



Escalating Water Crises of Punjab: A State Facing Threat of Water Scarcity and Choice of Repurposing Sewage Waters

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ABSTRACT:

A revolutionary shift towards sustainable water management aims to combat the Punjab water crisis, which is suffering the dire consequence of groundwater overexploitation caused by the cultivation of water-intensive crops like paddy. This transition has been spearheaded by innovative water conservation projects to secure the future of groundwater resources and offer economic relief to farmers and the government, fostering environmental sustainability.

Water scarcity is a harsh reality that farmers of Punjab are facing since the past two decades. Many of these farmers have total dependency on groundwater. This is among the root causes of the rising concern on this issue and forms the focus of this paper. Punjabi farmers do not have access to canal water, which makes groundwater their only option. According to some of the farmers of Punjab the groundwater was at 4.5 meters at the beginning of the 21st century. Currently, it is reachable as deep as 21 meters illustrating the declining groundwater level.

Globally, water taken from underground reservoirs supports 40 per cent of agriculture, but if the groundwater levels fall the crises will be compounded manifold. Punjab, known India's breadbasket is observing its groundwater being depleted faster than it can be replenished by natural sources.

Introduction

Many parts of the world are facing severe water scarcity because of the depleting underground water reservoirs which support 40 per cent of the global agriculture. Punjab has been known as India's breadbasket but is currently facing the rising crises of the groundwater being depleted faster than it can be replenished by natural sources. Punjab is an Indian state located in the northern region of the country. Water shortages in Punjab have raised the importance of addressing the issue of water scarcity. Every year, there is need to dig deeper to reach the groundwater. This is not a problem posed as a projection for future generations, but has become a grim reality as it is being experienced already. Currently reaching the groundwater is an expensive exercise but landowners

have no choice but to face the losses. There is the ominous threat of scarcity for farming or drinking. Without water there is no farming, and no future for landowners and landless farmers of Punjab.

Punjab's agricultural dominance has been faced with escalating water scarcity and pollution and food scarcity issues in the current century. The State produces approximately 2,200 million litres per day (MLD) of sewage water, with a significant amount being untreated, exacerbating environmental degradation. The Punjab water crisis is poised to change with 1,700 MLD of sewage water being treated daily by advanced facilities. Of this treated effluent 330 MLD is sourced from 60 sewage treatment plants (STPs) and is repurposed for



irrigating over 10,000 hectares via underground pipelines, a figure poised to expand to 600 MLD and 30,000 hectares in the coming years [4]. This adoption of treated sewage for irrigation has resulted in the decommissioning of around 5,000 tube wells, offering the dual benefits of conserving electricity and reducing the financial strain on the State, which heavily subsidizes agricultural electricity.

This initiative is a boon for small and marginal farmers who were previously unable to afford tube well irrigation. It also spares other farmers the cost of periodically deepening tube wells to combat the falling water table. Initial skepticism among farmers regarding the use of treated “dirty” water is gradually giving way to widespread acceptance and demand. This is due to the success of village pond water projects delivering safe, effective irrigation water through subterranean pipelines. To date, 110 such projects are operational, underscoring the transformative impact of these initiatives. The potential scale of transformation is monumental. Full utilization of Punjab’s 2,200 MLD sewage for irrigation could retire 75,000 tube wells. This can significantly conserve both water and power, while also preserving underground water reserves. This vision extends to leveraging water from 15,000 sewage ponds for irrigation, further expanding the scope of water conservation efforts. Farmers in regions like Ropar and Mohali, previously reliant on deep and expensive tube wells can now benefit from free, nutrient-rich treated water. The shift in perspective is reflected in villages like Rampura Phul and Phagwara, where farmers who once resisted are now participating in treated water irrigation projects as they are increasingly recognizing the benefits of reduced fertilizer needs and sustainable water sources.

Drawing inspiration from Israel’s efficient sewage water treatment and utilization model, Punjab aims to achieve similar success. The Soil and Water Conservation Department’s initiatives [2] are offering sustainable irrigation solutions with minimal

operational costs. The challenges remain, particularly in addressing the free power supply to agriculture and the unregulated extraction of groundwater.

Punjab’s Agricultural cycle of Wheat / Rice Cultivation

Solving water shortages in Punjab is an essential step towards protecting its economic stability, food security and the well-being of citizens. With agriculture as its backbone, this State’s future is dependent on water availability. Addressing this challenge will become increasingly urgent if the groundwater levels continue to dip further. The key factor why Punjabi farmers are depleting the region’s aquifers is that rice and wheat cultivation is forcing farmers to find water wherever possible and acquire as much as they can to support these cash crops.

The State has had to deal with inefficient water management systems because half of the State’s canal water flows into the neighbouring Rajasthan, state. The government has not been able to find a solution to this issue and farmers continue to be without access to canal water.

Another major issue contributing to water shortages in Punjab is the pollution of the surface water. There are four main stretches of polluted rivers namely, Ghaggar, Beas, Kali Bein and Satluj. Many of the State’s industries have been emptying toxic waste into these rivers, resulting in water that is unfit for human consumption and poisoned for agricultural use. The industrialization and urbanization of the state has been consistently accompanied by the harmful discharge of waste and sewage into Punjab’s rivers.

The solution and ameliorative steps

A project that was set up to assist Punjab’s crisis is the World Bank-supported plan named Hydrology II [6]. This project introduced new technologies. New systems to monitor important parts of the hydro-meteorological cycle and utilize digital gauges and sensors to measure water levels were introduced.



The Punjab government launched the *Paani Bachao Paisa Kamao Scheme* in 2018 to incentivize farmers to conserve both water and energy. About 300 farmers are enrolled in this program. These farmers receive cash incentives to save electricity, creating 6-25% in water savings. The Punjab State Power Corporation Limited (PSPCL) runs the scheme which the State government has encouraged.

Another project is the Punjab Municipal Services Improvement Project with funding approved in April 2021. It is helping locals switch from using groundwater resources to the utilization of surface water sources. The project focuses on two cities namely, Amritsar and Ludhiana. It aims to finance water treatment plans, water pumping systems, transmission lines, etc. The projected improvements in water supply are envisaged to benefit more than 3 million people by 2026.

Genesis of the problem

Farmers from Punjab have attempted to explain why they experience water scarcity and how they deal with it. The groundwater is not being recharged without adequate rains. It would be devastating for the entire agricultural community of Punjab if the groundwater disappears. There must be a movement where farmers come together and make a collective effort before the groundwater becomes unreachable or runs out completely. The rainwater must be saved through various means as there is no other solution.

The past two decades are witness to the alarming fact that the rainfall and weather patterns have been erratic and unpredictable. The canal water and groundwater situation is precarious. The ponds that were an essential feature of every village have all but disappeared under the vicious land grab measures of unscrupulous people. Many of the farming families are resorting to “traditional wisdom and traditional techniques for effective management of natural resources.

Among the main water sources for the Bathinda agricultural regions is the canal water that comes from the Harike wetlands and the Satluj River. Water is conserved by using the traditional water management system, but there is an urgent need to supplement it with groundwater. Integrated water management systems are essential to help save and conserve water especially when it is not required in the field. It functions as a back-up system which supplements the canal water and replenishes the groundwater.

Situational analysis of alarming predicament of the Punjab farmer

Where there is excess rainfall there is need to set up practices like rain water harvesting urgently. The State may soon suffer drought-like conditions if these steps are not taken the ground water which can easily come up to three to six meters through concentrated efforts may well become scarce and even disappear. A multi-pronged approach is required where farmers are incentivized to plant crops other than rice and other crops that are equally water-guzzling. A study from the Central Ground Water Board (2023) found that Punjab's groundwater levels could drop nearly 1,000 ft by 2039 [5].

According to one farmer family, they had sunk a bore well and installed a motor for the very first time in 1963, for irrigating 16.6 acres of land and the groundwater then had been at eight feet. However, by 2000, the ground water level had plummeted below 80 feet, and the level of groundwater has been dipping since then. In the course of two decades, the water level had declined by over 100 feet underground. A study conducted by Punjab Agriculture University from 1998 to 2018 [5] highlights that anyone who cultivates wheat and paddy on his land, is deeply troubled by the receding groundwater levels.

Paddy is a water intensive crop, needing up to 5,000 litres of water to grow a kg of the grain. There has been surging a grassroots movement advocating for



the allocation of canal water for both irrigation and domestic consumption. In various regions the augmentation canals lack sufficient water for irrigation, because there are several places where farmers are drilling tube wells to depths of 500 ft deep to access water. The extracted groundwater is also proving unsuitable for drinking and has affected the crop yields drastically.

Poor-quality water is referred to as „*do number paani*“ and the good quality water is referred to as „*ek number paani*“. It is believed that with good quality water, an acre of land yields approximately 35 quintals of paddy but with poor quality water, the yield is just 20 to 22 quintals. Lack of appropriate irrigation is impacting severely upon the yield.

Contamination of groundwater is another rising concern among the Punjab farmers. Deeper wells to tap across the groundwater and high powered motors are adding to the rising costs of farming and inadequate support from government is proving to be the last straw for the already overburdened farmers.

Declined canal irrigation practices dependency and bane of ‘free’ electricity

In the Sangrur, Malerkotla and Barnala districts which lie in the Malwa region of Punjab, and which are lying South of Sutlej river have over-exploited the groundwater levels in most administrative blocks, according to a 2020 block-wise groundwater resources assessment by the Central Ground Water Board. Only Sri Muktsar Sahib district does not fall in this group.

This situation is found to be common most of Punjab. About 78 percent of the assessment units in the State have been classified as “over-exploited”, and the remaining have been categorised as “critical” (4%), “semi-critical” (6.7%), and “safe” (11.3%), according to the CGWB report. The severity of the issue is highlighted in the CGWB which found that Punjab's groundwater levels could drop nearly 1,000 ft by 2039.

A study [4] had depicted that until 1970-71 there were about 190,000 tubewells in Punjab. By 2011-12 this number had to 1.38 million, due to the availability of free or subsidised electricity. Subsequently, the count further increased by an additional 100,000 in 2019. Currently, 72% of Punjab's land is reliant on tubewells for irrigation, while the remaining 28% depends on canal water.

The State's water resource department has assured that the construction of three distributaries dedicated to irrigation, namely Kanganwal, Malerkotla Minor, and Rohira, will be commissioned. This development is poised to significantly bolster farmers in 35 villages located within the Mehal Kalan and Malerkotla blocks, enabling them to efficiently irrigate their fields, but much more needs to be done to ameliorate the situation. However, Canal irrigation serves only as a temporary solution whereas in reality, the water scarcity is a looming issue that still remains. Constructing a canal and providing water to one area may result in a reduced share of water for other areas, but cannot take care of the similar water crisis across other parts of the State.

The water distribution process in each canal, emphasising the release of water is calculated based on the specific crop requirements of farmers as per the command area of farms. Any further duration from these distributor canals would alter the allocation of water to those farmlands that were already being irrigated for over 100 years.”

The Bathinda region canal waters provide drinking water and water for domestic use to several villages experiencing deteriorating groundwater quality, as also to the cities like Ludhiana and Jalandhar where water quality has declined. According to a recent study, over-extraction of groundwater which has led to the intrusion of contaminants such as uranium, arsenic, manganese, zinc, copper, lead and iron into the aquifers, deteriorating the quality of the water.



Sustainable solutions for survival

A potential solution to the depleting groundwater in Punjab is to consider a sustained strategy to diversify the cultivation of crops and reduction in the cultivation of water-guzzling paddy. It is not Punjab's traditional crop, nor a staple part of Punjab's population's diet. It is also not suited to the agro climatic character of the region. India must gradually and decisively shift rice growing towards the East. As per the India Spend report of June 2019 [3], about 4,118 litres of water is required to grow one kilogram of rice in Punjab, compared to 2,169 litres in West Bengal, which is a natural habitat for the crop.

According to some concerned farming families of Punjab approximately 200 trolleys approximately 60 quintals of paddy are produced, but not even half a trolley (approx 30 quintals) of paddy is consumed in the village all through the year.

It has been reflected that if a minimum support price (MSP) for traditional crops like cotton and maize had been given by the government there would probably not have been as much groundwater exploitation which ultimately resulted. Public procurement of crops other than paddy and wheat is negligible or totally non-existent in the State. This is why farmers consider the adoption of alternative crops as an unconvincing option.

While State government has been promoting crop diversification and asking farmers to grow crops other than rice but there has been very little success. Even after spending Rs. 274 crore on a crop diversification programme during 2014-19 the sown area of rice increased by 7.18% in Punjab at the cost of other crops (Audit report by the Comptroller and Auditor General (CAG) of India, 2022)[1].

Many farmers of Punjab are giving up on their traditional livelihoods and the younger generation is opting to settle abroad due to depleting water resources. The parents do not want their children to face such struggles in the future. Farming can no longer sustain water resources.

The curse of basmati production in Punjab

India is the world's biggest exporter of basmati rice, supplying nearly three out of every four plates consumed globally, according to 2019 data from the Agricultural and Processed Food Products Export Development Authority. In the decade of 2013 to 2023, India has exported its basmati rice to over 170 nations of the world. These nations include Iran, Saudi Arabia, Iraq, the UAE, and the Republic of Yemen in the Middle East and North Africa all of which form the world's most water-stressed region. These five countries purchase seven out of every 10 bags of basmati rice that India exports. In South Asia, where all the basmati is grown, seven out of every 10 individuals is exposed to extremely high water stress. People in these regions use at least 80% of their renewable water supply. It leaves little room for emergencies like droughts that slow down natural water recharge and put the region's water security at immediate risk.

One kilogram of rice requires 5,000 litres of water for its production, one kilogram of wheat requires about 3,000 litres of water. And, we are exporting 22 million tonnes of food grains but the cost is astronomical on the natural resources because of the water-intensive nature of these crops.

Punjab produces the largest quantity of basmati rice, followed by Haryana. In 2023, Punjab accounted for four out of every 10 bags of basmati rice produced in India. India started exporting its basmati rice about 38 years ago, with a significant surge in the mid-2000s. Simultaneously the water table has been receding at the rate of over a meter annually in several areas. Before the exports were initiated basmati was sold for Rs 300 to 400 per quintal in the local market but with the initiation of the exports the basmati prices surged to Rs 1,100 per quintal. Since then, basmati rice secured a premium place in India's food export basket and has been steadily growing by over 37 times in value. Basmati earns more dollars than non-basmati rice. Between 2013 and 2024, basmati accounted for just a third of India's total rice exports



but brought in more than 50% of India's total export revenue from rice.

This growth in basmati rice exports raises a critical question of what cost have the agri-rich regions of Punjab have paid. Out of the five leading basmati producers, groundwater levels in three districts are in either critical or over-exploited categories.

Canal water is released based on farmer requests through the village canal patwari under the indent system. These requests move up the system, and water is supplied accordingly. During certain months, such as November, when wheat sowing requires less water, demand decreases, and canals may remain dry. According to a farmer, in 1976, water was just a few feet below the surface—you could pull it up by hand. But after 2001, the water level began to drop. Now, it's at the depth of 300 to 400 feet, and in many places, even deeper. According to the Punjab Water Regulation and Development Authority: "When groundwater extraction exceeds 100% of its recharge, it is considered over-exploited. In Punjab, the problem is severe. Some blocks are over-exploited by over 200%. We've categorized these areas into two levels: yellow for 100% to 200%, and orange for blocks exceeding 200%. Of the 170 over-exploited blocks, 54 fall into the Orange category. Most of these are in southern Punjab, including Sangrur, Moga, and Ludhiana, with a few are in central Punjab, like Jalandhar".

Management of the crisis

A major cause for of crisis is paddy cultivation, including basmati, which has grown from a mere 6.6% of net cultivated area in 1960-61 and was maximized to 65.57% in 2008-09.

In 2023-2024, Punjab reportedly broke its previous records by growing paddy on 31.93 lakh hectares, including 5.87 lakh hectares dedicated to basmati rice, marking a new record for this crop as well.

With the escalation of the predicament in the 1970s, the government was eager to increase production and introduced the minimum support price (MSP) policy

to both stabilize prices and help farmers with their income. It also created multiple agencies from the Agriculture Prices Commission (now called the The Commission for Agricultural Costs and Prices) to the Food Corporation of India (FCI) and Public Distribution System to cover the whole supply chain, from production to procurement, storage, and distribution. There is dire need to examine and rejuvenate the policy planning initiatives of the government.

Punjab remains the biggest source of rice for the Food Corporation of India, which procured 26% of paddy from Punjab in 2023-24. The increased paddy cultivation indicates higher groundwater consumption, as over seven out of every 10 litres of water used for irrigation are pumped from below the ground.

To reduce the growing stress on its groundwater resources the State has enacted the Punjab Preservation of Subsoil Water Act which prohibits and regulates for cultivating paddy before the notified date released by the authorities. "Earlier the farmers tended to sow paddy in the first week of May. After 2009, the Punjab Preservation of Subsoil Water Act was passed to prevent early paddy cultivation. This was necessary because, during the summer months, the low relative humidity causes significant water loss through evaporation. However, with the arrival of the monsoon, cooler air and moist soil help reduce evaporation, conserving water for the crops."

Currently, newer varieties like basmati 1509 were developed with water conservation in mind because it matures early and is supposed to save around 33% of water normally required for irrigation. Farmers usually end up growing a third crop like peas between paddy and wheat, taking advantage of the short duration required for the crops to mature. This defeats the original aim of water conservation and ends up increasing overall water consumption.



Conclusion: Gaps in policy strategy and implementation of water efficient farming

The central government has launched schemes like the „Per Drop More Crop“ to save groundwater by making irrigation practices efficient. The programme funds farmers to install micro-irrigation systems like drip and sprinkler irrigation. Under this scheme, small and marginal farmers can receive 55% financial assistance, while other farmers get 45%. Additionally, some states offer extra incentives or top-up subsidies to encourage farmers to adopt micro-irrigation. These efforts, however, have not been successful in Punjab in the last nine years, and this is seen in the discrepancy in support Punjab receives compared to other states. From 2015 to 2024, Punjab received only Rs 56 crore (\$6.4 million) while states like Karnataka and Andhra Pradesh have received the most funds, over Rs 2,500 crore (\$287 million).

This is not because of a lack of funds but because of a lack of demand in Punjab, according to State government official. Punjab’s area under coverage of micro-irrigation systems is just about 1.2% of the area under cultivation.

A conventional drip irrigation system costs around Rs 1.8 lakh per acre. Without government support, farmers have little incentive to invest in these systems when they could use free electricity to pump groundwater for irrigation, he said.

There is a lack of dedicated one-stop shops, such as those in Andhra Pradesh and Gujarat, that provide information and install such systems for farmers.

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