ISSN: 0973-4929, Vol. 17, No. (1) 2022, Pg. 74-87

Current World Environment

www.cwejournal.org

An Appraisal of Legal Framework for Groundwater Governance in Punjab

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Abstract

Groundwater (GW) in India is emerging as the major source of water which contributes about 85% to drinking water supply in rural areas and 62% to irrigation. In Punjab, GW provides irrigation to more than 72% of the area under the rice-wheat cropping system and it has played a key role in its emergence as 'granary of India'. But the area under rice, a water-guzzling crop grown in the state during summer, has increased tremendously, i.e., from 3.90 lac hectares in 1970-71 to 31.03 lac hectares in 2018-19. The runaway growth of GW irrigation has also contributed to the depletion of the water table and thereby posing a huge environmental challenge. In this paper, an attempt has been made to review the development of the legal framework for GW governance and its effect on the groundwater situation in the state. However, the increasing stress on aquifers due to GW irrigation has been reduced to an acceptable degree by strengthening and enforcement of legal framework coupled with a set of incentives and disincentives for improving its efficiency. *The Punjab Preservation of Sub-soil Water Act 2009* coupled with some minor technical interventions have contributed to a reduction in the consumption of irrigation water by 413 liters per kg of production of rice due to a change in the crop calendar of rice and following the wheat. It is being increasingly acknowledged that for effective GW governance in Punjab, science and policy for GW use need to flank and complements the legal frameworks.

Article History
Received: 05 July 2021
Accepted: 04 April 2022

Keywords
Crop Calendar;
Groundwater Depletion;
Irrigation Water Demand;
Power Subsidy;
Water Conservation.

Introduction

Groundwater has played a dominant role in food grain production and the income security of farmers around the world. A certain lack of much-needed importance still manifests itself in fragmented legislative approach, insufficient institutional set-ups,and inadequate implementation of GW law in almost all countries of the world[1] and its governance has also been an area of neglect until recently.[2]

Legal frameworks encompassing surface and GW are more efficient and responsive than those

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Doi: http://dx.doi.org/10.12944/CWE.17.1.7

that distinguish them.[3] State laws have been treating these as separate resources due to limited understanding about the hydrologic connection between them. The third United Nations World Water Development Report[4] has warned about vastly severe consequences of the current unsustainable and inequitable water use. Conjunctive use of surface and GW has gained importance and States are embracing integrated approaches to GW development and regulation.

The GW governance has been defined it as "*the exercise of appropriate authority and promotion of responsible collective action to ensure sustainable and efficient utilization of groundwater resources for the benefit of humankind and dependent ecosystems*".[5] The concept of governance is evolving with time and is now being differentiated from GW management. While management is a specific day-to-day function to ensure optimal and efficient GW use, governance is the decision regarding which management functions to perform, when, for what purpose, and by whom. The four principal dimensions of a GW governance framework include: *politico-institutional* (transparency, responsiveness, accountability, and efficiency); *socio-cultural* (acknowledge and incorporate the local or regional socio-cultural values of water), *economic* (pricing to recognize the essential nature of water resources, use of rate structure to discourage inefficient use of water, incorporates treatment costs for improving groundwater quality), and *ecological* (environmental uses).[6]

GW is a classic common-pool resource[7] and an unlimited amount of this limited resource can be pumped freely by each user in case of unconstrained use.[8] Effective governance of a shared resource is easier when: (a) the uses, the user population, and social and economic situations are fairly stable or change only moderately; (b) low-cost monitoring and verification of its use can be carried out; (c) frequent interaction of communities using their source with each other; (d) easy exclusion of outsiders; and (e) users back enforcement and monitoring.[9] In such a situation, the GW governance begins with a drawback of modelling and mapping of aquifers, change of pumping rates with time, and unpredictable behaviour of users regarding coordination among themselves and limits on use. GW contamination is difficult to detect, and it is even more difficult to remodify it.[10]

Further, sound scientific andlegal regulations are necessary to counsel the behaviour regarding the use and misuse of water to reduce the pressure on available GW resources. New pressures, viz. climate change, population growth, economic development, and urbanization will further stress the available water resources[11] and necessitate the reorientation of institutions for water management.[12] The increasing threats to GW sustainability and its rising socio-economic importance indicate a pressing priority for sound GW governance. This study attempts to review the development of the legal framework for GW governance and its effect on the groundwater situation in Punjab. It briefly describes the new initiatives, analyses their shortcomings and suggests the way forward to make these initiatives more effective to check the GW depletion.

Punjab, a small state, comprising 1.54 percent of the geographical area of India and located between 29° 30' N to 32° 32' N latitude and 73° 55' E to 76° 50' E longitude, at an altitude ranging between 230m to 700m above mean sea level, has been divided in the three distinct physiographic areas i.e, Sub-Mountain Zone, Central Plain Zone and South-Western Zone and their characteristics are briefly given in Table 1. The average temperature in the State varies from 13°C in January to 34°C in June but the lowest may be near to freezing point in winter and highest as 45°C in summer. The average annual rainfall varies from 1250 mm in the north to 350 mm in the southwest, and more than 70 percent of it occurs during from July to September[13] i.e., the monsoon season. Total geographical area of the State is 50362 km^2, and the net sown area is about 41250 km^2 and more than 80% of this area is under Rice Wheat Cropping System (RWCS)[13]

'Green Revolution' contributed in doubling the wheat production in the state from 1966-67 to 1968-69. The new technologies also created a space for the cultivation of a non-traditional crop of rice which helped the state to play a unique and long-term role in the country's food security. The area under paddy has been increasing over the years and touched 3.1 million hectares in 2018-19 and so are its productivity

(6.2 ton per hectare), production (19.1 million tons), and state's contribution to the central pool (11.83 million tons) for public distribution system (Annexure I). Since rice is a summer crop and is mostly grown under puddled transplanted conditions, its water requirement is high. The number of tubewells has increased over the years for extension of GW irrigation to additional areas and the pumping culture has also shifted to electricity operated from diesel-operated which were more efficient in terms of water use (Annexure I). The increase in the number of tubewells and area under paddy are positively correlated (Figure 1). Groundwater irrigation (GI) has also been largely accountable for making Punjab '*food bowl*' of the country as GW irrigates nearly 72 percent of its area but this widespread adoption of tubewell irrigation prompted economist Robert Repetto to assert that 'the Green Revolution is more [a] tubewell revolution than [a] wheat revolution,.[15] Dependence on GI has been steadily increasing in Punjab after the introduction of the policy of subsidized power for agriculture in the 1990s, and then free power in 1997[16] Consequently, there has been a continuous over-extraction of GW, and a depletion of water table in Punjab. Central Ground Water Board has warned that "all available groundwater resources in the state till the depth of 300 meters will dry up in next 20 to 25 years "at the current rate of GW extraction.[17] This is likely to have grave consequences for the development of agriculture in the state, national food security, alleviation of poverty, and future growth. Thus, Punjab is a high-priority area for groundwater management as it is an area with intense competition for water and of water-driven degradation of ecosystems, such as drying rivers and depleting groundwater tables. In 2011, the Punjab and Haryana High Court barred the use of GW for construction and the authorities were allowed to approve buildings only after obtaining a legal affidavit about no GW use.[16] But, there has been almost no compliance of this order. However, the legal frameworks are considered as one of the most popular components of improving GW governance. Accountability requires an adequate legal framework where in responsibilities, obligations, and rights are well-defined. The legal frameworks can play a significant role in turning policy decisions into rights and obligations, thereby enhancing governance efficiency.

Table 1: Characteristics of different physiographic regions

Region	Area (000 ha)	Soil Type	Rainfall (mm)	Climate	Districts
Sub-Mountain Zone	1063	Clay, Clay loam	1150	Sub-humid	Gurdaspur, Pathankot, Rupnagar, Hoshiarpur, SBS Nagar, SAS Nagar
Central Plain Zone	2481	Loam	650	Semi-arid	Amritsar, Barnala, Moga, Fatehgarh Sahib, Jalandhar, Kapurthala, Patiala, Sangrur, Tarntaran, Ludhiana,
South-Western Zone	1492	Sandy loam, loamy sand	375	Arid	Bathinda, Ferozpur, Fazilka, Faridkot, Mukatsar, Mansa

Source: Sidhu Balwinder Singh and others[14]

Evolution of Law for GW Governance

Until 1857, British interfered with local customs and rules only when these affected its policy to amass wealth and expand colonial empire. The ownership of land regulated the rights to water. *The Indian Easements Act (1882)*[34] enshrined common law principles, which evolved over the years and noticeably survived till date, mostly through rulings by English and Indian courts during the 19th and early 20th century. The land owners had an unlimited access to GW under their holdings. The Northern India Canal and Drainage Act (1873)[34] was the most critical intervention which recognized the Government's right to control and use the water

of all natural rivers and streams and of all lakes for public purposes.[34] The legislative powers between the Centre and the States were separated by *The Government of India Act (1935)*, wherein control relating to water supply, water storage, hydropower, irrigation, canals, drainage, and embankments was given to the provinces, and regarding disputes between princely states or provinces to the Governor-General, who could get the conflict investigated by appointing a commission if deemed appropriate.[34] Taking a cue from the 1935 Act, the Constitution provided a vital role to the states in water management by incorporating water in the state list, recognizing the diverse conditions existing in different forms.

Water Under the Indian Constitution

The Constitution clearly provides legislative jurisdiction relating to water for the Union and State Governments, including local bodies. The Seventh Schedule of the Constitution expressly defines 'water' as a state subject, thus providing a significant part of legislative control for water-related issues to the states (leaving only inter-state river waters for the union government). Part III and IV of the Schedule contain the general principles and policies for natural resources management, including water resources, and thereby guarantee the fundamental right of free access and use to the citizens. The right to life makes it obligatory for the State to assure an equitable distribution of the resources and ensure their environmental and ecological improvement and preservation. Under the Constitution, some fundamental duties to this effect have been imposed on the citizens too.

Recognizing the need for equal access to water, the Constitution explicitly provides under Article 15(2) that all citizens shall have no restriction to the use of tanks, wells, bathing ghats, etc. on grounds of caste, place of birth religion, sex, and race. The Apex Court has interpreted that Article 21 of the Constitution includes all facets of life under the right to life. In India, the right to water is not explicitly recognized in the Constitution but the courts have time and again asserted its existence in many cases. While the judiciary has confirmed the Constitutional right but its actual content and active realization are the real problems in the country. Due to the absence of a legal framework, the courts have not elaborated the fundamental components of this right but the right to access to water and pollution-free water are also considered as its part by the Apex court and several high courts in a series of cases.

Under Article 245 of the Constitution, the State legislatures can make laws for the whole or any part of the State and the Parliament for country. The Parliament has exclusive powers to make laws on subjects given under Union List (List I) of the Seventh Schedule. Entry 56 in List I relate to development and regulation of interstate rivers and river valleys if Parliament states by law it to be of public interest. To resolve inter-state water disputes, Article 262 of the Constitution provides for the establishment of tribunals to adjudicate the disputes among states of water. Article 252 of the Constitution also allows the Parliament to legislate in any area in which states have exclusive rights to legislate, provided that the states' prior consent has been obtained. The legal framework for checking pollution has been enacted accordingly.

The 73rd constitutional amendment regarding Panchayats introduced the subjects Water management, Minor irrigation, drinking water, Watershed development and maintenance of community assets and 74th amendment regarding Municipalities introduced the subjects water supply for domestic, commercial, industrial purposes in the Eighth Schedule (Part IX), empowering the State legislatures to entrust these functions to local governments.

Legal Framework for Gw Governance

Legal framework in India does not explicitly provide for any specific water rights. But, the provisions of the *Easement Act 1882* and *the Transfer of the Property Act of 1882* give a right to the landowner to GW beneath his land, considering it as an easement of the landand ownership of GW is transferred when the land ownership is transferred.[34] This concept of absolute ownership allows the land owners to extract an unrestricted quantity of GW from beneath their land. Consequently, a land owner is free to extract more GW than his personal need and sell it to others in need. But for regulating the construction, maintenance, and distribution of irrigation water from a State Tubewell, the Punjab government enacted *the Punjab State Tubewell Act, 1954* to provide that except as otherwise provided the provisions of the Northern India Canal and Drainage Act, 1873 shall

apply in respect of any State Tubewell in like manner as if such State Tubewells were a canal within the meaning of the said Act.[41] Despite substantial changes in GW development regime over time, the legal framework for GW governance continued to remain the same. Rapid expansion in GW usein the country for domestic, irrigation and other purposes has contributed to GW over-extraction and consequent depletion of water levels in several parts of India.

Environment Protection Acts

As there is no entry in the Constitution relating to 'Environment', the Union Government enacted laws for its protection and pollution control, using the residual powers. This Act encompasses use of water, including GW use and exploitation. The Parliament enacted the Water *(Prevention and Control of Pollution) Act, 1974* to prevent water pollution due to discharge of industrial effluents.[34] For effective implementation of this Act, Water *(Prevention and Control of Pollution) Cess Act 1977* was passed which was adopted by the states by 1990 and provided for setting-up of State Pollution Control Boards in all states. Parliament passed the *Environmental (Protection) Act (EPA), 1986*[34] and the Hon'ble Apex Court vide its order dated 10th December 1996 created the Central Ground Water Authority under sub-section (3) of Section 3 of this Acton 14th January 1997 for regulating over-exploitation of GW.

Realising the need to restrict the excessive exploitation of GW, the Union Government drafted a model GW bill and circulated it to the state governments for enacting and implementing it. Based on this Bill, the Draft "*Punjab Ground Water Control and Regulation Act, 1998"* was prepared and presented to the Punjab State Water Resources Committee chaired by Chief Secretary, Punjab. The Committee in its meeting held on 25th August 2003 observed that instead of the legislative measures to control the falling water table, a system of incentives and disincentives is put in place to promote optimal and judicious use of GW.[19]

Expansion of Gw use in Punjab

Historically, in the period just after independence in 1947, the groundwater extraction was dominated by dug wells fitted with Persian wheels to lift the water and with depths generally not exceeding 10 meters below ground level (mbgl). The supply and demand of water could be balanced through the crop choice except during years of very low rainfall, and the water use, therefore, was generally sustainable. The green revolution technology, introduced during the mid-1960s, was a major turning point for Punjab's agriculture. The key change was not only new technologies, which included input-responsive dwarf varieties of wheat and rice, developments such as consolidation of land holdings, infrastructure (rural electrification, link roads, mandis, etc.), and institutions building (for credit, inputs, marketing, research, and extension, etc.), but also the peasantry, including a large displaced population eager to rebuild their lives.

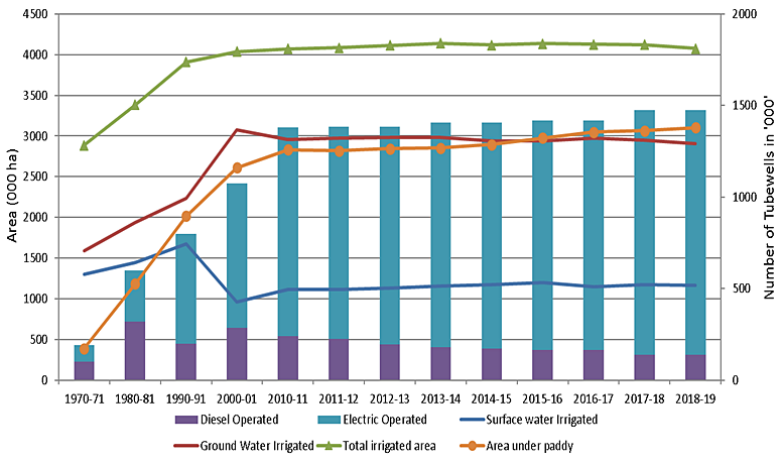

Fig. 1: Expansion of Irrigation and its Sources in Punjab

The irrigated area in the state expanded due to huge investments for surface water irrigation. But with more and more farmers realizing that groundwater could be applied 'just in time', something unthinkable in poorly managed and institutionally-complex canal systems, led to a rapid expansion of GW use at the expense of surface water irrigation (Figure 1). Thus, during the 1970s, there was a considerable growth of dug-cum-bore wells pumped with centrifugal pumps[20,21] with depth increasing to about 20 to 30 mbgl. This facilitated increase in the irrigated area due to the lifting of more water and also the growing of crops requiring frequent and more irrigation.

The availability of cheap institutional credit helped the farmers to change the GW extraction technology from centrifugal to submersible pumps during the mid1980s and the tubewell depth in many areas increased to beyond 125 mbgl. Also, the problem of water logging and/or salinity in the surface water irrigated and flood-prone areas were tackled by encouraging GI for vertical drainage, thus reducing the severity of the issue. Figure 1 brings out the contribution of groundwater in the growth of irrigated area which increased from 2.88 to 4.08 million hectares during years 1970–71 to years 2018–19; mainly due to growth in the share of tubewell irrigation from 28 percent to more than 72 percent (Annexure 1).

Drivers Of Growth Of Gw Use

The use of groundwater is highly contextual and has inter-sectoral links. The primary driver of the development of GI in the private sector is the unreliable and inadequate supply of irrigation water through the public canal systems, to meet the escalating water demand. The easy availability of electricity and low cost of pumping made the pumping of groundwater easy and economical. Further, GW irrigation offered an opportunity of providing the farmers a better control over the amount and timing of irrigation supplies. Supportive policies in terms of availability of cheap credit for tubewell construction and equipment; supply of power at subsidized rates or free of cost to the agricultural pump-sets; cheap diesel, input subsidies, and open-ended procurement of paddy and wheat at minimum support price (MSP) and sugarcane at a State Assured Price facilitated the use of groundwater for irrigation. The increasing area under RWCS led to unregulated groundwater extraction through an entirely private enterprise (Table 2), and GW irrigation became a pivot for growth in irrigated areas, especially for rice cultivation in Punjab.

Table 2: Shifts in Cropping Pattern in Punjab Overtime

Year	The area under the crop (thousand ha)					
	Paddy	Wheat	Maize	Cotton	Pulses	Oil seeds
1960-61	227	1400	327	447	903	185
1970-71	390	2299	555	397	414	295
1980-81	1183	2812	382	642	341	238
1990-91	2015	3273	188	701	143	104
2000-01	2612	3408	165	474	54	86
2010-11	2830	3510	138	483	20	56
2018-19	3103	3520	109	268	12.3	41.2

Source: Various Issues of Statistical Abstracts of Punjab[16]

Impact of Expansion of Gw Use

The development of GI, coupled with a favourable policy framework, has contributed to an expansion of area under paddy and development of rice-wheat mono-culture in Punjab, thereby contributing to increasing over exploitation of groundwater resources, increased private investment in irrigation infrastructure, and unmanageable power subsidy burden for the state. The 5th Minor Irrigation Census conducted

during 2013–14 enumerated 1.12 million groundwater units and their distribution by their ownership[20] shows that private individual farmers own more than 98 percent of tubewells. Thus, a large private capital investment of about Rs. 307503 million has been made by them in creating this GI infrastructure[23] and more than 95% of these are used for less than 200 hours during the Rabi season. The major impacts of this GW expansion have been as under.

Decline of Gw Table

The expansion of GW use in Punjab has resulted in a decline in GW level in its different regions. The rate of decline in the water table was 18 cm and 42 cm per annum during 1982-87 and 1997-2002[21] respectively but during 2002-06 it increased to 75 cm per annum.[22] And this increase in the rate of fall of GW was accompanied by deterioration in its quality, increased frequency of failure of tubewells, rising investment, and operation and maintenance cost. On the basis of the assessment of GW resources as per guidelines issued by the Groundwater Resource Estimation Committee-2015, the stage of groundwater extraction in the State is about 166 percent in the aggregate. However, the district-wise situation about existing extraction for irrigation indicates that in central parts of the state, the groundwater extraction is more than double the annual recharge.[18]

Burgeoning and Inequitable Power Subsidy

The promotion of efficient and productive agriculture has a tendency to favour the wealthy, and the promotion of equitable agriculture may not be essentially productive. The supply of free power is not only contributing to inefficient irrigation water use but also leading to anever-increasing and unsustainable amount of power subsidy for agriculture. During the last one and a half-decade (2004-05 to 2019-20), the power subsidy bill has grown more than seven times and the subsidy amount per hectare of net sown area has touched Rs. 21743 (Table 3). This provision is not only stressing the financial resources of the state but there is rising inequity amongst various sections of cultivators. The GW irrigation has negatively affected the equity issues due to necessary shift to capital intensive modern pumping technology and drilling techniques and consequently benefitted the big farmers.[24] Groundwater being a common property resource, large farmers has typically been its early exploiters and has an un-proportionate claim over the resource due to having tubewells with deeper depths and higher pumping capacity. The cost of GW irrigation also increases with the use of diesel-run prime movers for pumping and with entering water markets (for farmers having no tubewells).

Table 3: Power Subsidies in Punjab Agriculture

Year	Total subsidy (crore Rs.)	Subsidy (Rs/ha)
1990-91	385	913
2000-01	1659	3904
2005-06	1386	3261
2010-11	2737	6581
2015-16	5484	13256
2018-19	6256	15166
2019-20	8969	21743

Source: Worked out from Statistical Abstract of Punjab, various issues[17]

Loss of Bio-Diversity

GW irrigation coupled with free electricity for agriculture and assured procurement at MSP favoured the emergence of the current cropping pattern and marginalization of traditional crops viz. maize, cotton, pulses, oilseeds, etc. The cropping pattern in Punjab has gradually changed towards rice-wheat monoculture (Table 1). While the combined area under rice and wheat crops was less than 40% of the total cropped area during the late-1960s, it rose above 84% in recent times (Annexure I). Rice crop cultivation has been considered the primary culprit for the increasing GW use due to its water-intensive nature but in reality that it is the date of its transplanting which decides its water requirement, and thus its contribution to the depletion of water table.[25] Though the area under vegetables and fruits has increased, in general, crop diversification efforts have not succeeded much owing to relatively lower levels of profitability, higher production as well as marketing risks, and lack of profitable value chains for the alternative crops.

Recent Initiatives for Water Conservation

Puddled transplanted rice grown during the summer season is seen as the main culprit responsible for GW depletion and its replacement with less water exhaustive crops is being urgently sought.

In absence of a shift away from rice dominated cropping pattern, multiple measures, including agronomic and technological solutions have been devised and implemented. Some of these are discussed in the following sub-sections.

Precision Land Levelling

Precision levelling of land with laser levellers helps in uniform irrigation water application, and thereby to a better crop, improved productivity and lower labour requirements. Its adoption contributed to about 13% saving of irrigation water in wheat and about 14% in rice as compared to flood-irrigation.[26] The use of Laser Land Levellers has been propagated since 2005 through provision of these machines to entrepreneurs, cooperative societies, and farmer son subsidy. The number of laser land levellers in the state has increased to more than 7400[27] and about one million hectares have been laser levelled and a substantial portion being levelled annually.

Shift to Short Duration Varieties of Rice

The release of short-duration variety PR121 by Punjab Agricultural University (PAU) in 2013 was quickly adopted by the farmers of the state and it is presently grown over the largest acreage in the state. The time taken by these varieties to mature after transplanting (93 days by PR 121 and 110 days by PR 126) is lower than traditional variety PUSA 44 (139 days), thus water saving of 10-15 percent without any major yield discount.[28] Development of early maturing rice varieties PR 128 and PR 129 by PAU and their adoption by farmers is likely to give an additional advantage on account of low biomass; these are also highly amenable to *in-situ* paddy residue management technologies.

Direct Seeding of Rice

The direct seeding of rice offers some advantages over conventional puddled transplanted rice viz., less methane emissions, early crop maturity, saving of water and labour, low production cost, and better soil physical conditions for following crops. The water requirement of direct-seeded rice (DSR) is lower than puddled transplanted rice by about 10 to 35 percent.[29] Moreover, it offers the advantage of increased groundwater recharge owing to better soil physical conditions and the absence of hard pan in the soil profile.

Segregation of Power Supply Feeders

Physical segregation of the feeders supplying electricity to agricultural pump-sets has been completed and a rationed supply to 6–8 hours has been introduced while ensuring that it is of good quality i.e., uninterrupted and without voltage fluctuations. Restrictions on new electricity connections to tubewells in over-exploited areas have been enforced. Metering of feeders for electricity consumption calculations across all agro-ecological zones has been done so as to check the inflation of power bills by the electricity utility to claim a higher subsidy.

Direct Benefit Transfer of Electricity subsidy

A new scheme 'The Paani Bachao Paisa Kamao (PBPK)' (Save water, earn money) was launched in June 2018 on six feeders in 3 districts viz., Hoshiarpur, Jalandhar, and Fatehgarh Sahib. 287 consumers (30.5%) out of 942 have enrolled and have saved about 12 lakh units of electricity in the period from June 2018 to Feb 2020. Any consumption lower than the fixed entitlement, measured by energy meters, is reimbursed @ Rs.4.00 per KWH but consumption more than entitlement is not charged. The cost of electricity saved is directly transferred to the farmer's bank account. It also provides that in case 80% of farmers on the feeder opt for this scheme, supply hours to that feeder could be increased by 2 hours. In the second phase from June 2019; the PBPK project is being implemented in 250 feeders in Patiala, Ludhiana, Fatehgarh Sahib, Moga, Ferozepur, Ropar, Jallandhar, Kapurthala, Hoshiarpur, and SBS Nagar districts (A.S. Athwal Personal Communication)

Other Technical Interventions

The Soil and Water Conservation Department, Government of Punjab is also implementing water conservation programs as listed in Table 4. The Department is providing capital subsidy @ 90% for community underground pipeline projects and @ 50% to individual farmers to improve efficiency of on-farm irrigation water conveyance in the tubewell and canal commands. Micro-irrigation (drip and micro-sprinklers) is being propagated in a mission mode by subsidising the capital cost @ 80%.

Table 4: Achievements under various Water Conservation programmes

Year	Laying of Underground Pipeline System		Installation of Micro Irrigation Systems for Precision Irrigation		Solar Powered Lift Irrigation Systems		Rainwater Harvesting -cum- Recharge Structures in Kandi Area		Conjunctive Use of Treated Sullage Water of STPs for Irrigation	
	Length (KM)	Area (Ha)	Farmers (No)	Area (Ha)	Farmers (No)	Area (Ha)	Farmers (No)	Area (Ha)	Nos	Area (Ha)
2010-11	177	6770	-	4925	-	-			-	-
2011-12	488	15425	4477	4909	-	-	3293	1030	-	-
2012-13	702	20862	2707	2790	-	-	3116	2523	-	-
2013-14	614	17557	2000	2008	-	-	12529	2919	-	-
2014-15	1217	18069	791	876	-	-	85	2192	-	-
2015-16	1498	18729	2742	2286	-	-	150	3618	10	1569
2016-17	2040	41333	1626	2037	3	306	49	1297	16	2948
2017-18	2621	27591	379	600	2	352	11	129	6	640
2018-19	2058	21670	287	507	-	-	15	378	6	1772
2019-20	1675	18615	467	1114	-	-	108	2099	7	273
TOTAL	**13090**	**206621**	**15476**	**22052**	**5**	**658**	**19356**	**16185**	**45**	**7202**

Source: Compiled by the authors from Departmental website (https://dswcpunjab.gov.in)

Addressing the Gaps in Legal Framework

GW use to check its over-exploitation is a complex phenomenon, immensely influenced by various natural, economic, and political factors. Understanding the urgent need to check GW over-extraction and the role of the legal framework in GW governance, the State has recently taken following legal initiatives for this purpose.

The Punjab Preservation of Sub-Soil Water Act 2009

This Act replaces a 2008 Ordinance of similar name which prohibited the sowing or transplanting of paddy before the notified dates. It. Section 3 of the Act prohibits the sowing of paddy nursery before 10th May or such other date as may be notified by the State Government for any local area. It further prohibits the transplanting of paddy before a notified date. In 2009, it was notified as 10th June and in 2014, it was shifted to 15th June. Its implementation has a robust effect on checking the GW decline by avoiding the high evaporation period in May and June.[31] The effective enforcement of the 'change in crop calendar' by delay in the transplanting helped in reducing the depletion of water table by about 30 cm.[32] However, it is also being argued that due to shortening of harvesting window of time for rice on account of delayed transplanting, wind changes in North India during October–November and the temperature fall, the dispersion of particulate matter (PM) generated due to burning of paddy straw becomes difficult and it contributes to respiratory and cardiovascular diseases.[30]

'Right of Way' for the Conveyance of Irrigation Water

Punjab Government enacted Punjab Act No. 25 of 2017[41] which incorporates an amendment (a new Section 14-A in Chapter III) in *Punjab Land Improvement Schemes Act 1963,* enabling the farmers to lay underground irrigation pipelines through the land of other holders. It provides the 'Right of Way' to the Soil and Water Conservation Department and the farmers against payment of compensation for crop damage or damage to any structure, as per prevailing market rates. It has permitted the Department or the concerned farmers to lay pipeline at a depth of 3 feet beneath the land surface as per approved alignment in the fields of other land holders. A district-level committee under the chairmanship of the Deputy Commissioner is to be formed to determine the amount of compensation to be paid to the landholder.

Creation of a new Directorate of Groundwater Management

The GW governance suffered from the division of responsibility as many agencies in different sectors of the economy had a mandate for groundwater development for their sector, without any coordination among themselves. A new Directorate of Groundwater Management has been created in October 2017 with a focus on designing policies, programs, and strategies for the utilization, conservation, and management of GW resources in an equitable, judicious, and sustainable manner.

The Punjab Water Resources (Management And Regulation) Act, 2020

This 2020 Act provides for the regulation and management of water resources of the State so as to ensure their equitable, judicious, and sustainable use and management.[34] For this purpose, the Act provides that.

a) *A Punjab State Council for Water Management and Development,* chaired by Chief Minister, Punjab will be set-up. It will consider and direct the policies and programs of the State for ensuring supply of quality water to all persons at affordable costs and prices. The council shall approve an Integrated State Water Plan (ISWP) for the state, prepared by the government for every development block.

b) *A Water Regulation and Development Authority* will be established to ensure the management, development, and conservation of State's water resources in accordance with ISWP. The Authority may issue directions regarding installation and construction of any new structure for GW extraction through energized means. It may also lay down conditions for allowing the installation, reinstallation and construction of any existing or new GW extracting structures and for their operation. It may issue instructions to restrict the use of GW; volumetric measurement of GW extraction, recycling of available used water; and registration of users drawing GW.

c) *An Advisory Committee on Water Resources* comprising experts in the field of Agriculture, Environment, Hydrogeology, Water Resources or Economics, or Management will be constituted. It will be chaired by the Chairperson of the Authority and officials from different Government Departments will be its ex-officio members.

Discussion

The legal initiatives taken by the State Government despite being well intentioned have some basic shortcomings to achieve the aim of good GW governance. For the legislations to be effective, these should be simple to administer with sufficient independence to different institutions created under these Acts. These institutions need to have a coherent administrative structure which helps in the implementation of the Acts and their powers should be clearly defined to hold them accountable for their exercise. The Acts should permit a streamlined policy formulation and its implementation and subsequent enforcement. The political bureaucracy should have minimum interference and financial control over such institutions to enable them to work independently. The Water Acts are generally lacking in these basic tenets of efficient legislation.[31]

The provision of powers to Regulatory Authority to issue no-objection certificate to large farmers for construction of a new GW structure can help in a big way to check GW over-extraction, Further, empowering the regulating agencies to introduce compulsory metering of GW for estimating withdrawal by tubewells and its subsequent limiting can also help to check GW depletion. The shift to solar power for GW pumping can also help in matching the crop water demand with irrigation water availability through better control of famers on power supply and thus will contribute to efficient GW use. The legal framework needs to be strengthened to encompass these issues and should be backed by suitable policy initiatives in this regard.

Conclusion and Way Forward

GW is crucial resource for development of ecosystems and existence of humankind. However, its development outside a coherent governance framework has led to present scenario of inefficient and inequitable GW use, its depletion, and pollution. The recent initiatives to strengthen the existing legal framework for GW governance have contributed to reducing the irrigation water requirement of crops as indicated by the reduction in Water Footprint of RWCS in the state. The enforcement of Ordinance

in 2008 and the Act in 2009 coupled with the increase in productivity of crops have contributed to a saving of 413 litres of irrigation water per kg of produce i.e., from an average of 2634 litre/kg during 2000-07 to 2221 litres/kg during 2008-19.[14] Thus, despite the increase in area under rice, the average annual saving in irrigation water use due to change in crop calendar and other measures works out as 5.32 billion cubic meter (BCM) in rice-wheat rotation in Punjab, and most of it is derived from GW use which provides irrigation to about 72% of the net sown area (Figure 1).

Legal frameworks provide an opportunity for improving GW governance by taking GW resources under public domain through legal reforms and enforceable regulations.[32] Stronger GW governance is necessary for its efficient management and mitigation of problems. The number and depth of tubewells in Punjab is increasing (even in the 'over exploited' areas) due to the decline in the water table and so is the energy consumption and private investment in infrastructure related to GW irrigation. The inequity which exists amongst different users due to access to owning an electricity-run tubewell (in terms of resources and electric connection) and natural endowments (hydrogeology of the area and depth to the water table) contributes to inequity in the distribution of power subsidy. The small and marginal farmers who can hardly afford shallow tube-wells will be the first to lose access to groundwater due to the decline in water tables and long before different affluent users and well-to-do farmers. Reduced access to GW irrigation will force small and marginal farmers to join the already saturated unskilled labour markets, aggravating both the food security situation and the poverty. So, the existing legal framework for GW governance in Punjab is inadequate and its implementation challenging. A new legal framework for GW governance is necessary which can contribute to reduction in private and public investment in GW irrigation infrastructure

The Way Forward

The quote *"Everything has been said before, but since no one listens, one must always start again"*[33] fully characterizes the issue of GW governance in Punjab.We are well aware that GW plays a crucial role in availability of water for drinking, agriculture, industry, and ecosystems, and there are difficulties in its mapping, quantification, and evaluation, yet serious efforts in managing these challenges are lacking. Two common priorities for GW governance are its allocation (how much and to whom) and its quality. Financial resources are inadequate and human resources lack capacity to address these priorities. The changes in land use driven by economic growth, urbanization, and energy development, and population increase may alter the hydrologic cycle itself. Thus, ability of the state to address these common priorities is critical to efficient and responsive GW governance.

GW governance in Punjab is in a nascent state and the State does nothave anadequate legal and regulatory framework and required tools to address the problem of GW depletion. Legal frameworks for GW should reflect hydrologic realities linking quality and quantity GW and surface water. The governance framework should be able to deal with deficient data and information about the GW, connect across the spatial temporal scales, adapt to the evolving situations as these emerge and resolve the conflicts.[37] For the legal framework to be workable in practice, these should be coherent, equitable, fair, and enforceable; planned and well-sequenced to achieve transition; backed by water administration having operational capacity to implement the law; socially acceptable to support compliance; prepared with stakeholder participation in planning, legislative, and management processes; and coherent with socio-economic trends and policies. To sum up, an improved legal and regulatory framework based on costs and benefits of GW development and adapted to the ground realities can play a major role for improving GW governance.

Acknowledgment

The authors are grateful to Department of Laws, Lovely Professional University, Phagwara, Punjab for their support and access to the library services. The data provided by the Department of Soil and Water Conservation, Govt. of Punjab and Punjab State Power Corporation Ltd. is hereby acknowledged. In addition, we would like to express our sincere thanks to the constructive comments and feedback of the anonymous reviewers for improving the clarity and quality of this paper.

Funding
The authors received no financial support for the research, authorship, and/or publication of this article and it is part of the student research project.

Conflict of Interest
The authors have no conflicts of interest to declare that are relevant to the content of this article.

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