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**To Play or not to Play:
Role and Impact of Gamified Interventions on Watershed
Development**

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Dedicated to the farmers and grassroot workers of Maharashtra

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List of Acronyms

AFARM	Action for Agricultural Renewal in Maharashtra
ASSEFA	Association for Sarva Seva Farms
CCT	Continuous Contour Trench(es)
CSR	Corporate Social Responsibility
DDP	Desert Development Programme
DPAP	Drought Prone Areas Program
GSDA	Groundwater Survey and Development Authority of Maharashtra
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
INR	Indian Rupees
IWSM / IWSMP	Integrated Watershed Management/Program(s)
JYS	Jalyukt Shivar Abhiyan
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MYRADA	Mysore Resettlement and Development Agency
NABARD	National Bank for Agriculture and Rural Development
NGO	Non-Governmental Organization
PAR	Participatory Action Research
PFWC	Paani Foundation Water Cup

PoCRA	Project on Climate Resilient Agriculture
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
PRADAN	Professional Assistance for Development Action
SDG	Sustainable Development Goals
SHG	Self-Help Group
SWL	Static Water Level
USDA	United States Department of Agriculture
WASSAN	Watershed Support Services and Activities Network
WOTR	Watershed Organization Trust
WSDP	Watershed Development Program(s)

Abstract

Watershed development programs continue to be riddled with the puzzle of participation and maintenance failures, despite showcasing positive agricultural, economic, and environmental benefits. Addressing that, the introduction of gamification as a policy design provides an alternate and complex avenue in the commons literature. The voluntary participation of the beneficiaries can provide an important policy design to the missing puzzle of participation, which the paper attempts to explore and provide insights into. The paper addresses this puzzle by understanding the motivation to participate in competition based on watershed development and the extent of its impact on groundwater level in the context of Paani Foundation's Water Cup in Maharashtra, India. The paper utilizes a mixed method approach of qualitative interviews, participatory research tools, site visit and econometric evaluation of secondary data. The findings suggest that water scarcity is the major driver of participation and continuing participation, which is complemented by politico-administrative setup and local leadership, historical experiences of watershed activities, demonstration and bandwagon effects. The impact of the program participation is however muted for overall groundwater level increase. These results provide factors for motivation for voluntary participation in competition-based policy design and evidence for impact of gamified intervention.

Relevance to Development Studies

The issue of participation in watershed development practices, especially in commons literature is widely discussed. Additionally, the impact assessment of watersheds and long-term impacts constitute an important aspect of agricultural, rural, economic and environmental development/studies.

Keywords

Watershed development; gamification; participation; motivation; impact evaluation; policy design

Chapter 1 Introduction

India's growing concern over depleting water resources and its management can be linked to deeper issues of agrarian distress in the country. The linkages of water-related challenges contributing to the distress, manifest as a consequence of climatic uncertainties as well as a driver of the distress through governance and investment inefficiencies in water technologies (World Bank, 2013). Watershed¹ management² programs can be helpful in addressing water challenges while also enhancing livelihood security (Reddy *et al.*, 2004). However, a major impediment in adoption and success of sustainable development of watersheds has been beneficiary participation (Kasala, Ravula and Chakraborty, 2024; Kolavalli and Kerr, 2002). Despite the established benefits of watershed development, the program continues to face challenges in adoption of these programs and maintenance post program withdrawal (Hinchcliffe *et al.*, 1999) undermining the success of these programs.

The participation paradox has prompted exploration of alternative approaches to watershed development. In this context, a gamified intervention by Paani Foundation with the title, Water Cup, as a response to building drought resilience presents an alternate approach by integrating competition as a means to achieve watershed development. The intra-village competition frames watershed development as an outcome-based rewards system and utilizes the concept of gamification to achieve water saving behaviour. The competition claimed higher water levels, agricultural productivity, and more importantly voluntary participation of four thousand villages as an immediate impact of the competition.

The main objective of the paper is thus to find the motivating factors of voluntary participation in this competition, which attempts to find a resolution to the riddle of participation gap in watershed development. Additionally, the paper explores the translation of participation into impact on water levels post program withdrawal. The paper utilizes a mixed method approach of qualitative interviews, participatory research tools, site visit and econometric evaluation of secondary data.

¹ "Watershed is a topographically delineated area that is drained by a stream system. It is a hydrologic unit that has been described and used both as a physical-biological unit and as a socio-economic and socio-political unit for planning and implementing resource management activities." (Ratna Reddy, Saharawat and George, 2017)

² "Watershed Management (WSM) deals with the changes in the institutional arrangements required for collective action situations. Integrated Watershed Management (IWSM) is the process of formulating and implementing a course of action involving natural and human resources in a watershed, taking into account social, political, economic and institutional factors operating within the watershed and its surroundings to achieve certain socio-economic and ecological objectives."(Ratna Reddy, Saharawat and George, 2017)(Ratna Reddy, Saharawat and George, 2017)

The main objectives of the paper can be summarised as follows:

- **Understand the factors that motivated the villages to participate in the competition**
- **Assess the long/medium term impact of the competition on the villages**
- **Extend the literature on gamification strategies in sustainable development programs**

The paper intends to extend literature on participation in watershed development through gamified interventions, which has been sparse given the recent introduction of the intervention. It aims to find out the working principles of such interventions and provide insights if it works. Given the nature of watershed, the context is drawn from multiple strands of literature on watershed development, program implementation and evaluation, community-based resource management and gamification.

The paper is structured in the following sections. Section 2 will provide background on watershed development, evolution of the programs in India and State of Maharashtra, concerns in these programs, gamified approaches in water-related settings and an overview and details of the competition mentioned. Section 3 will detail the qualitative and quantitative data collection process as well as the methodology paper utilizes to analyse the data. Section 4 presents the results and Section 5 consequently presents policy discussion and conclusion.

Chapter 2 Literature Review

2.1 Background

A watershed, apart from being “a geo-hydrological unit which drains into a common point” (Government of India), is also underlined by hydrological relationships of multiple socio-ecological systems (Kerr, 2007). Watershed development refers to the “conservation, regeneration and the judicious use of all natural resources particularly land, water, vegetation and animals and human development within the watershed” (Goswami, 2018). Watershed development programs aim at internalizing concerns regarding management of water resources while also acting as a tool for improving livelihood security and human welfare in rural areas (World Bank, 2014). The programs have gained increasing importance in the light of building resilience against climate change related uncertainties in agrarian societies (Singh, et al., n.d.) as well as its contribution to numerous SDGs.³ Apart from that, diverse ecological, institutional, economic, social factors underpin these programs such as creating reciprocal externalities in these arenas to alleviate poverty by increasing productivity and generating employment (Joshi et al., 2005; Pathak et al., 2013). Therefore, watershed management can provide multiple benefits and address multiple concerns, making it a tool for rural development. Given the interconnectedness, watershed literature is often analysed through the lens of collective action and more importantly the commons. The literature provides the evolution of WSMPs, the role of government and non-government organizations in this evolution, the conundrum of participation and maintenance globally and in Maharashtra, the increasing role of gamification, the current focus of WSMPs.

2.2 Evolution of Watersheds

2.2.1 Evolution of Watersheds in India

The watershed development paradigm in India has been historically shaped by dual actors: federal and state governments, which focus on technical improvements and non-government actors, (mainly NGOs), which focus on social organization. From 1960s till 1990s, watershed management initiatives in India were initiated by the State in a centralised, technocratic, ecology focussed, top-down approach (Kerr, 2002). The projects were implemented at macro watershed levels without much regard for local community knowledge (Chhotray, 2011). These were implemented through specialized programs like Drought Prone Areas Program (DPAP) or Desert Development Programme (DDP). The programs were expensive (around INR 4215 million spent between 1963-1990) and farmers did not perceive any benefits from these programs due to loss in

³ SDG 1, 2, 6, 13 directly and SDG 5, 8, 12, 15 indirectly.

cropland (to build watershed structures) which led to problems in maintenance and implementation (Pretty and Shah, 1999 as quoted in Hinchcliffe et al., 1999). A fundamental problem cited was the notion that existing technologies are efficient and “it was just a matter of inducing or persuading farmers to adopt them” while it was difficult for farmers to adopt external technologies by ignoring their current practices (Hinchcliffe, 1999, p. 6-7). By 1995, expert reviews recommended participatory approaches and Watershed Development guidelines were developed which refocussed towards decentralization and adopted integrated watershed management (IWSMP) approaches.

In 2000s, these guidelines evolved further into encouraging people’s participation, holistic development involving contributions of non-state actors like NGOs and international organizations (Joshi *et al.*, 2004) and are deemed to be Integrated Watershed Management Programs (IWSMPs). In the phases of watershed program’s development analysed by Kumar et al., (2022), strategies post 2007-08 considered inclusive growth, heterogeneity of ecological factors and higher agency being given to the involved stakeholders while shifting from production centric to income centric WSMPs. In the same paper, they acknowledge the increasing roles of community participation and capacity building of the stakeholders especially *Panchayati Raj Institutions*. Through 2010s till date, the guidelines have merely increased the decentralization of WSMPs, culminating in Soil and Water Conservation Programs such as the Pradhan Mantri Krishi Sinchayee Yojana or bilateral programs with World Bank or National Bank for Agriculture and Rural Development, and emphasized on participation of local stakeholders (Gopal, Gokhale and Govindan, 2021). The recent pathway indicate the decreasing micro-level involvement of the government and increasing autonomy to the beneficiaries of the watershed development.

The vacuum at micro level is and was being filled by NGOs working in specific locations and influenced by foreign funding. The early successes of Sukhomajiri project by Ford Foundation, Ralegaon Siddhi in Maharashtra and MYRADA project in Karnataka, were owed to NGOs and other institutions in WSDPs (Singh, 2018). These projects paved the way for bilateral agreements between government and NGOs, which formed the wave of ‘convergence of interveners’ in watershed development in India (Fernandez, 2004). The government guidelines like common guidelines 2001, Hariyali 2003, and Parthasarthy Committee 2006 on watershed management explicitly acknowledged and included the NGOs in WSDPs (Fernandez, 2004). In recent times, the role of NGOs has evolved from implementors to a broader role of community governance advocacy, knowledge providers and innovators, as well as facilitators⁴. The NGOs also contribute

⁴ Based on the author’s exploration of roles of WOTR, BAIF and WASSAN.

to policy advocacy like the inclusion of WOTR's Ecosystem-based Adaptation model in Maharashtra state's climate action plan⁵ or WASSAN acts as the State Professional Agency to support programs by government of Odisha⁶. WOTR especially, apart from conducting WSDPs which have reached around 7 million lives in 10 states, have also ventured in climate resilience building, knowledge partnerships, training and advisory services, market linkages and agricultural technology innovation⁷. This provides evidence for the increasing role of NGOs in WSDPs, and the importance of participatory approaches in their methods, which shapes the WSDPs. Overall, the evolution of WSDPs reflect technical standardization in recent years, while promotion of local knowledge in the field, opening the arena for wider implementation of these programs and alternate approaches.

2.2.2 Evolution of Watersheds in Maharashtra

The state of Maharashtra has been an integral part of the evolution from the beginning. It became a locus of watershed development in India because of its semi-arid geography⁸, exposure to rainfall variability, droughts and dry spells. The state has a large drought prone area of 52% and is subject to frequent draughts (Samuel *et al.*, 2009). Eastern Maharashtra or the Deccan plateau is particularly affected by this, as this area falls in the rain shadow region of the Western Ghats making it difficult for rainfed agriculture (Kerr, 2002). Given the topography, the dependence of state's farmers' livelihoods on rainfed agriculture, exposes communities to varied vulnerabilities of crop failures, rising indebtedness, migration⁹. The area also features extremely porous soil and heavy percolation presents opportunities for watershed development (Kerr, 2002).

In the early phases of watershed development in Maharashtra, the villages of Ralegaon Siddhi and Hivare Bazaar illustrated the impact of participatory approaches and NGO successes in watershed development and later became case studies for guidelines formed in 2000s (Rao, 2000). Subsequently, several bilateral (the Indo-German Watershed Development Program) and unilateral (ASSEFA, Ford Foundation, World Bank) programs were run in multiple parts of the state. Apart from the benefits of the watershed development in these programs, limited flexibility deterred local participation in these programs in the state (Kerr, 2002; Pretty and Shah as quoted in Hinchcliffe *et al.*, 1999). Currently, WSD in the state is carried out by multiple agents: central government programs like Pradhan Mantri Krishi Sinchayee Yojana; State government programs like Jalyukt Shivar and Project on Climate Resilient Agriculture (PoCRA); various NGOs. The

⁵ [Maharashtra Government and WOTR Partner to Mainstream Ecosystem-Based Adaptation into State Policies](#)

⁶ [What We Do](#)

⁷ [WOTR: Climate Resilience for Rural India - NGO India](#)

⁸ 73% of the state's land is classified as semi-arid (Gray and Srinidhi, 2013)(Gray and Srinidhi, 2013)

⁹ WOTR, 2025 - [Most Trusted Watershed Projects in Maharashtra | WOTR](#)

NGOs can be intuitively classified into NGOs with specialized knowledge like WOTR, AFARM, which have been developing watersheds and creating knowledge surrounding the same; NGOs with celebrity linkages like Paani Foundation and NAAM Foundation; NGOs with CSR associations like Bajaj Foundation, Persistent Foundation. The government schemes are scaled up, targeted initiatives across the whole state while the NGOs like WOTR and BAIF work on case based approaches and initiative by Paani Foundation and NAAM are based on self-selection.¹⁰ Addressing the issue in micro-watersheds, more than 26,000 micro watersheds have been a part of watershed management programs by various State schemes as well as around 1000 NGO (Samuel *et al.*, 2009), indicating the importance of watershed development programs in Maharashtra.

2.3 Issues in WSDPs

The evolution of WSDPs is riddled by the issue of participation and long-term maintenance of structures. In terms of impact evaluation Hinchcliffe, (1999, p. 8) preface the long-term ineffectiveness of watershed management practices, with erosion of structures and practices over time. They argue that it may be because farmers are alienated from the watershed management intervention as they are “not involved in design and treated as labour” for the management, providing them little incentive to maintain. They provide cases from Ethiopia, where 40% of terracing structures were broken in a year; 120,000 hectares of bunds constructed in 1960s have disappeared in Burkina Faso; improper construction and poorly maintained structures in 5000 hectares in USA. Even after providing incentives in Ethiopia (food for work) and involving local consultation in a project in Niger, beneficiary participation and maintenance has been low. Kerr (1994, as cited in Hinchcliffe, 1999) argues that paying people for participation in these efforts is self-defeating. Therefore, a watershed approach which focusses on increasing participation is essential for the success and implementation of these programs.

2.3.1 Issues in India

In India, the importance of WSDPs has been recognized through visible impact. In their synoptic review of literature across South Asia, Ratna Reddy, et al (2017) found that WSDPs have improved resource base, especially groundwater and soil moisture; reduced soil erosion; provided positive cost-benefit ratios; increased net income and employment; improved gender participation; and strengthened participatory institutions. However, they also importantly remark that this impact varies widely across regions and overall success rate is low at 20-25%. While analysing impact on a single watershed, Sreedevi et al., (2008), mention 92% increase in irrigated land compared to only

¹⁰ Based on author's research on the organizations.

55% in control watershed; 33% increase in water storage capacity; 15% increase in yield per unit of irrigated area; and increase in crop diversification and availability of fodder and livestock. Puskur and Thorpe (as quoted in Sharma et al., 2005, p.96-115) also highlight the increase in productivity of cropping activities in another five micro-watersheds, while additionally providing evidence for WSDPs impact on non-cropping activities like livestock. Bagdi and Kurothe, (2014) analyse the level of participation in various stages of WSD, concluding 64% participation in planning, 58% participation in implementation and surprisingly, 75% participation in maintenance activities.

The conundrum of positive and effective impact on watersheds but localised or low uptake is additionally supported by the following literature and articles. Bouma, Van Soest and Bulte (2007) in their study of four meso-watersheds through 697 household surveys confirm effectiveness of IWSDPs in resource conservation however projects fail to mobilize community organization to ensure commitments to maintenance. (Joshi *et al.*, 2005) conducted a meta-analysis of 311 case studies of watershed programs in India, assessing their performance and that the average cost-benefit ratio of watershed program in the country was quite modest at 2.14, while the internal rate of return was 22%, which is comparable with many rural developmental programs. Krishna (as quoted in (Hinchcliffe et al., 1999, p. 143-156), while analysing large scale government intervention adds to the evidence of increased productivity (in terms of costs of work per hectare), foodgrain and fodder production. Despite addressing the difficulty in changing motivation and attitudes of the participants, he mentions the unwillingness of uptake of the program without a subsidy, where farmers were unwilling to take up these practices if they had to contribute more than 25 to 30% of the total cost.

2.3.2 Positive Case Studies

However, watershed development also has a bright side, in individual micro-watershed analysis, through interventions of NGOs, research institutes and government departments. As noted earlier, the development of successful village or micro watershed models like Sukhomajiri, Ralegaon Siddhi, Chitradurga, Fakot, Kothapally, Tejpura, Alwar provide individual success stories (Sharma et al., 2005, p.4). The case of Kasare mentioned by Lobo and Palghdmal (as cited in Hinchcliffe et al., 1999, p. 247-258) additionally provides to the successes of IWSDPs, where the villagers necessarily self-selected themselves into WSDP, which led increased maintenance activities, increase in public trust, peer effect by motivating neighbouring village to participate in WSDPs and a sense of proprietorship. In addition to that, the nexus of the grassroots NGO (Sevabrata)-professional NGO (PRADAN)-government department was able to scale up IWSDPs in 20 villages in Chotanagpur plateau successfully which sustained maintenance activities, built self-reliance and community resilience (Chatterji et al. as cited in Hinchcliffe et al., 1999, p.259-272).

However, “appropriate models for translating ‘points of success’ to ‘regions of success’ are still elusive and remain a formidable challenge for researchers and development agencies” (Sharma et al., 2005, p. 5).

2.3.3 Theoretical underpinnings of the issues in WSDPs

The literature points towards persisting issues in IWSDPs, which can be summarized as issues of participation, over-reliance on subsidies, changing attitudes and behaviours, scaling-up, project design and social capital. The responses to these issues broadly touch upon two aspects: improving project design or motivating people’s to participate.

Joshi et al., (2005) briefly address the drivers of participation by providing enabling conditions for people’s participation to be demand-driven watershed approaches, self-help groups, targeting poor regions, decentralized decision-making and commensurate cost and benefits. Badal, Kumar and Bisaria (2006) provide concrete evidence that factors like institutional effectiveness, frequent communication between implementing agencies and beneficiaries, training in social mobility and enterprise creation can guarantee involvement of people in watershed management. Additionally, Bagherian et al., (2009), provided evidence that people preferred involvement in social rather than economic and environmental activities, indicating six motivational factors¹¹. On the other hand, motivation of corporate watershed partnership participation varied drastically depending on the internal motivational categories (Roberts *et al.*, 2020). A more extensive bibliometric study pointed that community-based watershed management is influenced by socioeconomic, institutional and technical factors (Ikhlas and Ramadan, 2024).

Addressing the program design argument, WSDPs encompasses multiple dimensions that interact to influence outcomes: the targeting mechanism (agency-selected or self-selected villages), the decision-making structure (centralized or participatory), the funding model (full subsidy or cost-sharing or outcome-based rewards), the implementation approach (contractor-executed or community-executed), and critically, the post-intervention institutional arrangements (committees, maintenance protocols, conflict resolution mechanisms). Khwaja (2009) mentions that design features like decision making authority, resource allocation, accountability mechanisms determine meaningful participation of the communities. He also argues that project design can overcome community specific constraints like lack of motivation to participate, especially in community-maintained infrastructure (*ibid*). Well-designed community-based water services which feature transparent decision-making, collective monitoring, and equitable benefit distribution produce

¹¹ Satisfaction of prior programs, attitude toward WMP, knowledge of WMP, alternative monthly income, total monthly income and met expectations of WMP

superior sustainability outcomes compared to poorly designed participatory programs that achieve high nominal participation but lack institutional quality (Isham and Kähkönen, 1999). Additionally evidence from Indonesia shows that design of community driven projects can be more participatory mitigating the risks of elite control, and broader participation (Fritzen, 2007) which are crucial for commons resources like watershed development. Importantly, Mansuri and Rao (2004) conclude that design quality mediate the participation-outcome relationship. They also highlight the role of external agents but warn against the lack of training of facilitators due to rapidly scaled up initiatives.

Both of the above arguments draw from the strand of social capital which have earlier highlighted the important role of social capital WSDPs (Samuel et al., 2009; Reddy and Soussan, 2004; Singh, 2018; Krishna and Uphoff, 2002; Khwaja, 2009). Krishna and Uphoff, (2002) in their study on mapping and measuring of social capital through collective action in watershed development and conservation find that social capital is positively correlated with superior development activities.

2.3.4 What spurs participation?

The literature on evolution of WSDPs mentioned above accentuates the problem of participation, and more importantly motivation for post program maintenance. Therefore, the following question arises: what spurs participation¹²? Is it a better policy design or is it intrinsic motivation.

2.4 Impact Evaluation Studies

In the attempt to address the issue of participation or implementation, it is essential to assess the impact of the programs. The paper argues that impact assessment of the programs is essential in order to understand the success of participation as well as the long-term sustainability of such programs. The literature on impact assessment of (IWSDPs) provides mixed conclusions (Kerr & Chung, 2004, Joshi et al., 2004). Despite “silently revolutionizing the developments in the drylands, only 35% of them (IWSDPs) are performing above average” (Joshi et al. 2005, as quoted in Sreedevi et al., 2008) . Thus, in recent times, the development and relevance of IWSDPs has evolved by undertaking various innovative approach in technical, social institutional and linkages or upkeep to revitalize the goals of IWSDPs (Sreedevi *et al.*, 2008).

¹² The paper distinguishes between factors of participation as the initial reasons to participate in the program, which overlaps with the motivational drivers to maintain the structures.

A crucial factor in impact assessment watershed management programs has been assessing agricultural productivity and farmer's livelihood, with most of the studies focussing on contextual, local impact on water availability, soil loss, agricultural productivity and income (Wani et al., 2011; Wani et al., 2008; Palanisami et al., 2011). Meta-analyses, similar to micro level studies have mainly depended on cost-benefit analysis while the project was still in progress and provided correlational evidence. Kerr & Chung, (2004) note that despite widespread implementation of IWSDPs, reliable evaluation studies are scarce, overly optimistic while also indicated abandoning of projects after the end of subsidies. Given the direct impact of watershed on water availability, the above studies also calculate and report the change in water levels.

2.5. Gamification in water-related settings

The focus on behavioural nudging to address the aforementioned shortfalls in WSDPs and broader policies on common pool resources have been accelerated with the advent of behavioural economics post-2008 (Poteete, Janssen and Ostrom, 2010). Anecdotal evidence indicates that conducting experimental games within communities may itself influence and modify local practices (Camilo Cardenas and Carpenter, 2005). In order to promote motivation and achieve desired behavioural outcomes, the method of gamification is explored even in game-free contexts such as education, healthcare, workplace or consumer behaviour (Krath, Schürmann and von Korfflesch, 2021)¹³. The focus of game-based approaches in water governance has been on multicriteria-decision analysis, watershed governance and water systems planning and management (Aubert, Medema and Wals, 2019). In the same paper Aubert et al., (2019) highlight that the method can lead to ambiguity in players' experiences and realization of intended and unintended outcomes.

Gamification in WSDPs has been implemented in different contexts and methods. Corral-Verdugo et al., (2002), found that perception of externalities can affect the motivation to save water in residential setting (detailed in Figure 1). In a similar setting but using online experiments, Koroleva & Novak (2020) extend gamification design to collective action by understanding the motivational drivers for different stakeholders. Gamification in early childhood education also can be effective in water saving behaviour and promote sustainable behaviour (Bilancini, Boncinelli and Di Paolo, 2023). Importantly, household water usage behaviour across Europe has shown reduction in water usage after using gamified interventions, and the design principles for the same are elucidated by (Castelletti *et al.*, 2019). In India, simulation game by (Meinzen-Dick *et al.*, 2018) provide interesting evidence in effectiveness behavioural games on within community water saving behaviour and improving collective action to improve water governance. While they also

¹³ Gamification does not draw a lot of aspects from game theory literature in economics, but may be used in similar contexts.

importantly conclude that the games must be supplemented by concrete policies and collective action, only then they will be effective. Falk, Kumar and Srigiri (2019) add to this evidence by conducting simulated dam management challenges using a framed public good experiment which helped the villages overcome cooperation challenges and build institutional capacity. While the above cases provide support for gamification, the games are within group simulations and may not spillover to actual behaviour (Bouma, Bulte and Van Soest, 2008).

2.6 Water Cup Competition - A Brief Overview

In the above context, an inter-village competition called “the Satyamev Jayate Water Cup”¹⁴ was announced by Paani Foundation from 2016 to 2019 in Maharashtra. The foundation’s mission is “to empower rural communities to conquer drought and boost their livelihoods through community-led water conservation practices”. The foundation perceives the problem to be drought driven socioeconomic downturn of the farmers in Maharashtra, which has been accentuated by farmer’s suicide¹⁶. The barriers to the problems according to the foundation are societal divides, and they approach the problem by acting as a catalyst to unify rural communities. The means to achieve those ends included immersive training, collective action and incentive driven competition. The foundation thus organized two competitions, the Water Cup from 2016-2019 and Farmer Cup (2022-ongoing). It operates only in the state of Maharashtra. The paper focusses on the Water Cup aspect of the foundation and following section elaborates the motive of the competition, the operational details, the reward system and the reported impact.

The Paani Foundation’s Water Cup or PFWC, was an annual inter-village competition, which was conducted from 2016 to 2019. The aim of PFWC was to “make Maharashtra drought free” while also attempting to build/extend community cohesion by propelling already existing water conservation efforts under IWSDPs in line with the foundation’s goals. The competition provided rewards for the top-performing villages which were given specific targets for watershed development (the reward system is detailed in subsequent section). The competition did “not fund farmers directly, nor provide subsidies, nor implement on-ground work on their behalf”. Instead, the competition relied on voluntary participation of villages, technical training and the incentive of the competition to sustain mass-mobilization in water conservation activities. The funding, voluntary action and logistical mechanism required to achieve the goals of the competition was to be arranged by the participant villages themselves. In order to facilitate and encourage the villages, a platform was provided to the villages which detailed various government/non-government schemes, NGOs which would help them with the mechanical work or CSR initiatives which

¹⁴ The Satyamev Jayate name is taken from the popular TV show “Satyamev Jayate” hosted by the founders of the Foundation. The competition was carried out through Paani Foundation, which is why the paper uses the terminology Paani Foundation Water Cup (PFWC) to avoid confusion.

¹⁵ The foundation is set up by the famous Bollywood actors Aamir Khan and director Kiran Rao, while Satyajit Bhatkal acts as the CEO, and Reena Datta acts as the COO. The other board members include Dr. Avinash Pol (known for his work in watershed development), and CSR heads of few Indian conglomerates. For PFWC, the foundation partnered with the Watershed Organization Trust (WOTR) as the knowledge partner, which has developed the training materials and advisory for sustainable watershed development.

¹⁶ Maharashtra accounted for 38% of total agriculture related suicide as per NCRB. (NCRB: Maharashtra reports 38% of over 10,700 farmer suicides in 2023 - CNBC TV18, 2025)(NCRB: Maharashtra reports 38% of over 10,700 farmer suicides in 2023 - CNBC TV18, 2025)

provided funding or volunteers. Additionally, regional heads were given the responsibility to act as an intermediary but the mentioned aspects of WSDPs was to be arranged by the villages themselves. The foundation instead, provided technical and social training of villagers and awareness campaigns at the local level, while emphasising effective communication and voluntary work to achieve their goals. The goal of the PFWC was to decentralize watershed management and “to motivate, train and empower people for this purpose” (Paani Foundation, 2016). It can be inferred that the foundation’s approach was to act as an mediator between the villages and agencies involved in WSDPs as well as a facilitator of trainings and competition. The foundation attempts to link gamification to increasing social capital to increase the uptake of IWSDPs as well as the goal of making Maharashtra drought free (Mody et al., 2023; Paani Foundation, 2016).

2.6.1 Procedural timeline of the competition

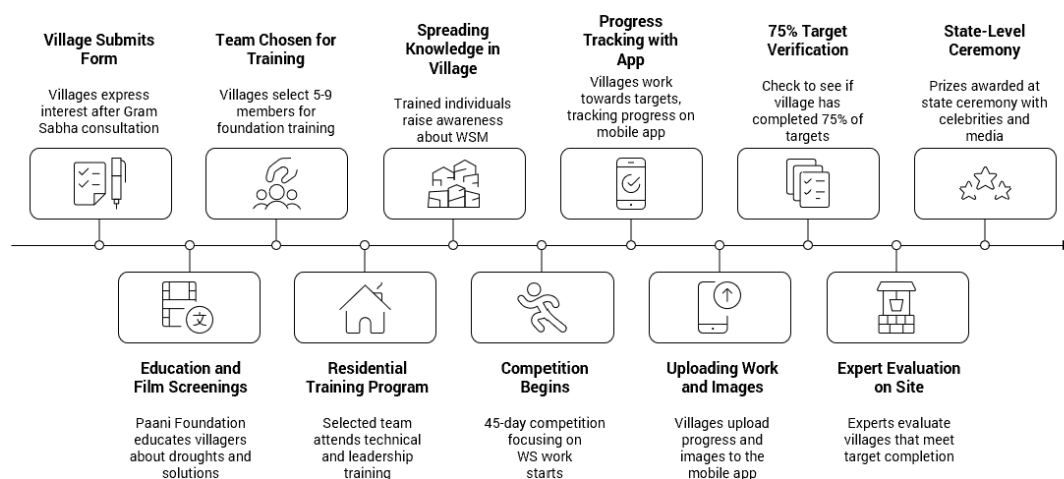
Prior to the public announcement of the competition, a pilot was conducted in 2016 in three districts (Satara, Amravati and Beed) with participation from 156 villages. The process of the competition started each year in the month of January/February with a form being submitted by a village showing their willingness to participate. The form was to be submitted after consultation with the villagers through *gram sabha* (village council meeting) and signed by the *sarpanch* or *gram sevak*. In order to garner participation, the foundation coordinators addressed these meetings, with information sessions and films on droughts and how to tackle them.

The subsequent form had to select five to nine members who would be attending training provided by the foundation. The training team was advised to be composed of a fair ratio of female and male members. The identification and submission of the training team in the second form rendered the application complete. The team of villagers selected for training then attended residential training arranged at a local centre in the month of April, which lasted for three or four days. The training covered two aspects of watershed development: technical training and leadership challenges impeding the process. The technical aspect included aspects like mapping watershed, understanding contouring, well measurement soil and water testing and structure maintenance. The training also consisted of motivation building as well as PAR to improve social cohesion and collective action. The foundation also provided a mobile platform to garner resources like technical information (in the form of manuals and videos) from experts and peers, funds through crowdsourcing and government aid. The trained individuals were given the responsibility to spread awareness in their respective villages. The competition usually starts in the first week of April and goes on for the next 45 days.

The villages were given differential targets through a mobile application classified into manual and machine work. The targets were adjusted as per the size of the village, arable land,

irrigation/cultivable land and population. The targets included construction of watershed infrastructure like loose boulder structures, continuous contour trenches, soil or concrete mounds on streams as well as works such as well rejuvenation and tree plantation. The targets and nature of work was inspired from the phrase – “let us make running water walk, walking water stand and standing water percolate” which follows the ridge-to-valley approach of WSD (Paani Foundation, 2016). The progress of the work was uploaded in the mobile application with classification of work and images of the work done. 75% completion of targets in the given time made the villages eligible for the awards. The villages which successfully completed the targets were then physically examined by set of experts based on a marking sheet (see Appendix Table 1), post which the prizes were declared, and the distribution ceremony took place.

Figure 1: Graphical representation of the process of PFWC (Source: Author, 2025)



The state level winner villages were given a reward of around INR 30 Lakh, INR 20 Lakh and INR 15 Lakh for the first second and third places respectively¹⁷. Lower amounts were given to villages that managed to win at the district and sub-district levels (INR 10 Lakh for the winner). The approach can be deemed as an outcome-based reward system in a competitive environment. All the rewards were provided to the villages in a state level ceremony, amongst coveted Bollywood film stars, chief minister and other politicians with ample media coverage. The funds can be used as per the discretion of the participating village members. Drawing from the qualitative data, one village built a community hall, while another one has deposited the money in a fund and provides

¹⁷ The prize money varied during different years of the competition but was in the range of 25-30 Lakhs. In addition to that, additional government support was announced for the winning villages.

it to the villagers in times of need. However, a village which has already won a prize at taluka level, was not qualified for another award in the subsequent year.

2.6.2 Reported impact of the competition

As per Paani Foundation's reports in 2019, around 4706 villages participated in the PFWC, across 76 talukas¹⁸. The definition of participation as given by Paani Foundation, was completion of 20% of work. The training component trained around 25,177 villagers with a women-to-men ratio of 44.9%. Across the 4 years of competition, 550 billion litres of water storage capacity was created across these villages. These included 7,000 kms of CCTs, 4,420 kms of deep CCTs, ~15,000 kms of compartment bunding, and ~4,000 kms of nala deepening and widening¹⁹. In 2019 PFWC, the villages took benefit from 12 government schemes and more than 350 NGOs.

Post 2019 PFWC, an impact assessment was conducted by the foundation. The evaluation system measured impact on groundwater levels (through observation wells) and sown area in Rabi season. The evaluation was conducted in 100 high performing villages in 67 talukas and 67 control villages from each taluka²⁰. The foundation selected control villages based on propensity matching. From each of the 167 villages, ten wells were chosen from each village as observation wells. The impact assessment found that the decrease in average well levels in 2019 compared to 2018²¹ was 0.08 meters lower in PFWC villages compared to control villages. The agricultural production in Rabi season increased by 6.57 percent in the PFWC villages, compared to the control villages. However, the report shows only preliminary analysis, devoid of any details (Paani Foundation, 2019).

A detailed psycho-social impact analysis was conducted by the Jnyana-Prabodhini Institute of Psychology. They developed a scale of '*mansandharan*' psycho-social community building indicators to assess the impact of participation in PFWC. The report analysed 45 villages and concludes that higher score in psycho-social indicators leads to a higher score or ranking in the PFWC as well. The report also finds no correlation between size of the village and social capital. However, the report mentions that the relationship between community-building and PFWC performance can be bidirectional or two way causality, leading to weaker cause-effect conclusion. The study also provides suggestions on the development of the competition and ways to maintain the community building momentum (Jnana Prabodhini's Institute of Psychology, no date).

Paani Foundation's reports reflect the improvement in resource levels after an immediate impact of the PFWC, adding to the evidence that community participation in water related projects

¹⁸ 2016 (pilot) – 116 villages; 2017 – 1321 villages; 2018 – 4025 villages

¹⁹ [Satyamev Jayate Water Cup: Overview, Impact and Success Stories | Paani Foundation](#)

²⁰ The control villages may have access to other NGO or GO based watershed practices.

²¹ 2018 was considered a drought year.

enhances project effectiveness, success and maintenance of infrastructure quality (Paani Foundation, 2019; Shigute, 2019). However, the long-term impact of PFWC needs to be assessed in order to analyse the effectiveness of the competition-based games to spur community level adoption of already existing WSDPs.

The competition claims to have addressed multiple concerns that were gripping the watershed practices in the state like scaled up voluntary participation in WSDPs, without existence of assured financial incentives. The participation in the competition has been voluntary and was sustained without any initial incentive as critiqued by (Hinchcliffe *et al.*, 1999). The involvement of farmers and local knowledge systems in the trainings during the competition may address the sense of alienation. In addition to that, framing the competition as a people-led movement may have generated sentiment of ownership and responsibility in the involved stakeholders, motivating participation. Additionally, the gamified design of PFWC provides a distinct departure from conventional WSDP design principles along multiple dimensions that this study explores. Rather than government-selected villages receiving predetermined interventions through established implementation channels, PFWC employs voluntary self-selection mechanisms requiring *gram sabha* approval, target-based competition creating peer comparison and ranking incentives, real-time monitoring through mobile technology providing transparency and progress tracking, and outcome-contingent rewards (prizes of ₹10-30 lakh) rather than assured subsidies or guaranteed wage.

2.6.3 A comparative to the PFWC

A concurrent scheme, *Jalyukt Shivar Abhiyan* (JYS) was announced by the government of Maharashtra in 2014 (which started implementation by 2016) with the same objective of making 5000 villages ‘drought free’ each year. It was an umbrella involving multiple departments under the government, unlike the previous schemes of Desert Development Program or Drought Prone Area Program. The program spent around INR 96.3 billion (USD 1.3 billion) on building or restoring 630,000 structures across more than 22,000 villages. The villages were selected into the program by the government based on agricultural, climatic and socio-economic criteria. JYS shares similar end goals and methods with the PFWC and hence acts as a comparable policy (Shah *et al.*, 2021).

Chapter 3. Data & Methodology

3.1 Data Collection

The paper follows a mixed method approach, wherein qualitative data from primary sources is collected to analyze the motivation and perceived impact, while quantitative data from secondary sources provides aggregated evidence for impact assessment. Qualitative data gathering was conducted in a focused geographical area, while quantitative data uses broader data for the entire state of Maharashtra. The data is analyzed at the village-level, since the paper delves into community participation²². The following section details the data gathering process as part of the study as well as the secondary sources of data along with required definitions. Post that, the section explains the methodological approach utilized to analyze the data.

3.1.1 Primary Data Collection

The qualitative data was collected in Wardha district in Nagpur administrative division²³ of East Maharashtra and is geographically located between 20 ° 44'30 Latitude and 78 ° 36'20 Longitude. The average rainfall in the district is between 985-1100 mm, which includes the regional average of 1080 mm and only slightly below the state average of 1174 mm²⁴. Wardha river is the main river that flows through the district and has 10 tributaries, all of which are seasonal except Wardha and Veni. The Bor dam is the major irrigation project with 3 medium scale irrigation projects and around 250 small irrigation projects. In hydrogeological terms, the district features deccan basalt, which has low porosity and permeability, resulting in lower water holding capacity of the soil. The major crops in the district are pigeon pea (*arhar/tur*), cotton and soybean while oranges and bananas are also grown in patches²⁵. Wardha is home to numerous NGOs and foundations, due to the history of Mahatma Gandhi and Vinoba Bhave's work in the district. Kakaddara (one of the villages in Wardha, also part of the sample) was the state level winner of the PFWC.

²² Kerr (2002, p. 18)Kerr (2002, p. 18) makes a case for the use of village as a unit of analysis, rather than the watershed, as most projects work at village and sub-village level, as well as people are organized at village level.

²³ Also known as the Vidarbha.

²⁴

Administrative Division	Summer monsoon (Avg Rainfall in mm)
Nagpur	1080
Amravati	744
Aurangabad	667
Pune	897
Nashik	693
Konkan	2966

²⁵ dcmsme.gov.in/old/dips/wardha_dips_12-13.pdf

The qualitative data was collected from 6 villages in the district in August 2025, based on snowball sampling method. The qualitative data collection involved three methods: qualitative interviews, participatory action research activity and field observations.

The qualitative interviews were based on semi-structured questionnaire, which looked at the work done during the time of the competition, WSDPs by other NGOs, details regarding the participation numbers and beneficiaries. A set of questions asked the respondents to reflect on the current situation regarding the infrastructure, the current maintenance practices, situation of water scarcity, agricultural productivity. The detailed list of questions can be seen in Appendix Item 3.

The researcher additionally conducted one PAR workshop with a group in the study area from a single village, who worked during the competition. The workshop involved mapping of the activities done during the competition, ranking their usefulness, followed by a group discussion with themes from the mentioned questionnaire. The field observation involved visiting the sites where watershed infrastructure was built, and assess the current situation of the infrastructure.

A complete list of villages, from which primary data was collected is given in the following table along with the number of interviewees and site visits.

Table 1: Qualitative Data collection details

Village	Respondents	Sites Visited	Method Used
Bajarwada	3	4 sites	Individual Interviews/Site Visit
Kakaddara	2	3 sites	Individual Interviews/Site Visit
Tembhari- Parsodi	2	0	Individual Interviews
Rohana	1	0	Individual Interviews
Bodad	1 interview and 1 FGD	4 sites	Individual Interview/FGD/Site Visit
Kharangana- Morangana	10	0	PAR / FGD

3.1.2 Secondary Data Collection

In order to conduct quantitative analysis, the paper utilizes panel data set consisting of village-season observations of static water level (SWL)²⁶ in observation wells between 2012-2024. The unit of measurement of SWLs is metres. A static variable of total depth of the well is also utilized for each observation unit along with the details of district and taluka to which the villages belong. The quantitative data on water level is obtained from the Groundwater Survey and Development Authority of Maharashtra. Additionally, the researcher has added data regarding variables like seasons, division and percolation. The seasons are defined as Pre-monsoon (March-April-May), Monsoon (June-July-August-September), Post-monsoon (October-November) and Winter (December-January-February) (Kumar, Madhnure and Lamsoge, 2025). The state has been divided into 6 administrative divisions, namely Konkan, Pune, Nashik, Amravati, Aurangabad and Nagpur (Kumar, Madhnure and Lamsoge, 2025), which are coded in the data for regional analysis. The district-month precipitation²⁷ data is obtained from ICRISAT²⁸ and the unit of measurement is millimetres.

The villages were selected by the author by purposive sampling and classified into four groups based on participation: participation in PFWC, participation in JYS, participation in both the interventions and control groups. The PFWC sampling was carried on the basis of highest performing villages which were winners in taluka and state level and matched with the availability of observation wells by the government agency in the village. The list of participants in the JYS was obtained from the government. Unavailability of the complete list of participants from the foundation is a limitation of the study in terms of data availability. The paper notes that other watershed intervention like national government programs (National Watershed Development Program or Jal Jeevan Mission) or NGO programs may also exist in the participating and control villages, however there is no database which details various programs working in a village/watershed. This makes it difficult to control for effects of other WSDPs.

²⁶ Defined as “distance from the ground surface to the water level in the well” (GSDA, no date)(GSDA, no date).

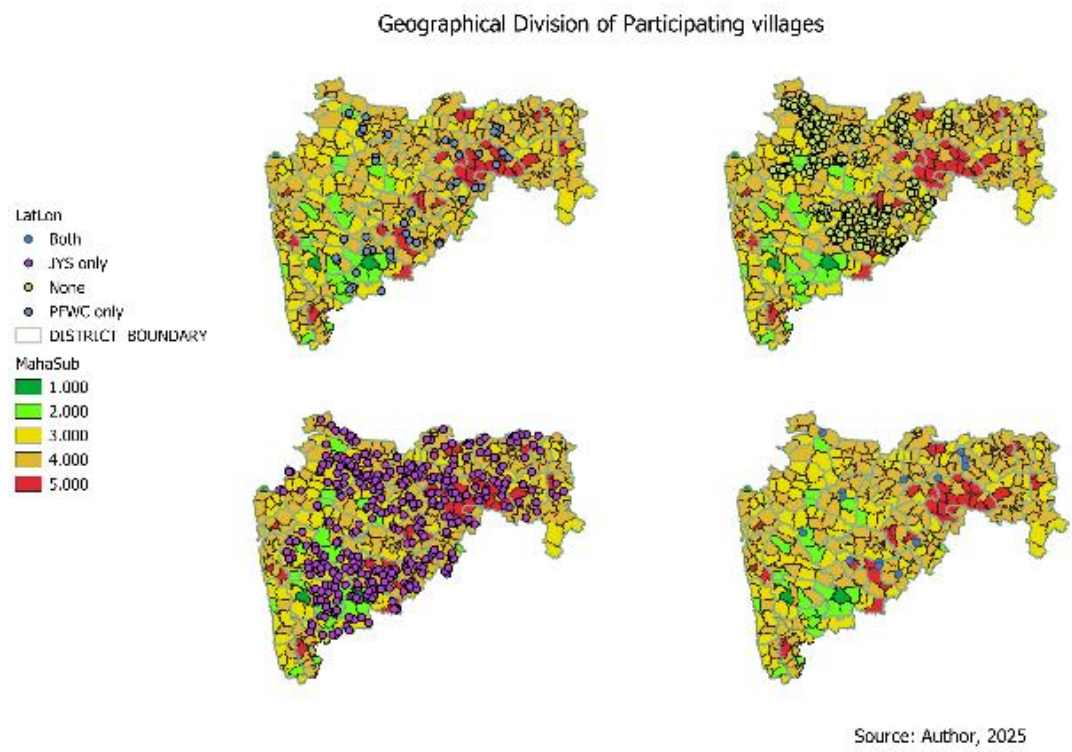
²⁷ Precipitation is defined as “water released from clouds in the form of rain, freezing rain, sleet, snow, or hail. It is the primary mechanism by which atmospheric water is delivered to the Earth”. Rain is a subset of precipitation.

[Observation and Processing of Precipitation Data](#)

²⁸ <http://data.icrisat.org/dld/index.html>

A broader view of the features of the participating villages reveals that around 61% of the participants in all the programs belong to a taluka with a high drought frequency²⁹. These are concentrated in the rain shadow belt mentioned earlier in literature (line 132) and can be graphically seen in Map 1 below (or Table 5 in appendix). The average rainfall in 2012-2015 was 59.7 mm throughout the year, compared to 69.8 mm in 2020-2023 with huge yearly variations and an average standard deviation of 92 mm indicating heterogeneity (for more details refer to graph 1 and table 3 in appendix).

**Map 1: Graphical Division of Participating Villages
(Source: Author, 2025)**



The total units of observation are 813 villages across 176 talukas, while total number of observations are 31,579 (refer table in appendix). For each unit of observation (village), the SWLs are collapsed at the levels of seasonal means for each year, so that fixed effects can be defined. The indicator of water level in well is widely used by watershed evaluation studies (Kerr and Chung, 2004; Sreedevi et al., 2008; Palanisami, Suresh Kumar and Wani, 2011).

²⁹ Drought frequency is a categorical variable from 1-5, where 1 is lower frequency of droughts and 5, with higher frequency of droughts compared to the mean rainfall analysed from 1901-2020 (Chuphal et al., 2023)(Chuphal et al., 2023).

3.2 Methodology

The study follows a mixed-method approach, with key person interviews, participatory action research approach and econometric analysis on secondary data as mentioned in the above section. The paper explores the qualitative data to gauge the motivation/drivers of participation and then follows it up with econometric modelling to analyse the long-term impact of the programs. The paper hypothesizes that the motivation to self-select a village into the competition maybe driven by different factors, which the qualitative analysis delves into, as well as the motivation may provide differential impact which is assessed by quantitative methods. The following section elaborates on the methodology followed to analyse the aforementioned data.

3.2.1 Qualitative analysis

The paper undertakes an inductive thematic analysis of the qualitative interviews and examines the drivers/motivation that encouraged villages to participate in the PFWC as well as factors that sustained the level of participation throughout the course of the competition. Both the paradigms of initial self-selection and sustained participation provide overlapping themes, but for the purpose of the paper are distinguishable and will be addressed briefly in the results section.

3.2.2 Quantitative Data Analysis

The secondary objective of the paper is to assess the impact of PFWC, to ascertain that participation in gamified interventions provide long term increased resource availability compared to other programs. In order to conduct an ex-post evaluation the competition in villages which participated and did not participate, a difference-in-differences strategy is justified as a valid econometric model.

A multinomial logit model was run to understand the variables affecting participation in the two programs (necessarily the opposite model to understand factors significant for each group of participation). Another fixed effect model was run to showcase the impact of rainfall and lagged rainfall on water level, with added controls of divisions. The indicator of drought frequency was used for descriptive analysis, however was not used in the fixed effects model as it is a time-invariant index.

A differences in differences model is a quasi-experimental evaluation method that compares the “change of effects of participation, before and after the implementation of the program” and compares it to a control group of non-participants (European Evaluation Network for Rural Development, 2014). In watershed programs where the program is not randomized, the model Kerr and Chung, (2004b) suggest a before/after - with/without approach (a basic differences in differences model). Most of the other studies use an instrumental variable approach (Kerr and

Chung, 2004b; Pender and Kerr, no date; (Palanisami, Suresh Kumar and Wani, 2011b) or a multinomial logistic/tobit regression (Palanisami, Suresh Kumar and Wani, 2011b; Badal, Kumar and Bisaria, 2006; (Pradhan, 2016) or with/without or before/after study separately (Samuel et al., 2009; Gray and Srinidhi, 2013; Palanisami and Suresh Kumar, 2009). Most of these studies lack baseline or pre-trend data and encounter issue of scale which are being addressed in this study.

The data availability of pre and post intervention variables, addresses the concerns raised by (Kerr and Chung, 2004b), providing a panel data structure detailed in the data section. However, due to unavailability of village-level data on agricultural, socio-economical indicators, the model is restricted to a single dependent variable and fewer controls.

3.2.2.1 Model Specification for Difference-in-Differences Model

The paper thus specifies the following difference-in-differences model:

$$Y_{it} = \beta_0 + \beta_1 \text{participation in individual program}_{it} + \beta_2 (\text{post} \times \text{participation}) + \beta_3 \text{post} + \beta_4 \text{rainfall}_{it} + \mu_{it}$$

where ' i ' is the individual village well observation in one quarter of a year, specified by ' i '. The standard errors are clustered at village level.

3.2.2.2 Dependent Variable

The dependent variable for the purpose of analysis is water level in observation wells. The objective of PFWC of making the state drought free, can be looked at through the lens of increasing water levels. Moreover, water conservation has been an integral goal of WSDPs as mentioned in the literature on evolution of these projects. Therefore, the paper assesses the impact of PFWC and JYS on water levels in well, which can be equated to increased groundwater level.

The paper constructs two dependent variables based on the initial Static Water Level Data and runs separate models for both the dependent variables.

filled_percentage: a variable which represents the percent of water filled in a well³⁰. It is calculated as follows:

$$\text{filled percentage} = \left(1 - \frac{\text{Static Water Level}}{\text{depth}} \right) * 100$$

Difference in filled percent (diff_filled_percent): a variable that calculates the change in filled percentage across pre monsoon and post monsoon. The variable provides an idea of seasonal change in water level or can be synonymous to water recovery post monsoon.

³⁰ Static water level defined as above measures the distance from the surface till incidence of water. However, for ease of logical analysis, the paper has converted the variable into the percent of water filled.

$$\text{diff filled percent} = \text{filled percentage in season 3} - \text{filled percentage in season 1}$$

The dependent variables are in percentages, hence the result analysis is in terms of change in percent points.

3.2.2.3 Independent Variable

The primary independent variable of interest is the participation in PFWC, participation in JYS, participation in both the programs and control. The participation is a binary variable of 0 and 1, which indicates the well falls in the village that participated in the PFWC, or was treated under JYS or was able to undergo both the treatments. Participation in a program is thus synonymous to treatment, and for the purpose of the paper both are used synonymously. The control sample consists of randomly selected villages, with no knowledge of existence of other watershed programs in those villages.

Separate models with different were tested for model robustness and variable interactions. Models were run with and without the during treatment time (2016-2019), and with pure controls (just participation and control group), to isolate the effect of the intervention, to provide a robust differences in differences model and strengthen causal inference. The results are reported in appendix table (3 tables).

Chapter 4 Results

The results section details the qualitative and quantitative findings of the paper from the proposed methodology and gathered data. The section explains the qualitative and quantitative findings separately and the synthesis is presented in the conclusion and discussion section. The qualitative section explains the themes of initial drivers of participation in the competition as well as the motivations to sustain the work done under the competition. The quantitative results contextualize the aspects that were brought up in the qualitative analysis and strengthens the finding of long-term impact of the competition.

4.1 Drivers of Initial Participation

The participation question in watershed management starts with the most basic need and answer of water requirement. The need/demand for water may have been a factor in history of participation in the programs, however the current scenario presents itself with supply side constraints given the increasing climate change risks and water scarcity.

4.1.2 Water scarcity

Water scarcity emerged as the broad reason to participate in the PFWC which was mentioned by all the respondents. This is in line with the projects and studies mentioned in literature, however, the earlier paradigm of WSDPs have targeted areas for multiple reasons befitting the broader goals of the programs like drought proofing, ecological conservation or livelihood upliftment. Compared to that, the self-selection of villages in PFWC reflects the initiation by the villages itself thus attracts participants which have recognized water scarcity as an issue.

The overall scarcity in the region can be identified as an effect of geomorphology of the land leading to low moisture or water absorption capacity. However, additional factors play a role in alleviating the scarcity. The other reasons that were highlighted by the villages facing water scarcity were the location of the village in a hilly area, the issue of transporting and carrying water from source to use and seasonality of water availability. This reflects that the villages are aware of the reasons that are driving water scarcity and are willing to act on it. The willingness to act and participate is also influenced by experiences with drought, reflecting recency bias. The experience of drought in 2017-18 was one of the mentioned drivers of participating in PFWC. Though the evidence for the level of awareness amongst the beneficiaries in earlier times is sparse, the literature also suggests that the awareness of a problem may not translate into action, especially in public goods scenario.

4.1.3 Politico-administrative setup and local leadership

Politico-administrative leadership and environment is observed to be a crucial impactor on participation as well as continuance off the program and maintenance of the structures. The initial decision to participate in PFWC involved the *gram panchayat* members and was to be duly signed by the *gram sevak*. In addition to that, the initial introduction and workshops explaining the PFWC was conducted through the medium of administrative and political machinery (interview excerpt). The role of this system as mentioned in the interviews was accentuated through the decision-making regarding participation despite opposition, the encouragement to participate in the trainings, continued persuasion by actors, as well as the participation only after certain people being elected enabled the initial decision. The political actors were crucial in raising awareness, mass mobilization.

“When I was the Sarpanch, I filled the form despite opposition and disinterest from the other villagers”

– (Respondent from Tembhari Parsodi)

“I persuaded and sent a team from the villagers for training in 2017, however, that did not work out. But I again readied another team in 2018, which came back from training and led the momentum for social transformation”

- (Government affiliated respondent from Bajarwada)

The political leadership was a factor during the course of the competition, which involved the local as well as higher political and administrative machinery. The lower levels of agents were involved in ensuring the documentation, but more importantly they were the driving force in making the decision and mobilizing resources like various funds and programs of the government for the watershed work that was to be done during the competition. One of the important linkage created by the involvement of political/administrative actors was the combining of benefits of the rural employment guarantee act (NREGA), which provides wages for work. The higher level of agents were cursorily involved in providing resource, mobilizing the public. Support from the government was provided at the highest level with additional prize money announced for the winning villages. A strong local leadership is therefore necessary to drive people, raise awareness and provide essential resources in a competitive environment. However, in this case major political and administrative actions revolved around providing funds, which is an important factor in implementation of the program but very synonymous with the previous programs. The local leadership also involved other influential actors like teachers, students and SHG groups which were initially utilized to gain social momentum for the competition.

4.1.3.1 Historical exposure to WSDPs

WSDPs have a long history in Maharashtra as detailed in the literature section, and exposure to these programs has led to participation in PFWC. Especially the case of Kakaddara, where watershed work was conducted in the 1970s, was a significant factor in their participation, quality of work and winning the competition in 2017. The earlier WSDP in the village was also participatory in nature, which had instilled a sense of cooperation, village unity and a habit of *gram sabhas* every week. The technical knowledge transfer from the previous program was built upon in the trainings provided by PFWC. The result of the existence of earlier NGO work was also seen in "better and lasting structures" as per the respondent and researcher's insights from the site observation as seen in the following photo.



Photo 1: LBS constructed during the competition. Growth of vegetation surrounding the structure. Storage of water, due to the structure.

(Source: Photo taken by the author on 13 August 2025 during field visit)

However, the earlier exposure to WSDPs resulting in active and successful participation in the PFWC maybe influenced by the nature of the earlier WSDPs. Besides the mentioned village, watershed activities were conducted by other NGOs and government related organizations³¹ in two other villages. The nature of this work did not follow a participatory method, did not involve

³¹ Bajaj Foundation and National Bank of Agriculture and Rural Development (NABARD) worked in Bodad and Tembhari Parsodi and have built concrete check dams, which were beneficial to the villagers. However, the involvement of the villagers in the process was low.

aspects of training and were constructed with minimal involvement of the villagers leading to complications mentioned in the literature (p.8-9). Interestingly, the work done by ASSEFA in 1970s was mentioned multiple times in the interviews and was credited the success in PFWC, while the other two villages only mentioned it in passing or when asked about it, despite the programs being implemented in last 15 years.

“The technical knowledge that was provided to us by the previous NGO stayed with us, therefore the structures that we built during the Water Cup were strong.

The practice of village meeting every Wednesday, below the tree in the middle of the village, was inculcated in us by the previous organization, and that helped us a lot for decision making during the Water Cup”

- Experience of Kakaddara

4.1.4 Demonstration and bandwagon effects

Demonstration and bandwagon effects³² were one of the other drivers, which drove participation inter and intra village. The visible benefits from neighbouring villages in agriculture and water level, their winning of award at the district level is a factor that accentuated the participation in PFWC constituting a bandwagon effect. The other factor was the demonstration of benefits of watershed by conducting watershed activities in a small area or providing reference from nearby villages where such demonstration already existed. These effects worked for inter-village actors to sustain the participation in the competition. The bandwagon effects were demonstrated through the persuasion of villagers who were hesitant to join the volunteering activities. Many respondents joined the activities because they saw other people doing it and benefits of well rejuvenation or bunding in other's farms led to increased interest. Therefore, demonstration and bandwagon effects contributed to the continued or increasing participation of individuals as well as villages.

4.1.5 Factors for self-selection and continuing participation

A crucial element of a competition like PFWC, according to the paper is not their efficient training model and procedural clarity or the social momentum or the incentive, but the ability of the competition to self-initiate participation in a WSDP, which was a downside of earlier programs. The self-selection into the program through a competition can be a crucial aspect to boost participation in WSDPs making them more effective. Additionally, self-selection ensures that the participants and beneficiaries acknowledge the existence of a problem. The stimulus to participate, reducing supply driven WSDPs and encouraging demand by the interested beneficiaries. This provides an alternate approach to targeting of policies involving common goods which were

³² Defined as “an inclination of persons to join in their preferences or behaviours what they perceive to be existing or emerging majorities or dominant positions in society” (Schmitt-Beck, 2016)(Schmitt-Beck, 2016)

puzzled with the issue of participation. The initiation of involvement makes sure that the programs benefit those who need it and are interested in it. While the bandwagon effects and local leadership were factors in motivating people to participate, financial resources also played an important role. The participants have little incentive initially to join the competition; multiple financial aspects influenced the progress of the competition. A major positive financial boost that motivated participants, especially the laborers, to continue working and building structures was the linkage to the rural employment guarantee program, which provided them with a minimum wage for working on watershed structures during the competition. The linkage helped the daily wage laborers to sustain themselves, which otherwise would have dropped out of the competition to look for paid work (as cited by a respondent from Bajarwada). The finances were also required for machine work related to watershed structures, and various government organizations and NGOs donated machines and required support, however it was context based and not universal. The motivation of participation was also sustained in successful villages by private donations. On the other hand, the rich farmers were able to invest themselves in watershed activities. While financial incentive may act crucial to join or sustain a program, the question of financial motivation as the primary driver and a program without financial incentives leads to reduced success of the program. However, a voluntary demand for financial incentives with ease of access to funds may provide a balance in alienation of projects, ownership of assets and non-participation from the outset.

The gamification of watershed development by setting targets to be achieved in a set of time, while providing updates and tracking progress through a mobile application was also a motivator to make people effectively participate in WSDPs. The target-based system ensured that people were informed of the work to be completed and the time under which it needed to be completed. According to the qualitative data collected, the completion of structures and the achievement of different levels helped the villages to gauge their performance. In addition to that, the proximity to completing the targets (district level or state level) encouraged the participants to “go the extra mile” to achieve the targets in the hope of winning the prize (as mentioned in the interviews). The sense of incremental achievement of success was an important factor that motivated people to continue working in the program.

The above factors reflect the motivating factors that influenced the participation in the competition and its sustainability throughout the course of the competition. The major factors for initial participation in the competition were local politico-administrative leadership, historical exposure to WSDPs, bandwagon and peer effects and was underlined by water scarcity. Aspects of the above factors were also responsible for continuing participation in the competition like influence of social actors (teachers, students, SHGs), linkages to financial remuneration and

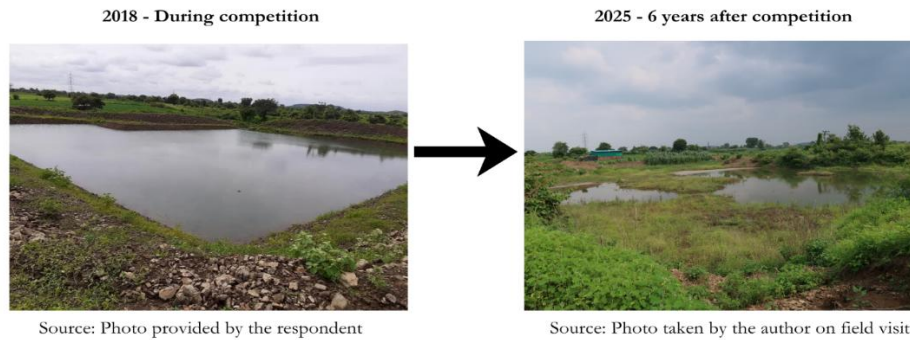
incremental achievement of targets helped the sustainability of the program throughout the duration.

4.1.6 Impediments in the course of the competition

There were a few impediments in continued participation or maintenance after the withdrawal of the competition. The onus of maintenance of infrastructure fell upon the private benefactors of the competition and maintenance of the public infrastructure, thus returned to being a common's problem, with nobody initiating the responsibility to maintain it. The initiation of post-competition activities may not have arisen due to not feeling the required need to do so, especially with favorable weather in recent years, reducing the recency bias mentioned in earlier sections. Another major concern on the continued watershed activities or maintenance was the change in politico-administrative powers and inefficiency of the government machinery. The consequences of change in politico-administrative actors was especially visible where the actor's power influenced the participation in the competition like in Tembhari-Parsodi and Bajarwada. The lack of continuity was caused by the unfavorable opinions regarding the work done by the previously elected members. This also affects the support and momentum of the program and the watershed related sentiments instilled in the villagers. This may relate to the erosion of social capital built for the purpose of watershed activities. On the other hand, the independent and "poorly informed"³³ decisions of the contractors of government schemes, led to dismantling of the structure that was built during the competition, exhibiting the inefficiency and alienation of government machinery. The above can be seen in the photo-comparison provided below, of the structure during and after the competition. Other factors influencing the post-competition activities are the knowledge transfer failure from the teams that got the training to the other members and a general outmigration in agricultural activities.

Photo 2: Situation of a farm pond built during the year of competition and 6 years after competition in Bajarwada

³³ As mentioned by one of the respondents during site visit.



4.2 Impact assessment

The paper’s objective is to understand the long-term effect of the competition in order to understand whether such programs can be recommended to boost participation and whether these programs provide long term benefits. The initial reports by the foundation, as mentioned in the background showcase high water-saving capacity, increased water levels and agricultural productivity as well as positive spillovers on socio economic indicators like income, migration.

4.2.1 Perceived impact

The current impact of the competition as self-reported by the villages was multifaceted and aligned with the benefits of the earlier programs nonetheless largely driven by additional availability of water. As reported by the respondents, agricultural productivity increased, the water levels had risen and crop intensity had increased. The increase in agricultural productivity is multi-faceted, with increase in crop cycles, intensifying the existing production as well as uptake of other crops like banana, which are water intensive crops. These externalities, despite benefitting the individual farmers, provides suggestive evidence for Jevon’s paradox³⁴, which remains undexplored in this paper.

On the socioeconomic side, the income of farmers did not reflect a major effect due to market inefficiencies. However, agriculture related labor migration was reported to be reduced due to increased opportunities as a spillover of increased agricultural density. The involvement of politico-administrative actors during the competition resulted in an increase in interaction and linkage with the villages and the actors.

³⁴ Jevon’s paradox states that “an increase in efficiency in using a resource leads to increased use of that resource rather than to a reduction” - (Polimeni et al., 2012)(Polimeni et al., 2012)

The impact is also influenced by the geomorphology of the village, where the PAR tool indicated that structures like well rejuvenation, CCTs, provided benefits like increased water levels, reducing soil erosion. In addition to that, activities like village cleanliness drive and tree plantation provided benefits related to social awareness. However, some activities like the soak pits, were absolutely not useful due to the geography of the village (as mentioned by respondent in FGD). The maps created during the mapping activity are provided in appendix figure 1. The self-reported qualitative accounts of impact may lead to subjectivity, biases or misrepresentation.

To account for the drawbacks, the long-term impact of the competition on ownership, maintenance and upkeep of watershed structures, can be seen through either by directly assessing the current state of the structures or the variables the structures have an impact on, in the case of this paper, groundwater level. Therefore, the qualitative insight of increase in water levels is tested further by providing quantitative evidence following the mentioned identification strategy.

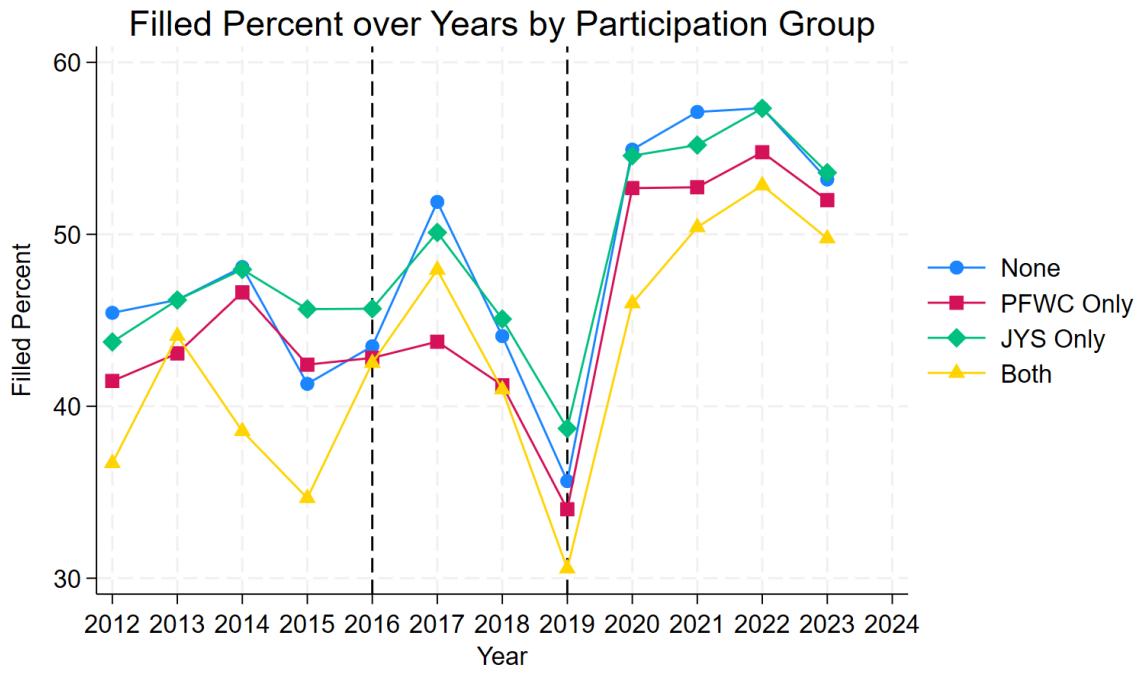
4.2.2 Empirical Analysis of Impact

The empirical findings section will provide descriptive statistics of the data and results for the econometric models to establish a relationship between participation in the competition and its impact on the groundwater level that is detailed in the methodology section.

4.2.2.1 Descriptive Statistics

A simple analysis of averages of the water level in wells between the treatment periods and participation groups, displays changes in the outcome of interest across various groups. The following graph illustrates the differences:

Graph 1 : Water level in participation group from (2012-2023)



The groundwater levels of the different participant groups reflect a similar trend over the years. The initial groundwater levels (pre-treatment from 2012-2015) are different, with the control group and JYS participants showcasing a higher average water filled percentage of 45.6% and 46% respectively compared to participants in PFWC only (44%) and in both the programs (39.5%). This indicates that villages with lower groundwater levels were likely to participate in both the programs. The lower levels can be considered as a driver to join the PFWC as well as JYS. The group with both participants also has a higher standard deviation compared to other groups (27.3pp compared to total deviation of 26.6pp), which can be related to higher vulnerability to shocks or also indicates higher heterogeneity in group members. The descriptive statistics table below provides additional details on rainfall and average depth of well in meters (static).

Table 2: Descriptive statistics – Means of indicators

	treatment_period				unit of measurement
	0	1	2	Total	
participation_group					
0					
rainfall	59.65	63.51	70.29	64.40	mm
filled_percent_seasonavg	45.45	44.29	55.81	48.29	percent
depthm	13.68	13.67	13.71	13.68	metres
1					
rainfall	57.86	65.68	75.23	66.10	mm
filled_percent_seasonavg	43.96	40.85	53.76	46.07	percent
depthm	11.45	11.65	11.76	11.62	metres
2					
rainfall	60.06	67.79	68.52	65.42	mm
filled_percent_seasonavg	45.98	45.08	55.42	48.72	percent
depthm	12.11	12.16	12.14	12.14	metres
3					
rainfall	59.99	69.16	72.04	67.23	mm

filled_percent_seasonavg	39.45	41.59	49.37	43.23	percent
depthm	12.91	13.01	12.66	12.87	metres
Total					
rainfall	59.74	65.68	69.77	65.02	mm
filled_percent_seasonavg	45.50	44.41	55.40	48.27	percent
depthm	12.82	12.86	12.85	12.84	metres

Source: Author, 2025

4.2.2.2 Factors affecting participation

A mlogit model performed on years before 2017³⁵ reflects the odds of being in mentioned programs (results provided in the following table). With control group as the baseline, the logit results show that villages with lower groundwater levels are more likely to participate in both the programs (significant at 5% levels). Drought frequency index also plays an important role, where higher index decreases the chances of being in individual interventions, while positive coefficient for group 3 indicates that higher drought frequency leads to higher chances of being in both the interventions. Interestingly, rainfall does not show significant effect on participation in the model. The rainfall indicator however, does not reflect any significant effect on participation, despite it having a significant lagged effect on water level (explained in detail in Note 1).

Table 3 Results of logit model for participation

VARIABLES	(1)		(2)		(3)	
	mfxc	for	mfxc	for	mfxc	for
	PFWC		JYS		Both	
filled_percent	-0.000613		0.00354***		-0.00548*	
	(0.00166)		(0.000857)		(0.00294)	
rainfall	8.59e-05		-2.08e-05		0.000590	
	(0.000531)		(0.000270)		(0.000886)	
drought_frequency	-0.377***		-0.521***		0.486***	
	(0.0526)		(0.0315)		(0.123)	
division	-0.670***		-0.712***		-0.0361	
	(0.0372)		(0.0201)		(0.0743)	
district_c	0.130***		0.0684***		0.0813***	
	(0.00676)		(0.00309)		(0.0113)	
taluka_c	0.00168*		0.00930***		0.00111	
	(0.000875)		(0.000423)		(0.00146)	
Constant	-0.732***		2.414***		-6.289***	
	(0.276)		(0.158)		(0.639)	

³⁵ Since PFWC was piloting the project in 2016, there were lesser participants, which were targeted by the foundation.

Observations	12,966	12,966	12,966
<hr/>			
Standard errors in parentheses	*** p<0.01, ** p<0.05, * p<0.1		
<hr/>			
Source: Author, 2025			

4.2.2.3. Difference in Differences Model

The first two-way fixed effects model specification which looks at the water level in terms of percentage of water filled in the well, as specified in methodology, provides no significant results for any type of treatment. The model shows a reduction in water level in post treatment period for all the groups, especially the villages with both programs, however they are not statistically significant. It should be noted, that despite the lack of significance, the magnitude of reduction of PFWC villages is associated with a lesser reduction in water level compared to JYS villages. While the villages which participated in both the programs, reflect higher reduction, which can be attributed to their vulnerability to shocks. The lack of significance for the programs can be explained by the general increase in water levels across all groups in post treatment period, significantly explained by rainfall, which drives groundwater levels. The model explains about 20% variation in water levels, while the rest is explained by unobserved or unaccounted factors.

The second model, which looks at the intra seasonal recovery from pre monsoon to post monsoon, reduces the number of observations considerably, due to analysis of just two observations per year, per well. The second model specification provides a significant reduction in recovery from pre monsoon to post monsoon water level in villages participating in JYS (-6.9 pp reduction in recovery significant at 1% levels) and PFWC as well (-6.4 pp reduction in recovery significant at 5% level). It can also be inferred that the reduction in recovery PFWC villages is marginally lower than the reduction in recovery in JYS villages, thus providing an important insight that participation in PFWC will likely to lesser reduction in groundwater recovery. A 0.5 percent point reduction in an overall effect of 35percentage points, thus provides a crucial causal impact of the PFWC. In addition to that, every 1mm of increase in rainfall is also associated with 0.13pp significant reduction in recovery of water levels indicating a higher rainfall may not necessarily lead to higher water level due to factors like excess runoff, increased agricultural usage due to anticipation. The model explains 40% of the variation in the recovery.

Table 4: Result for Difference in Differences Model

	(1)	(2)	(3)
	OLS Controlling for JYS	FE Controlling for JYS and both	FE Seasonal Change Controlling for JYS and both
VARIABLE (Y _i)	filled_water (%)	filled_water (%)	Change in filled water (%)
participate_PFWC	-2.756		
	(2.201)		

PFWC_treat_post	0.168 (1.532)	-0.472 (1.374)	-6.372** (2.712)
participate_JYS	0.203 (1.088)		
participate_both	-3.611 (3.059)		
JYS_treat_post	-0.435 (0.791)	-0.927 (0.748)	-6.893*** (1.709)
both_treat_post	-3.149 (2.393)	-2.504 (2.445)	1.663 (3.713)
drought_frequency	0.351 (0.632)		
post	6.330*** (0.746)	6.914*** (0.698)	-1.395 (2.443)
rainfall	0.0947*** (0.00204)	0.0923*** (0.00203)	-0.132*** (0.0286)
2013.year	-0.404 (0.465)	-0.367 (0.455)	21.65*** (1.251)
2014.year	2.380*** (0.524)	2.423*** (0.516)	-9.685*** (1.432)
2015.year	-2.151*** (0.623)	-2.139*** (0.619)	-8.465*** (1.503)
2016.year	-1.727*** (0.535)	-1.314** (0.515)	30.57*** (1.204)
2017.year	4.794*** (0.646)	5.020*** (0.616)	10.36*** (1.479)
2018.year	-0.868 (0.603)	-0.457 (0.573)	-17.19*** (1.705)
2019.year	-11.03*** (0.616)	-10.52*** (0.593)	8.493** (3.508)
2020.year	3.202*** (0.439)	3.460*** (0.426)	26.73*** (2.280)
2021.year	2.861*** (0.364)	3.130*** (0.347)	18.46*** (2.003)
2022.year	4.117*** (0.295)	4.330*** (0.280)	21.84*** (2.045)
2023o.year	-	-	-

Constant	39.05*** (2.486)	40.06*** (0.436)	35.10*** (1.411)
Observations	30,763	30,763	4,274
R-squared	0.154	0.204	0.400
Number of siteid_c		813	805

Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

Source: Author, 2025

The above models provide evidence that participation in any program may not significantly alter the groundwater level behavior which continues to be influenced by rainfall. However, it significantly affects the recovery rate of groundwater level from pre monsoon to post monsoon conditions, providing evidence that PFWC participation leads to favorable outcomes. Thus, the quantitative insights support the claim of groundwater increase in the villages post the competition, however, the competition has little contribution to the groundwater level recovery but instead lead by rainfall.

Chapter 4 Discussion and Policy Suggestion

The paper presents its conclusion at a juncture where multiple factors are converging in watershed development. The participatory approach has become a feature of guidelines and implementing principles of wide range of WSDPs. The innovation and progress in watershed technology has reached a point of stability, with ample evidence of definitive advantages in agriculture and ecology. The participatory approaches have also facilitated integration of local knowledge in watershed techniques. They are being utilized as means for rural development, with the end of alleviating poverty, reducing migration, mitigating vulnerabilities and, in the case presented, for psycho-social transformation as well. In addition to that, increasing awareness and observable impacts of climate change has led policy beneficiaries to engage in mitigation, conservation and related efforts, increasing the importance and demand for WSDPs. This juncture provides an optimal frame for competitions like PFWC and other innovative policy designs in watershed.

However, as water touches different aspects of society and environment, the complications continue to persist. The commons problem, majorly cited in the commons literature, continues to drive complexity in governance and sustainability of such programs from an anthropocentric perspective. Problems like individual versus collective rationality, inequitable distribution or savings induced usage are derived from commons literature. Growing concerns of WSDPs are being raised within the frames of accessibility to and exclusion of certain groups. Watershed development provides contextualized results and feature long intervention and follow up periods, where an agency cannot just implement the program and withdraw after program completion. Additionally, the increased availability of water leads to over-exploitation of groundwater resources, making WSDPs counterproductive. In addition to that, gamification based approaches can lead to equity and distributional issues, misalignment of polycentric governance, and may not address the collective action dilemmas at scale.

The participation and scalability concerns have drawn multiple responses, with differing results as mentioned in the literature review. The case of competition in a cooperative or commons policy arena, thus presents an alternative frame of thought. The motivation to participate in PFWC compared to other program can be analysed through project design elements mentioned in the literature, that helped the competition to elicit large-scale participation. The most fundamental design element differentiating PFWC from government programs concerns the targeting and selection mechanism whereby villages enter programs. A competition encourages voluntary participation in the program, which is emphasized earlier, ensuring active and willing community engagement and mitigating program targeting concerns (usually associated with numerous

development programs). Given the history of WSDPs with low participation despite the benefits, a competition thus can provide a suitable policy design to make people voluntarily take up watershed activities, which elicit a demand for the same. The target based awards in a competitions/gamified model, provides an incentive to participate and sustain in the program, however it differs from the framing of incentives in other programs. The existing framing of incentive, in food for work or employment benefit programs, portray it as a compensation more than an incentive, which one would expect to be guaranteed after the completion of the program. In a policy based on gamification, the incentive exists, but it is conditional on achieving certain targets and a winning position, only after which the incentive is provided. Therefore, a competition or gamified policy intervention can act as a nudge in policy uptake and sustainability.

PFWC approach effectively utilizes gamification through the tools of effective communication, demystified training modules, reducing information asymmetry by linking beneficiaries to programs, and social mobilization to put forward the ends of WSDPs. These factors can help extend the approach into gamified approaches and efficient program implementation. PFWC manages to minimize the risks and fallouts of beneficiaries, addressing a crucial drawback of earlier approaches. The competition was able to create momentum of collective action at a macro scale, which should have produced beneficial results for commons. It also, addressed the over reliance on incentives by the virtue of the competition, however, further research needs to explore the non-participation of villages due to missing out on a prize or losing the competition. Therefore, a gamified intervention, does marginally address a few problems, but also may exaggerate the other. The framing of WSDP as a multifaceted response to resource conservation, environmental sustainability, agricultural productivity and socio-economic development needs to be revisited. The idea of watersheds reducing vulnerability and risk contexts in these areas may sound plausible. However, pinning these targets on WSDPs, maybe analogous to overfitting an econometric model, in essence meaning, they would weakly affect all the objectives. The ends and means of these projects thus needs to be contextualized to the area, with objective prioritization. The solution also does not lay in intense institutional specialization leading to loss of interaction between multiple programs and duplication of efforts.

The paper provides evidence that WSDPs are indeed an approach that would marginally address the issue of resource conservation, however there are bigger factors at play. Rainfall drives the groundwater levels, and unpredictability induced by climatic factors influence the success or failure of a watershed, thus impacting the experiences of beneficiaries. While increased water availability is crucial for productivity enhancement, agricultural system efficiency also depends on other factors like market efficiency, technological innovation, and risk resilience. The factor that was

highlighted by one of the respondents was market inefficiency undermining the benefits derived from watershed development. A complementary set of policies addressing these inefficiencies thus needs to be introduced in concurrence with these programs. Therefore, WSDPs, along with perceiving them as the driver of agricultural and rural development, should also be seen as a subset of factors that are impacted in a wider system. Therefore, the paper proposes that WSDP programs should promote specific objectives complemented by separate policy instruments to address the extension services.

These extensions of various watershed related concerns and principles need to be further explored through the lenses of policy design and framework analysis, agricultural economic principles, and community based natural resource management theories.

Chapter 5 Conclusion

So what spurs participation and what is the impact of that participation? The question formed the central premise of the study and attempted to answer it by understanding the drivers of participation in a WSDP and project sustainability. It analysed a gamified intervention in the state of Maharashtra, the Paani Foundation's Water Cup, to understand voluntary participation in the watershed activities and assessed its impact in the long term. Based on the findings, the conclusions of the paper are presented in this section.

The literature review provides the context and evolution of WSDPs, highlighting the lack of participation, highly centralized planning, non-maintenance after post project withdrawal, thus reducing the efficiency of these programs. The current policy environment advocates for participatory approaches as a determinant of success of these programs, which ascribes decentralized, local-knowledge based approaches and direct involvement of the beneficiaries in the processes. However, the driver of participation varies contextually, making it difficult to motivate people to contribute to community-based practices, which are crucial for a commons resource like groundwater. Tapping into the broader issue of climatic vulnerability and social capital, the mentioned intervention provided a novel approach to watershed management, eliciting self-selection into the program and mass mobilization through the means of a competition.

The paper followed a mixed method approach to understand the drivers of motivation and the impact it leaves post competition withdrawal. The paper collected primary data through qualitative interviews, PAR activity and site observation in field visits to the villages that participated in the competition. The paper supports this qualitative exercise by econometric analysis of groundwater levels based on secondary data through a difference in differences model find causal impact.

The qualitative analysis presented diverse dynamics of the drivers/motivation for initial and continued participation by the people. Water scarcity in various forms and experiences of it predominantly steers the decision to participate in any watershed development program and is supported by the fact of geographical distribution of the watershed programs. The local politico-administrative additionally drive and influence the decision-making processes in all the phases of the competition. In addition to that, local actors like students, SHGs, teachers, and external actors like movie stars, state political leaders and water scientists supplement the momentum during the competition. The earlier successful exposure to participatory WSDP programs also play an important role in establishing awareness and providing technical knowledge that spurs voluntary participation in further programs. Other factors like self-initiated financial funding drive, demonstration and bandwagon effects, achievement of targets towards the prize. The impediments

in the drivers and long-term uptake were discussed to be the change in politico-administrative leadership, disintegrated government projects that do not involve community participation, a recency bias with respect to favourable weather conditions leading to not deriving the need for water conservation measures.

The quantitative analysis initially hypothesized the quantitative macro factors of participation before the programs commenced and found that water levels, rainfall, and being in a specific district and administrative division impacts the odds of participating in one of the programs. The impact of the competition post withdrawal, reflect that the water level increase in the state is a significant effect of the favourable rainfall patterns in recent years (2020-2023). While insignificantly, the participation in PFWC reduced the water levels in post competition scenario lesser than effect of the JYS program. Additionally, the increase in water level from pre monsoon to post monsoon was significantly lower in JYS participants, compared to the PFWC participants, despite both presented with decreasing water levels. The quantitative analysis is in line with the perceived impact of the villages, where they claimed that the water level has increased leading to agricultural productivity gains and socioeconomic spillovers. However, the increase is significantly impacted by the favourable rainfall and weather conditions, and less so by participation.

The major drawbacks of the paper are the limited sample size for qualitative and quantitative data analysis due to resource and time constraints. The qualitative data obtained through snowball may be biased to guide towards villages which were successful in the competition. In the quantitative data, due to unavailability of the complete participation list from the foundation, the selection of highest performing villages may provide biased results. The non-cognizance of watershed programs in control villages, makes it difficult to claim it to be pure control sample.

The study is limited in scope and provides further avenues for exploration. It can be furthered into assessing the impacts on agricultural productivity, socioeconomic indicators and importantly water usage patterns at village and household level can conducted to understand the holistic impact of the competition. The translation of water saving behaviour into other behavioural patterns also can be explored through the means of the competition. Tapping further into behavioural patterns, it is also essential to understand the perception and inculcation of competitive games on water usage of the individuals, the community as well as inter village dynamics in the same watershed. On a policy analysis level, the study of PFWC provides insights into linkages between various implementing agencies, as well as utilization of behavioural nudges to promote environment conservation. To further the econometric identification, usage of water and water use behaviour can provide useful insights, which is difficult to conclude with static water depth measures.

This drives the paper towards the conclusion that given certain favourable conditions gamification can lead to an additive effect in terms of participation and its impact. A competition or a gamified approach to watershed management can act as a nudge to foster voluntary participation. The intervention needs to be reinforced by complementing policies related to employment remuneration and technical training, entailing a nexus of implementing agencies working in collaboration. Therefore, the paper suggests a gamified watershed intervention policy design complemented by government support at regular time intervals to elicit people's participation and watershed development.

Note 1

Though rainfall may not be statistically significant for participation, it is a major contributor to aquifer recharge and raising groundwater level, with yearly increase of 1mm rains contributes to 0.17 percentage points (pp) of increase in groundwater levels. In addition to that, lagged rainfall also has a delayed impact on the groundwater level, due to the hydrological nature of groundwater resources. A lag of 1, 5 and 10 years of rainfall shows an 0.09pp, 0.07pp and 0.08pp increase for 1 mm increase in rainfall. This impacts the assessment of WSDPs, as watershed principles revolve around restricting the flow of water, especially rainfall. However, the annual rainfall variation in the state ranges from 667mm to 2966mm, making groundwater recharge in lower rainfall areas difficult. Therefore, the water level increase varies with rainfall as well as being in a particular division like Amravati (2) or Nagpur (4) reduces results in a lesser increase in groundwater levels compared to Aurangabad (3) or Nashik (5). The number of participation from villages also reflects that there are higher number of villages from divisions with lower rainfall.

Table 5: OLS regression showing relation of rainfall and water level

	(1)
Y=filled_water	rainfall and water level
rainfall	0.168*** (0.00243)
L.rainfall	0.0965*** (0.00999)
L5.rainfall	0.0673*** (0.00917)
L10.rainfall	0.0841*** (0.00347)
2.division	0.270 (0.885)
3.division	4.849*** (0.618)

4.division	2.635**
	(1.055)
5.division	12.90***
	(0.755)
Constant	18.06***
	(0.709)
Observations	12,760
R-squared	0.346

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Reference List

- Ananga, E.O. *et al.* (2021) “Examining the contribution of community participation in water resource production and management: perspectives from developing countries,” *SN Social Sciences*. Springer Nature. Available at: <https://doi.org/10.1007/s43545-020-00050-0>.
- Aubert, A.H., Medema, W. and Wals, A.E.J. (2019) “Towards a framework for designing and assessing game-based approaches for sustainable water governance,” *Water (Switzerland)*. MDPI AG. Available at: <https://doi.org/10.3390/w11040869>.
- Badal, P.S., Kumar, P. and Bisaria, G. (2006) “Dimensions and Determinants of Peoples’ Participation in Watershed Development Programmes in Rajasthan,” *Agricultural Economics Research Review*, 19, pp. 57–69. Available at: <http://ageconsearch.umn.edu>.
- Bagdi, G.L. and Kurothe, R.S. (2014) *People’s participation in watershed management programmes: Evaluation study of Vidarbha region of Maharashtra in India*, *International Soil and Water Conservation Research*.
- Bagherian, R. *et al.* (2009) “Factors Influencing Local People’s Participation in Watershed Management Programs in Iran,” *J. Agric. & Environ. Sci*, 6(5), pp. 532–538. Available at: <http://ssrn.com/abstract=2228425>.
- Basumatary, R., Kalita, S. and Bharadwaj, H. (2024) “Informal Credits in India’s Agriculture Sector: Debt Incidence, Size and Distribution across Major Farm-size Groups,” *International Journal of Rural Management*, 20(3), pp. 392–412. Available at: <https://doi.org/10.1177/09730052241262599/FORMAT/EPUB>.
- Bhatnagar, S. (2021) “Economics of Indian Farmers’ Movement: A Study of Agrarian Distress and a Vicious Debt Cycle,” *Yale Journal of International Affairs* [Preprint]. Available at: <https://www.yalejournal.org/publications/economics-of-indian-farmers-movement-a-study-of-agrarian-distress-and-a-vicious-debt-cycle> (Accessed: May 26, 2025).
- Bilancini, E., Boncinelli, L. and di Paolo, R. (2023) “Game-based education promotes practices supporting sustainable water use,” *Ecological Economics*, 208, p. 107801. Available at: <https://doi.org/10.1016/J.ECOLECON.2023.107801>.
- Bouma, J., Bulte, E. and van Soest, D. (2008) “Trust and cooperation: Social capital and community resource management,” *Journal of Environmental Economics and Management*, 56(2), pp. 155–166. Available at: <https://doi.org/10.1016/J.JEEM.2008.03.004>.

- Bouma, J., van Soest, D. and Bulte, E. (2007) “How sustainable is participatory watershed development in India?,” *Agricultural Economics*, 36(1), pp. 13–22. Available at: <https://doi.org/10.1111/J.1574-0862.2007.00173.X;WGROU:STRING:PUBLICATION>.
- Brooks, K. and Eckman, K. (2000) “Global Perspective of Watershed Management,” in *USDA Forest Service Proceedings*.
- Camilo Cardenas, J. and Carpenter, J.P. (2005) “THREE THEMES ON FIELD EXPERIMENTS AND ECONOMIC DEVELOPMENT,” *Research in Experimental Economics*, 10, pp. 71–123. Available at: [https://doi.org/10.1016/S0193-2306\(04\)10004-5](https://doi.org/10.1016/S0193-2306(04)10004-5).
- Castelletti, A. *et al.* (2019) “Gamified Approaches for Water Management Systems: An Overview,” in *Smart Water Grids*. CRC Press, pp. 169–201. Available at: <https://doi.org/10.1201/b21948-7>.
- Chhotray, V. (2011) “The Anti-Politics Watershed Machine: The Making of Watershed Development in India,” *The Anti-Politics Machine in India*, pp. 51–84. Available at: <https://doi.org/10.7135/UPO9780857288417.005>.
- Chuphal, D.S. *et al.* (2023) “Drought Atlas of India, 1901-2020,” *Zenodo* [Preprint]. Available at: <https://doi.org/10.5281/ZENODO.8280551>.
- Corral-Verdugo, V. *et al.* (2002) “Residential water consumption, motivation for conserving water and the continuing tragedy of the commons,” *Environmental Management*, 30(4), pp. 527–535. Available at: <https://doi.org/10.1007/S00267-002-2599-5>.
- Dascher, E.D., Kang, J. and Hustvedt, G. (2014) “Water sustainability: Environmental attitude, drought attitude and motivation,” *International Journal of Consumer Studies*, 38(5), pp. 467–474. Available at: <https://doi.org/10.1111/IJCS.12104;CSUBTYPE:STRING:SPECIAL;PAGE:STRING:ARTICLE/CHAPTER>.
- Dean, A.J. *et al.* (2021) “‘Stickiness’ of water-saving behaviours: What factors influence whether behaviours are maintained or given up?,” *Resources, Conservation and Recycling*, 169, p. 105531. Available at: <https://doi.org/10.1016/J.RESCONREC.2021.105531>.
- Deora, S. (2021) “Diagnosing Watersheds in India: Integrating Power and Politics in the Analysis of Commons Governance,” *Water Alternatives*, 14(3), pp. 734–754. Available at: www.water-alternatives.org (Accessed: November 3, 2025).
- Dhanaraj, S., Mahambare, V. and Vidya (2021) *Are India’s farm debt waivers a political tool that impacts government finances?*
- Dohale, V., Mustafee, N. and Nagarajan, M. (2024) “Orange grower’s perception of drought impacts and strategies for mitigation and adaptation: A study of the Vidarbha region in India,”

International Journal of Disaster Risk Reduction, 105. Available at: <https://doi.org/10.1016/j.ijdrr.2024.104392>.

Dubash, N.K. (2002) *Tubewell Capitalism: Groundwater Development and Agrarian Change in Gujarat*. New Delhi: Oxford University Press.

EPA, U. (2022) “An Interactive Guide to Nonpoint Source Monitoring (EPA 841-F-21-??).”

European Evaluation Network for Rural Development (2014) *CAPTURING THE SUCCESS OF YOUR RDP: GUIDELINES FOR THE EX-POST EVALUATION OF 2007-2013 RDPS*. Available at: <http://enrd.ec.europa.eu/evaluation/> (Accessed: November 12, 2025).

Falk, T., Kumar, S. and Srigiri, S. (2019) “Experimental games for developing institutional capacity to manage common water infrastructure in India,” *Agricultural Water Management*, 221, pp. 260–269. Available at: <https://doi.org/10.1016/J.AGWAT.2019.05.005>.

Fritzen, S. (2007) “Can the Design of Community-Driven Development Reduce the Risk of Elite Capture? Evidence from Indonesia,” *World Development*, 35(8), pp. 1359–1375. Available at: <https://sci-hub.st/10.1016/j.worlddev.2007.05.001> (Accessed: November 16, 2025).

Gopal, L., Gokhale, Y. and Govindan, M. (2021) *Food and Land Resources: Incorporating watershed based approaches for better sustainability-productivity balance*. New Delhi.

Goswami, N.K. (2018) *Watershed management and development*, TERI, India. Available at: <https://www.teriin.org/blog/watershed-management-and-development> (Accessed: May 31, 2025).

Government of India (no date) *Watershed Development Guidelines (2001 Revised)*. Available at: <https://www.megcnrd.gov.in/forms/WSD.pdf> (Accessed: November 3, 2025).

Gray, E. and Srinidhi, A. (2013) *Watershed Development in India: Economic Valuation and Adaptation Considerations*. Available at: <http://www.wri.org/>.

Hardin, G. (1968) *The Tragedy of the Commons, New Series*.

Hinchcliffe, F. et al. (1999) *Fertile ground: the impacts of participatory watershed management*. Edited by F. Hinchcliffe et al. London: Intermediate Technology Publication.

van Horen, F., van der Wal, A. and Grinstein, A. (2018) “Green, greener, greenest: Can competition increase sustainable behavior?,” *Journal of Environmental Psychology*, 59, pp. 16–25. Available at: <https://doi.org/10.1016/J.JENVP.2018.08.007>.

Ikhlas, N. and Ramadan, B.S. (2024) “Community-based watershed management (CBWM) for climate change adaptation and mitigation: Research trends, gaps, and factors assessment,” *Journal of Cleaner Production*. Elsevier Ltd. Available at: <https://doi.org/10.1016/j.jclepro.2023.140031>.

- Isham, J. and Kähkönen, S. (1999) *What Determines the Effectiveness of Community-Based Water Projects Evidence from Central Java, Indonesia on Demand Responsiveness, Service Rules, and Social Capital*. Available at: <https://www.scirp.org/reference/referencespapers?referenceid=2162935> (Accessed: November 16, 2025).
- Jnana Prabodhini's Institute of Psychology (2019) *PSYCHO-SOCIAL IMPACT ASSESSMENT Of Community building Of Participating villages in the Satyamev Jayate Water Cup*.
- Joshi, P. et al. (2008) *Impact of Watershed Program and Conditions for Success: A Meta-Analysis Approach*. Patancheru. Available at: www.icrisat.org.
- Joshi, P.K. et al. (2004) "Watershed Development in India Synthesis of Past Experiences and Needs for Future Research," *Indian Journal of Agricultural Economy*, 59.
- Joshi, P.K. et al. (2005) *Meta-Analysis to Assess Impact of Watershed Program and People's Participation*.
- Kasala, K., Ravula, P. and Chakraborty, A. (2024) "Inclusive Participation in Integrated Watershed Development Programmes: Insights from Bundelkhand, Central India," *International Journal of Water Governance*, 11. Available at: <https://doi.org/10.59490/ijwg.11.2024.6693>.
- Kerr, J. (2002) *Watershed Development Projects In India An Evaluation*.
- Kerr, J. (2007) "Watershed Management: Lessons from Common Property Theory," *International Journal of the Commons*, 1(1), p. 89. Available at: <https://doi.org/10.18352/IJC.8>.
- Kerr, J.M. and Chung, K.R. (2004) "Evaluating the Impacts of Watershed Management Projects: A Practical Econometric Approach," *Natural Resource Management in Agriculture: Methods for Assessing Economic and Environmental Impacts* [Preprint]. Available at: <https://cabidigitallibrary.org>.
- Khwaja, A.I. (2009) "Can good projects succeed in bad communities?," *Journal of Public Economics*, 93(7–8), pp. 899–916. Available at: <https://doi.org/10.1016/J.JPUBECO.2009.02.010>.
- Kolavalli, S. and Kerr, J. (2002) "Scaling up Participatory Watershed Development in India," *Development and Change*, 33(2), pp. 213–235. Available at: <https://doi.org/10.1111/1467-7660.00248>.
- Kolavalli, S.L. and Kerr, J. (2002) "Mainstreaming Participatory Watershed Development," *Economic and Political Weekly*, 37, pp. 225–242.
- Koroleva, K. and Novak, J. (2020) "How to Engage with Sustainability Issues We Rarely Experience? A Gamification Model for Collective Awareness Platforms in Water-Related Sustainability," *Sustainability* 2020, Vol. 12, Page 712, 12(2), p. 712. Available at: <https://doi.org/10.3390/SU12020712>.

- Krath, J., Schürmann, L. and von Korfflesch, H.F.O. (2021) “Revealing the theoretical basis of gamification: A systematic review and analysis of theory in research on gamification, serious games and game-based learning,” *Computers in Human Behavior*, 125. Available at: <https://doi.org/10.1016/j.chb.2021.106963>.
- Krishna, A. and Uphoff, N. (2002) “Mapping and measuring social capital through assessment of collective action to conserve and develop watersheds in Rajasthan, India,” *The Role of Social Capital in Development*, pp. 85–124. Available at: <https://doi.org/10.1017/CBO9780511492600.005>.
- Kumar, P.K., Madhnure, P. and Lamsoge, B.R. (2025) “Long-term monsoon rainfall variability (1998–2023) and its impact on groundwater level dynamics in Maharashtra state,” *Theoretical and Applied Climatology*, 156(6), pp. 1–19. Available at: <https://doi.org/10.1007/S00704-025-05572-2/FIGURES/12>.
- Kumar, S. *et al.* (2022) “Tracing the trajectory of watershed development in India using watershed guidelines: policy insights,” *Current Science*, 123, No. 8.
- Lankford, B.A. and Scott, C.A. (2023) “The paracommons of competition for resource savings: Irrigation water conservation redistributes water between irrigation, nature, and society,” *Resources, Conservation and Recycling*, 198, p. 107195. Available at: <https://doi.org/10.1016/J.RESCONREC.2023.107195>.
- Li, Z. and Tan, X. (2019) “Disaster-recovery social capital and community participation in earthquake-stricken Ya’an areas,” *Sustainability (Switzerland)*, 11(4). Available at: <https://doi.org/10.3390/su11040993>.
- Mansuri, G. and Rao, V. (2004) “Community-based (and driven) development : A critical review,” *Policy Research Working Paper Series* [Preprint]. Available at: <https://ideas-repec-org.eur.idm.oclc.org/p/wbk/wbrwps/3209.html> (Accessed: November 16, 2025).
- Meinzen-Dick, R. *et al.* (2018) “Playing games to save water: Collective action games for groundwater management in Andhra Pradesh, India,” *World Development*, 107, pp. 40–53. Available at: <https://doi.org/10.1016/J.WORLDDEV.2018.02.006>.
- Mishra, S. (2007) *Risks, Farmers’ Suicides and Agrarian Crisis in India: Is There A Way Out?*
- Mody, P., Srivastava, S. and KC, S. (2023) “Paani Foundation: A Gamified Approach to Water Crisis in Rural India,” *Asian Journal of Management Cases* [Preprint]. Available at: <https://doi.org/10.1177/09728201231191349>.
- NCRB: *Maharashtra reports 38% of over 10,700 farmer suicides in 2023 - CNBC TV18* (2025). Available at: <https://www.cnbctv18.com/india/india-maharashtra-farmer-suicide-2023-ncrb-data-19697526.htm> (Accessed: October 25, 2025).

- Nockur, L. and Pfattheicher, S. (2020) “Fostering sustainable behavior through group competition,” *Journal of Environmental Psychology*, 71, p. 101493. Available at: <https://doi.org/10.1016/J.JENV.2020.101493>.
- Oberoi, Z. *et al.* (2023) *Gamification in agriculture: A scoping study on opportunities and challenges*.
- Ostrom, E. (2014) “Do institutions for collective action evolve?,” *Journal of Bioeconomics*, 16(1), pp. 3–30. Available at: <https://doi.org/10.1007/s10818-013-9154-8>.
- Paani Foundation (2016) *Background*.
- Paani Foundation (2019) *PAANI FOUNDATION PROJECT REPORT*. Mumbai. Available at: <https://www.paanifoundation.in/wp-content/uploads/2021/01/Water-Cup-2019-Report.pdf> (Accessed: May 26, 2025).
- Palanisami, K., Suresh Kumar, D. and Wani, S.P. (2011) *Application of Econometric Methods for Assessing the Impact of Watershed Programs*. Available at: https://oar.icrisat.org/3561/1/Application_of_econometric_methods_for_assessing_the_impact_of_watershed_programs.pdf (Accessed: November 2, 2025).
- Pandey, R. *et al.* (2017) “Sustainable livelihood framework-based indicators for assessing climate change vulnerability and adaptation for Himalayan communities,” *Ecological Indicators*, 79, pp. 338–346. Available at: <https://doi.org/10.1016/J.ECOLIND.2017.03.047>.
- Pathak, P. *et al.* (2013) “Multiple Impact of Integrated Watershed Management in Low Rainfall Semi-Arid Region: A Case Study from Eastern Rajasthan, India,” *Journal of Water Resource and Protection*, 05(01), pp. 27–36. Available at: <https://doi.org/10.4236/jwarp.2013.51004>.
- Pender, J.L. and Kerr, J.M. (1998) “Determinants of farmers’ indigenous soil and water conservation investments in semi-arid India,” *Agricultural Economics*, (19), pp. 113–125.
- Polimeni, J.M. *et al.* (2012) “The jevons paradox and the myth of resource efficiency improvements,” *The Jevons Paradox and the Myth of Resource Efficiency Improvements*, pp. 1–184. Available at: <https://doi.org/10.4324/9781849773102>.
- Poteete, A., Janssen, M.A. and Ostrom, E. (2010) *Working Together, Collective Action, the Commons, and Multiple Methods in Practice*. Princeton University Press. Available at: <https://doi.org/doi:10.1515/9781400835157>.
- Pradhan, D. (2016) *Essays on Groundwater Management Strategies in Water-Scarce Agriculture: Case Studies from South India*.
- Ranjan, Ram. *et al.* (2017) *Climatic stress, structural change and farm and non-farm enterprise uptake by farmers in India and Bangladesh*. Australian Centre for International Agricultural Research.

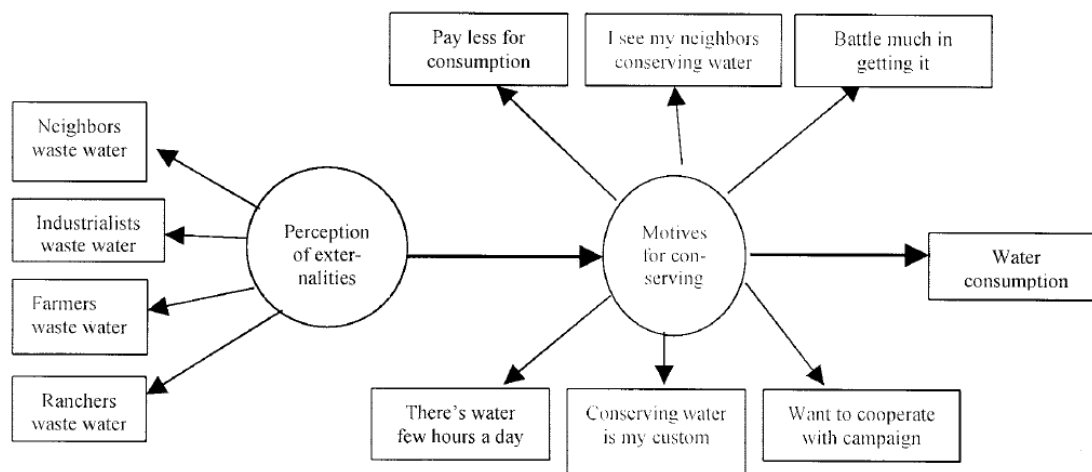
- Rao, C.H.H. (2000) “Watershed Development in India: Recent Experience and Emerging Issues,” *Economic & Political Weekly*, 35(45), pp. 3943–3947.
- Ratna Reddy, V., Saharawat, Y.S. and George, B. (2017) “Watershed management in South Asia: A synoptic review,” *Journal of Hydrology*. Elsevier B.V., pp. 4–13. Available at: <https://doi.org/10.1016/j.jhydrol.2017.05.043>.
- Reddy, A.A., Raju, S. and Bose, A. (2020) “Farmers’ Income, Indebtedness and Agrarian Distress in India,” *The Microfinance Review*, 12(1), pp. 20–38. Available at: <https://www.ssoar.info/ssoar/handle/document/87735> (Accessed: May 26, 2025).
- Reddy, R. v. and Soussan, J. (2004) “Assessing the Impacts of Watershed Development Programmes: A Sustainable Rural Livelihoods Framework,” *Indian Journal of Agricultural Economy*, 59(3).
- Roberts, R.M. *et al.* (2020) “Examining motivations influencing watershed partnership participation in the Intermountain Western United States,” *Environmental Science & Policy*, 107, pp. 114–122. Available at: <https://doi.org/10.1016/J.ENVSCI.2020.02.021>.
- Rothler, Y. *et al.* (2024) “Economic factors mediate the impact of drought on farmer suicides in India,” *Global Environmental Change*, 86. Available at: <https://doi.org/10.1016/j.gloenvcha.2024.102844>.
- Samuel, A. *et al.* (2009) *Watershed Development in Maharashtra: Present Scenario and Issues for Restructuring the Programme*.
- Schmitt-Beck, R. (2016) “Bandwagon Effect,” *Communication* [Preprint]. Available at: <https://doi.org/10.1093/OBO/9780199756841-0113>.
- Shah, S.H. *et al.* (2021) “A ‘Drought-Free’ Maharashtra? Politicising Water Conservation for Rain-Dependent Agriculture,” *Water Alternatives*, 14(2), pp. 573–596. Available at: www.water-alternatives.org (Accessed: November 13, 2025).
- Sharma, B.R. *et al.* (2005) “Watershed Management Challenges Improving Productivity, Resources and Livelihoods Watershed Management Challenges Improved Productivity, Resources and Livelihoods.” Available at: <http://www.iwmi.org> (Accessed: October 31, 2025).
- Sharma, K. (2019) *The Agrarian Distress in India- An Inter-Disciplinary Perspective*, JETIR1908C39 *Journal of Emerging Technologies and Innovative Research*. Available at: www.jetir.org.
- Shiferaw, B.A. *et al.* (2003) *Watershed Management and Farmer Conservation Investments in the Semi-Arid Tropics of India: Analysis of Determinants of Resource Use Decisions and Land Productivity Benefits*. Patancheru 502 324, Andhra Pradesh, India. Available at: www.icrisat.org (Accessed: November 3, 2025).

- Shigute, Z. (2019) “Community participation and the quality of rural infrastructure in Ethiopia.” Available at: <https://repub.eur.nl/pub/115725> (Accessed: May 25, 2025).
- Singh, C. (2018) “Is participatory watershed development building local adaptive capacity? Findings from a case study in Rajasthan, India,” *Environmental Development*, 25, pp. 43–58. Available at: <https://doi.org/10.1016/j.envdev.2017.11.004>.
- Singh, P., Behera, H.C. and Singh, A. (no date) *Impact and Effectiveness of “Watershed Development Programmes” in India*. Mussoorie.
- Singha, B. *et al.* (2022) “Water conservation behavior: Exploring the role of social, psychological, and behavioral determinants,” *Journal of Environmental Management*, 317, p. 115484. Available at: <https://doi.org/10.1016/J.JENVMAN.2022.115484>.
- Sreedevi, T. *et al.* (2008) *Impact of Watershed Development in the Low Rainfall Region of Maharashtra – A Case Study of Shekta Watershed*. Patancheru. Available at: https://oar.icrisat.org/2357/1/442_2008_GTAE49_imp_of_ws_dev_maha.pdf (Accessed: May 25, 2025).
- Srinidhi, A. (2024) *Advancing Climate Resilient Development for Semi-arid Farming Systems in India*.
- Srivastava, A. and Chinnasamy, P. (2024) “Watershed development interventions for rural water safety, security, and sustainability in semi-arid region of Western-India,” *Environment, Development and Sustainability*, 26(7), pp. 18231–18265. Available at: <https://doi.org/10.1007/s10668-023-03387-7>.
- Udmale, P. *et al.* (2014) “Farmers’ perception of drought impacts, local adaptation and administrative mitigation measures in Maharashtra State, India,” *International Journal of Disaster Risk Reduction*, 10(PA), pp. 250–269. Available at: <https://doi.org/10.1016/j.ijdrr.2014.09.011>.
- Ushes James, M. (2024) *Agrarian Distress in India: Causes, Consequences, and Policy Implications*, *International Journal for Research Trends and Innovation (www.ijrti.org)*. Available at: www.ijrti.org.
- Wani, S.P. *et al.* (2011) “Assessing the Environmental Benefits of Watershed Development: Evidence from the Indian Semi-Arid Tropics,” *Journal of Sustainable Watershed Science and Management*, 1(1), pp. 10–20. Available at: <https://doi.org/10.5147/jswsm.2011.0036>.
- World Bank (2012) *India: Issues and Priorities for Agriculture*. Available at: <https://www.worldbank.org/eur.idm.oclc.org/en/news/feature/2012/05/17/india-agriculture-issues-priorities> (Accessed: May 25, 2025).
- World Bank (2013) *How is India addressing its water needs?* Available at: <https://www.worldbank.org/en/country/india/brief/world-water-day-2022-how-india-is-addressing-its-water-needs> (Accessed: May 25, 2025).

World Bank (2014) *WATERSHED DEVELOPMENT IN INDIA An Approach Evolving through Experience.*

Appendix

Item 1: Figure: Hypothetical model of relations in perception, motives and water consumption



(Source: Corral-Verdugo et al., 2002)

Item 2: Table PFWC Competition Marksheet

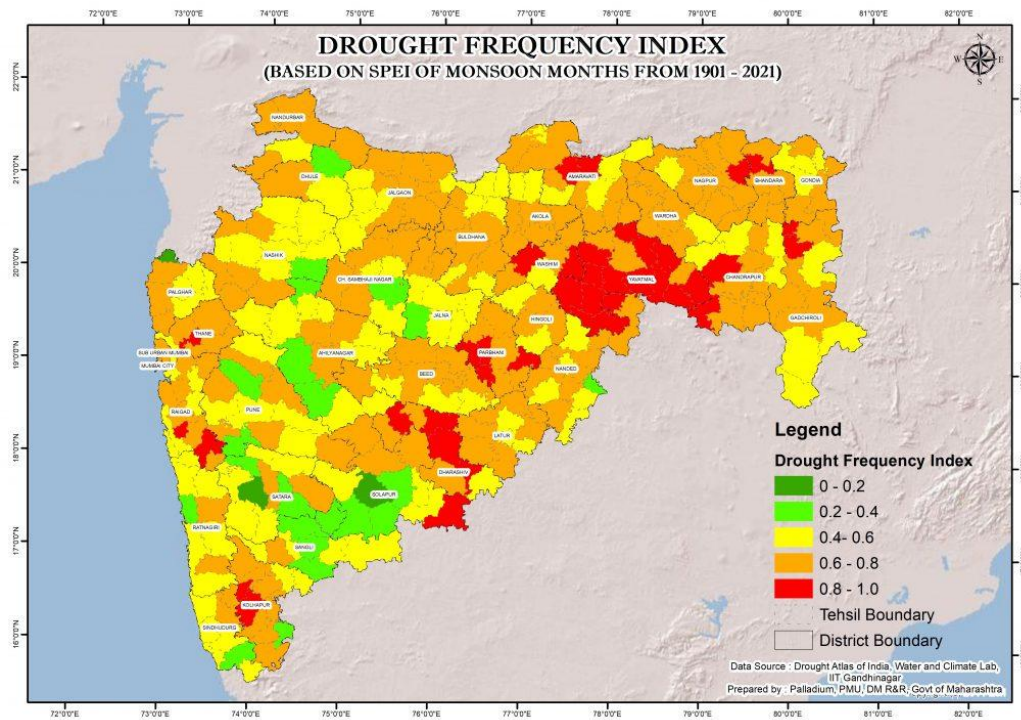
1	Wastewater Management	5
2	Conservation of Trees	5
3	Soil and Water Conservation Structures Built Through Shramdaan	25
4	Soil and Water Conservation Structures Built Using Machines	15
5	Adequate Weightage to Area Treatment and Ridge Line Work	10
6	Quality of Structures	10
7	Soil Testing	5
8	Farms Free of Crop Burning	5
9	Water Saving Techniques	5
10	Water Budgeting	10
11	Repair of Existing Structures/Innovative Initiatives	5

	TOTAL	100
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Item 3: Interview Questions

- o Summary of the work done under Paani Foundation Water Cup
- o Summary and existence of work under other NGOs
- o Why did you, as a village decide to participate in the competition? Who were interested in participating, was it difficult to motivate people, how did you motivate?
- o Who all/how many participated in the works for the competition? How many benefited from this competition?
- o What were the results of the participation according to you?
- o What is the situation currently, after 6 years.
- o Situation of the infrastructure
- o Who maintains it? Has it been people who were involved in the competition or even other people have? Is it a challenge to get people to participate in maintenance work.
- o Water scarcity has reduced? Is the situation due to the Paani foundation or due to more rainfall.
- o What is the agricultural situation? Has the productivity increased due to PF activities? Do you take more crops now?
- o Socio-economic conditions?
 - How has income changed? Has income increased due to these activities of the PF?
 - How has the debt levels and stress changed due to PF activities?
 - What about migration?
- o How was the overall experience? What did you like or what helped? What did you feel was not done right or could be improved?

Item 4: Map Drought Frequency index



(Source: SDMA, Government of Maharashtra) ³⁶

Item 5.1 Photo: PAR Activity

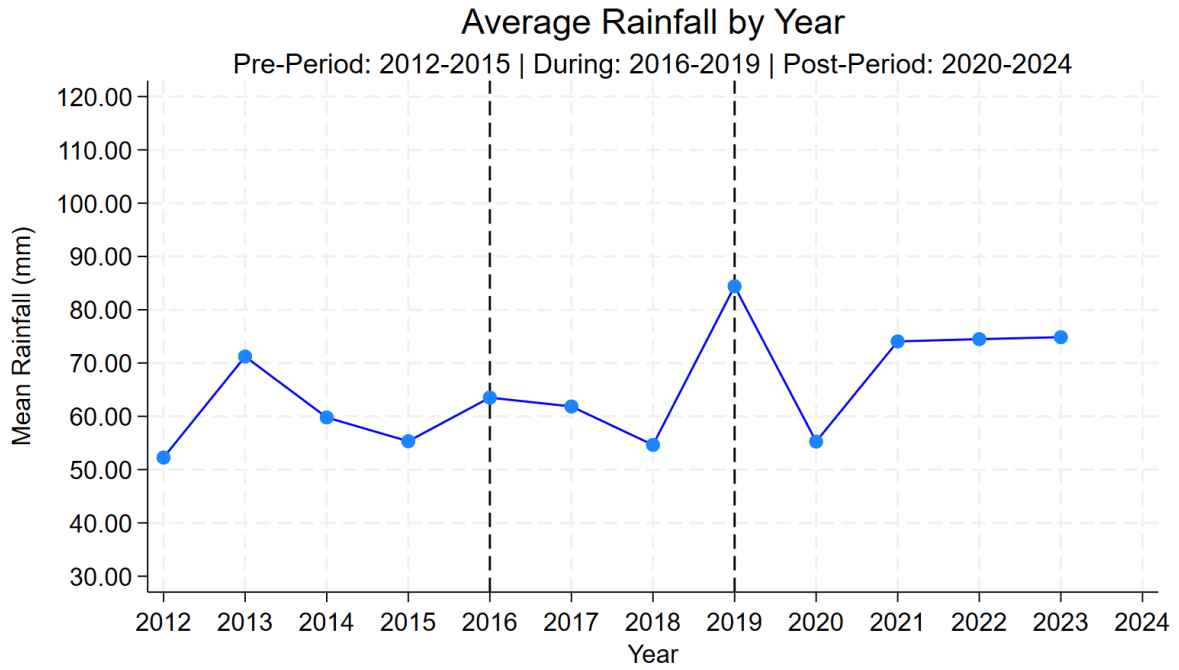
³⁶ [Hazard, Vulnerability, Risk Overview | Maharashtra State Disaster Management Authority | India](#)



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Item 6: Graph Average rainfall of year

³⁷ The images show AI-generated content due to the image editing software used to crop the photo. If needed, the physical material regarding the activity can be accessed from the author.



Item 7: Table of Mean rainfall throughout the year

Mean rainfall throughout the year

		Treatment_period			
		0	1	2	Total
participation_group = 0	Mean	59.64964	63.5057	70.2904	64.39931
	Standard deviation	78.16166	88.30027	98.09294	88.53327
participation_group = 1	Mean	57.85572	65.68469	75.23223	66.10245
	Standard deviation	80.95286	93.89685	102.4907	92.89613
participation_group = 2	Mean	60.05925	67.79353	68.52221	65.42309
	Standard deviation	86.05928	99.73781	99.57347	95.35664
participation_group = 3	Mean	59.9866	69.16184	72.04062	67.23158
	Standard deviation	83.1695	96.07014	105.0707	95.32749
Mean		59.74213	65.6783	69.77286	65.01581

participation_group =	Standard				
total	deviation	82.14683	94.12438	99.1559	92.10288

Item 8: Tabulation of participation group according to drought frequency

participation_group	drought_frequency					
	1	2	3	4	5	Total
0	0	24	123	202	29	378
1	0	2	14	21	8	45
2	4	33	110	187	42	376
3	0	1	2	8	3	14
Total	4	60	249	418	82	813

Item 9: Table of filled percent of water by participation group in each treatment period

Filled percent of water by participation group in each treatment period

		Treatment_period			
		0	1	2	Total
participation_group = 0	Mean	45.44738	44.29243	55.80754	48.29013
	Standard deviation	25.2203	28.2676	24.64736	26.59651
participation_group = 1	Mean	43.96387	40.85012	53.75723	46.06843
	Standard deviation	24.6671	27.93815	23.99526	26.13137
participation_group = 2	Mean	45.9811	45.08189	55.41866	48.71754
	Standard deviation	25.98173	27.84309	24.63441	26.59428
participation_group = 3	Mean	39.45377	41.58504	49.37417	43.22667
	Standard deviation	24.90952	28.35347	27.85118	27.30287

participation_group	=	Mean	45.50407	44.41348	55.40189	48.27438
total		Standard deviation	25.54987	28.07331	24.67594	26.59609

Item 10 : Regression Results

OLS Regression model

OLS Regression Iterations						
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	OLS without controls	OLS with controls	Controlling for JYS and both	Pure post comparison	pre Purest: w/o during and Only Control	Only Control and PFWC (w/during)
participate_PFWC	-2.653 (2.185)	-2.742 (2.149)	-2.714 (2.214)	-2.045 (2.385)	-2.048 (2.379)	-2.728 (2.205)
PFWC_treat_post	0.911 (1.458)	0.444 (1.476)	0.179 (1.533)	-0.392 (1.692)	-0.477 (1.698)	0.113 (1.537)
participate_JYS			0.185 (1.090)	-0.143 (1.240)		
participate_both			-3.482 (3.053)	-3.713 (4.044)		
JYS_treat_post			-0.422 (0.793)	-0.130 (0.998)		
both_treat_post			-3.171 (2.393)	-2.905 (3.678)		
post	10.38*** (0.391)	6.037*** (0.635)	6.306*** (0.747)	6.655*** (0.820)	4.969*** (0.884)	4.474*** (0.871)
rainfall		0.0947*** (0.00203)	0.0947*** (0.00203)	0.0745*** (0.00226)	0.0912*** (0.00287)	0.110*** (0.00253)
2013.year		-0.414 (0.466)	-0.408 (0.465)	-0.0271 (0.458)	-1.340** (0.600)	-1.714*** (0.604)
2014.year		2.370*** (0.525)	2.379*** (0.524)	2.530*** (0.522)	2.274*** (0.658)	2.212*** (0.660)

2015.year	-2.157***	-2.147***	-2.090***	-4.717***	-4.764***
	(0.625)	(0.624)	(0.622)	(0.835)	(0.836)
2016.year	-1.746***	-1.728***			-3.890***
	(0.537)	(0.535)			(0.701)
2017.year	4.773***	4.789***			4.458***
	(0.648)	(0.646)			(0.910)
2018.year	-0.885	-0.869			-1.980**
	(0.605)	(0.603)			(0.827)
2019.year	-11.05***	-11.04***			-13.41***
	(0.616)	(0.616)			(0.835)
2020.year	3.202***	3.208***	2.811***	3.953***	4.403***
	(0.439)	(0.439)	(0.431)	(0.585)	(0.590)
2021.year	2.858***	2.868***	2.852***	3.609***	3.575***
	(0.364)	(0.363)	(0.357)	(0.467)	(0.473)
2022.year	4.113***	4.123***	4.116***	4.118***	4.090***
	(0.295)	(0.294)	(0.287)	(0.371)	(0.375)
2023o.year	-	-	-	-	-
Constant	45.12***	40.38***	40.34***	41.52***	41.56***
	(0.539)	(0.716)	(0.879)	(0.942)	(0.981)
Observations	31,579	30,763	30,763	20,314	10,526
R-squared	0.034	0.153	0.154	0.109	0.145

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Fixed Effects Difference in Differences model

XTREG iterations						
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	FE without controls	FE with controls	FE controlling for JYS and both	Pure post comparison	pre Purest: w/o during and Only Control	Only Control and PFWC (w/during)
o.participate_PFWC	-	-	-	-	-	-
PFWC_treat_post	0.706 (1.309)	0.0313 (1.322)	-0.472 (1.374)	-1.339 (1.516)	-1.426 (1.522)	-0.543 (1.378)
o.participate_JYS			-	-		
o.participate_both			-	-		
JYS_treat_post			-0.927 (0.748)	-0.591 (0.965)		
both_treat_post			-2.504 (2.445)	-1.700 (3.631)		
post	10.46*** (0.366)	6.410*** (0.602)	6.914*** (0.698)	7.000*** (0.780)	5.307*** (0.840)	5.241*** (0.814)
rainfall		0.0923*** (0.00203)	0.0923*** (0.00203)	0.0719*** (0.00224)	0.0894*** (0.00275)	0.108*** (0.00248)
2013.year		-0.372 (0.455)	-0.367 (0.455)	-0.0230 (0.446)	-1.319** (0.586)	-1.612*** (0.592)
2014.year		2.423*** (0.516)	2.423*** (0.516)	2.531*** (0.515)	2.273*** (0.649)	2.283*** (0.649)
2015.year		-2.144***	-2.139***	-2.061***	-4.594***	-4.653***

		(0.620)	(0.619)	(0.618)	(0.828)	(0.828)
2016.year		-1.319**	-1.314**			-3.327***
		(0.515)	(0.515)			(0.667)
2017.year		5.014***	5.020***			4.996***
		(0.616)	(0.616)			(0.854)
2018.year		-0.466	-0.457			-1.265
		(0.574)	(0.573)			(0.774)
2019.year		-10.53***	-10.52***			-12.63***
		(0.593)	(0.593)			(0.798)
2020.year		3.456***	3.460***	3.117***	4.267***	4.643***
		(0.426)	(0.426)	(0.417)	(0.575)	(0.583)
2021.year		3.122***	3.130***	3.181***	3.904***	3.785***
		(0.348)	(0.347)	(0.340)	(0.459)	(0.467)
2022.year		4.326***	4.330***	4.366***	4.388***	4.283***
		(0.281)	(0.280)	(0.274)	(0.363)	(0.366)
2023o.year		-	-	-	-	-
Constant	44.95***	40.06***	40.06***	41.28***	41.22***	39.96***
	(0.112)	(0.436)	(0.436)	(0.434)	(0.556)	(0.560)
Observations	31,579	30,763	30,763	20,314	10,526	16,033
R-squared	0.046	0.204	0.204	0.151	0.205	0.253
Number of siteid_c	813	813	813	813	423	423

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Fixed effects model with dependent variable as seasonal change in water level

XTREG With difference season 3 – season 1						
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	FE without controls	FE with controls	FE controlling for JYS and both	Pure post comparison	pre Purest: w/o during and Only Control	Only Control and PFWC (w/during)
o.participate_PFWC	-	-	-	-	-	-
PFWC_treat_post	-4.397 (3.279)	-1.642 (2.479)	-6.372** (2.712)	-3.309 (3.218)	-1.729 (3.205)	-4.134 (2.731)
o.participate_JYS			-	-		
o.participate_both			-	-		
JYS_treat_post			-6.893*** (1.709)	-6.405*** (1.890)		
both_treat_post			1.663 (3.713)	1.187 (4.207)		
post	7.464*** (0.952)	7.304*** (2.074)	-1.395 (2.443)	-3.423 (2.532)	-14.87*** (3.493)	-13.20*** (3.540)
rainfall		0.140*** (0.0288)	-0.132*** (0.0286)	-0.160*** (0.0304)	-0.168*** (0.0557)	-0.114** (0.0566)
2013.year		21.60*** (1.249)	21.65*** (1.251)	21.84*** (1.266)	18.44*** (1.770)	17.91*** (1.717)
2014.year		-9.838*** (1.424)	-9.685*** (1.432)	-9.999*** (1.411)	-15.18*** (2.094)	-14.43*** (2.180)

2015.year	-	-8.465***	-8.723***	-14.35***	-13.89***	
	8.725***					
	(1.499)	(1.503)	(1.498)	(2.272)	(2.310)	
2016.year	30.50***	30.57***			30.20***	
	(1.202)	(1.204)			(1.599)	
2017.year	10.28***	10.36***			7.440***	
	(1.480)	(1.479)			(2.013)	
2018.year	-	-17.19***			-20.81***	
	17.59***					
	(1.696)	(1.705)			(2.592)	
2019.year	9.713***	8.493**			8.696	
	(3.503)	(3.508)			(7.880)	
2020.year	29.27***	26.73***	28.52***	36.84***	35.48***	
	(2.257)	(2.280)	(2.432)	(3.823)	(3.824)	
2021.year	19.23***	18.46***	19.79***	27.66***	25.99***	
	(1.987)	(2.003)	(2.019)	(3.474)	(3.489)	
2022.year	22.52***	21.84***	23.09***	29.87***	27.62***	
	(2.046)	(2.045)	(2.119)	(3.562)	(3.605)	
2023o.year	-	-	-	-	-	
Constant	34.62***	35.55***	35.10***	36.16***	40.24***	38.67***
	(0.233)	(1.410)	(1.411)	(1.413)	(2.450)	(2.629)
Observations	4,478	4,274	4,274	3,060	1,426	2,092
R-squared	0.016	0.397	0.400	0.350	0.421	0.468
Number of siteid_c	805	805	805	805	419	419

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Item 11: Count of Village at Taluka level

Count of Village at Taluka level					
Row Labels	Both	JYS only	None	PFWC only	Grand Total
Ahmednagar	1	14			15
JAMKHED		4			4
KARJAT		3			3
NAGAR		2			2
PARNER	1				1
PATHARDI		2			2
RAHURI		2			2
SHEVGAON		1			1
Akola	1	10	21	1	33
AKOLA		1			1
AKOT		2	10		12
BALAPUR		2			2
BARSHITAKLI		4	4	1	9
MURTIJAPUR		1			1
PATUR	1				1
TELHARA			7		7
Amravati		13			13
AMRAVATI		1			1
BHATKULI		2			2
CHANDURBAZAR		1			1
CHIKHALDARA		3			3
DHARNI		1			1
MORSHI		3			3
WARUD		2			2

Aurangabad	2	19	28	2	51
AURANGABAD		3			3
FULAMBARI			11	2	13
KANNAD		3			3
KHULDABAD	2		3		5
PAITHAN		1			1
SILLOD		5			5
SOEGAON		5			5
VAIJAPUR		2	14		16
Beed			62	2	64
AMBEJOGAI			10		10
ASHTI			21		21
BEED			15		15
DHARUR			2		2
KAIJ			5	1	6
PARLI			9	1	10
Bhandara		4			4
BHANDARA		1			1
MOHADI		1			1
PAUNI		1			1
TUMSAR		1			1
Buldana		22			22
CHIKHLI		4			4
KHAMGAON		5			5
LONAR		4			4
MALKAPUR		2			2
MOTALA		1			1
NANDURA		2			2
SHEGAON		4			4

Chandrapur		9			9
CHANDRAPUR		1			1
CHIMUR		2			2
GONDPIPRI		1			1
MUL		1			1
RAJURA		1			1
SINDEWAHI		1			1
WARORA		2			2
Dhule		14	49	2	65
DHULE		7	25	1	33
SAKRI		2			2
SHINDKHEDE			24	1	25
SHIRPUR		5			5
Gadchiroli		4			4
ARMORI		1			1
DHANORA		2			2
GADCHIROLI		1			1
Hingoli		5	6	2	13
HINGOLI		2			2
KALAMNURI		1	6	2	9
SENGAON		2			2
Jalgaon		17	59	4	80
AMALNER		1	10	1	12
BHADGAON		2			2
CHALISGAON		2	18		20
CHOPDA		1			1
DHARANGAON		2			2
JALGAON		2			2
JAMNER		1	22	1	24

PACHORA		1			1
PAROLA		5	9	2	16
Jalna		12	13		25
AMBAD		2			2
BADNAPUR		1			1
BHOKARDAN		3			3
JAFFERABAD			13		13
JALNA		3			3
MANTHA		1			1
PARTUR		2			2
Kolhapur		2			2
PANHALA		1			1
SHIROL		1			1
Latur	1	15	33	3	52
AHMADPUR		2			2
AUSA		2	12	1	15
CHAKUR		3			3
DEONI			7	2	9
LATUR		3			3
NILANGA	1	2	14		17
RENAPUR		2			2
SHIRUR-ANANTPAL		1			1
Nagpur		7			7
KUHI		1			1
PARSEONI		3			3
RAMTEK		2			2
SAVNER		1			1
Nanded	1	16	11	1	29
ARDHAPUR		1			1

BHOKAR			6	1	7
BILOLI		3			3
DEGLUR		3			3
HADGAON		3			3
KANDHAR		2			2
KINWAT		1			1
LOHA	1		5		6
MUDKHED		1			1
MUKHED		2			2
Nandurbar	1	3	18		22
AKRANI		1			1
NANDURBAR			13		13
SHAHADE	1	2	5		8
Nashik		17	20		37
BAGLAN		3			3
CHANDVAD			5		5
DINDORI		1			1
MALEGAON		4			4
NANDGAON		2			2
SINNAR		2	15		17
SURGANA		2			2
TRIMBAKESHWAR		3			3
Osmanabad	3	20	38	2	63
BHUM	1		8		9
KALAMB	2		8	1	11
LOHARA		1			1
OSMANABAD		10	13	1	24
PARANDA		3	9		12
TULJAPUR		2			2

UMARGA		4			4
Parbhani		10	8		18
GANGAKHED			8		8
JINTUR		3			3
PARBHANI		3			3
PATHRI		1			1
PURNA		1			1
SONPETH		2			2
Pune		31		1	32
BARAMATI		3			3
DAUND		4			4
HAVELI		1			1
INDAPUR		6		1	7
JUNNAR		1			1
KHED		3			3
MAWAL		2			2
MULSHI		2			2
PURANDHAR		5			5
SHIRUR		4			4
Sangli		17		4	21
ATPADI		2		1	3
JAT		7		1	8
KAVATHE- MAHANKAL				2	2
KHANAPUR		3			3
MIRAJ		3			3
WALWA		2			2
Satara		13		2	15
KHATAV		7			7

KOREGAON		1			1
MAN		4		2	6
PHALTAN		1			1
Solapur		35		6	41
AKKALKOT		4			4
BARSHI		5		1	6
KARMALA		7		1	8
MADHA		5		2	7
MALSHIRAS		3			3
MOHOL		7			7
PANDHARPUR		4			4
SOLAPUR NORTH				2	2
Wardha	3	15	12	5	35
ARVI	2		5	5	12
ASHTI	1		7		8
DEOLI		1			1
HINGANGHAT		5			5
KARANJA		3			3
SAMUDRAPUR		1			1
SELOO		5			5
Washim	1	13		2	16
KARANJA	1	4		1	6
MALEGAON		1			1
MANGRULPIR		2		1	3
MANORA		2			2
RISOD		2			2
WASHIM		2			2
Yavatmal		19		6	25
ARNI		1			1

BABULGAON		2			2
DARWHA				1	1
DIGRAS		2			2
GHATANJI		4		1	5
KALAMB		2			2
MAREGAON		1			1
PUSAD		1			1
RALEGAON				2	2
UMARKHED		3		2	5
WANI		2			2
YAVATMAL		1			1
Grand Total	14	376	378		