







## Article

# Barriers in Participative Water Governance: A Critical Analysis of Community Development Approaches

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**Abstract:** Participatory approaches within development programs involving common-pool resources are intended to revive a community's role in managing these resources. Certainly, to ensure the successful and equitable use of such resources, community participation is essential. However, in many cases, attempts at applying a participatory approach often fail to genuinely engage all subgroups within a community due to assumptions of homogeneity and a lack of understanding of the deep socio-political divisions between people. As a result, development programs can be plagued by these pre-existing power relations, potentially resulting in tokenistic community participation and the continuation of elite capture of natural resources to the same extent or worse than before a development program has begun. This in turn can negatively impact good governance and the fair distribution of a common pool resource. This paper explores the use of participatory approaches in water projects, assessing to what degree power relationships impact water management programs. Using a qualitative approach, the paper identifies key challenges of participatory water governance through case studies from Turkey, India, and Sri Lanka, exploring: lack of social trust, elite capture of participatory processes, power heterogeneity and imbalances at the micro-level, and a lack of inclusive participation in decision-making. Based on the analysis of these case studies, this paper argues that it is essential for participatory development interventions to understand socio-political power relations within a community—an inherently complex and contested space. The so-called “exit strategy” of a community project play a key role to decide the project sustainability that grants the “community ownership” of the project. Such an understanding can bring about greater success in development interventions attempting to address water-related issues.

**Keywords:** social trust; community-based water management projects (CBWM); climate change; micro-political dynamics; common-pool resources; exit strategy; India; Turkey; Sri Lanka

## 1. Introduction

Active community participation has been a core principle in rural water resource management. Studies show how traditional water management systems actively manage and govern water resources with the inclusive engagement of local people [1–4]. Hereby,

the role of local elites belonging to the dominant social class, tribe, or caste can be observed in some traditional water management systems at the community level [5]. By recapturing social norms and traditions, the modern development process promotes the community-based or community-led participatory mechanism that grants decision-making powers, management, and rights to funds to communities [6].

Community-based water management projects (CBWM) are generally either externally funded and initiated or self-initiated with support from external funds [7]. The main aims of these CBWM are to increase people's inclusive participation in decision-making regarding their water resources and to strengthen capacities to coherently manage these resources [8]. From an economic perspective, CBWM are also based on price mechanisms, as the community takes over the responsibility for further management of the water resources, including operational, maintenance, and governance processes [7].

The demand-induced scarcity in dry zones may lead to socio-political conflicts within and across localities up to the transboundary scale [9,10]. The pressures on the surface and groundwater sources potentially result in water conflicts that circumvent the active community engagement in resource management and governance [11–13]). Thus, inclusive and active community participation in rural water management is necessary to avoid social conflicts, to alleviate economical disadvantages, and to sustain water resources [3,14]. However, intentions to be engaged in the community activities and, social trust between social groups and individuals are contravened by external and internal pressures in the environment, user-community, and governance attributes [15–17].

This research paper examines factors that act as barriers to the interaction among members participating in CBWM, and the level of tolerance for cooperative use of water resources at the local level. The case studies are generated from three countries, namely India, Sri Lanka, and Turkey. These cases are focusing on three scales, such as Rajasthan, India (regional-scale), dry zone, Sri Lanka (local-scale), and Turkey (national-scale).

The structure of this research paper is as follows: The next section provides a thorough literature analysis, identifying external and internal obstacles to community participation. Subsequently, a theoretical framework for the diagnostic analysis of community participation will be depicted. Section three outlines the methods applied, followed by section four presenting the case studies regions, and section five, which elaborates on results from the case research. Common themes and diverging results are briefly compared and discussed in the sixth section before the research paper concludes with a brief summary of the main arguments.

## 2. Literature Review and Theoretical Framework

### 2.1. Literature Review

#### 2.1.1. Typology of Participation

First of all, a definition of participation is called for. Participatory approaches aim to recuperate the declining role of community participation in international development programs [18,19]. Participation is identified as an inevitable denominator in development projects [20,21], natural resource management [22], and other local governance [23].

Yet, either as “citizens’ participation”, as “peoples’ participation”, or as “community participation”, participation is differently defined in accordance with diverging concepts and contextual conditions. Whether intentional or not, the concept of “citizen participation” at times contains notions of “exclusiveness” [24,25], since parts of the population in a certain geographical context may not be recognized as “citizens” when constitutions exclude refugees, non-documented migrants, or stateless people [26]. In this definition, “citizens’ participation” would be limited to the legal citizens of a county. In comparison, “people’s participation” and “community participation” represent more inclusive concepts. In practice and theoretical analyses, people’s participation and community participation are interchangeably used.

A key dimension of community participation is people’s direct involvement in the decision-making process and the development mechanism as stakeholders or shareholders.

In this perspective, community participation is based on a broader allocation of power and responsibility to communities, considered as part of processes of decentralisation or devolution [27–29]. Arnstein (1969) categorised different ways of citizens' involvement under citizen participation in reference to the degree of citizens' power. [30] Delegated power is a type of decentralisation of power and responsibility in the scope of citizens' participation. However, decentralisation without coordination results in the creation of a set of fragmented power blocks, weakening the expected performances of water governance [31].

Top-down sectoral-based water governance and management mechanisms diminish community participation. They also institutionalise the hierarchical policy implementation within a political culture [32]. Within the Integrated Water Resource Management (IWRM) paradigm, participation is identified as the key element for effective and efficient water management. Active participation in IWRM is reached when all stakeholders in the designated spatial scale contribute to the decision-making process and development processes [33]. In CBWM, active community participation is a key factor of the integration process [8]. However, internal and external obstacles have the potential to terminate or limit active community participation in community-based development projects [16]. If the essence of community engagement is not reflected in the management process, IWRM solely appears as an arena of knowledge elites and experts' dominance [34,35].

As Ahmad & Abu Talib [36] analyse, which activities are pursued in the program, who participates, and how people are involved are important operationalizing questions for clarifying the community participation mechanism in a development project. In most cases, people's real, active or sustainable participation in a community natural resource management as a common pool resource is not durable due to different internal and external factors [4,16,17]. In the following, the main barriers to community participation identified in the literature will be reviewed.

### 2.1.2. Power Heterogeneity

In development practices there has been a parallel move towards local 'participation' and 'empowerment.' However, the over-theorization of the local end underemphasizes both local inequalities and power relations [37] (Stokke and Mohan, 2000). Community participation in community-based water management is a part of decentralising government responsibilities and power for efficiency, equity, and responsiveness for the community demands as the direct beneficiaries [16] (Tantoh et al., 2019). Since being mainstreamed in the 1970s in international development, participatory approaches have been criticised as a form of political control and even a form of subjugation, resulting in unclear outcomes for community members who are never entirely in control of the participatory process [38] (Williams, 2004). Social stratifications based on class, caste [39], tribes, and gender [40] lead to the under-representation of subaltern groups [41] (Spivak, 2000) in decision-making bodies. This lack of representation is considered a key factor determining power relations between competing actors in local natural resource management [42,43].

Decentralisation of decision-making at the grassroots level may work against people's participation when allowing only the local elite's opinion [44]. If the participation mechanism does not address the pluralistic nature of society, the inclusive participation and concept of empowering people at the grassroots level does not function [42]. This adverse impact of participatory approaches is often due to inadequate attention to power and politics within the landscape of development interventions and has been seen to increase within technical approaches, leading to depoliticization of development [19,45].

The spaces of participation are not neutral [46]. V.S Saravanan et al. (2008) argue that the positions of actors in the water management process are configured by the intrinsic interests of water usage [34]. This may be defined by either historical, socioeconomic, or cultural factors. Some interests are more articulated than others. Peter P. Mollinga et al. (2007) [47] emphasise that some particular interests have considerably more political power than others, which allows them to manipulate water management or governance processes

in their favour. Thus, the functionality of each stakeholder depends on their position and interest that correlate with the social relation of power, not only the water realm but also the general social system. Carr et al. (2012) report that power dynamics among participants can contribute to low community involvement leading to project failure [8].

### 2.1.3. Exclusive Governance Tools in Community-Based Water Resource Management

As Botes and Van Rensburg (2000) [48] review, state-led community development programs may function as extension of government politics or ruling party politics that justify the hegemonic development agenda on the community level. The ascendancy of professionals in water resource management excludes the civic engagement of communities in water-related decision-making and policy implementation at the grassroots level [49]. Consequently, lack of cooperation with non-state actors, including communities, leads to a conflict of interests. On the other hand, trained experts act as agents or key stakeholders in this process and wish to share their views and approaches with the community. The community increasingly turns into a passive stakeholder, reduced to observer status in a tailored development program [48]. Such professional or experts' hegemony within community water management projects may occur not only within the sectoral-based water governance and management regime, but also in the IWRM regime as well [37]. The knowledge elites and experts hold or anchor the management tools and governance objectives in a CBWM within an IWRM regime. Based on Gramscian's viewpoint, this individual or group hegemonic power is exercised through different forms in material, discursive, or organisation levels [50] that deny or erase the value-based knowledge or practice-oriented local knowledge in water management [37].

Nature and level of peoples' participation within a given structure can vary considerably. Furthermore, representation mechanisms within a community participation program could practically lead to the dominance of a "selected" elite group in the community or locality, creating a paradox in the democratic process. In most cases, these objectives or deliverables are not in line with the aspirations of the community. From the critical institutionalism scholars' perspective, these barriers and obstacles in the community-based development projects, particularly natural resource management, could be a result of the interaction between formal and informal, traditional and modern arrangements, and the power relations between people, natural resource and society [51].

In community project management, a crucial factor is the so-called "exit strategy" or project sustainability strategies after the formal termination of direct partner involvement. In the scope of the project plan and as part of this "exit strategy", there should be a clear roadmap outlining how the community will take over the "community ownership" of the project. In this regard, "community ownership" describes a strong feeling of being in direct control of the project and resource management among the target community [51].

### 2.1.4. Climate Change as a Stress Factor Enhancing Intra-Community Competitiveness

Apart from user community attributes and governance attributes, the natural environment has a potential to impact people's participation. The consequences of climate change drastically restrain the access to land, water, fresh air, and other ecosystems that affect human survival [52]. Climate change is a visible factor in spatial scales such as global, regional, local, and temporal scales as well as synoptic timescale, seasonal timescale, decadal timescale, and century timescale [53]. The impact of climate change can be observed in different forms of land and water resources. Lack of surface water availability leads to elevated groundwater usage for agriculture and daily consumption, mainly municipal water supply [54–56].

Other socio-economic (e.g., social unrest, conflict) and demographic factors (e.g., population growth, urbanisation) increase climate change vulnerability in fragile and climate-sensitive areas, particularly areas prone to long-term droughts and flash inundations [57–59]. Schilling et al. [58] define water and land as critical resources sensitive to

climate shocks, therefore vulnerability to extreme weather and climate patterns create stress on the availability and accessibility of arable lands and water resources.

At the community level, the competition for sharing these resources essential to human survival is intensifying [60,61]. If the governance system does not adequately integrate the community in the form of participatory mechanism to ensure fair access to, and use of arable land and water resources, social conflicts are inevitable. Climate change-related social unrest can lead to resource-based intra- and inter-community conflicts, thus enhancing political volatility [62,63].

#### 2.1.5. Land Distribution Issues and Demographic Processes

Rapid population growth in some countries of the Global South has resulted in an increase in household size, which gave rise to changes in land distribution and to land fragmentation. Changing demographics have caused shifts in land ownership and distribution, particularly in the context of water governance, led to the decline in groundwater resources, often leading to conflicts [64]. The spatial and temporal variability of access to water, along with extreme events, has built up water over the last two to three decades [65]. Herein lies the reason why there is an urgent need for effective and efficient water governance, and regular review and amendment of policies, laws, and regulations are crucial to address water scarcity [66]. In this light, community-based natural resource management strategies have become the ‘darling of funding agencies’, stressing the importance of devolution of power to the local level.

#### 2.1.6. Diversified Local Natural Resource Ownership

The government, private sector, and communities tend to hold the legal and commercial responsibility for stewardship of natural resources across social, political, and ecological scales [67]. The debate over common pool resources (CPR) highlights the shifting of governance modes and property institutions among different stakeholders across spatial scales [68–70].

CPR is identified as an alternative to the single property ownership or the tenure system [71]. However, it has to be distinguished between “de facto” or “de jure” ownership, and non-commercial or commercial usage among the beneficiaries of CPR [71,72]. Legally CPR are often either owned either by the government or by the community [71]. Both kinds of ownership allow for general utilisation of the resource by the community within a regulated governance system, which could be either legal or customary [70].

Open-access natural resources, as another variety of common-pool resources, have “null” ownership [72] and are recognized as unregulated resources [73]. Thus, there is a high risk of fast depletion of open-access resources. Negative externalities, such as environmental pollution and negative market impacts for non-users or other users, could be a result of the exploitation of the resource [73]. Although open-access natural resources are free to access for all in principle, the inequality among users in practice arises from varied access to technologies, proximity, and socioeconomic power [74]. These dynamics create tensions among users under competitive behaviour [75]. Under this condition open-access natural resources may be converted into defined property ownership in the framework of CPR: A specific user community could claim ownership [75]. However, this conversion would likely not be accepted by other user-community groups or individuals [74,76]. In such a situation, conflicts among past and present beneficiaries or indirect users of these open-access natural resources are likely to increase. In this case, social trust or communal trust diminishes [68,77].

#### 2.1.7. Social Trust

Social trust is defined as a set of collective norms based on reliability, reciprocity, fairness, and even mutual assistance. It does not only extend to interpersonal relationships, but also to notions of trustworthiness in the functioning of society or community as a whole. In addition, there is evidence that high levels of individual or interpersonal trust within a



community may foster the preparedness to engage in collective action [78]. Social trust is important to collective action problems because it contributes to explanations why individuals feel inclined to cooperate instead of acting as rational egoists [79]. Accordingly, social trust in common-pool resource use plays a large role in mediating inter-user competition, enabling equity of resource use, sanctioning freeriding, and overall ensuring communal stability, thus enabling self-reinforcing virtuous cycles. Goetzmann [80] argues that social trust is the “emergent product of a complex system of property relations”, relating social norms back to the character of the resource system.

2.2. Theoretical Framework

Grounded on the literature review, a diagnostic analysis of people’s participation is proposed. Figure 1 illustrates the key impacting factors of community participation based on three groups of attributes, referring to environment, user-community, and governance [72,81,82]. This conceptual framework is supported by the following diagnostic queries which reflect the existing scholarships in community-based water management and community participation.

Using this conceptual framework, we ask in the spirit of diagnostic queries:

1. What are social factors that circumvent the interaction between members in community-based water governance?
2. Why do communities tend to disengage from community-based water management?
3. What is the level of tolerance for cooperative use of a natural resource?

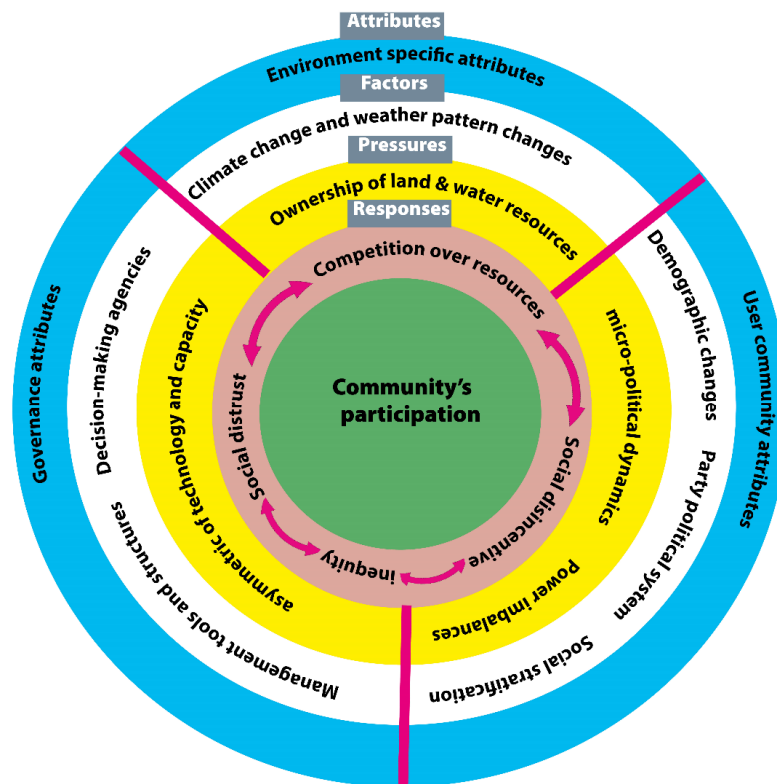


Figure 1. Conceptual framework for analyzing the impacting factors of the community participation.

Power heterogeneity, climate change impacts, land distribution issues, governance intrusion in the community water management program, and transition of common-pool resources into local ownership are the external and internal obstacles that negatively impact social responses in the participatory system [4,16,17].

### 3. Materials and Methods

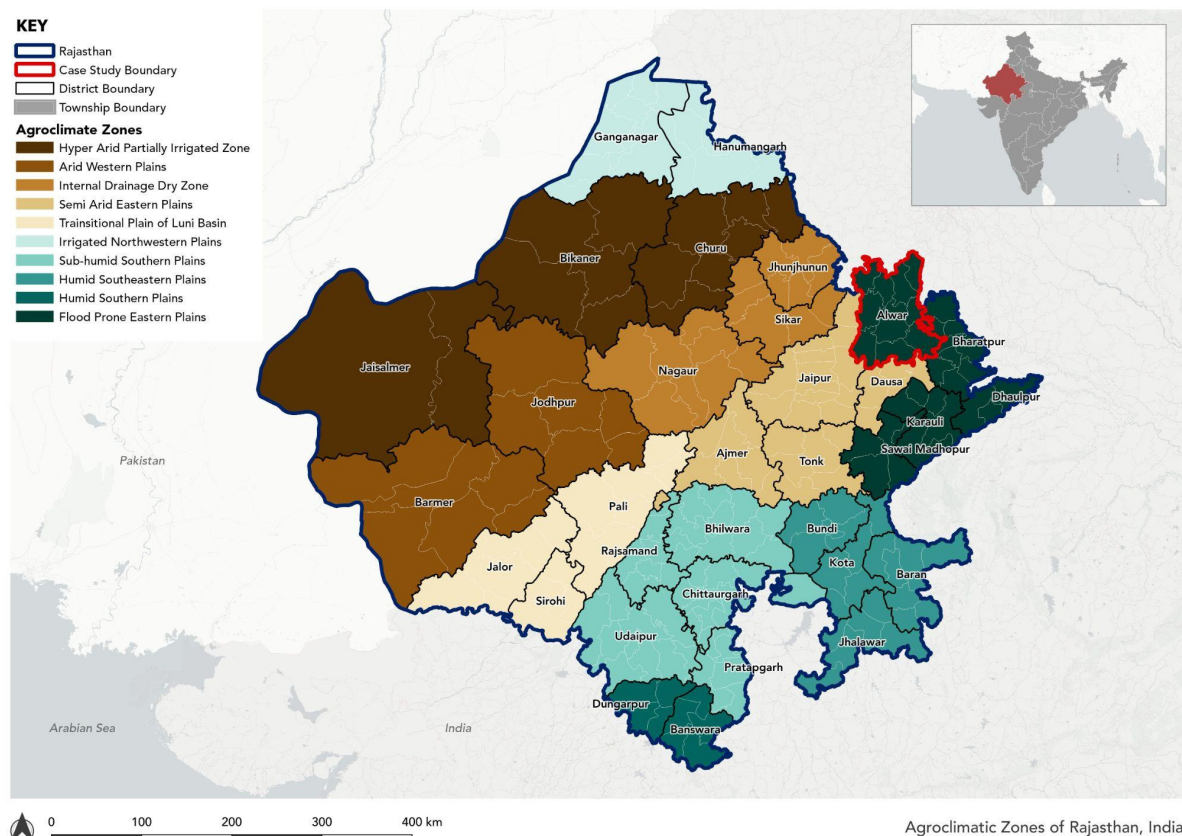
Based on qualitative methods, researchers focusing on the three case study regions conducted field studies, carried out interviews, as well as analyzed laws, regulations, agreements, and government policy documents. In the Rajasthan case study, the data collection for the study was gathered using a combination of desk-based research, document analysis, and field survey using in-depth interviews with community members undertaken remotely via skype and WhatsApp calls between August and October 2021. The Case studies in Sri Lanka are based on the field-based interviews with members of the local communities, and experts and officers in the administrative and technical institutes. A qualitative and normative methodology was adopted in analyzing Turkey case-study. Laws, bylaws and other official documents, such as reports, manuals were scrutinized to this end. Moreover, extensive consultations with the representatives of the water and irrigation bureaucracy were held. Furthermore, the authors' past positions at the water-based regional development agency, namely the Southeastern Anatolia Project (GAP in Turkish acronym) Regional Development Administration (RDA) (The GAP RDA strives to boost the benefits and mitigate the social and environmental impacts of water development projects, which are comprised of a number of large-scale dam and irrigation systems along the Turkish portion of the Euphrates-Tigris River basin.), gave them the unique opportunity to interact with both water technocrats and irrigation associations. The GAP RDA strives to boost the benefits and mitigate the social and environmental impacts of water development projects, which are comprised of a number of large-scale dam and irrigation systems along the Turkish portion of the Euphrates-Tigris River basin.

### 4. Case Study Research Regions

#### 4.1. Water scarcity in Rajasthan and the Socio-Political Factors Exacerbating the Problem

Rajasthan, India's largest state, is situated in the northwest of the country and is a dry and semi-arid region that frequently experiences drought and water scarcity (Figure 2). 75.10% of the population of 68.55 million reside in rural areas, their livelihoods are overwhelmingly dependent on agriculture [83]. However, although the state contains 5.5% of India's population and 10% of its livestock, it has only 1.15% of the country's water resources [84]. Furthermore, in recent years, rivers and other water sources have become increasingly dry, and droughts more prolonged. With low rainfall, increasing population, a rising average temperature, and accelerated desertification, the region is projected to slip further into water scarcity [84]. As a result, life becomes increasingly challenging particularly for farmers, forcing many to abandon traditional agricultural livelihoods practices and migrate to urban areas in search of labour. Alwar is geographically located in north-east Rajasthan between 27°4' to 28°4' N latitudes and between 76°7' to 77°13' E longitudes [85] and with an average temperature of 24.9 °C and annual precipitation of 672 mm or 26.5 inch. December is the driest month with 5 mm or 0.2 inch of rain while August receives the maximum rainfall [86].

While climate change has certainly played a role in Rajasthan's environmental changes, there are also numerous socio-political factors at play that are inhibiting effective water governance and exacerbating water shortages. Of these, central and state governmental factors are undoubtedly involved, however, local socio-political factors play a significant role but are often overlooked. While India is largely known for its caste stratification [88,89], other major factors often result in power imbalances and divisions within communities that can undermine effective local water governance and equity of water access. These factors include political affiliation, landholding status, access to political power, religion, gender, class, and wealth. How these factors play out and affect power dynamics in Rajasthan can vary dramatically from one region to another or even from one village to another.



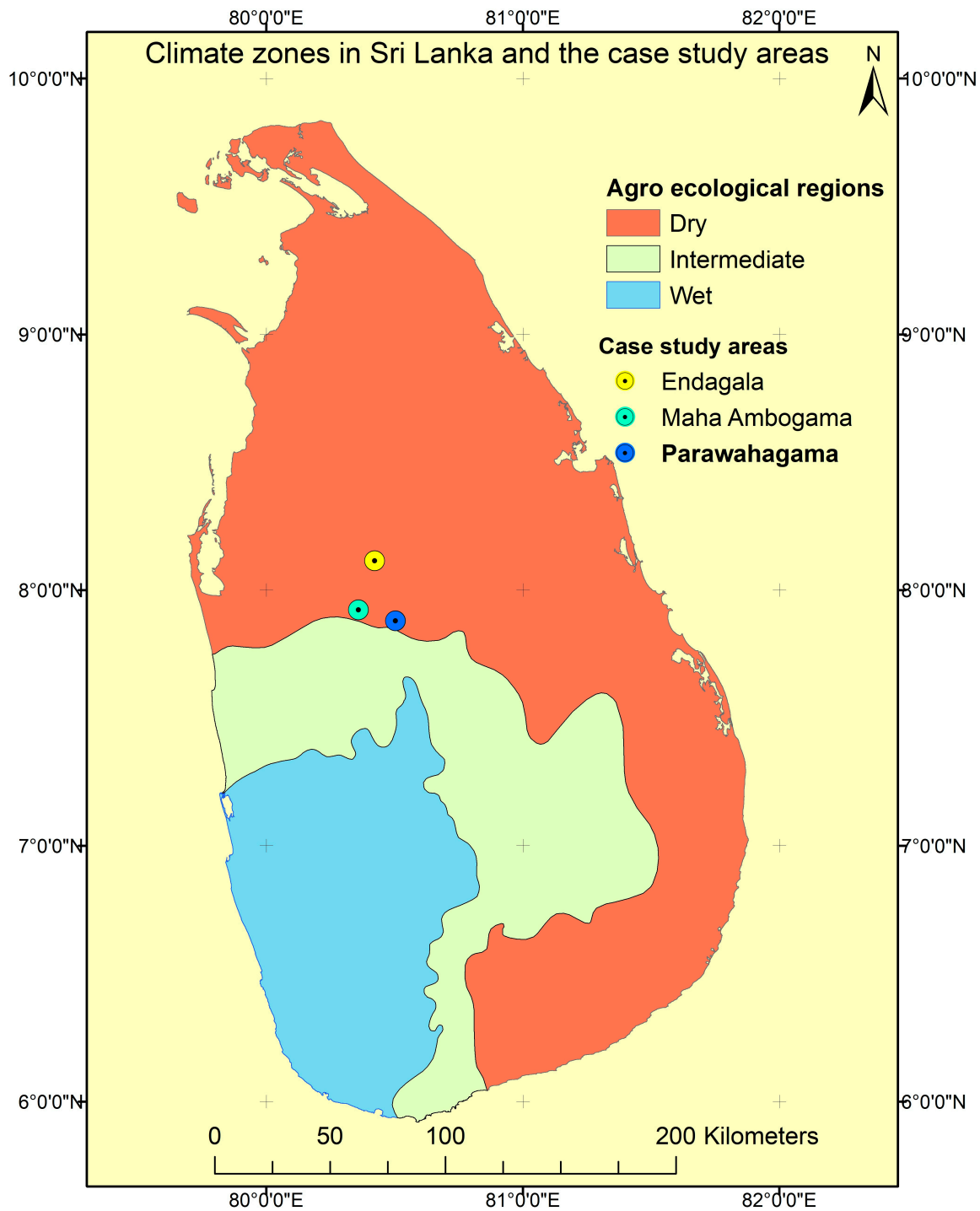
**Figure 2.** Climate Zones in India and the case study area (Authors' illustration based on the data from Department of Agriculture Government of Rajasthan) [87].

#### 4.2. Challenging Climate Conditions and Socio-Political Factors in Sri Lanka's Dry Zone

The projects which are the focus of the Sri Lankan case lie within the dry zone area of the country (Figure 3). The annual precipitation in the dry zone is between 1200 and 1900 mm [90] and the average temperature is about 33 °C [91]. The dry zone is recognized as the main part of the historical hydraulic civilization which was established around 250 B.C and existed till around 1100 A.D [92]. Based on archaeological data, Abeywardana, et al. [1] argue that the traditional water governance and management in the dry zone was founded on a community-based local system rather than on a centralised and bureaucratic system. After independence in 1947, state-oriented development programs have been focusing on new human settlements and reconstruction of ancient irrigation systems. Some of these development programs deliver mainly large-scale and multi-purpose water resource management programs, such as the Mahaweli Development Program (MDP). These are identified as highly bureaucratic and centralised water governance systems with less or limited community participation [92]. However, CBWMs were also established as a part of the rural development programs since independence. In the early 1960s to 1970s, these rural development programs were either organised as a field of development assistance or as an approach to fostering rural economy, driven by welfare-state principles [93,94]. After the 1980s, the rural development programs focused on poverty reduction and capacity-building at the village level. Urban and peri-urban communities were also included in the community pro-poor development programs administered by government-based institutes, non-government organizations, and civil associations during the last two decades. Some international donor agencies financed the rural water supply schemes and CBWM as a part of the global agenda with IWRM in the framework of the Millennium Development Goals (MDGs), or more recently, the Sustainable Development Goals (SDGs) [95,96]. The key objectives of CBWM are expanding towards more collaborative and cohesive rural



development, empowering communities with more hands-on water resources management, operation functionalities, and responsibilities on water infrastructures [95,97]. We examine four CBWM in the dry zone in Sri Lanka, namely Maha Ambogama Rural Water Supply Schemes, Endagala Community Water Project, Randiyawara rural water management project in Parawahagama, and Bamunakotuwa Water Project (Figure 3).



**Figure 3.** Climate Zones in Sri Lanka and the case study areas (Authors’ illustration).

Maha Ambogama Rural Water Supply Scheme was launched in 2010 by the Galgamuwa Local Council in the Kurunegala District, Northwestern Province. The key objective of this CBWM is to address the enduring drinking water issue due to the stagnant nature of

the groundwater in the region. Endagala Community Water Project in Anuradhapura District was implemented in 2011 as an Asian Development Bank project under the guidance of the central government. The focus of the project is to supply purified drinking water for villagers. The Randiyawara rural water management project in Parawahagama, Anuradhapura District was established in 2012. With the financial support from the Sithuwama Organization and the Government of Sri Lanka, this project addresses competing local demands on water resources, using primarily small rural tanks and spring water sources, under the impact of climate change.

#### *4.3. Challenging Climate Conditions and Socio-Political Factors in the Irrigation Management of Turkey*

Compared to the India and Sri Lanka case studies, the Turkish case mainly focuses on the national-level irrigation management transfer and the related socio-political issues. Devolution of irrigation management has been widespread in Turkey. Thus, an overall outlook attempts to provide relevant analysis on participative performances of the numerous irrigation management organizations established rapidly all around the country. The successive governments were quite content with the 'accelerated transfer process' in irrigation management back in the 1990s, whereas the World Bank had also pronounced Turkey a 'case of success.' Our analyses, on the other hand, aim at providing overall analysis through synthesis of local studies and expert opinions on the origins, evolution and implications of the devolution of irrigation management. The macro analysis approach adopted for this case complements other case studies with its focus on participative governance features of the irrigation management organizations.

Turkish agriculture depends heavily on climatic conditions. Precipitation figures exhibit great variance throughout the country. The average annual rainfall is 574 mm, ranging from 250 mm in the southeast to more than 3000 mm in the northeast Black Sea region [98], which is characterized by a mid-latitude temperate climate with a low-level drought probability and risk (Figure 4) The country's highlands feature a cold continental climate, whereas the lower-lying lands are classified as semi-arid and arid.

Water is a limiting factor for agriculture throughout much of the country. Irrigation has gradually been expanded over the past sixty years to the point where it now accounts for the largest allocation of water by sector at 74 percent [99]. The construction, management operation, and maintenance (O&M) of the large-scale irrigation systems in Turkey have been carried out by public sector institutions, namely the State Hydraulic Works (DSI in Turkish acronym). However, its Establishment Law (No. 6200, 1953) entitles the DSI to transfer O&M of irrigation systems to irrigation management organizations, such as village administrations, municipalities, cooperatives, irrigation associations, and other private legal entities. Within the framework of an accelerated program of irrigation management transfer, irrigation associations were established to operate and maintain almost all the irrigation systems in the country. Irrigation association (IA) was introduced as an innovative institutional mechanism formed to manage an irrigation scheme covering more than one local administrative unit, such as a village or municipality [100].

Since the early 1980s, the neoliberal transformation of the Turkish political economy has resulted in significant changes in water policy and management. The devolution of irrigation water management in the early 1990s serves as an illustration. Key background conditions leading to the irrigation management transfer included a national budgetary crisis that led to severe limitations on financial allocations to the DSI in general and to the O&M Department in particular and progressive deterioration of the irrigation infrastructure due to deferred maintenance [100]. Conditions at the national level combined with the motivation of the World Bank for the transfers became an important factor among those leading to transition in irrigation management. From the mid-1980s World Bank authorities had been pushing the Turkish Government to take measures to reduce operation, management, and investment costs of irrigation facilities [100].

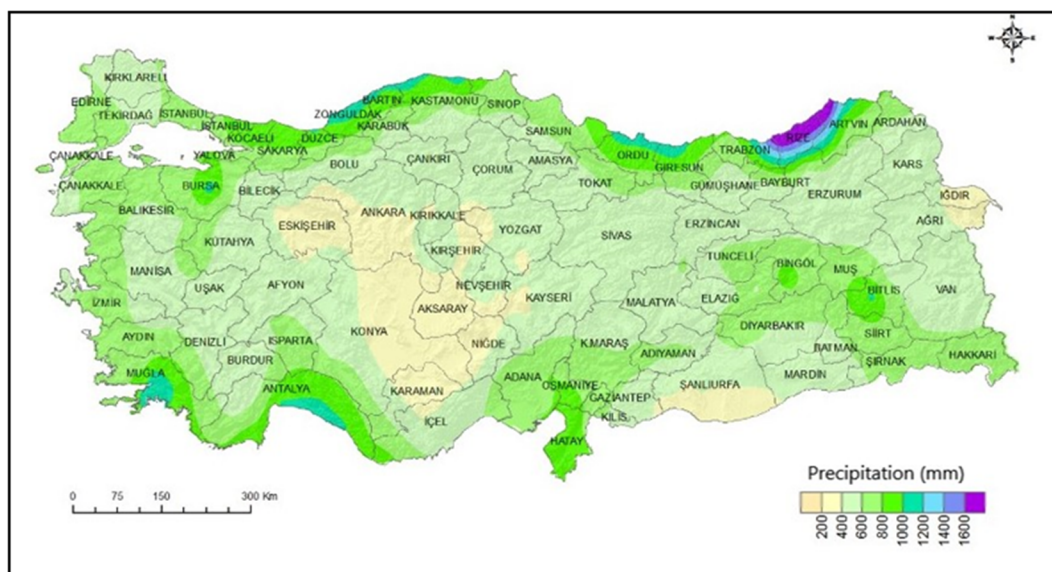


Figure 4. Annual Total Precipitation in Turkey (1981–2010) [101].

## 5. Results

### 5.1. Micro-Level Power Heterogeneity as User-Community Attributes

#### 5.1.1. Rajasthan, India

Research conducted for this paper revealed that power and decision-making processes within the community in Khejrigram (Khejrigram is a pseudonym for the village used in this case study to ensure the anonymity of the interviewees and the privacy of the village), a village of approximately 3000 people in Alwar, Rajasthan, were dominated by only a few families.

Results of the study found that local power was largely derived from landholding, resulting in intergenerational domination of decision-making, including decisions related to water management and access. While these families were traditionally from what is considered a low caste background—along with the entire village—their ownership of a significant amount of land resulted in greater social and economic status.

Regarding the social dynamics in the region, and how landowners manage to consolidate their powers, it is common practice for the dominant land-owning elite to consolidate their power through political marriages with elite families in other villages. Another approach used to achieve and consolidate power is through money lending and usury, where village elites often extend loans to farmers at the start of the season. When farmers are unable to pay back the principal amount with high rates of interest, they are forced to sell their cows and buffalos, and as a last resort, to sell their land. In this way, certain village elites have been known to take over the land resources of poor farmers, who are often uneducated and vulnerable. Access to land resources and water management issues are closely related, as landholding and water use rights are strongly interlinked.

The control over Khejrigram village resources by these large landholders have manifested in political power, with the families maintaining their position as the village sarpanch, or village head. As a result, a form of elite capture in the village has emerged, whereby these few families were able to dominate decisions related to the management of water resources, resulting in inequitable water management and access, as well as a lack of village-wide local ownership. For example, the dominant families within Khejrigram exercised control at community gatherings and influenced the allocation of funds for waterworks, including using their position to try and directly benefit themselves or pass on these benefits to others based on personal relationships. Though not the case for Khejrigram, it was further mentioned by the respondent that within the Alwar district of Rajasthan it is often upper caste members who are allowed to stand for the post of *sarpanch* and that people from

lower castes are not allowed to stand for elections, which marks another form of exclusion that perpetuates power relations across the region. The zamindar or landlord (village elite) may also act at times like the local strongmen, with political connections or patrons, and have a strong influence over the affairs of the village, at times threatening village members to act according to their wishes and to turn a blind eye to instances of corruption.

#### 5.1.2. Dry Zone, Sri Lanka

The active engagement or the willingness to cooperate in volunteer rural development community projects is hindered through the direct or indirect disruption between groups or individuals in the villages. One of the key factors for these divisions can be found in micro-level party politics. The micro-level diversity of political opinion, which is called political heterogeneity, is an inevitable part of democracy [102]. In contrast, the penetration of party politics into rural relations works as an obstacle for collective community participation in the observed three projects. Villager groups are identified in line with national political parties. In the case of Maha Ambogama Rural Water Supply Schemes and Endagala Community Water Project, the appointment of positions in the volunteer committee of the village organisations depends on the political allegiance with the contemporary national-level ruling party. However, there is no clear claim or encouragement of party politicians in such matters. Even though the appointment procedure always follows the vote among members, the candidatures for the election to the committee are generally entrenched in party politics. In the Endagala Community Water Project, funds for the management of the project in the second phase were not allocated by the provincial council when the opposition groups came to power, rivalling the political group that initially supported the project. Even within the same political parties, groups are created based on the different allegiances to local politicians. Although the village belongs to the same lineage, politically, they have different favouritism or attachments to the local politicians. In the Randiyawara rural water management project, one group was reluctant to join the other group throughout the implementation of water diverting actions.

The lack of trust and hierarchical social relations between generations in the villages turn into a barrier for active and inclusive community participation [103,104]. In the Maha Ambogama project, social and ideological divisions between the youth and adults can be observed. This division is due to the lack of confidence in the activities of the youth and the reluctance of some adults to accept new ideas, particularly from the youth, resulting in suspicion between the groups. In the Randiyawara water project, chairman, secretary, and treasurer as the top three officials are elected from traditional adult leaders of the village. This is a major challenge that has been observed when both groups work together and have also been identified as an obstacle for community participation, leading to the failure of effective governance in water projects. Most of the top officials of this community-based water project are represented by adults. Information obtained in field research reveals that most of the youth do not have the interest to join volunteer activities at the village level due to a lack of intention to work with the adult members, taking into account the strong hierarchical social system. This drives the internal migration of youths, who long to find jobs in cities.

The elitism and the caste system generate social hierarchies within a village that lead to social exclusions and minimise the community participation in rural democracy [41]. In all three water projects, the social elites in the village are always appointed to the main positions in the committee. These village elites are often formed by individuals who have been occupied in government services, mainly former village officers, former school principals, or people who worked for military or police service. These village members have the de-facto decision-making power in the projects and other members are acting as passive members. These structures and the resulting social exclusion are challenging the community voluntary participation for maintenance or small construction works of water distribution lines. There is less participation in common actions. Although the committee

members put blame on absent villagers, the hidden aversion to participation is founded in the continuous dominance of one selected elite group in the committee.

Micro-power behaviour interlinked to the socio-economic status of social class has a potential impact on the engagement with the resources-based community project at the village level [105]. The field studies in Maha Ambogama, Endagala, and Randiyawara projects show that direct or sole beneficiaries of the water projects are lower-income families, mainly those who receive the pro-poor grants (Samurdhi) (Samurdhi is a welfare program focused on poor people based on income with diverse actions such as the village banking system, the social group program, and participatory development programs). The economically middle-class villagers are reluctant to receive water from these projects because they have limited time to be an active part of the project. Thus, they prefer to buy purified bottled water from water purification companies. Bottled water is primarily used for drinking purposes and well-water for other household purposes. Even when a water purification system is to be installed within these community projects, there is still a high demand for purified bottled water. Under these circumstances, there is limited participation from some middle-class families for these water projects in these villages. Another claim for these middle-class villagers is that they do not have enough time for taking part in social activities in villages compared to earlier times.

### 5.1.3. Turkey

In the functioning of the IAs, a key problem has been identified in main decision-making bodies (council and assembly), where mayors and village heads are often widely regarded culturally and politically as being “natural” members of the council. This process has enabled municipal mayors and village heads to elect those close to them as council and assembly members for personal or political reasons [106]. However, such opportunities for “elite capture” became narrower after Law No. 6172, which stated that only water users could be assembly members. In Turkey, the accelerated transfer program progressed much faster than planned, and it took more than a decade to empower the IA with enabling legislation (Law No. 6172, 2011), which would lead them to establish an autonomous administrative structure. Moreover, prior to Law No. 6172, self-auditing mechanisms for the IA existed but they were not widely used. Law No. 6172 established an audit committee selected from among the councilors. However, the extent to which this committee can perform its duties depends on the power asymmetries in the local context, particularly in eastern and southeastern regions of the country where a large landownership and tribal social structure still dominate social and economic life.

Yet, in 2018, major amendments were made into Law 6172, which put the IA strictly back under the control of the government particularly in terms of decision-making bodies and procedures. The state authorities highlighted the cases of corruption in the administrative performance of associations particularly generated through illegal actions of chairs. With this amendment, the chair of the associations started to be appointed by the Minister from among the civil servants upon the suggestion of DSI. The assembly does not elect the chair anymore. Moreover, responsibility for the abolition of an IA is taken away from the IA assembly [107].

## 5.2. Non-Participative Lineaments in the Participatory Mechanism

### 5.2.1. Rajasthan, India

It was noted by a respondent from Khejrigram village that in the past the entire community had been more actively involved in community affairs, including decisions on the water. Life revolved around the water well and there were systems in place to manage this common resource, along with financial and labour contributions from all community members. However, the respondent noted that now there was no common system or thinking in place and the well had fallen into disrepair. They contend that a major factor that resulted in community breakdown was the decline in social trust caused by several reasons including divisions along the lines of economic class, education, and religion, as



well as competition between migrants and locals. Such divisions have resulted in scenarios similar to Khejrigram across the Alwar district.

#### Tarun Bharat Sangh: A Unique Approach to Community-Led Water Governance

Similar socio-political challenges as observed in Khejrigram which contribute to water-related issues were observed in the 1980s by Rajendra Singh (Rajendra Singh was awarded the 2015 edition of the prestigious Stockholm Water Prize for his pioneering work.), a water conservationist known as the 'waterman of India'. Singh realised that if local power dynamics were contributing to the cause of the problem, they could also be one of the solutions if understood and engaged appropriately. This realisation came after meeting a farmer in a village called Gopalpura in 1985 while Singh was attempting to help the village through medicine and education [108].—"We don't need medicine; we don't need education. We first need water," the farmer told Singh. He then went on to explain how the village used to conserve water and that he could teach Singh how to do it. Singh responded: "If you can teach me, why don't you do it yourselves?" The farmer explained how the village used to work together to do it themselves but had become divided due to elections and conflicting political affiliations. "They don't work together anymore, nor do they think about a common future," he said before highlighting that Singh had a unique opportunity to help the village as he didn't belong to anyone's side (108).

Singh took up the farmer's advice and through his organisation, Tarun Bharat Sangh (TBS), went on to launch a grassroots revival in the village, unifying and mobilising the community to manage their own resources as they had once done. This was achieved particularly through building traditional water harvesting structures called *johads*, which are semicircular earthen ponds that capture run-off from tiny streams and rivulets in a micro-catchment [108] mostly built along mountain slopes to store rainwater [109] along with other traditional water harvesting structures. Using local know-how, over 8600 earthen water harvesting structures were built in over 1086 villages between 1985 and 2007 across 6500 square kilometers in Alwar district alone [110,111] at strategic locations to recharge the underground aquifers, which in turn helped restore local river systems that had been waterless for a few decades.

To achieve the outcome described above, one of the methods applied by TBS is the use of grassroot level village council meetings where issues, including water management, are discussed and decisions are taken unanimously by the entire village community. This approach was used to prevent the formation of sub-groups and decision making occurring in secret. Another method applied by TBS is the use of existing social networks such as *yatras* (In Hindi Yatra means a procession or pilgrimage. TBS used such yatras to bring people together in local campaigns to spread awareness within and beyond the community.)—Three types of yatras were used 'Jal Bachao Johad Banao' (save water, practice water harvesting); the second was 'Gram Swavalamban' (village self-reliance); and the third was 'Ped Lagao Ped Bachao' (plant trees, save trees). In this way, TBS offers a unique approach to overcoming socio-political challenges through community-led leadership and governance of common water resources [108].

After the initial success in Gopalpura, Singh's TBS approach became part of a broader movement that has been instrumental in transforming water-scarce regions of Rajasthan into self-sufficient and water-rich communities. In the context of the above challenges outlined in the Khejrigram example, the work of TBS is particularly important in understanding how to frame a solution with an approach to water governance that involves galvanising the entire community to build sustainable and democratic institutions at the local level that are inclusive and participatory. Through such an approach, the TBS example demonstrates that through improved community participation and ownership, and by combating the socio-political divisions within communities, significant results can be achieved in water management, availability, and access for the benefit of both people and the environment.

### 5.2.2. Dry Zone, Sri Lanka

Technical complexities of the water management processes impact the reluctance for active community participation in the projects. In Maha Ambogama Rural Water Supply Schemes, the maintenance of the water diversion system and pipe system could not be correctly conducted by villagers due to their lack of technical know-how. After the launch of the project, there was little technical support and guidance from the technical experts of the local authorities. Edhagala Community Water Project is supervised by the local councils. The construction and environmental officers visit the site regularly. However, the issue is the absence of knowledge transfer and the resulting lack of capacity on the part of the users. In Randiyawara projects, villagers in the water association are unable to deal with the complex connections between different water sources for the water allocation and distribution process. Due to the failed or incorrect maintenance, silt removal is not properly and timely conducted. Villagers do not have enough technical knowledge to manage resources cooperatively. Three community water projects in Sri Lanka show that there is no capacity-building mechanism for villagers addressing drought mitigation or management. The funding agencies or the institutes that initiated the projects are unable to provide qualified facilitators or trainers.

In the Maha Ambogama project, the lack of financial stability also leads to operational and maintenance issues in water management. With the limited water fees from users, the association could buy only low-quality pipelines, pumps, and motors which decrease the durability of the operation system. To keep the proper maintenance of community water management projects, considerable financial capital investment and technical involvement are essential, according to the National Water Supply and Drainage Board of Sri Lanka (NWSDB 2008) [112]. Under the above-mentioned circumstances, water users as the community members of the water associations are reluctant to be active partners in the water project.

To be a member of the water association in these projects, an initial financial installment is required from villagers. Low-income families could pay their installments via day labor as compensation. However, some of the low-income families are still unable to become part of the community project as they do not have the basic infrastructure at their houses to get water.

The local-level winners and losers in water resource management are determined by the politics of the land [113]. The location of some houses in villages also influences participation. Due to long distances to resources, or hilly locations, water diversion through the pipeline is not technically possible. If this geospatial issue impacts their water supply, affected households are not willing to take part in user associations. The water supply for these places could not reach the required pressure from the pumping sources, particularly during the day when the demand is high. In addition, the villagers in the tail of the water distribution pipeline receive a limited amount of water that is not enough for their household consumption. One of the key issues is the high demand during the daytime that has inconsistencies of water supply and in most cases. Technically, it should be possible to store water during the night for use in the daytime.

The limited attention on the “exit strategy” can be identified as another issue concerning the CWBM pointing towards an ambiguous project future. The interview illustrates that the planning process does not follow a roadmap with the transfer of ownership to local communities, but rather officiating the locals for the water associations. Local reflect that they are still not integrated partner of the project and still do not own the water resource. The main claim is that they are heavily dependent on local government or the Nation Water Supply and Drainage Board.

### 5.2.3. Turkey

Irrigation associations in Turkey are not a product of any grassroots movement or organization but came largely from DSI staff as the major initiators and executors of the transfer program. Yet there were intensive negotiations between the DSI as the relevant

agency and the local communities, particularly the representatives from the local governments concerning the terms of transfer (Kibaroglu, Baskan and Alp, 2009) [100]. The outcomes of irrigation management decentralization, particularly in terms of participatory performances of irrigation associations, display mixed results. Even though a whole-of-Turkey study on the participatory performance of IAs is still lacking, the researchers, who have conducted field studies in different parts of Turkey have provided useful findings on participation and social trust in irrigation management. In this context, Harris [114] claims that state agencies in Turkey had high expectations from the IAs, which were expected to increase efficiency, to promote the sustainability of irrigation resources, and to establish horizontal networks. However, there are divergences in farmer satisfaction from the services they receive from the IA [107]. Irrigation associations were unable to implement participatory irrigation O&M in some local contexts characterized by power asymmetries. In such settings, the associations are sometimes captured by powerful and large landowners, who can use the association's resources for their own benefit. In other contexts, though, local participatory management of irrigation enabled a more efficient co-management of irrigation, especially at times of drought. The state agency (DSI) and the associations were able to devise new payment mechanisms to reduce the amount of irrigation without endangering the crops [107].

### 5.3. *Delineating Commons in the Community—Land Distribution and Climate Changes as Environmental Attributes*

#### 5.3.1. Rajasthan, India

##### MGNREGA—A Government Scheme to Strengthen Localized Approaches

Approaches that empower local people to revive their traditional water systems, such as the approach used by TBS, could be complemented by an Indian government scheme called the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). The Act initially came into force in India in 2006 and was expanded to cover all rural districts in the country in 2008 [115]. MGNREGA legally sanctions a guarantee of 100 days of employment every year for manual labour at a notified rate to all rural households of India [116]. The Act was introduced with the aim of ensuring a better quality of life and improving the income and social well-being of the rural population of India. It provides a legally-backed guarantee for any rural adult to get work within 15 days of requesting it [117]. Through this government employment, MGNREGA has the potential to be used by local communities and grassroots organisations to mobilise local people to address local water-related challenges at the same time as addressing the lack of rural livelihood opportunities. For example, TBS's approach of encouraging the local community to build and restore their traditional johads, which helped to revise their local water systems, could use the MGNREGA scheme to compensate community members involved and encourage even greater participation.

#### 5.3.2. Dry Zone, Sri Lanka

The sense of commonality in the community is challenged by competitive and contested natural resource usages that negatively affect community participation. With the generational expansion, the third and the fourth generation of farmers settled in the dry zone areas own only small plots in farmlands, as well as house yards. Thus, competition over resources, mainly land and water, can be observed. Farmers are accustomed to having rainwater for agricultural purposes generally, but under extreme weather patterns and severe climate change, this is not a stable water source. The field study in Maha Ambogama and Endagala GS divisions shows that farmers tend to use water from community water projects for agricultural purposes, particularly, for home gardening. This water using behavior increases water demands dramatically. The field information from three projects reveals that the trust between farmers is fading, which sometimes causes latent social conflicts over water sharing.

There is no general agreement or commitment among water users to define the water usage of other water sources in the villages. The social trust is the key element that build the social web and cooperation. In the same area in the Randiyawara rural water management project in Parawahagama, Anuradhapura District, we observe the latent conflict among water users about sharing water sources. Villagers from Parawahagama and Manamperiyagama have been sharing the Manamperiyagama anicut or *amuna* (Anicut or *amuna* is the traditional irrigation system that diverts the tributaries to the paddy fields.) for their agricultural purposes. Not only farmers but also a part of the community in the adjacent village plucked water lilies for selling in Mihintalaya and Anuradhapuraya. These community businesses have a 30-year history with a strong supply chain. However, the anicut came under the de-facto administrative regulation of farmer associations of the village, and plucking flowers was forbidden. Farmer associations set up a few boards by declaring the warning to plucking flowers in the anicut. Flowers picking being a traditional occupation in the village community, villagers questioned this arbitrary decision by the farmer association over these common water sources. The counter-argument from the farmer association is that the flower pickers harmed the anicut and had a negative impact on the water quality. This argument is denied by flower pickers. Under those circumstances, the shifting of ownership of a common water resource in the village created social tensions.

With the climate change impacts, farmers explain that they cannot get uninterrupted water supply from either water tanks or water channels. Consequently, they shift to extracting water from groundwater wells. In most cases, each farmland has or has private water well. The village water projects could not agree on the water extraction principles or common code of conduct among farmers who are members of the association. Excessive pumping of groundwater has already led to lowering the groundwater table and drying up some wells, as experienced by some farmers. Another issue is that overpumping leads to a decline of surface water supply and directly affects the common water-well or channel as the main water source for the drinking water project. These issues cause tense situations in meetings among user communities, and as a result, some farmers avoid participating in the water association.

### 5.3.3. Turkey

Most of the review studies on the transfer program emphasize that IAs have helped to overcome some of the problems such as the low collection rates of irrigation fees, maintaining the secondary and tertiary canals, and operation of the irrigation network. DSI paid all operation and management expenses before transfer but only about 15 percent afterward, so the transfer succeeded in reducing the government economic burden. However, increasing water use efficiency remains a challenge. Both government and independent research studies demonstrate that irrigation efficiency has not improved and stagnated around a low 40 percent in irrigated areas managed by the IAs, about the same as before the transfer [107,118]. Moreover, climate change impacts including decreasing water resources, as well as an increase of frequency and severity of extreme climatic events like droughts have become prevalent in irrigation areas. Many key adaptation measures that would increase the climate resilience of water-dependent sectors fall within the domain of sustainable water management including management methods and technologies for using water more efficiently, which largely lack in the current management of the irrigation systems by the IAs.

## 6. Discussion

Promoting decentralized models that encourage local ownership through 'water user associations, community control and transferring resource management to local users is hailed as a viable option. In particular, these models are capable to reduce subsidies and enable cost recovery in the case of failing state-led resource management due to poor performance or fiscal failure, thereby alleviating the financial burden of the state [119]. With the government involvement or initiatives from NGOs or IGOs, CBWMs turn into

an important tool for integrating villagers into governance and management of their own water resources. While most of the projects featured in the case studies aim to create a sustainable project cycle of these initiatives, we observe different dynamics in the community participation throughout Rajasthan, Turkey, and Sri Lanka's dry zone. The degree of community participation in CBWM depends on the internal and external factors of the governance and management process of the project.

Power imbalances and micro-scale heterogeneity within the community and localities alter social concordances and trust. External political party pressures and the bonds towards the national or regional level political alliances configure the power structures within the rural communities. The case studies in Sri Lanka illustrate how political party interests penetrate local social relations in a negative way. The fragmentation within the community directly impacts the functionalities and the unity of the CBWM. The case studies from India and Sri Lanka show the extent of influence from social hierarchies, including caste and class-oriented stratification, within the CBWM. In Turkey, the power transition in the irrigation association councils to ruling elite (i.e., village heads or mayors) and the economically powerful families through land ownership resulted in them taking control of the irrigation associations.

Asymmetric access to technologies and the lack of capacity-development at the community level are key factors which define a community's active engagement in water management. All cases in this study demonstrate that the lack of financial capabilities in the community renders the community activities dysfunctional or creates a threat to the durability of the projects. In Turkey, State Hydraulic Works has transferred a large number of irrigation schemes to irrigation associations because of their poor performance in O&M and to increase cost recovery of the expanding irrigation systems. However, successive governments have developed negative opinions about the administrative and technical performances of the irrigation associations by highlighting the cases of corruption and systemic inefficiencies (low-level irrigation ratios; excess water use, etc.). Thus, the government recently introduced a major change in the law of the irrigation associations, which puts them under close government control, particularly by appointing the chairs of the irrigation associations from among civil servants working at various public institutions. Researchers, on the other hand, underlined the poor performance of irrigation associations in participatory irrigation water management. Various case studies have also demonstrated that farmers have had persistent complaints about inequities in irrigation associations' administrative and technical (i.e., water distribution) functioning. Essentially, the Turkish case of irrigation management devolution demonstrates that building social trust and consensus among major stakeholders becomes an absolute necessity for any reform to make a positive impact on equity and efficiency in irrigation management.

In the research areas, the main occupation in the communities is agriculture, which means that they face increasing demand for water and this, in turn, impacts the ground-water availability in these regions negatively. In Sri Lanka's dry zone, the main challenge to the sharing of water sources in the community was observed as inequitable land distribution and land fragmentation due to the limited availability of land. Rather than having cooperative actions in the community for these scarce water sources (river, water tank, and groundwater), communities compete with each other to access the water. Competition over the resources among different community groups illustrates how the concept of common-pool resources at the village level is evolving more towards "group-private ownership". As demonstrated through the case study, in Rajasthan water scarcity and related issues have been a challenge for communities across the state. However, the TBS approach presented provides an example of community-led water management which has proved instrumental in improving the water governance of commons in Rajasthan. As outlined, this has been enabled through addressing community divisions, and restoring social trust, particularly through overcoming socio-political conflicts and power hegemonies at the local level. Subsequently, this has resulted in improved community participation and unified decision making about local water management. As the TBS example demonstrates, this



approach can be used successfully to respond to and address the effects of climate change on local water systems in dry zone areas. It is evident that the key factors of success for TBS are the localised approach and the understanding that the organisation has on how to overcome the unequal local power dynamics which, as demonstrated in the India and Sri Lanka cases presented, are often the cause of ineffective water governance. However, through addressing these power dynamics, the social problem can be transformed into a social solution. In order to scale up the positive impacts experienced by communities through the TBS approach, we argue that the MGNREGA scheme could be used to mobilise greater community participation through TBS and other similar grassroots organisations' working towards the same aim. Through the use of this scheme, in conjunction with an approach that works towards greater community unity and trust, the impacts of water system restoration could be seen across the country. In doing so, MGNREGA can have positive effects for sustainable water management for the community, but it also has the potential to stabilize/legitimize existing power asymmetries in heterogeneous communities. However, this cannot be done in isolation—it needs to be merged with approaches that address power inequalities within society.

In Turkey, the participatory aspect of the transfers in particular has been questioned owing to the exclusion of irrigators from IA general assemblies and boards. In addition, successive governments have developed negative opinions about the administrative and technical performance of the IAs. Thus, the government recently introduced a major change in the law of the irrigation associations, which puts them under close government control, particularly in appointing the chairs of the IAs from among civil servants working at various public institutions. This top-down approach has caused fierce debate over the characterization of the associations as democratic. The Turkish case of irrigation management devolution demonstrates that a broader consensus among major stakeholders, namely the farmers and the government, is an absolute necessity for any reform to have a positive impact on equity and efficiency in irrigation management.

## 7. Conclusions

In this paper, we could show that CBWM is facing many interrelated challenges. Applying a set of diagnostic queries to case study regions in Rajasthan (India), dry zone in Sri Lanka and Turkey, we could identify a number of obstacles. These include social divisions within communities on the micro-level, elite capture of decision-making bodies in user communities, the politicization of community user organizations through micro-level party politics, and repossession of decision-making processes through the central government. Contrary to expectations, we did not find that climate-change-induced scarcity had a direct impact on community participation, but that competition over increasingly scarce water resources was mediated through institutional arrangements of land tenure. Overall, we find a prevalence of social division in communities, social disincentive, inequity, lack of social trust and capacities as central barriers to community participation. This reflects the embeddedness of local communities in regional and national social structures and political configurations. These conflict-laden social dynamics across scales negatively impact preparedness to engage in community participation and highlight the importance of contextual (political, socio-economic, and historical) factors to a diagnosis of resource-user communities. This insight questions the notion that the complexity of resource-user competition over water management could be modeled as rational games.

Insights from our case studies suggest that despite these multifold challenges, CBWM are most successful when projects are implemented and continuously operated as bottom-up projects with considerable grassroots character, such as the TBS movement. However, if the project planning process ignored the “exit-strategy”, the sustainability of CBWM cannot be assured. What is more, we suggest that donor agencies and governments with an interest in truly participatory processes regarding CBWM should pay more attention to empowering marginalized users and building social trust on the micro-level of communities. More empirical research is needed on those institutional mechanisms which foster inclusive

participation in community-based water management. The design of such institutional mechanisms along the lines of equity, fairness, and sustainability appears crucial given the expected increase of water stress in dryland countries.

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