rivers/streams is primarily untreated/partially treated domestic and industrial wastewater. Farmers in peri-urban regions have come to depend on the continuous water supply from urban streams/rivers to grow food crops to meet urban food demand. Government in several states also encourage wastewater reuse in irrigation. However, several studies have reported contaminants in the food crops irrigated using wastewater. In 2018, high levels of lead were reported in one of the fast-food products in India. The event led to a public outcry, and one of the demands voiced was to understand the source of heavy metals (HMs) in the food product. Investigation revealed that the vegetables used to prepare the products were sourced from the region practising wastewater irrigation.[3] This study established a direct link between the use of contaminated wastewater and risk to human health.[4] In addition to this, several other studies have also reported the impact of the use of industrial/mixed wastewater for irrigation on the quality of the agricultural products and human health[5,6].

In this paper, we highlight one of the reasons for the continued use of contaminated wastewater for irrigation in India, viz., the gaps in the legal and monitoring framework for surface water use. Currently, water quality criteria (WQCs) identified by the Central

1 H. Anantha & K.V. Raju, *Groundwater depletion and coping strategies of farming communities in hard rock areas of southern peninsular India*, 17 Asia-Pac. Dev. J. 119–144 (2010).

2 CPCB, *Status of water quality in India* (2010).

3 Altaf Patel*A light meal with heavy metal?*, Mumbai Mirror, https://mumbaimirror.indiatimes.com/opinion/columnists/dr-altaf-patel/a-light-meal-with-heavy-metal/articleshow/67426798.cms (last visited May 6, 2021).

4 Vidya Venkat, *"Soil, source of lead in Maggi,"* The Hindu, June 6, 2015, https://www.thehindu.com/news/national/soil-may-be-the-culprit-officials/article7287375.ece (last visited May 6, 2021).

5 Priyanka Jamwal, S. Lele & M. Menon, *Rethinking water quality standards in the context of urban rivers*, *in* Urbanization and the Environment: Eighth Biennial Conference of the Indian Society for Ecological Economics (2016).

6 Jeena T. Srinivasan & V. Ratna Reddy, *Impact of irrigation water quality on human health: A case study in India*, 68 Ecol. Econ. 2800–2807 (2009); Jeroen HJ Ensink et al., *Sewage disposal in the Musi-River, India: water quality remediation through irrigation infrastructure*, 24 Irrig. Drain. Syst. 65–77 (2010); Indrajit Sen, Ajay Shandil & V. S. Shrivastava, *Study for determination of heavy metals in fish species of the River Yamuna (Delhi) by inductively coupled plasma-optical emission spectroscopy (ICP-OES)*, 2 Adv. Appl. Sci. Res. 161–166 (2011).

Pollution Control Board (CPCB) are used to determine whether water is fit for a particular use. This determination is based on a certain set of parameters. The sampling of surface water bodies to measure these parameters and thereby determine their suitability as per the WQCs is then carried out on a monthly or less frequent basis using grab sampling. Our case study of the Vrishabhavathy River (V-River) in Bengaluru, however, highlights that there are major gaps in both the criteria as well as the monitoring protocols, leading to highly contaminated water being used for irrigation in areas downstream of Bengaluru. We describe the regulatory framework and official monitoring protocols, before presenting results from our multi-parameter, time-intensive and multi-locational study to illustrate the inadequacy of this framework and protocol and suggest improvements.

Water Quality Regulatory Framework

The main objective of regulating water quality is protecting and minimising risk to human and environmental health. The risk posed depends upon both the type of contaminant and the purpose for which the water is being used. For instance, non-pathogenic organic matter may be tolerated in (and even welcome in) irrigation water, but not in drinking water. Keeping this in mind, CPCB, the nodal technical agency for the setting of water and air quality standards in India, has defined 'water quality criteria' (WQCs) to determine whether water is fit for particular uses, identified the parameters to be monitored and set their acceptable maximum values for each of 5 kinds of uses in decreasing order of water quality: drinking with minimal treatment, recreation, drinking after conventional treatment, fishing, and irrigation. Accordingly, rivers and streams in India are classified into six categories (A, B, C, D, E and below E) depending upon which WQC they meet.

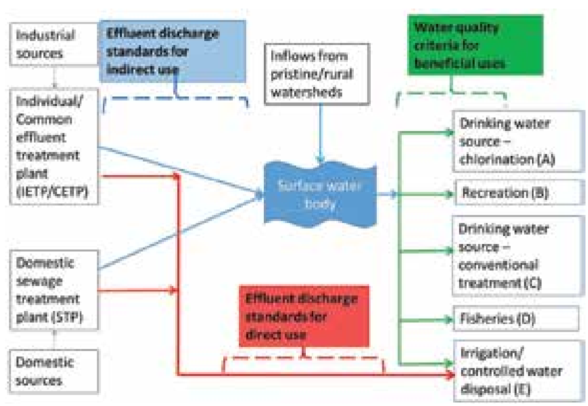

Figure 1: Regulating wastewater reuse through direct and indirect use standards (adapted from Jamwal, Lele & Menon)[7]

7 Jamwal, Lele, and Menon, *supra* note 5.

It is clear that the current WQCs are only applicable in situations where streams emanate from pristine or rural catchments, or in situations of 'indirect reuse' of wastewater. By indirect reuse, we mean a situation where wastewater is let out into a 'natural river or stream' and this mixed fresh water wastewater stream is picked up somewhere downstream for human use (Figure 1: blue arrows). (The other situation is of 'direct reuse', where domestic or industrial effluents might be applied directly for (say) irrigation—this is represented by the red line in Figure 1. There are separate standards for such direct use, defined in Rule 3 (schedule 1) and Rule 3A (schedule 6) of the Environmental (Protection) Rules 1986). Specifically for irrigation suitability (class E), the WQC parameters and thresholds specified are: pH between 6.0 to 8.5, electrical conductivity at 25°C < 2250 micro mhos/cm, sodium absorption ratio < 26, and boron < 2mg/l.

How are these parameters (to determine the suitability of a particular stream/river/lake for human use) monitored? Given that the Environmental (Protection) Rules are almost entirely focused on setting *discharge standards,* that is, regulating the level of pollution at the point where effluents exit from industrial units, most of the monitoring efforts of the State Pollution Control Boards (SPCBs) is on sampling these 'tailpipe' emissions on a frequent (once in three month) basis, in addition to surprise inspections. In contrast, the law does not specify any standards for *ambient* water quality in surface water bodies, and the WQCs are only used to indicate the suitability of the water body for certain use. Therefore, there are no standard protocols for the monitoring of streams, rivers or lakes to determine their suitability for human use using the WQCs. Those that fall within the ambit of the National River Conservation Plan (NRCP) or National Water Quality Monitoring Programme are sampled seasonally or possibly once a year. It should be noted that, in the absence of guidelines, the sampling takes place during day time and is based on one-time sampling or 'grab' sampling approach.

Water Quality of Urban Rivers: A Reality Check

Between 2014 and 2015, we were involved in major study of the Vrishabhavathy river (hereinafter V-river) that originates in Bengaluru itself and flows south-southwest for about 69 km through Bengaluru Rural district before joining the Arkavathy river. The entire project covered many different aspects, including downstream impacts on agriculture, upstream source identification and apportionment, understanding the pollution monitoring, enforcement and underlying governance issues[8]. We present here a few results

8 Priyanka Jamwal & Sharachchandra Lele, *Addressing Pollution in Urban Rivers: What we learnt from the Vrishabhavathy River in Bengaluru, in* Transcending boundaries: Reflecting on twenty years of action and research at ATREE 104–113 (Ankila J. Hiremath, Nitin Rai, & Ananda Siddhartha eds., 2017).

that highlight the inadequacy of the regulatory framework and the monitoring protocols.

The Peenya sub-catchment within the V-river catchment (see Figure 2) contains a large number of so-called 'red category' industries, thereby making it susceptible to industrial contamination, and also to domestic sewage inflows due to the absence of any sewage treatment plants in the sub-catchment. Although the V-river is not included in the NRCP, the Karnataka SPCB was forced to begin monitoring river water quality along this stretch following orders from a High Court-appointed committee[9]. This makes the Peenya sub-catchment a perfect site to evaluate both the basic regulatory framework and its implementation (monitoring). One of our river water quality-monitoring sites (Chowdeshwari-CHO) was located immediately downstream of a major industrial cluster. The location for the monitoring site was selected such that the surface water quality data a) can be compared with the data from sites monitored by the Karnataka State Pollution Control Board (KSPCB) and b) can capture variability in contaminants levels before they transform. We present data primarily from this site for illustrative purposes.

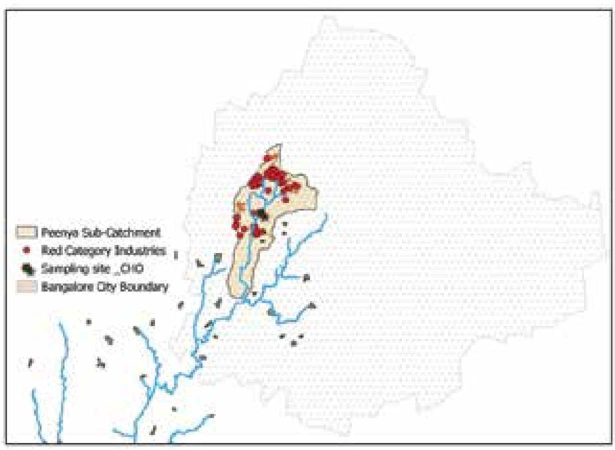

Figure 2: Location of red category industries and the sampling location CHO in the Peenya sub-catchment of the V-river

Criteria for Irrigable Water

Historically, the contaminants that were of concern in irrigation (when using freshwater) were salt and boron that may originate in soils/rocks, because both affect crop productivity negatively. This thinking is reflected in the WQC for irrigation water described above. Salt presence is detected indirectly by measuring electrical conductivity (EC), as salts increase

9 KSPCB, *Vrishabhavathy Valley heavy metal test orders by KSPCB* (2014).

conductivity, whereas boron presence is measured directly.

The question is what happens to these parameters when partially or poorly treated industrial and domestic wastewater is added to freshwater, and whether these parameters capture all the threats posed to irrigation by such wastewater-mixed sources. Our data from the monitoring show that, in the case of the Peenya sub-catchment, while salt standards may not be exceeded, heavy metals can be a major contaminant from industrial sources (Figure 3) and fecal coliforms a major contaminant from domestic sources (Figure 4).

The contents of industrial effluents depend on the types of industries, and can result in an increase in salts (tanning and dyeing industries, pickling industries) or heavy metals (electroplating, alloy smelters, car washing units) or chemical oxygen demand (other dying industries, petrochemical industries). In theory, all these contaminants are supposed to be captured by Effluent Treatment Plants (ETPs) within the industry's premises or Common ETPs for a group of industrial units, before the treated wastewater is let out into the river. However, the purpose of ambient quality monitoring is precisely to check whether adequate 'tailpipe' treatment has occurred or not. Heavy metals are particularly dangerous because once they enter the food chain, the process of bio-magnification means their concentrations keep rising as they pass from plants to animals (milching cows) to human beings.

Our data shows that even when the EC levels are within the WQC threshold, heavy metals such as chromium (Total Cr) are present in the V-river in concentrations that repeatedly exceed the standard specified for irrigation water by the World Health Organization (WHO)[10], making the water unfit for irrigation (Figure 3). Our multi-date and multi-parameter measurements (not presented here)[11] showed that this was the case for several other metals, and not just episodically but many times during a 24-hour cycle for all the months in a year of monitoring. Indeed, even 35 km downstream, at the Byramangala irrigation reservoir, the heavy metal concentrations are still significantly high[12, 13].

10 Hanseok Jeong, Hakkwan Kim & Taeil Jang, *Irrigation water quality standards for indirect wastewater reuse in agriculture: a contribution toward sustainable wastewater reuse in South Korea*, 8 Water 169 (2016).

11 *See* Jamwal and Lele, 2017, op.cit.

12 Sharachchandra Lélé et al., *Water Management in Arkavathy Basin: A Situation Analysis* (2013).

13 N. Jan et al., *Impact of municipal and industrial pollution on Byramangala Lake, Bengaluru Rural District, India*, *in* Taal 2007 : The 12th World Lake Conference 1717–1728 (2008); R Madhukar & S Srikantaswamy, *Impact of industrial effluents on the water quality of Vrishabavathi river and Byramangala lake in Bidadi Industrial Area, Karnataka, India*, 3 Int. J. Geol. Earth Environ. Sci. 132–141 (2013).

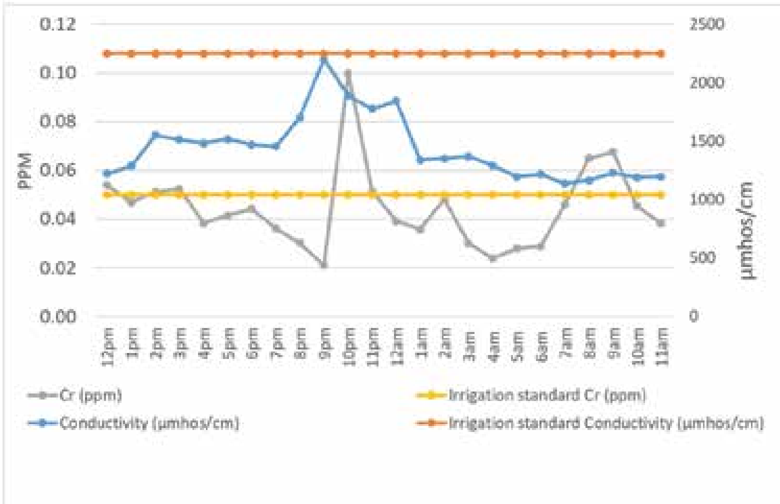

Figure 3: Diurnal variability in EC and Cr levels at CHO (14th-15th July 2015), compared with Conductivity standard for irrigation by CPCB WQC, and Cr standard for irrigation by WHO

Similarly, we found that the quantity of fecal coliform bacteria (an indication of untreated sewage) was consistently more than 10 million, when the WHO standard for unrestricted irrigation requires it to be below 1000[14] (see Figure 4). Fecal coliforms and associated pathogens threaten the health of farmers who handle the irrigation water, as well as increasing the health risk posed by the crops to which the water is applied.

Clearly, the V-river at CHO is actually contaminated far beyond acceptable levels by both industrial effluents and domestic sewage that pose serious health risks. Equally clearly, for the purposes of this paper, the WQC standards for irrigation water, which focus only on EC (and boron and pH) do not capture the new set of contaminants that vitiate water quality when a stream passes through an urban/industrial area, thereby threatening the health of farmers and their crops downstream. V-river continues to be classified as class E (suitable for irrigation) because of the misplaced focus on only 4 parameters that would have been appropriate in a context where pollutants were largely 'natural' in origin.

14 Ursula J. Blumenthal et al., *Guidelines for the microbiological quality of treated wastewater used in agriculture: recommendations for revising WHO guidelines* 1104–1116 (2000).

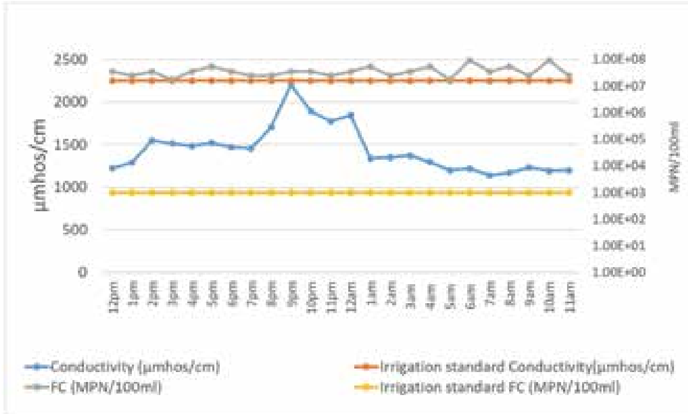

Figure 4: Diurnal variability in conductivity and FC levels at CHO (14th-15th July 2015), compared with Conductivity standard for irrigation by CPCB WQC, and the fecal coliform standard for irrigation by WHO

Protocols for Monitoring

The absence of HMs in the list of parameters to be monitored for irrigation (and other) uses as per the WQCs was partially rectified in the case of the V-river by the Karnataka High Court ordering in 2008 that KSPCB also monitor HMs along this river (in light of reports of industrial contamination)[15]. Nevertheless, even after years of monitoring, complaints continue to pile up from farmers downstream about health problems, and study after study, including ours, showed presence of unacceptable levels of HMs in irrigation water and crops[16,17]. What might explain this discrepancy? How do our results compare with those of KSCPB, the statutory agency? Noting that KSPCB only collected one ('grab') sample on the dates of monitoring, we compared their grab sample data for 14 months (May 2014-July 2015) with our hourly sampling across the same period at the same site (CHO) for two metals (chromium and copper). The results are presented as box-and-whisker plots in Figure 5 below.

15 KSPCB, *supra* note 9.

16 Srinivasan et al., *Climate vulnerability and adaptation of water provisioning in developing countries: approaches to disciplinary and research-practice integration*, 5 Curr. Opin. Environ. Sustain. 378–383 (2013).

17 Jamwal and Lele, *supra* note 8.

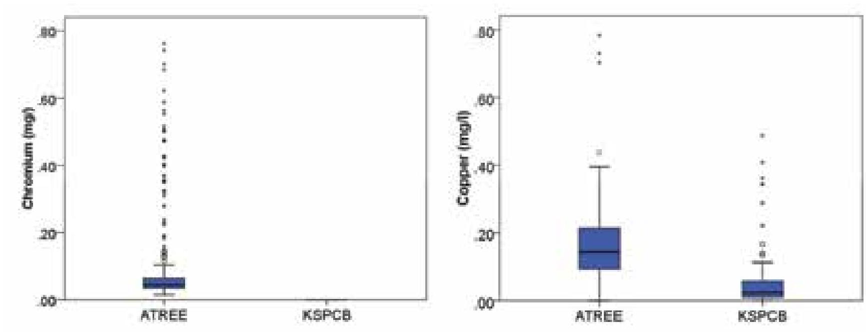

Figure 5: ATREE vs KSPCB surface water quality data comparison at CHO (May 2014 - July 2015)

Comparison of the two datasets shows that the average chromium (Cr) and copper (Cu) levels observed by ATREE are significantly higher than the data presented by KSPCB. The explanation for this lies in the monitoring protocols followed. KSPCB's protocol is to pick up one sample each month sometime during working hours. Whereas our protocol involved collecting samples every hour for 24 hours. As Figure 6 below shows, the peaks for Cr occurred at 9pm or 8am and for Cu between midnight and 3am. Clearly, industries (illegally) discharge untreated effluent during the night, which leads to the sudden increase of HM levels in the Peenya stream. Not surprisingly then, grab samples obtained during working hours do not reflect the real extent of pollution. These mixed wastewater flows from Peenya stream reach Byranmangala reservoir downstream from where water is used for irrigation purposes. Presence of heavy metals in groundwater and their accumulation in soil and food crops has been reported in the villages exposed to contaminated irrigation water downstream.

Figure 6: Variability in HM levels at CHO for single sampling campaign (14^{th}-15^{th} July 2015)

Conclusion

Streams and rivers that pass through urban and industrial areas are bound to get contaminated with industrial pollutants, not just domestic sewage. Given the extent and rapid pace of urbanization in India, one would be hard pressed to find many river stretches whose catchments are primarily 'pristine' or even 'rural' any more. Moreover, there is ample evidence over decades that the measures taken 'at source' for regulation of discharge, whether industrial or domestic' are highly insufficient/ineffective across most Indian cities and town, notwithstanding the focus of the legal provisions on such regulation. In this context, monitoring of ambient water quality to determine its fitness for uses downstream needs to be comprehensive and rigorous. Our study highlights the major gaps in the ongoing framework for regulating ambient water quality.

The implications are manifold. First, it is crucial to upgrade and rethink the WQCs to reflect the fact that the catchments of surface water bodies are increasingly urbanized/ industrialised and likely to bring in both biological and industrial contaminants into the freshwater flow. Indeed, in some cases such as the V-river, where the river was originally seasonal, the entire lean season flow may be treated/untreated wastewater. These flows are bound to get reused downstream, given the scarcity of water in the summer in most parts of India. Thus, the parameters included in the WQCs must be expanded to include contaminants such as heavy metals, other chemicals, and fecal coliforms reflecting industrial, commercial and domestic activities in the catchment . Indeed, this would be applicable not only to irrigation water use (which is the 'lowest' quality use in the WQCs) but talso for other 'higher quality' uses. Thus, use-specific standards must be set in determining the suitability of this mixed water stream for each use.

Second, the WQCs by themselves do not serve much purpose except as warnings. If the V-river were designated as 'below class E' tomorrow, it may or may not deter farmers from using the water, and it certainly will not improve the quality of that river water. The legal framework needs to include a process of setting *goals* for ambient water quality depending upon its likely or socially chosen use, and a legally mandated process of reducing the gap between goals and reality, i.e., of working 'backwards' from these goals to specific regulatory actions against point and non-point source polluters.

Third, to correctly determine the status of a river/stream/lake even from the perspective of a wider set of parameters will require revised and more rigorous monitoring protocols. While domestic sewage may flow throughout the day and a 9 am sampling time may actually capture the peak concentration of sewage in the river, industrial effluents, when illegally discharged, cannot be captured through one-time sampling and requires a 24-hour sampling protocol, with associated investments in equipment, personnel and effort. Such changes can provide the necessary push for improving upstream monitoring and enforcement that is essential to improving surface water quality and making irrigation and other uses of mixed-water sources safe from a public health and ecosystem health point of view.

* * * * *

PART II

Use of Technology in Water Conservation and Usage

Chapter 7
ICAR Flexi-Check Dam (Rubber Dam) Technology for Water Conservation and Efficient Use for Agriculture

Dr. Susanta Kumar Jena* Dr. P. S. Brahmanand**

Abstract

ICAR flexible check dam commonly known as rubber dam is an inflatable structure build across a stream used for water conservation, flood control and regulating flow of water in the stream. When it is inflated, it serves as a check dam/weir and when it is deflated it functions as a flood mitigation device and sediment flushing. The head or height of rubber dam is variable. This variable head also regulates the depth of flow in the irrigation diversion channel present in the upstream side of the check dam or in irrigation canals and distributaries. This can also be used in coastal creeks, estuaries, streams and channels to restrict the inflow of sea water into land mass. During high tide it can also prevent the high tides to enter into the fresh water system. For each rubber dam of 5 m width and 1.5 m height in a stream of around 8 to 10 m width, adoption of this technology created additional storage of water to the tune of 4800-10000 m^3 at any point of time during kharif. Total volume of 80000 m^3 could have been diverted for irrigation in 8-15 ha area during kharif and an additional area of 2-5 ha during post monsoon season. The installed rubber dams have resulted in enhanced rice productivity by 22% to 62% during Kharif season, pulse productivity by 46 % during Rabi season and vegetable productivity by 22 to 48% during summer season. The technology has a benefit cost ratio of 2.3 and internal rate of return as 14.3%.

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Keywords: *Rubber dam; Water conservation; Watershed management, Flexible check dam; Irrigation.*

In climate change scenario we experience more extreme events of cyclone, flood, drought, long dry spells etc. The intensity, amount and distribution of rainfall are also not as per the crop requirement. Secondly land and water are the two most vital natural resources of the world and these resources must be conserved and maintained carefully for environmental protection and ecological balance. Prime soil resources of the world are finite, non-renewable over the human time frame, and prone to degradation through misuse and mismanagement. Total global land degradation is estimated at 1964.4 M ha, of which 38% is classified as light, 46% as moderate, 15% as strong and the remaining 0.5% as extremely degraded, whereas present arable land is only 1463 M ha which is less than the land under degradation (Koohafkan 2000). The annual rate of loss of productive land in the whole world is 5 to 7 M ha, which is alarming. In India, out of 328 M ha of geographical area, 182.03 M ha is affected by various degradation problems out of which 68 M ha are critically degraded and 114.03 M ha are severely eroded whereas total arable land is only 156.15 M ha (Velayutham 2000). It was reported that in India 0.97% of total geographical area is under very severe erosion (> 80 t ha^{-1} yr^{-1}), 2.53% area under severe erosion (40-80 t ha^{-1} yr^{-1}), 4.86% area under very high erosion (20-40 t ha^{-1} yr^{-1}), 24.42% area under high erosion (10-20 t ha^{-1} yr^{-1}), 42.64% area under moderate erosion (5-10 t ha^{-1} yr^{-1}) and rest 24.58% area under slight erosion (0-5 t ha^{-1} yr^{-1}) (Singh et al. 1992). Therefore, the problem of land degradation due to soil erosion is very serious and with increasing population pressure, exploitation of natural resources, faulty land and water management practices, it will further aggravate. Land degradation also reduces world's fresh water reserves. It has a direct impact on river flow rates and the level of groundwater tables. The reduction of river flow rates and the lowering of groundwater levels lead to the silting up of estuaries, the encroachment of salt water into groundwater, the pollution of water by suspended particles and salinization, which in turn reduces the biodiversity in fresh and brackish water and consequently fish catches. Lower river flows also interfere with the operation of reservoirs and irrigation channels, increasing coastal erosion and adversely affecting human and animal health.

Proper watershed management, which is a comprehensive term meaning the rational utilization of land and water resources for optimal production and minimum hazard to natural resources could be the solutions to all these problems (Jena 2002). There are several measures such as mechanical (engineering) and biological (agricultural) which are used for soil and water conservation in watershed management. Check dams are engineering measures which are mainly used for soil and water conservation in watersheds. In India, several types of check dams are being used for regulating runoff in watersheds which in turn help in assured water supply to crops. Generally, most of the check dams in watersheds are made of steel, concrete, soil, rock (permanent) or with vegetation (temporary). The use of rubber as a construction material is a technological innovation in materials application. At the same time, the check dams are rigid one and they cannot allow more water to pass over it at times of heavy flood/runoff or store sufficient runoff at lean season of rainfall for use in Rabi season by farmer for different Rabi crops like pulses, oilseeds and vegetable. To give more flexibility in release and control of water flow across the streams, research efforts were made at ICAR-Indian Institute of Water Management (IIWM), Bhubaneswar in collaboration with Indian Rubber Manufacturers Research Association (IRMRA), ICAR-Central Institute for Research on Cotton Technology (CIRCOT) and Kusumgar corporate Pvt. Ltd. (KCPL), Mumbai to prepare and install rubber sheets instead of cement concrete/ stone material for check dams and to study their impact on crop performance.

Rubber dam (ICAR Flexi-check dam)

Rubber dam (ICAR flexible check dam) is an inflatable structure build across a stream used for water conservation, flood control and regulating flow of water in the stream. When it is inflated, it serves as a check dam/weir and when it is deflated it functions as a flood mitigation device and sediment flushing. Rubber dams are installed to function as weirs or barrages which are relatively low-level dams constructed across a river for the raising of river level for the diversion of flow in full, or a part, into a supply canal or conduit for irrigation, domestic, industrial use (Tam 1998). Most of the civil engineering structures constructed in the history of humankind are made of steel, concrete, soil, or, rock. The use of rubber as a construction material is a technological innovation in materials application (Tam and Zhang 2002).

The head or height of rubber dam is variable (0.5 to 3 m). This variable head also regulates the depth of flow in the irrigation diversion channel present in the upstream side of the check dam or in irrigation canals and distributaries. This can also be used in coastal creeks, estuaries, streams and channels to restrict the inflow of sea water into land mass. During high tide it can also prevent the high tides to enter into the fresh water system.

As an innovative hydraulic structure, the rubber dam mainly consists of the following parts: (i) a concrete foundation with head wall extension, side wall and wing wall of a normal check dam; (ii) the head wall replaced by rubberized fabric dam body; (iii) anchoring system (anchoring of rubber sheet with bottom and side of the check dam); (iv) Inflation deflation system (an inlet/ out let piping system for inflation and deflation by water); and (v) a pump for filling water for inflation.

The span or length of the rubber dam can vary from 1 m to 10 m (depending upon the width of the stream). For wider streams also, there can be several spans (even up to 100 m) (Plate -1).

The detail specification of the composite rubber is available with ICAR**.**

Plate 1. Rubber dam at Konkan region, Dapoli

Advantages of Rubber Dam

- Traditional check dams get silted due to continuous inflow of sediment from upstream side thus reducing the storage capacity. Rubber dam can be occasionally deflated during flood to flush out all the sediment to the downstream side.
- During dry period/ lean season the head wall can be easily inflated to store more water.
- Due to flexibility of the head wall, during extreme events of high intensity rainfall and extreme flood situation, the structure can be easily deflated, so there is no damage to the structure and there is no breaching of stream bank/ levees and no scouring or erosion of stream bed.
- Earth quake, land slide cannot damage the head wall as it is made of rubber and repair to the side and wing walls can be easily done without dismantling the structure.
- There will be no conflict of interest of farmers and other beneficiaries as desirable amount of water can be easily delivered to downstream side by storing desirable quantity in the upstream side and maintaining environmental flow in the downstream side.

Cost of the Structure and Operational Cost

The cost of rubber dam along with its RCC base structure varies from Rupees 5 lakh to 10 lakh in small watershed streams of 5 m to 15 m width. If the span of rubber check dam is more, the cost will be less in comparison to concrete check dams with mechanical gate. Since the head wall is semicircular in shape and hydraulic jump occurs very close to the structure, a long apron is not required, thus reducing the cost of the base structure. The head wall is replaced by a composite rubber sheet. The cost of rubber composite sheet is around Rs. 3800 per m^2 for 8 mm thick at present. However, the cost will reduce when produced on commercial scale in large quantity. The operating cost is variable and is required to deflate during high flood, inflate during dry period or any other emergency condition and then pumping cost for inflation. On an average 4 to 5 times inflation/ deflation is required which will cost around Rs.1000 per year.

Installation and Field Evaluation

Initially, five rubber dams were installed in watersheds at different locations of Khurda district, Odisha with innovative manufacturing, fabrication and installation technology. These are the first indigenous rubber dams which were been fabricated and installed in our country by Indian scientists. The Table-1 shows the location of sites where rubber dams have been installed and evaluated.

Table 1. List of ICAR-Flexi Check Dam (Rubber Dams) installed in India by IIWM

Sl. No.	Name of the Indian State	Name of the district	No. of rubber dams
1.	Odisha	Khordha	5
		Koraput	3
		Nabarangpur	1
		Baleswar	3
		Dhenkanal	1
2.	Maharashtra	Ratnagiri	3
		Pune	3
3.	Gujarat	Navsari	4
4.	Uttarakhand	Dehradun	3
		Tehri Garhwal	1

5.	Meghalaya	Ri-bhoi	1
6.	Himachal Pradesh	Kangra	2
7.	Tamil Nadu	Nilgiris	1
8.	West Bengal*	West Medinipur	2

**Technical support provided to West Bengal Govt. for installation of 2 no. of Rubber dam at Medinipur (WB)*

Enough care has been taken during development of the rubber composite along with nylon reinforcement that when installed across streams it does not have any adverse effect on water quality (may be due to oozing out of chemicals or any extracts from the rubber composite) and also on crop productivity. It does not have any adverse impact on environment.

Rubber composite sheet manufactured by IRMRA was fixed with concrete base structure through double rows anchoring mechanism. The angle of inclination of side anchoring to the base has been optimized by IIWM to minimize wrinkles and easiness to inflate and deflate. The spacing between bolts and also the dimension and structural strength of different bolts were tried. The dimension and strength of different anchoring bots were optimized by IIWM for different dimensions of rubber dam. The structure was made leak proof (no water flow between top of the base of the concrete foundation structure and the rubber sheet) using different proportions of adhesives like Sillica gel etc. and were tested by filling with water through inlet pipe using at least 1.5 hp kerosene operated petrol start centrifugal pump. Two of the installed rubber dams at Chandeswar are presented through Plate 2.

Plate 2. Rubber dams installed in watersheds of Odisha by IIWM, Bhubaneswar

Impact of Rubber Dam on Crop Performance and Livelihood Improvement

The Chandeswar and Baghamari check dams are operated and maintained by farmers for paddy cultivation during kharif and pulses, oilseed and vegetable cultivation during rabi and summer season in the surrounding field. Various types of evaluations of rubber dams were done such as water storage and impact of rubber dam on crop yield and other agricultural and watershed parameters.

Majority of farmers under rubber dam command area in Baghamari and Chandeswar (Khurda district of Odisha) have small and marginal landholdings and they were not in a position to generate good returns due to poor crop establishment and crop productivity before installation of rubber dam. The adoption of technology has enhanced the rural livelihood options. It has enhanced the crop productivity, crop production, crop diversification, cropping intensity thus increasing the rural income. It stores an additional amount of water in the range of 4500m^3 to 10000 m^3 and irrigates around 10 to 20 ha during kharif to 2-5 ha during summer depending upon the slope and capacity of the stream. The additional water resource created by installation of rubber dam has helped in supplemental irrigation there by resulting in higher cropping intensity, crop productivity which in turn generated additional net returns to the farmers. The economic analysis indicated that the intervention of rubber dam has potential to enhance the gross returns of the farmers by 62% from Rs. 28,700 ha^{-1} to Rs. 46,700 ha^{-1} if farmers grow only rice crop. At the same time, the total gross returns of the farmers may increase from Rs. 45184 ha^{-1} to Rs. 70792 ha^{-1} if farmer practices rice-green gram cropping system with the additional water available through rubber dam and the total gross returns may increase to Rs. 72500 ha^{-1} and Rs. 75135 ha^{-1} if farmers practice rice-cucumber and rice-sunflower cropping system. Similarly, the net returns of the farmers will increase from Rs. 12400 ha^{-1} to Rs. 27600 ha^{-1}, Rs. 43942 ha^{-1}, Rs. 43200 ha^{-1} and Rs. 47935 ha^{-1} under sole rice cropping, rice-green gram, rice-cucumber and rice-sunflower cropping systems respectively. The rice-vegetable cropping system has potential to enhance this margin by additional Rs.12000 per ha. The migration rate of the farmers was also found reduced by 22% during post installation phase of rubber dam compared to the pre-project phase.

This ICAR Flexi Check dam technology was commercialized and an MoU was signed in between the ICAR and Zenith Industrial Rubber Products Pvt. Ltd., Mumbai for a period of 3 years. Thereafter the MoU has been signed with M/s Forech Mining & constructions International LLP, New Delhi. The consultancy of the technical team of ICAR-IIWM, Bhubaneswar can be taken by any agency for installation of ICAR flexi check dam (rubber dam).

Limitation of the Technology

The technical textile reinforced rubber composite sheet used in rubber dam installation can be damaged by human being with a sharp knife having wrong intentions. However, it will not be damaged by any natural events such as flood, cyclone etc. and not also by floating animal carcass, broken glass bottle, stones and pebbles, uprooted trees or bamboos coming with flood water. Similarly, the rubber sheet can be damaged by fire.

Conclusion

From the agricultural and hydrologic data observation it is apparent that, rubber check dams can be well utilized for achieving sustainable crop production and could be instrumental for enhancing crop and water productivity in watersheds. It does not have adverse impact on environment. It can be easily installed, operated by farmers of the watersheds. There is almost no maintenance except the running cost of filling (inflating) with water at the time of need.

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Chapter 8
Impact of Treated Sewage Water from KCVP on Farm Economy in Kolar District, Karnataka

N. Ramesh* Dr. Jagannath Olekar**

Abstract

Supplying treated sewage water for farming is an effort to address the issue of irrigation water distress as water sources are fast depleting. Rejuvenation of open and bore wells would bring the parched lands back into agricultural operations. To analyze the impact of KCVP on farming, the present study was undertaken in the farms of 120 randomly selected farmers. Descriptive Statistics, Composite Externality Index, and Crop Diversification Index tools were employed for data analysis. The results revealed that project implementation changed the cropping pattern towards higher crop diversity as indicated by a Simpson's index value of 0.85 in the KCVP, while it was 0.77 in the Non-KCVP. The positive externalities outweigh the negative externalities as shown by the standard deviation of 0.312 for the positive externalities in comparison with negative externality having a standard deviation of 0.156. Total income per year from crop production was 24 per cent higher in KCVP than in Non-KCVP area. Employment generation in KCVP was higher by 4 per cent. In essence, implementation of KCVP has increased irrigated area as well as farmers' annual income. The farmers consider treated waste water resource as a boon which ensures irrigation throughout the year.

Keywords: *Treated sewage water, Crop diversification, Employment generation, Kormangala and Challaghatta Valley Project (KCVP), Non-KCVP area.*

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Introduction

Water is vital for the survival of human beings on the earth, but is being increasingly endangered with growing population. Two-thirds of the present food grain production is met through irrigated agriculture. Increasing irrigation water requirement in the country is likely to exert tremendous pressure on our water resources in the future. The agriculture sector and the society have already faced daunting challenges in the water sector. The demands of a speedily industrializing economy and urbanizing culture come at a time when the potential for augmenting water supply is limited, the water tables are falling, and water quality issues have increasingly come to the fore.

Increasing competition for water use among urban and semi-urban centres, rural areas, industrial, and agriculture sectors is challenging and is putting heavy pressure on the current irrigated agriculture practices at alarming levels. The gap between the supply and demand for water is widening. In India, paradoxically more than 50 per cent of the irrigation needs for agriculture is met through groundwater source.[1] Ground water table has reached dangerously low levels in some parts of the country having detrimental effect on the production and productivity of crops, and in turn, on the farm economy of the country. It is an opportune time, to refocus on one of the ways to recycle water i.e. through the reuse of urban wastewater, for irrigation and other purposes.

Currently agricultural land has become a disposal site for waste water. Waste water is used as a source of irrigation, since it serves as a source of plant nutrients to some extent. It allows farmers to reduce the use of chemical fertilizers. Under this situation, treated sewage water can be used as an option to supply nutrients for crop growth productively.[2]

Sewage generation from urban areas in the country is estimated at 61,948 million liters per day (mld), against which a sewage treatment capacity of 23,277 mld is available. The remaining untreated sewage either flows into rivers and other water bodies or percolates into the ground. Wastewater is an important source of water and nutrients for irrigation in developing countries particularly, but not restricted to those located in arid and semi-arid areas. The use of wastewater is widespread and represents around 10 percent of the total irrigated surface worldwide, although varying widely at local levels. The largest area irrigated using waste water is in China with around 13, 30,000 ha, whereas India is

1 N Nagaraj & M G Chandrakanth, *Combating negative externalities of drought: A study of groundwater recharge through Watershed Development Programme* 39 Economic and Political Weekly 1164 (2012).

2 N. Haruvy, *Agricultural reuse of wastewater: Nation-wide cost benefit analysis* 66 Agric. Ecosystems & Environment 113 (1997).

irrigating around 78,000 ha. It is the responsibility of the State Governments/ concerned local bodies to set up facilities for collection, transportation and treatment of sewage for abatement of pollution of rivers.[3]

The actual performance of the sewage treatment plants is often different from their installed treatment capacity. A 2014 study by the Central Pollution Control Board (CPCB) found that only 86 per cent of the studied plants were operational, nearly 40 per cent of the plants did not meet general discharge standards, and the average capacity utilization was 72 per cent. The major constraint that the farmers are facing in crop production is poor availability of irrigation water. So, there is a scope for use of treated waste water for crop production and reduce depletion of ground water table.

It was Israel which pioneered the technology of using treated sewage water to grow crops through micro irrigation system. Following this, for the first time, India has successfully implemented supplying treated sewage water to irrigation tanks of Kolar district under Kormangala and Challaghatta Valley Project (KCVP). Under this project, treated sewage water from Bengaluru city is supplied to fill 126 irrigation tanks of Kolar district in the Eastern Dry Zone (EDZ) of Karnataka. Thus, KCVP has been designed to attain double benefits. To solve the ever growing problem of Bangalore city's drain and sewerage water on the one hand and on the other hand, to rejuvenate ground water table in the surroundings of the irrigation tanks in rural areas, which is steadily declining over the years. Treated sewage water reuse in agriculture is considered an efficient tool for managing scarce water resources with regulated supply that compensates for water shortages caused by rainfall shortage and uneven distribution of the rain throughout the hydrological year. The present study was taken under the research project titled "Institutional and Market Innovations Governing Use of Agriculture Water" funded by Indian Council of Agricultural Research – Institute of Water Management, Bhubaneswar. The study analysed the economic impact of this KCVP lift irrigation project in Kolar district.[4]

Methodology

Sampling Procedure Adopted

Purposive sampling technique was employed for the selection of study area. The villages in

3 *National status of waste water generation & treatment*, ENVIS Centre, Ministry of Environment & Forest, Govt. of India, http://www.sulabhenvis.nic.in/Database/STST_wastewater_2090.aspx.

4 CENTRAL POLLUTION CONTROLE BOARD, 2014, Guidelines for the safe use of wastewater, excreta and grey water: Policy and regulatory aspects. Central Pollution Control Board (CPCB),pp:1229.

which the survey was conducted included Chowdadenahalli, Doddavallabbi, Singenahalli, Dinne Hosalli, Uddapanahalli, and Lakshmisagara Narasapura in the KCVP area, and Imarakunte, Dasara Thimmanahalli, Baipanahalli, Nukkanahalli and Mallasandra in the Non-KCVP (NKCVP) area i.e. the control area.

Primary Data

The primary data was collected from 120 random sample farmers, with 60 respondents each in KCVP area and NKCVP area. The primary data collected consisted of general information regarding the socio-economic status, size of land holdings, livestock inventory, educational level, family size, source of irrigation, pattern of investment including purchase of agricultural land, bunding, levelling, farm buildings, farm machinery and equipment, improvements on land, irrigation structures and equipment's, livestock, etc. Gathered information is purely based on memory of the respondents.

Analytical Tools and Techniques Employed

For the purpose of assessing the objectives of the study, based on the nature and extent of data, the following analytical tools were employed for processing the data to draw meaningful results and conclusions.

1. **Descriptive statistics**: Tabular method of presentation was employed to compile the socio-conomic characteristics, cropping pattern, institutional participation, sources of income, cost and returns, and sources and pattern of investment. In order to assist the interpretation of findings, descriptive statistical measures like percentages, averages and ratios were worked out wherever necessary.

Normalization: Normalization of the indicators has been carried out for the selected parameters in both positive and negative externalities owing to measurement on different scales for each parameter.[5] If the parameter had positive functional relationship with the irrespective index, then the normalization has been applied with the following equation.

5 Katherine Vincent, *Creating an index of social vulnerability to Climate Change in Africa* 56 TYNDALL CENTRE FOR CLIMATE CHANGE RESEARCH (2004); A. Raizada, et. al., *Application of indicators for identifying climate change vulnerable areas in semi-arid regions of India* 70 ECOL. INDIA 517 (2016).; A. Kumar, *Extent of vulnerability in wheat producing agro-ecologies of India: tracking from indicators of cross-section and multidimension data* ECOL. INDIA 780 (2018).

$$Normalization = \frac{(Actual \;\; value - Minimum \;\; value)}{(Maximum \;\; value - Minimum \;\; value)}$$

Assignment of weights to parameter through principal component analysis:

After normalizing the indicators, weights were assigned based on their level of influence on externalities. The PCA technique employed to assign weights with assumption of linear relationship existing among the variables.[6] Therefore, PCA method has been adopted in this study.

The functional formulation is as follows:

$$X_t = \Lambda_t F_t + e_t$$

Where,

- Xt indicates the N-dimensional vector of variables influencing externalities
- Λ_t represents the r ×1 common factor
- F_t represents the factor loading
- e_t represents the associated idiosyncratic error-term of order N ×1

The weights from the PCA were calculated with the following equation.

$$W_i = \Sigma | L_{ij} | E_j$$

Where,

- W_i represents the weight of the i^{th} variable
- E_j represents the eigen value of the jth factor
- L_{ij} represents the loading value of the i^{th} variable on jth factor

3. Composite externality index (Positive and Negative)

Positive and negative externality composite index were calculated separately by using their respective indicators along with their respective calculated weights in the following equation.[7]

6 K. C. Ayyoob, et. al. *Intra-regional disparities in agricultural development in Kerala* 8 Hind Agricultural Research And Training Institute 103 (2013).

7 A. Kumar, *Extent of vulnerability in wheat producing agro-ecologies of India: tracking from indicators of cross-section and multi dimension data,* Ecol. India 780 (2018).

$$\text{Index} = \frac{\sum_{i=1}^{n} X_i W_i}{\sum_{i=1}^{n} W_i}$$

Where,

- X_i represents the normalized value of i^{th} variable
- W_i is the weight of i^{th} variable

4. Categorization of Externalities

Finally, positive and negative externalities composite index were categorized into two groups High and low based on Mean+/- standard deviations.

5. Crop Diversification Index

a. **Simpson Index (SI) -** It is the most suitable index for measuring diversification of crops in a particular geographical region and is calculated using the equation:

SI = $1 - \sum_{i=1}^{N} P_i^{2}$ --------------------------------------(1)

Where, $P_i = A_i / \sum A_i$ is the proportion of the i^{th} activity in acreage.

Simpson index of near to zero, indicates that the zone or region is near to specialization in growing of a particular crop and if it is close to one, then the zone is fully diversified in terms of crops.

Sources of Income

Important concepts and definitions used are explained below:

1. **Farm income**: It was estimated as the value of main product and byproducts, after accounting for the cost of seeds, payment to hired human labour, draught and machine power, farm yard manure (FYM), chemical fertilizers, pesticides, irrigation charges and fixed cost. It also comprises the net income received from livestock and perennial crops.

2. **Non-farm Income**: Net income generated from non-agricultural activities like, non-agricultural labour, salaried government and private jobs, business, remittances, rental income etc., were considered.

3. **Off-farm income:** It was analyzed by considering the income generated by the family members working as agriculture laborers in other farmers' fields and income from hired out bullocks, farm machineries and implements.

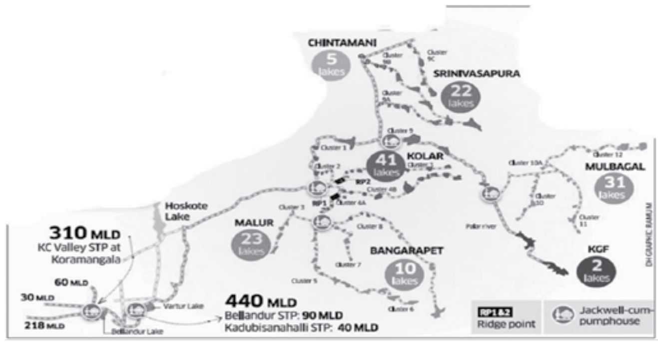

Fig 1: Line Diagram of KC Valley Project.

Fig 2: KCVP Treatment Unit

Results and Discussion

Treatment technology used under this Project is "Physical-Chemical treatment with a lamella setting system, Depth filtration and Disinfection". The project was started in two phased manner in 2016. The aim of the project is to fill 126 irrigation tanks and 1400 check dams in the first phase and 257 tanks in Second Phase that will cover the entire district. So far, 121 tanks and 698 check dams have been filled and the first phase is yet to complete. In the second phase, to fill 257 irrigation tanks, up gradation works of 248 MLD Capacity STP, in the premises of KC Valley, will be undertaken in the year 2021-22 with an investment of Rs.450 crores by Bengaluru Water Supply and Sewerage Board in collaboration with Bruhat Bengaluru Mahanagara Palike.

Table 1: Main features of the KC Valley Project

Sl. No.	Particulars	KC Valley Project
1	Year of Start of the Project	2016 November.
2	Total cost of this project	Rs. 1,342 Crores
3	Volume of water in TMC per year	5.67
4	Responsibility of operation and management	Minor Irrigation Department
5	Power Stations	6 Power Sub Stations
6	Capacity of Power station	66 KV
7	Pumping Stations (number)	3
8	Motors with their capacity	23 Motors have been installed with capacity in the range of 160-2800 Horse Power.
10	Pump Houses (number)	6
11	Total Number of Irrigation Tanks	126
12	Number of tanks and check dams filled so far	121 tanks and 698 check dams
13	Annual Cost of water treatment(Rs. Lakhs/MLD)	747.15
14	Capacity of waste water treated and sent every day	440 million litres per day
15	Average Quantum of Daily pumping in MLD	290

Table 2: The Eigen value and Principal Component Analysis (PCA) weights of related parameters in the KCVP area

Variable	Eigen value 1	Eigen value 2	PCA Weights
Positive externalities			
Bore well recharge	0.3553	0.638	1.875511
Water table	0.4032	0.5523	1.917153
Cropping intensity	0.4698	-0.3278	1.84548
Yield level	0.4922	-0.2608	1.831838
Area under irrigation	0.4982	-0.3352	1.94177
Negative externalities			
Water quality deterioration	-0.7652	-0.0419	1.088438
Human health issues	0.4029	0.7471	1.399638
Animal health issues	0.5021	-0.6634	1.439132

PCA weights indicate amount of accordance of particular variable, higher the PCA weightage more will be occurrence of particular variable due to project implementation in the study area.

Assessment of Positive Externalities and Negative Externalities Associated with Supply of Treated Sewage Water in the Project Area

The externalities created in KC valley project area are presented in Table 2, wherein Principal Component Analysis (PCA) weights for positive and negative externalities have been indicated. The results reveal that area under irrigation was assigned the highest weight (1.94) which implies that there was increased cropping intensity and yield of the crops. Similarly, for the increased water table the weight was 1.92, the lowest weights were observed in case of cropping intensity (1.84) and yield level (1.83). In case of negative externalities, the highest weight was found in case of animal and human health issues (1.399 and 1.43, respectively). The lowest weight was found for water quality deterioration (1.08).

Table 3: The Positive and Negative Externalities Composite Index in KC valley project area

Composite Index	**Mean**	**Std dev.**
Positive externalities	0.709	0.312
High	39 (65)	
Low	21 (35)	
Negative externalities	0.291	0.156
High	43 (71.67)	
Low	17 (28.33)	

The Composite Index for positive and negative externalities were computed by using parameters like bore-well recharge, water table, cropping intensity, increase in yield, increased irrigated area, water quality deterioration, human health issues and animal health issues. The Positive and Negative Externalities Composite Index (Table 3) revealed that mean index of positive externalities was 0.709 and the standard deviation was 0.312. In case of negative externalities mean index was 0.29 and the standard deviation was 0.156. Since the mean index value and standard deviation value are higher, the positive externality is more. The positive externalities outweigh the negative externalities in the study area of KC Valley Project. Implementation of KC Valley Project has resulted in significant ground water recharge in the study area.

Fig 3: The Positive and Negative Externalities under KC Valley project.

The prevailing cropping pattern in the NKCVP & KCVP project areas are presented in Table 4, and the findings of the study showed that tomato, mulberry, ragi and mango were the major crops cultivated in both KCVP area and NKCVP area. The perennials like mango and mulberry accounted for about only 56% of the total cultivated area in the KCVP in contrast to that in the NKCVP area (71%). Tomato accounted for 15% and ragi 12% in KCVP area when compared to NKCVP area (9% and 8% of tomato and ragi, respectively). The cropping and irrigation intensity were found to be higher in the KCVP area (162.78% and 171.02%, respectively) when compared to NKCVP area (137.41% and 163.50%, respectively), because of the availability of irrigation water throughout the year and revival of groundwater table in the area. The Simpson's index was found to be higher in KCVP when compared to NKCVP, indicating that the extent of crop diversification was more in KCVP region compared to NKVP region. Radhika (2016)[11] in her study obtained similar results that continuous availability of sewage water resulted in higher cropping intensity (257%) and crop yields (10 to 30%). This is because treated sewage water is a rich source of nutrients as against fresh water (230%).

Table 4: Cropping pattern in KCVP and NKCVP areas

Sl. No.	Crops	KCVP Area	% to GCA	NKCVP Area	% to GCA	% difference in GCA
I	**Kharif**					
A	**Cereals**					
1	Ragi	12.50	9.11	10.2	7.98	14.16

Note: In Hectares

B	**Vegetables**					
1	Tomato	9.80	7.20	6.80	5.32	35.33
2	Potato	4.00	2.94	6.40	5.01	-41.31
3	Cabbage	1.80	1.32	0	0	100
4	Beans	2.20	1.62	0	0	100
5	Carrot	3.00	2.20	0	0	100
6	Others(Brinjal, cauliflower, Radish, Coriander, Green leafy vegetables)	8.52	6.26	3.00	2.35	62.46
C	**Flower crop**					
	Marigold	1.00	0.73	1.60	1.25	-41.60
	Subtotal	42.72	31.38	70.00	21.90	43.28
II	**Rabi**					
A	**Cereals**					
1	Ragi	4.00	2.94	1.00	0.31	89.45
B	**Vegetables**					
1	Tomato	10.20	7.49	4.80	3.76	49.79
2	Cabbage	2.00	1.47	0	0	100
C	Others(Coriander, Green leafy vegetables)	1.00	0.73	3.40	2.66	-64.38
	Subtotal	17.20	12.64	8.60	6.72	46.83
III	**Perennials**					
1	Mango	46.80	34.38	77.40	60.56	-76.14
2	Mulberry	29.40	21.60	13.80	10.80	50
	Subtotal	76.20	55.98	91.20	71.36	-27.47
1	GCA (ha)	137.71		129.29		
2	NCA (ha)	84.59		94.08		
3	CI (%)	162.78		137.41		
4	GIA (ha)	121.12		105.21		
5	NIA (ha)	71.04		64.34		
6	Irrigation Intensity. (%)	171.02		163.50		
7	Simpson's Index	0.85		0.77		

Note: KCVP=Koramangla –Challaghatta Valley Project, NKCVP=Non KC Valley Project area (Control area), SI=Simpson's Index, GCA: Gross cropped area, NCA: Net cropped area ,CI: cropping intensity, GIA: Gross irrigated area., NIA: Net irrigated area.

Income of the sample farmers of both the areas was estimated by adding net returns per acre from all the crops, average income from livestock, non-farm income and average off-farm income of sample farmers and are depicted in Table 5. It can be observed that net returns from all the crops were higher for KCVP farmers than that for the NKCVP farmers. However, livestock income was higher in NKCVP (Rs.21637) as compared to KCVP (Rs.19729). This is mainly due to two reasons. Firstly, livestock acts as buffer stock during drought periods and generates income throughout the year and secondly farmers pay more attention to livestock rearing and less attention towards crop production due to the non-availability of water around the year.

Average annual rental income from hiring out farm machinery and income from shops, businesses, other non-farm activities was higher among KCVP farmers (Rs. 48725 and Rs. 30659, respectively) than among NKCVP farmers (Rs.35213 and Rs.25816, respectively). Because, higher possession of farm machinery increased hiring out income and enabled farmers to invest in other off-farm businesses. Total income from farm per year was higher among KCVP farmers (Rs. 5,41,042) than among NKCVP farmers (Rs. 4,33,099). It is evident from the above results that implementation of KCVP project resulted in higher annual income by making use of treated water by KCVP farmers (Fig 1) The farmers earn higher income in KCVP area, made possible by rejuvenation of village tanks and increased ground water table. Karaita and Drechel (2004)[8] studied the agricultural use of untreated urban waste water in Ghana. Results of their study showed that waste water use in agriculture not only supports the livelihoods of many farmers and traders but also contributes significantly to the supply of perishable vegetables to cities.

Year-round the urban farmers can achieve annual income levels of US$400-800/ha. These levels are achieved due to the intensive nature of farming made possible partly by the free and reliable supply of waste water round the year.

Table 5: Source-wise Income Received by Sample Farmers in KCVP and NKCVP areas

Sl. No.	Income source	KCVP farmers	NKCVP farmers	Difference in income of KCVP over NKCVP	Percentage difference in KCVP income over NKCVP income (%)
	Crops	**Rs**	**Rs**	**Rs**	
1	Tomato	191524.00	125021.00	66502.54	53.11

8 B. N. Keraita & P. Drechsel, Agricultural Use of Untreated Urban Wastewater in Ghana en: Wastewater use in irrigated agriculture: confronting the livelihood and environmental realities, 2004, p. 101.

2	Ragi	2425.18	1587.87	837.30	52.73
3	Mulberry	50192.10	35497.30	14694.78	41.39
4	Mango	296901.00	270993.00	25907.83	9.56
	Sub total	541042.40	433099.90	107942.50	24.92
	Livestock	19729.44	21637.70	-1908.27	-8.81
	Non-farm Income				
1	Service	48725.00	35213.64	13511.36	38.36
2	Rental Income	30659.27	25816.04	4843.22	18.76
3	Pensions	18750.00	22600.00	-3850.00	-17.03
	Total	240604.00	162099.70	78504.33	48.42

Note: KCVP=Koramangla –Challaghatta Valley Project, NKCVP=Non KC Valley Project area (Control area)

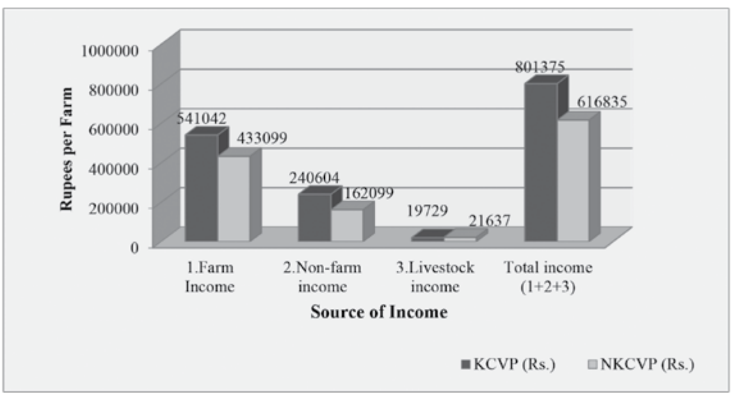

Fig 4: Annual Income realized from different enterprises by the sample farmers in KCVP and NKCVP project area.

Employment Generation and Cropping Pattern under KCVP and NKCVP areas

After implementation of the KCVP, farmers shifted towards cultivation of water intensive crops like tomato, mulberry and other minor vegetables. The cropping intensity was increased to the tune of 174 per cent and employment generated was about 97 man-days per season. The employment generated in the KCVP area was about 195 man-days per season as compared to 169 man-days per season in NKCVP.

Difference is 97 Between KCVP and NKCVP.

Table 6: Labour utilization pattern under KCVP and NKCVP project area in Kolar district

Operation	KCVP (man days)			NKCVP(man days)			Percentage difference in KCVP labour over NKCVP labour
	Family labour	Hired labour	Total labours	Family labour	Hired labour	Total labours	
1. Preparatory works	15	11	26	10	10	20	30
2. sowing	9	26	35	9	18	27	29
3. Farm yard manures (FYM) application	12	13	25	12	16	28	-10
4. Fertilizers application	6	4	10	5	3	8	25
6. Pesticides spraying	4	6	10	4	4	8	25
7. Weeding	14	22	36	12	20	32	12
8. Irrigation	4	0	4	3	0	3	33
9. Harvesting	14	17	31	13	16	29	6
10. Transport and marketing	8	9	17	6	8	14	21
Total man days	87	108	195	74	95	169	15
Total area cultivated			3.16			3.09	0
Man days per acre	26	31	57	18	23	41	39
Cropping intensity			162.78			173.98	0
Man days per crop/ season	54	66	119	43	54	97	22

Note: KCVP = Koramangla – Challaghatta Valley Project, NKCVP=Non KC Valley Project area (Control area)

It was mainly due to additional area brought under irrigation in KCVP area which enhanced the agricultural activities. Among the agricultural operations, weeding and sowing were found to be more labour intensive that required about 71 man-days of labour in KCVP area whilst in NKCVP they required about 59 man-days. However, FYM application required more man-days in NKCVP when compared to KCVP (Table 6).

The Annual Employment Generation from Various Sources in Study Area

Total employment generation from farm, livestock and non-farm sector in KCVP area was higher (301 man days) when compared to NKCVP area (289 man days). In KCVP area, the crop sector generated highest employment (118 man-days) compared to livestock (103 man-days) and non- farm sector (80 man days). In NKCVP area livestock generated higher employment (144 man days) followed by crop and non-farm sectors (97 and 48 man-days, respectively). Because of non-availability of water throughout the year, the farmers in NKCVP area shifted their focus from crop production to live stock rearing in order to earn regular income from animal husbandry (Table 7 and Fig 5).

Table 7: Annual employment generation from various sources under KCVP and NKCVP project area

Source	KCVP	NKCVP	Percentage difference in KCVP labour over NKCVP labour
Crop sector	118	97	21.64
Livestock sector	103	144	-28.47
Non-farm sector	80	48	66.66
Total Employment (man-days / year)	301	289	4.15

Note: KCVP=Koramangla – Challaghatta Valley Project, NKCVP=Non KC Valley Project area (Control area)

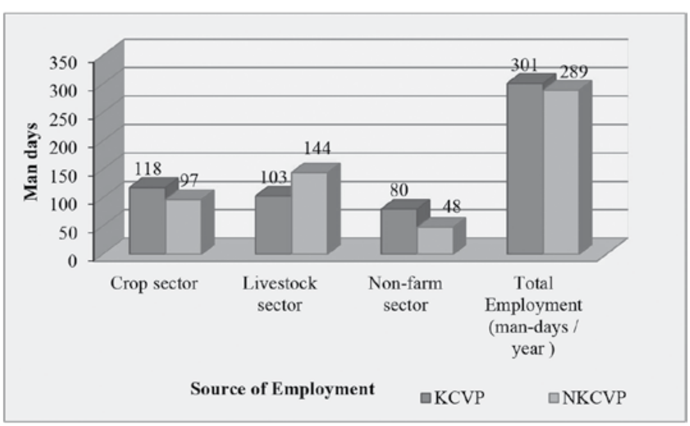

Fig 5: Annual employment generation from various sources under KCVP and NKCVP project area.

Conclusion

Keeping in view the fast declining ground water levels in the state and evidence from the study that supplying of treated sewage water to irrigation tanks of Kolar district has improved ground water table, has recharged farmers' bore wells in those tank command areas, the government should think of replicating similar projects in other ground water scarcity areas of the state. However, caution needs to be taken to study the presence of harmful chemical residues and if it is so, analyze the long term effect of such residues, before extending similar projects to other regions. Awareness needs to be created among the farmers not to use treated sewage water directly to irrigate crops, and use only the recharged well water. This needs to be monitored regularly. KCVP beneficiaries need to make sure that their bore well water is tested at least once in three months for pollutants which have adverse impact on human as well as animal health. Further, extensive studies to assess the economic impact of using treated urban waste water on agriculture, have to be initiated to strengthen the findings of this study.

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PART III

Indian Framework in Light of Regulation of Water Conservation and Resolution of Disputes

Chapter 9
Water Quality in Agriculture: The Need for a Revisit of Land Use Patterns and Policies

Dr. Vani Kesari*

Abstract

Research studies have regarded changes to land use management as one of the key influential factors responsible for the poor water quality levels. The reason is that hydrological systems have a significant relationship with land use patterns especially due to increased human activities within the watershed. Agricultural activities mainly depend on land use. Agriculture has been both the cause as well as a victim to water pollution and consequently deterioration of the water quality. The paper throws light on the innate relationship between land use and water quality in farming activities. It evaluates the critical role played by the land use policies in maintaining water quality and the need for farsighted integration of the same in the context of agriculture. It investigates the sufficiency of the existing regulatory patterns with regards to land use. It also examines how far the existing policies in India, in the area of water, land and agriculture, take into consideration the need for integrating land use and water policies with regard to agriculture.

***Keywords**: Agriculture, Land use, Water quality, Land use planning, Water policy*

Introduction

Water is essential for sustenance of all forms of life on this earth. However, the global statistics reveal that 1.1 billion people worldwide lack access to water, and a total of 2.7

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billion find water scarce for at least one month of the year.[1] Quantity of water has an essential connection with the way water is used. Not only we need water but we need fresh water to have a dignified existence since all human activities depends on it.[2] Agriculture forms the major component of the global economy and the dramatic fall in the proportion of population working in agriculture has resulted in the pressure to produce enough food which has consequently led to a worldwide impact on agricultural practices. It is a well-known fact that agriculture is deemed to be the single largest user of freshwater resources i.e., it uses a global average of 70% of all surface water supplies. Except for water lost through evapotranspiration, often it can be found that agricultural water is recycled back to surface water and/or groundwater. However, it needs to be understood that agriculture is both cause and victim of water pollution. Agriculture is a cause of water pollution in the sense that the discharge of pollutants and sediment during farming to surface and/or groundwater is something very common and it is also through net loss of soil by poor agricultural practices, and through salinization and waterlogging of irrigated land. Further, agriculture is a victim of water pollution in the sense that, the use of wastewater, polluted surface and groundwater leads to contamination of crops and as a result leading to disease in consumers and farm workers.[3] According to a 2016 report by the UNEP, agriculture pollutes water resources as a result of the use of agrochemicals, organic substances, saltwater drainage, and as a net result, this pollution threatens aquatic ecosystems and human health.[4] Hence, the need for maintaining water quality is a matter of global concern. It not only leads to ecosystem dysfunction and loss of biodiversity, but also a global effect on human health due to persistent organic pollutants leading to massive impact on all life forms. Therefore, an understanding of the impact of water pollution on the agrarian sector as well as the effects of agrarian activities on water pollution[5] needs to be understood and analysed in proper perspective. In order, to understand the same we need to understand it in terms of the relationship between land and water.

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1 Water Scarcity, World Wild Life, https://www.worldwildlife.org/threats/water-scarcity#:~:text=As%20 (last visited May 11, 2021).

2 *Human Rights to Water and Sanitation*, United Nations, https://www.unwater.org/water-facts/human-rights/ (Last visited on May 11, 2021).

3 Food and Agricultural Organization [FAO], Guidelines Document on Control And Management of Agricultural Water Pollution, http://www.fao.org/3/w2598e/w2598e04.htm.

4 United Nations Environment Program, A Snapshot of the World's Water Quality: Towards a global assessment, U.N. Doc. DEW/1975/NA (2016).

5 Hristina Harizanova & Zorniksu Stoyanova, *Impact of Agriculture on Water Pollution*, 4 AGROFOR 111 (2019).

Land and Water: The Indispensable Link

Land and water are the natural resources that are inextricably entwined.[6] This becomes even more evident in the context of agriculture. The relationship between the two, i.e. land and water, is of equal importance. In fact, water is an indispensable element in all forms of productive use of land. One of the major constraints with regards to agriculture faced by countries with arid climates is the availability of water rather than land. At the very same time, it can be found that the use of land has a major impact on both the quality and quantity of water resources. Thus it can be inferred that the decisions regarding the use and allocation of one resource would necessarily have an impact directly or indirectly on the use and allocation of the other. Therefore, in order to ensure sustainability, the need for an integrated approach to the use and management of these resources is increasingly recognized.[7] The inherent tension between the growing demand for crop production and available water supply is already deemed to be moving at a faster pace, since agriculture currently accounts for more than 70 percent of all human water withdrawal. In fact , reports reveal that water demand in many parts of the world is meeting or exceeding natural supply.[8] Global water scarcity as commonly conceived is caused not only by the physical scarcity of the resource but also by the progressive deterioration of water quality in many countries, reducing the quantity of water that is safe to use by all life forms.

At this juncture, one needs to understand the pivotal role played by irrigation. Often variations in rainfall creates the potential for low crop yields and risk of crop failure in semiarid regions wherein irrigation is needed most of the time. Further, irrigation in humid and sub humid regions is desirable and is often deemed to be an insurance against crop losses. Similarly, summer rainfall ordinarily is sufficient for crop growth however sometime during the year a drought may occur. Here again irrigation plays a significant role.

Production of a profitable crop is generally the objective of agriculture. In this context, irrigation provides the necessary insurance for a profitable agriculture in semi-arid, sub-humid, and humid areas whereas it is a necessity in arid regions. However, the prominent question is whether planned irrigation systems are employed by those engaged in agriculture? Often it is found that salinity, sodicity, and ion toxicity are major problems

6 E.K. Weatherhead & N.J.K. Howden, *The relationship between land use and surface water resources in the UK,* 26 Land Use Policy 243 (2009).

7 Stephen Hodgson, FAO, Land and Water – the Rights Interface (2004).

8 Francis Gassert, Why the relationship between water and agriculture needs to change, GreenBiz (Nov. 5, 2013) https://www.greenbiz.com/article/why-relationship-between-water-and-agriculture-needs-change.

in irrigation waters which seriously impact the water quality. In fact, sodicity which means the presence of excess sodium, will lead to deterioration of the soil structure, thereby reducing water penetration into and through the soil. Whereas, toxicity which is understood to be the critical concentration of some salts such as chloride, boron, sodium, and some trace elements, adversely affects plant growth. Hence water quality and proper management of land is essential for sustainable agriculture.

Water Quality: Certain Basic Understandings

Water quality is affected by both natural and anthropogenic factors. The natural factors affecting water quality includes precipitation intensity and discharge, river discharge, topography, soil type, etc. Human induced factors include changes in river discharge due to abstraction, urbanization or impounding; discharges from industry, sewage, agriculture, etc.[9]

Water quality is an essential requirement for plant health since it has immediate impact on soil health as well.[10] Poor quality water can be responsible for slow growth, poor aesthetic quality of the crop and, in some cases, can result in the gradual death of the plants.[11] Conversely, improper agricultural methods and practices also raises the concentrations of nutrients, faecal coliforms, and sediment loads. Animal wastes are commonly used by farmers and thus increased nutrient loading from animal waste leads to eutrophication of water bodies which may eventually damage aquatic ecosystems. This not only affect soil health but also can have adverse impact on our public health as well. Similarly, farming activities such as grazing of livestock may intensify erosion processes, raising sediment input to nearby water sources. Again the increased sediment loads effects the aquatic life especially the fish and macro-invertebrates.[12] Certain irrigation techniques such as surface flooding, localized drip, and subsurface irrigation though efficient yet lead to certain problems. For instance, under-irrigation or in the case of drip irrigation, it is found that it can lead to salt build up on the soil surface and can damage crops. Similarly, there are also problems perpetuated by over-irrigation as well as in the case of surface irrigation, wherein it may not only trigger nutrient/chemical runoff, but can also cause perched water tables

9 PK Goel, Water Pollution: Causes, Effects and Control, 1 (2006).

10 RS Ayers & DW Westcot, FAO, Water Quality in Agriculture, 2 (1985).

11 *Water Quality for Crop Production,* University of Massachusetts, Amherst, https://ag.umass.edu/greenhouse-floriculture/greenhouse-best-management-practices-bmp-manual/water-quality-for-crop (Last Visited on May 11, 2021)

12 Agricultural Uses of Water, Utah State University, https://extension.usu.edu/waterquality/learnaboutsurfacewater/usesofwater/agriculture (last visited May 12, 2021).

resulting in soil salinity problems.[13] Thus it can be inferred that in the mad race to increase agricultural productivity, irrigation has become more dependent on poorly characterized and virtually unmonitored sources of water. Moreover, reports point out the fact that increased use of irrigation water has led to impaired water and soil quality in many areas. [14] Use of untreated wastewater is becoming prevalent in developing countries where around 80–90% of wastewater remains untreated.[15] The use of untreated waste water affects the soil and water alike. Use of engineered nanomaterials in agriculture has also added to the woes.

The 2030 Agenda for Sustainable Development has stressed on the importance of water quality and includes a specific water quality target in the Sustainable Development Goals (SDG).[16] The major issue is with regard to it is to what extent the same had been taken into consideration by the nation states? In most developed countries as well as many emerging economies, agricultural pollution has already overtaken contamination from settlements and industries as the major factor in the degradation of inland and coastal waters (e.g. eutrophication). It has also been reported that nitrate from agriculture is the most common chemical contaminant in the world's groundwater aquifers.

Land Use Patterns and Water Quality

The type and severity of water contamination is often directly linked with human activity, which can be quantified in terms of the intensity and type of land use in the source areas of water to streams and aquifers. The analysis of patterns of land use and population provides a tool in the investigation of sites with known contamination, and consequently enables the prediction and prevention of future contamination of downstream water. Land use is generally considered as the varying activities undertaken and executed by humans so as to exploit the landscapes e.g., hunting, ploughing, quarrying etc.[17] Each type of land use has a varying effect on the water cycle, thereby affecting the people and the natural resources on a landscape. It needs to be understood that watershed acts as a receiver, collector, and

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13 Huma Ziya et al, *The Impact of Agricultural Activities on Water Quality: A Case for Collaborative Catchment-Scale Management using Integrated Wireless Sensor Networks*, 96 Computers and Electronics in Agriculture 126 (2013).

14 Arindam Malakar et al, *Irrigation Water Quality—A Contemporary Perspective*, 11 Water (2019).

15 UNESCO, The United Nations World Water Development Report 2017 (2017).

16 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally" (United Nations, 2016).

17 Isaak S. Zonneveld, *What is Meant by Land Use Change?*, The National Academics Science, Engineering, Medicine, https://www.nap.edu/read/2211/chapter/4 (Last visited on May 12, 2021).

conveyer of precipitation on a landscape. Hence land uses affect these pathways by altering surface runoff and groundwater filtration, thereby changing the quantity and quality of water resources.[18]

Land use change is an important and complex environmental issue that needs "many eyeballs" working together.[19] Currently, land use and land cover change are one of the major cause of global environmental change especially the water quality. Water quality is defined by the World Health Organization (WHO) as the chemical, physical and biological properties of water that are required for safe use.[20] Water quality is determined by several parameters like temperature, dissolved oxygen, pH, total suspended solids, nutrients, and heavy metals which are very crucial to the survival of the habitat. Agriculture can be said to be the prominent activity which cannot be carried out without land use for e.g. row crops, rangelands, animal farms, aquaculture, other agribusiness activities, etc. The search for excessive yields through the application of high fertilizer doses, use of herbicides and pesticides, highly mechanized field operations rather than labour intensive ones have been the modern approach to agriculture.[21] This has not only affected the water quality but has also led to soil compaction and increased surface erosion. Undoubtedly, farming involves soil and water manipulation through tillage and irrigation, thereby affecting runoff water and groundwater. Hence, planned use of land is the most essential aspect while agricultural activities are undertaken. Out of India's total geographical area of 328.7 million hectares, the statistical information about the land use pattern in India is available for only about 305.69 million hectares which is based on village papers and on estimates.[22]

Generally, land-based pollution of water considers two main sources of pollution: point and non-point sources. A point source of pollution is usually coming from a single source which can be easily identifiable whereas non-point sources of pollution comes from multiple sources and which are not easily identifiable. However, one needs to understand that the terminology "*land use*" not only encompasses land used for agriculture alone but for use of land for settlements, industrial sites, roads, and other human activities. Land use, in this context can be termed as sustainable only if it seeks to achieve such a

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18 Land-Use Planning, WATER ENCYCLOPAEDIA http://www.waterencyclopedia.com/La-Mi/Land-Use-Planning.html (last visited May13, 2021).

19 Aakriti Chauhanand & S C Verma, *Impact of Agriculture, Urban and Forest Land Use on Physico-Chemical Properties of Water A Review,* 4 INT. J. CURR. MICROBIOL. APP. SCI. 18-22 (2015).

20 MD Sharif Hossain, *Impact of Land Use Change on Stream Water Quality: A Review of modelling approaches*, 2 JREAS 1 (2017).

21 Willy Verheye, *Land Use Management* 4 Encyclopaedia of Life Support Systems (2015).

22 What is Land Use Pattern? Types of Land Use in India, SANSAR LOCHAN, https://www.sansarlochan.in/en/land-use-pattern-types (last visited on May , 12,2021).

spatial distribution or configuration for different uses, since it guarantees conservation of biodiversity and preserve the eco-balance of the whole system. Thus rational land use planning is fundamental to this process.[23]

Land use planning process aims at integrating the social, economic, and legal aspects of agricultural economy in which the agricultural production system is operating. In this mode of planning with regard to agriculture, an assessment of the production potentials of various agro-ecologies at sustainable levels is undertaken and then the same is matched with the market forces. The strength of this form of planning is in prioritizing all land use (in a zero-base budgeting context) according to its capability coupled with the renewable water resources availability.[24] In this context agriculture is meant to include production of the 5Fs - food, feed, fodder, fibre and forest products. Thus, in land use planning, besides the cropland assessment of suitable production capacities of forests and other land-based activities such as animal husbandry and inland and coastal fisheries sectors are also undertaken. Hence it is an essential part of sustainable development.

The Legal Framework on Land Use Planning vis á vis Water Quality

The concept of land use planning developed in India when the need for planned development of towns and cities was felt. Earlier it was regarded that, the population growth and availability of resources were in consonance with one another and therefore there was no need for human planning. This approach underwent a drastic change when the country faced the crisis of increase in population and the depleting resource availability. Hence of late, there has been a trend towards the requirement for smart planning of land.

Agricultural land constitutes a major proportion of India's geographical area, while forests being the next. India has geographical area of 328.7 million hectares, of which around 42% is currently used for cultivation of various food and non-food crops.[25] This proportion is one of the highest in the world, but the fact is that due to excessive population pressure, the per capita availability of arable land is much less than the world average. Land owners have the freedom to transfer the land but a change in use from agricultural to commercial, industrial or any other purpose usually requires the permission from revenue authorities and such permission is generally accorded easily on the payment of a required fee.

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23 D. De Wrachien, Land Use Planning: A Key to Sustainable Agriculture (2003).

24 Ravindra Srinivasrao Ravindra Gajjala, B.M.K Raju, Vijay Jakkula and Y.Rani., *Land use planning for low rainfall (450-750 mm) regions of India,* 24 (02) AGROPEDOLOGY, 197, 198 (2014).

25 Ghanshyam Pandey & Thiagu Ranganathan, *Changing land-use pattern in India: has there been an expansion of fallow lands?* 31 Agricultural Economics Research Rev, 111 (2018).

Presently, planning at the national level is done by the Planning Commission of India, now renamed as NITI Aayog. Land use planning is undertaken at the national, state, district, village, and even at the farm level. Entry 18 of List II deals with land including assessment and use. Hence land use management is a state subject. Article 243ZD (1) of the Indian Constitution states that every state shall constitute at the district level a District Planning Committee to consolidate the plans prepared by the panchayats and municipalities which prepare a draft development plan for the district as a whole. The Constitution (Seventy-fourth Amendment) Act, 1992 provides for District Planning and Metropolitan Area Planning that consolidates plans of both panchayats and municipalities having regard to spatial (land use) planning. The District Plans prepared currently, in general, do not cover spatial (land), environmental and urban concerns including water quality.[26]

Statistics of land use are compiled from the village land records maintained by the patwari. The information is available according to their survey number and they are recorded under the nine categories which include forests, area under non-agricultural use, barren and uncultured land, permanent pastures and other grazing land, miscellaneous tree crops, culturable waste land, fallow land other than current fallows, current fallows, and net area sown. The nine-fold classification of land use based on village records is not adequate enough to address the question of water quality in agriculture. At the macro level in India, there are two main sources of land use data, namely the Bureau of Economics and Statistics and the National Remote Sensing Agency; however, unfortunately the land use statistics is not available at the village or district level of the states. Similarly, most of the land records in several states are hardly computerised.[27] Hence all these continue to pose challenges to land use planning.

In the year 1976, the National Commission on Agriculture emphasized for scientific land use planning for achieving food security, self reliance and enhanced livelihood security, and also suggested that a separate policy for water in agriculture needs to be made. [28] Similarly, in 2007, the National Policy for Farmers had recommended revival of existing Land Use Boards and their linkage to district-level land-use committees, so that they can provide quality and proactive advice to farmers on land use.[29] The Committee on "State Agrarian Relations and the Unfinished Task in Land Reforms" in 2009 has also emphasized

26 Department of Land Resources (Ministry of Rural Development; Government of India), *National Land Utilisation Policy* (2013).

27 *4.7. Land Use,* Government of India Ministry of Statistics and Programme Implementation, http://mospi.nic.in/47-land-use (last visited on may,13,2021).

28 National Commission on Farmers, *Jai Kisan: a Draft National Policy for Farmers* (2004).

29 Department of Agriculture & Cooperation Ministry of Agriculture, *National Policy for Farmers* (2007).

the need for land use planning in the country.[30] However, in all these policies what one can infer is the silence on the linkage between land use and water quality.

As per the Constitution of India, water and sanitation extending to 'water supplies, irrigation and canals, drainage and embankments, water storage, and water power' falls within the legislative competence of state which includes not only power to enact laws but also to frame policies or fix prices of related services.[31] These powers enjoyed by the states are, however, subject to the authority of the Centre since the Centre has the legislative power to regulate the development of inter-state rivers and settle inter-state water disputes.[32] Legislative subjects like minor irrigation, water management, and watershed development are included in the list of subjects in the eleventh schedule, which can be transferred to panchayats if the state government so notifies in terms of the state legislation, and it can be observed that several states have already done this. Planning and implementation of water development projects is currently handled both at the centre and state levels. This often has been reported to be fragmented and not holistic in nature.

The National Water Policies (NWP) since 1987 has significantly contributed to carving out policies at the state and local level. Though the NWP of 1987 gave priority to irrigation yet it was silent on the land use patterns in agriculture. NWP of 2002 for the first time gave emphasis to ecological and environmental aspects of water allocation. The NWP of 2012 advocated a common integrated perspective to govern the planning and management of water resources. It emphasised the need consider local, regional, and national contexts and be environmentally sound. The most positive aspect of this policy was that it emphasised that water needs to be managed as a common pool community resource which is to be held by the State under the public trust doctrine to ensure equitable and sustainable development for all.[33]

One of the critical factors all these policies failed to address is the increasing scarcity and deterioration in quality of water resources and their management and the need to integrate the same with the land use planning. Though NWP recommends spatial planning for conserving groundwater it is silent on other water sources. The Guidelines for Integrated Water Resources Development and Management, 2016 is also silent on integrating land use planning with water quality in agriculture. It has also been reported that with the

30 State Agrarian Relations and the Unfinished Task in Land Reforms, *Report of the Committee on State Agrarian Relations and the Unfinished Task in Land Reforms* (2008).

31 India Const. sch VII, list II, entry 17.

32 India Const. sch VII, list I, entry 56.

33 S Vijay Kumar & Girija K Bharat, *Perspectives on a Water Resource Policy for India* 1 The Energy and Resources Institute (2014).

onslaught of the New Economic Policies, most of the states like Maharashtra, Tamil Nadu, Andhra Pradesh, Gujarat, etc. have shown laxity on their part in addressing the question of sustainable land use.[34]

Conclusion

It has been pointed out that the global land area is 13.2 billion ha. Out of this 12% is currently used for cultivation of agricultural crops.[35] It can be inferred that undoubtedly modern approach to agriculture exerts pressure and does have certain negative impacts. The variations in farming activities in the land as well as at site specific level has impacts both on land as well as water. This is so with regard to plant, animal and human health as well. Hence appropriate initiatives need to be undertaken in this regard. All the land and water resources are to be treated as social resources and their use has to be planned on the scientific basis. Using GIS in combination with other techniques for studying the relationship between landscape patterns and water quality needs to be undertaken and this should be the basis for land use planning and policies.

Similarly, water quality monitoring should be undertaken at the local level and the data needs to be integrated with the land use planning and policies by the states and by the district planning agencies. The land and water use is to be planned on the basis of watershed planning with up lying portion being reserved for erosion control using graded bunds and suitable grasses and trees, so as to ensure stabilization of water supply. Water management policies should prioritize quality and maintenance of quality standards while at the same time stressing on access to water. A holsitic planning needs to be undertaken while drafting orders relating to land use as well as water management policies.

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34 *Demand and Supply Productions Towards 2033: Crops Livestock, Fisheries, and Agricultural Inputs,* NITI Aayog, http://niti.gov.in/sites/default/files/2019-07/WG-Report-issued-for-printing.pdf (Last Visited on May 11, 2021).

35 *THE STATE OF THE WORLD'S LAND AND WATER RESOURCES FOR FOOD AND AGRICULTURE : Managing Systems at Risk,* Earthscan from Routledge, http://www.fao.org/3/i1688e/i1688e.pdf (Last Visited on May 11, 2021).

Chapter 10
Agri Water Regulatory Kinetics

Dr. C. N. Manjappa* Dr. Manjunatha C. S.**

My habitat is in the backyard of river Sharvathi reservoir i.e. Channiganathota[1] - Athavadi, Sagar taluk, Shivamogga District, Karnataka. It is amidst the Western Ghats identified as an Ecologically Sensitive Area (ESA). My village, in 1970, was enveloped with 2160.22 acres of land out of which 387.02 acres was covered in dense evergreen forest with a density of at least 100 heritage trees per acre, 410.21 acres of rain fed cultivable land, 150 acres of meadows to feed 1500 cattle and buffalos - excluding other livestock - apart from wild herbivores and omnivorous, thirteen tanks, five tributaries, springs, rivulet, streams used to flow unabatedly for ten months in a year, leading to river Sharavathi, fifteen open wells were meeting the requirements of thirty five undivided families/joint families consisting of 500 people and agricultural needs. Annual rain fall was 2600mm and water level was two to four feet beneath the surface level. Areca nut, paddy, pepper, ginger, sugar cane, coffee, plantain etc., were nurtured with the aid of bio fertilizers and herbal pesticides. Our village was enveloped with the fragrance and euphonic chorus of woods. The forest was the perennial source of fruits, greens, roots, vegetables and herbs. Purchasing them from the market fair was uncommon. The alarming decline in forest fruits, greens, roots, vegetables and herbs made us depend on the market fair.

Today, in 2021, our village has 374.06 acres of evergreen forest with low density i.e. comprising about 10 heritage trees per acre. Nearly 30% of the species are on the verge of

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1 Dr. Kasturirangan in his Report 15th April, 2013, Sl. No. 1434 Appendix 3, List of Villages in ESA of the Western Ghats, Vol. II, April, 2013. Channiganathota and Athavadi villages are geographically indispensable Unit.

extinction, 150 acres are enveloped with acacia, eucalyptus, pellota and myangium and there are 674.22 acres of rain fed cultivable land. There are very scanty meadows to feed about 300 cattle and buffalos - excluding other livestock - apart from wild herbivores and omnivorous, five tributaries, springs, rivulet, streams flow for five months in a year, nearly 300 open well 30 bore wells, public water supply and mobile water tanker is quenching the thirst of 210 nuclear families consisting of 824 people and agricultural needs. Only four tanks are satiating the needs of the populace as other tanks are filled with silt. The rain fall in 2020 was 2200 mm and the water level was ten to sixty feet underneath the surface level.[2] Agricultural crops are sizeably supported with chemical fertilizers and pesticides. This tendency has been gradually depriving us from experiencing the fragrance and sounds of the woods.

Agro - Eco – Legal – Philosophy

As per the Bhagavad Gita, we are living beings clinging on to nature. Earth, water, fire, air, space, mind, intellect and ego are components of our material energy and existence. Water – grains – sacrifice – makes us fetch food and gain strength. It is a natural cyclical process. No one is free from it.[3]

Agronomy, one of the best means of gaining wealth, is not novel to the Indian society. It has been preached and practiced since ages. Rain water has been the archaic source of water for agriculture. Accordingly, earth, air, fire and sky do have dominancy in agriculture. This has made our ancestors worship all the natural phenomenon i.e. Earth (Pruthvi), water(Apas), air (Vayu), fire (Agni) and sky (Akasha) as personified deities.[4]

Mother earth, created by the Almighty, rears a bond between the living being and the nature which is so sacred and solid that it cannot be dispensed with.[5] The onus is on man to remain humane to nature and fellow beings and to strive for the survival of the present and future generations.[6] Indubitably, nature allows him to consume the natural resources

2 The statistics afore mentioned are approximate figures

3 annād bhavanti bhūtāni parjanyād anna-sambhavaḥ yajñād bhavati parjanyo yajñaḥ karma-samudbhavaḥ||14|| chapter 3, Bhagavad gita

bhūmir-āpo ’nalo vāyuḥ kha□ mano buddhir eva cha ahankāra itīya□ me bhinnā prakṛitir aṣhṭadhā ||4|| chapter 7, Bhagavad gita

4 Vedic Agricultural System - The Base of Modern Agronomy , Indira Gandhi National Centre for the Arts, Ministry of Culture, Government of India vedicheritage.gov.in/…/agriculture-2

5 Article 1, KeytoIndigenous Peoples’ Kyoto Water Declaration Third World Water Forum, Kyoto, Japan, March 2003.

6 Article 2, 3, ibid

to satiate his hunger but not his lust. Any defiance would be an unpardonable sin[7].

We are indigenous people who are born free and enjoy equality in dignity and rights.[8] We have inherent self - determining rights and can exercise our authority in entirety and control natural resources including water.[9]It could be used as a common pool resource, subject to reasonable restrictions, by all without any discrimination on the ground of caste, creed, religion, community, class, gender, age, disability, economic status, land ownership and place of residence since the people hold it in common heritage and public trust.[10]

Water is a spiritual and physical entity. It has all the rights, powers, duties, and liabilities of a legal person. Any defiance is a punishable offence.[11]Accordingly, in the course of utilizing water resources no one shall either pollute natural lake or pond or stream or river or affect the rights of subjacent and adjacent soil of another person or cause material injury to the person or property or both. The water which passes or percolates shall ever be pristine.[12] The State is a Public Trustee.[13]It is empowered to direct the sustainable use of aquifers and the groundwater table to ensure that the needs of future generations are met and to ensure equitable/fair distribution and access to water strictly in compliance with priorities prescribed. The significance of the intrinsic value of biological diversity and of the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its components including the importance of biological diversity for evolution and for maintaining life sustaining systems of the biosphere - a march from 'anthropo-centrism' to 'eco-centrism' has started.[14]In pursuance of it a long

7 Qur'an 7:31, 6:141, 17:26-27, 40:34

8 Article 1, Universal Declaration of Human Rights,1948; Article 14, Constitution of India

9 Article 9, supra Note 8, Subhash Kumar V State of Bihar (1991) 1 SCC 598

10 Section 4,19, Draft Protection, Conservation, Regulation and Management of Groundwater Act, 2016.

11 Section 13,14,21, Te Awa Tupua (Whanganui River Claims Settlement) Act 2017. Mohd. Salim Vs State of Uttarakhand & others Writ Petition (PIL) No.126 of 2014 Dated: March 20, 2017,in the High Court of Uttarakhand at Nainital. Section 141,277,430, Indian Penal Code, 1860, Section 41, 42, 43,s44, Water (Prevention and Control of Pollution) Act, 1974, Section 15, Environment (Protection) Act, 1986.

12 The Indian Easements Act, 1882, § 7,

13 MC Mehta v. Kamal Nath (1997) 1 SCC 388, Intellectual Forum v. State of A.P(2006) 3 SCC 549, Fomento Resorts & Hotels Ltd. v. Minguel Martins (2009) 3 SCC 571

14 "Whereas with the growing pace of urbanisation, industrialisation and increasing population, there has been indiscriminate felling of a large number of trees in the rural and urban areas of the State of Karnataka leading to erratic rainfalls, recurring famines and floods, soil erosion and consequent ecological disturbances; Whereas it is expedient to provide for the preservation of trees in the State by regulating the felling of trees and for the planting of adequate number of trees to restore ecological balance and for matters connected therewith", Preamble to the Karnataka Preservation of Trees Act, 1976; Forest policy,1988, F. No. 1-1/2012-FP (Vol.4) Government of India Ministry of

term security plan, needs to be designed in consultation with the neighbouring State to eliminate or mitigate the possible harm to attain equitable and reasonable utilization for mutual benefit and to promote environmental values.[15] The appropriate Government in consultation with the Water User Associations (WUAs) has the onus to review crop plan, subject to the availability of water, to move from water intensive cash crops to water non -intensive cash crops.[16] At the same time the State shall identify the recharge and discharge zones of transboundary aquifers or aquifer systems that exist within its territory.[17]

Indian Panorama

India has to support 16 per cent of the world's population and 15 per cent of livestock relying on inequitable natural resources, especially land and water, with 2.4 per cent of land and 4 per cent of fresh water resources. India used to get an average annual rain fall of about 4000 billion cubic meters (BCM). Out of which nearly 75% precipitation occurs during the monsoon period. The average maximum rainfall i in Meghalaya is 10900 mm and the average minimum rainfall in Rajasthan is 100 mm as against the national average annual rainfall of 1100 mm. It is estimated that by 2050 India would require 1447 BMC fresh water for diverse uses, which is insufficient to meet all future needs as the population of the country may stabilize by the year 2050 at around 1.6 billions.[18]Virtually, per-capita availability of water, at national level, is 1,829 cubic metres (CUM). This is expected to decline by 1,341 CUM at 2025 and 1.140 CUM by 2050, owing to increase in population. The per-capita storage capacity in India is about 207 CUM. Out of the total water supply, the share of irrigation at present is about 80 per cent. This is likely to go down to 73 per cent by 2025.[19]

Environment, Forest and Climate Change Forest Policy Division Draft National Forest Policy, 2018 (Approved Draft version).

15 Article 3,10,12, Draft Articles on The Law of Transboundary Aquifers 2008, Section 5,9, Draft Protection, Conservation, Regulation and Management of Groundwater Act, 2016, Article –VIII, IX, Treaty Between the government of the Republic of India and the government of the People's Republic of Bangladesh on Sharing of the Ganga/Ganges Waters at Farakka, December 12, 1996.

16 Draft Protection, Conservation, Regulation and Management of Groundwater Act, 2016. § 19,

17 Article 12, Draft Articles on the Law of Transboundary Aquifers 2008.

18 General Guidelines For Water Audit & Water Conservation, December 2005, Central Water Commission Evaluation of Water Utilisation Directorate , Ministry Of Water Resources, Government of India, New Delhi

19 V. Basil Hans - Water management in agriculture: Issues and strategies in India - International Journal of Development and Sustainability ISSN: 2186-8662 – www.isdsnet.com/ijds Volume 7 Number 2 (2018): Pages 578-588.

India ranks third globally in storing the runoff water with 5254 large dams, in operation, and about 447 dams are under construction apart from the thousands of medium and small dams. However, water security in the country is an emerging issue of concern for all on account of uninhibited growing population, fast track ground water depletion and poor irrigation systems.[20] The country has 115.6 million farming families and two-thirds of the country's population work in agriculture. There are 183 million hectares of cultivable land out of which 139.89 hectares has the potential of being irrigated with the use of only 108.3 m ha (i.e. about 77 per cent) accounting about 60 per cent of food grains production to feed over 1000 million people every day.[21]

State Water

The water derived from any river, natural stream or natural drainage channel, natural lake or other natural collection of water is in the domain of the State Government. It is not only empowered to regulate the collection, retention and distribution of the water of rivers and streams flowing in natural channels, and of natural lakes and ponds, or of the water flowing, collected, retained or distributed in or by any channel or other work constructed at the public expense for irrigation[22]but also exercises right on all irrigation work and all land, earth, pathways, gates, beams and hedges belonging to, or forming part of or standing on any such irrigation work and every embarked tow path along the embankment maintained by the State Government.[23]

Policy Initiatives

In furtherance of the Constitutional mandate, the Government is aiming to utilize finite water resources, for diverse uses, by unveiling demand management, conservation and efficient utilization policy for the domestic sector, agricultural sector and for river basin management.[24] The contours of finite water resources is designed with priorities considering environmental viability, economic and social good i.e. - integrated water resource management; participatory approach; fresh and clean water; water literacy and knowledge dissemination.[25]

20 cwc.gov.in/damsafety/home; damsafety.in/dharma/Home1/images/NRLD.pdf

21 *Supra* note 22

22 Article 262, Entry 56, State List, Seventh Schedule of Constitution of India.
Section 2, Indian Easements Act, 1882, Section 2A, Schedule -I,II,III, Karnataka (Gram Swaraj and Panchayat Raj) Act, 1993

23 Section 4,7,11,27,29,Karnataka Irrigation Act, 1965, Section 4, Bihar Irrigation Act, 1997.

24 State Water Policy of Assam (Draft), 2007

25 *Ibid*, Water for Sustainable Food and Agriculture A report produced for the G20 Presidency of Germany Food and Agriculture Organization of the United Nations Rome, 2017

Water Use Prioritisation

The appropriate Government is empowered to prioritise and determine the allocations of water, with a view to promote conservation and efficient use, considering availability of water and the local circumstances, prevalent activities and livelihoods, and the land-uses signified by those circumstances. However, such determination shall aid sustenance of aquifers and ecosystems. The priority to be accorded shall further – (1) the right to water for life; (2) achievement of food security; (3) sustenance agriculture; (4) sustainable livelihoods; and (5) eco-system needs.[26]

Water Quality and Quantity Monitoring

The onus is on the State to supply quality water of requisite quantity on equitable volumetric basis from the "utilizable water resources". Water, i.e., both surface water and groundwater, to be supplied shall be wholesome and aseptic.[27] For this purpose the State shall prevent and control pollution and contamination of water sources by -

a) Enforcing recycling and reuse of water;
b) Minimising the generation of waste in all water uses;
c) Reducing non-point source of pollution;
d) Recovering, to the extent possible, water for some use from waste; and
e) Ensuring that nothing that does not meet certain stringent quality standards, as may be prescribed, is allowed to enter water sources.[28]

Further, the State shall scientifically assess water potential at specified intervals. The citizens owe a corresponding duty to protect and improve the water resources.[29]

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26 Section 11,National Water Framework Bill, 2016,Section 10, Draft Protection, Conservation, Regulation and Management of Groundwater Act, 2016.

27 Article 39(b),48,48A, Constitution of India, Section 6, Maharashtra Groundwater (Development and Management) Act, 2009,Karnataka State Water Policy June 2019 Karnataka Jnana Aayoga (Karnataka Knowledge Commission) Government of Karnataka

28 Section 19 supra note 29

29 Article 51A(g), Constitution of India) Any defiance would attract punishment on the edifice of 'polluter pays principle'. Water Act, Environmental Protection Act, Karnataka Panchayat Act, 1993, 9.2, State Water Policy of Assam (Draft), 2007. Guidelines 1.1.4. General Guidelines For Water Audit & Water Conservation, December 2005, Central Water Commission Evaluation Of Water Utilisation Directorate , Ministry Of Water Resources, Government Of India, New Delhi

Soil Health

Today, soil, water and the other biological resources are under extreme stress. Agri-cultivability and agricultural production are solely dependent on the soil health condition. The 'Soil Health Card' would indicate the present soil nutrient content, deficiencies as well as the requirement of various nutrients in the soil to bring it back to optimum fertility level.[30] While placing reliance on the 'Soil Health Card', care needs to be taken to promote its economic use by making provisions for adequate lung space in and around the villages, "One village - one tank" and "One village - one pond" including tree planting along with boundaries of cultivable land at least at the rate of 5 trees per acre.[31] Further, action plan needs to be designed to envelop -

a) Prevention or mitigation of erosion of soil;
b) Preservation and improvement of soil;
c) Reclamation of waste, saline or water-logged land;
d) Improvement in the methods of cultivation.[32]

Watershed Management

The focus of Watershed Management development program is to conserve soil and moisture apart from putting the lands to the best use to facilitate and improve its capabilities and productivity holistically. The Watershed Development program/scheme is being executed on a multi-disciplinary scale availing the expertise and co-ordination from several departments.[33]

Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), 2017

It is an end-to-end irrigation supply program that applies to water sources, distribution network and farm level applications. The aim of this program is to create protective irrigation by harnessing rain water at micro level through 'Jal Sanchay' and 'Jal Sinchan'. Micro irrigation is an integral component of the scheme to maximise water use efficiency at farm level. PMKSY adopts state level planning and projectized execution that allows states to draw up their own irrigation development based on District Irrigation Plans and

30 Karnataka Agricultural Policy 2006.
31 *Ibid*
32 Section 9, Bihar Soil and Water Conservation and Land Development Act, 1970
33 Karnataka Agricultural Policy 2006

State Irrigation Plan. The Components of the PMKSY are - Accelerated Irrigation Benefit Programme (AIBP), PMKSY (Har Khet KoPani), PMKSY (Per Drop More Crop) and PMKSY (Watershed Development).[34]

Irrigation

Irrigation is of two types, i.e. (1) Flow irrigation; and (2) lift irrigation, which may be of major, medium and minor categories. The reservoirs, tanks, dams, barrages, weirs, canals, channels, ponds, springs-ponds, spring channels, open wells, tube wells aquaducts, sluices are the sources of water.[35]Irrigation, a major consumer of water, plays a predominant role in agriculture. It accounts for about 83 percent of the current level of total water utilization in the country. The State machinery is aiming to reduce its demand to about 70% by 2050. The supply of water from the source point is planned, developed and managed by infusing integrated approach for a hydrological unit, i.e., river basin or sub-basin or inter-basin or watershed - multi-sectorally/ conjunctively, for surface and ground water and rainfall taking quantity, quality and environmental elements into consideration.[36]

The criterion for allocation, planning and management is defined on demand approach to ensure effective and efficient utilization. This is because, even a marginal improvement in the efficiency of water use in irrigation sector would result in saving of substantial quantity of water which can be utilized either for extending the irrigated area or for diverting to other sectors. The demand for water is region specific and generally depends on the type of soil, cropping pattern/practices, climatic condition, infrastructure, conveyance system, water application technique etc. Day by day the usage efficiency of irrigated water is going down since most of the irrigation projects are not using state –of – the – art technologies.[37] Water auditing of irrigation water is yet to emerge as a decisive instrument in decision making in this regard.[38]

34 Introduction, Operational Guidelines of Per Drop More Crop (Micro Irrigation) Component of PMKSY, 2017.

35 Section 2 (o)(i), Bihar Irrigation Act, 1997, Karnataka Agricultural Policy 2006.

36 State Water Policy of Assam (Draft), 2007.

37 The latest irrigation technologies viz. Israel method, Subhash Palekar, Anna Hazare, Sri.Rajendra Singh and other State award winning methods may be encouraged and adopted to enhance irrigation and thereby reap agricultural benefits.Karnataka Agricultural Policy 2006.

38 Draft General Guidelines For Water Audit & Water Conservation Evaluation of Water Utilisation Directorate, April 2017, Ministry of Water Resources, RD&GR, Government of India, New Delhi

Water Security Plans

The appropriate Government shall prepare and oversee the implementation of a Water Security Plan for (a) attainment of sufficient quantity of safe water for life and sustainable livelihoods by every person; and (b) ensuring water security even in times of emergencies like droughts and floods.[39]

Water Conservation

It is said the water is a finite resource it shall be used judiciously. Indiscriminate utilization of water, i.e., indiscriminate extraction of ground water reduced the ground water level by more than 4 meters in 40 districts of 16 states in the country during the last decade. Consequently, 182 districts (972 blocks) comprising an area of 7,45,914 sq.km have been covered under 'Drought Prone Areas Programme'.

This has been making us to put all our efforts to utilize the monsoon runoff, unto its brim, and store at all probable storage sites. In addition to creating new storages it is essential to renovate the existing tanks and water bodies by desilting and repairs. The revival of traditional water storage techniques and structures should also be given due priority.[40]

For the purpose of promoting water conservation to - minimize water losses, prevent water wastage and to increase efficiency in water use the following action may be considered -

a) Performance improvement of irrigation system and water utilization;
b) Restoration / provision of appropriate control structures in the canal system with efficient and reliable mechanism;
c) Adopting drip and sprinkler systems of irrigation for crops, where such systems are suitable;
d) Revision of cropping pattern in the event of change in water availability;
e) Utilisation of return flow of irrigation water through appropriate planning;
f) Imparting trainings to farmers about consequences of using excess water for irrigation;
g) Promoting multiple use of water;
h) Introducing night irrigation practice to minimize evaporation loss;

39 Section 15, National Water Framework Bill, 2016.

40 General Guidelines For Water Audit & Water Conservation, December 2005, Central Water Commission Evaluation of Water Utilisation Directorate , Ministry Of Water Resources, Government of India,New Delhi

i) Assuring timely and optimum irrigation for minimizing water loss and water-logging;
j) Introducing rotational cropping pattern for balancing fertility of soil and natural control of pests;

It has been experienced that with scientific use of mulching in irrigated agriculture, moisture retention capacity of soil can be increased to the extent of 50 per cent and this in turn may increase yield up to 75 per cent.[41]

Ground Water

Ground Water is a replenishable/rechargeable source, catering to nearly 90% of rural and 50% of urban domestic water needs and 70% agricultural requirements. About 433 billion cubic meter (bcm) is replenished/recharged every year out of which about 58%, i.e. 253 bcm, is from monsoon rainfall. Over-extraction of ground water is leading to water logging, salinity, biological and chemical contamination causing serious threat to the society at large. Nearly 60% districts of India are reeling under this problem. This has made the policy makers to ponder over our aquifers and approach towards the use and management of groundwater resources. The ground realities have made us treat groundwater as a common pool resource and adopt an aquifer-based approach to its management on a decentralised and participatory basis. This would facilitate us to ensure equitable, efficient and sustainable management of ground water resources.[42]

Ground Water Authority

The State Government/Union Territory shall, by notification in the Official Gazette, establish Ground Water Authority (GWA) to oversee the regulation and management of Ground Water.[43] In addition to this other authorities such as the National Wetlands Committee, State Wetlands Authority or Union Territory Wetlands Authority, Water Resources Department (WRD), Command Area Development Authorities (CADA), Water and Land Management Institute (WALMI) District Groundwater Council, State Ground

41 Guidelines 2.1 ibid,United Nation Convention of Bio-Diversity,1992, Section 36, Bio-Diversity Act, 2002, Section 14, Karnataka Command Areas Development Act, 1980, Section 31,32, Karnataka Irrigation Act, 1965, Rules 19, Karnataka Irrigation Rules, 1965, Karnataka Agricultural Policy 2006, Karnataka Jnana Aayoga (Karnataka Knowledge Commission) Government of Karnataka

42 Report of The Ground Water Resource Estimation Committee (GEC-2015), Ministry of Water Resources, River Development & Ganga Rejuvenation Government of India New Delhi October, 2017

43 Section 3, Ground Water Regulation and Control of Development and Management) Act, 2005

water Advisory Council and Drought Monitoring Cell is responsible for ensuring overall efficient management of water resources systems in the State. These institutions are expected to synergise the knowledge gap in planning, development and management of water resources in a sustainable manner as also making it more service centric/ professional.[44]

River Basin - Planning, Development and Management

In the course of water management an integrated approach shall be adopted to manage all natural, agricultural, and human resources of a river basin by considering the social, economic and institutional factors operating in a river basin. Correspondingly, every water-related activity in any part of a river-basin, or a sub-basin of a large basin including any water resources project(s) proposed at the river basin or a sub-basin level by the concerned entity shall be undertaken with due regard to -

1) Hydrological, ecological and agro-climatic characteristics and features of the basin or sub-basin as a whole;
2) Land-use appropriate to the relevant area;
3) Inter-linkages between water quality and quantity consistent with broader environmental management approaches; and
4) Holistic view of the relationships of all such activities with one another and with the basin or sub-basin as a whole.[45]

Extraction and Use of Ground Water

Every existing user of ground water shall register the well from which he is drawing water and the person desirous to sink a well in the notified and non – notified area for any purpose, either on personal or community basis, shall obtain permission from the

44 Guidelines 2.1.1. Guidelines For Improving Water Use Efficiency In Irrigation, Domestic & Industrial Sectors, November,2014, Performance Overview & Management Improvement Organization Irrigation Performance Overview Directorate, R.K.Puram, Sewa Bhawan, New Delhi- 110066 Ministry of Water Resources Central Water Commission, Government of India,Section 13, Draft Protection, Conservation, Regulation and Management of Groundwater Act, 2016,Section 10, Karnataka Ground water (Regulation and Control of Development and Management) Act, 2011. Karnataka Agicultural Policy 2006, Section 3,10, Karnataka Command Areas Development Act, 1980, Rules 5, 6, Wetlands (Conservation and Management) Rules, 2017

45 Section 12, National Water Framework Bill, 2016.

Authority prescribed.[46] Even the registration of machinery by the rig owner's/agencies is mandatory.[47] While granting permission the Authority shall consider the following -

a) Purpose or purposes for which ground water is to be used;
b) Existence of other competitive users;
c) Availability of ground water;
d) Quantity of ground water to be drawn;
e) Quality of ground water with reference to use;
f) Spacing of ground water structures keeping in consideration the purpose for which ground water is to be used;
g) Long-term ground water level behaviour;
h) Likely chance of adverse effect on the water availability of any drinking water source in its vicinity; and
i) Any other factor relevant thereto.

The permission so accorded is not absolute. It may be cancelled on violation or non-compliance of the conditions stipulated, after being heard, by the Authority. Even, the wrong doer may be punished either with fine or imprisonment or both.[48]

Conservation and Protection of Ground Water Resources

Groundwater is an important component of the hydrological cycle. It supports the springs in the hilly regions and the river flow of all peninsular rivers during the lean period. For sustainability of ground water resources it is necessary to arrest the ground water outflows by -

a) Construction of sub-surface dams;
b) Watershed management;

46 Section 2(1),3 to 9, The Karnataka Ground Water (Regulation for Protection of Sources of Drinking Water) Act, 1999, Section 11, Karnataka Ground water (Regulation and Control of Development and Management) Act, 2011, Rules 3,4, Karnataka Irrigation Rules, 1965.

47 Section 13 Karnataka Ground water (Regulation and Control of Development and Management) Act, 2011. In Re: Measures for prevention of fatal accidents of small children due to their falling into abandoned bore wells and tube wells Vs Union of India and Ors. Writ Petition (C) No.36 of 2009 August 06, 2010. Supreme Court of India

48 Section 6, 7,8, 9, 11,21, Ground Water Regulation and Control of Development and Management) Act, 2005,Section 18,27, Draft Protection, Conservation, Regulation and Management of Groundwater Act, 2016, Section 16, The Karnataka Ground Water (Regulation for Protection of Sources of Drinking Water) Act, 1999

c) Treatment of upstream areas for development of springs;

d) Skimming of freshwater outflows in coastal areas and islands;

e) Use of organic fertilizers should be encouraged to protect ground water from pollution due to excessive use of chemical fertilizers; and

f) Ground water vulnerable zones may be identified by preparing vulnerability maps for physical, chemical and biological contaminants.[49]

Drought Mitigation and Management –

Identification of drought prone area and preparation of policy and action plan shall make provision for –

a) participatory management of irrigation;

b) crop water budgeting;

c) soil and water conservation;

d) agro-forestry;

e) measures that are necessary to reduce soil erosion;

f) Augmentation of groundwater recharge and soil moisture;

g) Reduction of the volume and velocity of run-off; and

h) Improvement in the efficiency of water use.[50]

Rain Water Harvesting

The concept of rain water harvesting is unveiled to collect and store rainwater at the surface or in sub-surface aquifers, to make good the ground water table, before it is lost as surface runoff and to avert environmental degradation. Generally, rain water harvesting is done by considering watershed unit and feasible recharge structures including the construction of gully plugs, contour bunding, gabion structure, check dam/weir, percolation tank, recharge shaft, roof top rain water harvesting structures etc. Further, the Authority shall identify the recharge worthy areas and direct the department concerned to include Rain Water Harvesting in all developmental schemes falling under notified areas and undertake construction of recharge unit(s). This is furthered through MGNREGA with programmes

49 Guidelines 1.1.2 & 1.1. 6.General Guidelines For Water Audit & Water Conservation, December 2005, Central Water Commission Evaluation Of Water Utilisation Directorate , Ministry Of Water Resources, Government of India, New Delhi

50 Section 21, National Water Framework Bill, 2016

on watershed development and restoration of water bodies.[51]

This artificial recharge structure/scheme does have both direct and indirect implications i.e.

1) Direct Impacts –
   a) Rise in water level;
   b) Increase in cropped Area
   c) Increase in yield of wells
   d) Increase in pumping hours
   e) Improvement in ground water quality

2) Indirect Impacts -
   i. Increase in vegetation cover in surrounding areas
   ii. Increase in non-seasonal flow in the streams/ rivers
   iii. Less frequent development of cracks in soil due to increased soil moisture.[52]

Sustainable Groundwater Management

In the process of providing safe water for life and sustainable livelihoods to every person the appropriate Government shall design water Security policy, planning and development to conserve, protect, regulate and manage water with an aim to -

a) Ensure realisation of the right to life through the provision of water for life;
b) Meet livelihoods and basic human needs, and livestock needs;
c) Promote sustainable groundwater use in the public interest, based on a long-term protection of available resources;
d) Ensure that the protection, conservation, regulation and management of groundwater is integrated with the protection, conservation, regulation and management of surface water to ensure conjunctive use;

51 Section 19, Ground Water Regulation and Control of Development and Management) Act, 2005.,Rule 2.9.7, Model Building Bye Laws 2015, Town and Country Planning Organisation, Ministry of Urban Development, 1.114, Twelfth Five Year Plan (2012–2017) Faster, More Inclusive and Sustainable Growth Volume I,Planning Commission (Government of India) 2013, Guidelines 1.1.3, supra Note 41, Section 22, Karnataka Ground water (Regulation and Control of Development and Management) Act, 2011, Rules 19, Karnataka Ground water (Regulation and Control of Development and Management) Rules, 2012 Schedule I, Section 4, Mahatma Gandhi National Rural Employment Guarantee Act 2005

52 Guidelines For Impact Assessment of Artificial Recharge Structures/Schemes Central Ground Water Board Department Of Water Resources, RD & GR Ministry of Jal Shakti February 2021

e) Ensure the implementation of the principle of subsidiarity;

f) Protect ecosystems and their biological diversity;

g) Reduce and prevent pollution and degradation of groundwater;

h) Ensure that present and future generations have access to sufficient quantity and quality of groundwater for life; and

i) Ensure protection against gender discrimination and other socio-economic inequalities in access to groundwater.

j) Rejuvenate depleted and stressed aquifers on a scientific basis.

k) Undertake aquifer remediation to restore the quality.

l) Ensure minimum interference in –
   1. Existing natural river flows;
   2. Natural state of water bodies and wetlands and in floodplains and riverbeds.

m) Protect river from construction on their floodplains and from sand mining.

n) Recognise the rivers, water bodies, aquifers and wetlands as ecological systems and protected from over-use/depletion, abuse, pollution/contamination, and degradation.

o) Ensure rejuvenating efforts shall focus on conservation and restoration of the river basin integrating participatory watershed management and recycle-reduce-and-reuse principles.

p) The regulation of groundwater shall be in consonance with the principles of non-discrimination and equity, the principles of subsidiarity, the precautionary principle, an integrated approach to groundwater management and shall conform to the constitutional provisions for decentralisation of powers and functions.

q) Groundwater shall be protected, conserved, regulated and managed primarily by panchayati raj institutions, both rural and urban.[53]

Water Audit

Water audit improves the knowledge and documentation of the distribution system, problem and risk areas and aids in better understanding of the flow of water after it leaves the source point. Seepage detection programs help in minimizing leakages and tackling small problems before they become major problems. These programs lead to (a) reduced

53 Section 5,6,15,18, National Water Framework Bill, 2016, Rules 4, Wetlands (Conservation and Management) Rules, 2017, Section 4, Provisions of the Panchayats (Extension to the Scheduled Areas) Act, 1996

water losses, (b) improved financial performance, (c) improved reliability of supply system, (d) enhanced knowledge of the distribution system,(e) efficient use of existing supplies, (f) better safeguard to public health and property, (g) improved public relations, (h) reduced legal liability, and (i) reduced disruption, thereby improving level of service to customers.[54]

Water Users Associations (WUAs)

The establishment of Water Users Associations (WUAs) is initiated to secure transparency and accountability in irrigation planning, development and sustainable management of water resources and water quality ensuring peoples participation and decentralisation. This would facilitate the authorities to prioritise, allocate, distribute and save both surface and ground water including local rainwater harvesting by recognizing, encouraging and empowering the local initiatives and avail the benefit of traditional wisdom and practices on water management. This would fuse the working relationships between the non-discriminatory informal community institutions for water-related activities and the formal institutions of local governance, including Local Bodies, Gram Panchayats and NGOs.[55]

Mass Awareness

The authority shall initiate Mass Awareness & Training Programs on Rain Water Harvesting and Artificial Recharge to Ground Water with the aid of Local Self Governments (LSGs) and/or through Government Agencies/ Non-Government Organizations (NGOs)/Volunteer Organisations (VOs)/ Educational Institutions/ Industries/Individuals.[56]

Legitimate expectations

The scenario of the Western Ghats and of my village is not distinctive. People in this area are on the same footing and face similar challenges, with little variations. They have the

54 Guidelines 1.1.1. *Supra* note 47, Section 26, Draft Protection, Conservation, Regulation and Management of Groundwater Act, 2016.

55 Section 7, National Water Framework Bill, 2016, Guidelines 2.1.1. Guidelines For Improving Water Use Efficiency In Irrigation, Domestic & Industrial Sectors, November,2014, Performance Overview & Management Improvement Organization Irrigation Performance Overview Directorate, R.K.Puram, Sewa Bhawan, New Delhi- 110066 Ministry Of Water Resources Central Water Commission, Government of India Section 24, National Water Framework Bill, 2016, Rule 3,8, Karnataka Gram Swaraj and Panchayat Raj (Tank Development and Executive Committee of Gram Panchayat) Model Bye Law, 2019,Section 13, Draft Protection, Conservation, Regulation and Management of Groundwater Act, 2016,Section 2(1), The Karnataka Ground Water (Regulation for Protection of Sources of Drinking Water) Act, 1999, Section 62A to 62D, Karnataka Irrigation Act, 1965<,,

56 Section 22, Karnataka Ground water (Regulation and Control of Development and Management) Act, 2011.

right to determine, develop - priorities and strategies for the usage of their lands and other resources including conservation and protection of environment and the productive capacity of the land and resources. The Government should provide effective, just and fair, mechanisms and appropriate measures to mitigate adverse environmental, economic, social, cultural or spiritual impact. The Citizenry are ready, willing, committed and dedicated to toil for better, eco – centric endeavours, agri – water – management system. My villagers, if properly trained and empowered, would put honest labour and skill to meet their innate demands. Hence, they are legitimately looking towards the Government to –

a) Ensure coordination between the line departments concerned to ensure uniform input of knowledge, skills and attitudinal orientation on Guidelines for Preparation of Gram Panchayat Development Plan (GPDP)[57];
b) Ensure convergence of schemes/programs to percolate to the field level;
c) Train and orient the officers, personnel and elected representatives of Panchayat Raj Institutions and officials of line Departments to accept newer responsibilities;
d) Facilitate villagers to prepare and integrate sub – plan at Habitation Sabha Level, Ward Sabha Level and Gram Sabha in consultation with the line departments;
e) Promote a pilot hub to develop agro forestry/ silviculture and permaculture in the precincts of schools and colleges with the technical and material support of Agriculture Horticulture, Forest, Watershed Departments, Agricultural Universities and Education Department but under the care of Rural Development and Panchayat Raj Department. This would motivate the farmers to replicate in their fields;
f) Establish,rear and maintain cattle, buffalo and other livestock tenements;
g) Revive, foster and maintain meadows;
h) Prohibit planting of acacia, eucalyptus, pellota, myangium and the like saplings in western Ghats since it spoils natural vegetations and adversely affect water resources;
i) Plan to rejuvenate, develop, maintain and manage springs, rivulet, streams, tanks and feeder canals of Western Ghats – in particular Malnad - region considering the local conditions and indigenous skills;

j) Employ people friendly agencies to conduct periodical social auditing of water resource management and to review crop pattern.

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57 Guidelines for Preparation of Gram Panchayat Development Plan (GPDP) 2018, Ministry of Panchayati Raj, Government of India, Section 4, Provisions of the Panchayats (Extension to the Scheduled Areas) Act, 1996

Chapter 11
Water and Food Security – Indian Perspective

Dr. Nataraju. S*

Abstract

Agriculture plays a pivotal role in the Indian economy and for overall progress of the Nation. Water is the basis for food security. Water, energy and food are essential to all living creatures, human well-being, poverty reduction and sustainable development. The Water-Energy-Food Nexus is interdependent source from nature on which we depend to achieve a range of socio-economic; health and environmental goals. Food security is a multi-dimensional problem requiring policy interventions across different areas. India is facing a severe water crisis due to changing climatic conditions, ecological factors and wide gap between water supply and demand, and poor water resource management; are resulting in increased estimation for water by 32% by 2050 according to the FAO estimation-2016 due to population growth, urbanization and Industrialization. Hence, there is a need to relook for scientific approaches in agricultural practices by strengthening the farmer's financial position and other stakeholders of food production and distribution. The National Food Security Act, 2013 aims to provide subsidized food grains to 2/3rd of its population which can be realized only through proper utilization of water resources of the country. The environmental sustainability in agriculture is reiterated in twelve five years plan which emphasizes on scientific use of water and fertilizer in Indian agriculture. Therefore, there is a need for holistic approach towards the utility of water in agriculture and food security sustenance demands for the overall growth

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of the Country. Agriculture is central to food security and for economic growth in developing countries and it provides the main source of livelihood, access to water and food security; which are considered to be both an aspect of human right and a fundamental right reiterated by the SC mandates. Conserving water resources and increasing the food production are the responsibilities of Governmental agencies through the public and private partnership. Further, Voluntary Groups, Farmers Associations, Local Self Governmental Institutions, and NGOs are expected to contribute to reach expected outcome in the conservation of water and food security.

The COVID-19 pandemic situation reveals that, the non-availability of adequate food to public has hampered the commons to the access to nutritious food, resulting in economic crisis including the local farmers, small scale producers and agricultural market. Hence, proactive of resilience-building is compulsive necessity to overcome the future crisis in food and agro-ecology. The available natural resources are also under severe pressure due to high population and increased urbanization. Indiscriminate use of water for agriculture, climate changes also pose extra stress on food production and can be improved through adopting sustainable agricultural practices and we can reach the FAO goal, 'Access to food, adequate in quantity and quality to fulfill all nutritional requirements for all household members throughout the year'. This article aims at holistic approach towards the conservation of water in order to achieve the food security and focuses on the interrelationship of water conservation in agriculture and use of innovative agricultural practices to ensure realization of current imperatives of National Policy on Agriculture, Laws and its Management in India for the sustenance of food security from the National and International perspective.

***Keywords**: Food Security, Water Conservation, Sustainable Agriculture, Agricultural Policy, Water Rights.*

Introduction

Water and food are the two most fundamental basic needs of humans including all life forms. Ensuring food security and availability of pollution free water is equally important for a healthy life. The importance of water for life, for economic development and of water for food security makes the issue one of the most debated. Keeping safe water and to save the purity and potency of water is one of humanity's biggest challenges. Availability of nutritious food is one of the most complexes with very diverse contemporary issue from the national and local situations. Sufficient quantity and quality water is essential for agricultural production and for the preparation and processing of food. Irrigated agriculture accounts for 70 percent of all water withdrawals globally (surface and groundwater). Reliable irrigation is fundamental to increase and stabilize income and providing livelihood resilience for a vast number of small landholding farmers, 40 percent of irrigation uses groundwater sources, some of them non-renewable at human time scale. In this regard, it is our utmost concern to agriculture because 63% of population live-in rural areas and most are dependent on agriculture as producers or workers, 30-60% GDP covers from agriculture and agro processing in developing countries. Hence, Water and food security revolves are on the important factors such as availability, access, use, quality and reliability locally and globally. The four pillars of food security are availability, access, utilization and stability.[1] Water and food security are intertwined aspects of basic need for survival of flora and fauna and its sustenance for a long period. Crops consume large amounts of water, resulting in future challenges for demand for drinking and irrigational purpose. The only way is to conserve it is through the sustainable development.

Around the world, at least 4 billion people, more than half the global population-experience disruption in water supply at least one month in a year. This is driven by dramatic changes in rainfall, flooding, and temperatures; the construction of mega-dams and paving of huge swaths of land; and increasing industrial and agricultural water use. Water security has also been limited by poor governance, aging water delivery systems, depleted groundwater supplies, rising water costs, and widespread chemical and microbial contamination.

National Water Policy, 2002 initiatives which give effect to the planning, development and management of the water resources on a hydrological unit basis, along with a multi-sectoral, multi-disciplinary and participatory approach as well as integrating quality, quantity and the environmental aspects, the existing institutions at various levels under the water resources sector will have to be appropriately reoriented or reorganized and even created, wherever necessary. As maintenance of water resource schemes is under non-plan budget, it is generally being neglected. An extensive survey conducted by the Indian Institute of Water Management, ICAR, Bhuvaneshwar canal water management, groundwater management and on-farm technology dissemination (including wastewater management, water policy & governance, assessment of groundwater contamination and its management, socio-economic and environmental linkages of groundwater irrigation in the Godavari districts of Andhra Pradesh[2] Identifies the effective methods of water conservation includes rainwater

1 Committee on World Food Security 2009, In 2015, the United Nations General Assembly adopted the 2030 Agenda for Sustainable Development, whose second goal (SDG 2) is to “End hunger, achieve food security and improved nutrition and promote sustainable agriculture”. *https://www.researchgate.net/publication/344932364.*

2 http://www.iiwm.res.in/pdf/IIWM_AR_2018-19.pdf.

management, including waterlogged area management), canal water management, groundwater management and on-farm technology dissemination (including wastewater management, water policy and governance. The development of irrigation plans, safe drainage of excess water; development of runoff water recycling, and land modification/ shaping technique for enhancing productivity; water and nutrient self-reliant farming system for rain fed areas; climate resilient agriculture, groundwater management for enhancing adaptive capacity to climate change, design of groundwater recharge structures for hard rock areas, assessment of groundwater contamination and its management. The water management also requires the preventive malnutrition avoiding the contamination of water and food with pathogenic micro-organisms is a major public health and nutrition concern.

NITI Aayog[3] has stated that India is facing its first water crisis and the demand for potable water may outstrip supply by the year 2030 if precautionary steps are not taken. It has suggested the preventive and remedial measures includes; the prioritization of the water usage need to be identified, revitalization of rivers needs to be brought in focus because many of our rivers and rivulets are drying and the policy parameters need to be set up accordingly, technological innovations like sensors, Geographic Information Systems (GIS) and satellite imagery need to be introduced to modulate the water and track the flow, overcome with the natural and human caused challenges, development of command area by creating small water channels and need to focus on the water availability according to the particular agro climatic zones and find suitable cropping patterns suiting the particular needs and also implementation of globally available technologies like micro irrigation by using single drop of water in a judicious way. The sustainability and resilience should be the key terms in the management of problems like water shortage or excessive water availability.

Water Rights and Constitutional Initiatives

Water rights, use and its allocation depend on our approach to water as property. Water should be seen as a social, common property distinct from State property. State acts as a trustee to that property and it is the duty of State to ensure access to a fair share of that water for reasonable use to every citizen as a right.[4]Ascribing water rights in the agricultural sector is pertinent as it has a direct bearing on food security, employment opportunities

3 The National Institution for Transforming India, also called NITI Aayog, was formed via a resolution of the Union Cabinet on January 1, 2015. NITI Aayog is the premier policy 'Think Tank' of the Government of India, providing both directional and policy inputs.

4 Water and the laws in India by: Ramaswamy R. Iyer, Sage law publications page 225-226.

and economic contributions. As India is an agrarian economy, it goes without saying that the performance of the agricultural sector has a substantial impact on the economic performance of the country as a whole[5].

Under the Indian Constitution water is a resource which comes under the legislative jurisdiction of States. Law making process in relation to water resources are conferred to the State List under the VII schedule of the Constitution.[6]However, the regulation and development of interstate rivers and river valleys is under the control of the Union Government in the public interest and as interstate affairs. Majority of the States have enacted laws to protect their water resources and its management by means of water development Area, through water conservation projects and by rural and urban Local Self Governmental Institutions'. The Indian jurisprudence and case law have evolved from different directions and resulted in conferring the water rights as an aspect of both fundamental and human rights dimensions.

The scope of the fundamental right to life as enshrined under Article 21 of the Constitution of India has been expanded drastically in the last couple of decades through judicial interpretations. As a result, the fundamental right to water is a part of the fundamental right to life under Article 21 of the Constitution.[7] If anything endangers or impairs that quality of life in derogation of laws, a citizen has a right to have recourse to Article 32 of the Constitution for removing the pollution of water or air which may be detrimental to the quality of life' held in *Subhash Kumar v. State of Bihar.*[8] High Courts have followed the Supreme Court and recognized the fundamental right to water and the corresponding duties of the government it was held in *Hamid Khan v. State of Madhya Pradesh*[9] and also held in the case of *Vishala Kochi Kudivella Samarkshana Samithi v. State of Kerala.*[10] In case of *Keoladeo National Park case,* the disputes involves the irrigation needs of the local farmers and the needs of the Bharatpur wetland bird sanctuary, a world heritage and Ramsar Site, dispute was resolved temporarily on *ad hoc* basis. The major problems associated with water resources are scarcity, pollution, inequity arising from the absences of an ecological perspective in the governance of water resources. Here understanding of the totality of local conditions has to support micro-level governance and macro-level management. This can be

5 A primer Agricultural Water Use Law in India, editors: M.K.Ramesh & Sairam Bhat, Published jointly by: NLSIU-CEERA & ICAR-IIWM-Bhubaneswar, UAS-Bengaluru (2020) page-5.

6 Entry 17, list-II r/w Entry 56of List-I –VII Schedule of the Constitution of India.

7 The right to live is a fundamental right under Article 21 of the Constitution and it includes the right of enjoyment of pollution-free water and air for full enjoyment of life.

8 AIR 1991 SC 420, Para. 7

9 AIR 1997 MP 191.

10 2006 (1) KLT 919.

achieved through the public participation of citizens in the governance of water and other natural resources.

Further, the right to water can be considered as recognized indirectly in the laws governing local bodies in rural and urban areas. The Section 18 of the Factories Act, provides that 'in every factory effective arrangements shall be made to provide and maintain at suitable points conveniently situated for all workers employed therein a sufficient supply of wholesome drinking water'. The Water (Prevention and Control of Pollution) Act, 1974 dealing with water quality, particularly protection of water sources for regulating and controlling pollution of water bodies, such as rivers and streams. It mandates the entire industrial unit and other authorities to maintain the wholesomeness of water bodies and it confers the powers to the Pollution Control Boards to punish the polluters.[11] The protection of the quality of water resources is further governed by the Environment (Protection) Act, 1986 mainly through various Rules governing waste management (e.g. Municipal Solid Waste (Management and Handling) Rules, 2000). The provisions of the Environmental Protection Act, 1986, also relate to water quality and access to water, through its notifications on permissible quality standards, environmental impact assessments, and public hearings. For instance, the Coastal Regulation Zone (CRZ) Notification prohibits certain activities such as the discharge of untreated wastes and effluents in coastal areas declared as CRZ. In *S.Jagannath v Union of India,*[12] the Court held that *keeping with the international commitments, and in greater national interest, the Government of India and the Governments of the coastal States are under a legal obligation to control marine pollution and protect the coastal environment'.* The Court also highlighted that *'any activity which has the effect of degrading the environment cannot be permitted.* Therefore, in order for water to be secure and usable, everyone must also have safe and easy access to water facilities.

In *Municipal Council Ratlam v Vardhichand,*[13] the Supreme Court reiterates that the state cannot claim insufficient funds as a reason to not carry out its duties; it is the bounden duties of urban and locals self governmental institutions to provide basic amenities to the general public. In *M.C.Mehta v. Kamal Nath*[14] the doctrine of public trust was reiterated by the SC held that, natural resources includes lakes are held by the State as a trustee of public, and can be disposed of only in a manner that is consistent with nature of such trust. In *M.C.Mehta V.Union of India*[15] commonly known as ground water case, Supreme Court held that keeping in view the declining level of underground water all over the country,

11 Refer: *Right to Water in India: Privileging Water for Basic Needs published by the Forum* for Policy Dialogue on Water Conflicts in India, Pune, Maharashtra, India page 3-7.

12 (1997) 2 SCC 87.

13 AIR 1980 SC 1622.

14 AIR 1999 SCW 2619.

15 (1997)11 SCC 312.

it is necessary to regulate withdrawal of the underground water. Implementation of all activities of planning, development, allocation, implementation, research and monitoring of all water resources need to be established to promote intra and inter-generational equity, as also to operationalize the precautionary principle in sustainable water resource management.

The human right to water for food and agriculture needs to be reflected in national laws that affect water management, with particular attention to disadvantaged and marginalized farmers, subsistence farming, rural women and indigenous community. National law should be reviewed to ensure priority for water use in agriculture and pastoralism when necessary to prevent starvation, as well as in subsistence or traditional agriculture that is essential for securing livelihoods and cultural practices.[16] Hence, the human right to water extends to water for food production, water is essential to preparing food for human consumption. National law should ensure that it pays special attention to those individuals and groups who have traditionally faced difficulties in exercising their right to water for food and agriculture.

International and National Initiatives in Conservation of Water and Food Security

International water law, food security and its policy has contributed in the Human Rights and Environmental treaties. The Universal Declaration of Human Rights (*UDHR*) was the first international instrument that recognized the human right to food formally, as part of the right to a decent standard of living[17] since then, the right to food or some aspects of it have been incorporated into a variety of binding and non-binding human rights instruments, at both international and regional levels. The recognition of the right to food as part of an adequate standard of living and a fundamental right to be free from hunger acknowledges that hunger and malnutrition are caused not just by a lack of available food, but also and above all by poverty, income disparities and lack of access to health care, education, clean water and sanitary living conditions. It also points to the strong links between the right to food and other human rights. The practical implications of this perspective are substantial. Whereas the concept of freedom from hunger requires the state to provide food to those who are unable to meet their food needs for reasons beyond their control (such as age, disability, economic downturn, famine, disaster or discrimination), the right to food

16 Refer: The right to water for food and agriculture, published by Food and Agriculture Organization of the United Nations (FAO), Rome, 2020 Legislative study-113.

17 Art. 25 *UDHR*.

requires a progressive improvement of living conditions that will result in regular and equal access to resources and opportunities so that every individual is enabled to provide for themselves.[18]The significance of water rights is ensured in *Jain v. State of Karnataka,*[19] the Court held that the "right to life includes the right to live with human dignity and all that goes along with it, namely the bare necessaries of life such as adequate nutrition''. In *Chamelli Singh & Ors. State of U.P. & Anr.,* [20] it was held that, the right to life implies the right to food, water, decent environment, education, medical health and shelter. According to the Court: "These are basic human rights known to any civilized society. All civil, political, social and cultural rights cannot be exercised without these basic human rights." In the case of *G vs. An Bord Uchtála* before the Irish courts, justices referred to the right to life as necessarily implying "the right to be born, the right to preserve and defend, and to have preserved and defended, that life and the right to maintain that life at a proper human standard in matters of food, clothing and habitation".[21]

The International Conference on Water and the Environment (ICWE) in Dublin, Ireland on 26-31st January 1992 commonly known as Dublin Statement of Water and Sustainable Development reiterated the concerted action on the reverse effect of water pollution, over consumption of water and threats by way of droughts and floods.[22] Berlin Rules are focus towards the significance of water management through the principles followed by the in all spheres of water users and adopted the general principles applicable to all waters[23], the right of public participation, the obligation to use best efforts to achieve both the conjunctive and the integrated management of waters, and duties to achieve sustainability and the minimization of environmental harm.[24] Further, the basic principles applicable solely to international waters, including the right to basin States to participate in the management of shared water, the duty of basin States to cooperate, the principle of equitable utilization, and the obligation to avoid transboundary harm. The five general principles that apply to States in the management of all waters, wholly national or domestic waters as well as internationally shared waters, namely; Participatory water management, Conjunctive management, Integrated management, Sustainability and Minimization of environmental harm, which is commonly known as

18 http://www.fao.org/3/i0815e/i0815e.pdf visited on 20.4.21.
19 AIR (1992) SCC 1858.
20 (1996) 2 SCC 549.
21 Irish Human Rights Commission-2005 p.107.
22 https://www.gdrc.org/uem/water/dublin-statement.html.
23 http://www.cawater-info.net/library/eng/l/berlin_rules.pdf.
24 Dellapenna Joseph W. article on 'The Berlin Rules on Water Resources: A New Paradigm for International Water Law' page 4-8. https://iwra.org/member/congress/resource/abs568_article.pdf

Berlin Rules[25]. Water resources will be sufficient to produce the food required in 2050, but many regions will face substantial water scarcity. Water shortages will result in increasing competition, which will constrain agricultural production and affect the incomes and livelihood opportunities of many residents in rural and urban areas.

Innovative and more effective governance mechanisms, together with investments in water technologies and infrastructure will be needed to mitigate the impacts of growing water shortages to ensure water is allocated in such a way as to secure its efficient use, protection of the natural resource base, and to ensure access to water for household use and agricultural production. Countries in water-scarce regions will increasingly need to devise food security strategies that explicitly consider structural food supply deficit and trade arrangements that will provide protection from food price volatility.[26] In many countries, agriculture will remain an important determinant of economic growth, poverty reduction, and food security, even as, over time, the proportion of agricultural revenue in national gross income declines. Water use in agriculture will remain substantial, irrigated areas will expand and competition for water will increase in all sectors. Most likely, overall supplies of land and water will be sufficient to achieve global food production goals in 2050; although poverty and food insecurity will remain pressing challenges in several regions and countries.

The Declaration of the World Summit on Food Security, published in 2009, defines food security as the condition in which "all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food, which meets their dietary needs and food preferences for an active and healthy life".[27] Within this definition, four dimensions of food security are identified, namely; a. Food availability; b. Economic and physical access to food; c. Food utilization; and d. Stability, which involves exposure to vulnerability and shocks, over time. These dimensions can be evaluated at each of the relevant levels or scales by examining indicators pertaining to global, national and household food security. The Food and Agriculture Organization of the United Nations (FAO) has been promoting the concept of Sustainable Food and Agriculture for many years. The premise for the programme is somewhat self-evident, as the notion of sustainability is embedded within the definition of food security. A household or country cannot be food secure if the agricultural sector

25 International Law Association (2004) "The Berlin Rules on Water Resources," in Report of the Seventy-First Conference (Berlin 2004), International Law Association, London, UK.

26 Towards A Water and Food Secure Future Critical Perspectives for Policy-makers- White Paper FAO-UN Rome, 2015 Revised reprint WORLD WATER COUNCIL Marseille, 2015 page-7.

27 The State of Food Security in the World, Economic Crisis–impacts and lessons learned A Report FAO-2009. http://www.fao.org/3/i0876e/i0876e.pdf.

within the country, or in the countries from which food is imported, is unsustainable. Thus, efforts to ensure food security must ensure the sustainability of agriculture.

The other important aspect and challenges towards the conservation of water and food security is climate change. It will bring greater variation with more frequent, extreme weather events. New challenges will require adaptation, particularly with regard to water and agriculture. More investments will be needed for measures that strengthen adaptation at the regional, watershed and household levels, such as water storage structures, the use of groundwater and surface water, wastewater capture and reuse, agro-forestry, and research that generates more resilient production systems for smallholders. Increased effort is required to protect and sustain upland areas and mountainous regions, where much of the world's water supply originates. Optimizing the combined use of surface water and groundwater will enhance the sustainability of irrigated agriculture in many regions, particularly where excessive withdrawals cause costly increases in groundwater pumping depths or the return flows from agriculture degrade water quality in receiving streams[28]provides an overview of India's Groundwater Recharge Master Plan, which is designed to raise groundwater levels in the post-monsoon season to 3 m below ground level. The programme will involve the annual 'managed artificial recharge' of 36.4 km^3 of water, using an estimated four-million spreading-type recharge structures. While commending the intent of this ambitious recharge programme, the author recommends focussing on the most depleted basins, while utilizing the 11 million private dug wells already constructed by Indian farmers. In addition, Shah (2008) recommends revising energy tariffs to encourage farm-level support for the groundwater recharge programme which facilitates for sufficient food production.

Many rural households lack secure title to the land and water they use to produce crops and raise livestock, as part of their essential livelihood activities. Many smallholders operate in rain fed settings, in which the crop water supply is inherently uncertain. Small reservoirs are helpful in capturing and storing rainwater for use in households or on crops, as needed, but not all farm households can afford such an investment, partly because of the cost of installation and partly because of the opportunity cost of withdrawing land from crop production. Efforts to assist farmers in constructing small reservoirs and training farmers to optimize rainwater-harvesting strategies would be helpful in many areas. Where water is available from an irrigation scheme, or a wastewater treatment facility, many smallholders could benefit from assistance that would help them secure a permanent or long-term right

28 Refer: Shaw, 2009, 2014; Singh, 2014). Siderius *et al.* (2015) also refer article; Study on Climate Change and Agriculture in South Asia: Adaptation Options in Smallholder Production Systems. https://link.springer.com/article/10.1007/s10668-019-00414-4.

to receive some portion of the available water in perpetuity. Over time, as funds allow, long-term land and water security will motivate smallholders to invest in improving their crop, livestock and aquaculture operations. In many low-income countries, investment in water can be viewed as an investment in poverty reduction. The need for investments in water supply and treatment, irrigation, drainage, flood control and rainwater harvesting is quite high in many countries. Investors in the water sector can substantially improve livelihoods and greatly enhance the welfare of households and communities across much of Africa and Asia.

Therefore, it is needless to say that, there is a naturally created link between conservation of natural resources including a water body which supports increasing of food production and evidently it leads to improvement in food security and ultimately to enhance the national income.

The disastrous year 2020, resulted in a global pandemic a devastating outbreak of locusts, and an economic downturn affecting every corner of the world. The phenomenal impact of these multiple crises is rapidly escalating food and nutrition insecurity for millions of people, but especially for those who are already most vulnerable. According to initial predictions, the pandemic and its economic fallout could double the number of people facing acute food crises. If we do not take significant action now, these acute crises might set the stage for increasing levels of chronic hunger and related health problems in the long run[29]. As demonstrated by the 2020 GHI, many parts of the world are suffering from unacceptable levels of hunger. At the regional, country, and sub-national levels, the experience of living without adequate access to sufficient, nutritious food is all too common. India now ranks 94th among 107 countries in terms of hunger, and continues to be in the 'severe' hunger category according to the Global Hunger Index 2020. According to the study, 14% of India's population is undernourished. Hence, there is proper management is required to equipping ourselves by adopting innovative agricultural practice by balancing environmental issues. The interrelatedness between the right to food and other human rights is the basis of international consensus on the requirement for states to ensure that decision-making processes (from policy formulation to law making down to administrative acts) to implement the right to food and their outcomes comply with participation, accountability, non-discrimination, transparency, human dignity, empowerment and rule of law.

29 Refer: Global, Regional, and National Trends-Chapter 01, 2020 Global Hunger Index. B.

Indian Scenario of Water and Food Security

The right to food, and its variations, is a human right protecting the right for people to feed themselves in dignity, implying that sufficient food is available, that people have the means to access it, and that it adequately meets the individual's dietary needs. The right to food protects the right of all human beings to be free from hunger, food insecurity and malnutrition. The right to food does not imply that governments have an obligation to hand out free food to everyone who wants it, or a right to be fed. However, if people are deprived of access to food for reasons beyond their control, for example, because they are in detention, in times of war or after natural disasters, the right requires the government to provide food directly. The right is derived from the International Covenant on Economic, Social and Cultural Rights which has 170 state parties as of 2021. States that sign the covenant agree to take steps to the maximum of their available resources to achieve progressively the full realization of the right to adequate food, both nationally and internationally. In a total of 106 countries the right to food is applicable either via constitutional arrangements of various forms or via direct applicability in law of various international treaties in which the right to food is protected'. Hunger affects the ability of individuals to work productively, to think clearly and to resist diseases. Hunger is attributed to chronic food insecurity and even today policy makers attempt to find solutions to the problem of hunger and malnutrition in food security[30].

The World Food Summit of 1996 defined food security as existing when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet dietary needs for a productive and healthy life. At the 1996 World Food Summit, governments reaffirmed the right to food and committed themselves to half the number of hungry and malnourished from 840 to 420 million by 2015. However, the number has increased over the past years, reaching an infamous record in 2009 of more than 1 billion undernourished people worldwide. Furthermore, the number who suffers from hidden hunger - micronutrient deficiencies that may cause stunted bodily and intellectual growth in children amounts to over 2 billion people worldwide. Whilst under international law states are obligated to respect, protect and fulfill the right to food, the practical difficulties in achieving this human right are demonstrated by prevalent food insecurity across the world, and ongoing litigation in countries such as India. In the continents with the biggest food-related problems - Africa, Asia and Latin-America - not only there is shortage of food and lack of infrastructure but also mis-distribution and inadequate access to food.[31]In

30 Refer: Food Security law: Interdisciplinary perspectives by Dr.Bimal N.Patel and Dr.Ranita Nagar, Pub: Eastern Book Company Edition 2014.page-6.

31 The future of food and agriculture trends and challenges, Food and Agriculture Organization of the United Nations Rome, 2017 http://www.fao.org/3/i6583e/i6583e.pdf.

order to achieve the supply of adequate food, the agricultural sector has to develop in such a way that, water availability is equally important factor to achieve self sufficiency in food production. Furthermore-Green Revolution Period (1950-65) was on enhancing food production and improving food security through agrarian reforms and large-scale investment in irrigation and power, the Post-Green Revolution Period gains from green revolution technologies continued through the mid-1980s.Economic Reforms Period (1991 onwards) which focuses on new agricultural policy since 1991 and it has shifted to improving the functioning of markets, reducing excessive legislation, and liberalizing agricultural trade.

National Agricultural Policy (NAP) 2000 aims towards, efficient use of natural resources, while conserving soil, water and biodiversity,Growth with equity i.e., growth which is widespread across regions and farmers. Growth that is demand-driven and caters to the domestic markets and maximizes benefits from exports of agricultural products in the face of challenges arising from economic liberalization and globalization,Growth that is sustainable technologically, environmentally and economically,the policy also seeks to utilize large areas of wasteland for agriculture and afforestation. The major focus is on horticulture, floriculture, roots and tubers, plantation crops, aromatic and medicinal plants and bee-keeping. Higher emphasis is also placed on raising the production of animal and fish products. The National Agricultural and Water Policy in Karnataka were formulated to govern the planning and development of water resources and their optimum utilization. The first NWP was adopted in September, 1987. It was reviewed and updated in 2002 and later in 2012.It is mainly focused towards the availability and sustainable use of water in the agriculture sector, the research efforts have to be made to address the problems and challenges in implementation of polices at the micro-level[32]. Besides the Government has initiated legislative measure to combat the conservation of water through specially legal instruments namely,*The* Karnataka Groundwater (Regulation for the Protection of Sources of Drinking Water) Act 1999, The Karnataka Groundwater (Regulation and Control of Development and Management) Act 2011, Irrigation and Command Area development, Karnataka Irrigation Act, 1957and The Karnataka Command Areas Development Act, 1980. It might be tentative measures to meet the scarcity of water for irrigational needs. However, there is a need for effective implementation through proactive role of the legislature. The allied agricultural laws also support the interests of Farmers, which aims to protect the holistic development and regulate the entire sector in an orderly manner. In this regard, as early as in 1914, the Government of India passed a comprehensive Act, known as Destructive Insects and Pests (DIP) Act, to regulate or prohibit the import of any article

32 Refer: A primer Agricultural Water Use Law in India edited by M.K.Ramesh & Sairam Bhat, Published jointly by: NLSIU-CEERA & ICAR-IIWM-Bhubaneswar, UAS-Bengaluru (2020) page-254.

into India likely to carry any pest that may be destructive to any crop, or from one state to another. The Directorate of Plant Protection, Quarantine and Storage (DPPQS) under the Ministry of Agriculture is responsible for enforcing quarantine regulations).The Seeds Act was enacted in 1966 to ensure that farmers get good quality seeds. Quality is ensured through variety development. Seed legislation provides notification of varieties or kinds of crops, certification, labeling of seeds, seed testing; and the Seeds (Control) Order, provides licensing of dealers, display of stock etc,

Pesticides Import, manufacture, sale and distribution is regulated under the Insecticides Act, 1968. The Protection of Plant Varieties and Farmers' Rights Act, 2001, there is a provision for an authority for protection of plant varieties and farmers' rights at national level. The above said enactments are focussed towards specific and generalised purposes, but a consolidated agricultural policy and law would meet the needs of local and National Levels. Recently, The Pesticide Management Bill, 2020 seeks to regulate the manufacture, import, sale, storage, distribution, use, and disposal of pesticides, in order to ensure the availability of safe pesticides and minimize the risk to humans, animals, and environment. The Bill seeks to replace the Insecticides Act, 1968. The enactment will provide for the Constitution of the Central Pesticides Board to advise the central and state governments on scientific and technical matters arising under the Act. It will also advise the central government in formulating standards and best practices for: (i) pesticide manufacturers, laboratories, and pest control operators, (ii) working conditions and training of workers, and (iii) recall and disposal of pesticides .The Board will frame model protocols to deal with poisoning cases due to pesticides. The purpose of the bill is to minimize risk to human beings, animals, living organisms other than pests and the environment, with an endeavor to promote pesticides that are biological and based on traditional knowledge.[33]

Agriculture is the biggest user of water, accounting for about 80 percent of the water withdrawals. There are pressures for diverting water from agriculture to other sectors. A study has warned that re-allocation of water out of agriculture can have a dramatic impact on global food markets. It was projected that availability of water for agricultural use in India may be reduced by 21 percent by 2020, resulting: in drop of yields of irrigated crops, especially rice, thus price rise and withdrawal of food from poor masses. Policy reforms are needed from now to avoid the negative developments in the years to come. These reforms may include the establishment of secure water rights to users, the decentralization and privatization of water. Management functions to appropriate levels, pricing reforms, markets in tradable property rights, and the introduction of appropriate water-saving technologies. The needs of other sectors for water cannot be ignored. Therefore, it is necessary that an integrated water use

33 https://prsindia.org/billtrack/the-pesticide-management-bill-2020.

policy is formulated and judiciously implemented. Several international initiatives on this aspect have been taken in recent years. In the UK irrigation is supplemental to rainfall. Growers use relatively little water by international standards and are generally highly conscious of the need to improve water efficiency. But even in a humid climate, there is scope for using less water in agricultural food production. Making the maximum use of soil moisture and rainfall, knowing precisely where and when irrigation needs to be applied and then applying it accurately and uniformly, are fundamental steps in the 'pathway to efficiency' (Knox et al., 2012). Introducing new technologies and management practices, often developed in arid countries, together with efforts to bring the average irrigator nearer to the best, can help improve both on farm water management and reduce the environmental impacts of irrigation. UK agriculture, along with the food industry as a whole, is charged with 'ensuring food security through a strong UK agriculture and international trade links with EU and global partners which support developing economies'.[34] Agricultural water resource management covers a wide range of agricultural systems and climatic conditions across OECD countries, drawing on varying water sources, including: surface water; groundwater; rainwater harvesting; recycled wastewater; and desalinated water. It also operates in a highly diverse set of political, cultural, legal and institutional contexts, encompassing a range of areas of public policy: agriculture, water, and environment, energy, fiscal, economic, social and regional. The OECD is a unique forum where the governments of 30 democracies work together to address the economic, social and environmental challenges of globalisation. Information on water resource management in agriculture across OECD countries was collected through a questionnaire and the analysis was also enriched by a set of background reports on; Agricultural water pricing in Australia, European Union, Japan, Korea, Mexico, Turkey and the United States. Financing water management and infrastructure related to agriculture. Policy issues concerning agriculture's role in flood adaptation and mitigation. Experiences and lessons from the Australian water reform programme. Economic analysis of the virtual water and water footprint concepts in relation to the agri-food sector.[35] India should critically examine these initiatives and develop its country-specific system for judicious and integrated use and management of water.[36] Major quantity of water shortage and its demand due to remarkable increase of water for irrigation and supply of water is provided through the conserving it through the construction of reservoir and tanks. Under ground water is also being extracted using bore wells resulted in depletion

34 Water for UK agriculture – key challenges and opportunities, an article by Dr Jerry W Knox, Cranfield Water Science Institute,Cranfield University-IET Sector Insights. https://www.theiet.org/media/3223/uk-agriculture.pdf.

35 Sustainable Management of Water Resources in Agriculture, OECD(2010) https://www.oecd.org/greengrowth/sustainable-agriculture/49040929.pdf.

36 Reference:Agriculture Policy: Vision 2020Indian Agricultural Research Institute, New Delhi page7-8http://www.indiagri.in/admin/uploadpdf/991840Agriculture-Policy,-Vision -2020.pdf visited on 25.4.21.

of underground water[37]. According to the Central Water Commission, the Ministry of Water Resources, for 1993-94, irrigation contributed to 52% of the food grain production in the country. Most of the major schemes for irrigation had been planned and implemented much before the major advances in hydro sciences were made in the world. Hence, On-farm adoption of drip irrigation is one measure widely believed to conserve water and majority of the State governments extended subsidies to those farmers adopted drip system in their agriculture practice which is a better way of conserving legitimate use of water and enriching food production. Future of agriculture is a very important question for the planners and all other stakeholders. Government and other organizations are trying to address the key challenges of agriculture in India, including small holdings of farmers, primary and secondary processing, supply chain, infrastructure supporting the efficient use of resources and marketing, reducing intermediaries in the market. There is a need for work on cost-effective technologies with environmental protection and on conserving our natural resources.[38] The need for responsible investments in food and agriculture, which contribute to food security and nutrition, especially for the most vulnerable, and the progressive realization of the right to adequate food. There is a need to establish central monitoring agency to assess the various issues, regulatory concerns, water laws and legislations, research and technology development and dissemination, social mobilization and participatory and community involvement, including gender and equity concerns and economic aspects. The authority should function in a trusteeship mode and seen as the flagship of a national system for sustainable water security.

Legal Mechanisms in the Enhancement of Agriculture and Food Policy

In India there is a deeply rooted tradition of reflecting of the fundamental right to food of human beings and on consequences of violating the right to food. The Indian concept of *Dharma* stresses the importance of growing and sharing food. *Atharva Veda* a sacred text on Hinduism states: "All have equal rights in articles of food and water." Mahatma Gandhi, the Father of the Nation, once said: "Without food it is difficult to remember God and hunger eats into the ethos of culture".[39] India is an active member of the United Nations and is a State Party to International Covenant on Economic, Social and Cultural Rights (ICESCR).

37 According to the Central Water Commission, the Ministry of Water Resources, for 1993-94, irrigation contributed to 52 percent of the food grain production in the country. Refer: *CWC, MOWR, July 1998 as cited in table 3.21 of GOI 1999.*

38 https://www.downtoearth.org.in/blog/agriculture/the-future-of-indian-agriculture-75384visited 11.5.2021.

39 Voluntary Guidelines on Right to Food by M.B. Shah,2006 (24-25).

Hence there is an obligation to respect, protect and fulfil the right to food for every citizen of India.

The administration of agricultural and food policy in India is therefore complex and involves many ministries, agencies and other institutions at both the central, state and other levels, such as districts within a state. The Constitution also allows the states to devolve their authority in some subjects, including agriculture, to a lower level of government. The 73rd and 74th Constitutional Amendments is a new step by involving the Rural and Urban LSG's in environment conservation process and focus towards the improvement of agriculture by providing loans and other subsidies plan for promoting and protecting the interest of farmers. The Constitutional also aims at implementing the socio-economic welfare schemes as specified under the Part-IV of the Constitution, including progress of agriculture and allied sectors. It was clearly provided under the Constitution for the promotion of social order,[40] Just and Humane Conditions of work[41] Living wages for workers[42] raise the level of food and nutrition[43] and organisation of agriculture and animal husbandry under Article.[44] A country's Constitution plays a fundamental role in the realization of the right to food because it is the supreme law of the land, in this regard, the decision of the Supreme Court of India in both *Kishen Pattnayak & another v. State of Orissa*[45] and *People's Union for Civil Liberties (PUCL) v. Union of India and others*[46] has recognized the right to food under the right to life stipulated in article 21 of the Indian Constitution, read with the Directive Principle of State Policy concerning nutrition, contained in Article 47of the Constitution. The inclusion of a specific provision on everyone's right to food, particularly of children and women, within the constitution has significant merit in providing legal protection of the right to food, as such, and in ensuring freedom from hunger. Currently, In relation to the right to food international human rights law provides particularly freedom from hunger. It puts the state as the primary duty bearer of the right, and the individual as the recipient. Violation of the right to food occurs when a state fails to ensure the minimum threshold of freedom from hunger. Many states have already ratified all the relevant human rights conventions relating to food and prevention from hunger.[47] Indian constitution protects

40 Art. 38, Constitution of India.

41 Art. 42, Constitution of India.

42 Art. 43, Constitution of India.

43 Art. 47, Constitution of India.

44 Art. 48 The state shall endeavour to organize agriculture and animal husbandry on modern and scientific lines and shall in particular take steps for preserving improving the breed, and prohibiting the slaughter, of cows and calves and other milch and draught cattle, which clearly indicates to achieve the Socio-economic welfare Schemes to implement Constitutional goal of Welfare State.

45 A.I.R.1989 SC. 677.

46 (2004)12 SCC108.

47 Teklu G (2019), Analysis on Legal Status of the Right to Food. J Pol Sci Pub Aff 7: 361. doi:10.4172/2332-

the right to food either implicitly or explicitly as a justifiable right or explicitly in the form of a directive principle of state.[48] In addition, through the direct applicability of international treaties, the right to food is directly applicable, with a higher status than national legislation.[49] Successful legislation should be employed after a thorough process involving all stakeholders, government and civil society alike, legislation also needs constant follow up from all sides, in order to be effective. In *People's Union for Civil Liberties (PDs matters) v. Union of India*[50]commonly called as right to food case, Supreme Court initiatives in recognizing the right to food as a Constitutionally protected entitlement requiring government action to ensure its fulfillment protection and promotion resulted in the passing of national food security legislation. In India, the significant development is the enactment of Central law, The National Food Security Act 2013 universally known as 'Right to Food Act' which aims to provide subsidized food grains to approximately two thirds of India's 1.2 billion people. The Food Security Act suggests converts into legal entitlements for existing food security programme of the Government of India. It includes the Midday Meal Scheme, Integrated Child Development Services scheme and the Public Distribution System. The Coverage and entitlement under Targeted Public Distribution System (TPDS) is up to 79.56% of the rural population and 64.43% of the urban population will be covered under TPDS, with uniform entitlement of 5 kg per person per month, the Antyodaya Anna Yojana (AAY) households constitute poorest of the poor, and are presently entitled to 35 kg per household per month, entitlement of existing AAY households will be protected at 35 kg per household per month. Food grains under TPDS will be made available at subsidized prices and the eldest woman of the household of age 18 years or above to be the head of the household for the purpose of issuing of ration cards. In order to tackle food and nutrition insecurity in India, it is important to renew our commitment in improving both agricultural and horticultural production of farm products necessary for meeting the nutritional requirements of all sections of society.[51]

The Indian agricultural sector is also on the verge of a significant transition. The government, through the new agricultural policy, allows farmers to sell their produce to whomever and wherever they want. Farmers would have to harness new innovations to match the changing dynamics and stay updated with market knowledge. The ambitious

0761.1000361 https://www.longdom.org/open-access/analysis-on-legal-status-of-the-right-to-food.pdf

48 Art. 21 r/w 47, Constitution of India.

49 Refer: Constitutional and Legal Protection of the Right to Food around the World, by: Lidija Knuth and Margret Vidar published in Food and Agriculture Organization of the United Nations Rome, 2011.

50 (2013)2 SCC 688.

51 Refer: Food Security Law: Interdisciplinary perspectives by Dr. Bimal N.Patel and Dr. Ranita Nagar, Pub: Eastern Book company Edition 2014.page 106.

farm liberalization agenda of the government legislating three enactments could be a new way of engaging food producers and their buyers. This legislation would work to reduce inefficiencies through productive investments and allow free trade between farmers and buyers. This new policy would also provide a requisite forum for buyers to avail the correct remuneration to sell their goods. The Farmer's Produce Trade and Commerce (Promotion and Facilitation) Act, 2020 the purpose of FPTC Act,[52] enacted by the Central government, gives the freedom to sell and buy farm produce at any place in the country—within APMC mandis or outside them. To promote e-commerce in agriculture, the new law also allows the setting up of an electronic platform for the sale and/or purchase of farm produce. The Act also has a provision to prescribe modalities for the registration of traders and trade transactions in trade areas. Thus, if the new system does not work satisfactorily, then the government can intervene to regulate the system. Another enactment is the 'Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Act', 2020 (APAFS)[53]. This Act seeks to provide farmers with a framework to engage in contract farming, where farmers can enter into a direct agreement with a buyer (before sowing season) to sell the produce to them at pre-determined prices. It is greatly simplified and an improved version of the Contract Farming Act that has already been adopted by 20 states. The new Act shifts the balance in the favour of farmers. It removes the complicated system of registration/license, deposits, and various other compliances in contract farming provisions in various states. An additional inclusion to the Essential Commodities (Amendment) Act, 2020[54], this amended act seeks to restrict the powers of the government with respect to production, supply, and distribution of certain key commodities. The Act has been modified for agriculture and food stuff, including cereals, pulses, potato, onion, edible oilseeds and oils. The amendment provide for the Central government may regulate the supply of the above commodities only under extraordinary circumstances, which may include war, famine, extraordinary price rise and natural calamities. The modification lays down a transparent criterion on imposing or regulating stock limit, which is 100% increase in retail price of horticulture produce or 50% increase in retail price of non-perishable agri-food stuff over the price prevailing in the preceding 12 months or average price of last five years, whichever is lower.

52 Refer: Section 3-7 of the 'Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act, 2020' [received the assent of the President on the 24th September, 2020).

53 Refer: Section 6-12 The Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Act, 2020 (APAFS) received the assent of the President on the 24th September, 2020.

54 Refer: section.2 of the 'Essential Commodities (Amendment) Act,' 2020 received the assent of the President on the 26th September, 2020.

The new reforms are likely to provide farmers with an environment where they can sell their agricultural produce in any part of the country. So far, farmers have relied on their respective state mandates to sell their produce; however, the new legislation establishes infrastructure that will ultimately reduce the reliance of farmers on selective mandis. Also, the new legislation ensures that the minimum support price mechanism and land tenure security will remain in place to protect the interests of farmers.

Initiatives to reach Sustainable Agriculture and Sustenance of Food Security

Managing water for food security needs a multipronged approach. At the aggregate level, the irrigation water supplies and the demand for irrigation need to be balanced. Irrigation would continue to play an unquestionable role in achieving food self-sufficiency, creating grain surpluses, stabilizing food prices, sustaining agricultural growth, absorbing labour force in rural areas, and alleviating rural poverty; all of which are vital for food security.[55] The Common Agricultural Policy has been a central instrument for rewarding and supporting farmers who embrace more sustainable farming practices but without undermining food security. Agriculture is a fundamental human activity that intrinsically depends on nature and at the same time poses a threat to it. Thus, sustainability has emerged as a necessity in future agricultural policy and practice.[56]

Unlike intensive agriculture, sustainable farming has a great potential for benefiting the environment and preserving natural resources. It does so by following natural cycles, recycling nutrients and water, while omitting excessive use of agricultural chemicals.

A sustainable food system is one that does not require chemicals, conserves energy and water, emphasizes local production, decreases inputs and utilizes resources more efficiently on site, values biodiversity and ecology, and works within our global natural resource limitations. Sustainable agriculture includes the use of farming systems and practices which maintain or enhance the *economic viability of agricultural production, the natural resource base*, and *other ecosystems which* are influenced by agricultural activities. It is an integrated system of plant and animal production practices, having a site specific application that will, over the long term, Satisfy human food and fiber needs, enhance

55 Refer: Kumar, M. D. 2003. Food security and sustainable agriculture in India: The water management challenge. Colombo, Sri Lanka: International Water Management Institute (Working paper 60).

56 Oberc, B.P. & Arroyo Schnell, A. (2020), Approaches to sustainable agriculture, exploring the pathways towards the future of farming. Brussels, Belgium: IUCN EURO page 1-3.

environmental quality and Natural resource base on which the agricultural economy depends.

Sustainable agriculture through soil, water and seed management can increase crop yields, an efficient warehousing and distribution system is also necessary to ensure that the output reaches the consumer. The goal of sustainable agriculture is to minimize adverse impacts to the immediate and off-farm environments while providing a sustained level of production and profit. Inherent to this goal is the understanding that sustainability must be extended not only globally, but indefinitely in time, and to all living organisms including humans. Simply stated, sustainable agriculture refers to the ability of a farm to produce food indefinitely, without causing irreversible damage to ecosystem health. The main theme of Sustainable agriculture is intertwined in agriculture which is economically viable, environmentally friendly, and socially acceptable. Sustainable food production through use of regenerative technologies and full participation of farmers and other stakeholders of agriculture and conserving natural resources through adopting modern technologies, and access to food through strengthening local capacity by building strong and diversified rural economies. The agricultural sustainable practice includes, crop rotation keeps the soil healthy, mixed farms allows the uses of livestock manure, conserving natural areas protects our environment, Small changes in practices can help, rather than harm, the environment, Grass-fed livestock control weeds without chemicals or mowing, Science can determine the right amount of fertilizers and pesticides, Farming removes nutrients and fertilizers or manures replace them, Farming multiple crops allows farmers to reduce their financial risks by having multiple products to sell. Sustainable agriculture is a complex issue associated with producing food while maintaining our biophysical resources including soil, water and biota with no adverse impacts on the wider environment. An innovative farming approach (i.e., adoption of improved production technology including integrated pest management, soil and water conservation measures, plant nutrient management and contract farming) no doubt will enhance crop yield but that will not be enough for the sustenance of small and marginal farmers with small land holdings, and his family.[57] The tools and strategies used to achieve food security must align with food safety, and public health as well as sustainability. Sustainable agriculture enables resource efficiency; they help produce greater output while using lesser land, water and energy, ensuring profitability for the farmer. A holistic agricultural policy from the centre will support farmers who adopt more sustainable agricultural practices but without undermining the food security.

57 Mandavi Mishra, Article on the 'Role of Eco-Friendly Agricultural Practices In Indian Agriculture Development, Published in International Journal of Agriculture and Food Science Technology (IJAFST) ISSN No. 2249-3050, Volume 4 No. 2 (2013) https://www.ripublication.com/ijafst_spl/ijafstv4n2spl_03.pdf.

To reach the 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDGs), the Paris Agreement under the United Nations Frame work Convention on Climate Change (UNFCCC) provide both the framework and the targets that should guide global efforts towards more inclusive growth and sustainable livelihoods. Agriculture, through its link to food security, nutrition and health, rural development and environment are the major driving forces for attainment of sustenance of food.[58] In this regard, India has developed sufficient tools and techniques for contributing sustainable agriculture development and food security. The major precautionary steps are to implement the new techniques without damaging local agricultural varieties by restricting the introduction of Genetically Modified Organisms or Species (GMOs) in the name of food sufficiency. A few GMO crops were already widely adopted with clear economic, social, and environmental benefits, including in the small farm sector of developing countries. However, the Government of India has legal measures through IPR laws to protect both the interest of farmers and steps to adopt without damaging the environment.

National policies that are designed to achieve sustainable use of land and water resources, with the goal of achieving or sustaining food security in 2050, must address the socio-economic and cultural dimensions of resource use in agriculture. In order to achieve the anticipated target of food security, adoption of scientific method of in agriculture and through the adoption of sustainable agricultural practice as per the National Agricultural Policy initiatives might be possible to reach the target of water and food security.

Conclusion and Suggestions

Among the basic needs, water and food are considered to be fundamental requirement for all living beings. The inter-relationship between water and food security is inseparable part of life, which is complex and significant. The demand for production will be met only if farmers increase crop yields through better soil and water management. Water use can be reduced through a suite of solutions like reducing food loss and waste, shifting to healthier diets, transforming conventional agriculture to agribusiness models would shorten the supply chain fostering forward and backward linkages, requiring a favourable policy. Shrinking land and water resources have put greater pressure on national governments to increase agricultural production per unit land area and water consumed. Immediate policy and knowledge oriented action for sustainable agricultural production is the need of the hour. Identifying sustainable agricultural practices, sharing knowledge, and facilitating scale-up of practices

58 Refer: FAO. Water at a Glance: the relationship between water, agriculture, food security and poverty. Rome. 15 pp (also available at http://www.fao.org/nr/water/docs/waterataglance.pdf.

will reduce the current scarcity for food. There is a need for the current input subsidy regime for reorienting agricultural incentives to promote resource efficient agricultural technologies and sustainable practices. The need to transform conventional agriculture into agri-business model by entrepreneurship development workshops and promoting organic farming is to be implemented by the governments. The present world population is about 7.7 billion and India's population is approximately 1.38 billion and is equivalent to 17.7% of the total world population. In order to satisfy the feeding requirement of the steadily growing population FAO suggested for efficient fiscal systems, for ensuring economy-wide income earning opportunities, effective social protection, and competitive and equitable domestic and international markets for inputs and outputs in agriculture. The goal of Food and Agriculture Organisation is to reach the human needs in the generation to come is that "a world in which food is nutritious and accessible for everyone and natural resources are managed in a way that maintain ecosystem functions to support current as well as future human needs. It is the need of the hour that the production of more nutritious food with less water saving crops to be adopted through innovative agricultural technologies can ensure a greener and more sustainable food production. In this regard, the National Agricultural Policies and legal instruments are to be designed to achieve sustainable use of land and water resources, with the goal of achieving or sustaining food security by 2050. Further, more economic support should be provided to the agricultural sector to ensure wide income earning opportunities to the farmers to facilitate and ensure; water and food security. Institutions and capacity-building have played important roles in efforts to improve water management and increase farm yields. The states should have a uniform agenda to create a socio-legal obligations on the world communities with due diligence of commitments towards realization of water and food security in a justifiable approach. The fair and equitable distribution of water must satisfy the basic human needs and reconcile the preservation of ecosystems with domestic, industrial and agricultural needs. Adequate access to water for subsistence farming would necessitate more sustenance in food to meet the needs of future generations.

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Chapter 12
Role of Panchayat in Implementation of Water Policies and Schemes in Agricultural Sector: An Assessment

Dr. N. Sathish Gowda*

Abstract

India being one of the fastest growing economies in recent times, it still has a large populace depending on primary sector for livelihood. Agriculture is considered to be the backbone of our country, but it is plagued by various shortcomings, one of them being scarcity of water for irrigation. In recent times, there has been a global increase in water scarcity largely due to the abuse of water resources, this has cost dearly to the agriculture sector which primarily depends on farming. Various methods of water conservation have been introduced but, none of these implemented properly owing to the administrative lacunae. It would be inappropriate to completely put the onus of water conservation on the farmers as they are firstly not aware and secondly, would resort to inefficient and draconian methods of water conservation.

In this background, the author in the present paper has adopted the following approach; Firstly the identification of the problem of water scarcity and the reasons behind the same and role of Panchayat in taking measures to adopt good practices to conserve water and its resources to help the farmers to cultivate different crops in their farm. Secondly the author has provided a brief analysis of the Constitutional and Legislative framework regarding the conservation of water in tandem with the need for increase in agricultural produce and also has recognized various lacunae

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in the law and challenges of implementation; Lastly the author has attempted to suggest various findings for improving water conservation for agricultural purpose with strong and dependable authority.

Keywords: *Water Conservation; Agriculture; Laws and Policies; Implementation*

Introduction

Water and water resources are natural resources that are extremely important for improving the living conditions of the farmers and maintaining economic growth and development. Encouraging agricultural activities through proper cultivation, while saving and enhancing natural resources, such as water, is an essential requirement for farmers to increase food supplies on a sustainable basis. The role of small landholding farmers and their families in increasing agricultural productivity growth sustainably will be crucial. But, in the present scenario, India is facing a diminution in available water resources that has implications on India's agriculture sector. Different regions in the country are suffering water stress. If water use efficiency does not recuperate, the country could suffer water scarcity within one or two decades. Water shortage has a huge impact on food production. To avoid and prevent water scarcity to cultivate crops, sound and implementable water policies are very much required.

But, in reality, water policies formulated by the governments are more encouraging for industry rather than agriculture. Though there are umpteen water policies,[1] programmes, plans prepared by both the Centre and State governments to ensure irrigation facilities to encourage farming activities in the country, still, in rural India, farmers have been facing huge water shortage to grow different crops in their agriculture land. The availability and demand for water resources in India show considerable variations from one region to another. There is an inefficient and inequitable use of and distribution of water. Small farmers who lack the adequate resources to adapt themselves to the current reality of water scarcity. The farmers are really vulnerable and facing water crisis to grow varieties of crops in their farms. Poor governance and lack of co-ordination among many departments regarding water management is making farmers conditions more miserable. Weak administrative measures are an important factor in creating water scarcity. In evaluating the impact of the various water policies and plans prepared by both the Centre and State governments, it is evident that the government is creating more institutions to cover the

1 The first National Water Policy in India was adopted in September, 1987. It was reviewed and updated in 2002 and later in 2012 and Karnataka State Water Policy, 2002 and 2019.

inefficiency of parent institutions has damaged the farming sector."

Further, the farmers are also not interested in knowing about the management of water resources and fertility of soil and never make an attempt to go for testing soil in the laboratories to decide what type of crops can be grown within the available water resources. The lack of water and awareness about use of latest technologies to save water and other resources including finance weakens the ability of the farmers to cultivate on farms. There is no proper maintenance of water bodies such as irrigation canals, bunds, channels, village tanks, ponds and, check dams etc. which will decrease the efficiency of use of water resources in agriculture sectors.

Farmers are at the centre of any process of change involving natural resources and they need to be encouraged and guided, through appropriate incentives and governance practices, to conserve water, water resources, natural ecosystems and their biodiversity, and minimize the negative impact on agriculture production. In this regard, Panchayats can play an important role as "Raitha Mithra"[2] in association with AID (Agriculture, Irrigation and Department of Rural Development) departments to adopt best practices in agriculture activities to conserve water resources. By virtue of Article 243-G[3] of the Indian Constitution, Panchayats (District, thaluk and Village) can take some good initiatives to save water resource by introducing popularized technologies for conservative agriculture to increase water use efficiency and measures for conserving soil moisture, improving soil nutrient status, and reviewing existing water policies in the agriculture sector from time to time. Members of panchayat, with the help of experts can make a comprehensive plan to safeguard the surface and ground water in agriculture land. Further, they can find out the best methods for disseminating awareness to increase water use efficiency and providing sustainable financing/subsidies to ensure that existing public irrigation infrastructure.

In this background, an attempt has been made in the paper to discuss the role of panchayat in taking measures to adopt good practices to conserve water and its resources to help the farmers to cultivate different crops in their farm and identifies in what ways Panchayats at different levels are involved in water management, and what is there in the existing water policies and plans and mechanisms governing water management in India Further, the paper identifies the bottlenecks and challenges in implementation of laws, policies and scheme to improve water bodies in villages and the role of panchayats in tackling the complex problems with respect to water management and strategies for reducing water

2 Friend of Farmer (Panchayat can help farmers by implementing policies and plans of Governments in true spirit).

3 Article 243-G read with entries 1 to 3 of the 11th schedule of Indian Constitution.

and improving crop water-use efficiencies by changing irrigation practices and integrating watershed development and tank management etc. with participatory groundwater management.

Conservation and Management of Water Resources in Agricultural Sector

Water use for agriculture constitutes the maximum percentage of water consumption both at the national and international level. Water is the key resource for sustainable agricultural production in the dry land or rain fed areas. However, the major part of the rain water coming over the farmers field goes away unused as runoff. The overflow does not only cause loss of water but it also washes away precious top soil. Therefore, there are methods in which water resources can be increased and conserved in villages for agriculture purposes with the help of local bodies, particularly Gram Panchayat.

A. Rain Water Harvesting

The water management process can be easily practiced in agriculture field. As a result, it helps to recharge dry bore wells, creates water banks in drought areas and ensures availability of water resource. Harvested rainwater can also be used for charging the groundwater aquifers through suitable structures like dug wells, bore wells, recharge trenches and recharge pits.

B. Construction of Check Dam

Construction of check dam helps to promote ground water. Check dams are small barriers built across the direction of water flow on shallow rivers and streams for the purpose of water harvesting. The small dams retain excess water flow during monsoon rains in a small catchment area behind the structure. Pressure created in the catchment area helps force the impounded water into the ground. The major environmental benefit is the replenishment of nearby groundwater reserves and wells.

C. Establishment of Farm Ponds

Establishment of ponds is useful for the purpose of catching and storing rain water. Farm ponds have drainage channels which direct run-off to the pond. Outlets built into the pond help discharge excess water into surrounding areas. Water in the ponds is most often used for irrigation purposes within a farm. One of the biggest advantages of farm ponds is that they help reduce farmers' dependence on ground water or rain. They also replenish ground water supplies, improve and recharge borehole water supplies.

D. Build Bunds and Trenches

Local level micro-irrigation through small bunds, field ponds, agricultural, and engineering methods for watershed development would be very useful for enhancing water use efficiency. A bund is like an embankment, often built around the periphery of farmland to prevent water run-off. Bunds and trenches help reduce soil erosion and retain water in times of scanty rainfall. They also improve ground water levels by increasing filtration. Farmers have to build bunds and trenches around their farms as part of their soil and water conservation efforts.

E. Use of Silt

Advantages of silt application include increased soil fertility and, therefore, crop yields, increased moisture content of soil, improvement in water table due to increased filtration, among many others.

F. Drip Irrigation

Drip irrigation systems deliver water directly to a plant's roots, reducing the evaporation that happens with spray watering systems. Latest technologies with respect to timers can be used to schedule watering and further reducing water loss.

G. Sprinkler Irrigation

Sprinkler irrigation is a method of applying irrigation water which is similar to natural rainfall. Water is distributed through a system of pipes usually by pumping. In sprinkler type of irrigation, it irrigates not only the crop plants but the entire environment. This type of irrigation not only supplies water but also cools the micro-environment.

H. Use of Technology to Save Water

Technologies alone will not help in saving of water in agriculture sector unless supported through unique and innovative management, policy and institutional reforms. Modernization of irrigation systems should not only be confined to upgrading of physical infrastructure but also integrate improved irrigation services. Measures for water conservation need to be based on thorough understanding of water equilibrium and linkages between surface and groundwater and beneficial and non-beneficial uses of water.

I. Adoption of Natural/ Organic Farming

Natural/Organic farming also helps to conserve water. Organic farmers, in general, tend to spend time amending soil correctly and using mulch - both of which help conserve water. Cotton, an in-demand crop, requires a lot of irrigation and excess water when grown conventionally. However, organic/Natural Zero budget cotton farming needs less irrigation and thus conserves water. Mulch is a material spread on top of the soil to conserve moisture.

There are so many ways and methods to ensure and conserve water sources in agriculture sectors. These types of projects can effectively be implemented and monitored by the local bodies such as Grama and Taluk Panchayats with the help of Rural and agriculture departments. Both Centre and States have prepared and formulated many plans and policies to adopt these water conservation methods. Further, Governments have allocated funds to implement the same through Panchayats. Further, MGNREGA,[4] provides provision for carry out public works relating to natural resources management such as water conservation and water harvesting structures to augment and improve groundwater like underground dykes, earthen dams, stop dams, check dams with special focus on recharging groundwater including drinking water sources and watershed management works such as contour trenches, terracing, contour bunds, boulder checks, gabion structures and spring shed development resulting in a comprehensive treatment of a watershed etc.

Constitutional and Legislative Frameworks to Ensure Water Management in India

The Constitution of India lays down the legislative framework for the Union, State and local governments on the subject matter relating to 'water'[5]. Water falls under the State

4 Para 4(1), Schedule I of MGNREG Act, 2005.

5 Under Constitutional provisions, the allocation of responsibilities between the states and the centre falls in three categories. First, the Union List (List I), second, the State List (List II) and the third, the Concurrent list (III). In the Constitution of India, water as a whole is included in Schedule VII in Entry 17 of list II, i.e., State List which states "Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to the provisions of Entry 56 of List I". Thus, this entry is subject to the provision of Entry 56 of List I i.e., Union List. Entry 56 of List I (Union List), reads as follows: "Regulation and development of inter-state rivers

List of the Indian Constitution. Ground water is usually treated as a state subject as the Constitution of India does not empower Central Government to directly deal with its management. 73rd and 74th amendments to the Constitution regarding Panchayats and Municipalities introduced the following entries in the schedules listing the subject-areas in which the State governments and legislatures may devolve functions to such bodies, so as to make them evolve as local self-governing institutions:

- *In the Eleventh Schedule (Part IX) dealing with Panchayats, the subjects, "Minor irrigation, Water management and Watershed development", "drinking water" and "maintenance of community assets" are listed*[6].

- *In the Twelfth Schedule (Part IX) dealing with municipalities, the subjects "water supply of domestic, industrial and commercial purposes" is listed. Here it may be noted that ground water comes under minor irrigation, drinking water and water supply.*

Further, The Supreme Court of India has reinterpreted Article 21 of the Constitution of India to include the right to water as a fundamental right to life. In *Subhas Kumar v. State of Bihar,*[7] *Court observed that* Right *to live is a fundamental right under Art 21 of the Constitution and it includes the right of enjoyment of pollution free water. If anything endangers or impairs that quality of life in derogation of laws, a citizen has right to have recourse to Article 32 of the Constitution for removing the pollution of water or air which may be detrimental to the quality of life."*

Legislative Framework

There are series of Central and State level legislations which discuss the subject of water or relate to institutions which are concerned with preservation, conservation and management of water resources in India. Further, State and local governance institutions are empowered to manage the proper use of local resources, local communities and local governance institutions. Panchayats and Municipalities have to work in coordination with each other and the State departments concerned.

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and river valleys to the extent to which such regulation and development under the control of the Union, is declared by Parliament by law to be expedient in the public interest".

6 The 11th Schedule of Indian Constitution was added in 1992 by the 73rd Constitution Amendment Act. This schedule contains 29 subjects. This schedule covers important topics such as Panchayat's powers, rural development, poverty alleviation, market, roads and drinking water etc. Entry 5 of 11th Schedule enumerates subject matters on Minor irrigation, water management and watershed development.

7 1991 AIR 420, 1991 SCR (1) 5.

A. The Mahatma Gandhi National Rural Employment Guarantee Act, 2005 (MGNREGA)

Works related to water & soil conservation and land development were given top priority under the MGNREGA. This piece of legislation has a strong water management component and they account for almost 40 per cent of funds spent on physical work. Major Natural Resource Management (NRM) assets created under MGNREGS. The major works taken up under NRM include check dam, ponds, renovation of traditional water bodies, land development, embankment, field bunds, field channels, plantations, contour trenches etc[8]. The water management (WM) works specifically includes,

- water conservation and water harvesting
- implementing watershed works,
- desilting village tanks, ponds and irrigation canals, Check Dam, Vermi/ NADEP Compost Pit
- carrying out land levelling and afforestation.
- provision of irrigation facility to land owned by households belonging to SC/ST
- renovation of traditional water bodies;
- flood-control and protection work

These type of works generally, will be undertaken to promote water conservation and water harvesting. MGNREGA was introduced to promote constant and large volume of available water for meeting the need for the agriculture purpose. No doubt, MGNREGA will yield a remarkable impact on rural water management, providing water security in water-deficit areas and protecting some other areas of devastation caused by floods.

But, in reality, the author strongly opines that there are some bottlenecks in implementation of the Act. Due to lack of skilled adult workers and shortage of workers in many villages, it is very difficult to carryout works relating to building of rainwater harvesting pits, de-silt check dams and lakes, repair tank bunds, rejuvenate storm water drains, construct soak pits and Krishi hondas in farms, construct tanks for livestock, create new tanks, re-charge borewells, etc. As a result, there is no progress in conservation of water bodies in village. With the help of machines, during the time of non-availability of workers/ skilled labours in the village, above mentioned works can be executed effectively and systematically. But, under MGNREGA, suggested list of works can be carried out only by

8 Water Conservation under MGNREGS, Ministry of Rural Development Posted On: 02 JUL 2019 12:58PM by PIB Delhi.

the machines.[9]

Further, Specific permission for use of machines listed under para 22 of Schedule-I of MGNREGA must be sought from THE competent authority and the operation of such machines should be duly recorded/ documented in each such case and be made part of the case record. The estimate of MGNREGA work should contain machine rate, as per the prevailing Schedule of Rates (SOR) of the line departments in the area. Such works must be specifically taken up for Social Audits. Village Panchayats are not empowered to decide on these types of subject matters.

The Major Challenges Identified during the Renovation Work of Water Bodies

- Removal of sand mounds and wild *babul* trees and silt
- Desilting and repairing of the existing check dams.
- To complete the work with the limited workforce as landed farmers are not willing to work on lands other than their own.
- Digging of the continuous contour trenches on the hill slopes and the mining areas is a challenge during hot summer.
- Difficulty in digging the hard dry soil under intense heat,
- The farmers generally are not interested in giving their land for digging the farm pond, as they are not aware of the benefits of the water harvesting structures
- Women workers were reluctant to take up the works due to a lack of confidence in the outcome of project.

To overcome the above mentioned challenges of water conservation, the government must have an inclusive approach by making NGO's and National Service Scheme (NSS) a part of such work. Many hurdles to water conservation such as desilting, bund cleaning etc. have to be carried out without the use of machines. As a result, scarcity of labourers have glaring effects on the completion of such work. To tackle the problem of scarcity of labourers, the government must channel NSS volunteers in such direction by conducting special camps to help labourers in tackling the challenges of water conservation. Additionally, the

9 Para 22 of Schedule-1, Mahatma Gandhi NREGA, lays down that "As far as practicable, works executed by the programme implementing agencies shall be performed by using manual labour and no labour displacing machines shall be used". However, there may be activities in executing works which cannot be carried out by manual labour, where use of machine may become essential for maintaining the quality and durability of works.

government must invite NGO's to conduct such work through the help of their volunteers.

Lastly, there is general unwillingness of rural labourers to involve themselves in such work. To tackle this, the government must direct free fair shops to continue providing free food grains to such labourers upon production of a minimum 50 days completion certificate out of the 100 mandated days (under MNAREGA) by the concerned authorities. The author opines that if an inclusive approach of the community is done, it would mitigate the problem of labour scarcity and also further the underground water conservation for agricultural development .

B. State Panchayat Raj Acts

Among many laws, the most important legislation particularly to deal water resources in agriculture sector at least from the point of view of institutionalization, is the State Panchayati Raj Acts. Minor irrigation, water management, and watershed development are included in the list of subjects in the Eleventh Schedule, which can be transferred to Panchayats if the State Government so notifies in terms of the State legislation, as several States have done.

Karnataka Panchayat Raj Act, 1993

The Karnataka Panchayat Raj Act, 1993 clearly provides for the functions of various levels of rural self-governments. As per Act, the Taluk Panchayat has the function of promotion of agriculture, minor irrigation, water management and watershed development[10]. Similarly, the Zilla Panchayat also has the functions relating to agriculture, minor irrigation, water management and watershed development under Entries II and IV.[11] Further, even the Gram Sabha has the function of choosing locations of public wells, water tanks and irrigation systems. The language so used in the Act signifies that the Panchayat can only function based on the projects undertaken by the central and state government.

However, the Gujarat Panchayat Raj Act, 1993 could act as a model legislation for other states to follow. The provisions clearly provide for an independent power to the Gram, Taluk and Zilla Panchayats to undertake projects relating to agriculture and water management. For example, the Act provides for the Taluk Panchayat as follows[12]

10 Entry II and IV of Schedule II of the Karnataka Panchayat Raj Act, 1993.

11 Section 184 read with Schedule III of the Karnataka Panchayat Raj Act, 1993.

12 Sections 179 and 180 of Gujarat Panchayat Raj Act, 1993.

"Agriculture and Irrigation - Use of land and water resources and propagation of improved agricultural methods according to the latest researches - construction and maintenance of irrigation works in the Taluka - providing credit and other facilities for irrigation and agricultural development - increasing the area of land under irrigation by construction and repair of wells, digging and repair of private ponds by undertaking minor irrigation works and by supervision of field channels - increasing the use of sub-soil water by boring wells and giving assistance in regard to such wells - providing for the timely and equitable distribution and full use of water available under irrigation schemes"

Gram Panchayat	Taluka Panchayat	District Panchayat
Construction and cleaning of ponds, tanks and wells other than tanks and wells used for irrigation purposes.[13]	Agriculture and Irrigation - Use of land and water resources and propagation of improved agricultural methods according to the latest researches - construction and maintenance of irrigation works in the Taluka - providing credit and other facilities for irrigation and agricultural development -	Minor Irrigation Projects - Provision for irrigation by canals from tanks and bunds - Implementation of the schemes for tube-wells - Digging new wells and repairing old wells for irrigation - Giving assistance for purchase of pumping sets and machinery -
	increasing the area of land under irrigation by construction and repair of wells, digging and repair of private ponds by undertaking minor irrigation works and by supervision of field channels - increasing the use of sub-soil water by boring wells and giving assistance in regard to such wells - providing for the timely and equitable distribution and full use of water available under irrigation schemes. [14]	Providing detonators and boring equipment for wells - Encouraging and assisting irrigation schemes on a cooperative basis.[15]

This clearly indicates that the Taluk Panchayats in Gujarat have a higher relative independence than Taluk Panchayats in Karnataka.

13 *Ibid*, Schedule I (k) of Section 99.
14 *Ibid*, Schedule II (I) of Section 130.
15 *Ibid*, Schedule III(11) of Section 154.

C. Karnataka Irrigation (Levy of Betterment Contribution and Water Rate) Act, 1957

Pricing publicly-provided irrigation water at its scarcity value is desirable for both efficiency of usage and fiscal recovery, but paradoxically is least feasible in regions of water scarcity. In the context of Karnataka state, given the rent-seeking possibilities in crop-specific water rates and the infeasibility of metering in the developing country context, a flat quantum of water entitlement per net hectare of command area, with an accompanying fixed charge per net hectare is best. The principle of levying betterment contribution and water rates in respect of lands benefited from the irrigation work is now accepted universally. The question of introducing a single irrigation law to the extent possible, applicable to the whole State is under consideration. In the meantime it is considered necessary to consolidate the laws relating to the levy of betterment contribution and water rate and amend them so as to suit the conditions.[16]

D. The University of Agricultural Sciences Act, 1963

This Act was passed to establish a University of Agricultural Sciences in the State and help to increase productivity, closely linked on the one hand with the programme of training of students in Agricultural Sciences and on the other hand with the extension service which carries the benefits of these improvements to the cultivators. The urgency of bringing about rapid increase in food production in the State necessitates the reorganization and integration of the existing patterns of Agriculture, Animal Husbandry Education and Research with the aim of bringing about the greatest possible co-ordination of these basic activities in the service of agriculture[17]. Further, under this Act, there will be provision for conducting Investigations by experts in agricultural sciences with respect to relative agricultural productivity as measured by yields of crops in India. With the help of agriculture experts, it will be a benefit to know what type of crops can be grown by the farmers with the available water source in agriculture field. Further, these experts with the help of their students and Panchayat, can prepare a comprehensive plan for conserving water by taking soil test of particular region in the State.

16 http://dpal.kar.nic.in/

17 Published in Karnataka Gazette (Extraordinary) Part IV-2A dated 16th February 1963 as No. 26 at page. 257.)

E. The Karnataka State Rural Development and Panchayat Raj University Act, 2016

This Act was enacted with an intention to strengthen the local self-governance system and to give impetus for the study and research for a comprehensive rural development in the state of Karnataka. Further, the Act mandates School of Environment Science and Public Health and Sanitation Management to perform following the functions: [18]

- to study environmental problems and their effect on human health and agricultural productivity, water pollution and water scarcity, air pollution, soil degradation, deforestation, loss of bio diversity, atmospheric changes etc[19].
- to evolve techniques of watershed management, supply and conservation of water resources, Protection and development of lakes, streams and rivers[20]
- to evolve innovative technologies to manage our water resources more efficiently. Micro irrigation technology using appropriate devices, especially manufactured locally for semi-arid, rain water dependent agricultural area. Conjunctive water use methods to be encouraged even in irrigated area[21].

Under the Act, School of Rural Development and Panchayat Raj undertakes the study of bottlenecks in the implementation of the provisions of the Constitution and the laws relating to Panchayat Raj Institutions and to suggest reforms.[22]

KSRDPR University and Department of Rural Development can take the help of agriculture university to implement all these important water policies/plans/programmes in collaboration with all the stakeholders in order to ensure the proper usage and conservation of water in agriculture sector.

Water Policies, Plans, Schemes and Programme

Government of India and respective State Governments have been formulating many number of policies, plans and designing programmes with the help Panchayat to ensure, preserve and save water source from time to time to help the farmers to adopt scientific methods of cultivating crops with aid of new technology.

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18 (Karnataka Act No. 16 of 2016).

19 Section 50(1) of the Karnataka State Rural Development and Panchayat Raj University Act, 2016.

20 *Ibid,* Section 50(4).

21 *Ibid,* Section 50(8).

22 Section 48(3) of the Karnataka State Rural Development and Panchayat Raj University Act, 2016.

A. **The National Water Policy, 1987:** This policy was formulated by the Government of India and it was first enunciated in 1987. The policy laid down an allocation prioritization principle for water among them irrigation also one.

B. **The National Water Policy, 2002:** This was subsequently introduced in relation to the rapidly changing scenario in the domain of water to address the emerging issues and provide critical policy inputs. NWP 2002 gave emphasis for the first time to ecological and environmental aspects of water allocation.

C. **National Water Policy, 2012**: It discusses about the coordination process for the implementation of the national water policy. Considering the large-scale use of water in agriculture and the fact that water rights in India are loosely linked with land rights, policy also talks about the integration of the water use and land use policies[23]. The central and the state governments are equally responsible for preventing the detrimental overexploitation of water.

D. **National Mission for Sustainable Agriculture:** The scheme was introduced in 2014-15 and aims to ensure efficient and sustainable water management practices with mainstreaming rainfed methods. It also aims to adopt modern methods for irrigation.

E. **Pradhan Mantri Krishi Sinchai Yojana:** This Scheme aims to increase the coverage of irrigated area in a phased manner by accounting for distribution, management and end to end solutions. This scheme consolidated other schemes such as Accelerated Irrigation Benefit Programme (AIBP), Integrated Watershed Management Programme (IWMP) and On Farm Water Management (OFWM) scheme.

F. **Micro Irrigation Fund scheme:** Under this scheme, the Centre encourages installation of micro irrigation facilities. The states are provided interest subvention for loans taken for this particular purpose. Rs. 5000 crores was allocated for the same in the 2019-20 budget proposal.

Additionally, there are other schemes and programmes of the Union government such as PM-KUSUM, Paramparagat Krishi Vikas Yojana, National Rural Employment Guarantee scheme *inter alia* for the purpose of development of agriculture in particular. However, since agriculture and water are primarily in the domain of the states[24], it would be imperative to consider the role of states in formulation and implementation of policies and programmes to promote sustainable use of water and ensuring its availability in agriculture.

23 Para 9.2 of National Water Policy 2002.

24 Entries 14 and 17 of the Seventh Schedule of the Indian Constitution

The Government of Karnataka has taken several steps with respect of effective use and availability of water for agriculture. Up to end of 31st March 2017, the state has ensured that 2873610 hectares of land is potentially available for irrigation under major and medium irrigation projects. However, despite this, there are disparities among various regions as far as accessibility to water and its availability is concerned. The Karnataka State Water Policy of 2002[25] and 2019 discuss and highlight the various aspects relating to water management and its availability. The documents clearly show that Karnataka faces shortage of water and that there is a need for its conservation, efficient and sustainable utilization. The gravity of the situation has been reaffirmed in the Karnataka State Water Policy, 2019[26]. The problem persists due to the lacunae which is present in framing of scientific method-based policies and its implementation. Such lacunae are present due to the lack of community level participation. Due to the lack of awareness regarding such schemes introduced by the central government and the state government, its implementation has not been effective at the ground level. At this juncture, the role of Panchyats become important. As already mentioned above, by the virtue of Article 243-G even Panchayats can undertake works relating to water management and water distribution. Also, it has become evident that the present structure involves a top-down approach as far as policies and programmes are concerned. Further, it is noticed that the central government and state governments frame policies which do not necessarily account for the diversities which are present in the country and states as such.

Multiple Agencies to Implement and Supervise Water Management

Presently, there are multiple agencies and bodies which have been entrusted with the implementation of water management and water distribution projects. Development of structures and systems for water distribution is carried out by the Water Resources Department (i.e., the erstwhile Major and Medium Irrigation Departments) and the Minor

25 "The State is endowed with limited water resources that are stressed and depleting. Different Sectoral demands are growing rapidly. Increase in population, urbanization, rapid industrialization and rising incomes are putting this resource under stress. Unless water resources are properly developed and managed, the State will face acute crisis within the next two decades. Serious destabilization of the water sector affecting the hydrology, economy and ecology of the State is likely."

26 "The current status of the water sector in Karnataka today is a matter of serious concern. First, the summer season flows in most rivers are declining and there is evidence of some rivers (Arkavathy, Dakshina Pinakini, etc.) almost drying up. This is visible in declining inflows into major reservoirs. Thousands of minor irrigation tanks have also dried up completely. Second, groundwater levels have been dropping at an alarming rate for several decades in many parts of the state. 44 of the 176 talukas in the state have been declared as 'over-exploited."

Irrigation Department, with the Neeravari Nigams being quasi-companies. Apart from the Irrigation Department, the Command Area Development Authorities (CADAs, under WRD) are supposed to help with the final (tertiary and field channel level) distribution of surface irrigation water. The Agriculture Department handles components such as drip irrigation subsidy, while the state electricity supply companies are indirectly involved because of the free electricity supply for irrigation pumpsets. It is also said that Water Users Associations (WUAs)/Water Users Cooperative Societies (WUCSs) have been set up with farmers as members to manage the final distribution of irrigation water. Rural Development & Panchayati Raj Department has been entrusted with the function of supplying water to rural areas. Therefore, there are multiple agencies/bodies which have entrusted with similar functions. This division and distribution of similar functions has caused several complexities as far as implementation of the schemes are concerned.

Challenges for Implementation

1. **Lack of Coordination among Departments:** There is a lack of coordination among different vertical departments which are responsible for different aspects of schemes relating to water management and distribution in rural areas, specifically to the rural areas.

2. **Lack of Budgetary Support:** The departments concerned do not receive sufficient monetary support for undertaking projects.

3. **Lack of Community Participation:** Several projects do not take the confidence of the stakeholders concerned and affected. It has a top-down approach.

4. **Lack of Awareness programmes:** Several farmers and the stakeholders concerned are not aware about the schemes and programmes of the government. They also do not have access to technology and the modern methods of irrigation which provide for water efficient and land specific utility.

5. **Lack of Transparency:** There are no transparent mechanisms which provide details regarding the process involved in undertaking projects and implementing them. This is done without community outreach.

6. **Bottlenecks in Implementation of MGNREGA:** Under MGNREGA scheme, maximum works should be carried out by manual labours without using machines. But unfortunately, it is very difficult to arrange labourers to carry out some works to conserve water bodies in village.

7. **No accountability :** Officers who are in charge of implementing all these important works are not committed due to many additional works assigned to them or they may not be interested to work in rural areas or because of lack transportation facilities.

8. **Lack of Human Resources:** Many posts in irrigation and rural department still remained as vacant. No notification issued to fill-up vacancies to carry out these types of job. As a result, policies and plans with respect to conservation of water in agriculture sector remained in white paper.

Conclusion

Panchayat with the help of expert groups from agriculture science and rural development departments can play a significant role in making proper plan to save and conserve water in agriculture sectors. Panchayat members and officers have to create an environment and implement the concept of community service in a effective way, where farmers who may be the owner-cultivators. Tenants have to join their hands in cleaning water bodies with the help of MGNREGA labourers, NGO and Volunteers of National Service Scheme etc. to conserve water source in agricultural area of their villages. The day when the watercourse should be cleaned is also decided and communicated to farmers one day in advance by the officers of Panchayat water harvesting is the key water-related interventions with the potential to contribute to rapid improvements in the yields.. Adoptions of water saving technologies such as sprinkler and drip irrigation systems have proven extremely effective in not just water conservation but also leading to higher yields. New agronomic practices like raised bed planting, ridge-furrow method of sowing, subsurface irrigation, and precision farming which offer vast scope for economizing water use. Small-storage technologies will also be helpful to save and provide water for agriculture use.

Suggestions

1. Ensuring that there is proper coordination: There is a need to ensure proper coordination among different agencies and bodies which are involved in framing and implementation of the policies.

2. Creating Awareness: Firstly, awareness has to be created for the Panchayat members regarding water sustainability, conservation and its importance. Then, it can be further extended to the stakeholders involved who can then make informed representations.

3. Identification of different types of land areas: Since there are different irrigation

methods like drip irrigation, sprinkler irrigation etc., which are suitable for different regions and types of land, it would be pertinent to create community specific/location specific awareness programmes to ensure that the targeted beneficiaries reap good benefits.

4. National Agriculture Market gives an e-marketing platform at the national level and support creation of infrastructure to enable e-marketing. It brings in transparency & competition to enable cultivators to get improved remuneration for their produce moving towards 'One Nation One Market'[27]
5. Rainfed Area Development Programme was started as a sub-scheme under the Rashtriya Krishi Vikas Yojana (RKVY). This helps in increasing agricultural productivity of rainfed areas in a sustainable way by adopting suitable farming system based approaches. It minimises the adverse impact of possible crop failure because of drought, flood or uneven rainfall distribution through diversified & composite farming system[28].
6. Gram Panchayats should be given the task of implementing, operating and Managing the help them plan to address water scarity.
7. Technology such as drip/sprinkling irrigation is an excellent way to improve the production of crops and save water.
8. Soil and water testing laboratories should be established at the taluk level under the supervision of Taluk Panchayat.
9. Capacity building is also important for saving water and more information should be forwarded to the farmers through Panchayat.
10. A crop selection approach should be adopted by all the farmers to save water.
11. People should elect committed people in the panchayat elections to implement all these schemes/plans/programmes in true spirit.
12. Funds should be raised by the government under corporate social responsibility to carry out certain work to clean water bodies for water conservation with the help of noted non-governmental organisation. They can also adopt villages to serve this object.

27 https://krishijagran.com/
28 *Ibid.*

Chapter 13
Irrigation Law and Policy in India

Dr. Uday Shankar*

Introduction

Water is an important resource that is vital to the survival of all beings. While about 71% of the planet Earth is covered by water, no more than 2.5% of it is freshwater out of which only 0.3% is available in liquid form.[1] Water is naturally recycled through the water cycle, but we are consuming it faster than it can be replenished[2] and therefore the availability of freshwater is a matter of serious concern as it drives life on the planet.

India has a huge requirement for water because of its large population and the fact that about 50%[3] of the population is involved in agriculture. Irrigation policies of the Central and State Governments are therefore of great importance not only for the efficient management of water since about 80% of the water use is for irrigation,[4] but also to adequately support agriculturalists especially considering that they account for 19.9%[5] of the nation's GDP.

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1 Water in Crisis: Chapter 2, Peter H. Gleick, Oxford University Press, 1993.

2 Tim Smedley, *Is the world running out of fresh water?*, BBC, 13th April 2017 https://www.bbc.com/future/article/20170412-is-the-world-running-out-of-fresh-water.

3 Madhusudhan, L. 2015. Agriculture role on Indian economy. Business and Economics Journal 6: 176. doi: 10.4172/2151b6219.1000176.

4 Nathaniel B. Dkhar & Qazi Syed Wamiq Ali, *Critical policy interventions to fast forward micro-irrigation in India*, The Energy and Resources Institute (2019).

5 Ministry of Finance, *Economic Survey* 2020-21.

Despite our huge population, India is not only self-sufficient for its food requirements, but also has been a major exporter.[6] Throughout history, groundwater has been the major source of water which took even greater relevance since the inception of the 'Green Revolution.'[7] India, therefore, abstracts the world's largest volume of groundwater,[8] most of which is non-renewable in nature.[9]

In India, 60% of irrigated agriculture depends on groundwater whereas the other 40% depends on surface water according to a World Bank report.[10] This is a cause for concern because of the depleting water table, which is showing abnormally high values in certain minerals and salts since the groundwater is not allowed to be recharged adequately.

The Jal Shakti (water resources) Minister Mr. Gajendra Singh has recently stated that about 22% of water resources have dried up, is critical, or is in the overexploited category.[11] He further stated by saving merely 10% of the water consumed by the agriculture sector now, water could be made available for all users for the next 50 years.[12]

Therefore, there is a growing need for an all-encompassing irrigation policy, taking into consideration all factors, including those beyond agriculture, to make water use sustainable and ensure that we do not encounter a future where water becomes an exclusive, inaccessible commodity.

Irrigation – Pre-Independence Era

In 1919, the colonial rulers introduced a reasonable measure of autonomy to the Provinces as the first step in the process of self-government. The division of the legislative subjects between the centre and the state placed the divided responsibility on the governments.

6 Derek Headey, *Rethinking the global food crisis: The role of trade shocks*, 36 Food Policy, 136 (2011).

7 Prabhu L Pingali, *Green revolution, impacts, limits, and the path ahead* 109 Proc. Natl. Acad. Sci. U S A, 12302 (2012).

8 DK Panda et. al., *Groundwater depletion in northern India: Impacts of the sub-regional anthropogenic land-use, socio-politics and changing climate* 35 Hydrological Processes (2021).

9 C. Dalin et. al., *Groundwater depletion embedded in international food trade* 543 Nature, 700 (2017); J. S. Famiglietti, *The global groundwater crisis* 4 Nature Climate Change, 945–948 (2014); Cheryl M. van Kempen et. al., *Global depletion of groundwater resources. Geophysical Research Letters* 37 Int. Groundwater Res. Asses. Centre (2010).

10 *Water Sector in India*, World Bank (Sept. 29, 2011), https://www.worldbank.org/en/news/feature/2011/09/29/india-water.

11 Vishwa Mohan, *22% of India's groundwater dried up or in critical state: Gajendra Singh Shekhawat*, Times of India, Nov. 25, 2019, https://timesofindia.indiatimes.com/india/22-of-indias-groundwater-dried-up-or-in-critical-state-gajendra-singh-shekhawat/articleshow/72215191.cms.

12 *Ibid*.

Of the three great commercial departments of government, Railways and Posts and Telegraphs were retained by the Centre, while irrigation was handed over to the Provinces.[13] Initially, the British focused on the strengthening of canals and reservoirs to channelize the water resources for agriculture purposes. Due to successive famines in the early part of the twentieth century, the First Irrigation Commission stressed the planning and the development of irrigation in the country. The colonial rulers displayed the exploitative approach by extracting the maximum level of resources from the existing infrastructure. Also, they invested in irrigation in the region which was producing exporting crops such as cotton, opium, sugar cane, etc.[14] In 1935, the British has presented an advanced version of the earlier Act to quell the demand for independence from the leaders of the independence movement. In the new arrangement, the resource allocation on irrigation continued to be with the provinces.[15]

Irrigation - Constitution of India

Though the framers continued the same constitutional arrangement on irrigation after gaining independence from the colonial rulers, some of the members were skeptical of complete devolution to the provinces considering the mammoth task needed to develop an irrigation plan for the country. Prof. Shibban Lal Saxena, a member of the Constituent Assembly who got elected from the United Provinces, moved an amendment to place the subject matter related to agriculture, irrigation, land, etc. in the concurrent list of the Schedule of the Constitution. He advocated for the shared responsibility so that both governments could join hands to build a robust system for the entire country. He commented that "...I feel it should be realized that agriculture, irrigation, cattle, land, forests, etc. shall have to be developed according to an All-India Plan and under Central direction. In fact, we have in List III one entry No. 34 for planning. If we take up any book on planning we will find that no plan can be complete, unless it includes all-around long-term development of land and agriculture within its purview. Today we are thinking that if we put these items in List III, then we shall be depriving provinces of their autonomy. This is quite incorrect. By putting them in List III, we only mean that the Centre will have the power to co-ordinate these activities, to finance them when necessary, and to give expert advice. I do not want them to go to List I, but they should be put in List III so that the Centre will not interfere with the States and will only advise and co-ordinate their activities. It may be pointed out that even the 1935 Act had made such a complete division as is now proposed. In that Act there

13 Government of India Act, 1919, No. 1 of 1919.

14 Mike Davis, Late Victorian Holocausts: EL Niño Famines and the making of the third world (2002).

15 The Government of India Act, 1935, 26 Geo. 5. CH. 2, Schedule VII, Entry 19 in List II.

was the Central responsibility of the Governor-General which was overriding and so that could keep the whole administration centralised but today we are dividing the functions of the Union Govt. and the State Govts. in water-tight compartments. Today we are fortunate in having one part ruling the whole country but tomorrow it may not be so and then it will be difficult to carry out the same plan in all the States. If India is to be made self-sufficient in food it must have irrigation facilities on a very large scale for the entire country, but can we know that the provinces and States will not be in a position to carry out large irrigation schemes costing several hundred crores?...”[16] This proposal was turned down factoring in the autonomy of the provinces. Though during the debate he highlighted the magnitude of investment needed to develop the irrigation system for the entire country and to secure food for the whole population, now the overdraw of water for agriculture purposes need the intervention from the centre so that the parochial interests of the provinces should not yield to the interest of the nation.

Since India’s Independence in 1947, it is the States that have been regulating territorial water bodies, embankments, drinking water supply, irrigation, floods, water conservation, water pollution, rehabilitation of the displaced, fisheries, and ferries.[17] Entry 17 under List II of Seventh Schedule of the Indian Constitution provides that “Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to the provisions of Entry 56 of List I”.[18] Therefore the policy on the water in India is primarily State-driven. Even though the state-bound policy implementation can prove to be useful, considering the diversity in the local situation, even within a state, no single management option can be feasible.[19]

Irrigation – Law and Policy

A. Central Law

The Constitution entrusts the centre to regulate and develop inter-state rivers and river valleys.[20] A liberal reading of Entry 56 of List I would include the use, distribution, and allocation of the waters of the inter-State rivers and river valleys between different riparian States. The National Commission on the Review of the Working of the Constitution

16 Constituent Assembly Debates, September 2, 1949 http://loksabhaph.nic.in/writereaddata/cadebatefiles/C02091949.html.

17 The Evolution of the Law and Politics of Water 159 (Dellapenna, Joseph W., Gupta, Joyeeta eds., 2009).

18 India Const. Schedule VII, List I, Entry 56.

19 *Supra* note 8.

20 *Supra* note 20.

suggests the wider interpretation of the term 'regulation and development' by including allocation and use of the water.[21] Parliament has passed the River Boards Act which enables the Centre to create boards to advise on the integrated development of inter-state basins, in consultation with the states concerned.[22] The river boards were supposed to prevent conflicts by preparing development schemes and working out the costs to each state. However, no such water board has ever been created.[23] As per the constitutional scheme, the centre plays the role in resolving the inter-state water disputes.[24] Amongst many reasons for the dispute, the overutilization of river water for irrigation causes disputes between the states. The Indian Parliament has enacted the Inter-State Water Disputes Act, 1956 which establishes a quasi-judicial adjudicatory mechanism to resolve the dispute within 3 years of the constitution of a tribunal.[25] The conflict between the states is resulting from possession and control of river water, water scarcity, and rapid rise in demands for freshwater in rural and urban areas. The centre has a role to play in limiting the power of the state to not exclusively utilise the water by depriving another state located downstream. It has been argued that the planning, social and economic, aspects authorise the centre to evaluate the major and minor irrigation projects of the states and imposes an obligation to obtain environmental clearances for the same.[26] Thus, even without formal legislation, the Union government has the power to exercise significant control.[27] The demarcated subject matters and the discussed legislations do not directly touch upon the issue of irrigation. Still, the centre can, justifiably, intervene in case the irrigation plan of one state adversely affects the water resources of another state.

B. State Laws – Selected States

Irrigation was a legally regulated subject from colonial times considering the interest of the state to invest in the agriculture sector.[28] The Irrigation Statutes largely cater to the

21 Department of Legal Affairs, Ministry of Law & Justice, *National Commission to review the working of the Constitution Report*, 1 (2002).

22 The River Boards Act, 1956, No. 49 of 1956.

23 M Sridhar Acharyulu, *The great Indian river question: Three Bills threatening federalism*, Down to Earth, https://www.downtoearth.org.in/news/water/the-great-indian-river-question-three-bills-threatening-federalism-72913 (August 19, 2020).

24 India Const. art. 262.

25 The Inter-State River Water Disputes Act, 1956, Act 33 of 1956, § 5.

26 Ramaswamy Iyer, Indian Federalism and Water Resources 10 Int. Jour. of Water Resources Dev., 191(2007).

27 Ambar Kumar Ghosh & Sayanangshu Modak, *Federalism and Interstate River Water Governance in India*, Observer Research Foundation (2021).

28 Northern India Canal and Drainage Act 1873, No. 8 of 1873.

interest of the states without taking into account the participation of the beneficiaries. The Madhya Pradesh Irrigation Act, 1931 enabled the constitution of irrigation panchayats for every village that had, inter alia, been assigned the functions of distribution of water and collection of irrigation fees and remittance to the government. The Panchayat shall be comprised of Sarpanch, two or more elected and one nominated member, to be nominated by the Collector.[29]

Since independence in 1947, most states have regulated territorial water bodies, embankments, irrigation, floods, water conservation, etc. States have legislated on the entire extent of surface water available within their borders. Gradually, the Government of India has been stressing the participation of farmers in developing an efficient irrigation system.[30] In recent periods there has been a great deal of fresh thinking on the role of the beneficiary farmer. There are demands to bring the farmer to centre-stage and reform the irrigation system and its structure.[31] In pursuant to the call of the Government of India, States of Andhra Pradesh, Assam, Bihar, Chhattisgarh, Goa, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Nagaland, Orissa, Rajasthan, Sikkim, Tamil Nadu, and Uttar Pradesh have enacted exclusive legislations for the involvement of farmers in irrigation management. Some of the legislation will be highlighted, hereinafter, to establish legal recognition of the participation of farmers in irrigation management.

The Andhra Pradesh Farmers' Management of Irrigation System Act, 1997 provided for the formation of the Water Users' Association which shall be responsible for planning and execution of the irrigation schemes. The State Government has issued orders on sharing of water charges among the various farmers' organisations and the irrigation department.[32] The Government of Tamil Nadu has introduced Rotation Water Supply with an objective is to distribute the water with equity to maximize the production with efficient use of water. The Water Users' Association was given the responsibility to prepare and implement an operational plan and Rotation Water Supply for each irrigation season.[33] In Rajasthan, the Water Users' Association is entrusted to prepare a plan for the maintenance, extension, improvements, renovation, and modernisation of the irrigation system in the area of its operation. The Association needs to monitor the flow of water for irrigation and resolve the

29 The Madhya Pradesh Irrigation Act, 1931, Act 3 of 1931 § 62.

30 Ministry of Water Resources, *Status of Participatory Irrigation Management (PIM) In India Policy Initiatives Taken And Emerging Issues*.

31 Planning Commission, Report of The Steering Committee on Water Resources and Sanitation for Twelfth Five Year Plan (2012).

32 The Electric Power Act, 1997, No. 11 of 1997.

33 Tamil Nadu Farmers Management Of Irrigation Systems Act, 2000, No. 7 of 2001.

disputes between the members and water users within its area of operation.[34] The Orissa Pani Panchayat Act, 2002 has institutionalized the role of the farmers' in the management of irrigation systems. In 2005, the Government of Maharashtra enacted the Maharashtra Management of Irrigation System by Farmers Act which allows the land under irrigable command of a canal where management of irrigation of water distribution to be handed over to the Water Users' Association.[35] The Gujarat Water Users' Participatory Irrigation Management Act, 2007 prioritises the involvement of farmers in managing the water for agriculture purposes. The Users' Association has been made responsible to ascertain the demand for water and ensuring the distribution of the water to each holder of land. The Association comprises of the landholder should prevent the unauthorised use of water or waste of water.[36] There is an interesting legal intervention made in the State of Punjab by regulating the cultivation of paddy during a specified period. The activity of sowing paddy nurseries and transplanting of seedlings from the month till late May was causing the over-extraction of groundwater during summer. To mitigate the complication of the diminishing water table in the State, the government came up with the Punjab Subsoil Preservation Act, 2009. As per the Act, farmers were prohibited from sowing paddy seeds in nurseries before May 10 and transplanting the seedlings before June 10. The objective of the Act was to delay the sowing of paddy seeds so that the water used for harvesting these seeds can be reduced. Before the Act, farmers used to harvest paddy seeds in April.[37]

These legislations have provided legal backing for implementing measures to institutionalise the participation of irrigation users in the operation and maintenance of irrigation systems. The participation ensures equitable and reliable supplies and presents water audit and decentralisation of irrigation management. The recognition of the Water Users' Association resulted in the creation of a distinct legal entity independent of its members. The acknowledgment of juristic personality in favour of the Association reflects the determination on the part of the lawmakers to institutionalise the participation of the farmers in irrigation systems.

34 **Rajasthan Farmers Participation in Management of Irrigation Systems Act, 2000, No.** 21 of 2000**.**

35 Maharashtra Management of Irrigation Systems by Farmers Act, 2005, Mah. No. XXIII of 2005.

36 Sec. 19, The Gujarat Water Users' Participatory Irrigation Management Act, 2007 Act No. 18 of 2007.

37 Punjab Preservation of Subsoil Water Act, 2009, Punjab No. 6 of 2009.

C. Irrigation – Policy

National Water Mission

The Government's National Water Mission under the National Action Plan on Climate Change seeks to address issues such as groundwater depletion, improvement of resource management as opposed to augmentation, etc. The objective of the National Water Mission is "conservation of water, minimizing wastage and ensuring its more equitable distribution both across and within States through integrated water resources development and management".[38] For irrigation, the Mission stresses on 'optimising the efficiency of an existing irrigation system including rehabilitation of systems that have been run down and also expand irrigation, where feasible, with a special effort to increase storage capacity'.[39] It also identifies the benefit of sprinkler and drip irrigation for minimising wastage. Participatory Irrigation Management gets approval in the Mission Document and was recommended to give legal recognition in every state. It is suggested that the concerned ministries promote basin level integrated water resources management by laying down guidelines for different uses of water e.g., irrigation, drinking, industrial, etc.

Micro-irrigation helps in the conservation through the efficient use of water resources, mitigating waste. It enables in making crops that are high yielding but consuming less water through the use of drip irrigation and sprinkler irrigation.[40] It is a part of the fourth goal of the National Water Mission.[41] Micro-irrigation systems have an estimated efficiency of about 80% to 95%.[42] These systems have nominal conveyance losses and at the same times, there is a minimal loss through evaporation, run-off, and deep percolation.[43] Water efficiency can be improved by utilizing drip and sprinkler irrigation for rice and wheat[44] which are the major food crops cultivated in India. Pressurized irrigation systems such as

38 Water Sector in India, The World Bank (Sept. 29, 2011) https://www.worldbank.org/en/news/feature/2011/09/29/india-water.

39 Ministry of Water Resources, *National Water Mission under National Action Plan on Climate Change, Comprehensive Mission Document* 3 (2009).

40 Q S Ali & Nathaniel Dkhar, *Critical policy interventions to fast forward micro-irrigation in India,* The Energy and Resources Institute (2019).

41 Our Goals, National Water Mission, http://nwm.gov.in/?q=goal-4.

42 Central Water Commission, *Guidelines for Improving Water Use Efficiency in Irrigation, Domestic & Industrial Sectors*, India Environmental Portal (Nov. 1, 2014) http://www.indiaenvironmentportal.org.in/content/403968/guidelines-for-improving-water-use-efficiency-in-irrigation-domestic-industrial-sectors/.

43 A. Phocaides, Food And Agriculture Organization, Handbook on Pressurized Irrigation Techniques, (2007).

44 Raj Pal Meena, et. al., *Improving water use efficiency of rice-wheat cropping system by adopting micro-irrigation systems*, Int. Journ. of Bio-resource and Stress Management (2015).

sprinkler, surface, and subsurface drip, can increase irrigation water efficiency in line with crop needs, decreasing runoff, and can help maintain a more stable soil environment that can decrease soil evaporation and increase the capacity of soils to collect rainfall.[45] Through the use of drip irrigation in rice, water use was reduced by about 200mm with subsurface drip commencing two weeks before panicle initiation when compared to conventional flooding methods. But again, there was a loss in yield.[46]

National Water Policy:

Though Water is a state subject, the central government formulates a policy to guide all the stakeholders to efficiently use the water resources throughout the country. National Water Policy, 1987 identified irrigation as the second priority in the list of water allocation priorities, much above industrial and other uses. It eulogised that water allocation in an irrigation system should be done with due regard to equity and social justice.[47] In 2012, a new policy identified the inadequate maintenance of existing irrigation infrastructure as a cause of wastage and under-utilization of water resources. It suggested adopting strategies based on demand-side management, including the planning of cropping patterns and improved water application methods. The Policy highlights inadequate maintenance of existing irrigation infrastructure is causing wastage and under-utilisation of available water resources. It spells out the widening gap between irrigation potential created and utilized. The Policy endorsed the idea of micro-irrigation as it enhances the water use efficiency. It stressed that water saving in irrigation is the need of the hour.[48]

Pradhan Mantri Krishi Sinchayee Yojana:

Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) was launched with an overarching vision to ensure access to some means of protective irrigation for all agricultural farms in the country, and to produce 'Per Drop More Crop', thus bringing much desired rural prosperity. To channelize the resources and for better planning, the existing schemes on Accelerated Irrigation Benefits Programme, Integrated Watershed Management Programme and On-Farm Water Management plans were amalgamated by the Central Government. PMKSY not only focuses on creating sources for assured irrigation but also creating protective irrigation by harnessing rainwater at the micro-level through 'Jal Sanchay' and 'Jal Sinchan'. Furthering the commitment to water conservation and its management, the

45 Camp CR., *Subsurface drip irrigation: a Review*, 41 ASABE 1353 (1998).

46 HG Beecher et. al., *Effect of raised beds and irrigation management on growth, yield and water use of rice in south-eastern Australia* 46 Australian Journal of Experimental Agriculture 1363 (2006).

47 Ministry of Water Resources, *National Water Policy, 1987* (1987).

48 Ministry of Water Resources, *National Water Policy, 2012* (2012).

scheme suggested the convergence of investments in irrigation and acknowledges micro-irrigation as an integral component of the system.[49]

Conclusion

Groundwater-based irrigation systems received enormous support from small farmers due to absence of the regulation and shortage of canal irrigation from rivers and large dam reservoirs. Groundwater offered an edge because it could be tapped where needed, was not dependent on the slow bureaucratic machinery for infrastructure development, and was more reliable during droughts when surface water reservoirs dried up. The excessive dependence on groundwater, however, comes at a high environmental cost.[50] Rapid depletion of the water table, low irrigation efficiency, and frequent droughts indicate a water crisis shortly if the existing water use pattern is not rectified. Farmers' participation in the irrigation system received legal recognition and found a prominent place in the policy prescription of the country. It truly highlights that the success of the irrigation system squarely depends upon the bottom-top approach with more decision-making power to people instead of over-reliance on a bureaucratic system to manage water resources.

With the depletion of groundwater level for irrigation purposes, there is also a need to revisit the suggestion advanced by Prof. Saxena, a member of the Constituent Assembly, to shift subject matters enlisted in Entry 17 of the state list to the concurrent list so that the management of irrigation becomes shared responsibility. A well-managed irrigation system does not only promise food security and but also conservation of valuable water resources. Thus, a fragmented approach to channelize the irrigation system may prove counterproductive and over-assertion by the states as per constitutional scheme may compromise national interest.

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49 Pradhan Mantri Krishi Sinchayee Yojana, https://pmksy.gov.in/.

50 M. Smilovic, et. al. *The Limits of Increasing Food Production With Irrigation In India,* 7 Food Sec. 835 (2015).

Chapter 14
Resolution of Inter State Water Disputes in India - A Look at Recent Developments

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Abstract

The Constitution of India, empowers the Central Government to legislate in relation to regulation and development of inter–state rivers; and the States, subject to power of the Union, can legislate in respect of water supplies, irrigation and canals, drainage and embankments, water storage and water power. The State can make laws relating to water flowing through inter-state rivers, only if the control of such river waters is not taken over by the Union and it does not affect the waters beyond its territory. The Inter–State River Water Disputes Act, 1956 deals with adjudication of disputes relating to the waters of any interstate river. Further, the Inter-State River Water Disputes (Amendment) Bill 2019, the Dam Safety Bill 2019, draft National Water Framework Bill 2016, draft River Basin Management Bill 2018 also are on the anvil and have an impact on the management of water resources. The paper makes a doctrinal study, by analyzing the current legal framework, significant decisions of the Supreme Court, and also the proposed amendments, on the parameters of effective water management in public interest.

Keywords: *Inter–State River Water Disputes, Water Dispute Tribunals, Resolution.*

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Introduction

India is a land of many rivers, with eight important[1] and more than 400 other rivers.[2] The Central Water Commission (CWC) has divided India into 20 river basins[3] comprising 12 major and 8 composite river basins.[4] All of the longer and major rivers in India are inter-state rivers[5] divided into four broad categories namely Himalayan[6], peninsular,[7] inland,[8] and small coastal rivers[9] flowing into the Arabian Sea.[10] India has approximately 17% of world's population but has only 4% of the world's freshwater resources,[11] and the annual utilizable water resources in the country are 690 BCM from surface sources and 447 BCM from groundwater.[12]

1 Indus (2900 km), Brahmaputra (2900 km), Ganga (2510 km), Godavari (1450 km), Narmada (1290 km), Krishna (1290 km), Mahanadi (890 km) and Kaveri (760 km). *See*: Length of Some Important Indian Rivers | Know India: National Portal of India, https://knowindia.gov.in/general-information/length-of-some-important-indian-rivers.php (last visited May 18, 2021); 8 important rivers of India: Stories behind famous rivers of India, India Today (2018),(May 18, 2021), https://www.indiatoday.in/education-today/gk-current-affairs/story/important-rivers-of-india-1372859-2018-10-22.

2 Ananda Banerjee, *India's misunderstood rivers*, LiveMint (2015), (May 18, 2021), https://www.livemint.com/Politics/xb05tga2lJHln7oot8lhXN/Indias-misunderstood-rivers.html.

3 (1) Brahmani-Baitarni Basin; (2) Cauvery Basin; (3) East Flowing rivers between Mahanadi and Pennar; (4) East Flowing rivers between Pennar and Kanyakumari; (5) Ganga/Brahmaputra/Meghna/Barak Basin; (6) Godavari Basin; (7) Indus Basin; (8) Krishna Basin; (9) Mahanadi Basin; (10) Mahi Basin; (11) Minor rivers draining into Myanmar and Bangladesh; (12) Narmada Basin; (13) Pennar Basin; (14) Sabarmati Basin; (15) Subarnarekha Basin; (16) Tapi Basin; (17) West Flowing Rivers from Tadri to Kanyakumari;(18) West flowing rivers from Tapi to Tadri; (19) West flowing rivers of Kutchh and Saurashtra including Luni; and (20) Areas of Inland Drainage in Rajasthan.

4 Annual Report 2019-2020, Central Water Commission, 32–33 (2020).

5 The Mahanadi, for example, rises near Mhow in Madhya Pradesh and flows through Orissa before draining into the Bay of Bengal; the Chambal rises near Mhow in Madhya Pradesh and flows through Uttar Pradesh before draining into the Yamuna, which then flows into the Ganga. *See* N. Shantha Mohan & Sailen Routray, *Resolving inter-state water sharing disputes*, 626 Seminar, 31–32 (2011), (May 17, 2021), http://eprints.nias.res.in/239/1/Resolving_interstate_water_sharing_disputes.pdf (last visited May 17, 2021).

6 Himalayan rivers such as the Ganga, Brahmaputra, Lohit, and Teesta acquire their water from melting snow throughout the summer, resulting in their perineal character.

7 Apart from the Narmada and Tapti, which flow into the Arabian Sea, the Subernarekha, Mahanadi, Brahmani, Godavari, Krishna, Cauvery, and Pennar are the major east-flowing rivers in peninsular India.

8 Ghaggar and Luni rivers do not find an exit into the sea and end up in Rajasthan and Gujarat's arid wastelands.

9 Small and fast-flowing rivers such as the Zuari, Mandovi, Netravati, and Periyar originate in the Western Ghats and drain into the Arabian Sea.

10 Mohan and Routray, *supra* note 5.

11 Indian Institute of Tropical Meteorology, *Climate Change Impacts on Water Resources in India* 2, (May 23, 2021), http://www.indiaenvironmentportal.org.in/files/india-climate-5-water-DEFRA.pdf.

12 NITI Aayog, *Composite Water Management Index* 187 (2019), (May 23, 2021), http://social.niti.gov.in/uploads/sample/water_index_report2.pdf.

Agriculture and food security are most intimately tied to water, and the scarcity of water resources has many cascading effects including desertification, risk to biodiversity, industry, energy sector and risk of exceeding the carrying capacity of urban hubs.[13] To address India's complicated water problem, it is critical to adopt a holistic approach to water, beginning with the hydrological system and its connections with climate change on the one hand and human activities in agriculture, industry, and energy generation on the other. There is a pressing need to utilize the limited available water resources better and to implement interventions to manage water more responsibly, by moving beyond the petty differences among States, and to make water use more effective and sustainable.[14] The increased demand for water resulting from population growth, urbanization, and economic development processes, has created a sense of acute pressure on the existing finite supply of water and also led to predictions of extreme scarcity, crisis, conflicts, and 'water wars'.[15] Some of India's largest inter-state water disputes include the Krishna-Godavari, Ravi-beas, Narmada, Mahanadi, Cauvery River conflicts, as well as the Satlej-Yamuna Linking Canal[16].

Water as a Right

The right associated with water has three facets i.e., as a property right, state's right, and human right. The right to water as property benefits the market and corporations; the right of a state over water legitimizes the State as the actor in the water sector[17]; and water as human right focuses on 'people' and 'society'.[18] There is an increasing move to argue for the recognition of human right to water, taking into account social benefits and concerns of equity, and not just issues of efficiency and sustainability.[19]

Water was designated as one of the natural resources that needed to be protected during the United Nations Conference on the Human Environment in Stockholm in 1972.[20] Agenda-21

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13 *Ibid.* at 188–189.

14 *Ibid.* at 190.

15 Ramaswamy R. Iyer, *Water: Some Crucial Questions*, 49 Indian J. Public Adm. 280–295, 280 (2003).

16 R Girish, *Water Disputes in India: Constitutional Mechanism and Judicial Control of Disputes on Inter-State Rivers*, 9 GNLU J. Law, Dev. Polit. 199–226, 200 (2019).

17 In India, the legislative competence of the Union and State legislatures could be seen from Entry 56 of Union List and Entry 17 of State List in the VII Schedule and the role of Parliament under Article 262 of the Constitution of India.

18 Sailen Routray & N. Shantha Mohan, *Water as an ethic: three ways of talking about water, rights, and conflicts, in* Sharing Blue Gold: Locating water conflicts in India 1–12, 3 (Sailen Routray & N. Shantha Mohan eds., 2015).

19 SailerRoutray, *The Water Sector in India: An Overview,in* River Water Sharing: Transboundary Conflict and Cooperation in India 23 – 44, (N.Shantha Mohan, SailenRoutray, and N. Shashikumar eds., 2010).

20 Principle 2 of the Stockholm Declaration on Human Environment states that *"the natural resources*

of Rio Summit in Chapter-18 focused on the need and rights to water[21] and established that all people have the right to have access to drinking water.[22] In 1999, the General Assembly issued a resolution on "*The Right to Development*" declaring a human right to water, and linking this right to the overall right to development.[23] However, the UN Water Courses Convention (UNWC) of 1997[24] confined its concerns to the issue of "*vital human needs*"[25] but did not directly address the issue of the human right to water.[26]

In India, the Courts inferred the right to water from Article 21 of the Constitution, which guarantees the right to life. As such, this right is recognized by judicial interpretation rather than legislative action.[27] The judiciary in cases such as *Narmada Bachao Andolan* v. *Union of India,*[28] *M.C. Mehta* v. *Union of India,*[29] and *A.P. Pollution Control Board* v. *Prof. M.V. Nayadu*[30] has upheld the State's duty to provide clean drinking water to all its citizens.[31] As has been remarked by the Committee on Economic, Social and Cultural Rights, *"The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for*

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of the earth including the air, water, land, flora and fauna and especially representative samples of natural ecosystems must be safeguarded for the benefit of the present and future generations through careful planning or management, as appropriate."see Declaration of the United Nations Conference on the Human Environment, June 16, 1972, U.N. Doc. A/CONF.48/14/Rev.1, Sales No. E. 73.II.A.14 (1973).

21 Chapter 18 stated that ". . . water resources have to be protected, taking into account the functioning of aquatic ecosystems and the perenniality of the resources, in order to satisfy and reconcile needs for water in human activities. In developing and using water resources, priority has to be given to the satisfaction of basic needs and the safeguarding of the ecosystems." *See Earth Summit, Agenda 21, The United Nations Programme of Action from Rio,* U.N. ISBN 92: 92-1-100509-4; Sales No. E.93.1.11, 166 (United Nations Publication 1993).

22 *See Id.*, paragraph 18.47, at 175.

23 *See* A/Res/54/175 of December 17, 1999 (83rd Plenary Meeting), paragraph 12: *"the rights to food and clean water are fundamental human rights and their promotion constitutes a moral imperative both for national Governments and for the international community."*

24 United Nations Convention on Non-Navigational Uses of International Watercourses (1997), (May 18, 2021), https://treaties.un.org/doc/Treaties/1998/09/19980925%2006-30%20PM/Ch_XXVII_12p.pdf.

25 In determining "vital human needs", special attention is to be paid to pro- viding sufficient water to sustain human life, including both drinking water and water required for production of food in order to prevent starvation. *See* Report of the Sixth Committee convening as the Working Group of the Whole, April 11, 1997, U.N. Doc.A/51/869, at 5.

26 *See* Salman M.A. Salman & Siobhán McInerney-Lankford, The Human Right to Water: Legal and Policy Dimensions 7–44 (2004).

27 *See* Philippe Cullet, *Right to water in India - plugging conceptual and practical gaps*, 17 Int. J. Hum. Rights 56–78 (2013); Upendra Baxi, *The Human Right to Water: Policies and Rights*, *in* Water and the Laws in India 149–166 (Ramaswamy R. Iyer ed., 2009).

28 (2005) 4 SCC 32.

29 (1988) 1 SCC 471.

30 (1999) 2 SCC 718.

31 V. Narain, *Water as a fundamental right: a perspective from India*, 34 Vt. Law Rev. 917–925 (2010).

personal and domestic uses."[32]

In the *Cauvery Water Disputes Tribunal, In re*[33] the right to the flowing waters of rivers was described as a right *publici juris* or a right of the public, and the Supreme Court applied the same analogy in *Special Reference No. 1 of 2001, In re*[34] holding that people of the entire country have a stake in natural gas to be found in Gujarat.[35] Even, the Supreme Court of United States in *Kansas* v. *Colorado*[36], observed that the right to use flowing water is not an absolute, exclusive right to all water flowing past their land, such that any obstruction would constitute a cause of action; rather, it is a right to regulate the flow and enjoyment of water, subject to a similar right in all other stake holders[37] to the reasonable enjoyment of the same providential gift.

Theories and Rules of Transboundary Water Allocation: International Perspective

Late in the nineteenth century, many ideas and concepts reflecting differing state practices on the usage of international rivers and lakes began to develop, owing to the increasing significance of the water resources and conflicts surrounding them.

- *Harmon Doctrine/Absolute Territorial Sovereignty*: In 1895, Judson Harmon, Attorney General of the United States of America, propounded this doctrine while opining on the usage of the Rio Grande waters shared by the United States and Mexico. According to the doctrine, a State has the right to dispose of the waters of an international river in whatever way it sees appropriate inside its borders, without regard for the adverse impact such usage may have on other riparian nations. However, international tribunals and experts in the domain challenged and rejected this view, and the core principles of international law forbid riparian governments from harming other

32 Economic and Social Council, Committee on Economic, Social and Cultural Rights (Twenty-ninth session, Geneva, November 11–29, 2002), Substantive Issues Arising in the Implementation of the International Covenant on Economic, Social and Cultural Rights; General Comment No. 15 (2002), The right to water (arts. 11 and 12 of the International Covenant on Economic, Social and Cultural Rights, U.N. Doc. E/C.12/2002/11 (Twenty-ninth session, 2002).

33 1993 Supp (1) SCC 96 (II) .

34 (2004) 2 SCC 489.

35 Kamala Sankaran, *Water in India: Constitutional Perspectives*, *in* Water and the Laws in India 17–31, 27 (Ramaswamy R. Iyer ed., 2009).

36 206 U.S. 46 (1907).

37 Generally Riparian States.

nations and encourage collaboration and peaceful conflict settlement.[38]

- *Absolute Territorial/Riverian Integrity*: It establishes the right of a lower riparian State to demand the continuation of an international river's natural flow into its territory from the higher riparian State/s, and also imposes a responsibility on that State not to limit the natural flow of waters to other lower riparian States. This minimalizes the use by an upstream state, and it is the polar opposite of total territorial sovereignty, as it benefits downstream states by safeguarding current usage or past appropriation. Even this theory has been criticized like the Harmon Doctrine, and is not recognized as part of modern international water law.[39]
- *Limited Territorial Sovereignty/Limited Territorial Integrity*: It provides that every riparian State has the right to utilize the waters of an international river, but also lays down the responsibility to ensure that such usage does not cause injury to other riparian States. As a result, this theory limits both the preceding theories and affirms the equality of all riparian States in the usage of the international river's waters.[40] The UNWC relies on this theory as a basis for water allocation[41].
- *Community of Co-Riparian States/Interests*: The entire river basin is considered as an economic unit, and rights to the entire river's waters are devolved in the collective body of riparian nations, or shared among them either proportionally or by agreement.[42] This is an extension of the theory of limited territorial sovereignty and is ideal as it is beyond nationalism.[43]This theory can serve as a foundation for international watercourse law, as well as a principle that establishes duties of riparian states, like equitable utilization.[44] However, the riparian States believe that it forces them to reach an agreement.[45]

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38 Salman M A Salman, *The Helsinki Rules, the UN Watercourses Convention and the Berlin Rules: Perspectives on International Water Law*, (Water Resources Development, Vol. 23, No. 4, 625–640, December 2007) 627 (2007); Alistair Rieu-Clarke, Ruby Moynihan & Bjørn-Oliver Magsig, UN Watercourses Convention : User's Guide 101 (2012).

39 *Ibid* at 627; Rieu-Clarke, Moynihan, and Magsig, 37 at 102; N Kliot, D Shmueli & U Shamir, *Institutions for management of transboundary water resources: Their nature, characteristics and shortcomings*, 3 Water Policy 229–255, 232–233 (2001).

40 Salman, *supra* note 38 at 627; Rieu-Clarke, Moynihan, and Magsig, *supra* note 38 at 103–104.

41 Articles 5-6, UNWC 1997.

42 The Permanent International Court of Justice made reference to the concept in the 1929 Territorial Jurisdiction of the International Commission of the River Oder, in the context of its use as a navigable river. *See*: Judgement no. 16 (10 September 1929), PCIJ Series A, No. 23, at 5-46.

43 Salman, *supra* note 38 at 628; Rieu-Clarke, Moynihan, and Magsig, *supra* note 38 at 104–105.

44 McCaffrey Stephen C, The Law of International Watercourses 150 (2nd ed. 2007).

45 Salman, *supra* note 38 at 628.

- *Helsinki Rules*: The International Law Association (ILA) has made significant contributions to the law of international watercourses. In its 52nd Conference at Helsinki in 1966, ILA issued the Helsinki Rules[46] consisting of 36 Articles. These rules are applicable to the use of the waters of an international drainage basin,[47] which is *"a geographical area extending over two or more States determined by the watershed limits of the system of waters, including surface and underground waters, flowing into a common terminus."*[48] The Helsinki Rules entitled each basin State to *"reasonable and equitable share"* in the waters of an international drainage basin,[49] and laid down the relevant factors for such determination of the share,[50] which emphasized satisfying the needs without causing any "*substantial injury to a co-basin State.*"[51] Although these Rules do not have any legally binding effect, they have been widely accepted as representing customary international law and have major influence on UNWC also.

- *Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention)*: The Convention[52] is a legally binding instrument promoting the sustainable management of shared water resources, the implementation of the Sustainable Development Goals, the prevention of conflicts, and the promotion of peace and regional integration. The Water Convention requires Parties to prevent, control and reduce transboundary impact, use transboundary waters in a reasonable and equitable way and ensure their sustainable managementby way of cooperation, entering into specific agreements, and establishing joint bodies.

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46 The Helsinki Rules on the Uses of the Waters of International Rivers, (1966), (May 19, 2021), https://www.internationalwaterlaw.org/documents/intldocs/ILA/Helsinki_Rules-original_with_comments.pdf .

47 Article I, Helsinki Rules 1966.

48 Article II, Helsinki Rules 1966.

49 Article IV, Helsinki Rules 1966.

50 Article V, Helsinki Rules 1966; The relevant factors to be considered include, but are not limited to: (a) the geography of the basin, including in particular, the extent of the drainage area in the territory of each basin state; (b) the hydrology of the basin, including in particular the contribution of water by each basin state; (c) the climate affecting the basin; (d) the past utilization of the waters of the basin, including in particular, existing utilization; (e) the economic and social needs of each basin state; (f) the population dependent on the waters of the basin in each basin state; (g) the comparative costs of alternative means of satisfying the economic and social needs of each basin state; (h) the availability of other resources; (i) the avoidance of unnecessary waste in the utilization of waters of the basin; (j) the practicability of compensation to one or more of the co-basin states as a means of adjusting conflicts among uses; and (k) the degree to which the needs of a basin state may be satisfied, without causing substantial injury to a co-basin state.

51 Article V(2)(k), Helsinki Rules 1966.

52 It was adopted in Helsinki in 1992 and entered into force in 1996. (May 19, 2021), https://unece.org/DAM/env/water/publications/WAT_Text/ECE_MP.WAT_41.pdf

- *UN Watercourses Convention*: The UNWC 1997 consists of 37 Articles and applies to uses of international waters and for their protection, preservation, and management. Itlays down two basic principles for sharing of the transboundary water resources i.e., "*equitable and reasonable utilization*"[53] and "*not cause significant harm*"[54] to neighboring States.[55]

- *Berlin Rules*: The ILA, in its 71st Conference at Berlin in 2004,revised the Helsinki Rules and issued the detailed Berlin Rules[56] consisting of 73 Articles. Unlike the Helsinki Rules, a number of the Berlin Rules are applicable to the management of all waters, both national and international.[57] Further, it mandates each basin State to "manage"[58] the waters of an international drainage basinequitably and reasonably[59], having due regard for the obligation not to cause significant harm to other basins States.[60] The UNWC and Helsinki Rules emphasize each riparian state's entitlement to a fair and equitable share, while the Berlin Rules underline the need to manage the shared

53 The determination of equitable and reasonable utilization requires taking into account all relevant factors and circumstances, including: (a) geographic, hydrographic, hydrological, climatic, ecological and other factors of a natural character; (b) the social and economic needs of the watercourse states concerned; (c) the population dependent on the watercourse in the watercourse state; (d) the effects of the use or uses of the watercourse in one watercourse state on other watercourse states; (e) existing and potential uses of the watercourse; (f) conservation, protection, development and economy of the water resources of the watercourse and the cost of measures taken to that effect; and (g) The availability of alternatives, of comparable value, to a particular planned or existing use. *See:* Articles 5-6, UNWC 1997. India is not a party to this Convention.

54 Articles 7-8, UNWC 1997.

55 Rieu-Clarke, Moynihan, and Magsig, *supra* note 38 at 39.

56 The Berlin Rules on Water Resources, (2004), (May 19, 2021), https://www.internationalwaterlaw.org/documents/intldocs/ILA/ILA_Berlin_Rules-2004.pdf .

57 Article I, Berlin Rules 2004; These Rules express international law applicable to the management of the waters of international drainage basins and applicable to all waters, as appropriate.

58 Here manage "includes the development, use, protection, allocation, regulation, and control of the waters"; *See* Article 3(14), Berlin Rules 2004.

59 The relevant factors to be considered for determination or equitable and reasonable use include, but are not limited to: (a) Geographic, hydrographic, hydrological, hydrogeological, climatic, ecological, and other natural features; (b) The social and economic needs of the basin States concerned; (c) The population dependent on the waters of the international drainage basin in each basin State; (d) The effects of the use or uses of the waters of the international drainage basin in one basin State upon other basin States; (e) Existing and potential uses of the waters of the international drainage basin; (f) Conservation, protection, development, and economy of use of the water resources of the international drainage basin and the costs of measures taken to achieve these purposes; (g) The availability of alternatives, of comparable value, to the particular planned or existing use; (h) The sustainability of proposed or existing uses; and (i) The minimization of environmental harm. *See* Article 13, Berlin Rules 2004.

60 Article 12, Berlin Rules 2004.

watercourse in an equitable and reasonable way[61] and specifically state the obligation not to cause significant harm.[62]

The interaction between States over international transboundary river basins has typically been described as one of either conflict or cooperation.[63] But, within transboundary water interaction, conflict and cooperation coexist in differing intensities.[64] The perspective of coexisting conflict and cooperation helps to analyze situations where institution-building efforts are made, but without much change in the way water is allocated.[65] Within basins, a state with relative power over others, or 'the hydro-hegemon' can enable preferential water allocation through three main strategies: resource capture, integration and containment.[66] It is therefore important to consider the asymmetric transboundary water interactions in which hydro-hegemons apply various strategies by the use of 'soft' power,[67] to influence the decision making of water resources management and governance.[68] The *'no significant harm'* principle may be considered as the guiding principle in the resolution of interstate freshwater disputes, by balancing competing interests in order both to achieve reasonable use and prevent harm, and also having a resource-focused, rather than a state use-focused, approach to the resolution of inter- state water disputes.[69]

Water under the Indian Constitution

Under the Government of India Act 1919, irrigation was a provincial subject, while matters affecting relations of provinces were a central subject. Later, in 1937, based on

61 Salman, *supra* note 38 at 636.

62 Article 16, Berlin Rules 2004.

63 Mark Zeitoun & Naho Mirumachi, *Transboundary water interaction I: Reconsidering conflict and cooperation*, 8 Int. Environ. Agreements Polit. Law Econ. 297–316, 298 (2008).

64 Naho Mirumachi, Mark Zeitoun & Jeroen Warner, *Transboundary water interactions and the UN Watercourses Convention: Allocating waters and implementing principles*, *in* The UN Watercourses Convention in Force: Strengthening international law for transboundary water management, 355 (Flavia Rocha Loures & Alistair Rieu-Clarke eds., 2013).

65 *Ibid.* at 356.

66 Mark Zeitoun & Jeroen Warner, *Hydro-hegemony - A framework for analysis of trans-boundary water conflicts*, 8 Water Policy 435–460 (2006).

67 'Soft' power is the ideational power, unlike the coercive or bargaining power which is referred as 'hard' power. 'Soft' power is employed during formal and informal negotiations, declarations, media reports and rumors, and through the development of persuasive storylines that justify the maintenance of the status quo in the way water resources are allocated or managed.

68 Mirumachi, Zeitoun, and Warner, *supra* note 64 at 364; Mark Zeitoun, Naho Mirumachi & Jeroen Warner, *Transboundary water interaction II: The influence of "soft" power*, 11 Int. Environ. Agreements Polit. Law Econ. 159–178 (2011).

69 Tamar Meshel, *Swimming Against the Current: Revisiting the Principles of International Water Law in the Resolution of Fresh Water Disputes*, 61 Harvard Int. Law J. 135–184, 178 (2020).

the Government of India Act of 1935, irrigation was transferred to the exclusive legislative jurisdiction of the provinces.[70] The legislative framework of the Constitution related to water is based on Entry 17 of the State List,[71] Entry 56 in the Union List,[72] and Article 262 of the Constitution.[73] The Indian Constitution provides for irrigation as a State-subject and the State Governments exercise full control on planning, development, regulation, distribution, and control of water flowing through their territories. But, the power of the States is not unfettered and is subject to the power of the Center/Union with respect to regulation and development of inter-state rivers and river valleys. Further, in case of any inconsistency laws between a law made by Centre and States, the Central Legislation would prevail.[74] So far, the Parliament has not made much use of the powers vested in it by the Entry 56 of the Union List.[75] The Constitution makes a special provision regarding disputes relating to inter-State waters, by carving out an exclusion to the jurisdiction of the Supreme Court under Article 131,[76] allowing Parliament to decide the forum and manner

70 Haripriya Gundimeda & Charles W. Howeb, *Interstate river conflicts: lessons from India and the US*, 33 Water Int. 395–405, 396 (2008).

71 Entry 17 in List II (State List) in Schedule VII: Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to the provisions of Entry 56 of List-I.

72 Entry 56 of List I (Union List): Regulation and development of inter-state rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest.

73 Article 262 Adjudication of disputes relating to waters of inter State rivers or river valleys: (1) Parliament may by law provide for the adjudication of any dispute or complaint with respect to the use, distribution or control of the waters of, or in, any Inter-Stateriver or river valley. (2) Notwithstanding anything in this Constitution, Parliament may by law provide that neither the Supreme Court nor any other court shall exercise jurisdiction in respect of any such dispute or complaint as is referred to in clause (1).

74 *See* Article 254 Inconsistency between laws made by Parliament and laws made by the Legislatures of States: (1) If any provision of a law made by the Legislature of a State is repugnant to any provision of a law-made by Parliament which Parliament is competent to enact, or to any provision of any existing law with respect to one of the matters enumerated in the Concurrent List, then, subject to the provisions of clause (2), the law made by Parliament, whether passed before or after the law made by the Legislature of such State, or, as the case may be, the existing law, shall prevail and the law made by the Legislature of the state shall, to the extent of the repugnancy, be void. (2) Where a law made by the Legislature of a State with respect to one of the matters enumerated in the concurrent List contains any provision repugnant to the provisions of an earlier law made by Parliament or an existing law with respect to that matter, then, the law so made by the Legislature of such State shall, if it has been reserved for the consideration of the President and has received his assent, prevail in that State: Provided that nothing in this clause shall prevent Parliament from enacting at any time any law with respect to the same matter including a law adding to, amending, varying or repealing the law so made by the Legislature of the State.

75 Sharad K. Jain, Pushpendra K. Agarwal & Vijay P. Singh, *Constitutional Provisions, Inter-State Water Disputes and Treaties*, *in* Hydrology and Water Resources of India 1035–1064, 1036 (2007).

76 Article 131 Original jurisdiction of the Supreme Court: Subject to the provisions of this Constitution,

of resolution which has resulted in the enactment of the Inter–State River Water Disputes Act, 1956 (ISWD).[77] However, the jurisdiction under Article 131 has been invoked in certain situations.[78]

Inter-State River Water Disputes in India – Legal Framework

An intra-state river runs from its source to its mouth inside one state, while an inter-state river flows through the territory of two or more states.[79] Structures on rivers, such as dams or barrages, that interfere with natural flows; and a huge disparity in perceptions between upper and lower riparian states, are the two main factors resulting in inter-state river water disputes.[80] There is an incessant demand for more and more water by riparian states,and as the source is limited, in order to get this more water, big dams, canals and long-distant water transfers are planned, resulting in new conflicts.[81] The Inter-State River Water Disputes Act, 1956 (ISWD) and the River Boards Act, 1956 (RBA) have been enacted by the Parliament under the Entry-56 of List-I of the Constitution.

River Boards Act, 1956

The RBA contemplates the constitution of river boards by the Governments of India in consultation with State Governments. These boards are supposed to advise and promote integrated development of water resources of inter-state rivers for beneficial purposes and

the Supreme Court shall, to the exclusion of any other court, have original jurisdiction in any dispute (a) between the Government of India and one or more States; or (b) between the Government of India and any State or States on one side and one or more other States on the other; or (c) between two or more States, if and in so far as the dispute involves any question (whether of law or fact) on which the existence or extent of a legal right depends: Provided that the said jurisdiction shall not extend to a dispute arising out of any treaty, agreement, covenant, engagements, and or other similar instrument which, having been entered into or executed before the commencement of this Constitution, continues in operation after such commencement, or which pro-vides that the said jurisdiction shall not extend to such a dispute.

77 Harish Salve, Inter-State River Water Disputes, *in* The Oxford Handbook of the Indian Constitution (Sujit Choudhry, Madhav Khosla, & Pratap Bhanu Mehta eds., 2016); P. Ishwara Bhat, Constitutionalism's Challenges and Responses in the Domain of Inter-State Water Dispute Law: An Analysis Towards Enhancement of Social Acceptability, *in* Inter-State and International Water Disputes (P. Ishwara Bhat ed., 2013).

78 State of Rajasthan v. Union of India, (1977) 3 SCC 592; State of Karnataka v. Union of India, (1977) 4 SCC 608; State of Bihar v. Union of India, (1970) 1 SCC 67.

79 Jain, Agarwal, and Singh, *supra* note 75 at 1035.

80 Ramaswamy R. Iyer, Towards Water Wisdom: Limits, Justice, Harmony 107 (2007). Large projects, riparian divergences, water-security concerns, environmental impact are some of the primary reasons for inter-state river water disputes.

81 *Ibid.* at 116.

for flood control. The Board, apart from being an advisory body to Central Government is also tasked with the responsibility of preparation and implementation of schemes. Any dispute arising between two or more State Governments regarding any advice, measures taken, sharing of benefits etc., is referred to arbitration, by the arbitrator appointed by the Chief Justice of India. However, this Act envisaged the setting up of virtually powerless River Boards which are just advisory in nature, and there is no River Board constituted thereunder, virtually reducing it to a dead letter.[82]

Inter-State River Water Disputes Act, 1956

The ISWD Act deals with adjudication of disputes relating to the use, distribution or control of the waters of any inter-state river or river valley between two or more State governments.[83] Upon receiving a complaint, the Central Government[84] constitutes an Inter-state River Water Disputes (ISWD) Tribunal for the adjudication of the dispute in question.[85] There are 9 Tribunals established under the Act,[86] and the disputes in Ravi &

82 Fali S. Nariman, *Inter-State Water Disputes: A Nightmare!*, *in* Water and the Laws in India 32–57, 47 (Ramaswamy R. Iyer ed., 2009).

83 *See* ISWD Act, Section 2(c).

84 ISWD Act, Section 3.

85 ISWD Act, Section 4.

86 (1) *Godavari Water Disputes Tribunal* was constituted in April, 1969 for the States of Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh & Orissa, and the Report & Decision was given in July, 1980; (2) *Krishna Water Disputes Tribunal-I* was constituted in April, 1969 for the States of Maharashtra, Andhra Pradesh & Karnataka, and the Report & Decision was given in May, 1976; (3) *Narmada Water Disputes Tribunal* was constituted in October, 1969 for the States of Rajasthan, Madhya Pradesh, Gujarat & Maharashtra and the Report & Decision of the tribunal was given in December, 1979 and Narmada Control Authority (NCA) was constituted to give effect to the decision; (4) *Ravi & Beas Water Tribunal* was constituted in April, 1986 for the States of Punjab, Haryana & Rajasthan and the Report & Decision was given in April, 1987 but Further Report is pending; (5) *Cauvery Water Disputes Tribunal* was constituted in June, 1990 for the States of Kerala, Karnataka, Tamil Nadu & Puducherry and the Report & Decision was given on 05-02-2007. Supreme Court slightly modified the decision on 16-02-2018. Cauvery Water Management Authority (CWMA) and Cauvery Water Regulation Committee (CWRC) were constituted to give effect to the decision of CWDT as modified by the Supreme Court; (6) *Krishna Water Disputes Tribunal-II* was constituted in April, 2004 for the States of Karnataka, Andhra Pradesh & Maharashtra and the Report & Decision was given on 30-12-2010. SLPs filed are pending in the Supreme Court, and the term of the Tribunal has been extended after the bifurcation of united Andhra Pradesh State, and the matter is therefore under adjudication in the Tribunal; (7) *Vansadhara Water Disputes Tribunal* was constituted in February, 2010 for the States of Andhra Pradesh & Odisha and the Report & Decision was submitted on 13-09-2017 but Further Report is pending; (8) *Mahadayi Water Disputes Tribunal* was constituted in November, 2010 for the States of Goa, Karnataka & Maharashtra, and the Report & Decision was submitted on 14-08-2018 but Further Report is pending; and (9) *Mahanadi Water Disputes Tribunal* was constituted in March, 2018 for the States of Chhattisgarh& Odisha, and the dispute is under adjudication by the Tribunal. *See* (May 19, 2021) http://cwc.gov.in/tribunals.

Beas Tribunal (1986), Krishna Water Disputes Tribunal-II (2004), Vansadhara Water Disptues Tribunal (2010), Mahadayi Water Disputes Tribunal (2010) are yet to reach as final decision, whereas, the decision is awaited in Mahanadi Water Disputes Tribunal (2018).[87] The ISWD tribunal investigates the matter and forwards a Report to Central Government,[88] with its decision, which may be modified upon reference by the Central or State Government.[89] The decision becomes final and binding after it is published in Official Gazette by Central Government and is implemented by formulating a scheme.[90] Subsequent to the amendment of 2002, the decision of ISWD tribunal has the same force as an order of the Supreme Court.[91] Further, any court, including the Supreme Court does not have jurisdiction in respect of water disputes.[92] However, there is a bar of reference to the Tribunal, regarding any matter which may be referred to arbitration under the River Boards Act, 1956.

The Sarkaria Commission,[93]in its Report of 1988 remarked that there is inordinate delay on an average of 10 years at every stage of the ISWD Tribunal starting from the setting up of the Tribunal, the announcement of award to the implementation of the award. Further, the Union Government cannot do anything to appoint a Tribunal on its own motion, even if it is aware of the existence of an inter-State water dispute. Also, if any State refuses to give effect to the decision fully or even partially, the Union Government does not have any means for enforcement. The Report suggested that a tribunal's verdict be elevated to the stature of a Supreme Court decision by proper legislation or constitutional modification. The ISWD Amendment Act 2002 adopted recommendations of the Commission and put it into action.[94]

87 Sayanangshu Modak & Ambar Kumar Ghosh, *Federalism and Interstate River Water Governance in India*, Obs. Res. Found. Ocas. Pap. No.294, 4 (2021), (May 4, 2021), https://www.orfonline.org/research/federalism-and-interstate-river-water-governance-in-india/); *See* (May 19, 2021), http://cwc.gov.in/tribunals.

88 ISWD Act, Section 5(2).

89 ISWD Act, Section 5(3).

90 ISWD Act, Section 6.

91 ISWD Act, Section 6A.

92 ISWD Act, Section 11.

93 With a view to reviewing the working of the existing arrangements between the Union and the States in the changed socio-economic scenario, the Government constituted a Commission vide Ministry of Home Affairs Notification No.IV/11017/1/83-CSR dated June 9, 1983 under the Chairmanship of Justice R.S. Sarkaria with Shri B. Sivaraman and Dr. S.R. Sen as its members. The Commission after conducting several studies, eliciting information, holding discussions and after detailed deliberations submitted its report in January 1988. The report contains 247 recommendations spread over 19 Chapters. Chapter-17 of the Report dealt with Inter-State River Water Disputes. The Report is available at http://interstatecouncil.nic.in/SARCOMM.htm (last visited May 19, 2021).

94 G. B. Reddy, *Effective Resolution of Inter-State Water Disputes in India-Lessons to be Learnt and Unlearnt*, *in* Inter-State and International Water Disputes (P. Ishwara Bhat ed., 2013).

The National Commission to Review the Working of the Constitution (NCRWC) appointed by the Government of India under the chairmanship of Justice M.N.Venkatachalaiah has also looked into various aspects of the inter-State water disputes in the eighth chapter of its Report.[95] It expressed anguish on the inordinate delay caused in constituting the Tribunals, delay in passing awards, framing of schemes or plans for giving effect to the decisions followed by judicial review by Supreme Court. The Commission also recommended to amend the ISWD Act and confer the exclusive jurisdiction to the Supreme Court to avoid adjudication by two forums. The increase in friction between States, the underutilization of water resources, caused by delays are hindering the timely development of the nation.[96]

Supreme Court and ISWD Act

The Supreme Court of India has played an essential role in resolving many types of inter-state water conflicts within the constraints set by the Constitution. In *Cauvery Water Disputes Tribunal, In re:,*[97] the Apex Court held that an ordinance made on inter-State water dispute by State is *"beyond the legislative competence of the State and is, therefore, ultra vires the Constitution."* It was also clarified that an ISWD Tribunal is competent to grant any interim relief to the parties to the dispute when a reference for such relief is made by the Central Government, and also that the Supreme Court has an authority to decide the limits, powers and the jurisdiction of the Tribunal constituted under the Act.

In *State of Karnataka* v. *State of Andhra Pradesh and Ors.,*[98] it was held that matter of inter-state river water dispute which was not covered by the decision of Tribunal could not be implemented by the Supreme Court. Further, in *State of Haryana* v. *State of Punjab and Ors.,*[99] it was held that, where the State Governments have entered into an agreement on the intervention of the Prime Minister and withdrawal of the pending suits in the court, they cannot be permitted to take a stand contrary to the agreements. Also, in *The Punjab Termination of Agreement Act, 2004, In re:,*[100] the Court held that an enactment of the State cannot nullify the judgment, terminate the agreement arrived through the ISWD, and such act would be considered ultra vires the Constitution of India.

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95 *Report of the National Commission to Review the Working of the Constitution* (2002), (May 19, 2021) http://lawmin.nic.in/ncrwc/finalreport/v1ch8.htm.

96 Reddy, *supra* note 94.

97 1993 Supp (1) SCC 96 (II).

98 (2000) 9 SCC 572.

99 (2002) 2 SCC 507.

100 (2017) 1 SCC 121.

In *State of Orissa* v. *Government of India and Ors.,*[101] the Supreme Court observed that the bar of its jurisdiction in respect of any water dispute between two or more States comes into play only when Water Disputes Tribunal is constituted and water dispute is referred to the said Tribunal, and not otherwise. The Court considering that the ISWD Tribunal was not constituted in spite of the application, assumed jurisdiction under Article 32 of the Constitution. It held that it had ample powers to pass interim order in an inter-state river water dispute till a ISWD tribunal is constituted and the bar under Section 11 of ISWD Act would apply only once the tribunal is constituted, and water dispute is referred to it.

In *State of Himachal Pradesh* v. *Union of India and Ors.,*[102] it was observed that Article 131 of the Constitution does not prescribe any period of limitation within which a State or the Union of India had to file a dispute in the Court. It considered the claim of power for loss of land and water under the Bhakra-Nangal and Beas Projects as maintainable, since the States of Punjab and Haryana were carved out of the composite State of Punjab, and the right to share the power generated is covered under the jurisdiction of Article 131. However, recently in *State of Tamil Nadu* v. *State of Karnataka and Ors.,*[103] where a suit was filed by Tamil Nadu under Article 131 against Karnataka and the Union of India with respect to the use of the waters of the river Pennaiyar which is an inter-state river without making an application under the ISWD Act, the Supreme Court directed to the state to make an appropriate application invoking the powers of the Central Government and to seek constitution of an ISWD Tribunal.

Further, the Apex Court in *State of Karnataka* v. *State of Tamil Nadu and Ors.,*[104] clarified the extent of the bar to its jurisdiction under Article 262 of the Constitution. The Court pointed out that under Article 262 the bar to its jurisdiction only applies to taking cognizance of an original water dispute or complaint and does not apply to any appeal under Article 136[105] against an order of a duly constituted Tribunal with original jurisdiction to adjudicate such a water dispute. The Supreme Court held that the phrase *"same force as an order or decree"* cannot be construed as a decree for the purpose of excluding the Supreme Court's jurisdiction, and that Section 6 of the ISWD Act was not intended to impose any restrictions

101 (2009) 5 SCC 492.

102 (2011) 13 SCC 344.

103 (2019) SCC OnLine SC 1471.

104 (2017) 3 SCC 362.

105 Article 136 Special leave to appeal by the Supreme Court: (1) Notwithstanding anything in this Chapter, the Supreme Court may, in its discretion, grant special leave to appeal from any judgment, decree, determination, sentence or order in any cause or matter passed or made by any court or tribunal in the territory of India. (2) Nothing in clause (1) shall apply to any judgment, determination, sentence or order passed or made by any court or tribunal constituted by or under any law relating to the Armed Forces.

on the Court's jurisdiction under Article 136. Hence, the Supreme Court has retained jurisdiction in Appeal under Article 136.

Recently, in *The State of Karnataka and Ors.* v. *State of Tamil Nadu and Ors.,*[106] the Court categorically held that the drinking water requirement of the overall population of all the States to be placed on a higher pedestal as a hierarchically fundamental principle of equitable distribution. The Court observed that the inter-state river constitutes a national asset and no single State can claim exclusive ownership of its water, and applied the '*principle of equitable apportionment*'. The court referred to the Helsinki Rules, Campione Rules and Berlin Rules and National Water Policy, and remarked that the sharing of river basins should not result in substantial injury to any State. The Court, in this case, reaffirmed its jurisdiction under Article 136.

Inter-State River Water Dispute – Recent Developments

National Water Policy, 2012

The Policy emphasizes on the need to evolve a National Framework Law governing the exercise of legislative, executive powers by the Centre, the States, and the local governing bodies.[107] It emphasizes on scientific planning on river basin/sub-basin basis[108] and establishment of basin authorities, comprising party States, with appropriate powers to plan, manage and regulate the utilization of water resource in the basins.[109] Also, a drafting committee has been constituted in November 2019 to revise the current National Water Policy.[110]

Draft National Water Framework Bill, 2016

This Bill envisaged the enactment of the National Water Framework Act,[111] to overcome major problems of litigation relating to interstate water resources. The Government appears to have taken cognizance of factors like the human interventions such as over-extraction of groundwater in the immediate vicinity of a river, destruction of catchment areas and river flood-plains which have very negatively impacted river flows in India, the

106 (2018) 4 SCC 1.

107 National Water Policy, (2012) para 2.3.

108 *Ibid.* para 1.2(viii).

109 *Ibid.* para 2.3.

110 Draft National Water Policy, Ministry of Jal Shakti, Press Release, (2020), (May 19, 2021), https://pib.gov.in/PressReleasePage.aspx?PRID=1607166.

111 The Draft Bill was circulated to States / UTs for comments, however, no progress has been witnessed on it subsequently. *See* (May 15, 2021) https://pib.gov.in/PressReleasePage.aspx?PRID=1607166.

Supreme Court's recognition that fundamental right to water is integral to the right to life, and that the existing legal provisions governing water have aggravated its unsustainable and iniquitous extraction creating a serious water crisis and denying access to water for life for large numbers of people.[112] If this Bill with many effective provisions for resolution of inter-state water disputes was enacted, it could have certainly prevented the litigation and resolved many ongoing disputes.

The Inter-State River Water Disputes (Amendment) Bill, 2019

The ISWD Amendment Bill of 2019[113] seeks to replace the dispute resolution mechanism under the ISWD Act. The Bill proposes that when a State puts in a request regarding any water dispute, the central government will set up a *Disputes Resolution Committee (DRC)*, to resolve the dispute amicably. The DRC will comprise of a chairperson, and experts with at least 15 years of experience in relevant sectors, to be nominated by the central government. It will also comprise one member from each State (at Joint Secretary level), who are party to the dispute, to be nominated by the concerned State Government. The DRC will seek to resolve the dispute through negotiations, within one year, extendable by six months, and submit its report to the central government. This is an endeavour towards a negotiated settlement of the disputes by establishing a pre-litigation mechanism.

If a dispute cannot be settled by the DRC, the central government will refer it to the ISWD Tribunal, within three months from the receipt of the report from the DRC. Further, the Bill proposes to constitute a standalone *Permanent Inter-State River Water Disputes Tribunal*, having multiple Benches, comprising of 1 Chairperson, 1 Vice-Chairperson, 3 Judicial Members and 3 Expert Members. The dispute is to be assigned to a Bench by Chairman, and the Tribunal shall give its decision within 2 years extendable by 1 year. If the matter is again referred for further consideration, the Tribunal shall give its decision within 1 year, extendable by 6 months. Also, the requirement of publication of the final decision in the Official Gazette is removed, and the decision of the Bench of the Tribunal will be

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112 *See* The Statement of Objects and Reasons of the Draft National Water Framework Bill, 2016 Dated 18th July, 2016. The Bill *inter alia* also categorically recognizes the inter-use, intra-State and inter-State conflicts and the need for a national consensus on water-sharing principles, and the arrangements for minimising conflicts and settling them quickly without resort to adjudication to the extent possible. Available at: (May 15, 2021) http://jalshakti-dowr.gov.in/sites/default/files/Water_Framework_18July_2016%281%29.pdf.

113 The Inter-State River Water Disputes (Amendment) Bill, 2019 (Bill No.187-C of 2019) was introduced in Lok Sabha on July 25, 2019 by the Minister of Jal Shakti, Mr. Gajendra Singh Shekhawat, and was passed by Lok Sabha on July 31, 2019. Available at: (May 19, 2021) https://prsindia.org/files/bills_acts/bills_parliament/Inter-State%20River%20Water%20Disputes%20bill%20as%20passed%20by%20LS.pdf.

final and binding on the parties. A single agency to maintain a data bank and information system, by way of a transparent data collection system at the national level for each river basin is proposed to speed up the adjudication of water disputes. However, the inefficiency in interstate water dispute resolutions extends to factors beyond the functioning of the tribunals.[114]

Draft River Basin Management Bill, 2018

The draft River Basin Management Bill[115] proposes optimum development of inter-state rivers by facilitating inter-state coordination, ensuring scientific planning of land and water resources, taking basin/sub-basin as a unit with unified perspectives of water in all its forms (including soil moisture, ground and surface water), and ensuring comprehensive and balanced development of both catchment and commingled water. It proposes establishing 13 River Basin Authorities[116] for the country's major river basins, including inter-state river basins. The River Basin Authority consists of a Governing Council[117]and an Executive Board.[118] The Governing Council is to resolve dispute by the method of persuasion, conciliation and mediation within 12 months, and the Executive Board is to administer decisions. If the Authority fails to resolve a dispute reference is to be made to ISWD Tribunal. This Bill also proposes to repeal River Boards Act, 1956 from date of its notification.

Dam Safety Bill, 2019

The Dam Safety Bill[119]provides for the surveillance, inspection, operation, and maintenance

114 These are linked to legal ambiguities, an institutional vacuum for implementing awards, noncompliant States, politicisation and also the constitutional anomaly, or the exception to the Supreme Court's jurisdiction. *See* Srinivas Chokkakula, *The Water Tribunal Trap*, The Hindu (2015),(May 5, 2021), https://www.thehindu.com/opinion/op-ed/water-tribunals-mired-in-delay/article7275527.ece.

115 (May 19, 2021), https://prsindia.org/files/bills_acts/bills_parliament/Draft%20River%20Basin%20Management%20Bill,%202018.pdf.

116 Schedule-I Inter-State River Basin under the Act (see Section 10): The inter-State river basins for which River Basin Authorities are to be constituted under this Act include: I. Brahmaputra, Barak and other inter-State rivers of North East; II. Brahamani-Baitarini basin; III. Cauvery basin; IV. Ganga basin; V. Godavari basin; VI. Indus Basin; VII. Krishna basin; VIII. Mahanadi basin; IX. Mahi basin; X. Narmada basin; XI. Pennar basin; XII. Subarnekha basin; XIII. Tapi basin.

117 Governing Council comprises of Chief Ministers and Water Ministers of Basin States.

118 Executive Board comprises of a Chairman nominated by the Central Government, Administrative Secretaries of the State and Experts.

119 The Dam Safety Bill, 2019 was introduced in the Lok Sabha on July 29, 2019 and passed by the Lok Sabha on August 02, 2019. Available at: (May 19, 2021) https://prsindia.org/files/bills_acts/bills_parliament/Dam%20Safety%20Bill, %202019.pdf.

of all specified dams[120] across the country and was introduced in the Lok Sabha under Article 252.[121] The Bill provides for dam safety regulatory and monitoring authorities at the national[122] and state[123] levels. The functions of the National Committee on Dam Safety, the National Dam Safety Authority, and the State Committee on Dam Safety are provided in Schedules to the Bill.[124]

Conclusion

State identities have proven too strong, and instead of planning across borders for the best use of a river basin's available water resources, the path taken has been to allocate shares in a river among the States involved, either through inter-state agreements or through tribunal adjudication, and then leave it up to each state to use its share within its borders.[125] however, with better water management, it seems probable that each of the

120 These are dams with height more than 15 metres, or height between 10 metres to 15 metres with certain design and structural conditions.

121 Article 252 Power of Parliament to legislate for two or more States by consent and adoption of such legislation by any other State: (1) If it appears to the Legislatures of two or more States to be desirable that any of the matters with respect to which Parliament has no power to make laws for the States except as provided in Articles 249 and 250 should be regulated in such States by Parliament by law, and if resolutions to that effect are passed by all the House of the Legislatures of those States, it shall be lawful for Parliament to pass an Act for regulating that matter accordingly, and any Act so passed shall apply to such States and to any other State by which it is adopted afterwards by resolution passed in that behalf by the House or, where there are two Houses, by each of the Houses of the Legislature of that State. (2) Any Act so passed by Parliament may be amended or repealed by an Act of Parliament passed or adopted in like manner but shall not, as respects any State to which it applies, be amended or repealed by an Act of the Legislature of that State.

122 At the national level, it constitutes (i) the National Committee on Dam Safety, whose functions include evolving policies and recommending regulations regarding dam safety, and (ii) the National Dam Safety Authority, whose functions include implementing policies of the National Committee, and resolving matters between State Dam Safety Organisations (SDSOs), or between a SDSO and any dam owner in that state. The central government may notify the qualifications, and functions of the officers of the National Dam Safety Authority.

123 At the state level, it constitutes the (i) State Dam Safety Organisations (SDSOs), whose functions include keeping perpetual surveillance, inspecting, and monitoring dams, and (ii) State Committee on Dam Safety which will supervise state dam rehabilitation programs, review the work of the SDSO, and review the progress on measures recommended in relation to dam safety, among others. State governments may notify the qualifications, and functions of officers of the State Dam Safety Organisations. They may also notify dam safety measures to be undertaken by owners of non-specified dams.

124 Their functions include: (i) resolving issues between State Dam Safety Organisations (SDSOs), or between a SDSO and a dam owner, (ii) assessing potential impact of dam failure and coordinating mitigation measures with affected states, and (iii) supervising dam rehabilitation programmes.

125 Ramaswamy R. Iyer, *Indian Federalism and Water Resources*, 10 Int. J. Water Resour. Dev. 191–202, 193 (1994).

contending parties can make do with much less water than it thinks it needs.[126] There is not a single real river basin authority in India. The current condition of interstate river water governance in India warrants a new approach for cooperative federalism and interstate water governance. In terms of identifying a unit of governance, river basins are the most appropriate.[127] It is about time to create a paradigm that views water as a basic right to be distributed equitably, as a major component of the environment, and as source of multiple livelihoods, rather than a natural resource to be effectively allocated.[128]

For the success of the Jal Jeevan Mission or major projects like the linking of rivers, Ganga rejuvenation, etc., it is essential to shift the focus from conflict resolution to enabling cooperation.[129] States should engage in negotiation for resolution of the water use issues and the prospect of hydropower development to prevent further disputes and clashes.[130] As an alternative, state mediation offers the best chance at this reconciliation because it would allow both the states to take charge of the proceedings while the mediator would only facilitate dialogue between them.[131] Greater centre-state coordination is crucial for the success of the ISWD Amendment Bill and Dam Safety Bill and there is an imminent need to move towards a robust federal water governance ecosystem.[132] Also, the riparian states and the Union government have to take a political decision on the effective use of available waters in the region.[133] Further, the steps taken at the union level are extremely important in forcing all actors to acknowledge the need for change, and there is a need for more proactive role of the Centre in its legal, policy, and institutional dimensions.[134] Dr. B.

126 Iyer, *supra* note 80 at 116.

127 Modak and Ghosh, *supra* note 87 at 18.

128 Philippe Cullet, Lovleen Bhullar & Sujith Koonan, *Inter-Sectoral Water Allocation and Conflicts Perspectives from Rajasthan*, 1 Econ. Polit. Wkly. 61–69 (2015).

129 Srinivas Chokkakula, *Interstate River Water Governance : Shifting the Focus from Conflict Resolution to Enabling Cooperation*, Policy Challenges 2019-2024: The Key Policy Questions for the New Government and Possible Pathways 118–121 (2019).

130 Tamiris Askarova, *The Need for Negotiation in Water Resource Disputes between Central Asian States*, 21 Cardozo Journal. Confl. Resolut. 663–690, 689–90 (2020).

131 Iram Majid, *A perpetual tussle over Water Resources: An inevitable need for Inter-State mediation in Inter-State Water Disputes*, SCC Blog (2021), (May 4, 2021), https://www.scconline.com/blog/post/2021/03/27/a-perpetual-tussle-over-water-resources-an-inevitable-need-for-inter-state-mediation-in-inter-state-water-disputes/.

132 Srinivas Chokkakula, *Centre, states must seize opportunity to come together for water governance*, The Indian Express, November 19, 2020, (May 19, 2021), https://indianexpress.com/article/opinion/columns/river-water-disputes-amendment-bill-water-conservation-governance-7056512/.

133 Amit Ranjan, *Inter-State River Water Disputes in India: A Study of Water Disputes Between Punjab and Haryana*, 65 Indian J. Public Adm. 830–847, 15 (2019).

134 Philippe Cullet, *Governing water to foster equity and conservation: Need for new legal instruments*, 51 Econ. Polit. Wkly. (2016); N. R. Madhava Menon, *Toward a National Framework Law on Water for India*, 5 World Bank Leg. Rev. 231–244 (2014).

R. Ambedkar was also in favour of "*more positive participation by the Centre*" and emphasized that Central Government should ensure that inter-state projects benefiting more than one state were not affected by difficulties in arriving at an agreement between the states.[135]

It is gratifying to note that some headway has been made in recent times to link inter-state rivers.[136] Probably, a negotiated settlement of all the issues raised by the concerned states by using the good offices of the Central Government could resolve many of the inter-state water disputes in India.

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135 P Abraham, *Notes on Ambedkar's Water Resources Policies*, 37 Econ. Polit. Wkly. 4772–4774, 4773 (2002).

136 The National Perspective Plan (NPP) was prepared by the then Ministry of Irrigation (now Ministry of Jal Shakti) in August 1980 for water resources development through inter basin transfer of water, for transferring water from water surplus basins to water-deficit basins. Under the NPP, the National Water Development Agency (NWDA) has identified 30 links (16 under Peninsular Component and 14 under Himalayan Component) for preparation of Feasibility Reports (FRs). *See* (May 3, 2021), https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1705795.

Chapter 15
Water Conservation and Usage in Indian Agriculture

Dr. Misha Bahmani* Yashdeep Lakra**

Abstract

Recently the Times Water Summit of 2020 has depicted that there is an urgent need to conserve water in India. Sadly, depleting water levels has been a major concern. It is essential to conserve and make proper usage of water. The agricultural land needs protection, which can be done only when water conservation policies maintain uniform standards. The vegetation depends on the adequate use of water and its proper distribution. It is a crucial time for the Indian government to take drastic measures to save agricultural land. The water demand supply needs to be managed by the government to secure water usage in agricultural land. Usage of rainwater and dam should be environment-friendly.

Water and food are the ultimate reasons for human survival there is a need to maintain balance so that it doesn't also affect the climate. India requires efficient technology, which protects natural resources. The Indian policymakers, agricultural community, and the people of this nation need to maintain an ecosystem where effective actions and progressive awareness programs can support its conservation.

***Keywords**: Agricultural Sector, Climate, Conservation, Technology, Water Usage.*

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Introduction

Recently the World Water Day has been celebrated on 22nd March of 2021 worldwide. Unfortunately, due to the COVID-19 pandemic, the situation has gotten worse across the globe. People have been deprived of open access to natural resources due to strict lockdown guidelines. In a developing nation like India, proper utilization of water needs to be valued. The Indian government needs to encourage awareness programs so that the Indian population who are deprived of safe water can have access to it for their personal use. Almost 2.2 billion population globally is deprived of safe water.[1] It is essential to "value water" in real practice in India in the coming years so that there can be proper distribution of water.[2] Interestingly the livelihood of humans depends on the growth of the agricultural sector. About 1.37 billion Indian people are is facing many challenges due to the water crisis. Significantly 78 percent of water is utilized for agricultural activities this reflects irrigation depends on the availability of water supply.[3] The Central Water Commission has estimated that there will surge in the use of water by 2050. Sadly, this will reduce the water supply for irrigation to 68 percent which is expected to cause more difficulty for the agricultural sector.[4] World Resources Institute in their report has clarified that there is water stress which India needs to overcome. It is suggested that only by "improving water use efficiency" India can protect this sector.[5]

Due to the water crisis, Indian farmers have been facing difficulty in surging their production level and have badly impacted the agricultural sector by making the process costlier.[6] This has poorly affected the population in dry areas. As a result, people have been deprived of their livelihood because of water deprivation in these areas. This has brought many families below the poverty line due to poor irrigation systems.[7] Currently, there is

1 Debjani Chatterjee, *World Water Day 2021: Theme, History and 10 Key Water facts,* NDTV (Mar. 22, 2021), https://www.ndtv.com/india-news/world-water-day-2021-theme-history-and-10-key-water-facts-2396075.

2 *Explained: Why is World Water Day celebrated?,* The Indian Express (Mar. 22, 2021), https://indianexpress.com/article/explained/explained-why-is-world-water-day-celebrated-7239803/.

3 Preeti Kapuria & Rohan Saha, *Water a binding constraint for agriculture in India*, Observer Research Foundation (Feb. 28, 2020), https://www.orfonline.org/expert-speak/water-a-binding-constraint-for-agriculture-in-india-61823/.

4 Bharat R. Sharma et al., *Water Productivity Mapping of Major Indian Crops*, NABARD (2018), https://www.nabard.org/auth/writereaddata/tender/1806181128Water%20Productivity %20Mapping%20of%20Major%20Indian%20Crops,%20Web%20Version%20(Low%20Resolution%20PDF).pdf.

5 *Id.*

6 R G Agarwal, *Water Management key to Sustainable Agriculture growth in India*, Financial Express (Mar. 14, 2019), https://www.financialexpress.com/opinion/water-management-key-to-sustainable-agriculture-growth-in-india/1515331/.

7 Agarwal, *supra* note 6.

a need to focus on food security along with crop quantity and quality so that India can achieve its sustainable development goals. Water scarcity has caused adversely impacted farmers' livelihood.[8] The Times Water Summit has recently pointed out that India is at a drastic stage, it needs to have a water-saving system. NITI Aayog has estimated in its report that 40 percent of the Indian population will not have drinking water by 2030.[9] India has been ranked 120th among 122 nations in the water quality index.[10] Also, the unposition of lock down during the COVID-19 pandemic has adversely impacted society across India due to its huge population. The ecosystem needs to be managed with an active initiative of nongovernmental and government organizations for securing water bodies.[11] Climate change has resulted in dwindling of adequate water bodies due to global warming. There has been a spur in migration which has resulted in the expansion of the water crisis. Due to this, lifeline of rural as well as urban areas would be badly disturbed.[12] India is the "biggest groundwater user" and its deterioration will lead to an ecological imbalance.[13] Unfortunately, water scarcity and decreasing rainfall are forcing Indian farmers to grow other crops which have negatively impacted their income and crop quality also.[14]

Indian Government Initiatives

The Pradhan Mantri Krishi Sinchayee Yojana has been one of the major initiatives to provide "water for every farm". It also emphasizes "more crop per drop" which has been among their prime goals. One needs to maintain the efficiency of this natural resource it can be valued

8 Kapuria, *supra* note 3.

9 *Composite Water Resources Management: Performance of States*, NITI AAYOG (2018), https://niti.gov.in/sites/default/files/2019-06/Final%20Report%20of%20the%20Research%20Study%20on%20%20Composite%20Water%20Resources%20Management%20Index%20for%20Indian%20States%20conducted%20by%20Dalberg%20Global%20Development%20Advisors%20Pvt.%20Ltd_New%20Delhi.pdf.

10 *World Water Day: India is 3rd largest groundwater exporter, but 21 cities are running out of water by 2020*, India Today(Mar. 22, 2019), https://www.indiatoday.in/science/story/world-water-day-2019-water-crisis-india-1483777-2019-03-22.

11 *Times Water Summit 2020: It's still not late in saving India from becoming a waterless country if we start acting on it now!,* The Economic Times(Nov. 30, 2020), https://economictimes.indiatimes.com/news/economy/policy/times-water-summit-2020-its-still-not-late-in-saving-india-from-becoming-a-waterless-country-if-we-start-acting-on-it-now/articleshow/79439424.cms.

12 *High and Dry: Climate change, Water, and the Economy*, The World Bank(Mar. 20, 2021), https://www.worldbank.org/en/topic/water/publication/high-and-dry-climate-change-water-and-the-economy.

13 *Supra* note 11.

14 Bibhudatta Pradhan & Pratik Parija, *India' s Water crisis is forcing farmers to finally rethink what they grow*, The Print(Jul. 22, 2021), https://theprint.in/india/indias-water-crisis-is-forcing-farmers-to-finally-rethink-what-they-grow/465770/.

in reality.[15] Water conservation and focusing on its management is the ultimate goal of the Indian government by introducing this program. Since 2015 this initiative has been taking place by amalgamating "Accelerated Irrigation Benefit Programmes" and "Integrated Watershed Management Programme."[16] With the help of the District Irrigation Plan and State Irrigation Plan, the Agriculture Ministry has been focusing on water provisions. It includes facilities confining to drinking water, sanitation, application of science as well as technology, etc.[17] Moreover, encouragement is given to indulge in activities that promote "water conveyance" as well as provide clarity in using water application devices. Devices such as sprinklers, rain guns, drips, etc. should be preferred. It needs to promote agronomic steps and scientific moisture conservation for water.[18] Earlier about 75 percent of the Mahatma Gandhi National Rural Employment Guarantee Act funds have been used for its conservation. There is a need to address poor groundwater recharge to stop pluvial flooding from occurring in the near future.[19]

Present

Indian micro-irrigation system has been using a drip facility by 1.80 Lakh Ha and Sprinkler has focused on 2.88 Lakh Ha with the support of "Pradhan Mantri Krishi Sinchayee Yojana" from 2020 to 2021.[20] India has its own "India Water Tool" website which provides support to the companies as well as the users to demarcate the water difficulties which India is coming across lately. This guides the companies to understand the water risk involved in running their corporate operations around India.[21] Unfortunately, 60 percent of the Indian land is facing a shortage in the water supply due to the absence of an effective water management system.[22] The focus has been made on cultivating diversified crops, improving water supply for paddy crops, and aims in maintaining transparency in subsidy disbursal. Due to the COVID-19 pandemic, the Indian agriculture sector has been facing difficulties in implementing government schemes concerning agricultural land and water supply.[23]

15 Department of Agriculture, Cooperation & Farmers Welfare, *PMKSY*, PMKSY, https://pmksy.gov.in/.

16 *Ibid.*

17 Department of Agriculture, Cooperation & Farmers Welfare, *About PMKSY*, PMKSY, https://pmksy.gov.in/AboutPMKSY.aspx.

18 *Ibid.*

19 Bhitush Luthra & Kowshik Ganesh, *City water plans: How to get more data smart*, Down To Earth, (Mar. 22, 2021), https://www.downtoearth.org.in/blog/water/city-water-plans-how-to-get-more-data-smart-76067.

20 *Supra* note 15.

21 *About*, INDIA WATER TOOL, https://www.indiawatertool.in/.

22 Agarwal, *supra* note 6.

23 Anuj Agnihotri, *Punjab: 75% fall in registrations under Capt govt's ambitious 'Pani Pachao, Paisa Kamao'*

Usage of the system of rice intensification, direct-seeded rice, alternate wetting, and drying technique has been considered as appropriate methods for irrigation.[24] By indulging in the micro-irrigation method in India, at present there is a need to have a demand-based system that would improve the outcome of this method.[25] Unfortunately, the World Economic Forum of 2020 highlighted concern on overexploitation of groundwater that has taken place in Punjab because of subsidies provided to farmers in that state.[26] The water bodies are drying out a which has caused depletion of groundwater. Deforestation caused by development projects has lowered the level of groundwater.[27]

The Living Planet report has illustrated that the water kingdom has been badly affected due to water contamination.[28] This reflects that not only the water but also the growth of other natural resources is affected. There is an urgent need to have governmental policies, for the ecosystem. The "Make India Water Positive" initiative has indulged in the establishment of the unified water system and awareness concerning using better techniques for water-saving.[29] Nearly 600 million of India's population is currently under water stress. It is estimated by National Commission that the water requirement by 2050 will be 1,180 BCM. This illustrates that at present India needs to encourage water usage sparingly. It would be interesting to see how the composite water management index records the performance of the states in water-saving. Data system and proper coordination mechanism would be a great support for governing water system[30] The tree cover, grazing, and cropland should be safeguarded from excessive use. Water supply can result in new crop varieties, food security impacts biodiversity growth, and livestock production.[31] India despite being a member of FAO, OIE, and IPPC requires environment-friendly steps to preserve its natural atmosphere.

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scheme, THE INDIAN EXPRESS (Sep. 18, 2020, 10:48 PM), https://indianexpress.com/article/india/75-fall-in-registrations-under-capt-govts-ambitious-pani-bachao-paisa-kamao-scheme-6594098/.

24 Dr Arabinda Kumar Padhee, *Repurposing public policies for Sustainable Water Management in Indian Agriculture*, ICRISAT (Feb. 28, 2020, 2:30 PM), https://www.icrisat.org/repurposing-public-policies-for-sustainable-water-management-in-indian-agriculture/.

25 *Ibid.*

26 *Intentivizing Food systems transformation*, WORLD ECONOMIC FORUM (Jan., 2020), http://www3.weforum.org/docs/WEF_Incentivizing_Food_Systems_Transformation.pdf.

27 Vikram Soni, *World Water Day: With Burgeoning threats, Water conservation needs urgent action!*, THE WEATHER CHANNEL (Mar. 22, 2021, 12:15 PM), https://weather.com/en-IN/india/environment/news/2021-03-22-water-conservation-needs-urgent-action.

28 WWF, *Living Planet Report 2020 Blending the curve of biodiversity*, ZSL (2020), https://www.zsl.org/sites/default/files/LPR%202020%20Full%20report.pdf.

29 *Supra* note 11.

30 *Supra* note 9.

31 Hinz H. et al., *Agricultural Development and Land Use Change in India: A Scenario analysis of Trade-Off between UN Sustainable Development Goals,* ADVANCING EARTH AND SPACE SCIENCE (Feb., 2020), https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029 /2019EF001287.

Biotechnology, pre and post-harvest, energy-saving technology should be used. India has been an agricultural products exporter but the COVID-19 pandemic has promoted the Indian government to be self reliant through the "Atmanirbhar Bharat Abhiyan" to make itself efficient. About 48 percent of irrigation land is at subject to government schemes and reforms must focus on soil conservation, efficient water usage, and healthy soil management.[32] About 60 percent of the water supply is used for crop cultivation where rice, as well as sugar, uses 24 percent of it.[33]

Fortunately, common area development, moisture conservation, floor protection, and watershed management have been beneficial for the protection of water resources by the central government. By participating in awareness programs which include workshops, seminars, etc. can promote rainwater harvesting activities.[34] It is essential that funding and implementation methods should be more practical. "Interlinking of River Programme" has been brought to provide water supply in areas affected by rain-fed and drought.[35] Recycling of water and canal seepage, automated irrigation methods should be used. Moreover, agricultural engineering methods should be adopted to avoid water scarcity.[36] For instance, National River Conservation Plan has been followed to prevent river pollution.[37] The water reservoirs and proper water distribution can balance soil and water conservation. By maintaining international and uniform standards which encourage the right amount of water supply for cultivation Indian authorities should permit its implementation. For instance, in Andhra Pradesh, its government has welcomed proper use of canals, reservoirs, and water security.[38]

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32 Nushrat Hassan & Yosham Vardhan, *Agricultural Law in India: Overview*, THOMSON REUTERS (Oct. 1, 2020), https://uk.practicallaw.thomsonreuters.com/1-604-1046?transitionType=Default&contextData=(sc.Default)&firstPage=true.

33 Soutik Biswas, *India election 2019: How sugar influences the world's biggest vote*, BBC NEWS (May 8, 2019), https://www.bbc.com/news/world-asia-india-48173677.

34 Ministry of Jal Shakti, *Steps taken by the Central Government*, JAL SHAKTI, http://jalshakti-dowr.gov.in/sites/default/files/Steps_to_control_water_depletion_Feb2021.pdf.

35 Ministry of Jal Shakti, *Interlinking of Rivers*, MOWR, http://mowr.gov.in/schemes-projects-programmes/schemes/interlinking-rivers.

36 Ministry of Water Resources, *National Water Policy (2012)*, JAL SHAKTI, http://jalshakti-dowr.gov.in/sites/default/files/NWP2012Eng6495132651_1.pdf.

37 Ministry of Environment, Forest & Climate Change, *National River Conservation Plan*, NRCD, https://nrcd.nic.in/writereaddata/FileUpload/23617950NRCP%20Backgrpund.pdf.

38 Government of Andhra Pradesh, *Welcome to Water Resources Department*, IRRIGARION NAP, https://irrigationap.cgg.gov.in/wrd/home.

Water-Saving Matters

The National Geophysical Research Institute study illustrates that India will be facing the largest depletion of groundwater soon where Delhi would be the most affected area.[39] The data depicts that by 2030, due to water scarcity, the Indian GDP will be reduced by 6 percent. Unfortunately, 70 percent of groundwater has been utilized. This has worsened the availability of water supply for the future generation. It is suggested that there should be an establishment of water infrastructure which could solve the water crisis from ground level. Crop quality, as well as its quantity, can be improved only when there is an adequate presence of water for cultivation.[40]

Farmers must produce crops which are appropriate as per regional requirement. This will save framers from excessive wastage of money. Water being a state subject, the state governments should act more pro-actively and are responsible to manage the water resources.[41] Crop cultivation should be balanced with changing ecological circumstances. Due to climate change, availability of water has varied which has resulted in wastage of water, affected the soil quality, and burdened the farmers to invest in uncertain futures where there is depletion of groundwater. Agricultural water can be the source to make the Indian economy stronger by welcoming effective methods which promote water conservation. It should indulge in collecting rainwater through tanks and reservoirs. Rainwater can be reused by following efficient techniques such as setting up barrels for collecting rainwater. However, there is a need to have a proper management system so that there can't be any water wastage due to its limited capacity. By following dry systems in homes the tanks are required to be placed next to the premises so that they can be utilized when required. The use of gully plug dug well recharge, groundwater dams, and percolation tank can be beneficial to rural areas for rainwater harvesting purposes.[42] There is an urgent need to have optimal use of water by using better irrigation methods such as rotational grazing. It is also the responsibility of every human to stop ourself from excess use of water. For everyday living, water should be used appropriately. Production of organic food would result in maintaining healthy soil. This would help in recharging the groundwater supply by 20 percent.[43] Interestingly compost, as well as mulch, helps in improving water holding strength. Also, by following the irrigation scheduling method one can prevent crops

39 Agarwal, *supra* note 6.

40 *Ibid.*

41 Kapuria, *supra* note 3.

42 *The best Rainwater Harvesting methods*, UGAOO (Jun. 29, 2016), https://www.ugaoo.com/knowledge-center/rainwater-harvesting-techniques/.

43 *10 ways Farmers are saving water*, CUESA (Aug. 15, 2014), https://cuesa.org/article/10-ways-farmers-are-saving-water.

underwatering as well as overwatering.[44] To stop land degradation as well as desertification Indian farmers should use solar pumps. The Indian government should maintain a check on the performance of Indian policies and programs such as the National Rural Employment Guarantee Scheme, Neeranchal, etc. This shows watershed management system needs to be practical. [45] Participatory irrigation management and usage of treated sewage can be a great support for the improving current situation in Indian agricultural land. World Bank has supported the "Paani Bacho, Paise Kamao" project for saving water and encouraging people to earn money from this project. The use of communication technology can aid in following effective traditional irrigation methods, setting up PVC water conveyor pipes, properly managed underground pipeline system, and enhancing remote sensing system the soil and the land can be protected.[46] India needs to develop a sustainable management system that could distribute natural resources adequately.[47]

Climate change and water insecurity need to be resolved by better policies. Droughts and floods can make the situation worse therefore water allocation and its efficiency depend on water saving investment.[48] Good water management can increase the country's GDP by 2050. Water scarcity is a climate challenge that can be cured by optimal utilization.[49] With centralized policy, it is hoped that India can control and manage water usage. Developed water purification technology, equal division, groundwater preservation, surface water availability can result in the availability of water for irrigation.[50] Water should be judiciously used and its quality should be maintained. The agricultural sector need better infrastructure for water management. This will protect the nation from unexpected events concerning overexploitation of natural resources and the survival of the human race.[51] The COVID-19 pandemic has depicted the major gaps of particular the Indian agricultural policy. The migrant farmworkers in play a vital role in crop production. Unfortunately this pandemic has caused a rise in cost and excessive water usage for maintaining hygiene.[52] Irrigation efficiency and water productivity support in achieving this sustainable development goal. Indian agricultural land requires a water accounting mechanism, minimal soil usage, crop

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44 *Ibid.*

45 Padhee, *supra* note 24.

46 *Ibid.*

47 Padhee, *supra* note 24.

48 *Supra* note 12.

49 Schuyler Bull, *Water is the Climate Change, says World Bank,* News Scurity Beat (May 6, 2016), https://www.newsecuritybeat.org/2016/05/water-climate-challenge-world-bank/.

50 *Supra* note 11.

51 *Id.*

52 R. Ramakumar, *Agriculture and the Covid-19 Pandemic: An Analysis with Special Reference to India,* 10 Rev. of Agrarian Studies 72, 103-104 (2020).

rotation method, agroecological systems which would be a great effort to balance the distribution of water among different activities for surging crop production.[53]

Conclusion

Recently the government has initiated the "Catch the Rain" campaign for harvesting rainwater under National Water Mission. Under this, every state needs to have its rain centers which would provide technical guidance for collecting rainwater in those states.[54] The authorities are required to be more cautious and must indulge in proper advocacy skills, implementation stricter of water policies by local self-government. [55] The water crisis needs to be taken seriously before it is too late. There is an urgent need to have water wastage monitored in order to safeguard farmers' interests. The groundwater table needs to be maintained and protected from excessive use. Water-saving techniques need to be at a reasonable price so that farmers can afford them. Cost and environment-friendly technology should be utilized for water usage and its conservation.[56] There should not be any water storage encroachments. One needs to focus on properly treating sewage water and energy cost should be low. For watershed purposes, one should encourage the use of rubber dams, manage urban wastewater flow and step-wells should be maintained for open access. India must value water for economic valuation, sanitation, and growth in the agricultural sector to safeguard everyone.[57] The government must maintain an effective irrigation mechanism and drainage system which can be possible with the support of an adequate funding process.[58]

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53 *Water usage, policies and technological interventions in the field of agriculture in India*, GRAMWORKX (Apr. 1, 2020), https://gramworkx.medium.com/water-usage-policies-and-technological-interventions-in-the-field-of-agriculture-in-india-8a41c9682270.

54 Ministry of Jal Shakti, *Catch the Rain*, NWM, http://nwm.gov.in/?q=catchtherain.

55 Agarwal, *supra* note 6.

56 Agarwal, *supra* note 6.

57 *Water Development Report, explores Water's value,* IISD (Mar. 22, 2021), http://sdg.iisd.org/news/water-development-report-explores-waters-value/.

58 *Water in Agriculture*, The World Bank (May 8, 2020), https://www.worldbank.org/en/topic/water-in-agriculture.

Chapter 16
Ground Water Crisis on The Frontlines in India – Shift from Groundwater Management to Groundwater Governance

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Abstract

India is the world's largest user of groundwater with 40% of country's water-needs being satisfied by groundwater. However, over exploitation of groundwater resources have depleted the groundwater table and brought India on the frontlines of a groundwater crisis. In order to effectively restore the groundwater table, the perspective should be shifted from groundwater management to groundwater governance. The two main principles of groundwater governance are: (i) local participation on large scale and effective community efforts; and (ii) institutionalized support through effective laws and regulations and proactive judiciary. Further, groundwater governance also requires a shift from resource-based approach to source-based approach. The authors in this paper provide an analysis of the legal and policy framework, and the role played by the judiciary relating to groundwater. It also discusses the success story of Kerala in restoring groundwater table through the use of effective technology and community participation. The authors conclude the paper by providing recommendations and suggestions that should form the backbone of legal and policy framework relating to groundwater restoration, conservation and preservation.

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Introduction

Over exploitation of groundwater resources and consequent depletion of groundwater levels in India are rapidly bringing India closer to a groundwater crisis. In such a situation, a coherent understanding of the exact legal position with respect to the Indian groundwater system is imperative to undertake concrete steps in that direction. It not only helps in tracing the methodologies adopted by the administration to deal with the crisis but also helps in implementing effective techniques to strengthen the legislative stance to deal with the imminent ground water crisis. There are many laws and regulations and even judicial pronouncements in this respect. However, the adequacy and efficiency of the same is in question. What we need to realise is that environmental concerns cannot be solved alone by a legislative or executive framework but requires local participation at the ground level. It requires a perspective shift in public policy formulation. It is imperative that groundwater must be seen as a decentralised resource requiring customised methodologies and regulations for its conservation and restoration.

The authors in the present paper, firstly, provide a brief insight on the need to conserve groundwater as a resource for India as the country is on a frontline of a water crisis. Secondly, the authors analyse the existing legislative and judicial framework for groundwater management. The legislative analysis deals with Constitutional provisions and the Water (Prevention and Control of Pollution) Act. The judiciary of the country has been at the forefront by recognising groundwater as a part of Article 21 and the Government has taken several initiatives like the Aquifer Management Programme and the Atal Bhujal Yojana in order to preserve and restore groundwater levels. These initiatives have been dealt with by the authors extensively. Thirdly, the authors provide an analysis of the current regulations and laws that are recently passed by the Parliament and are debated such as the Guidelines to Regulate and Control Ground Water Extraction in India, 2020. Even though it is a laudable step, it does not completely solve the problem of groundwater governance. Fourthly, the authors highlight the lacunae in the existing legal framework to identify why the problem still exists even after the comprehensive legislative and judicial framework. The authors also stress the urgent need to change the law and policy framework developed for dealing with the groundwater crisis. Fifthly, the authors have surveyed the success story of Kerala in dealing with the problem of groundwater crisis by using rainwater syringe technique for deep aquifers and recharging groundwater using the Mazhapolima technique. Lastly, the authors conclude the paper with recommendations and the way forward.

The need to Conserve - The Tragedy of Groundwater Commons

A nation that inhabits 20% of the world's population is at the frontlines of a water crisis and is running almost out of water.[1] India is the largest user of groundwater resources. It caters to almost 40% of the India's water supply needs out of which approximately 90% is used for drinking purposes and irrigation.[2] A major portion (40%) of urban as well as rural population depend on groundwater for their needs.[3] About 50% of the water supply in urban areas comes from groundwater.[4] Along with groundwater levels, the other surface water sources are also running below normal water levels making the crisis even more severe.[5]

The NITI Aayog Report of 2018 estimated that about 21 cities in India, including the metropolitans like Delhi, Bengaluru and Chennai, will run out of ground water by 2020.[6] Having reached the upper limit of the prescribed time as stipulated in the report, it is imperative that India shifts its approach of dealing with the crisis from groundwater management to groundwater governance.[7]

In the light of this situation, it is imperative to understand the three factors resulting in groundwater crisis. They are: (i) Depletion of groundwater table levels; (ii) exploitation of aquifers; and (iii) contamination of groundwater sources by elements like Fluoride, Arsenic and other geogenic and anthropogenic sources. Effective management of Groundwater resource requires extenuation of all these factors.[8]

Legal Framework Relating to Groundwater in India

As a subject matter for legislation, groundwater, *per se*, does not find any mention in the VII Schedule of the Constitution. However, it can be related to Entry 17 read with Entry

1 P S Vijay Shankar et al., *India's Groundwater Challenge and the Way Forward*, 46 E.P.W. (2011), http://www.indiaenvironmentportal.org.in/files/groundwater.pdf.

2 Neeta Deshpande, *The Tragedy of the Groundwater Commons*, India Water Portal (Dec. 2015), https://www.indiawaterportal.org/articles/tragedy-groundwater-commons.

3 Asit K. Biswas & Kris Hartley, *From Evidence to Policy in India's Groundwater Crisis*, The Diplomat (July 2017), https://thediplomat.com/2017/07/from-evidence-to-policy-in-indias -groundwater-crisis/.

4 Deshpande, *supra* note 2.

5 *Ibid.*

6 NITI Aayog, Ministry of Jal Shakti & Ministry of Rural Development, Composite Water Management Index (2019), https://niti.gov.in/sites/default/files/2019-08/CWMI-2.0-latest.pdf.

7 *Ibid.*

8 Daniel Aguilar, *Groundwater Reform in India: An Equity and Sustainability Dilemma*, 46 Texas Int'l L.J. 623, 624 (2011).

6 of List II of Constitution of India.[9] Further, the parliament does not have the power to legislate for states for matters regarding pollution or conservation of water except for as provided in article 249 and 250 of the Constitution.[10] The reason for the same can be that the Constitution makers could not have foreseen that that water depletion could reach such a severe crisis.[11]

However, by the exercise of article 252, the Water (Prevention and Control of Pollution) Act, 1974[12] came into force. However, the Act does not explicitly mention 'groundwater'. The nearest interpretation that can be drawn is by reference to the which states that the Act is for "*the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water*",[13] which can include groundwater in its ambit. Additionally, the definition of "stream" as mentioned in Section 2(j)(iv)[14] of the Act includes sub-terranean waters, which again takes groundwater within the preview of the Water Act.[15]

The establishment of Central Ground Water Board[16] and subsequently Central Ground Water Authority, after the judicial decision of *M.C. Mehta v. Union of India*,[17] have been milestones that have triggered the series of guidelines regarding groundwater depletion and exploitation as a major issue that requires urgent attention. However, looking at the severity of the issue, what we need are groundwater management and conservation requiring specific and personalised techniques which cannot be taken in the purview of domestic legislation.

9 India Const. sched. VII, list I, entry 56 ("Regulation of development of inter-state rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest.") & entry 17 r.w. entry 6 of list II ("Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to the provisions of entry 56 of List I").

10 India Const. art. 249 (Power of Parliament to legislate with respect to a matter in the State List in the national interest).

11 Rema Devi, *Groundwater Development and Legal Regulation*, 38 J.I.L.I. 614 (1991).

12 Water (Prevention and Control of Pollution) Act, 1974 (hereinafter the Water Act, 1974).

13 The Water Act, 1974 pmbl. ("An Act to provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water, for the establishment, with a view to carrying out the purposes aforesaid, of Boards for the prevention and control of water pollution, for conferring on and assigning to such Boards powers and functions relating thereto and for matters connected therewith...").

14 The Water Act, 1974 §2(j)(iv).

15 *Ibid.*

16 Devi, *supra* note 11.

17 M.C. Mehta v.Union of India, (1997) 11 SCC 312.

Right to water is an inalienable part of right to clean and healthy environment under Article 21 of the Constitution as elucidated by Supreme Court in numerous cases.[18] The Courts in the country have played an active role with respect to restoration of groundwater and identifying the conservation process as a part of State's duty.[19] The landmark case of *Indian Council for Enviro Legal Action v. Union of India*,[20] has displayed the proactive stance of Supreme Court in protecting groundwater. In this case, the hon'ble Apex Court applied 'polluter pays principle' to address groundwater contamination.[21]

Recently the Supreme Court, while looking into the unauthorised construction in Delhi that effected the groundwater resources, emphasised the need of alternatives that would not degrade groundwater resource.[22] The Court while adopting this approach applied 'public trust doctrine',[23] which has been accepted in environmental matters in several cases like *MC Mehta v. Kamal Nath*[24] *and Fomento Resorts and Hotels Ltd. v. Minguel Martins*.[25]

The High Courts have also exhibited enthusiasm while deciding on cases concerning groundwater conservation and restoration.[26] In the case of *Wasim Ahmed Khan v. Government of Andhra Pradesh*,[27] the Andhra Pradesh High Court ruled that since safe water is a fundamental right of every citizen and it cannot be denied at any cost and hence set up a committee to supervise matters of groundwater pollution.[28] Similarly, the Madras High Court, in 2019, called for immediate action in a case concerning illegal tapping of groundwater for commercial purposes.[29]

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18 Vrinda Narain, *Water as a Fundamental Right: A Perspective from India*, 34 Vermont L. Rev. 917, 920 (2010).

19 Sayantari Sen & Meenakshi Mandal, *India's Groundwater Woes: Fight for Resortation and Remedation*, 3 E.L.S.J. 6 (2015).

20 Indian Council for Enviro-Legal Action v. Union of India, (1996) 3 SCC 212; Indian Council for Enviro-Legal Action v. Union of India, (2011) 8 SCC 161.

21 Narain, *supra* note 18.

22 MC Mehta v. Union of India, Unreported Judgements, W.P. (Civil) No. 4677 of 1985, decided on 14 August 2020 (SC).

23 Jayant Boruah & Farzin Naz, *Groundwater Management Under Indian Legal Framework*, 1 Indraprastha L. Rev. 1 (2020).

24 MC Mehta v. Kamal Nath (1997) 1 SCC 388.

25 Fomneto Resorts and Hotels Ltd. v. Minguel Martins (2009) 3 SCC 571.

26 Boruah & Naz, *supra* note 23.

27 Wasim Ahmed Khan v. Government of Andhra Pradesh, 2002 (5) ALT 526.

28 *Ibid*.

29 Mrs. Sheela v. The District Collector, Madras High Court, Unreported Judgement, W.P. No. 15304 of 2019, decided on Oct. 04, 2019 (Mad. HC); *See also Madras HC to state: Bring law to curb illegal water extraction*, Times of India (Oct. 13, 2019), https://timesofindia.indiatimes.com/city/chennai/hc-to-state-bring-law-to-curb-illegal-water-extraction/articleshow/71560234.cms.

Additionally, a positive shift has been noticed in the groundwater conservation process since the establishment of the National Green Tribunal ("NGT"). The Tribunal in a plethora of decisions has stressed on the importance of groundwater management and conservation and focused on the implementation procedures in order to tackle the groundwater crisis in a systematic way.[30]

For instance, the case of *Janardan Kundalikrao Pharande v. MoEF*[31] emphasised on the need to submit an action plan by the industry to control contamination.[32] The action plan must contain the remediation mechanism for doing good the contamination caused by the industry in order to preserve the fundamental rights of the citizens living in the nearby areas.[33] Furthermore, in the case of *Raghunath Lokhane v. MPCB*,[34] the Tribunal employed the 'precautionary principle'[35] while dealing with matters of groundwater contamination because the complex system of groundwater makes it difficult to ascertain the level of pollution even with the latest technology.[36] The Tribunal also stated that it is essential to have a plan for implementation of remedial actions as the "*the precautionary principle denotes a duty to prevent harm, when it is within our power to do so, even when all the evidence is not available*".[37]

Similarly, in the case of *Mahesh Chandra Saxena v. Central Pollution Control Board*,[38] the NGT

30 Sen & Mandal, *supra* note 19.

31 Janardan Kundalikrao Pharande v. MoEF, Unreported Judgements, Application No. 7(THC)/2014(WZ), decided on May 05, 2014 (NGT).

32 *Ibid.*

33 *Ibid.*

34 Raghunath Lokhane v. MPCB, Unreported Judgements, M.A.145 of 2014 in Application No. 11(THC)/2013, decided on: Sept. 24, 2014 (NGT); *See also* Shri Sant Dasganu Maharaj Shetkari Sangh Akolner v. Indian Oil Corporation Ltd., Unreported Judgements, Application No 42/2014, decided on Nov. 10, 2014 (NGT).

35 Ian G. Steward et al., *Groundwater Contamination Science and the Precautionary Principle, in* ADVANCES IN GEO-ETHICS AND GROUNDWATER MANAGEMENT: THEORY AND PRACTICE FOR A SUSTAINABLE DEVELOPMENT 17, 21 (M Abrunhosa et al. eds., 2021), https://link.springer.com/chapter/10.1007/978-3-030-59320-9_4#citeas.

36 *Ibid*.

37 Vellore Citizens Welfare Forum v. Union of India, (1996) 5 S.C.C. 647; *See also* M.C. Mehta v.Union of India, (1998) 2 S.C.R. 530; M.C. Mehta v. Kamal Nath, (1997) 1 Suppl. S.C.C. 388; S. Jagannath v. Union of India, (1997) 2 SCC 87; A.P. Pollution Control Board. v. Prof. M.V. Nayudu, 2000 S.C.A.L.E. 354.

38 Mahesh Chandra Saxena v. Central Pollution Control Board, Unreported Judgements, O.A. No. 526 of 2019, order dated May 31, 2019 (NGT), *See also Order of the National Green Tribunal Regarding Groundwater Recharge not Being Done Scientifically, Resulting in Contamination of Groundwater, 31/05/2019*, INDIA ENVIRONMENT PORTAL (May 31, 2019), http://www.indiaenvironmentportal.org.in/content/464157/order-of-the-national-green-tribunal-regarding-groundwater-recharge-not-being-done-scientifically-resulting-in-contamination-of-groundwater-31052019/.

in 2019 noted that the groundwater recharge techniques including rainwater harvesting structures which are not constructed in a scientific manner causing groundwater contamination must be checked and properly installed to make sure the conservation and restoration process is efficient.[39]

Various decisions of the Courts and Tribunals have emphasised on the point that it is extremely essential to identify the source of pollution in order to frame an effective and scientific remediation technique.[40] The Courts have also pointed that groundwater pollution is extremely severe as it becomes very challenging to estimate the exact pollution level and the extent of it in order to take appropriate action.[41]

Therefore, we see a proactive role of the judiciary in preserving groundwater resources.[42] However, we need to realise that the efforts of judiciary standing alone cannot help in resorting groundwater levels. What is required is an amalgamation of legislative, judicial and local efforts in achieving the results.[43]

Policy Initiatives

Apart from the judicial decisions and the existing legal framework, various policy initiatives have been taken by both Central and State Governments, from time to time, to accelerate conservation of groundwater in India.

The Government of India implemented the 'Aquifer Management Programme' in order to address the issue of management of aquifers and groundwater in India.[44] Apart from the national initiative, various successful community-based initiatives have been adopted by Andhra Pradesh, Rajasthan and Gujarat have indicated that the groundwater conservation requires collaboration and community participation to be efficient.[45]

To further strengthen and accelerate the efforts of conservation, the Government of India

39 *Ibid*.

40 Aguilar, *supra* note 8.

41 Gitanjali Nain Gill, *Environmental Justice in India: The National Green Tribunal and Expert Members*, 5 Transnat'l Envtl. L. (2016).

42 Boruah, *supra* note 23.

43 Institute for Resource Management and Economic Development, Institutional Framework for Regulating Use of Groundwater in India (2008) http://cgwb.gov.in/INCGW/Kamta%20Prasad%20report.pdf.

44 Himanshu Kulkarni, *The Key to Successfully Managing Groundwater in India*, India Water Portal (Mar. 23, 2014), https://www.indiawaterportal.org/articles/key-successfully-managing-groundwater-india.

45 *Ibid.*

and the Jal Shakti Ministry launched the 'Atal Bhujal Yojana'.[46] The scheme aims to fortify the "*institutional framework of administering groundwater resources and aims to bring about behavioural changes at the community level for sustainable groundwater resource management*".[47] The plan is a central government scheme which is funded by world bank with the objective of resorting the condition of aquifers in the country and improve the management of groundwater.[48] The scheme has within its ambit, the seven targeted states of Madhya Pradesh, Gujarat, Rajasthan, Uttar Pradesh, Haryana, Karnataka and Maharashtra. It is because these states are facing a severe groundwater crisis.[49] Therefore, the aim of the scheme is to restore the Water User Associations (WUAs) financially.[50]

Even though these initiatives are laudable steps towards conservation, they are not sufficient.[51] There are various perspectives that need to be considered while devising a mechanism for groundwater management.[52] While conservation is necessary, the demands of the farmers for irrigation must also be taken into consideration. Therefore, balance must be drawn in order to meet the competing demands.[53] This dichotomy was resolved in Punjab by employing an innovative solution, wherein there was a gradual reduction of subsidies as well an offer of cash compensation to the farmers for every unit of electricity saved.[54] In Andhra Pradesh the practice of community level management and sharing of borewells has ensured equitable distribution of waters.[55]

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46 *Atal Bhujal Yojana*, Ministry of Jal Shakti, http://jalshakti-dowr.gov.in/schemes/atal-bhujal-yojana (last visited Aug. 6, 2021).

47 *Ibid*.

48 Lok Sabha Secretariat, Reference Note, *Atal Bhujal Yojana*, No. 04/RN/Ref./January/2020.

49 *What is Atal Bhujal Yojana: All You Want to Know About Atal Jal Scheme*, The Times of India (Dec. 25, 2019), https://timesofindia.indiatimes.com/india/what-is-atal-bhujal-yojana-atal-jal/articleshow /72964373.cms.

50 Hency Thackrey *"Effective Groundwater management in India"* The CSR Journal (Feb 6, 2020) https:// thecsrjournal.in/effective-groundwater-management-in-india/.

51 Manisha Shah & Nikita Deshpande, *Understanding Atal Bhujal Yojana Through the Program Guidelines*, India Water Portal (Aug. 10, 2020), https://www.indiawaterportal.org/articles/understanding-atal-bhujal-yojana-through-program-guidelines.

52 *Why it is Critical to Involve People in Solving Water Woes*, Hindustan Times (Jan. 30, 2018), https://www. hindustantimes.com/editorials/why-it-is-critical-to-involve-people-in-solving-water-woes/ story-i1EjHFhCMfXhddWNLeizIJ.html.

53 *Ibid*.

54 M Dinesh Kumar & A Narayanmoorthy, *New Era of Pervasive Agricultural Subsidies?*, The Hindu (Aug. 13, 2019), https://www.thehindubusinessline.com/opinion/columns/new-era-of-pervasive-agricultural-subsidies/article29085634.ece.

55 *Manging India's Groundwater Woes- A Prescription for Policy Makers and the Industry*, Economic Times (Oct 5, 2020), https://energy.economictimes.indiatimes.com/news/renewable/opinion-managing-indias-groundwater-woes-a-prescription-for-policymakers-and-the-industry/78499050.

Another hindrance that is usually encountered even after implementation of various initiatives, has been that of financing.[56] In order to overcome this obstacle, financing strategies are required that can be both economically and environmentally friendly.[57] For example, the idea of establishment of a regulatory authority is conceptualised in order to observe the water management aiming to promotes a trade model for recycling and reuse of wastewater and setting of a cap on the use of water by various entities.[58] The World Bank report titled, "*Grow in Concert with Nature: Sustaining East Asia's Water Resources through Green Water Defense*",[59] talks about a similar idea which has been adopted in the Murray-Darling basin in Australia which allows the user to use a certain volume of water for a fixed period of time, which is determined according to the rainfall pattern.[60] Similar, "cap-and-trade model" can be used as a sustainable market tool for encouraging the water conservation and usage in the country.[61]

The New Regulatory Regime

Apart from the initiatives, the discussion on groundwater has stirred again with the new guidelines passed by the Central Government.

The order passed by the National Green Tribunal in July, 2020 mandates that Central Groundwater Authority has the power to exercise overriding effect by the issuance of statutory regulatory orders.[62] The order also stated that all the permissions related to groundwater withdrawal must be made in time and quantity bound manner, i.e., after

56 Kulkarni, *supra* note 44.

57 *Ibid*.

58 EU Water Directors, Common Implementation Strategy for the Water Framework Directive and the Floods Directive: Guidelines on Integrating Water Reuse into Water Planning and Management in the context of the WFD, 2016, https://ec.europa.eu/environment/water/pdf/Guidelines_on_water_reuse.pdf.

59 Xiaokai Li et al., Grow in Concert with Nature: Sustaining East India's Water Resources Management Through Green Water Defense (2012), https://elibrary.worldbank.org/doi/abs/10.1596/978-0-8213-9588-2.

60 *Ibid*.

61 *Managing India's Groundwater Woes- A perspective for Policymakers and the Industry*, Economics Times (Oct. 5, 2020), https://energy.economictimes.indiatimes.com/news/renewable/opinion-managing-indias-groundwater-woes-a-prescription-for-policymakers-and-the-industry/78499050.

62 Vishwa Mohan, *Centre Notifies Revised Guidelines for Groundwater Use; Prohibits New Industries, Mining Projects in 'Over Exploited Zones'*, Times of India (Sept. 26, 2020), https://timesofindia.indiatimes.com/india/centre-notifies-revised-guidelines-for-ground-water-use-prohibits-new-industries-mining-projects-in-over-exploited-zones/articleshow/78326470.cms.

conducting a proper environmental impact assessment.[63] The order further stipulated and mandated the installation of various mechanism such as digital flow meters, audit for tracking compliance of groundwater condition and the publication of these compliance reports, in order to foster of conservation of groundwater resource.[64]

In order to tackle the crisis, there are various legislations in place. Recently, the Ministry of Jal Shakti has issued guidelines titled, "*Guidelines to regulate and control ground water extraction in India*"[65] in response to the NGT order passed in July, 2020.[66] The notification mandates that no Non-Objection Certificates ("NOC") shall be issued to new industries, except Micro, Small and Medium Enterprises ("MSME"), for operating in over-exploited assessment units and limits the amount of water that can be drawn by mandating industries to submit water audit reports to CGWA.[67] It aims to reduce groundwater exploitation by 20% at least in next 3 years.[68]

There can be issues with the compliance of the above-mentioned rules given that the guidelines demand a certain level of investment to be made by the industries or other commercial establishments.[69] However, a long-term sustainable development and economic perspective demands that the industries and commercial establishments exploiting groundwater must take steps so as to avoid any unnecessary regulatory or statutory compliance cost in the future.[70] In order to do so, the industries must adopt technologies that are water efficient and should also focus on developing water recycling and reuse projects.[71] These practices can be adopted both at an individual industry level as well at a collective industry level.[72] Along with these measures, commercial entities must

63 Gireesh Chandra Prasad & Japnam Bindra, Prathma Sharma, *NGT Sets Tough Conditions for Commercial Use of Groundwater*, LiveMint (July 28, 2020), https://www.livemint.com/news/india/ngt-sets-tough-conditions-for-commercial-use-of-groundwater-11595902152868.html.

64 *Ibid*.

65 Central Ground Water Authority, Guidelines to Regulate and Control Ground Water Extraction in India, S.O. 3289(E) (Issued on Sept. 24, 2020).

66 Mohan, *supra* note 62.

67 Central Ground Water Authority, Guidelines to Regulate and Control Ground Water Extraction in India, S.O. 3289(E) (Issued on Sept. 24, 2020).

68 *Ibid.*

69 *Ibid*.

70 Alvar Closas & Karen G. Villholth, *Groundwater Governance: Addressing Core Concepts and Challenges*, 7 Wires Water e1392 (2019), https://onlinelibrary.wiley.com/doi/abs/10.1002/wat2.1392.

71 Kirstin I. Conti & Joyeeta Gupta, *Global Governance Principles for the Sustainable Development of Groundwater Resources*, 16 Int'l Envtl. Agreements Pol. L. Econ. 849, 871 (2016).

72 Aarti Kelkar Khambete & Harshvarshan Dhawan, *Decentralised Groundwater Governance to Deal with the Groundwater Crisis*, India Water Portal (Feb. 17, 2020), https://www.indiawaterportal.org/articles/decentralised-groundwater-governance-way-ahead-deal-current-groundwater-crisis-india.

explore alternative surface-water systems in order to fulfil their demands in a sustainable manner.[73]

The Government, on the other hand, must also employ technology to facilitate the process of conservation.[74] The guidelines should also provide for a real time monitoring system that overlooks the withdrawal levels. The development of such central database system requires the cooperation of institutions at all levels.[75] The database can involve development of a dashboard that not only indicate the level of groundwater withdrawn for industrial needs but also indicate the quality of water in the stressed areas. Additionally, the establishment or revision of rules or guidelines for reuse of treated wastewater can further the process of conservation.[76]

Regardless of these considerations, the guidelines provide a framework. However, the efficiency of the guidelines shall be tested with time.[77] What is imperative to understand is that along with stricter norms, due consideration must be given for building financing structures so that the economic factor does not come in way while determining the best mechanism for conservation.[78] Adoption of a "planned, time-bound and strategic approach" can facilitate the process of conservation.[79]

Apart from these, guidelines have been adopted by states as well. Attention can be drawn to the recent rules legislated by Uttar Pradesh.

The State Pollution Control Boards work for the revival of Groundwater levels and the States too recognising the need to do so adopt guidelines.[80] This was seen in Uttar Pradesh, where the dropping levels of groundwater alarmed the governments.[81] The state accounts

73 Bruno Conicelli et al., *Groundwater Governance: The Illegality of Exploitation and Ways to Minimise the Problem*, GeoSciences (2021), https://www.scielo.br/j/aabc/a/7c6553Hqb9FsK8nz4cMZJPh/?lang=en.

74 Conti & Gupta, *supra* note 71.

75 Swati Bansal, *New Groundwater Guidelines Prohibit Industries and Mining in Over-exploited Zones*, India Water Portal (Oct. 8, 2020), https://www.indiawaterportal.org/articles/new-groundwater-guidelines-prohibit-industries-and-mining-over-exploited-zones.

76 *Ibid*.

77 *Ibid*.

78 Closas & Villholth, *supra* note 70.

79 Conti & Gupta, *supra* note 71.

80 Planning Commission, Government of India, "*Evaluation Study on the functioning of State Pollution Control Boards*" https://niti.gov.in/planningcommission.gov.in/docs/reports/peoreport/peoevalu/index.php?repts=peopoll1.htm

81 Kushagra Dixit, "*GB Nagar groundwater table depletes again, worst decline in Greater Noida's Gulistanpur*" The Hindustan Times (24 July 2020) https://www.hindustantimes.com/noida/gb-

for 82 overexploited, 47 critical and 151 semi critical blocks.[82] In order to regulate the usage of the groundwater, the Uttar Pradesh cabinet approved the "*Uttar Pradesh Groundwater (Management and Regulation) Rules, 2020*".[83]

The Rules contain a different regulatory mechanism at different levels, at state, district, block and village or municipal level. At every level, the Rules provide for punishment for exploitation of groundwater resources.[84] It further categorised various areas as 'notified' and 'non-notified' wherein all the users of groundwater have to register themselves to the prescribed authorities.[85] Additionally, there is capping on the usage of groundwater for commercial, infrastructure or any other industrial or bulk user along with a designated fee for their usage.[86] Any contravention to the prescribed conditions shall be subjected to fines ranging from Rs. 2 to 20 lakh and/or imprisonment with a term ranging from six months to seven years depending on whether it is a first, second or third offence.[87]

Issues and Challenges Relating to Groundwater Management

Having studied various legislative enactments and judicial pronouncements, we see that there is a robust framework. So, the essential question is that why are the levels still depleting and where is the wrong? According to us, the problem exists because the current mechanism of management does not support equitable collaboration between the federal institution and the state agencies for dealing the groundwater crisis.[88] What we require, other than robust legislative and enforcement mechanism, is a more decentralised and local level support for addressing the imminent threat at hand.[89]

The problem is even when the threat of 'no groundwater' situation is imminent and near, the schemes and projects like Atatl Bhujal Yojana and Jal Shakti Abhiyan provides a generic solution to the problem across various regions and since groundwater levels are not same in

nagar-groundwater-table-depletes-again-worst-decline-in-greater-noida-s-gulistanpur/story-mCg1rURcYaZVzQCsG683eK.html.

82 Conti & Gupta, *supra* note 71.

83 *UP Draws up Rules to Regulate Groundwater Usage, Fixes Fines for Violations*, Hindustan Times, (Feb. 12, 2020), https://www.hindustantimes.com/cities/up-draws-up-rules-to-regulate-groundwater-usage-fixes-fines-for-violations/story-XYYiJqF3VihwZm3cG4xYNO.html.

84 Uttar Pradesh Ground Water (Management and Regulation) Rules, 2020.

85 *Ibid*.

86 *Ibid*.

87 *Ibid*.

88 Henry Vaux, *Groundwater Under Stress: The Importance of Management*, 62 Envtl. Earth Sci. 19, (2011).

89 Sharon B. Megdal, *Invisible Water: The importance of Good Groundwater Governance and Management*, 1 N.P.J. Clean Water 15 (2015).

all the regions, such solutions can prove to be not so effective.[90] The present issue involves invention of new techniques which are personalised as per the demands of the region and the physiographic situation of the region.[91] An example for the same is illustrated below.

Case Study: Story of Kerala's Groundwater Restoration

Around 50% of the urban population and 80% of the rural population in Kerala are dependent on groundwater via open wells for their needs.[92] However, the last decade has experienced an annual decline in the wells up to half a meter.[93] In these desperate times, the locals took to the forefront and invented techniques at the grassroot level to tackle the crisis like the Rainwater Syringe Technique and the Mazhapolima Well Recharge Programme.[94]

The above-mentioned techniques considered local parameters not only to resort groundwater level but also rejuvenate the surrounding environment and the aquifers in the region.[95] The initiatives are the examples of how the crisis can be solved by the efforts of the locals.[96]

The Technique for Deep Aquifers- Rainwater Syringe

The aquifers of Vaikom are usually saline except the aquifers in few areas and these saline acquifers cover most of the area in the Ernakulam district of Kerala.[97] The technique used in this area or in such aquifers uses a pressurised motor pump or the gravity method to inject rainwater into the deeper aquifers, depending on the dynamics of local aquifers.[98] What

90 Closas & Villholth, *supra* note 70.

91 *Ibid.*

92 Aarti Kelkar, *Scarcity Amidst Plenty: Kerala's Drinking Water Paradox*, India Water Portal (Nov. 14, 2015) https://www.indiawaterportal.org/articles/scarcity-amidst-plenty-keralas-drinking-water-paradox.

93 *Id.*

94 Abhinav Madhavanunni & Sai Rama Raju Marella, *Groundwater Recharge Needs Grassroots Solutions: A Study of Two Techniques in Kerala*, India Water Portal (Oct 9, 2020), https://www.indiawaterportal.org/articles/groundwater-recharge-needs-grassroots-solutions-study-two-techniques-kerala.

95 *Ibid.*

96 *Ibid.*

97 *Rainwater Syringe: A Novel Approach of Water Conservation,* National Innovation Foundation, https://nif.org.in/innovation/rain_water_syringe_a_novel_-approach_of_water_conservation/53 (last visited Aug. 6, 2021).

98 Tanvi Patel, *Kerala man innovates rainwater syringe by Accident, restores 300 Cr. Litres in 30 years!*, The Better India (May 31, 2019), https://www.thebetterindia.com/184426/kerala-rainwater-harvesting-syringe-innovation-water-conservation-india/.

follows next is not just the conservation of rainwater as in rainwater harvesting system but it also results in formation of a "freshwater lens".[99] When rainwater gets injected into an aquifer which contains saline water, it neither mixes nor dilutes the saline water, which is usually denser than rainwater. Instead, it creates a new freshwater lens and this is how water is conserved. The positive effects of the similar technique were observed in Kochi where the technique was utilized to create the storage spaces for deep aquifers.[100]

Recharging Groundwater Using the Mazhapolima Technique

The district of Thrissur accounts for 4.5 lakhs and cater to the need of around 75% of the population.[101] However, a majority of the wells (around 70%) run dry during the summer. On account of the desperate situation, the locals resorted to the technique of well recharge programme to ensure a regular supply of water through a source.[102] The Mazhapolima Water Recharge Programme involves collecting the rainwater from the rooftops into the wells dug in the households.[103]

In order to further the initiative, a community level structure based on rain water harvesting was installed in the year of 2019.[104] The structure captures the rain water and allows it to accumulate in a sump after going through various infiltration trenches. The water thus collected in the sump is employed to recharge the open wells and restoring the aquifers.[105] This technique showed success within a year of its installation and the region witnessed restoration of shallow aquifers and open wells.[106]

The results of the techniques employed in various districts of Kerala with the help of local efforts have shown significance positive results, especially in the coastal areas where the

99 Madhavanunni & Marella, *supra* note 94.
100 Kelkar, *supra* note 92.
101 Ayan Biswas, *Mazhapolima: Recharging Open Wells in Kerala*, India Water Portal (Feb 2015), https://www.indiawaterportal.org/articles/mazhapolima-recharging-open-wells-kerala.
102 *Ibid*.
103 Swati Bansal, *Small Steps to Win the Big Battle Against Water Scarcity*, India Water Portal (May 11, 2014), https://www.indiawaterportal.org/articles/winning-through-battle-water-scarcity.
104 *Mazhapolima: Ensuring Water Security Through Participatory Well Recharge in Kerala*, OneWorld Foundation India, https://oneworld.net.in/focus-area/knowledge-and-research/mazhapolima-ensuring-water-security-through-participatory-well-recharge-in-kerala (last visited Aug. 6, 2021).
105 Sreehari Paliath, *Harvesting Rain: How one Kerala district is solving its water problem*, The Business Standard (Mar. 7, 2018), https://www.business-standard.com/article/current-affairs/harvesting-rain-how-one-kerala-district-is-solving-its-water-problem-118030700088_1.html.
106 Seetha Gopalakrishnan, *When it Rains, it Stores!*, India Water Portal (Mar. 2014), https://www.indiawaterportal.org/articles/when-it-rains-it-stores.

people highly depend on aquifers and open wells for their needs and where they can employ these mechanisms to collect direct rainwater through simple filtering mechanism.[107]

The case study clearly demonstrated the success the localised efforts that can be adopted for groundwater recharge. It shows us that we need to move beyond generic solutions. Individuals, or locals are in a position to understand the hydrogeological condition to ensure the balance between extraction rates and recharge patterns.[108] There is a need for more and more locals take up such responsibility and adopt a decentralised approach to ensure that the techniques can be efficient and yield maximum possible results.[109]

Recommendations and Suggestions

1. *Change of Perspective- From management to Governance :* Since groundwater is a 'common pool resource', the decisions regarding its conduct and use requires a series of practical considerations including principles that facilitate proper allocation, evaluation, participation, attribution of responsibility, transparency, access to information, adherence to the laws.[110] Groundwater governance, therefore, offers a combination of various elements of socio-hydrogeological setting by triggering partnerships and collaborations in order bring the support of communities and being them close to the resources.[111]

2. *Recognising groundwater as a decentralised resource for governance:* Groundwater, by its very nature is a widely distributed and local resource and therefore there is a need to establish boundaries and introduce arrangements and mechanism at the local and aquifer level.[112] The crisis requires governance at a decentralised level and national or regional structures or policy can hardly prove to be an effective solution.[113]

3. *Requirement of correct and large-scale data for formulating correct policies:* In order to accelerate the efforts of conservation of groundwater, there is a need for collating data

107 C.R. Bijoy, *Kerala's Plachimada Struggle- A narrative on Water and Governance Rights*", 42 E.P.W. 4332 (2006).

108 *Ibid.*

109 Paliath, *supra* note 105.

110 Simi Mehta & Amita Bhaduri, *Decentralised Water Resources Management*, India Water Portal (Mar. 18, 2021), https://www.indiawaterportal.org/article/decentralized-water-resources-management.

111 Gregory A. Thomas, *Centralised vs. Decentralized Approaches to Groundwater Management and Allocation in the Context of Overdevelopment*, *in* Management of Shared Groundwater Resources (E. Feitelson & M. Haddad eds., 2001).

112 Shankar et al., *supra* note 1.

113 C.P. Kumar, *Climate Change and its Impact on Groundwater Resources*, 1 Int'l J. Engg. Sci. 43 (2012).

at the aquifer level.[114] Data with regards to the quality and quantity of groundwater resource in a particular area compared to the domestic population need and the industrial need would help in devising effective macro and micro level groundwater governance mechanism at macro and micro level.[115] The challenge however is the collection of data at a localised level given the diversity of groundwater resource along with the availability and accessibility of the data to the public.[116]

4. *The need to join hands- Working on governance via partnerships:* Partnerships have been crucial in addressing the environmental concerns.[117] The success of the partnerships can be attributed to the collaboration of local skills and the generation of data at the local level with the advanced management techniques of the other partner that helps in boosting up the effort for conservation.[118] A variety of examples such as that of PGWM and Springshed, where various strategies have been adopted under different hydrogeological setting by employing the support of local communities to demystify the science of groundwater.[119] However, the challenge that persists is scaling up the participation of the various organisation and stakeholders to come to the forefront to accelerate the effort of groundwater governance.[120]

5. *Emphasis on quality:* The depletion of groundwater resources coupled with the quality of groundwater is another critical issue for India which is posing a great environment and health risk.[121] In order to address the issues of exploitation of the quality of the resource, there is a need to integrate the quality issues within the groundwater governance framework and undertake the data and capacity building parameters at the institutional level.[122]

6. *Strengthening the institutions :* The enforcement and regular monitoring of laws is essential to ensure that the laws are implemented effectively. There is a need for the

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114 Philippe Cullet, *Use and Control of Groundwater: Towards a New Framework*, 1 E.L.P.R. 73 (2011).

115 *Ibid*.

116 *Ibid.*

117 *Piloting Participatory Groundwater Management (PGWM) through partnership of resource centre on groundwater*, Arghyam, http://arghyam.org/piloting-participatory-groundwater-management-pgwm-through-a-partnership-of-resource-centres-on-groundwater/ (last visited Aug. 6, 2021).

118 *Ibid*.

119 Water Governance Facility, Groundwater Governance in India: Stumbling Blocks for Law and Compliance, WGF Report No. 3, https://watergovernance.org/wp-content/uploads/2015/06/2013_No3_Groundwater_Governance_India.pdf.

120 M. Moench, *Approaches to Groundwater Management: To Control or Enable?*, 29/39 E.P.W. A 135 (1994).

121 *Ibid*.

122 Sheetal Sekhri, *Sustaining Groundwater: Role of Policy Reforms in Promoting Conservation in India*, India Policy Forum 149 (2012-13).

executive to come up with a strong enforcement and monitoring mechanism of the groundwater laws.[123] In order to make the entire mechanism effective, there should be introduction of model laws for states.[124] Apart from that, there is also a need for personalised laws for the local bodies so that institutional gap can be covered and the conservation of the groundwater can be done by marking it as a common yet decentralised resource.[125]

7. *Making ancillary laws effective:* It is equally important to not only strengthen the legislative framework concerning groundwater governance but also ancillary legislation affecting the quality of groundwater.[126] For instance, provisions should be incorporated to make use of technology to detect the quantity of water in aquifers to estimate its judicious use. Furthermore, the Solid Waste Management Rules[127] must be amended to eliminate dumping of waste in the areas which can essentially affect the quality of water resources, especially the groundwater resources. In this manner we can adopt a holistic view and can achieve an efficient groundwater conservation regime.

Conclusion

The depletion of groundwater in India is a very severe issue that threatens the life and livelihood of the population. The inefficient implementation of legal and policy measure further exacerbates groundwater crisis in India. There is an urgent need to change the perspective from groundwater management to groundwater governance. The case study of Kerala's groundwater restoration is a prime example of how the shift in perspective from groundwater management to groundwater governance can help in restoration, conservation and preservation of groundwater. Groundwater governance requires[128]: (i) local participation on large scale and effective community efforts; and (ii) institutionalized support through effective laws and regulations and proactive judiciary. Groundwater governance also requires a shift from resource-based approach to source-based approach.

123 Himanshu Kulkarni et al., *Shaping the contours of Groundwater Governance in India*, 4 J. Hydro. Reg'l Stud. 172, 192 (2015).

124 *Ibid.*

125 Sayantari Sen & Meenakshi Mandal, *India's Groundwater Woes: Fight for Resortation and Remedation*, 3 E.L.S. J. 6 (2015).

126 *Ibid.*

127 Solid Waste Management Rules, 2016.

128 Aarti Kelkar Khambete & Harvardhan Dhawan, *Decentralised Groundwater Governance to Deal with the Groundwater Crisis*, India Water Portal (Feb 17, 2020), https://www.indiawaterportal.org/articles/decentralised-groundwater-governance-deal-groundwater-crisis.

Further, in contrast to groundwater management, groundwater governance provides a structure than not only ensures effective management of resources but also accelerates group effort or collective action to allow socially sustainable utilisation and protection of groundwater to preserve and benefit the ecosystem dependent on it.[129]

Therefore, in toto, it can be reasonably concluded that an effective participatory attitude at the local level along with a strict and efficient institutionalised mechanism is the need of the hour to ensure that India can reduce the impact of the imminent water crisis.

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129 Shankar et al., *supra* note 1.

PART IV

Water Policy for The Agricultural Sector in Light of Climate Change

Chapter 17
Rethinking Agricultural Water Use Law and Policies in the Light of Climate Change

Omkareshwar Pathak* Dr. Yogendra Kumar Srivastava**

Abstract

The numerous, complex and diversified region based interaction between agriculture, water and climate change calls for consideration of agricultural water management and policy in the context of climate change and rethinking the same under ever stronger factors of urbanization and increase in pollution. The article presents challenges of agricultural water use and it's management across the globe with special focus on India in context of climate change. It presents the overview of status of agricultural water use and examines the related data, trends and indicators of water usage while determining stress at regional level coupled with expected adverse effect of climate change. The article further analyzes the suitability of present water use policies, if any and tries to point out the factors which needs to be considered in improvising the agriculture water use policies one effecting ground water agriculture usage. Accordingly authors have tried to identify the policy solutions to address the ever growing and diverse challenges of water resource management in agriculture considering that the topic in hand is under studied. A review of impact of climate change on water cycle has been done and it's implication on agriculture has been examined and analyzed in this article.

Keywords: *Climate Change, Agricultural Water use, Water Resource Management, Water Policy, Urbanisation.*

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Introduction

The numerous, complex and diversified region-based interaction among agriculture, water and climate change calls for consideration of agricultural water management and policy in the context of climate change and rethinking the same under ever stronger factors of urbanization and increase in pollution. It's axiomatic to say that there is growing concern about the availability of water in longer term and to add on to that, degrading water quality over the years cannot be ignored as the evidences suggests that water has been polluted significantly in most of the agrarian economies now. These risks associated with water are surely going to have adverse effects on the agricultural sector which is definitely a highly water dependent sector.

It is therefore important to set the facts straight with respect to the status of agricultural water use and also examine the related data, trends and indicators of water usage while determining stress at regional level coupled with expected adverse effect of climate change. Consequently, one can be in the position to analyze the suitability of present water use policies and can point out the factors which need to be considered in improvising the agriculture water use policies on effecting ground water agriculture usage.

Water resource management has been defined as "the activity of planning, developing, distributing and managing the optimum use of water resources. It is a sub-set of water cycle management. Ideally, water resource management planning has to give regard to all the competing demands for water and must seek to allocate water on an equitable basis to satisfy all uses and demands."[1]

It is pertinent to mention here that ground water is used majorly in irrigation i.e. one of the key components of agriculture and amounts to over 70% of its total usage followed by domestic usage and industrial uses in term of total percentage. Therefore, it is essential to state the facts related to groundwater consumption and extraction with special reference to India.

Background of the Ground Water Scenario in India

The National Compilation on Dynamic Ground Water Resources of India, 2017, Ministry of Jal Shakti, Department of Water Resources, Central Ground Water Board have made certain assessments with respect to the availability of water and categorized the areas as follows:

1 Shinde, S.M., "Water Resource Management and Agricultural Development in Maharashtra", Vol.1, No. 7, pp. 1-10, *International Journal of Multifaceted and Multilingual Studies*, (2015).

"According to the current estimates, the total yearly ground water recharge is 432 billion cubic metres. Taking into account natural discharge, the yearly extractable ground water reserve is 393 billion cubic metres. The average yearly ground water extraction is at 249 billion cubic metres. The normal stage of ground water extraction in the nation is around 63 percent. The extraction of ground water is for a variety of purposes. Out of the entire 6881 assessment units throughout the nation, 17 percent of the total units have been classified as 'Over-Exploited,' meaning that ground water extraction exceeds the yearly renewable natural ground water recharge. The proportion of ground water extraction in these places is greater than 100%. Furthermore, 5 percent are classified as 'Critical,' indicating that the degree of ground water extraction is between 90 and 100 percent amounts 14 percent to moderately critical units, where the degree of ground water extraction is between 70 percent and 90 percent, and 63 percent of the total units have been classified as 'Safe,' where the degree of ground water extraction is less than 70 percent."[2]

It is to be noted that "in 2004, for every 100 units of ground water that was recharged and added to the water table, 58 units were extracted for consumption. This increased to 62 in 2011."[3] Further it is important to point out here that "in India, the net annual ground water availability is 398 billion cubic metres."[4] Furthermore it has been found that "due to the increasing population in the country, the national per capita annual availability of ground water has reduced from 1,816 cubic metres in 2001 to 1,544 cubic metres in 2011."[5] It is therefore pertinent to mention here that there is a direct relationship between the rise in population and ground water consumption. Also not to forget that urbanization after 2011 has increased manifold as compared to 2001-2011, which by all reasonable means is suggestive of additional pressure on the ground water in the agricultural land surrounding such urban area. Lastly it is pertinent to mention here that "rainfall accounts for 68% recharge to ground water, and the share of other resources, such as canal seepage, return flow from irrigation, recharge from tanks, ponds and water conservation structures taken together is 32%."[6] Therefore it can be reasonably concluded that per capital annual availability of ground water must have reduced drastically by now considering unplanned

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2 The National Compilation on Dynamic Ground Water Resources of India, 2017, Ministry of Jal Shakti, Department of Water Resources, Central Ground Water Board, http://cgwb.gov.in/Dynamic-GW-Resources.html (Last visited, April 26, 2021).

3 Water and Related Statistics, April 2015, Central Water Commission, http://www.cwc.gov.in/main/downloads/Water%20&%20Related%20Statistics%202015.pdf (Last visited, April 26, 2021).

4 Central Ground Water Board website, FAQs, http://www.cgwb.gov.in/faq.html. (Last visited, April 27, 2021).

5 Overview of Ground Water in India, https://www.prsindia.org/hi/theprsblog/status-ground-water-extraction-exceeds-recharge, (Last visited, April 25, 2021).

6 *Id.*

urbanization has adverse effects on recharging of groundwater and also considering the adverse effects of climate change and rising temperature. In fact, in reply to one of the questions related to groundwater in Lok Sabha on June 27, 2019 it was noted that 52 percent of government-monitored wells indicated a decrease in water level in 2018[7] when compared to the medium-term average, which makes the situation much more problematic considering substantial no. of wells have dried up in Rajasthan alone.[8]

It can be reasonably deduced that climate change has adversely affected Semi-Arid regions of the country which are at much higher risk[9] than ever when it comes to ground water capacity, consumption and therefore requires priority in the agricultural ground water management ultimately. States like Rajasthan, Karnataka, and Punjab are facing problems which if further neglected might lead to the position from where restoration would be next to impossible. Therefore it is quite important to have pragmatic legislative framework in place with respect to ground water management which should ideally include agricultural water use in the light of climate change.

Legislative Framework Related to Groundwater Management

It should be noted that water management is a subject matter of state under the Constitution of India, as mentioned in entry 17 of List II of the Seventh Schedule, and state governments have the power and ability to manage and control groundwater developments within their territorial jurisdiction. This Entry is subject to the provisions of Entry 56 of List –I[10], which discusses the management and development of interstate rivers and river valleys to the level, that such management and development under Union administration is determined by Parliament by legislation to be expedient in the public interest.

At this point, it may be pertinent to mention whether ground water has been covered as a separate entry in the constitution and if so, how is it provided.

7 Government Of India Ministry Of Jal Shakti, Department Of Water Resources, River Development & Ganga Rejuvenation Lok Sabha, "Groundwater Resources In India", Unstarred Question No. 900 Answered On 27.06.2019.

8 Government Of India Ministry Of Jal Shakti, Department Of Water Resources, River Development & Ganga Rejuvenation Lok Sabha, "Annexure II - Groundwater Resources In India", Unstarred Question No. 900 Answered On 27.06.2019.

9 Government of India Ministry of Jal Shakti, Department of Water Resources, River Development & Ganga Rejuvenation Lok Sabha, "Annexure IV - Groundwater Resources In India", Unstarred Question No. 900 Answered On 27.06.2019.

10 Entry 56 of List–I, Seventh Schedule, India Const. 1950.

Further its pertinent to mention here that, Section 7 of the Easement Act of 1882 which talks about, easements restrictive of certain rights among others, grants every landowner the right to collect and dispose of all water under the ground and on the surface within his own boundaries. Because ground water is held by the person who owns the property which is situate above the water table, it is difficult to restrict its extraction. This offers landowners considerable control over ground water. Furthermore, the statute precludes landless ground water consumers from its application.

Further the Central Government in 2011, published a Model Bill for Ground Water Management based on which states could choose to enact their laws. In addition, in 2012, it published a National Water Policy including core concepts pertaining to demand management, consumption efficiency, infrastructure, and water pricing[11]. It asserts that all current Acts must be amended to reflect the fact that water must be managed as a public resource in order to promote food security, livelihood, and equitable and sustainable development for everyone. It advocates for the strengthening of Water User Associations, the creation of knowledge about efficient and responsible water use, and the design of all projects with social considerations, stakeholders and beneficiaries in mind.[12]

In 2013, the government issued a National Water Framework Bill, as proposed in this policy. The Model Bills and National Water Policy addressed ground water governance under the public trust theory.[13] The public trust principle assures that public assets are not converted into private property.

One of the most essential aspects of the model bill is its attempt to implement the subsidiarity idea, which includes allowing communities management over groundwater at the aquifer level.[14] For example, an aquifer located entirely within a village will fall immediately under the supervision of the Gram Panchayat.

It should be highlighted that the execution of the policy element that strives to provide basic access to water while developing commercial value and full cost recovery is a contradictory ambition. In the absence of an appropriate financial mechanism, it is unclear how water will be distributed to consumers with low financial ability. Furthermore, it appears that the policy is incoherent and inadequate due to a lack of clear rules. It is important to point out at this juncture that only few states (Maharashtra, Rajasthan, and Gujarat) have taken

11 National Water Policy (2012) - Para 6 and 7, Government of India- Ministry of Water Resources.

12 National Water Policy (2012) - Para 1.3, 9.6, 7.5, 14 and 15, Government of India- Ministry of Water Resources.

13 Draft National Water Framework Bill, 2016, Section 4.

14 Draft National Water Framework Bill, 2016, Section 5,6 22 and 23.

the job seriously and have enacted laws[15] and to some extent shown intent with respect to proper management of ground water in their territory by generating awareness and creating community groups working towards this direction.

States like Madhya Pradesh, Haryana and Uttar Pradesh are lagging behind[16] in formulating a state-wide framework law which should be in consonance with National policies and guidelines. This situation may reasonably lead to unaccounted groundwater extraction in these states putting extra pressure on farmers especially in areas like Bundelkhand etc which are severely affected by climate change and declining ground water level over the years continuously.[17]

Institutional Framework Related to Ground Water Management

The Government of India established National Water Resource Council in 1983 which is an apex non – statutory body for water resources in India with Prime Minister as its chairman. The council main function lays down the national water policy and reviews the same; consider and reviews major water development plans submitted to it and makes such other recommendations which would foster expeditious and environmentally sound economical development of water resources etc.

In 1990 Government of India went on to establish National Water Board, which is responsible for reviewing the programme of implementation of National Water Policy and report to the National Water Resources Council and to take various other matters related to development and management of water resources.

Apart from above mentioned two institutions The Ministry of Water Resources is the nodal ministry in the Govt. of India for water resources. It is also responsible for laying down policies for surface and ground water. The functions with respect to ground water are carried out with the assistance provided by Central Ground Water Board. The Central Ground Water Board is an apex body at the national level responsible for investigation, exploration, assessment and rendering technical advice for development and management of ground water resources in India.

15 Maharashtra Water Resources Regulatory Authority Act, 2005/2011, Rajasthan River Basin And Water Resources Planning Act, 2015.

16 The World Bank, National Groundwater Management Improvement Program Environmental and Social Systems Assessment, September 29, 2016. The link for this Report ought to be provided.

17 Radhika Singh & Shail Joshi, “Managing the Water Crisis in Bundelkhand, India: A Governance Approach”, *Massachusetts Institute of Technology, May 2020*.

The Central Ground Water Authority which is considered to be an appendage to Central Ground Water Board plays a key role in regulation and control of development of ground water in over exploited areas to protect the quantitative as well as qualitative aspects of ground water availability.

It is however pertinent to mention here that water is a State subject and therefore state governments have primary responsibility for use and control of this resource. State Water Resource departments and Department of irrigation is majorly responsible for irrigation across respective states with the support of agriculture department, Zila Parishads, Panchayats etc.

It is to be noted that multiple agencies deals with ground water directly/indirectly with varying degree of coordination. It is pertinent to mention here that legislative and institutional framework has remained largely ineffective in preventing declining over exploitation of groundwater in India. It is to be noted that "the percentage of over-exploited blocks, has increased from 4% to 15%, making over exploitation of ground water a matter of concern"[18] especially in the light of climate changes. Considering the fact that there is lack of awareness among masses related to effect of climate change and to add on to it lack of awareness and readiness of people for registration of ground water structure[19], it can be reasonably concluded that "the present institutional set up is totally inadequate to take care of the increasing incidence of over exploitation of ground water in the country"[20]. The matter becomes more problematic in the absence climate change specific legislation with due consideration being given to agricultural water use and management in it. Further in the absence of proper monitoring and implementation of guidelines related to ground water extraction, farmers are forced to use pesticides and chemicals in order to increase crop production in reduced agricultural land[21] which eventually pollutes the groundwater, dilutes the nutritional value of soil and water both. This is more prominent in agricultural land near metro cities and areas heavily urbanized.[22] To add to these following major effects of climate changes add to the already existing problems –

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18 Planning Commission, Report of the Expert Committee, 2007, p.8.

19 Institute for Resource Management and Economic Development, "Institutional Framework for Regulating Use of Ground Water in India - Final Report", Sponsored by Ministry of Water Resources Government of India, 2008.

20 *Ibid.*

21 Avazdahandeh, S., Khalilian, S. The effect of urbanization on agricultural water consumption and production: the extended positive mathematical programming approach. *Environ Geochem Health* 43, 247–258 (2021). https://doi.org/10.1007/s10653-020-00668-2.

22 *Ibid.*

- It is expected that less water will penetrate and replenish groundwater as a result of reduced and unpredictable rainfall adversely affecting irrigation and consequently security of food.
- Increased deficit of water content in atmosphere because of increased temperature, leads to excessive evaporation from soil, water, and plant surfaces.
- To avert drought, land ecosystems would require additional water to satisfy growing water demand.

  One study for India found that “the crop yield projection over the medium term might decline slightly (4.5-9%), while the long-term projection sees that a substantial reduction (25% or more) is likely to occur.”[23]

Averting the Crisis

Having understood the crisis, it becomes more important to find out the way to mitigate the crisis. It is need of an hour to step up efforts to document the causes and effects of climate change/global warming on regional water supplies, rainfall patterns, both geographic and temporal; Water intrusions into aquifers; regional climate vulnerability of water resources; prioritisation of adaptation and mitigation strategies, and so on. Different strategies have been suggested at different points of time with respect to the crisis in hand. Some of the effective ways to mitigate the crisis are as follows –

- Institutional Improvisation
- Water Harvesting
- Agronomic
- Rehabilitation and
- Modernization of irrigation network
- Water saving methods like drip and sprinkler irrigation
- Social and Political Will

Among all of these agronomic is one core aspect around which rest of the ways revolves around. Appropriate authorities should try to work on the following questions to handle the crisis effectively –

23 Guiteras, R. “The impact of climate change on Indian agriculture”, Department of Economics, MIT, (2007).

- Can we promote seed banks in order to assist farmers in diversifying crops and agricultural varieties?
- Can we work in the field of research and development of more resistant crop varieties?
- Can we increase the Department of Agriculture's capability to distribute seeds from a broader range of crops and create agricultural extension programmes?
- Can we use incentive programmes to improve crop diversity and crop variety?

These question points towards framing of the support policies which eventually make the system more resilient. This would be in contrast to the policies which give subsidies to use solar water pump which essentially ends up resulting into more extraction of ground water which for the most of time is unaccounted for making the system weak when it comes to agricultural water use management. Therefore, what actually is pointed out here is that there is a need of legislation on water which can incentivize conservation and at the same time raise the income of farmers by raising the values of the harvested alternative crops, considering the fact that the urgency for focusing on the welfare and prosperity of the farmers can't be neglected and in fact has gained prominence recently. The fresh approach suggests that priority to be accorded to making the agricultural sector socially and economically sustainable to farmers in terms of prosperity, welfare and social security and not only ecologically sustainable in its use of soil, water and forests.

Role of the Judiciary and Executive

It is important to mention here the need of restoration and preservation of ponds, lakes and wells wherever possible, especially in Sub-urbs/Outskirts of city, villages sharing boundaries with the Municipalities. Reliance can be place upon Supreme Court case where in it was held that "schemes which extinguish local water bodies albeit with alternatives, as provided in the 2016 Government order by the State of UP, are breach of Constitutional Principles and are liable to struck down."[24] It is to be noted that properly maintained and preserved common resource pools helps in increasing ground water level of surrounding areas.

The Supreme Court further, in *M.K. Balakrishnan v. Union of India,*[25] has held that "Our ancestors were wise people, ... they made the provision of a pond near every village, tanks in or near temples, etc., which were the traditional rainwater harvesting methods. ... Unfortunately, people have forgotten the wisdom of our ancestors ... When water is not

24 Jitendra Singh v. Ministry of Environment, 2019 (17) SCALE 29.

25 M.K. Balakrishnan v. Union of India, (2009) 7 MLJ 184 : (2009) 4 Scale 185.

available, people come to the streets …, to awaken the government authorities to take some measures to make available the necessity of life to the general public called water."[26] This is in consonance with objective of National Water Policy highlighted above and also in line with report on 'Institutional Framework for Regulating Use of Ground Water in India'[27] which placed emphasis on increased community participation and it's important role in ground water conversation.

Further judiciary has recognized and upheld that the local communities like panchayats can have control over the water resources situated within their territory. They have been recognized as custodians of natural water resources drawing their power from section 218 of Panchayat Raj Act and specifically under third schedule of the said Act. Reliance can be placed upon *Perumatty Grama Panchayat v. State of Kerala*[28] it was held that "Grama Panchayat can cancel the licence of a factory manufacturing non-alcoholic beverages on the ground of excessive exploitation of ground water by Hindustan Coca-Cola Beverages (Pvt.) Ltd."[29]

These cases clearly reflect the positive intent of judiciary in managing the ground water resources. However role of executive is questionable considering the observation made by Supreme Court of India. . Reliance for the same can be place on *M.C. Mehta v. Union of India and others*[30] wherein it pointed out the fact that there is inefficiency and unwillingness of executive bodies in handling such crisis. It should be noted that encroachments on such water bodies don't happen in a day and clearly suggests the fault on the part of local authorities within whose territories they fall in. Therefore proper functioning and prompt action by the executive authorizes in dealing with the issues of water management at local level is of utmost importance.

Conclusion

Water management requires strong pro-democratic and environmentally friendly mechanisms to be put in place. They must also be incorporated with optimum farming techniques. Without a doubt, this will be a difficult challenge given the fact that climate change will increase the need to predict global water shortages. In light of climate

26 *Ibid.*
27 *Supra Note* 19.
28 Perumatty Grama Panchayat v. State of Kerala, 2004 (1) KLJ 414.
29 *Ibid.*
30 M.C. Mehta v. Union of India and others, AIR 2004 SC 4016.

change and global warming, India's water management challenge may have far-reaching consequences. The scenario would necessitate large-scale adaptation and mitigation strategies, as full restoration groundwater level to original situation is next to impossible but at the same time preventing it from further exploitation is still in our hand provided proper heed is paid to the effects of the climate change and it’s pattern, if possible. This would ensure devising specific strategies conducive to people involved in agriculture in respective diverse regions facing different effects of climate change

At last, one needs to understand that the water is core aspect when it comes to adaptation in context of climate change. It is quintessential for adaptation process to equip ourselves as to the impact climate change has on agriculture production wherein water is a core aspect. This becomes more relevant when one can not anticipate the effect of climate change in general considering the fact that it does not seem to be uniform and largely depends on specific regional factors too, which requires diverse strategies to avert the crisis. It is high time that we should be in the position to assess the connection between agriculture, water and climate change considering the uncertainty which climate change presents and area specificity linked to water. No single way can be best but common ways need to be identified such as better clarity the of role of water under different temperature zones with varied carbon dioxide level. These can have positive impacts on agricultural production and can help the agricultural sector to understand the huge benefit of innovative agricultural water use management practices.

Lastly, steps like investing in farmer education and training in response to climate change and related problems in order to strengthen farmers’ adaptive ability; Promotion of knowledge sharing and collectivism, information sharing, and involvement in adaptation plans can serve as such non-monetary rewards, as well as increase societal acceptability of altering water distribution systems further towards versatility; Eliminating policies that encourage excessive water usage; efficient free commodity storage platforms in place can assist local farmers in smoothing price shocks caused by extreme water events such as flooding and droughts over time, lowering the total cost of increased output instability caused by climate change.

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Chapter 18
Climate Change, Sustainable Water Management and Agricultural Sector: A Study in India

Vidya Ann Jacob*

Abstract

Climate change has been having an adverse impact on various natural resources including water, which is an important aspect of sustaining life. Developing nations like India are grappling with climate change as the rise in sea levels and climatic catastrophes are increasing both in intensity and frequency. In addition, concerns of public health due to air pollution, heat waves, threats to food security and access to clean energy for all are pressing. Water has been one of the most critical sources for agricultural sustainability in India. Population growth along with increase in agricultural needs, climate change and developmental activities are causing stress on natural resources including water. As per the report of the central water commission date in 2020, 78% of fresh water is currently being utilised in the agricultural sector in India. Hence for sustainable agricultural development in the era of climate change, sustainable and reliable water resources are the need of the hour. The existing water policies at Central and State levels are not comprehensive enough to ensure sustainable water use in agricultural sector in the era of climate crises. The government needs to bring about mechanisms to meet the supply demand gaps as the population increases, address environmental concerns, identify potential energy sources and provide access to all. India requires mechanisms to eradicate poverty and enable development that can be achieved through sustainable development.

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Keywords: *Agricultural sector, Climate Change, Food security, Sustainable, Water Management.*

Introduction

Climate change has been at the forefront of legal discussion in the contemporary world due to adverse environmental and ecological consequences that the world is witnessing. Climate Change at an adverse level is a universal problem faced by all humans and is a disastrous evil that has arisen out of complacency and negligence of mankind towards to planet. The Intergovernmental Panel on Climate Change (IPCC)[1] defines climate change as "a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity."[2] The definition provided by United Nations Framework Convention on Climate Change (UNFCCC)[3] differs as it emphasizes on a change that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.[4] There is a dire need for countries across the world to come up with effective solutions to improve their technology, reduce emissions into the atmosphere and also move towards sustainable development goals to ensure intergenerational equity.

Climate change derives its cause from an increase in greenhouse gases emissions due to human activities. There was a 1.3% increase in greenhouse gas emissions, most of which had been produced by the industrial sector, between the years 1970 and 2000 and this figure almost doubled to 2.2% in the decade that followed.[5] Agriculture is directly related to and dependent on the environment and fluctuations in climatic conditions could cause widespread destruction of crops as well as changes in the availability of arable land.[6] This would inevitably impact the availability of food in several countries across the world and countries where agriculture is the primary occupation of the people, like in India, are sure to be the worst affected. India could lose anywhere between 2-4% of its arable land to

1 Intergovernmental Panel on Climate Change.

2 *Appendix I – Glossary*, Intergovernmental Panel on Climate Change, (Apr. 29, 2021, 12: 30 P.M), https://www.ipcc.ch/ipccreports/tar/wg1/518.htm.

3 United Nations Framework Convention on Climate Change, 1992, New York, 4 June 1992.

4 *Ibid* at Article 1.

5 J. Shuldt et al, CLIMATE CHANGE SCIENCE: The Facts, Communicating Climate Change: A Guide for Educators, 7-20. ITHACA; LONDON: Cornell University Press (2018).

6 Xiao Zhang, *Climate change impacts on global agricultural land availability,* IOP SCIENCE (May 1, 2021, 21:35 PM), https://iopscience.iop.org/article/10.1088/1748-9326/6/1/014014/meta.

climate change and this could cause devastating effects on the livelihoods of the farmers as well as other sections of society.[7]

Food security can be defined as the ability of all persons to enjoy economic, social and physical access to safe, healthy, nutritious food in order to meet their dietary requirements to lead a healthy, active life.[8] This concept is enshrined in several international conventions and documents as well as the Indian Constitution. Article 25 of the Universal Declaration of Human Rights talks about the right of every individual to enjoy access to adequate food and other necessities.[9] Article 11 of the International Covenant on Economic, Social and Cultural Rights recognizes the right of every individual to be 'free from hunger', thereby reinforcing the right to food.[10] Articles 24 and 27 of the Convention of the Rights of the Child also emphasize the right of every child to adequate and nutritious food. The UN Committee on Economic, Social and Cultural Rights also issued a General Comment in 1999 concerning the 'Right to Adequate Food.' It can therefore be safely noted that international bodies and organizations give great importance to the elimination of food insecurity.

Articles 21 and 47 of The Indian Constitution can also be interpreted to include the Right to Food. Article 47, although unenforceable, talks explicitly about the duty of the State to 'raise the level of nutrition and standard of living' whereas Article 21 talks about the 'Right to Life' guaranteed to every Indian citizen.[11]

Although all states must endeavour to ensure that these aforementioned rights are protected and enforced, there are several limitations, both economic and social. A huge roadblock in the path to global food security is undoubtedly climate change.[12] In India, the majority of people rely heavily on agriculture and other activities like pisciculture or forestry that are directly affected by environmental changes. The major problem in a country battling poverty is the asymmetry between the vulnerability to climate change and the ability to withstand it.

7 *Ibid.*

8 United Nations Food and Agriculture Organization, *Trade Reforms and Food Security* (2003), Chapter 2, 25.

9 Universal Declaration of Human Rights, Article 25.

10 International Covenant on Economic, Social and Cultural Rights (1966), Article 11(2).

11 INDIAN CONST. Art. 47.

12 *Food Security and Climate Change*, IAEA (Apr. 29, 2021, 22:55 PM), https://www.iaea.org/topics/food-security-and-climate-change.

Climate Change Impacts on Water and Agricultural Sector

The Indian agricultural sector is widely known for being in the disadvantaged position and is already plagued by ever shrinking land holdings and disguised unemployment.[13] The effects of climate change have the potential to therefore completely destabilize the sector and severely impact production of food in the country. Climate change will not only adversely impact quantity and quality of produce but also drive up prices in several parts of India which would be disastrous for the large number of poor people in the country.[14] The Public Distribution System as established by the National Food Security Act, 2013 would be directly affected and this could potentially affect more than 60% of India's population.

Climate change therefore could have a potentially devastating impact on India's food security which is already below par with the country languishing at 76th position in the Global Food Security Index in 2018.[15] Factors like unpredictable rainfall, flooding, inadequate water resources, drought and natural disasters would have severe consequences in terms of food access, availability, sustainability and affordability in India.[16] Increased severity and frequency of natural disasters and erratic hydrological cycles are bound to disrupt nation-wide produce as Indian agriculture remains heavily dependent on the monsoons.[17] Climate change has been impacting water resources in India which in turn has had adverse impact on the agricultural sector.

Climate change results in inter-annual and intra-seasonal variability of monsoon rainfall. According to the World Bank estimates, Northern India faces an increased risk of droughts while Southern India faces risks of increased wetness. [18]There will thus be an impact on water availability for irrigation. According to the World Bank projections, with an international mean warming of 2°C above pre-industrial levels, food water requirements in India will exceed inexperienced water availability.[19] This disparity between demand and supply of water will have large implications on the agricultural sector and India's food

13 M.V. Nadkarni, *Crisis in Indian Agriculture*, 53 EPW Issue 17, April 2018.

14 *Climate Impacts on Food Security,* World Food Programme (Apr.30, 2021 19:50 PM), https://www.wfp.org/climate-change/climate-impacts.

15 *Rankings and Trends*, GFSI (30 Apr. 20:30 PM), https://foodsecurityindex.eiu.com/Index.

16 Khyal Chand, *Climate Change and Food Security in India: Contemporary Concerns and Issues*, 4 IJDR. 359-365 (2014).

17 *Ibid*.

18 "Turn Down the Heat: climate Extremes, regional impacts, and the case for resilience", World Bank, 2013 (Apr. 28, 2021, 22:58), http://www.worldbank.org/content/dam/Worldbank/document/Full_Report_Vol_2_Turn _Down_The_Heat_%20Climate_Extremes_Regional_Impacts_Case_for_Resilience_Print %20version_FINAL.pdf

19 *Ibid.*

security. Considering that India's agriculture depends largely on rain, this will bring about scarcity of larger proportions than that already existing.

Legal Framework Governing Climate Change, Sustainable Water and Agricultural Sector in India

As per the 'Global Urban Ambient Air Pollution Database (updated 2016)'[20] released by the World Health Organisation (WHO), 22 cities in India figured in the most polluted hundred cities in the world[21]. The drastic effect of this has affected the young and the aged alike causing health hazards like stroke, heart disease, lung cancer, and chronic and acute respiratory diseases. The emission of greenhouse gases has caused lasting and sometimes irreversible damages to the environment. It is now established that global warming has resulted in the melting of glaciers causing the rise of sea level thus posing a threat not only to port cities and related businesses but also the coastlines and associated livelihood.[22] Indian government has initiated steps to reduce the greenhouse gas emission without any pressure or compulsion under international treaties and obligations. The measures taken up by the Government of India (GOI) includes promotion of renewable energy and investment in green development technology[23].

The Indian Constitution casts a duty on the State as well as on the citizens to protect the environment[24]. The various legislations such as the Air Act[25], Water Act[26] and Forest Conservation Act[27] were the outcome of the United Nations Conference on Human Environment held at Stockholm in 1970. The Environment (Protection) Act, 1986 came in the after math of Bhopal gas tragedy. The Judiciary has played a very important role in laying down important environmental jurisprudence such as the polluter pays principle[28],

20 World Health Organization report 2016 (Apr. 30, 2021, 10:00) http://www.who.int/phe/health_topics/outdoorair/databases/AAP_database_summary_results_2016_v02.pdf?ua=1.

21 Article 2 (a) to (b) of the UNFCC does not impose responsibility on developing countries whose industrial process started during the 20th century to reduce their carbon emission target.

22 Physical and socio-economic trends in climate-related risks and extreme events, and their implications for sustainable development, UNFCCC, November 20, 2008 (2 May 2021, 12:00) http://unfccc.int/resource/docs/2008/tp/03.pdf .

23 Deepa Badrinarayana, *Emerging Constitutional Challenge of Climate Change: India in Perspective, The*, 19 Fordham Envtl. L. Rev.1, 38 (2009).

24 INDIAN CONST. Arts. 48 A and 51 A (g) inserted by the 42nd Constitutional Amendment Act in 1976.

25 The Air (Prevention and Control of Pollution) Act, 1981; The Air (Prevention and Control Pollution) Rules, 1982.

26 The Water (Prevention and control of Pollution) Act, 1974; The Water (Prevention and Control Pollution) Rules, 1975.

27 The Forest (Conservation) Act, 1980; The Forest (Conservation) Act, 1981.

28 Indian Council for Enviro-Legal Action v. Union of India AIR 1996 SC 1446, the courts have stated

precautionary principle and sustainable development principle to protect the environment. There are various laws and rules governing environment protection, water conservation and sustainable agricultural development in India. However a comprehensive legislation is necessary to address problems pertaining to climate change.

One of the reasons why India adopted the National Climate Change Policy (2008) was to ensure green and sustainable energy supply to all its citizens with minimal impact to environment (sustainable development is a means through which this can be achieved). India aims at elevating the standard of living of the people and is also trying to promote green energy. Delhi was the first State in India to launch a State Action Plan (2009).[29]Climate change policy also provides for sustainable water management and agricultural development. One of the main sources of water for irrigational purposes in India has been underground water. The use of groundwater resources have drastically expanded over the years due to various factors that include but are not limited to the shift to private water supply by rural and urban residents alike due to poor service from public sector supply systems.[30]

In addition, under the Indian Constitution, public health, land, sanitation and water are primarily State Entries (State List, entry 17, Seventh Schedule). Water is understood to include water supplies, irrigation, drainage and embankments, water storage, water power and groundwater.[31] The Centre, therefore, has been vested only with limited legislative powers with respect to matters related to water. In 1997, the Supreme Court, in *M.C. Mehta v. Union of India*[32], while applying Article 253 of the Constitution, ruled that the Centre's limited powers extended to the constitution of an authority that is empowered to regulate and control groundwater management and development to ensure its long term sustainability. [33]

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that there is an absolute liability on the party who caused the harm to the environment by not only paying compensation to the victims of pollution but also by restoring the environment.

29 J. Kahn, ''India Cleans Up its Act'', Newsweek.com, 6 November 2009 (May 2, 2021, 12:00) http://www.newsweek.com/ 2009/11/05/india-cleans-up-its-act.html.

30 The World Bank, Deep Wells and Prudence: Towards Pragmatic Action for Addressing Groundwater Overexploitation in India (Mar. 13, 2021, 5:25 PM), https://www.unigrac.org/sites/default/files/resources/files/GWMATE%20Books%20-%20Deep%20Wells%20and%20Prudence.pdf

31 UNDP-SIWI Water Governance Facility, Groundwater Governance in India : Stumbling Blocks for Law and Compliance (Mar. 29, 2021, 7:25 PM), https://www.watergovernance.org/resources/groundwater-governance-in-india-stumbling-blocks-for-law-and-compliance-water-governance-facility-report-no-3/#:~:text=The%20main%20findings%20show%20bottlenecks,persistent%20culture%20of%20non%2Dcompliance.&text=2013.-,Groundwater%20Governance%20in%20India%3A%20Stumbling%20Blocks%20for%20Law%20and%20Compliance,WGF%20Report%20No.

32 (1998) 3 CompLJ235 (SC).

33 UNDP-SIWI Water Governance Facility, Groundwater Governance in India : Stumbling

The Central Ground Water Board (CGWB) was given the status of an Authority i.e. CGWA as a result of the judgment. The CGWA also derives is powers from the Environment (Protection) Act, 1986 to identify and notify areas that follow patterns of groundwater extraction beyond the rate of its recharge. The mandate under Section 3 of the Environment (Protection) Act also allowed the CGWA to formulate and circulate necessary guidelines and regulations attached with penal provisions to manage the use of groundwater. Other listed functions under the Environment (Protection) Act are to achieve quality standards, educate people and persuade States to set up their own Groundwater Authorities. [34]The Ministry of Water Resources was also constituted as a subordinate office to the CGWA.

Sustainable agricultural practices in India are lacking due to which agriculture is less productive. To meet the growing demand for food, there is a need to reorient farming practices by bringing about more public investment in development and dissemination of crop varieties that are tolerant of temperature and precipitation fluctuations and more water and nutrient efficient. Better management of water resources must be a key feature of sustainable agriculture. According to the Fourth Assessment Report of the IPCC, 200 to 600 million people could suffer from hunger by 2080, globally.[35] In India, the impact of climate change on food access will extend to the rural and urban areas. In the rural areas, the uncertainty of climatic events will affect the net income of small and marginal farmers who rely on rain-fed monocropping. Similarly, the fishers and forest-dependent people and landless agricultural labourers face the risk of food inaccessibility. This food insecurity drastically affects vulnerable children and communities alike. Urban food insecurity is also a critical issue because of the migration of rural folk from coastal areas and villages in search of livelihood. This search leads these people to take up manual labour in informal sectors where there is no job security and the wages are not sufficient. The highest risks of climate change are concentrated among the low-income groups that reside in the informal settlements located in areas vulnerable to floods and landslides, like in Chennai and Mumbai.[36] Moreover, the loss of livelihood or damage to productive assets due to extreme

Blocks for Law and Compliance (Mar. 29 2021, 7:25 PM), https://www.watergovernance.org/resources/groundwater-governance-in-india-stumbling-blocks-for-law-and-compliance-water-governance-facility-report-no-3/#:~:text=The%20main%20findings%20show%20bottlenecks,persistent%20culture%20of%20non%2Dcompliance.&text=2013.-,Groundwater%20Governance%20in%20India%3A%20Stumbling%20Blocks%20for%20Law%20and%20Compliance,WGF%20Report%20No.

34 *Ibid.*

35 Yohe et al., "Perspectives on climate change and sustainability", Climate Change 2007: Impacts, Adaptation and Vulnerability (Apr. 28, 2021, 23:23), https://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter20.pdf.

36 Cecilia Tacoli et al., "Urban poverty, food security and climate change", International Institute for Environment and Development, London, 2013 (Apr. 28, 2021, 23:23), http://pubs.iied.

weather events will have a direct impact on food security because of the large expenditure incurred on consumption of food.[37]

Recent trends in terms of food distribution show that there is an ongoing struggle in fortifying food security. India was ranked 103 in the Global Hunger Index Rankings, which is the lowest for India till date.[38] This indicates that India has not reached the level of fulfilling the Sustainable Development Goal 2 which aims to end hunger, provide food security, improve nutrition and implement sustainable agricultural practices. With respect to the Sustainable Development Goals (SDG's), the issue of eradicating the negative repercussions of climate change is included as the 13th goal as proposed by the United Nations(UN)[39]. This establishes the fact that a positive transformation can arise if the sustainable goals are achieved in the long run. Hence, climate change and the goal of ensuring sustainable agricultural production go hand in hand.

Climate Change can affect the extent to which resources can be accessed. This deficiency in access hampers the scope in providing equitable distribution of resources amongst the citizens. The Preamble of the Indian Constitution emphasises on the fact that the state works on a socialist regime where we are given to interpret that India aims to be the welfare state. The emphasis on India being a welfare state is given in the Directive Principles of State Policy (DPSP). The DPSP'S aim to provide social, political and economic justice poses as an impetus to formulate and establish legislations and policies that foster implementation from the government.[40] Art. 47 and Art. 48-A of the Constitution which talks on the duty of the state to raise the level of nutrition and protection of the environment indicates the positive correlation of climate change and food security in the legal framework of India.

Conclusion

India is a country where almost 22 percent of the population is involved in agriculture and that is almost up to 263 million farmers across the nation.[41] The rest of the population is heavily dependent on these farmers for their daily nutrition. This makes India an agrarian economy which will have to spend huge amounts of wealth on the upkeep of the produce of agriculture. It is a well-known fact that climate change is changing the dynamics of

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org/10623IIED.html.

37 *Ibid.*

38 https://www.globalhungerindex.org/results/

39 http://in.one.un.org/page/sustainable-development-goals/sdg-13/

40 Indian Const. Art. 38.

41 Census, 2011, http://censusindia.gov.in/Census_And_You/economic_activity.aspx.

population in many spheres. This change in population dynamics poses challenges in analysing and understanding the current state in demography and the extent to which climate law and policy can impose actions against this change.

Climate change can be viewed as a global threat and its outcomes are a matter of great concern all around the world. In developing countries like India, it is a grave issue when it comes to agricultural sector, water management and ensuring food security. India has taken up certain steps to combat this problem which includes adopting of the Nation Action Plan on Climate Change which includes various dimensions to combat climate including the National Solar Mission and the National Mission for Enhanced Energy Efficiency.[42] However, there is no set policy nor legislation in place that can handle the issues regarding sustainable usage of water in agricultural sector that arise exclusively due to climate change. Legislative action would be a crucial step in supporting those sections of society who are especially vulnerable to food insecurity due to climate change. The policies set in place should place better management of resources at the forefront so as to improve efficiency and conserve scarce resources. If the adverse impacts of climate change must be mitigated and food insecurity must be effectively dealt with in a country such as India, there is a need for better mitigation and adaptation strategies which need better research and greater developmental effort in concurrence with financial, institutional and policy support.[43]

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42 Terry Townshend, *India's Climate Change Laws,* CLIMATE HOME NEWS (Apr. 30, 2021, 10:07), https://www.climatechangenews.com/2013/02/19/in-focus-indias-climate-change-laws/.

43 Akram A. Khan & Asim Hasan, *Climate Change: Concern for Food Security in India*, 22 IOSR-JHSS 52, 56 (2017).

Chapter 19

Rethinking Rainwater Harvesting for Addressing Climate Change: Policy Measures for Water Conservation in India

Ishita Das*

Abstract

As India grapples with the phenomenon of climate change, water scarcity could be a reality several states could face soon. Climate change can disrupt weather patterns and create extreme weather events such as droughts and floods. With the onset of the disasters, the risks associated with water contamination, water scarcity and overall water availability will rise manifold. It can increase water stress and could lead to a situation of heightened conflict or competition over water resources among the people living in such areas. Therefore, it is crucial to turn to time-tested techniques of water conservation that have benefitted humankind since ancient times. This paper aims to highlight the importance of rethinking rainwater harvesting in India keeping in view the global threat of climate change. The first part explores the background to rainwater harvesting vis-à-vis climate change and the second part discusses the importance of rainwater harvesting as an adaptation tool to climate change. The third part highlights the current policy instruments adopted by five states in India comprising Maharashtra, Delhi, Gujarat, Karnataka, and West Bengal. The final part provides the concluding remarks and suggestions.

Keywords: *Rainwater Harvesting, Climate Change, Policy.*

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Introduction

Rainwater harvesting as a tool to conserve water has been used by humanity since ancient times. This technique represents one of the key solutions to adapting to climate change, a global threat that is responsible for extreme weather events causing floods in one region and droughts in another. Rainwater harvesting can be tailored to match the contemporary requirements of people situated in different water-stressed regions across the world by incorporating new technology and adopting new knowledge. If rainwater harvesting techniques are utilised by different countries efficaciously, it may help them in addressing their water security issues.

Many countries such as India are struggling with depleting groundwater levels due to excessive dependence on this water resource.[1]The natural causes that contribute towards the depletion of groundwater levels include no rainfall for several years, high temperature, and high evaporation. The human factors behind such depletion include high dependency of the agricultural sector for irrigation purposes, frequent pumping,[2] increase in the density of population and lastly, deforestation that results in severe surface-run offs. According to UNICEF, nearly half of the world's population could be living in areas that face the problem of water scarcity by as early as 2025, and around seven hundred million people could be displaced by severe water scarcity by 2030.[3]

Therefore, India should come up with strong measures to deal with its water security challenges. Many states in India, including Delhi, Karnataka, and Gujarat, have adopted rainwater harvesting policies to encourage adopting this technique in the respective states.[4] The comprehensive report prepared by the ENVIS Centre, Central Pollution Control Board, Delhi,provides a good overview of the practices adopted by different states to implement rainwater harvesting techniques and the mandatory requirements that varied categories of buildings have to comply with, in these states.[5]

1 Swarup Dangar et al., *Causes and Implications of Groundwater Depletion in India: A Review*, 596 Journal of Hydrology (2021).

2 *Ibid.*

3 United Nations Children's Fund [UNICEF], *Water Scarcity: Addressing the Growing Lack of Available Water to Meet Children's Needs*, (14 May, 2021), https://www.unicef.org/wash/water-scarcity#:~:text=Key%20facts,by%20as%20early%20as%202025.

4 Centre for Science and Environment [CSE], *Laws and Policy*, (14 may, 2021)https://www.cseindia.org/laws-and-policy-1161#:~:text=of%20India%20has%20made%20modifications,unless%20such%20provision%20is%20provided.&text=Buildings%20with%20plots%20of%20200%20sq(last visited May 14, 2021).

5 Central Pollution Control Board [CPCB] Envis Centre, *Rainwater Harvesting in India: An Appraisal* (2016), (14 may, 2021), http://cpcbenvis.nic.in/envis_newsletter/RWH%20in%20India%20-%20An%20Appraisal%20CPCBENVIS.pdf.

However, it is crucial that there is a centralised framework that deals with the benefits of adopting rainwater harvesting as a mechanism to adapt to climate change, addresses the challenges stemming from water scarcity, and provides a blueprint to develop India's response to water security concerns. While the Central Government has taken active steps to encourage the implementation of rainwater harvesting in the states through different mechanisms, there is no dedicated national policy framework that deals with this concern. The Central Government has formulated the National Water Policy 2012 that advocates for the adoption of rainwater harvesting among the states, conservation of water, and augmenting the availability of water through direct utilization of rainfall, *inter alia*.[6]

The Model Bill to Regulate and Control the Development and Management of Groundwater, 2005, and its 2011 successor that aim to deal with the conservation, regulation, protection, and management of groundwater, do not refer to climate change but only refer to environmental protection in general.[7] However, the 2016 version does specify that the equitable and sustainable utilization of groundwater resources can aid in curbing the pressing problems of farmer suicides in India as well as adapting to the global threat of climate change.[8]Thus far, about fifteen states have implemented policies reflecting the Model Bill as per the Ministry sources.[9] Further, the Ministry of Housing and Urban Affairs' Model Building Byelaws 2016 contains a chapter dedicated to rainwater harvesting in buildings. It applies to all residential plots above a hundred sq. m.[10]

The Central Ground Water Authority [hereinafter referred to as "CGWA"], constituted under Section 3 (3) of the Environment (Protection) Act, 1986, aims to regulate, control, and manage groundwater resources in the country.[11]Under Section 5 of the Act, the CGWA is empowered to issue directions for mandatory rainwater harvesting or roof-top rainwater harvesting for all target areas in the country, including Union Territories.[12] The 'No Objection Certificate' is recommended for drawing groundwater only after the guidelines

6 Ministry of Jal Shakti (Water Resources), Government of India, *National Water Policy 2012*, (14 may,2021), http://jalshakti-dowr.gov.in/sites/default/files/NWP2012Eng6495132651_1.pdf..

7 Kerstin Mechlem, *Groundwater Governance: The Role of Legal Frameworks at the Local and National Level - Established Practice and Emerging Trends*, 8 (8): 347 Water 9 (2016).

8 Ministry of Water Resources, Government of India, *Model Bill for the Conservation, Protection, Regulation, and Management of Groundwater 2016*, (14 May, 2021), http://mowr.gov.in/sites/default/files/Model_Bill_Groundwater_May_2016_0.pdf.

9 Ministry of Water Resources, Government of India, *Steps taken by the Central Government to Control Water Depletion and Promote Rainwater Harvesting/Conservation*, (14 may, 2021), http://mowr.gov.in/sites/default/files/Steps_to_control_water_depletion_Jun2019.pdf.

10 Ministry of Housing and Urban Affairs, Government of India, *Model Building Bye-Laws 2016*, (14 may, 2021, http://mohua.gov.in/upload/uploadfiles/files/MBBL.pdf ((last visited May 14, 2021).

11 The Environment (Protection) Act, 1986, § 3.

12 *Ibid.* at § 5.

on mandatory rainwater harvesting are implemented.[13] As under the Constitution of India, the subject relating to water resources is contained in List II or the State List under the Seventh Schedule,[14]the states are expected to take the lead in resolving issues relating to this subject. However, the lack of a uniform binding framework is a hurdle towards recognising the importance of rainwater harvesting as an essential tool towards addressing the global threat of climate change and contributing to resolving problems relating to groundwater security.

Groundwater depletion is a global phenomenon with over-reliance, over-exploitation, and over-utilisation of this resource that could pose a huge challenge in developing sustainable strategies. For example, Wada et al. estimate in their 2010 study, through mathematical tools, that global groundwater depletion has increased from 126 (±32) $km^3\ a^{-1}$ in 1960 to 283 (±40) $km^3\ a^{-1}$ in 2000. The authors further note that the latter equals 39 (±10)% of the global yearly groundwater abstraction, and reflect about 2 (±0.6)% of the global yearly groundwater recharge. They have defined groundwater depletion as abstraction in excess of recharge.[15] Many groundwater systems are increasingly viewed by experts as 'non-renewable' that will have an inadvertent impact on its future use.[16]The withdrawal figures are far higher than the recharge of the groundwater systems, with many aquifers considered as 'stressed' globally. Groundwater stress is essentially the ratio between groundwater use and availability. This could be further aggravated by climate change or variability that may affect groundwater recharge and use.[17]Therefore, it is important to focus on strategies for artificial recharge of the groundwater systems, such as rainwater harvesting, that can greatly contribute towards the restoration of the groundwater levels.

The Central Groundwater Board [hereinafter referred to as "CGWB"], Ministry of Jal Shakti, prepared a Guide on Artificial Recharge to Groundwater in 2000 that specifies how in urban areas rooftop rainwater harvesting can be used to recharge groundwater levels.[18] The rooftop rainwater harvesting technique involves the use of the outlet pipe to divert the water so collected in the rooftops to wells, borewells, tube-wells, or specially designed

13 *Supra* note 9.

14 India Const., Seventh Schedule, List II – State List, Entry 17.

15 Yoshihide Wada et al., *Global Depletion of Groundwater Resources*, 37 (20) Geophys. Res. Lett. 1 (2010).

16 B.F. Thomas & J.S. Famiglietti, *Identifying Climate-Induced Groundwater Depletion in GRACE Observations* 9 Sci. Rep. 4124 (2019).

17 *Ibid.*

18 Central Ground Water Board, Ministry of Water Resources, Government of India, *Manual on Artificial Recharge of Groundwater*, (14 May, 2021), http://cgwb.gov.in/documents/Manual%20on%20Artificial%20Recharge%20of%20Ground%20Water.pdf (2007).

wells. The larger the surface area of the rooftops, the greater is the quantity of water collected. For example, as opposed to a rooftop measuring two hundred sq. m. that receives two hundred mm rainfall, out of which only thirty-two mm can be conserved through this technique, for a rooftop measuring two thousand sq. m., for the same amount of rainfall received, three hundred twenty mm can be conserved. The table below indicates how this mechanism can be given effect to, with the instance highlighted above [Table 1].[19]

Table 1: Availability of Rainwater for Roof Rainwater Harvesting as per the Manual on Artificial Recharge of Groundwater, 2007

Rainfall (mm)	100	**200**	300	400	500	600	800	1000	1200	1400	1600	1800	2000
Rooftop area (sq. m.)	Harvested water from rooftop (cu. m.)												
20	1.6	3.2	4.8	6.4	8	9.6	12.8	16	19.2	22.4	25.6	28.8	32
30	2.4	4.8	7.2	9.6	12	14.4	19.2	24	28.8	33.6	38.4	43.2	48
40	3.2	6.4	9.6	12.8	16	19.2	25.6	32	38.4	44.8	51.2	57.6	64
50	4	8	12	16	20	24	32	40	48	56	64	72	80
60	4.8	9.6	14.4	19.2	24	28.8	38.4	48	57.6	67.2	76.8	86.4	96
70	5.6	11.2	16.8	22.4	28	33.6	44.8	56	67.2	78.4	89.6	100.8	112
80	6.4	12.8	19.2	25.6	32	38.4	51.2	64	76.8	89.6	102.4	115.2	128
90	7.2	14.4	21.6	28.8	36	43.2	57.6	72	86.4	100.8	115.2	129.6	144
100	8	16	24	32	40	48	64	80	96	112	128	144	160
150	12	24	36	48	60	72	96	120	144	168	192	216	240
200	16	**32**	48	64	80	96	128	160	192	224	256	288	320
250	20	40	60	80	100	128	160	200	240	280	320	360	400
300	24	48	72	96	120	160	192	240	288	336	384	432	480
400	32	64	96	128	160	192	256	320	384	448	512	576	640
500	40	80	120	160	200	240	320	400	480	560	640	720	800
1000	80	160	240	320	400	480	640	800	960	1120	1280	1440	1600
2000	160	**320**	480	640	800	960	1280	1600	1920	2240	2560	2880	3200
3000	240	480	720	960	1200	1440	1920	2400	2880	3360	3840	4320	4800

Rainwater harvesting is a cost-effective solution to deal with the pressing water scarcity issues that are going to become a reality shortly for several countries, including India.[20] The problems of water security will only worsen with climate change or variability and therefore, India should address this concern directly through an effective legal instrument at the Central level. This piece of legislation can be later modified to suit the needs of

19 The table has been reproduced from the Manual on Artificial Recharge of Groundwater, 2007 (Table 7.4.a).

20 *Supra* note 5 at 18-19.

the different states. The next section explores how rainwater harvesting can serve as an adaptation mechanism for dealing with the global threat of climate change.

Rainwater Harvesting as an Adaptation Mechanism to Climate Change

Extreme changes triggered by climate change can affect human society in an extremely profound manner. Events such as floods, droughts, aridity, heat wave, cyclones, and hurricanes can have a long-lasting impact on humankind. Many extreme weather events may cause the widespread migration of people, dislocation or relocation, abandonment of existing dwelling premises, severe restriction of access to drinking water, and creation of a ripe environment for the spread of water-borne diseases. Some experts argue that the impact of extreme weather events created by climate change can be addressed by adopting strategies such as rainwater harvesting that help in the conservation of water and deal with the needs of the affected people during times of such crises.[21]

Recent studies have traced how climate change has affected societies in the prehistoric and early historic times,[22] wherein climate variability and drought have been considered as the primary factors behind human migration and the ultimate collapse of their societies. Human migration due to climate change and stress on the environment are well-documented survival strategies across several continents such as Australia, Africa, Eurasia, and South America.[23]The team of experts have determined how humans have focused on survival throughout history in North America, the Arabian Peninsula, and South America by constructing reservoirs, water impounding structures, and artificial water bodies to deal with adverse climatic conditions.[24]

Concerning India, according to archaeological and historical pieces of evidence, people resorted to the intensive utilisation of rainwater harvesting to deal with aridity, as evident from paleo-climatic studies. Rainwater harvesting as an extremely potent solution to conserve water finds mention in the ancient texts comprising the *Rig Veda*, the *Atharva Veda*, the *Arthashashtra*, the *Brihat Samhita*, and the *Rajatarangini*.[25]The authors, Jackson *et*

21 DN Pandey et al., *Rainwater Harvesting as an Adaptation to Climate Change*, 85 (1) Current Science 46 (2003).

22 J Pedro *et al.*, The Spatial Extent and Dynamics of the Antarctic Cold Reversal, 9 *Nature Geosci* 51–55 (2016).

23 *Supra* note 21 at 47.

24 *Ibid* at 52-53.

25 KS Nair, 2004, 'Role of Water in the Development of Civilization in India: A Review of Ancient Literature, Ancient Practices and Beliefs' in JC Rodda and Lucio Ubertini (eds.), *The Basics of Civilization – Water Science?, Proceedings of the UNESCO/IAHS/IWHA Symposium held at Rome,*

al., note that rainwater harvesting is more relevant for contemporary times than historical times due to an increase in population density, rising stress on freshwater resources, lack of access to clean drinking water, and sanitation services.[26]

While climate variability is triggered by both natural and anthropogenic factors, the latter is increasingly contributing to the rise in global warming through activities such as high dependence on fossil fuels for meeting energy demands, and deforestation for various purposes such as developing industrial projects, among others. The Intergovernmental Panel on Climate Change ["IPCC"] states that human actions have deeply affected the water cycle due to the impact on the carbon cycle.[27]This problem would only compound over time, and in the future, when water scarcity would become a huge challenge for India, the country may be compelled to look for solutions that could be capital-intensive and time-consuming. Therefore, India should consider time-tested solutions that have benefitted generations of humankind in tackling adverse climatic conditions in the past.

While the Central Government and different state governments have shown an active interest in adopting this method to deal with water security issues in modern India, the lack of a streamlined and focused approach towards the implementation of rainwater harvesting is perhaps one of the major reasons behind the outcomes not being up to the mark as envisioned by the policy-makers. While it is great to have good policy mechanisms that contain details regarding the adoption of rainwater harvesting, such policies would be futile without proper implementation across various districts of the respective states. For example, the state of West Bengal is struggling with the issue of arsenic poisoning that results from the Ganges aquifers being contaminated with naturally occurring arsenic.[28] This has grave health repercussions for the people dependent on water in such areas. This has been dealt with in greater detail in the next part.

Further, with the rise of global temperatures, there is a high possibility of an increase in deadly pathogens in freshwater resources that could be extremely detrimental to the health of the humans consuming such water.[29]Freshwater resources such as groundwater could

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December 2003, IAHS Publications, 286, p. 160.

26 Jackson et al., *Water in a Changing World*, 11 (4) Ecol. Appl. 1027 (2001).

27 Intergovernmental Panel on Climate Change [IPCC], *Climate Change 2013: The Physical Science Basis, Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* 467 (TF Stocker et al. eds., Cambridge University Press, 2013).

28 DG Mazumder& UB Dasgupta, *Chronic Arsenic Toxicity: Studies in West Bengal, India*, 27 (9) The Kaohsiung Journal of Medical Sciences 360 (2011).

29 R. Cavicchioli et al., *Scientists' Warning to Humanity: Microorganisms and Climate Change*, 17 Nat. Rev. Microbiol. 569 (2019).

be contaminated by bacteria, viruses, and other microbes, with proximity to agricultural activities and certain geological factors increasing the vulnerability of such areas.[30] There is also an increased possibility of water stress that may lead to competition over water resources. According to the World Resources Institute [hereinafter referred to as "WRI"], more than two billion people live in countries that experience high waterstress.[31]The WRI found that several countries would face aggravated challenges and competition issues over water scarcity soon.[32]

There are different methods to adopt rainwater harvesting to deal with surface runoff and also engage in the process of artificial recharge of the groundwater resources. Rainwater harvesting can help the urban communities to utilise the surface-runoff through mechanisms such as tube-well, recharge pit, recharge trench and recharge well.[33]Conservation of rainwater that gets lost as runoff could be key to addressing water security issues in urban areas. Rainwater harvesting techniques can be used to recharge groundwater aquifers through artificial recharge techniques that can be adopted in rural areas through contour bund, dugwell recharge, gully plug, percolation tank, nala bund, and recharge shaft.[34]As per the Manual prepared by the CGWB, rainwater harvesting can be used to artificially recharge groundwater through percolation tanks and dams apart from rooftop rainwater harvesting and conservation of runoff rainwater.[35]

The conservation of rainwater is one of the key mechanisms to deal with water stress in those areas where there is tremendous pressure on a certain segment or section of the human population concerning drinking water. For example, the CGWB's 2000 Guide highlights that artificial recharge through injection wells was successfully adopted at Bhadrachallam, Andhra Pradesh, wherein about two to three lakhs of pilgrims were provided with access to safe drinking water,during the festival of Ramanavami. The injection well is similar to that of the tube. The essential difference is that the former is designed to enhance the groundwater storage of a confined aquifer by injecting treated

30 Kari Lydersen, *Will Climate Change Increase the Presence of Pathogens in Drinking Water?*,Ensia (Oct. 21, 2020), https://ensia.com/features/climate-change-drinking-water-pathogens/#:~:text=An%20increase%20in%20heavy%20precipitation,types%20of%20geology%20increase%20vulnerability.

31 Anastasia Moloney, *Water Wars: How Conflicts over Resources are Set to Rise Amid Climate Change*, World Economic Forum (Sep. 7, 2020), https://www.weforum.org/agenda/2020/09/climate-change-impact-water-security-risk.

32 Andrew Maddocks et al., *Ranking the World's Most Water-Stressed Countries in 2040*, World Resources Institute (Aug. 26, 2015), https://www.wri.org/insights/ranking-worlds-most-water-stressed-countries-2040.

33 *Supra* note 18 at 48-50.

34 *Ibid.*

35 *Ibid.*

surface water under pressure.[36]

Therefore, climate change or variability has a deep interlinkage with water resources, including freshwater resources such as groundwater . About fifty percent of the world's population depends on drinking water, and forty-three percent of the global population relies on it for meeting their agricultural needs. Nearly two and a half billion people depend on groundwater resources to meet their daily needs.[37]According to some experts, about twenty percent of the world's aquifers face over-exploitation that may result in serious ramifications such as saltwater intrusion and land subsidence.[38]As climate change has a multi-faceted impact on Indian society, including environmental, social, and economic aspects, the Central Government should pave the path for a binding Central policy framework that may be adopted after suitable modifications by the respective states.

Policy Instruments to Implement Rainwater Harvesting in Five States

States such as Gujarat, West Bengal, Delhi, Karnataka, and Maharashtra have adopted different strategies to promote the concept of rainwater harvesting as a water conservation mechanism in their respective states. The CGWB has created a document dedicated to laying down the standard designs for the adoption of rainwater harvesting in the state of Delhi wherein trench and trench with bores have been provided as the recommended harvesting structures across the different districts of New Delhi, North-West, West, South-West, North, North-East, West, Central, and South Delhi. The document, apart from containing the basic guidelines regarding the construction of the harvesting structures, includes a detailed plan regarding trench with recharge well and recharge trench for rooftop measuring up to hundred sq. m., between hundred and two hundred sq. m., between two hundred and three hundred sq. m., three hundred and four hundred sq. m., and four hundred and five hundred sq. m., respectively. The table below represents the data concerning trench with recharge well [Table 2].[39]

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36 Central Ground Water Board, Ministry of Water Resources, Government of India, *Guide on Artificial Recharge to Groundwater*, (14 may,2021), http://cgwb.gov.in/documents/ArtificialRecharge-Guide.pdf (2000).

37 United Nations Educational, Scientific and Cultural Organization [UNESCO], *The United Nations World Water Development Report 2015: Water for a Sustainable World, Facts and Figures* (2015), (14 may,2021), http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/images/WWDR2015Facts_Figures_ENG_web.pdf.

38 *Ibid.*

39 Central Ground Water Board, Standard Designs for Adoption of Roof Top Rainwater Harvesting, (14 may, 2021), http://cgwb.gov.in/documents/Standard%20Dessign%20of%20AR%20for%20Delhi.pdf.

Table 2: Trench with Recharge Well

Roof Top Area (sq. m.)	Highest Rainfall Intensity (mtr/hourly)	Run-off Coefficient	Runoff/hr (cu. m.)	Annual Runoff (cu. m.)	Size of Recharge Structure (mtr)
a	b	c	d(aXbXc)	e(aX0.54Xc)	LXBXH
100	0.025	0.8	2.0	43.20	1.0X0.5X0.5
200	0.025	0.8	4.0	86.40	1.0X1.0X1.0
300	0.025	0.8	6.0	129.60	1.0X1.0X1.0
400	0.025	0.8	8.0	172.80	1.0X1.0X1.0
500	0.025	0.8	10.0	216	2.0X1.5X1.0

The state government of Maharashtra has made it mandatory for all buildings with an area measuring a hundred sq. m. and above to invest in rainwater harvesting, following the Model Building Byelaws, 2016. The main issues facing the groundwater resource in the state relate to the presence of contaminants in the form of fluoride, chloride, iron, nitrate, and salinity.[40] While the government has enacted the Maharashtra Water Resources Regulatory Authority Act 2005 that established the Maharashtra Water Resources Regulatory Authority under Section 3,[41] and a law dedicated to the sustainable, equitable, and adequate supply of groundwater, titled the Maharashtra Groundwater (Development and Management) Act, 2009,[42] these pieces of legislation do not promote the adoption of rainwater harvesting as a technique to deal with groundwater depletion.

The state of West Bengal, in addition to the presence of contaminants in the groundwater resources, also has the presence of arsenic in several parts such as Howrah, Murshidabad, North 24 Parganas and South 24 Parganas.[43] As per the World Health Organization ["WHO"], arsenic is highly toxic in its inorganic form and if consumed through drinking water and crops that have been irrigated using that contaminated water, can pose serious health risks for people. Long-term exposure to arsenic can cause skin lesions and even cause cancer. It may even harm the cognitive development of children and may even cause death among young adults.[44] The West Bengal Groundwater Resources (Management, Control, and Regulation) Act, 2005 and the Rules framed thereunder aim to deal with the management, control, and regulation of indiscriminate exploitation of groundwater resources in the state.

40 Central Ground Water Board, *State Profile: Ground Water Scenario of Maharashtra*, (14 may,2021), http://cgwb.gov.in/gw_profiles/st_Maharashtra.htm.

41 The Maharashtra Water Resources Regulatory Authority Act 2005, § 3.

42 The Maharashtra Groundwater (Development and Management) Act, 2009, § 1.

43 Central Ground Water Board, *State Profile: Ground Water Scenario of West Bengal*, (14 may,2021), http://cgwb.gov.in/gw_profiles/st_westbengal.htm.

44 World Health Organization [WHO], *Arsenic* (Feb. 15, 2018), https://www.who.int/news-room/fact-sheets/detail/arsenic.

While the Act does not make an explicit reference to rainwater harvesting, it does specify under Section 6 that the State Level Authority shall undertake efforts to creating awareness and encouraging interaction between ancient and time-tested water conservation strategies and modern technologies. This provision also emphasises that such water conservation strategies should be adopted to minimise the extraction of groundwater resources.[45]Rule 171 of the West Bengal Municipal (Building) Rules, 2007 states that rainwater harvesting shall be incorporated in new buildings, new housing complexes, or expansion of new buildings or housing complexes.[46]The state has also incorporated the requirements under the Model Building Byelaws, 2016. However, there is no detailed plan laid down to encourage the adoption of rainwater harvesting strategies in the state.

The state of Gujarat has established the Gujarat Ground Water Authority ["GGWA"] vide the government's resolution dated 19/09/2001, under the administrative control of the Narmada Water Resources and Water Supply Department, Government of Gujarat, to manage, develop, and regulate the use of the groundwater resources in the state.[47]The state has also adopted the Model Building Byelaws, 2016, to incorporate the adoption of rainwater harvesting through appropriate modifications in the Gujarat Town Planning Act, 1976. This state is dealing with contaminants such as fluoride, chloride, iron, nitrate, and salinity in several districts, including Ahmedabad, Amreli, Bharuch, Bhavnagar, Kachchh, Mehsana and Narmada.[48]

While the state has notified that they are working on the development of a Bill to regulate the use of groundwater resources, the same is yet to be enacted.[49] The state has a dedicated law to deal with water issues such as the Gujarat Irrigation and Drainage Act, 2013that seeks to promote equitable distribution of water resources with a specific focus on irrigation and drainage. While the cities of Gandhinagar and Mehsana face a severe crisis of groundwater exploitation, the Act may not guarantee the prevention of further over-exploitation of the resource.[50] Therefore, there is still no specific legal instrument that advocates for the adoption of rainwater harvesting in the state.

45 The West Bengal Groundwater Resources (Management, Control and Regulation) Act, 2005, § 6.

46 The West Bengal Municipal (Building) Rules, 2007, r. 171.

47 Gujarat Water Resources Development Corporation Ltd. [GWRDC], Gujarat Ground Water Authority, (14 may,2021), https://www.gwrdc.gujarat.gov.in/ggwa.html.

48 Central Ground Water Board, *State Profile: Ground Water Scenario of Gujarat*, (14 may,2021), http://cgwb.gov.in/gw_profiles/st_Gujarat.htm.

49 *Gujarat Drafting Bill to Check Depletion of Groundwater*, The Indian Express (Apr. 24, 2018), https://indianexpress.com/article/cities/ahmedabad/govt-drafting-bill-to-check-depletion-of-groundwater-5149009/.

50 Anupam Chakravartty, *Gujarat Passes Groundwater Bill*, DownToEarth (Mar. 31, 2013), https://www.downtoearth.org.in/news/gujarat-passes-groundwater-bill-40602.

The state of Karnataka faces issues such as contamination of groundwater resources through fluoride, chloride, iron, nitrate, and salinity.[51] Holland-Stergar notes that while the city of Bangalore is one of the wealthiest in India, and is referred to as the Silicon Valley of the country, only half of its residents have private access to municipal water resources. Those residents who do have access to municipal water meet their daily requirements by obtaining groundwater from public taps, wells, and unregulated street vendors, among others.[52] The municipal water supply in the city is taken care of by the Bangalore Water Supply and Sewerage Board [hereinafter referred to as "BWSSB"].

The city's primary source of municipal water is the Cauvery River, wherein the allotments noted by Holland-Stergar during the time of writing the research paper only catered to sixty percent of the city's per capita water needs. The city receives about thirty-four inches of rainfall annually, and various studies highlight that if the technique of rainwater harvesting is employed in the city, it could match more than half of the city's water requirements. The BWSSB tried to implement rainwater harvesting by mandating the new construction buildings to incorporate the same in 2004. However, their experiment was not successful. Therefore, in 2009, the BWSSB adopted the Bangalore Water Supply and Sewerage Amendment Act that mandated certain categories of buildings to adopt rainwater harvesting techniques in their premises.[53]

However, in 2013, the BWSSB found out that out of the fifty-five thousand households that were covered under the Amendment Act, only twenty-five thousand complied, while the remainder ignored. Therefore, more than fifty percent violated the rainwater harvesting norms as stipulated under the Act. Several reasons can be attributed towards this attitude of the residents who chose to not comply: (a) lack of proper enforcement of the requirements, coupled with a casual approach adopted by the representatives of the BWSSB, (b) lack of financial assistance to the residents who found the installation of the rainwater harvesting systems expensive or exorbitant, (c) lack of sufficient incentives for the residents to adopt rainwater harvesting when the BWSSB was providing municipal water at a highly subsidised rate, and finally, (d) attitudinal apathy towards the problem of water scarcity as some residents themselves did not face water shortage issues. Therefore, the BWSSB, essentially, failed to generate the requisite awareness among the residents of Bangalore regarding rainwater harvesting.[54]

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51 Central Ground Water Board, *State Profile: Ground Water Scenario of Karnataka*, (14 may,2021), http://cgwb.gov.in/gw_profiles/st_Karnataka.htm.

52 Brienne Holland-Stergar, *The Law and Policy of Rainwater Harvesting: A Comparative Analysis of Australia, India, and the United States*, 36 (1) UCLA Journal of Environmental Law and Policy 138-139 (2018).

53 *Ibid*. at 139.

54 *Ibid*. at 140-143.

Karnataka has also enacted the Karnataka Groundwater (Regulation and Control of Development and Management) Act, 2011 that aims to regulate and control the development and management of groundwater resources in the state. The primary goal of this piece of legislation is to curb the indiscriminatory exploitation of groundwater in the notified areas. While the state had enacted the Groundwater (Regulation for Protection of Sources of Drinking Water) Act, 1999 that focused on the regulation of access to drinking water, this fairly recent law establishes the Karnataka Groundwater Authority [hereinafter referred to as the "KGWA"], regulates the extraction of groundwater resources in the notified areas, and also specifies the minimum distance between the bore wells dug for irrigation purposes, *inter alia*.

The Karnataka law contains a dedicated chapter on the adoption of rainwater harvesting to address the problem of overexploitation of the groundwater resources wherein Section 22 of the 2011 Act stipulates that the KGWA shall (a) identify the recharge-worthy areas in the state, (b) provide appropriate directions to the concerned government departments to incorporate rainwater harvesting in the developmental activities falling under the purview of the notified areas, (c) issue appropriate directives in the urban spaces for the construction of the rainwater harvesting structures having an area of 100 sq. m. or more, (d) take action for the promotion of awareness about rainwater harvesting and recharge of groundwater resources through various agencies such as educational institutions, NGOs, industries, and individuals, and (e) devise incentivisation/subsidisation schemes for farmers who adopt rainwater harvesting techniques and engage in water conservation in their daily activities.[55]While the Act is a step in the right direction, it does not provide detailed specifications regarding the implementation of rainwater harvesting in the state.

Conclusion

The ancient knowledge, traditions, and practices relating to rainwater harvesting and conservation of water are being increasingly utilised across the globe to address various issues such as water scarcity, depletion or over-exploitation of groundwater resources, and access to safe drinking water. Rainwater harvesting can be adopted in both urban and rural spaces through appropriate mechanisms such as tube-well, recharge pit, recharge trench, recharge well, contour bund, dugwell recharge, gully plug, percolation tank, nala bund, and recharge shaft. While the Central Government has adopted several steps to promote rainwater harvesting in the country, as water is a state subject, the states have the main

55 The Karnataka Groundwater (Regulation and Control of Development and Management) Act, 2011, § 22.

responsibility to take action for water conservation and protection of the groundwater resources.

The author has explored how five states, including Gujarat, West Bengal, Delhi, Karnataka, and Maharashtra have adopted different legal and policy instruments to deal with issues such as indiscriminate utilisation of groundwater resourcesand the broad regulation, development, management and control thereof. However, these instruments do not lay down detailed guidelines regarding the implementation of rainwater harvesting as a mechanism to address various water security issues, especially to mitigate the global threat of climate change. The technique of rainwater harvesting can not only aid in the recharge of groundwater resources but also play a major role in dealing with water scarcity issues in times of severe weather events such as floods, hurricanes, cyclones, droughts, among others, triggered by the changing climate.

The Central Government's Rainwater Harvesting Guide is useful as it contains the different techniques through which rainwater can be harvested in both urban and rural spaces. However, this document does not include policy provisions that could be adopted by the states. Therefore, the current instruments are not sufficient to address the other problems stemming from climate variability. Therefore, there should be in place a centralised framework that aims to deal with rainwater harvesting that can be adopted at the respective state levels. This document titled, 'Rainwater Harvesting Policy' [hereinafter referred to as "RHP"] could serve as the blueprint connecting different aspects contained under the current policy or legal documents.

The RHP can incorporate different aspects associated with rainwater harvesting such as the promotion of different plans, schemes, policies, and programmes for spreading awareness about the benefits of rainwater harvesting in different states, especially concerning adapting to the global problem of climate change, and encourage the participation of the community towards contributing to the effectiveness of the RHP, such as the involvement of women who could be provided training to incorporate rainwater harvesting techniques in their homes and neighbourhoods. Young children should be provided mandatory education about rainwater harvesting and how it can aid in mitigating the climate crisis.

The RHP should, further, lay down the role of the respective regulatory bodies and their functions, provide for basic financial or technical assistance towards the installation of the rainwater harvesting systems if required, and also provide incentives for the citizens who contribute towards such adoption through different mechanisms such as tax rebates, etc. that the respective states may determine from time to time. The RHP, if designed and implemented efficaciously, could be replicated in other parts of the world where people face water security issues due to several factors, especially climate change. It is not sufficient to have guides or manuals on rainwater harvesting without having a strong regulatory framework in place.

Rainwater harvesting should be considered as an important tool towards addressing the global challenge of climate change and adequate efforts should be undertaken in India to ensure that the country is well-prepared to deal with the global threat before water scarcity becomes a reality for most states in India. Therefore, it is pertinent that the knowledge passed down to us from time immemorial is combined with innovation in technology in the contemporary setting, manuals or guides on rainwater harvesting techniques are adopted in both rural and urban spaces, there is awareness about its importance especially concerning climate change, and a strong policy framework is in place for India to be in a position to address its water security concerns effectively.

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PART V

Economic Evaluation of Efficiency of Water Projects

Chapter 20
Economic Analysis of Water Use Efficiency and Energy Costs in Godavari Command Area

Banda Sainath* Dr. P. S. Srikantha Murthy**

Abstract

The study was undertaken in Karimnagar and Warangal districts falling under the Godavari command area of Telangana to analyze the economics of irrigation among the farm households across surface water (SW), groundwater (GW), and conjunctive use (CU) regimes. The required data was collected and it was analyzed using descriptive statistics and natural resource economics tools. The farms under CU realized higher net returns per acre (₹ 11792), followed by GW farms (₹ 8229) and SW farms (₹ 7516). The economic water use efficiency was lower under the SW regime (₹ 96.45/acre-inch) compared to farms under GW (₹ 365.08/acre-inch) and CU (₹ 537.22/acre-inch) regimes. The share of energy cost in the total cost of irrigation was 31 per cent in the case of Conventionally Irrigated Farms (CIF), followed by 17 per cent in the case of Drip Irrigated Farms (DIF) under the GW regime. Whereas, it was found to be 35 per cent in the case of CIF under the CU regime. The outcomes of the study may be considered in formulating scientific pricing and rationalizing the energy costs under the SW regime and strengthening water policies to ensure equitable distribution of irrigation water in the command areas.

Keywords: *Conjunctive use, Water use efficiency, Energy costs, Conventional and Drip Irrigation Systems.*

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Introduction

Water is the prime source of life on earth. This precious but scarce resource is used for drinking, domestic use, irrigation and industrial purposes. In tropical countries like India, irrigation plays a vital role in securing food for the masses. The other key inputs *viz*., high-yielding variety seeds and chemical fertilizers cannot be used to the fullest extent if irrigation is not assured. Besides, the supply of land is highly inelastic and growth in the net sown area is impossible. This has led to the dependence of agricultural productivity on the efficient use of water and land resources. Irrigation has also greatly facilitated diversification in the cropping pattern towards high-value crops. Irrigation not only has improved the food production and economic conditions of a large number of farmers but also has contributed immensely towards ensuring food security and alleviating poverty. These benefits of water through irrigation have increased the demand for water at an exploitative rate.

To meet the demands of the farm and non-farm population, new technologies have come up with dynamic ways of extracting that natural resource. Earlier, farmers were mainly dependent on surface water sources like dams, reservoirs, canals etc., for the irrigation purpose. The dams are constructed to store flowing water and supply the stored water whenever required during different parts of the year. This continuous and assured supply of water through canals has helped to increase agricultural production.

Of late, increasing surface-water shortage and unreliable canal water supplies have induced the farmers to use more and more groundwater to irrigate their crops. This accessibility to groundwater has helped the farmers to improve the yield. However, in order to reap the benefits of high-value agriculture, the landowners have been frantically investing in drilling wells, especially in hard rock areas where there is no assured source of surface irrigation and pumping water enormously without caring for recharging of those wells. This is a kind of "tragedy of commons"[1], As groundwater level gets lowered, cost of irrigation raises for all, as they need to deepen their existing wells and require to install high-capacity pumps. This is a typical case of reciprocal negative externality associated with groundwater over-exploitation. In a study conducted on institutional arrangements in water sharing, it was observed that the institutional arrangement plays a crucial role in bringing down the negative externality[2].

1 Where in every well owner tries to draw as much water as he can and in the process deplete the resource. As groundwater is treated as a common pool resource, a user maximizing his share will reduce others' share.

2 Rohit, B. K., 2007. Economics of surface water irrigation institutions in Cauvery Basin of Karnataka. *Ph.D. Thesis (Unpub.),* Univ. Agric. Sci., Bengaluru.

To address the problem of over-exploitation of the available natural resource, a new management technique has been evolved, which is called as Conjunctive use of water. There is no rigorous definition for the 'conjunctive use' of groundwater and surface water resources. But it is proposed to consider the situations where both types of sources are developed (or co-existed) to supply irrigation water, although not necessarily using both sources continuously over time.

A planned conjunctive use of groundwater and surface water has the potential to offer benefits in terms of economic and social outcomes through significantly increased water use efficiency. It supports greater food and fiber yield per unit of water use, an important consideration within the international policy arena given the critical concerns for food security that prevail in many parts of the world. At the resource level, groundwater pumping for irrigation used in conjunction with surface water provides benefits that increase the water supply or mitigate undesirable fluctuations in the supply[3] and control shallow water table levels and consequent soil salinity.

Previous studies have shown that economic water use efficiency was higher under DIF than in CIF[4]. Studies have also revealed that economic water use efficiency was higher under the CU regime when compared to SW and GW regimes[5].

This study focuses on the importance of proper pricing of water as it deals with estimation of costs incurred in extracting and using water under surface and groundwater regimes. This study also explores the importance of adopting the conjunctive method of irrigation in water management. This study was funded by ICAR-IIWM, Bhubaneswar under Agri-Consortia Research Platform on Water.

Material and Methods

Data

Godavari command area, falling under Karimnagar and Warangal districts, was purposively selected as the study area. A random sampling technique was employed to select the sample respondents, including 60 farmers dependent largely on Groundwater (GW), 60 farmers

3 TSUR, Y., The stabilisation role of groundwater when surface water supplies are uncertain: The implications for groundwater development. *Water Resources Research*, 5, (1990).

4 Chandrakanth, M. G., Priyanka, C. N., Mamatha, P. and Kiran, K. R. P., Economic benefits from micro irrigation for dryland crops in Karnataka. *Indian J. Agric. Econ.,* 327, (2013)

5 Suhas Chandra, R. S., 2017. Institutional economic analysis of conjunctive use in Cauvery river basin of Karnataka. *M. Sc. Thesis (Unpub.),* Univ. Agric. Sci., Bengaluru.

using Surface water (SW), and 60 farmers practicing Conjunctive Use of water (CU). The sample farmers were interviewed using the pre-tested and structured schedules to collect the needed information, inter alia; farm inventory, cropping pattern, cultivation aspects and irrigation methods adopted, costs incurred, returns realized to achieve the objectives of the study. Secondary Data was collected from the Command Area Development Authority (CADA) regarding irrigation charges, cropping pattern, the area under command area, the storage capacity of the dam and so on.

Analytical tools

Energy costs for pumping water were calculated based on the HP of the irrigation pump sets installed. Suppose, the bore well is fitted with a 7 H.P. pump, then the number of units consumed in one hour was calculated by multiplying 746 watts (1 H.P. = 746 watts) by 7, which is equal to 5,222 Watts (5.22 Kilo Watts = 5.22 Units). The total number of units consumed during the entire year was multiplied by ₹2.50/unit, being the energy price for rural domestic connections in Telangana at the time of analysis, to work out the energy cost per annum.

Efficiency is an important concept in production economics, since resources are scarce and opportunities for developing and adopting better technologies are competitive. Economic Water Use Efficiency [EWUE] which is measured in ₹/acre inch of irrigation water was calculated by dividing the net returns by the volume of water used. The volumetric water meter was used to measure the discharge/yield of water from irrigation bore wells. In the case of surface water, it was estimated by multiplying the number of irrigations given to the crop by the area of irrigation (ha) and the depth of irrigation (cm).

Results and Discussion

The first part of the results mainly deals with cropping area and cropping intensity in the study area, followed by the economics of irrigation under different systems of irrigation. This is followed by net returns under different water use regimes and economic water use efficiency under different water use regimes and the summary and key conclusions of the study.

Cropping pattern of the sample farmers

Paddy is the predominantly grown crop in the study area followed by cotton and maize. Surface water dependent farmers completely follow mono-cropping of paddy both in the Kharif and rabi seasons, because of the abundant availability of water. Due to the release of surface water in the rabi season, paddy has been the main crop both in GW and CU regimes of irrigation too. Under the GW and CU regimes, cotton and maize are the other two crops grown along with the paddy. Cropping intensity was found to be highest under the GW regime (186 %) followed by CU (185 %) and SW (170 %).

Table 1: Cropping pattern under SW, GW and CU regimes (2017-18)

	Crops	SW		GW		CU	
		Area (acres)	% to GCA	Area (acres)	% to GCA	Area (acres)	% to GCA
I	*Kharif*						
1	Paddy	2.10	41.33	3.02	22.82	2.45	21.36
2	Cotton			2.31	17.46	1.50	13.08
3	Maize			1.80	13.60	2.25	19.62
	Subtotal	2.10	41.33	7.13	53.88	6.20	54.05
II	*Rabi*						
1	Paddy	2.98	58.66	5.45	41.19	4.06	35.40
2	Maize			0.65	0.05	1.21	10.55
	Subtotal	2.98	58.67	6.10	46.10	5.27	45.95
III	GCA (acres)	5.08	100	13.23	100	11.47	100
IV	NCA (acres)	2.98		7.13		6.20	
V	CI (%)	170		186		185	

Note: GCA- Gross Cropped Area, NCA- Net Cropped Area, CI- Cropping Intensity

Energy costs for pumping the groundwater under different irrigation systems

Ground Water regime

In a sample size of 60 farmers, there were a total of 76 bore wells, out of which 95 per cent were under CIF and the remaining 5 per cent were under DIF. The number of farms under DIF was very less due to its high initial investment requirement. Depth of the bore wells was higher in DIF (333 feet) compared to that in CIF (299 feet). Bore wells under DIF yielded 1433 GPH as compared to 2272 GPH in CIF. These two factors might have influenced farmers' decision of adopting drip irrigation technology. The yield of bore wells was varying across the methods of irrigation. Bore wells under DIF were drilled in recent years, having lesser yields and more drilling depths compared to that under CIF.

The number of hours the pump was put on in case of CIF was more (728 hours) when compared to that in DIF (333 hours), leading to higher energy costs under CIF (₹ 6632) than under DIF (₹ 4398). Share of energy costs in the total cost of groundwater irrigation varied from 31 per cent in CIF to 17 per cent in DIF.

Groundwater extracted per farm per year was highest in CIF (74 acre-inches), followed by that in DIF (37 acre-inches). This over-extraction of groundwater was the reason for increase in annual cost of groundwater irrigation and cost per acre inch of water in case of CIF.

Table 2: Economics of groundwater irrigation per farm under GW regime (n=60)

Sl No.	Particulars	CIF	DIF
1	Total number of bore wells	72	4
2	Number of farmers	57(95)	3(5)
3	Depth of wells (feet)	299	333
4	The yield of bore wells (Gallons Per Hour)	2272	1433
5	Pump Capacity (HP)	5	6
6	Number of hours pump put on in a year	728	333
7	Amount of electricity consumed in units in one year	2653	1629
8	Energy cost (₹) in one year	6632	4398
9	The annual cost of groundwater irrigation (₹)	21184	26272
10	Share of energy costs in total annual cost of GW irrigation (%)	31	17
11	Groundwater extracted/farm/year (acre-inches)	74	37
12	Energy costs per acre inch of water (₹)	90	119

Conjunctive Use Regime

The economic analysis of extraction of irrigation water by sample farmers under the CU regime was carried out and the results are presented in Table 3. All the farmers under CU regime follow only CIF because of the cropping pattern followed by them which includes paddy, cotton and maize.

Under this regime, the total number of bore wells was found to be 67, out of which, 60 bore wells (90%) were functioning and 7 bore wells (10%) had failed. As the farmers in the CU regime also use surface water for irrigation, proportion of well failures under the CU regime was less when compared to that under the GW regime (21%).

The average age of the functioning bore wells was around 9 years and the depth of the wells on an average was 188 feet under CU which is less compared to that under GW. The yield of ground water from the bore wells, expressed in gallons per hour, was found to be 2623. The amortized cost per functioning well was ₹ 9912.

The number of hours the pump was put on was on an average 461 hours in one year and the energy cost per annum was around ₹4858, with electricity consumption of around 1943 units. The total annual cost of groundwater irrigation was ₹13870 in which the share of energy costs was 35 percent.

The volume of groundwater extracted per farm per year was 56 acre-inches and the cost per acre inch of water used worked out to around ₹ 248. CU regime farmers also depend on the surface water for their irrigation which is the reason for their lower costs of irrigation when compared to that of GW regime farmers.

Table 3: Economics of groundwater irrigation per farm under CU regime (n=60)

Sl. No.	Particulars	CIF
1	Total number of bore wells	67
2	Number of functioning bore wells	60 (90)
3	Number of farmers	60 (100)
4	Number of failed borewells	7 (10)
5	Age of functioning bore wells (years)	9
6	Depth of bore wells (feet)	188
7	The yield of bore wells (GPH)	2623
8	Amortized cost per functioning well (₹)	9912
9	Pump capacity (HP)	5
10	Number of hours pump put on in a year	461
11	Amount of electricity consumed (units) in one year	1943
12	Energy costs (₹) for one year	4858
13	Annual repairs and maintenance (₹)	2000
14	The annual cost of groundwater irrigation (₹)	13870
15	Share of energy costs in annual cost of irrigation (%)	35
16	Groundwater extracted/farm/year (acre inches)	56
17	Energy costs per acre inch of water (₹)	87

Water Use Efficiency

Water being an important input and a highly scarce resource, needs to be utilized optimally to realize maximum productivity from each acre-inch used. Hence, the estimation of efficiency of water used for irrigation was attempted from different perspectives using the information on net returns realized, water used and cost of irrigation under different regimes. Among all the three regimes, net returns per acre-inch of water used was maximum under CU (₹ 11792) followed by GW (₹ 8229) and SW (₹ 7516). The net returns per acre-inch were highest in CU due to the timely availability of irrigation water and its sufficiency during all the critical stages of the crop, surface water being supplemented by ground water. Water applied to the crop per acre was highest in the SW regime (77.93 acre-inches) because of abundant availability of water in head-reach areas, followed by GW (22.54 acre-inches) and CU regimes (21.95 acre-inches).

Dependence on single source of water and its uneven availability led to untimely irrigation which reduced the net returns of crops under both GW and SW regimes. Hence, economic water use efficiency was higher in case of CU regime (₹ 537.22) followed by GW (₹365.08) and SW regimes (₹ 96.45) which is shown in figure 1. These results were in line with the findings of the study conducted by Ashok M Taradale[6], where the CU regime had shown the highest WUE followed by GW and SW regimes.

Economic water use efficiency of different crops across the irrigation regimes

Economic water use efficiency is defined as the net returns per acre-inch of water used. As we can see from Table 4, SW irrigated paddy had the lowest economic water use efficiency (₹ 96.45) when compared to CU irrigated paddy which was the highest (₹ 607.86) and GW irrigated paddy (₹ 292.84). This is mainly due to the overuse of water by the SW farmers and also optimized use of water by the CU farmers.

Even though water used for maize crop in CU (24.17 acre-inches) was higher when compared to that in GW (20.69 acre-inches), it had shown high economic water use efficiency under CU (₹ 444.28) than under GW (₹ 373.93) due to timely availability of optimum volume of water that yielded higher net returns.

6 Ashok M Taradale, 2018. Economic analysis of conjunctive use of irrigation water in Malaprabha command area of Karnataka. *M. Sc. Thesis (Unpub.),* Univ. Agric. Sci., Bengaluru.

Table 4: Net returns per acre and economic water use efficiency in different irrigation regimes

Regime	Crop	Net returns (₹/acre)	Water used (acre-inches)	Economic water use efficiency (₹/acre-inch)
CU	Paddy	14182.24	23.33	607.86
	Cotton	10453.29	18.35	569.69
	Maize	10739.76	24.17	444.28
GW	Paddy	7862.82	26.85	292.84
	Cotton	9089.28	20.09	452.54
	Maize	7735.34	20.69	373.93
SW	Paddy	7515.70	77.93	96.44

Conclusion

The main purpose of this study was to compare the economic efficiencies of different irrigation regimes. Based on the results and grass-root reality this study recommends the following policy measures.

This study has proved the superior economic efficiency and sustainability features of the conjunctive method of irrigation compared to the other two irrigation regimes in the study area. Equitable distribution of irrigation water in all the three reaches of the canal (head-reach, mid-reach and tail-end) paves the way for effective conjunctive use of water. This may be ensured by rejuvenating the defunct Water Users Cooperatives and following a participatory approach in the distribution of canal water, both in letter and spirit. Drip irrigation method should be popularized by convincing the non-adopters about its benefits, to save scarce resources and bring more area under micro-irrigation. The outcomes of the study may also be considered in formulating scientific pricing and rationalizing the energy costs under the GW regime. Farmers should be shifted from paddy monoculture to light irrigated crops to conserve water as well as to ensure equitable distribution of water.

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Chapter 21
Economic Evaluation of Water Productivity under Ramthal Project in Karnataka

M. Shivashankar Hugar* Dr. P. S. Srikantha Murthy**

Abstract

The study has analysed the water productivity under drip and canal irrigation methods indrip-irrigated farms (DIF) and Canal irrigated farms (CIF) under Ramthal micro-irrigation project area in Karnataka. A total sample size of 120 farmers, 60 each from DIF and CIF were randomly selected for data collection. Descriptive statistics and natural resource cost concepts were used for the analysis. The results revealed that, implementation of Ramthal micro-irrigation project reduced consumption of water by the major crops under DIF as compared to that under CIF, ranging from 42 per cent in bajra to 70 per cent in onion. Agronomic water productivity of major crops was higher in DIF compared to that in CIF, varying from 36 per cent in green gram to 78 per cent in chilli. Economic water productivity of those crops was also higher in DIF, when compared to that in CIF, ranging from 59 per cent in jowar to 84 per cent in onion. Thus, Ramthal micro irrigation project has proved to be a boon to the farmers by improving the water productivity in the study area and such projects may be replicated in other irrigation command areas of the land, having similar agro-climatic conditions.

Keywords: *Drip irrigation, Canal irrigation, Agronomic water productivity, Economic water productivity, Rainfed farming.*

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Introduction

India is an agrarian country where water is the life-blood of agriculture, which consumes over 80 percent of the freshwater resources. The growing need for food security and increased population has resulted in higher demand for irrigation water which can only be met by judicious exploitation and management of water, which is the key for the future growth of Indian agriculture. Even though 78 per cent of the total freshwater available in the country is diverted for agriculture, only 48 percent of the total gross cropped area is irrigated.[1] Further, growing population coupled with change in rainfall pattern are likely to reduce water supply to agriculture. Resource-wise, the country accounts for 16 per cent of the world's human population, but only 2.4 per cent of the land area and 4 per cent of the water resources.[2] With per capita water availability of 1544 cubic meter, India is already declared as a country that is under water stress by international irrigation standards.[3] Cross country water use efficiency comparison shows that India uses 2-3 times more water to produce one unit of food crops than other major agricultural countries such as China, Brazil and the United States.

As agriculture in India is vulnerable to drought, low frequency and low intensity of rainfall is likely to increase due to climate change. In this situation it is essential to make the best possible use of the limited water .resource. Despite this precarious condition, most of the irrigation water available in India is applied through the conventional flood irrigation method. Poor irrigation efficiency of the conventional method reduces the projected outcomes from investments in the irrigation sector of the country and causes. Environmental problems like decrease in the water table due to over-exploitation of sub-surface water resources, soil salinity, and water-logging, thus adversely affecting the crop yields. Hence, if there is one caution that requires utmost attention for ensuring sustainable development of Indian agriculture is efficient use of water. Every drop of irrigation water available is significant for overall farm efficiency.

The solution thus lies in analyzing the innovative models for their contribution to higher water use efficiency. Drip-irrigation is known to be one such effective system that allows for better control and monitoring of existing Water resource. Drip irrigation, also known as trickle irrigation or drip-irrigation, is a technique designed to apply only the appropriate

1 GOK (Government of Karnataka), 2018, Drought management strategies. Karnataka State Natural Disaster Monitoring Centre, GOK, Bengaluru.

2 Vibha Dhawan, 2017, Water and Agriculture in India, Background paper for the South Asia expert panel during the Global Forum for Food and Agriculture (GFFA), pp:1-28.

3 GOI (Government of India), 2019, Dynamic Ground Water Resources of India, 2017. Department of Water Resources, Central Ground Water Board, GOI, Bangalore.

quantity of water directly to the root zone of the crop in small amounts using. a low-pressure delivery system with a network of pipes with small emitters (or drippers) pipes built into them. It would minimize water losses from runoff, seepage and percolation.

Out of 225 million hectares irrigated area in the world, only a little over 11 million hectares is drip irrigated. Much of this lies in four countries: India, Spain, China and. the United States of America. Together, these countries represent nearly two-thirds of the world's drip-irrigated area. At present, the United States (1.64 million ha), China (1.67 million ha) and Spain (1.63 million ha) are the topmost countries that have adopted drip irrigation.[4] Only 4.75 per cent of the world's total irrigated area being covered currently under drip irrigation, shows the vast potential that remains untapped.[5]

With a total arable area of 140 million ha and almost 42 per cent of that being irrigated, India has a huge potential for drip-irrigation, which is at present underutilized. The spread of drip-irrigation has been restricted to only a few pockets across India. Despite the government at both centre and state initiating various schemes to promote drip-irrigation in the country; the efforts have fallen short to reach total potential of drip irrigation. Therefore, analysing the impact of adoption of drip-irrigation is crucial in the event of states like Gujarat, Andhra Pradesh, Rajasthan and Karnataka giving a massive push to promote drip irrigation for water resource conservation.

Karnataka, having the country's second largest drought prone area after Rajasthan, is a pioneer in introducing drip and sprinkler irrigation to save water, power and energy, as well as helping farmers to cope-up with economic scarcity of water resulting from depleting groundwater resource. As per the 2010-11 agricultural census, Karnataka's cultivable area is 12.2 m ha, of which nearly 10 m ha was cultivated and 3.4 m ha was irrigated[6] of which as per the records of Department of Agriculture and Department of Horticulture, a cumulative area of 0.94 m ha had been brought under drip irrigation since 1991-92. In spite of continuous efforts by the state government, total drip irrigation potential has not yet been met. Therefore, the Government of Karnataka took up a new initiative by implementing Ramthal micro-irrigation project in Hungund taluk of Bagalkot district by adopting a community drip irrigation system in alamatti command area at no cost to the beneficiaries.

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4 GOK (Government of Karnataka), 2018, Drought management strategies. Karnataka State Natural Disaster Monitoring Centre, GOK, Bengaluru.

5 GOI (Government of India), 2019, Dynamic Ground Water Resources of India, 2017. Department of Water Resources, Central Ground Water Board, GOI, Bangalore.

6 GOK (Government of Karnataka), 2018, Drought management strategies. Karnataka State Natural Disaster Monitoring Centre, GOK, Bengaluru.

This research work was taken-up by the Department of Agricultural Economics, UAS, GKVK, Bengaluru, with National Law School of India University, Bengaluru and IIWM, Bhubaneswar as partners, under the research project titled "Institutional and Market Innovations Governing Use of Agriculture Water" funded by Indian Council of Agricultural Research – Institute of Water Management, Bhubaneswar. The specific objective of this study was to 1. To analyze the changes in cropping pattern and income of the farm households. 2. To estimate agronomic and economic water productivity of key crops under Ramthal micro-irrigation project.

Methodology

Study Area

Ramthal is a village located in Hungund Taluk, Bagalkot District of Karnataka state. The average annual rainfall in the district is 562 mm, of which it receives 40 per cent of the total rainfall in the south west monsoon period, from June to September. Due to irregular availability of Water, farmers were unable to take two or more crops in a year. In view of this, the Government of Karnataka launched Asia's largest drip irrigation project under Stage II of Ramthal (Marol) Lift Irrigation Project in 2017.[7]

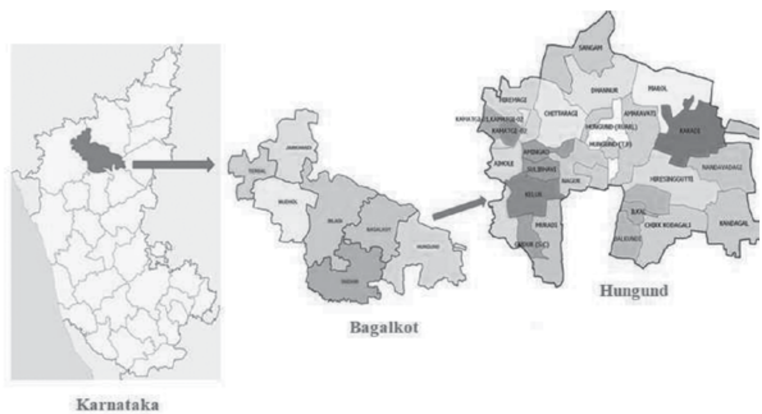

Figure 1: Map of the Study Area.

Source: Anonymous, 2017, Bagalkot district at glance 2016-17. District statistical office, Bagalkot, pp.1-46.

In the original proposal, there was.a plan to construct a barrage across Malaprabha river near Ramthal village and lift water from barrage in two stages. But the scheme was revised proposing to lift water directly from Narayanapur reservoir near Marol village. About

7 Anonymous, 2017, Bagalkot district at glance 2016-17. District statistical office, Bagalkot, pp.1-46.

5.84 TMC water is allotted for Ramthal Project under Upper Krishna project. The Ramthal Project was taken up in two stages. Under stage 1, about 13,629 ha area is being irrigated with a conventional flood irrigation method utilizing about 3.07 TMC of water. Under 2nd stage of the project, originally, 12,571 ha area was planned to be irrigated with flood irrigation. Later, after the involvement of Micro Irrigation companies NETAFIM Ltd. and Jain irrigation company, Krishna Bhagya Jala Nigam Ltd. (KBJNL) agreed to adopt drip irrigation system, which resulted in extending the area under 2nd stage of the project to 24,000 ha, an increase of 90 per cent in area under irrigation.[8]

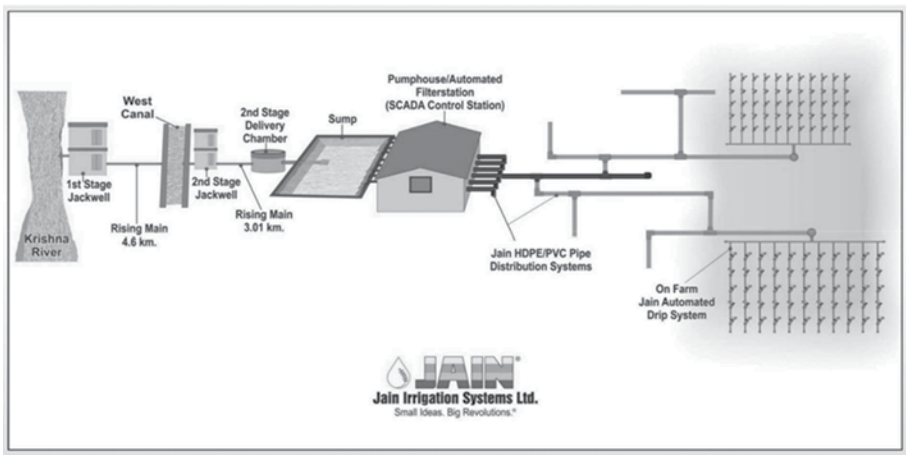

Figure 2: Line diagram of water supply in east package by Jain Irrigation Systems Ltd.

Source: GOK (Government of Karnataka), 2016, Ramthal lift cum drip irrigation project.

Sampling Method

A purposive sampling procedure was employed for the selection of study area. At the first level, Hungund taluk of Bagalkot district was selected as Ramthal Micro-irrigation project has been implemented there. In the second stage, 60 sample farmers having drip irrigated farms were randomly selected from three villages of Hungund taluk under Ramthal project consisting of twenty drip irrigated farms from each village. Sixty sample farmers having canal irrigated farms (following flood irrigation method) were randomly selected from three villages covered by canal irrigation in Hungund taluk.

8 Anonymous, 2016, Ramthal lift cum drip irrigation project. NETAFIM Ltd, pp. 1-51.

Primary Data

To achieve the objectives of the study, the primary data on cropping pattern, cost of cultivation, methods of irrigation, volume of water used, output realised, income earned and so on were collected from the selected sample farmers using pre-tested schedules through personal interview method.

Secondary Data

Secondary data with respect to project implementation, number of farms and area covered, facilities provided to farmers was collected from the Krishna Bhagya Jala Nigam Ltd. (KBJNL) which is responsible for planning, investigation, estimation, execution, operation and maintenance of all irrigation projects coming under the upper Krishna project (UKP). The Nigama is also responsible to obtain Government of India's clearance and execute the UKP with Jain irrigation and NETAFIM, a community micro irrigation company and an Israeli manufacturer of irrigation equipment, as a partner in implemention of drip-irrigation project. NETAFIM produces drip irrigation systems and other water technologies intended to increase yields and improve crop production while preserving quality and quantity of water and soil fertility.

Analytical Tools and Techniques Used

Measures of central tendency and natural resource cost concepts were used in estimation of cost and returns, and water productivity of major crops.

Quantification of Water Usage under Surface Water [SW] Irrigation

Number of irrigations provided for a crop is considered and average depth of irrigation for that crop is taken to work out the total quantity of water used in surface (canal) irrigation farms.

(a) Under Flood Irrigation System

$$\textbf{Quantity of water used} = \text{No. of Irrigations} \times \text{Depth of Irrigation (cm)} \times \text{Area of Irrigation (ha)} \quad \ldots\ldots(2)$$

(b) Under Drip Irrigation System

The responsibility of providing water to farmers' fields is shared by NETAFIM Ltd. and Jain irrigation company. As per the schedule both the companies provide 75 minutes of irrigation to each farm daily @ 1 lit per hour discharge rate. , The volume of water used for each crop was estimated as follows:

$$\textbf{Quantity of water used} = \frac{\begin{array}{c}\text{No. of drips in cropped area} \times \text{discharge per drip (litres per hour)} \\ \times \text{ No. of Hours pump was put on across all seasons and crops in a} \\ \text{year}\end{array}}{4.54 \times 22611} \quad \text{.......(3)}$$

(Note: One acre-inches = 22611 Gallons)

Estimation of Cost of Irrigation using natural resource economic concept

The methodology and approach of *Nagaraj et al* (2002)[9] who estimated the cost per acre-inch of water for surface irrigation was followed for valuing surface water or arriving at price of surface water in the present study. Authors estimated the price at Rs.12 per acre inch during 2002. That price of canal water (Rs.12/acre inch) was compounded at two per cent per annum to the present year and was worked out to be Rs.16.80 per acre inch by 2019 and was used in the present study to value the surface water.

Water Productivity (water use efficiency)

Efficiency is an important concept in production economics when resources are meagre and opportunities for developing and adopting better technologies are competitive. FAO (2003) defines water productivity as the amount or value of product over volume or value of water depleted by the plant of which the value of the product might be expressed in different terms (biomass, grain, money) Please check this definition. Agronomic water productivity can be defined as the yield of harvested crop product achieved from the water available to the crop through irrigation.

9 N Nagaraj, K Shankar & M G Chandrakanth, *Pricing of Irrigation Water in Cauvery Basin*, 5 Economic and Political Weekly 181 (2002).

$$\textbf{Agronomic Water productivity} = \frac{\text{Output derived from water use (qtl)}}{\text{Volume of water used (acre inches)}} \quad ....(4)$$

Economic water productivity (Rs. /acre inches) is defined as the economic value of all agricultural activities per one unit of available water supply within a command area. It is calculated as follows.

$$\textbf{Economic Water Productivity} = \frac{\text{Farm Output (qtl) * Price of Output (Rs.)}}{\text{Volume of Water used (acre inches)}} \quad ....(5)$$

Results And Discussion

Water being the most important input and scarce resource, needs to be utilized optimally to realize the maximum productivity from each acre-inch of irrigation water used. Hence, cropping pattern, estimation of water productivity of irrigation was attempted using the information on net returns realized, water used, and the cost of irrigation under different irrigation methods, income of sample farmers and the results are presented below.

From Table 1 it can be seen that volume of water applied was the maximum in canal irrigated farms (CIF) for all the crops. It was the highest in onion (21.82 acre-inches) and was the lowest in bajra (9.35 acre-inches) which requires less water for its life cycle compared to other crops.

Since onion crop requires more number of irrigations and water applied as irrigation involves more volume of water farmers reported rotting in onion which reduced of crops for one hour fifteen minutes a day @ one litre of water per hour, volume of water used was substantially less, ranging from 42.46 per cent in bajra to 70.03 per cent in Onion.

Agronomic Water Productivity

Yield of the major crops and their corresponding water used in acre-inches was used to estimate agronomic water productivity. Agronomic water productivity was observed to be higher in DIF than in CIF as we can see from Table 1 and Fig. 3. Yield of major crops cultivated was higher in DIF compared to CIF, to the tune of 9 per cent in jowar to 28 per cent in chilli, because of increased water and fertilizer use efficiency in DIF than in CIF. And it was the maximum in chilli at 6.32 quintals/acre-inch of water used and was the lowest in green gram (0.74quintals/acre-inch) in DIF. Agronomic water productivity in CIF was higher in chilli (1.37quintals/acre-inch) and was the lowest in chickpea (0.41quintals/acre-inch).When we calculate the percentage difference in agronomic water productivity of major crops in DIF over CIF, we observe higher agronomic water productivity in all the crops on adoption of drip irrigation and it was the highest in chilli (78.32%) followed by onion (75.56%) and was The lowest in green gram (36.49%). It is evident from the above results that DIF had higher agronomic water productivity, since water applied to the root zone increased water use efficiency. Whereas in CIF, water applied through flood irrigation was spread over the entire field, even outside the plant zone and got wasted. Hence water use efficiency was lower in CIF. The study by Narayanamoorthy and Devika (2017),[10] Ravindra et al (2014)[11] and Sanjay Singh et al (2014)[12] reported similar results.

Table 1: Agronomic Water Productivity of Major Crops under Different Irrigation Metods

Crops	Water used (acre-inches)			Yield (quintals)			AWP (Q/acre-inches)		
	DIF	CIF	P D	DIF	CIF	P D	DIF	CIF	P D
Pigeon pea	8.46	16.52	48.79	6.49	5.46	15.87	0.77	0.33	57.14
Chickpea	8.08	15.59	48.17	8.23	6.33	23.09	1.02	0.41	59.80
Jowar	5.77	10.91	47.11	6.97	6.33	9.18	1.21	0.58	52.07
Sun flower	7.69	15.27	49.64	7.87	6.55	16.77	1.04	0.43	58.65
Green gram	7.31	15.37	52.44	5.38	4.34	19.33	0.74	0.47	36.49
Bajra	5.38	9.35	42.46	8.02	7.25	9.60	1.49	0.46	69.13
Onion	6.54	21.82	70.03	32.33	26.39	18.37	4.95	1.21	75.56
Chilli	6.15	20.26	69.64	38.87	27.71	28.71	6.32	1.37	78.32

Note: AWP – Agronomic Water Productivity, DIF – Drip Irrigation Farm, CIF – Canal Irrigation Farm, PD – Percentage Difference

Higher Returns per rupee of irrigation cost of major crops cultivated was observed in DIF compared to CIF. This was due to fixed irrigation cost and increased returns from crops. But, in jowar and bajra higher returns per rupee of irrigation cost was observed in CIF as farmers with canal irrigation go for less number of irrigation to these crops and the irrigation charges fixed by the government are lower.

10 A Narayanamoorthy & N Devika, *Economic and Resource Impacts of Drip Method of Irrigation on Okra Cultivation: An Analysis of Field Survey Data*, 6 Journal of Land and Rural Studies 15 (2017).

11 Ravindra Singh et al, *Yield and water Productivity of Cumin as Influenced by Irrigation Techniques and Land Configuration*, Agro Tech 6 (2014).

12 Sanjay Singh Chouhan et al, *Maximizing Water Productivity and Yields of Wheat Based on Drip Irrigation Systems in Clay Loam Soil,* 3 International journal of Engineering Research Technology 533 (2014).

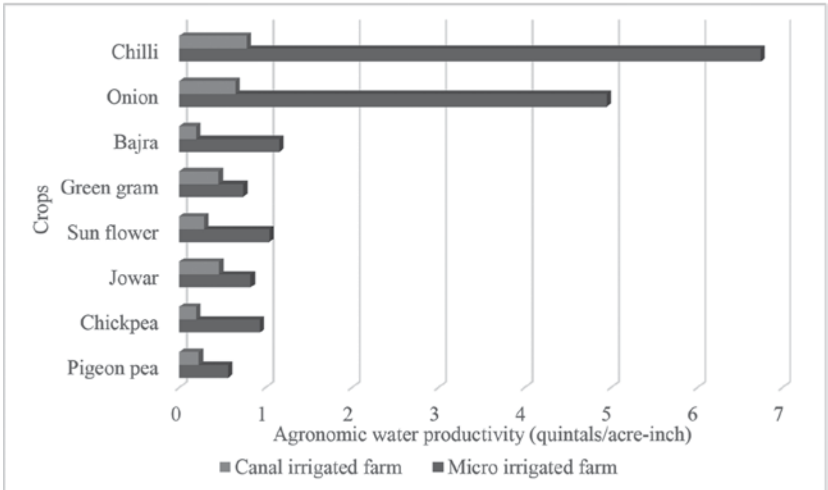

Figure 4: Agronomic Water Productivity of major crops under drip and canal methods

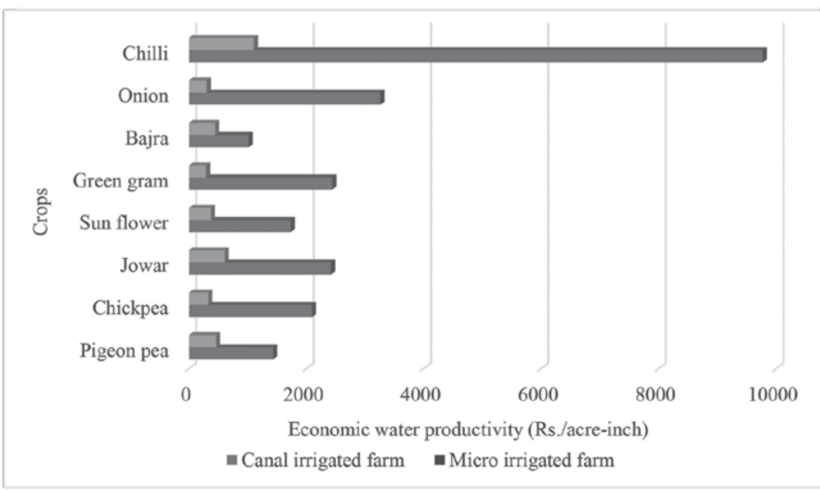

Figure 3: Economic Water Productivity of major crops under drip and canal irrigation methods

Economic water productivity (EWP) was observed to be higher in DIF than in CIF, since the implementation of drip irrigation resulted in higher water productivity and correspondingly higher net returns from the crops in DIF. Economic water productivity was the maximum in chilli at Rs.9164.06 /acre-inch of water used and was the lowest in bajra (Rs. 1309.24/ acre-inch) in DIF as net returns obtained from chilli was more compared to that from other crops and net returns per acre from bajra was less. Economic water productivity in CIF was the highest in chilli (Rs.1942.37 /acre-inch) and was the lowest in bajra (Rs.495.64/acre-inch), since water used for onion crop was more but net returns was less because of loss in quantity and price volatility in the market and net returns per acre of chilli was higher compared to other crops. When the percentage differences in economic water productivity of major crops in DIF over CIF were calculated, it was observed that higher in economic water productivity was higher in all the crops and the percentage difference in EWP was the highest in onion at 84 percent, followed by chilli (78 %) and was the lowest in jowar (59%). It is evident from the above results that DIF have higher economic water productivity as water applied to the root zone increased water use efficiency, yield and also net returns, compared to CIF where water was applied through flood irrigation (Table 2 and Fig. 2). The results are in line with the results of the study conducted by Chandrakanth et al. (2013),[13] Banda Sainath (2019)[14] and Ram and Makwana (2018).[15]

Conclusion

It is evident from the results that implementation of drip irrigation under Ramthal micro-irrigation project has reduced water use for crops and has increased net returns from the major crops. The agronomic and economic water productivity of major crops were observed to be higher in drip irrigated farms compared to that in canal irrigated farms. It is mainly due to efficient use of water and fertilizer in drip irrigated farms as water is applied to crop root zone. Water thus saved can be used to increase the area under irrigation. Hence, community Drip-irrigation projects like Ramthal Irrigation Project may be replicated in other irrigation command areas with similar conditions in the state and the country to achieve greater efficiency and sustainability in irrigation water use.

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13 M G Chandrakanth et al, *Economic Benefits from Micro Irrigation for Dry Land Crops in Karnataka*, 68 Indian Journal of Agricultural Economics 338 (2013).

14 Banda Sainath, *An Economic Analysis of Different Water Use Regimes in Godavari Command Area of Telangana* (Unpublished M.Sc. Thesis 2019).

15 Vaibhav Ram & D Ajay Makwana, *Impact Analysis of Micro Irrigation System (MIS) on Yield, Water, Fertilizer Saving and Farmer's Economy*, 7 Int'l J. Current Microbiology Applied Science 1016 (2018).