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Participatory Irrigation Management Acts in India: Need for a shift towards Sustainable Development

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Abstract

Water is a critical input for agricultural production, playing an important role in food security. Irrigation to regions where rainfall is scanty becomes very crucial. Approximately, 70% of the stored water is being used for irrigation. Thus, the regulation of water to ensure judicious use becomes highly indispensable. This study aims to critically appraise the Acts related to Participatory Irrigation Management (PIM) being enacted in 18 states of India. By a comparative study, the salient features of PIM such as entrustment, equity in water supply, bottom-up approach, pricing of water, sense of ownership and membership,

participation in decision-making process, and capacity building in its institutional arrangements are discussed. PIM can contribute significantly to Sustainable Development Goals (SDGs), including poverty reduction (SDG 1.2), food security (SDG 2.1 and 2.4), environmental conservation (SDG 15.1 and 15.3), and resilient livelihoods (SDG 9.1) in rural communities. This study aimed at pointing out the PIM concept with the lens of sustainability as it aligns community interests with environmental stewardship and economic viability, laying the foundation for long-term prosperity and wellbeing.

Keywords: Gender, India, Participatory Irrigation Management, Water Governance, Water Users' Association, Water Rights

1. Introduction

Water is a critical input for agricultural production and plays an important role in food security. Being the biggest consumer of water, agriculture accounts to almost 70% of the total withdrawals (Anderson *et al.*; Ingrao *et al.*)^[4, 15]. Freshwater is a limited resource and must be managed efficiently and sustainably involving all the stakeholders at every level (United Nations Environment Programme; Solanes and Gonzalez-Villarreal; Agarwal *et al.*)^[40, 33, 1]. For a sustainable, efficient utilization and equitable distribution of the irrigation water among users, Participatory Irrigation Management (PIM) through Irrigation Management Transfer (IMT) is the most appropriate method (Swain & Das, 2008)^[37]. The policies or acts formulated for the management of water in agriculture should encourage farmers to actively participate in the irrigation management and it should be framed in line with the scope of Sustainable Development Goals such as environmental protection, social inclusion, and economic growth (United Nations).

PIM, which is a decentralized water management practice, empowers farmers by giving a direct role in managing the irrigation water. The participation of farmers in the decision-making process enables them to address the region-specific problems faced by them, so that solutions can be arrived suited to the requirement of the farmer. PIM imparts improved water management and productivity in agriculture thereby enhancing the economic sustainability of the farmers. The stakeholder participation plays a major role in the successful upshots involving in the operation and maintenance of irrigation systems (Steduto *et al.*)^[35]. Many countries emphasize on the implementation of PIM in their agriculture and irrigation management system. PIM has been implemented since 1992 as a notable irrigation management policy in Sri Lanka (Aheeyar *et al.*)^[2]. In the Philippines, participatory approach of the users in irrigation has been adopted since mid - 1970s in small irrigation systems (Maleza and Nishimura). Mexico's Irrigation Management Transfer is a well-known water reform in the early 1990s due to its speedy implementation (Rap). Turkey implemented the transfer of management of irrigation system from Government to the users even in the beginning of the 1950s (Kuşçu *et al.*)^[18]. By the implementation of PIM in Thailand, a national development plan

called Sufficiency Economy Philosophy (SEP) was bolstered as it lined up with the participatory approach (Suwanmaneepong *et al.*)^[36]. The Irrigation Advisory Committee in Southern Ontario developed a sense of ownership among the water users because of their involvement in the management (Shortt *et al.*)^[31]. In India, however, the implementation of PIM has taken a snail's pace compared to other countries (Ghosh *et al.*)^[11].

Sustainable Development Goal (SDG 6) emphasizes on ensuring availability and sustainable management of water (United Nations). SDG targets 6.1, 6.4, 6.5 and 6.b collectively illuminate the equitable access of water to the farmer at every level, achieving water use efficiency with regulated and managed withdrawals by involving the users in the management of the limited resource by an integrated approach. Institutions which are responsible for the allocation and distribution of water to the farmers fails to serve at certain times, hence whether equity is maintained in each level of distribution network has to be examined regularly. Tail-end farmers may not receive adequate amount of water which is required for the crops they have cultivated. The authority which is responsible for the supply of water to the users should be accountable in such a case. In Egypt, a study corroborate that when the irrigation scheduling was done by the farmers, there were no conflicts among the users and the water levels in the respective area were sufficiently maintained (Batt and Merkley)^[8]. Water Users' Associations (WUAs) with potent leadership results in appropriate distribution of water among the water users (Kazbekov *et al.*)^[16]. Establishing WUAs help in resolving water conflicts among the users (Chami and Karaa)^[9]. Also, PIM improves the relation between the users and the government officials (Roy)^[29].

Another important aspect is to frame the reforms with gender lens because men and women have different perspectives over water management in agriculture. So, for a successful irrigation management, both men and women should be involved in all its activities. SDG targets 5.5, 5.a, 5.c, 10.2 and 10.3 accentuate the importance of social inclusion of farmers in view of achieving gender equality in the water management system. It is important to consider every user group irrespective of gender of an irrigation system while formulating reforms for water to work out an effective and sustainable water management. Collective action of men and women result in greater impact on water management (Were *et al.*)^[44]. Though the participation of women is being encouraged in the water management activities, their concerns or opinions were not taken into consideration in the decision-making process (Khandker *et al.*)^[17]. A gender-based strategy has to be developed while adopting Participatory Irrigation Management (Dasthagir, 2012)^[10].

Most of the legislation or associations created for managing irrigation at local level exists in paper but in reality, the beneficiary participation is poor (Shah & Sakthivadivel, 2018)^[30], since the farmers were not aware of the reforms or laws passed for their betterment and the importance of gender inclusion in water management. This requires proper strengthening and implementation of such Acts from national to local level. PIM exemplifies on decentralization, however in India, the ownership and irrigation plans or programme managing powers are still not entirely transferred to the farmers (Poddar *et al.*)^[27]. There is no

scope for improvement of reforms, monitoring and revising of the Acts that has been passed for the participation of farmers in irrigation management in most of the states of India. Hence there is a need to understand the policy formulation and implementation for water management.

This study critically analyses the Participatory Irrigation Management Acts existing in various states of India. These Acts were framed years ago without incorporating the concept of sustainable development in the management of irrigation water by the stakeholders at all levels. The Brundtland Commission report's (WCED) definition on Sustainable development can be revamped in case of irrigation management as "to meet out the needs of every water user (all stakeholders) in an irrigation system through effective management in water utilization, water distribution, and protection of water resources by making the resource available without compromising the needs of the future water users in that irrigation system". The factors for sustainable management is in vague and hence the principles of sustainable PIM have to be incorporated in the PIM Acts to achieve sustainable irrigation management by the farmers associations (Hamada and Samad)^[12]. SDG target 12.8 ensure that by 2030 everyone should be aware of sustainable development to have lifestyle in harmony with nature. This study looks into the inclusion of the concept of PIM in some states of India, but the implementation (the performance aspect) of such concept in the selected states is not analysed.

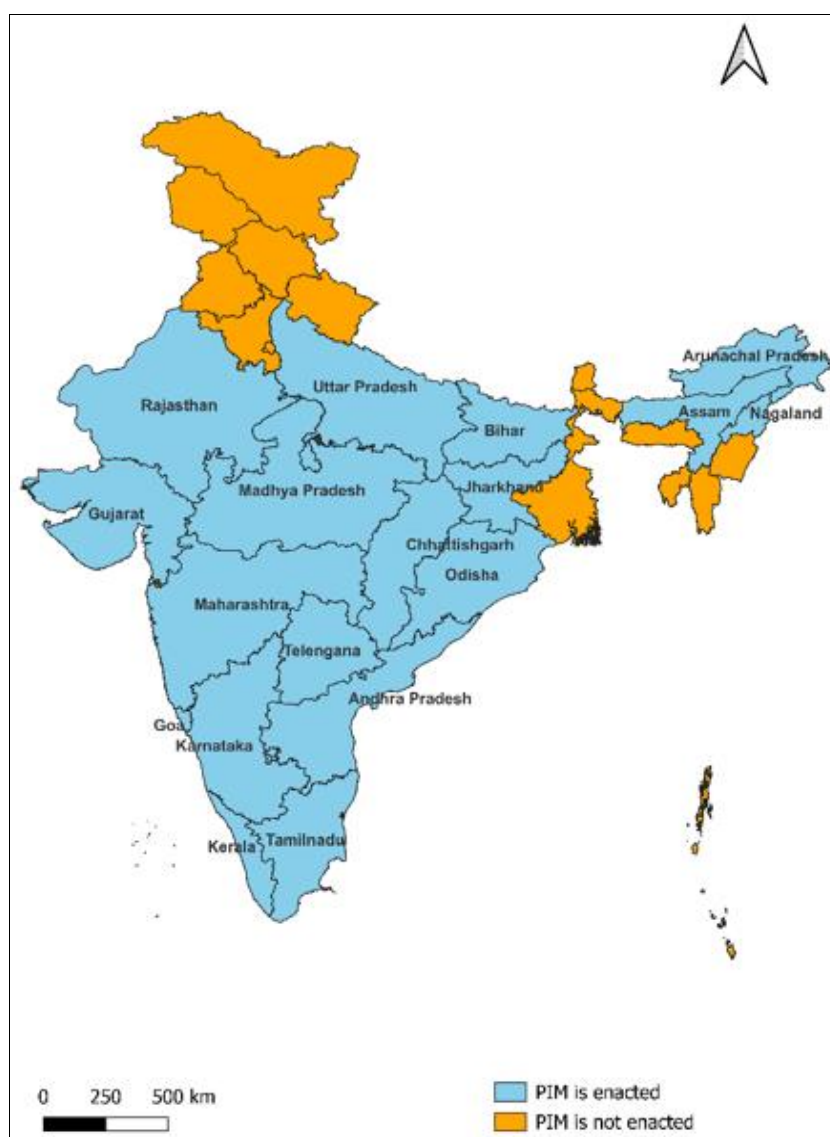
2. Methodology

The concept of PIM plunged into the irrigation sector for an effective management and appropriate distribution among its users in India in the 1990s (Srivastava and Kumar)^[34]. In India, Andhra Pradesh was the first state to implement PIM through an Act for the welfare of the beneficiaries under the governance and it was later followed by other states of India from 1997 onwards. The following Table 1 and Figure 1 shows some of the states of India which have implemented the concept of PIM in their jurisdiction and the respective years.

The below-mentioned irrigation management Acts were acquired from the FAOLEX database and other web sources and analysed. The sections included in most of the PIM Acts like basic definitions, delineation of water users' area and territorial constituencies, constitution of Water Users' Association, Managing Committee of Water Users' Association and election of its President and members, delineation of distributary area and constitution of the distributary committee, election of President, Vice-President and constitution of managing committee, Apex committee, federation of farmers organization at the State level, power to remove encroachment, delineation of project area and constitution of project committee, procedure for removal of the President by the managing committee, constitution of sub-committees in farmers organization, changes in farmers' organization, functions of the farmers' organization, utilization of funds for Water Users' Association, sources of funds of WUA, utilization of funds, budget, deposit and administration of the funds, reserve fund, audit, jurisdiction of civil courts, training, power to make rules, power to remove difficulties overriding effect of this Act repeal and saving sections are similar for all the above state irrigation management Acts.

Table 1: States of India with PIM concept in the Irrigation Act

S. No	Name of the State	Name of the Act	Enacted Year
1	Andhra Pradesh	Andhra Pradesh Farmers Management of Irrigation Systems Act	1997
2	Goa	The Goa Command Area Development Act	1997
3	Madhya Pradesh	The Madhya Pradesh Sinchai Prabandhan Me Krishakon Ki Bhagidari Adhiniyam	1999
4	Rajasthan	The Rajasthan Farmers Participation in Management of Irrigation Systems Act	2000
5	Karnataka	The Karnataka Irrigation Act – promulgated an ordinance in 2000 for amendment of the existing Act	2000
6	Tamil Nadu	The Tamilnadu Farmers Management of Irrigation Systems Act	2000
7	Odisha	The Orissa Pani Panchyat Act	2002
8	Kerala	The Kerala Irrigation and Water Conservation Act	2003
9	Assam	The Assam Irrigation Water Users Act	2004
10	Maharashtra	Maharashtra Management of Irrigation Systems by Farmers Act	2005
11	Chhattisgarh	Chhattisgarh Sinchai Prabandhan Mein Krishako ki Bhagidari Adhiniyam	2006
12	Bihar	The Bihar Irrigation, Flood Management and Drainage Rules	2007
13	Gujarat	Gujarat Water Users Participatory Irrigation Management Act	2007
14	Arunachal Pradesh	Arunachal Pradesh Water Resources Regulatory Authority Act	2007
15	Uttar Pradesh	Uttar Pradesh Participatory Irrigation Management Act	2009
16	Nagaland	Nagaland Farmer's Participation in Management of Irrigation System Act	2013
17	Telangana	Telangana Farmers Management of Irrigation Systems Act, 1997 (The Andhra Pradesh Farmers' Management of Irrigation Systems Act, 1997 has been adapted to the State of Telangana)	2014
18	Jharkhand	Jharkhand Participatory Irrigation Management Rules	2014

**Fig 1: PIM enacted States in India**

In addition to the above-mentioned Acts, literature on irrigation water policies and institutional setups for the water users, gender in water management, importance of participatory irrigation management, and implementation of PIM in other countries were retrieved and reviewed. To achieve a sustainable PIM, the legislation must have some salient features such as entrustment, equity in water supply, bottom-up approach, pricing of water, sense of ownership and membership, participation in decision-making process, and capacity building in its institutional arrangements, which will result in increased agricultural productivity and economic growth of the users.

3. Discussion

This study discusses on the above said features in the enactment of PIM in the states for achieving sustainable participation.

3.1 Membership

By 2030, SDG target 2.3, 6.5 and 16.7 ascertains to achieve integrated water resources management by inclusive, participative and representative approach, giving access to land, other productive resources and knowledge to every water user and thereby increasing the agricultural productivity. This requires membership in WUAs.

Table 2: Membership of users in the association

Name of the states	Land owners	Lease land	Non-recorded land	Wives of land holder who do not own land	Fishermen	Others	All water users
Andhra Pradesh	✓		✓				
Rajasthan	✓						
Karnataka	✓						
Tamil Nadu	✓	✓					
Odisha	✓				✓		
Kerala	✓						
Assam	✓	✓					
Maharashtra	✓	✓					
Chhattisgarh	✓	✓	✓	✓		✓	
Gujarat	✓					✓	
Nagaland	✓						
Jharkhand	✓	✓		✓			
Madhya Pradesh				✓			✓
Uttar Pradesh							✓
Telangana							✓
Goa							No separate clause provided regarding the membership of the users
Bihar							
Arunachal Pradesh							

Table 2 shows the membership of users in the association. SDG target 8.3 ensures to promote development-oriented policies which support productive activities, job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises. The experienced farmers may have less education but they have more traditional farming knowledge (Taqipour *et al.*, 2015) [38]. Being a member of WUA, the users can inoculate their new ideas in agriculture management. Providing the experienced farmers a leading role in a WUA, together with the new ideas of young and creative minds and technical and financial assistance through WUA, the agricultural productivity can be increased. SDG target 8.5 ensures productive employment for men and women. WUA aids employment to the members like collecting water tax or water rates from the users and involving in the operation of the irrigation system under the guidance of a government officials and in some states, membership to women in WUA aids a role in the administration. SDG target 10.2 and 10.3 ensures the political inclusion of all in all aspects of a sector, by reducing inequalities and promoting appropriate legislation and actions. SDG target 16.10 ensures public access to information. Attending the meetings related to irrigation management indirectly have effect on the performance of the system (Wang and Wu) [42]. Through WUA, the users gain knowledge by attending the meetings and trainings on new techniques, information about the policies or schemes

implemented by the government and efficient management of water for crop cultivation.

Mass effect suggests that increase in the number of members in the WUA belittle some users from demanding more water for irrigation over their due share and thus it ensure equitable irrigation distribution (Memon and Mari) [20]. Out of the 18 states which has implemented PIM concepts in the farmers' organization Act, 83% states provided a clause regarding the membership of the users. States such as Goa, Bihar and Arunachal Pradesh did not have any clause regarding the membership of users in the Acts. All the other above-mentioned states provide membership to the persons who owns land and 53% of states give membership to the persons who are tenants in a separate clause. Madhya Pradesh, Chhattisgarh and Jharkhand are the states which give membership to women even if they do not own land. Odisha is the only state which give membership to fishermen, though they does not own land. This may influence the growth of economic activity of a WUA. People who use water for purposes other than irrigation are also given membership in the states of Chhattisgarh and Gujarat. In Jharkhand, a farmer needs to apply for membership with certain amount of fee. Membership of a farmer may be break off, if he/she did not pay the fee. This creates a sense of responsibility over the membership in WUA among the users. Madhya Pradesh, Uttar Pradesh and Telangana are the three states providing membership to all water users in an irrigation system.

3.2 Participation of farmers in decision-making process with a gender lens

SDG target 2.3 ascertain equal access to land. Making agricultural land accessible to women empowers women and allows them to be a member in a WUA. SDG target 4.5 and

target 5.b suggests the elimination of gender disparity in educating the women. Women play a vital role in water management (United Nations Environment Programme) ^[40]. They should be aware about a WUA existing in their command area and should be involved in its administration.

Table 3: Participation of women in decision-making process with a gender lens

Representation from head, middle and tail reaches	Reservation in administration	Encouraged to take part in meetings/ trainings	States with no separate clause regarding women participation in the Act
Maharashtra	Andhra Pradesh	Jharkhand	Goa
Chhattisgarh	Madhya Pradesh		Rajasthan
Uttar Pradesh	Odisha		Karnataka
	Chhattisgarh		Tamil Nadu
	Jharkhand		Kerala
	Telangana		Assam
			Bihar
			Gujarat
			Arunachal Pradesh
			Nagaland

Table 3 shows the participation of farmers in decision-making process. As much as 56% of the mentioned states did not have a clause regarding the participation of women in managing committee. Lack of information and communication impede their active participation (Nixon and Owusu) ^[26]. SDG target 4.7 ensures that everyone should acquire knowledge to promote sustainable development through education for human rights, gender equality. and promotion of culture contribution in agriculture to sustainable development. Jharkhand is the only state which encourages women to take part in the meetings of WUA, even if they do not own a land. SDG target 5.5 insure effective participation of women and equal opportunities for leadership at all levels of decision-making. Women are interested to take the leadership role and feel comfortable in voicing the development and infrastructure needs but the culture, family tradition, and the inadequate representation in decision-making process prevent them from participating in the management (Khandker *et al.*) ^[17]. SDG target 10.2 and target 16.7 insists on social, economic and political inclusion of all users irrespective of their any sort of status in the way towards sustainable development. Maharashtra and Chhattisgarh and are the two states which provide the representation of women farmers from all level of water reaches in the administration of WUA. Uttar Pradesh gives representation to the women farmers from tail reach in the administration of WUA. Six out of the eight states which mention the participation of women in their Acts, have explicit reservation for women to be in the managing committees. Perspective of women upon management aspect differs from the perspectives of men; hence, inclusion of women in the WUA administrative committee should be mandatory (Khandker *et al.*) ^[17].

3.3 Entrustment

SDG target 2.a suggests that to increase the agricultural productivity, the government should increase the rural infrastructure, cooperation among the farmers and extension services in developing countries. Target 12.2 insists to achieve sustainable management. This requires a decentralized, community-driven water governance. Entrustment is the transfer of management by the Government to a WUA formed in the respective irrigation system. It requires adequate consultation and motivation

among the users; it is not simply possible just by passing orders (Roy) ^[29]. Transfer of management includes technical management and financial management. The Government either transfer the management functions partially or fully to WUAs present in the delineated command area (Vermillion and Sagardoy) ^[41]. Entrustment enhances accountability, responsiveness to local needs, and helps to tackle specific agricultural and environmental conditions and sustainable water use. Table 4 illustrate the technical management of WUA in the respective states of India.

Table 4: Transfer of management to the stakeholders

Government officials	End-users (WUAs)	Both
Andhra Pradesh	Goa	Karnataka
Madhya Pradesh	Maharashtra	
Rajasthan	Bihar	
Tamil Nadu	Gujarat	
Odisha	Arunachal Pradesh	
Kerala	Uttar Pradesh	
Assam	Jharkhand	
Chhattisgarh		
Nagaland		
Telangana		

SDG target 9.1 suggests that a government should develop quality, reliable, sustainable and resilient infrastructure, to support economic and social development. When a WUA is formed in a command area, initially the government should strengthen the infrastructure, making it reliable for the users. Target 9.c insists on increasing the access to information and communication technology for everyone. This significantly emphasis the exposure of farmers to affordable access to internet relying on WUA. The farmers should be exposed to the usage of technology by providing them trainings. By this, the farmers could able to know more about the technology, government schemes and policies, marketing etc. For each of farmers' organization registered under the relevant state's Act, the government designates an officer of the irrigation department, or the command area development department, as the competent authority. This officer is directly accountable to the individual farmers' organization for the implementation and execution of all decisions made by the organization, and he or she also ensures that the work is carried out in compliance with technical specifications and offers technical advice.

Here, Karnataka is the only state which entrusts the control, maintenance and monitoring of irrigation works to the water user societies and also it is managed by an official from the water resources department appointed by the government. From the other 17 states, 59% of states is managed by an official from the water resources department appointed by the government. As much as 41% of states follows bottom-up approach, where the government transfers the operation and management of the canal or tank irrigation system entirely to WUAs. The governments of Maharashtra and Arunachal Pradesh hand over the ownership of the canal system to WUAs. The Bihar government, when a particular WUA applies for the entrustment, it transfers the management to the respective WUA, for a fixed period. The Gujarat government by an agreement, transfers the management to WUAs. In Uttar Pradesh, the irrigation department transfers the management to WUAs. Based on the scale of the irrigation projects, the Jharkhand government transfers the management to the WUA/ WUA federation.

On the other hand, the financial management of WUAs is managed by the government itself in most of the selected states. All the above-mentioned states' farmers' organizations get revenue from the State and Central government for the operation and maintenance works to be done at the end of every cropping season, by collection of water tax and water fee, money raised by financing agency and other sources. Target 9.3 insists on increasing the access of enterprises to financial services. The farmers organisation

keeps its fund/revenue in a nationalised bank or a cooperative bank or in any agricultural cooperative society. The fund will be used to meet out the expenses incurred by the managing committee of the farmers concerned. The managing committee of the farmers organisation maintains a sinking fund for the repayment of money borrowed and paid back every year into the sinking fund and also for discharge of the loan. Target 16.6 asserts to develop effective, accountable and transparent institutions at all levels. Every farmers' organisation gets its accounts audited annually. In every financial year the managing committee of a farmers' organisation prepare a budget in respect of next financial year, showing the estimated receipts and expenditure of the committee and submit it to the general body for its approval. Transparency and accountability of finance may be seen in Goa since it is the only state which clearly explains the financial flow in the organization's management.

3.4 Equitable water supply

SDG target 1.4 ensure that everyone have equal rights to economic resources, as well as access to basic services, ownership and control over land and natural resources. Water a common natural resource needs to be managed under Public Trust Doctrine ensuring equitable water allocation among the users (Ministry of Water Resources) [21]. The Acts thus framed with the PIM concept should distribute the water that is available efficiently and equitably among the users (Arul and Karunakaran) [5].

Table 5: Equitable Distribution of Water

Secured/ assured supply	Equitable supply	Supply to all level of reaches
Andhra Pradesh	Karnataka	Chhattisgarh
Goa	Tamil Nadu	
Madhya Pradesh	Odisha	
Rajasthan	Kerala	
Bihar	Assam	
Gujarat	Maharashtra	
Telangana	Arunachal Pradesh	
	Uttar Pradesh	
	Nagaland	
	Jharkhand	

Table 5 illustrates the distribution of water to the users in the selected states. Establishing an institutional setup for water users in a command area helps to manage available water resources more effectively and equitably through collective action (Hüttel *et al.*) [13]. There is a need to prioritize water use rights in mitigating conflicts over water use to promote equitable water allocation among the users (Mutiga *et al.*) [22]. The tail-end farmers receives irrigation water less than the amount of water allocated for them (Aruna Shantha and Asan Ali; Basharat) [6]. There is a requisite for formulation and enactment of equitable water allocation policy such that the farmers in tail-end can get the required amount of irrigation water for the crops (Arul and Karunakaran) [5]. In case of irrigation in water scarcity areas, target 1.4, 6.4 and 12.2 together relates the access to appropriate water use efficiency techniques like micro irrigation and ensure sustainable withdrawals and supply of freshwater. Here, Chhattisgarh is the only state which ensures equitable water supply to all reaches. Among the remaining 17 states, 59% of states ensures equitable and efficient distribution of water

among the users. As much as 41% of states ensures assured and secure supply of water to the users. Entrustment in the state of Bihar enables WUAs to supply irrigation water to users using a logical and effective canal operation plan fixed by WUAs themselves. In Arunachal Pradesh, every landholder will be given a quota fixed by the authority, a volumetric quantity of water will be made available seasonally or annually to the user based on the quota, thus ensuring equitable distribution of water in a command area.

3.5 Water pricing

Water has an economic value irrespective of its uses, hence it has to be treated as an economic good (United Nations Environment Programme; Solanes and Gonzalez-Villarreal) [40, 33]. The agricultural system must be evolved in such a way that after meeting the domestic needs, the water allocated for irrigation use have to be priced fairly based on economic principles and distribute equitably in achieving efficient water utilization (Ministry of Water Resources) [21].

Table 6: Water pricing

Name of the states	Water tax	Water fee / rate
Andhra Pradesh	✓	All the states provided a clause regarding water fee to be collected by the users for the services rendered by a WUA
Madhya Pradesh	✓	
Rajasthan	✓	
Odisha	✓	
Kerala	✓	
Assam	✓	
Maharashtra	✓	
Chhattisgarh	✓	
Bihar	✓	
Nagaland	✓	
Telangana	✓	
Goa	No clause provided regarding the water tax	
Karnataka		
Tamil Nadu		
Gujarat		
Arunachal Pradesh		
Uttar Pradesh		
Jharkhand		

To meet equity and efficiency in the water distribution based on economic principles, the water charges should preferably be determined on a volumetric basis. Such charges should be reviewed periodically (Ministry of Water Resources) [21]. Arunachal Pradesh regulatory authority review and revise the water charges every three years. People tend to pay more when there is an assured supply of water (Alcon *et al.*, 2014) [3]. Equitable distribution of irrigation water among head-end and tail-end farmers can be achieved by volumetric pricing of water (Shantha & Ali, 2014) [6]. Ensuring that ecosystem services continue to be provided, SDG indicator 6.6.1 circuitously relates with irrigation water pricing in a view of protecting water-related ecosystems from degradation. Pricing brings sense of responsibility to the users to utilize water efficiently and thereby protect and restore ecosystem services from debilitation. The beneficiaries in the state of Goa have to pay the water fees to command area development board. The collected water fees from the water distribution co-operative societies/farmers by the development board credit the same to the Government treasury from time to time. All the mentioned states have water fee/rate collected from the users for the services rendered by the user association in operation and maintenance works in the respective command area. The collected water fee from the users will be added to the funds of the farmers' organization. As much as 61% of the states have adapted water tax in their jurisdiction. Karnataka collects water fee from non-members of the association too. Tamil Nadu is the only state which has mentioned the water price amount in the enacted Act. Penalty for unlawful offences such as encroachment, theft of water, demanding water without paying the fee, etc., within the delineated area of operation of an irrigation system should be made stringent under Indian Penal Code, 1860. The Kerala Irrigation and Water Conservation Act, 2003, (Act 31 of 2003) provided detailed clauses for penalty. States such as Bihar, Arunachal Pradesh and Jharkhand did not provide any clause regarding the penalty for offenses.

4. Conclusion

India received an annual rainfall of 1,102.8 mm in 2023 with a decreasing rainfall pattern from previous years against the normal rainfall (IMD). Northeast India received the maximum amount of rainfall, followed by central India,

and northwest India received minimum amount of rainfall on an average (Yadav) [45]. By 2030, the population of India is projected to reach 1.518 billion (National Commission on Population) [23]. Increase of population exerts more pressure on food and water security (Smolenaars *et al.*) [32]. To meet the increasing demand because of population growth, it is necessary to increase the agricultural productivity (SDG 2) and manage available water sustainably (SDG 6). Targets 6.5 and 6.b promote Integrated Water Resources Management (IWRM), emphasizing inclusive approaches to water resource management and development.

The institutions which are responsible for encouraging and involving the users to participate in the management must be strengthened and empowered. WUA aids knowledge to water users on sustainable water use, irrigation techniques, water rights, policies, legislation and schemes related to irrigation through training and capacity building programs. Membership in WUA plays a vital role in availing these benefits from WUAs. Hence all the stakeholders, even if they are not landholders, must be given membership in the users' association. Also, to create a sense of responsibility among the users, certain amount of fee must be levied on them to retain their membership as in the state of Jharkhand. The persistence of rural patriarchy enforces gender discrimination and continues to favour patrilineal customs in land distribution and inhibit the membership of women in WUA and their inclusion in water management. Land accessibility, reservation in the managing committee, access to information etc, encourage women to actively participate in water management. Effective participation of women in irrigation management will result in sustainable management of available resources and economic development. It is required to mainstream gender in farm and water policies (National Policy for Farmers [24]; United Nations).

Entrustment supports local governance with transparency and accountability, promotes sustainable water use and help the farmers to use the resources effectively. Giving responsibility for water management to a WUA guarantees that the decisions are based on a thorough grasp of local conditions and needs. Management at a local level enables quicker reactions to water problems like shortages or system failures in comparison to centralized management systems. The state of Gujarat transfers the management to WUAs through an agreement and provided a clause on usage of drip irrigation system in management practices in the Act. Through transfer of irrigation management, WUAs are vested with the power to levy and collect water tax or water fee which enhances their capacity to manage water resources effectively.

Entrustment enhances the representation of farmers from all reaches in the local water governance, thereby ensuring equitable supply of water to farmer in all reaches. Inequitable distribution of water may lead to conflict among users, particularly in water-scarce regions. Fair allocation of water enables farmers to plan and implement their agricultural activities effectively. Seasonal and annual allocation of water as per the requirement of the farmer fixed by the water resources regulatory authority of Arunachal Pradesh ensures equitable distribution of water to all users.

Water pricing brings a behavioral change, creating a sense of ownership and responsibility among the stakeholders to save the water resources and use it efficiently. It promotes

environmental sustainability by discouraging unsustainable practices and encouraging the use of water efficient technologies. Setting prices according to the season can assist in controlling water supply levels in both high and low demand times. Water pricing generates revenue for the government and enables the WUA to be self-reliant in carrying out the operation and maintenance works in the respective command area. Policy makers and the government should develop and implement a fair and effective pricing mechanism.

Uttar Pradesh ensures the membership to all stakeholders, participation of women in decision-making, equitable distribution of water among users through transfer of management, and water pricing in its legislation. Chhattisgarh ensures providing membership to landholders and tenants, participation of women in decision-making, equitable distribution of water to all reaches and water pricing in its legislation. The states and UTs which are yet to enact PIM act in the legislation, should adopt the clauses which are more inclusive from the PIM Acts enacted in Uttar Pradesh and Chhattisgarh. Being one of the coastline states, the government of Odisha in the Odisha Pani panchayat Act, 2002, (Act 10 of 2002) provided an explicit clause regarding the membership and leadership of fishermen in WUA even if they do not own a land. All the coastline states should integrate fisheries in irrigation management as a collaborative effort (SDG target 14.9) for achieving food security.

The SDG India Index has been increased from 57 to 71 in 2019-2020 and 2023-2024 respectively, showing that India has accelerated its progress towards sustainable development. It is a front-runner country (SDG index score 60 to 100) in achieving SDG 6 and a performer country (SDG index score 50 to 64) in achieving SDG 2 (NITI Aayog). To become an achiever country by 2030 (SDG index score 100), all the other states of India also should implement PIM concept in the Acts and policies for water management in agriculture which should be revised and amended periodically and implemented with a lens of sustainable development.

5. Statements and Declarations

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Conflict of Interest

All the authors declare that we do not have any conflict of interest.

Data access statement

The irrigation Acts reviewed were acquired from FAOLEX database. (<https://www.fao.org/faolex/en>).

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