International Journal of Innovative Research in Computer Science & Technology (IJIRCST)
ISSN: 2347-5552, Volume-10, Issue-2, March 2022
https://doi.org/10.55524/ijircst.2022.10.2.19
Article ID IRPV1040, Pages 96-101
www.ijircst.org

Management of Surface and Underground Water: A Possibility to Improve Irrigation Effectiveness

Dr. Sandeep Singla,

Professor Department of Civil Engineering, RIMT University, Mandi Gobindgarh, Punjab, India

Correspondence should be addressed to Dr. Sandeep Singla; sandeep.singla@rimt.ac.in

ABSTRACT- Conjunctive usage management may be used in a variety of contexts, and there do not seem to be any instances where it should not be used. Conjunctive usage management that is planned is much superior to spontaneous conjunctive use. The majority of the development has already happened, and there are unlikely to be any new "Greenfield" irrigation projects on a large scale. Most conjunctive usage administration shall be implemented by retro-fitting supervision structures to prevailing schemes. In irrigation regions, poverty reduction is strongly related to effective supply of water and, as a result, to conjunctive usage administration. The most significant setting for management methods will be the regulatory framework for water management for various sovereign states. Any institutional improvement will need significant policy and perhaps legislative reforms to be effective. Conjunctive usage administration shall be connected to autonomous strategies on energy, climate change adaptation, and food security, necessitating a more comprehensive government strategy. Documentation of the actual overall rate of water assets and the distinct charge to different people is an essential component of planned conjunctive usage (for example, electricity subsidies are very common). The overall actual cost and the cost of each individual water consumer may be very different. The degree of surface and groundwater connection is an essential technical issue, but it will have little impact on whether conjunctive use management is effective. In most cases, established solidification surrounding groundwater management and the establishment of a fully integrated water agency would be a significant issue. Conjunctive usage management will include a significant amount of public education and technical evaluations.

KEYWORDS- Conjunctive Usage, Environmental Advantage, Irrigation Effectiveness, Irrigation Efficiency, Water Management.

I. INTRODUCTION

The technique of utilizing water from two distinct sources for consumption in an irrigation environment is known as conjunctive usage surface and groundwater. Conjunctive usage may refer to a strategy or technique at the agricultural command stage whereby surface water and groundwater supplies are simultaneously controlled as a supply to irrigation systems, or it may bring up to a preparation at the field level of obtaining water both from a well and an irrigation supply canal [1]. As a consequence, conjunctive usage may be classified as planned (when it is carried out as a direct consequence of management intent, usually a top down strategy) vs spontaneous (where it happens at the grass roots, usually a bottom up strategy). This article examines the major differences among spontaneous and planned conjunctive usage, as well as the strategy government essentially take to make best use of the potential advantages from such use. When both surface and groundwater sources are immediately accessible to the end user, unplanned conjunctive usage is common, with people being able to make water-related choices at the farm size.

The simultaneous use of surface and groundwater is referred to as conjunctive use of water [2,3]. Higher water dependability may be obtained as a result of the increased water supply. As a result, concurrent usage acts as a buffer during times of water shortage [4,5]. The concept behind this management strategy is to utilize surface water while the water table is rising and groundwater when it is low. This method may be particularly useful in reducing the effects of weather shift, such as increasing heat and drought. Through substantially improved water use efficiency, the intentional conjunctive utilisation of underground water and outer surface water does have the potential to provide advantages in terms of financial and societal consequences [6]. At supply level, using ground-water for farm irrigation in combination with surface water has advantages such as increasing water availability, reducing supply volatility, and controlling deep water table levels and therefore soil salinity. It is critical to optimize output while also ensuring the extended sustainability of underground water & surface water supervision. In some respects, the difficulties presented by this imitate the fruition of goals and supervision methods that have been, and continue to be, prevalent in irrigated land development across the nation. Many current irrigation commands get their water from catchment runoff collection as well as aquifer schemes [7-11]. The water has traditionally been obtained from either surface or groundwater sources, with the main supply being augmented throughout time by the alternate source. Enhancing the supervision and use of such assets that have been created independently may need significant capital infrastructure investment and institutional change in certain cases. Simply said, planned conjunctive

usage is relatively easy to accomplish on Greenfield (or new development sites), but much more difficult in established hydro-physical and organisational systems.

Despite the fact that these difficulties and the accompanying advantages of a deliberately structured strategy are widely known, India's present state of water regulation and management indicates that little progress has been made toward broad adoption [12-16]. The causes for the apparent lack of complete incorporation in the monitoring & utilization of all foundations of water, as well as the lack of better coordinated planning, are explored in this article. According to the authors, there are still significant gaps in water managers' understanding of which aspects of the current management regime need to be overhauled in order to accomplish integrated management and the better outcomes that can be anticipated when contrasted to separate management provisions. This lack of knowledge is a major roadblock to governance, institutional and physical infrastructure changes, where planned conjunctive usage may enhance current managerial and supervisory setups. Different 'ownership' models of groundwater and surface water delivery infrastructure, as well as the associated entitlement regime (private and/or public), may obstruct reforms; a scenario that has effects on social and organisational behaviour, as well as the implementation of a conjunctive management approach.

This paper aims to shed light on these roadblocks to adoption, and thus provide a fresh perspective on a traditional model; a perspective that will help to advance the goal of enhanced water management as well as water use effectiveness, and thus endorse longer-term outcomes such as better food security throughout India's most vulnerable regions.

II. DISCUSSION

A. Beliefs and False Beliefs of Conjunctive Use

In most climates, peak river discharge occurs at a certain period of the year, while crop irrigation water needs are highest during times of low rainfall, when uncontrolled stream flows are considerably lower. Water supply is matched with agricultural water needs in many irrigation systems via the building and maintenance of dams, which collect water during high flow times and allow controlled releases to fulfil crop water requirements. Dams, on the other hand, are intrinsically expensive to build, operate, and distribute water from. Dams and their related distribution systems are also prone to significant system losses through to evaporation and leakage, and they have society and the environmental consequences for the people and environments in which they are constructed.

The goal of conjunctive use and monitoring is to maximize the benefits derived from the inherent features of surface and underground water use; characteristics that would provide supplementary and ideal productive capacity and water use performance outcomes through scheduled incorporation of both water sources [17]. Conjunctive usage is implemented on a daily basis at the farm level, with 'management' characterized by low-level (or micro) choices integrating variables such as resource availability, delivery costs to the crop, tradability of leftover allotment, and water quality. These variables work together to reduce costs, improve output, and increase net profit. Planned conjunctive water usage and management at the agricultural command level, on the other hand, strives towards higher level goals. The World Bank predicted that planned conjunctive usage will improve productivity and fairness in the management of surface and groundwater resources, as well as enhance economic, environmental, and social sustainability.

The aquifer serves as a natural storage system for groundwater during times of high demand. Effective maintenance may take benefit of underutilized storage capacity by enhancing recharge for subsequent recovery via Managed Aquifer Recharge (MAR) [18]. Such a management technique allows excess surface water to be collected and used when the stream flow is reduced or when water is needed for other reasons. Underground water may be increased by injecting water into recharge wells, storing water in infiltration basins, or delaying the regular flow of rivers and streams to encourage more underground water recharge.

The advantages of optimizing the conjunctive use of exterior and underground water have been studied at a broad level for many years via theoretical modelling and physical system investigations. These advantages come in the form of

- Productivity increases
- Gains in the economy
- Savings on energy
- Efficiency in the use of water resources
- Increased irrigating capacity across bigger regions
- Infrastructure improvement

B. Institutional Structures Required for Efficient Monitoring of Conjunctive Use

Conjunctive use management is hindered by inefficient and unreliable institutional processes, with separate management arrangements almost always established and maintained by different groups, rather than a lack of technical expertise, however this is a major constraint [19]. Moreover, water resources are often administered by agricultural agencies or specialised irrigation command authority at the national level, whereas irrigation commands are often governed by agricultural agencies or specialised irrigation operational control at the local level. The agriculture sector may be required to operate under the supervision of a regulatory agency, and a jurisdictional-level water resource plan may be created. As a result, a complex mosaic of selection and planning pathways develops, complicating the pursuit of an expected conjunctive management paradigm.

C. India's Capacity for Long-Term Conjunctive Management

Irrigation managers and policy makers in India must acknowledge that the epoch of building irrigation systems in India is speedily nearing its end. The major difficulty now would be to enhance the implementation of general populace irrigation resources. Further, disregarding the involvement of personal underground water irrigation in canal command implies seriously lacking out huge opportunity for unlocking value from watering systems. India's climate necessitates the

use of private groundwater irrigation and Indian agriculture has previously been tapped for very efficient soil and underground water management. Reconditioned surface assets and a conjunctive administration procedure are all the industry requires.

When canal irrigation system management teams purposefully direct fresh water deliveries away from water-logged regions to groundwater depleted areas, or when they suspend waterway supplies during the rainy season to provide irrigation during the dry season, or when they use treated urban sewage water to complement fresh canal or underground water supplies, for example, conjunctive management is at work. To combat groundwater depletion and minimize electricity subsidies to irrigation, the Gujarat government built a 600-kilometer-long spreading canal to utilize excess flood waters from the Kadana and Sardar Sarovar reservoirs in the south to replenish dry aquifers in north Gujarat. This is an excellent example of surface and groundwater management working together.

Thanks to a growing underground water irrigation activity in the command regions of surface irrigation systems, India's conjunctive administration capability has skyrocketed. This potential, however, is much away from being realized. Irrigation managers in canals often overlook or are ignorant of the advantages of conjunctive management. Conjunctive management is further complicated by inadequate enforcement mechanisms in canal commands. As a consequence, conjunctive management occurs in many Indian systems, although mostly by accident, as a result of farmers' private entrepreneurial activity. Intentional conjunctive control of soil and underground water necessitates a mindset shift among irrigation managers as well as stricter rule enforcement, in addition to, of course, canal and irrigation system modernisation. Rainfall, ground waters, wastewater, and groundwater must all be managed in a proactive and purposeful manner by institutions and management structures.

D. Examples of Conjunctive Use - Successes and Failures

Conjunctive usage of surface and groundwater is widely recognized in most nations with irrigated agriculture, both developed and developing. However, it is also acknowledged that, although conjunctive usage is likely to be the rule rather than the exception, its implementation inside an integrative water management system is woefully inadequate.

Foster characterized the conjunctive usage setting in India's Uttar Pradesh State, which is classified as a moist but drought-prone middle alluvial plain hydro-geological environment [20]. The Indo-Gangetic Plain (alluvial plains of the Ganges Valley) in Uttar Pradesh, India, is underlain by an enormous aquifer system that holds groundwater that accounts for up to 70% of total irrigation water supply. This is one of the world's biggest groundwater storage reservoirs. Its use as a water resource arose mainly in reaction to a decrease in supplies and the unreliability of irrigation canal systems. The aquifers are immediately replenished by entering monsoon rainfall, but they are also indirectly recharged by canal leakage and low applied irrigation effectiveness (i.e. excessive field application rates), which is a typical situation in such hydro-geological environments.

Increased groundwater extraction has resulted in a falling water table, especially in high-intensity "groundwater exploitation zones," while flood irrigation and canal leakage have kept water tables shallow in other regions (in some instances within 10-20 km). In certain places, evidence of irrigation tube well dewatering, yield decrease, and pump failure, as well as hand-pump failure in rural water-supply wells, has been linked to a drop in water tables. Shallow or increasing groundwater levels, on the other hand, pose a danger to approximately 20% of the land area, with salinization leading to agricultural losses and even land abandonment and water-logging [20].

In the Jaunpur Branch canal-command region in Uttar Pradesh, a "more planned conjunctive-use strategy" is being adopted in view of the difficulties presented by increasing water tables in certain places and reductions in water supplies elsewhere. These operations are linked with the development of an adequate management plan, for which the land surface has been split into ‘micro-planning and management zones' based on hydro-geological and agro-economic criteria. A canal reach (e.g. head, mid, or tail) is given to each zone, together with a current irrigation canal throughput and water table level indicator. The state of the irrigation water supply, groundwater resource status, and groundwater management requirements are then determine

Because of lower pumping costs and better agricultural methods, the combined management of surface and underground water has resulted in a 26 percent increase in average net income. Improved cropping patterns and more dependable and occasionally new (e.g., supplying water in previously dry areas) water sources for irrigation and other purposes, such as domestic/industrial supplies, have shown a more sustainable system. Pullback from groundwater pumping during the dry season avoids water-logging and maximizes storage capacity for monsoon recharge the following year.

Unused drainage canals built to prevent water logging and floods in the 1950s are now being considered as a method of channelling monsoon waters throughout India for agriculture, storage, and later usage, or recharge to underlying aquifers. Modifications to already lined canals may help them become temporary reservoirs, with ‘check structures' placed at appropriate intervals to restrict water flow and improve the carrier's aquifer recharge capacity.

One example of conjunctive usage by default is the Mahi Right Bank Canal System in central Gujarat [21]. The canal irrigation system, which was built in the 1970s, supplied water to 250,000 hectares of land that had become waterlogged and had suffered secondary salinization. About 100,000 private tube wells were built throughout the years, and they became the primary supply of irrigation water in command regions. These tube wells are currently used as vertical drains, which are a cost-effective alternative to a lateral drainage system. Waterlogged areas shrank, and agricultural flourished in formerly barren places. Irrigation efficiency was previously evaluated in cubic meters per hectare of canal supplies; however, it is now calculated in cubic meters per canal and groundwater watered area. Punjab's huge plains tell the same tale. Private tube well

construction has reduced or eliminated massive water-logging and secondary salinization in the 1950s and 1960s. Many canal irrigation systems in Tamilnadu's south had been over-extended to the point that canal water supplies have to be rotated to various blocks of command regions [22]. In certain systems, half of a command area receives all canal water for a set period of time, while the other half utilizes well water while waiting for its turn to get canal water privileges. Other systems operate the whole canal network for a certain season, with canal water supplies restricted to the left side one year and the right side the next. Irrigation system administrators may now disperse available surface supplies across a considerably wider area than before thanks to the development of tube wells in command regions. Furthermore, farmers appreciate groundwater recharge through canal irrigation as much as, if not more than, the direct irrigation advantage.

E. Social Conjunctive Use Schemes Provide Social And Environmental Advantages

In Utter Pradesh, a regionally planned strategy was used to affect changes in the water supply/demand balance by examining the nature of the whole water cycle for the area and how it behaved geographically and temporally. Following that, a number of measures were made to optimize the existing infrastructure, allowing for more water to be accessible in a more effective way. There seems to have been minimal state-sponsored investment and no visible improvements in management and/or regulation. Local ownership, on the other hand, was focused on improving overall water availability. The advantages of doing these steps have been extensively publicized.

"Effective conjunctive management can probably only be achieved by a strategy that combines groundwater and surface water into a single institutional framework; they must be managed jointly to be efficient," according to Bredehoeft. Conjunctive management is not feasible in today's institutions, which are based on the current application of the norms of previous appropriation." This is due to the fact that current surface water rights are strictly maintained and enforced by the appropriate water agencies, and as a result, groundwater cannot be utilized in an unrestricted conjunctive sense. The social, technological, and economic aspects must all be considered in the context of the local environment in order to create the best management arrangements. However, if existing institutional or regulatory frameworks prevent execution, the best method may end up being entirely theoretical. This pertains to the legal "ownership" of water rights, the capacity of local bodies or water user organizations to make day-to-day choices, and the ability to do efficient groundwater resource accounting, all of which are essential for successful management in a "changing world."

F. Approaches to Governance

The example of Uttar Pradesh illustrates the need for "multi-faceted governance structures for effective administration of smallholder surface water irrigation systems." These arrangements get more complicated when dealing with conjunctive usage. The requirement for integrated administration of the two factors necessitates more stakeholder involvement and networking at each step of water allocation, usage, and management, resulting in increasing management complexity." Furthermore, Livingston separates water governance approaches into three categories: bureaucracy, community, and market. Approaches to governance may favour one of these three components, but they will all be present in the end. Legislative, organizational, capacity, and socio-political issues will all need to be addressed in the governance paradigm. The organizational element of many nations will need the most substantial adjustments.

G. *Organisational foundation and strength*

To eliminate obstacles, water management institutions at both the regional and national levels would need to be reinforced. This will need the adoption of frameworks that encourage integrated water resource management, in which surface and groundwater functions work together toward a single overall goal, and the roles of the water and agricultural ministries are likewise linked. Organizations will have to be explicit about who runs and controls irrigation commands, which may include either the business or government sector, or a mix of both.

H. Legislation and Policy

There would be a need to evaluate and examine existing methods of distributing water rights, as well as the form and characteristics of those rights, in many cases. In many cases, rules & regulations may be inadequately designed and therefore ineffective in achieving the desired results. The importance of efficient water management planning cannot be overstated. Such management will have to be backed up by powerful central policy and carried out within a system that guarantees the resource's long-term viability. This will require a considerable amount of technical input, particularly given the necessity to evaluate the available consumptive pool.

I. *Design Strategy*

Planned conjunctive usage, by its very nature, will need a robust management framework. Objectives, objectives, activities, performance assessment, and compliance arrangements must all be clearly defined. Water allocation methods should be at the heart of such strategies, as should a technical knowledge of the overall consumerist groundwater available. Implementation of the plan will need the identification of investment requirements as well as choices on who will make those investments and who will eventually pay for them. The triple bottom line concept of attaining environmental, economic, and social goals should ideally be included into planning.

J. *Marketing and Valuation Methodologies*

Users will always have distinct pricing structures for surface water and groundwater. These cost patterns may be highly subsidized in centralised administrative systems as a result of associated policy choices (for example, those for energy and food), and there could be unintended consequences; typically, these are low water usage efficiency results. Groundwater users, on the other hand, often fund their own

infrastructure, while surface water infrastructure is either completely or partially subsidized by the government. Various ownership structures have different cost effects for irrigators, resulting in choices that aren't in line with optimal planning goals. Conjunctive administration will need to recognize and eliminate these roadblocks. Groundwater development that is subsidized by the government may need investment. At the local and global scales, there will be variations in economic methods, and any action aimed at improving the water market must take into account the two distinct scales of advantages. That's also relevant when financial incentives are used.

K. *Practical Implementation*

Irrigated farming will benefit greatly from, and perhaps need, strong ownership of planned conjunctive use management. Developing better public-water user associations via focused education and enabling activities may help accomplish this. Communities have hitherto been focused on single problems (either rainwater or groundwater), with a reluctance to participate in management challenges connected with the opposite side of the resource picture, which would need reorganization to better represent the distribution of users. A number of reasons make overcoming this problem more difficult, including the lack of a revenue basis for cost recovery and the politicization of user groups in favor of preserving subsidized surface water supplies.

L. Market-Based Economic Instruments for Planned Conjunctive Use Promotion

FMBIs (Financial and Market-Based Instruments) are a set of economic and financial tools that may be used to promote certain behaviours and trends. FMBI may be direct financial incentives (e.g., tax reductions, subsidies to reduce power costs) or disincentives (e.g., tax hikes) in the perspective of water resources development, or indirect trade-offs or offsets (e.g., pollution control programs) and the adoption of water trading. The establishment of well defined water "rights," the imposition of well-defined caps (i.e., maximum restrictions on groundwater and surface water usage), and finally the implementation of a water trading system may all work together to make overall water use more efficient. Many nations have surface water trade systems in place but groundwater trading systems are less prevalent. Trading regimes for surface water to groundwater and vice-versa are uncommon. Nevertheless, if properly managed, water trading may be a powerful market tool for encouraging conjunctive usage. However, there are just a handful cases across the globe when this has happened. This is particularly true when market processes aren't intended to take environmental consequences into consideration e.g. salinity effects.

III. CONCLUSION

Conjunctive usage management may be used in a variety of contexts, and there do not seem to be any instances where it should not be used. The majority of the development has already happened, and there are unlikely to be any new “Greenfield” irrigation projects on a large scale. Most conjunctive usage management will be implemented by retrofitting management structures to existing systems. Conjunctive usage management that is planned is much superior to unplanned conjunctive use. The most significant setting for management methods will be the regulatory framework for water management for various sovereign states. Any institutional improvement will need significant policy and perhaps legislative reforms to be effective. In irrigation regions, poverty reduction is strongly related to water delivery efficiency and, as a result, to conjunctive usage management. Conjunctive usage management will be connected to sovereign policies on energy, climate change adaptation, and food security, necessitating a more comprehensive government strategy. The degree of surface and groundwater connection is an essential technical issue, but it will have little impact on whether conjunctive use management is effective. Identification of the actual overall cost of water resources and the distinct cost to individual users is an essential component of planned conjunctive usage i.e., electricity subsidies. The overall actual cost and the cost of each individual water consumer may be very different. Conjunctive usage management will include a significant amount of public education and technical evaluations. In most cases, institutional strengthening surrounding groundwater management and the establishment of a seamlessly engaged water agency would be a significant issue.

REFERENCES

[1] Zhang X. Conjunctive surface water and groundwater management under climate change. Frontiers in Environmental Science. 2015.

[2] Li P, Qian H, Wu J. Conjunctive use of groundwater and surface water to reduce soil salinization in the Yinchuan Plain, North-West China. Int J Water Resour Dev. 2018;

[3] Yang Y, Zhu Y, Wu J, Yu L, Yang J. groundwater under conjunctive use of groundwater and surface water in Hetao Irrigation District. Paiguan Jixie Gongcheng Xuebao/Journal Drain Irrig Mach Eng. 2018;

[4] Goswami L, Kaushik MK, Sikka R, Anand V, Prasad Sharma K, Singh Solanki M. IOT Based Fault Detection of Underground Cables through Node MCU Module. In: 2020 International Conference on Computer Science, Engineering and Applications, ICCSEA 2020. 2020.

[5] Solanki MS, Sharma DKP, Goswami L, Sikka R, Anand V. Automatic Identification of Temples in Digital Images through Scale Invariant Feature Transform. In: 2020 International Conference on Computer Science, Engineering and Applications, ICCSEA 2020. 2020.

[6] Alam N, Olsthoorn TN. Sustainable conjunctive use of groundwater for additional irrigation. Hydrol Process. 2014;

[7] Rahul M, Kohli N, Agarwal R, Mishra S. Facial expression recognition using geometric features and modified hidden Markov model. Int J Grid Util Comput. 2019;

[8] Sharma M. Services of mobile commerce. In: Mobile Commerce: Concepts, Methodologies, Tools, and Applications. 2017.

[9] Dhingra V, Mudgal RK, Dhingra M. Safe and Healthy Work Environment: A Study of Artisans of Indian Metalware Handicraft Industry. Manag Labour Stud. 2017;

[10] Dhingra M, Dhingra V. Perception: Scriptures’ perspective. J Hum Values. 2011;

[11] Akhtar M, Mittal RK. Enterprise performance management and flexibility: Factors of effectiveness in upstream oil industry in india. Glob J Flex Syst Manag. 2010;
[12] Hirawat A, Taterh S, Sharma TK. A public domain dataset to recognize driver entry into and exit from a car using smartphone sensors. Int J Syst Assur Eng Manag. 2021;
[13] Sharma V, Sharma S, Verma OP, Bhardwaj B, Sharma TK, Pachauri N. Prediction and optimization of abrasive wear loss of ultrahigh strength martensitic steel using response surface methodology, Harris Hawk and artificial neural network. Int J Syst Assur Eng Manag. 2021;
[14] Malik S, Rana A, Bansal M. A survey of recommendation systems. Inf Resour Manag J. 2020;
[15] Kashyap K, Sharma TK, Rajpurohit J. Logistic map and wavelet transform based differential evolution. Int J Syst Assur Eng Manag. 2020;
[16] Sharma TK, Prakash D. Air pollution emissions control using shuffled frog leaping algorithm. Int J Syst Assur Eng Manag. 2020;
[17] Stahn H, Tomini A. On conjunctive management of groundwater and rainwater. Resour Energy Econ. 2017;
[18] Page D, Bekele E, Vanderzalm J, Sidhu J. Managed aquifer recharge (MAR) in sustainable urban water management. Water (Switzerland). 2018;
[19] Mani A, Tsai FTC, Kao SC, Naz BS, Ashfaq M, Rastogi D. Conjunctive management of surface and groundwater resources under projected future climate change scenarios. J Hydrol. 2016;
[20] Foster S, van Steenbergen F. Conjunctive groundwater use: A “lost opportunity” for water management in the developing world? Hydrogeol J. 2011;
[21] Mukherjee A. The effect of irrigated agriculture on bird populations on the Mahi Right Bank Canal System, India. Acta Zool Sin. 2006;
[22] Arya S, Subramani T. Rapid assessment of suitability of groundwater for drinking and irrigation purposes. Pollut Res. 2013;