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CASE STUDY

Groundwater governance and implementing the conservation policy: the case study of Rafsanjan Plain in Iran

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Abstract
The groundwater system in the Rafsanjan aquifer perpetuated sustainably for decades before 1950s; however, its groundwater resources have been overexploited in the recent decades. In this paper, we aim to investigate the water governance system to understand the reasons behind the ongoing overexploitation. Sustainability processes are considered a policy implementation problematic. As such, we employ the contextual interaction theory as a policy implementation framework to assess the groundwater governance as part of the context for the conservation policy. Data for this qualitative research were gathered from legal texts, articles, technical reports, and multiple interviews with authorities and groundwater users. The assessment results revealed that the poor quality of the governance system is central to the ineffectiveness of the conservation policies. Findings of this paper can be relied on to devise tools to underpin an appropriate context to sustain groundwater resources.

Keywords Governance · Groundwater · Conservation policy · Rafsanjan aquifer · Contextual interaction theory · Policy implementation

1 Introduction

The historical profile of conservation in most groundwater-dependent regions around the world reveals that conservation is an objective which has been mostly advocated from the state side, to ensure the sustainability of the nation in the long run (Giordano and Villholth

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2007). However, this objective has proven to be a difficult task and hardly ever reached (Famiglietti 2014). Iran is among the most extreme of groundwater users (Giordano 2009), and constant drawdown of groundwater levels is a typical issue in most aquifers all over the country (Madani 2014). The state has the responsibility to observe and control the groundwater resources, and during the last century, different organizations, laws, and instruments have been devised in this regard. However, drawdown of the groundwater level highlights the ineffectiveness of all the efforts. The systemic failure of conservation efforts all around the country indicates deeply rooted causes, and it suggests broadening the view from operational issues to the structural aspects of management, or better to say, the water governance. Therefore, the aim of this paper was to assess the groundwater governance for realizing the various persistent shortcomings in the governance system which are leading to the poor implementation of groundwater conservation policy in Rafsanjan.

Studies on the groundwater governance have been constantly growing around the globe in the last two decades, and now there are multiple frameworks and conceptualizations available for assessment of groundwater governance systems. Initiation of global projects in search for analyzing national and regional profiles, like GW-MATE[1] by World Bank, or "Groundwater Governance: A Global Framework for Action" by a network of multiple international agencies (GEF, World Bank, UNESCO-IHP, FAO, and IAH) underpins the tentative nature of groundwater governance. In spite of all such comparative analytical studies which have been undertaken based on diverse empirically and/or theoretically derived frameworks, no one has claimed to have reached into an all-encompassing framework. As Varady et al. (2015) concluded in their review paper based on the results of the latterly mentioned project, "There is no universal toolkit for groundwater governance." Thus, we believe that the process of testing new frameworks to study the groundwater governance from new perspectives is a prominent task for contributing to the body of the literature on groundwater governance. In this paper, we aim to do so by applying a policy–implementation-oriented framework.

To present our contribution in a meaningful way, we have designed the structure of this paper in the following order. First, through a brief review of the literature, we will set the scene for proving the contribution of our study and present the framework for assessing the groundwater governance which is based on a governance assessment tool. Second, a brief overview of the case study will be presented. Third, the data sources for this study and the methods for analysis of data will be explained. Fourth, analysis of results for each element of the adopted framework will be provided, and then, at the fifth step, the groundwater governance assessment will be discussed. Finally, after providing a summary of this research, we will conclude with the major findings of this study about the groundwater governance for implementing the conservation policies.

2 Background and the conceptual framework: groundwater conservation policy and governance

Groundwater conservation is one of the main groundwater management objectives and its concept depends on the context. When human demands do not put a significant pressure on groundwater resources sustainability, conservation is a matter of protecting the zone of wells both from quantitative and qualitative threats. Definition of the concept of 'Harim' in

[1] Groundwater Management Advisory Team.

Persia and at the ancient Islamic tradition for protection of the zones of wells and qanats is one of the earliest types of governmental or community-driven rules for groundwater conservation (García et al. 2017). With the emergence of new technologies and the transition in groundwater economy after 1970s, the groundwater irrigation rose extensively (Mukherji and Shah 2005). and this has changed the meaning of groundwater conservation in many parts of the world, especially in arid regions like the MENA countries. Declining groundwater levels and salinization of groundwater resources due to overexploitations are now a significant challenge, which threaten the future of such countries (Molle et al. 2017); groundwater conservation would mean halting the progress of overexploitation and restoring the aquifers.

The passive type of management development, as García et al. (2017) have noted, is dominant in many countries depending extremely on groundwater and experiencing declining groundwater levels and salinization. This reactive type of management has been acutely shown by the categorization of groundwater management stages in the report of Global Diagnostic on Groundwater Governance, as one of the main final products of "Groundwater Governance: A Global Framework for Action" project (FAO 2016). Three consequential stages: pre-management, initial management, and advanced management, represent the reactive type of development path of groundwater management. The path starts with the stage where groundwater management from a stage with no notions of control or protection (pre-management), moves toward a phase with a single-issue oriented basis (initial) and finally ends with a comprehensive and integrated approach (advanced). Surveys of the mentioned project reveal that most groundwater-dependent regions of the world are currently experiencing the initial management (ibid p.84). This has led the countries or governments to adopt groundwater conservation policies to control the rate of groundwater use; however, as scholars have witnessed, such attempts have not kept pace with the changing situations and still the groundwater depletion is going on (Giordano 2009; Shah 2014). This condition necessitates rigorous study of the policies and their implementation, to understand persistent shortcomings in the governance system, which are leading to the poor implementation of groundwater conservation policies.

Policy implementation, as a thread of public policy studies, has evolved in the last five decades after Pressman and Wildavsky (1973) published their report "Implementation: How great expectations in Washington are dashed in Oakland." In their first generation, policy implementation theories have focused on a top-down conceptualization of policies, making the policy goals clear and consistent, limiting the extent of change necessary, and placing the implementation responsibility in an agency sympathetic with the policy's goal (Matland 1995). Thus, in this generation, it is assumed that policy implementation could be controlled majorly by design of the policy from the central level. However, the last generation of theories, as Matland (1995) has shown, is more a combination of top-down and bottom-up approaches to the policy and implementation.

Contextual interaction theory (CIT) is one of the theories of the last generation (O'Toole 2000), that has been tested in a number of water and sustainability studies (refer to Özerol et al. 2012; De Boer 2012; Bressers et al. 2016; Casiano Flores et al. 2017). Regarding the policy nature of the groundwater conservation and the failure of implementing the state-led groundwater conservation policies, adoption of an implementation-based theory for analysis, like CIT, can shed light on different aspects, which are usually ignored or misunderstood in the problem formulation by policy-makers and practitioners.

According to CIT (Bressers 2009), policy implementation is a matter of interaction between target groups (whose behavior is targeted for change like groundwater users) and implementers (who are assigned for implementing the policy and interacting with the target group). The ultimate factors that determine the likeliness of policy implementation are the characteristics of the actors involved in the action, which are motivations, cognitions, and resources (ibid). When the actors have sufficient motivation and cognition aligned with the intended goals and have access to the required resources to react, the achievement of the goal is much likelier than that under weaker conditions of the three characteristics. These characteristics are dependent on the external context, mainly the governance system.

Significance of groundwater governance is not a new idea and many scholars have elaborated on conceptualizing the groundwater governance (see García et al. 2017), but the CIT's approach to governance is novel. Mukherji and Shah (2005), as well-known researchers, elaborated on the institutions and specifically laws in different countries or Theesfeld (2010) investigated different attributes of groundwater systems to understand the institutional aspects of groundwater governance, including voluntary compliance, traditions and mental models, conflict resolution mechanisms, political economy, etc. The seminal work by Giordano and Villholth (2007), which is a product of comprehensive studies by many scholars, has also figured out many attributes and important facts in ground systems. In their conclusion, they have emphasized on information gaps, dependency, and impacts of groundwater use, inattention to the threats of overexploitation, diversity of paradigms for managing groundwater, etc., Varady et al. (2015) emphasized on the enabling environment in terms of different issues like information, legislative and regulatory frameworks, governmental and non-governmental organizations or groups, awareness raising, communication, multi-level activities (policy, strategy and operation). The reports by World Bank (Wijnen et al. 2012), GWP (Shah 2014), OECD (OECD 2015), and IWMI (Closas and Molle 2016) are the other ground-breaking studies in this subject which all show the importance of governance in the effectiveness of management efforts. While all these types of studies have taken a general perspective toward groundwater governance, the CIT tries to focus on governance with regard to a specific policy goal; so as said, the groundwater conservation policy can experience a specific condition of governance setting which might be different from the one for rain harvesting to recharge the groundwater resources or avoiding water-logging.

Governance definition in CIT, as stated by Bressers et al. (2013), "is the combination of the relevant multiplicity of responsibilities and resources, instrumental strategies, goals, actor-networks and scales that forms a context that, to some degree, restricts and, to some degree, enables actions and interactions". Assessing the governance system from a public policy perspective can help to uncover how different aspects of a water system have been (or not have been) supportive of the designed policies of water conservation. CIT incorporates five elements for the governance system that shape the structural context for any policy implementation process. Those five elements are:

- Levels and scales: Multi-level characteristics of the policy process and implementation,
- Actors and networks: Multi-actor characteristics of the policy networks,
- Problem perspectives and goal ambitions: Multi-faceted characteristics of the problems and the solutions,
- Strategies and instruments: Multi-instrumental characteristics of the strategies, and
- Resources and responsibilities: Multi-resource base for implementation.

Governance elements are not normative as they simply reflect the structural circumstances that a policy is being implemented within. To assess the governance, four criteria such as extent, coherence, flexibility, and intensity (de Boer and Bressers 2011) are designed in the form of a governance assessment tool. This tool (Bressers et al. 2013) requires answers to a set of broad questions about the elements and qualities of the governance (Table 1) that affect the sustainability of groundwater conservation. The current questions in governance assessment tool have been developed for assessing drought governance (Bressers et al. 2013, 2016); however, they are generalizable to other water issues like groundwater conservation or flood management as well (Vinke-de Kruijf et al. 2015). Our goal of understanding groundwater conservation and our non-Northwest European case study may justify a different emphasis or grading of multiple aspects of each element or quality. As such, we have explained our metrics for the best and worst situation for each of the qualities in Table 1.

The governance assessment is applicable to a specific goal or policy like groundwater conservation. When it is found to be poor, it means that there are lacking conditions to support the groundwater conservation. Thus, it is not reasonable to generalize the results for other goals like infrastructural development. When a specific quality of an element is evaluated to have a good condition, it means that according to the assessments, that quality does not have any specific negative impact on the policy implementation. Alternatively, it could help to compensate the other poor qualities. The qualities alone cannot give sufficient information for judging the desirability of the governance system with regard to a specific goal. How different qualities are compensating or impacting each other, and how they support or restrict the goal should be analyzed in concert. Thus, when the assessment is finalized, it should be helpful for policy makers and practitioners to better understand and prioritize the problems (or different dimensions of the same problem) for supporting the achieving their goals.

3 Overexploitation of groundwater resources in Rafsanjan

Rafsanjan is the main and the best-quality producer of pistachios in Iran which is called the "city of green gold" (Jamali-Jaghdani 2012). The prosperous monoculture of pistachio in Rafsanjan (Abtahi 1998) is the main groundwater consumer (IWRMC 2006), and the unsustainable rate of groundwater exploitation has led to undesirable outcomes. At the local scale, the average rate of groundwater drawdown in the last 30 years has been more than 70 cm per year (IWRMC 2006), and this has led to the annual land subsidence of about 50 cm (Mousavi et al. 2001; Motagh et al. 2008).

Rafsanjan Plain (RP), with an area of about 12,000 km^2, is located in the Southeast of Iran and is one of the sub-basins of the Kavir Daranjir basin as shown in Fig. 1. Rafsanjan has a dry climate with an average annual rainfall of 90 mm, and average annual potential evaporation of more than 3 m.[2] Since RP, like other central parts of Iran, has no permanent surface streams, groundwater is the main resource for water supply. The ground-breaking innovation of Qanat (horizontal tunnel that delivers groundwater to a specific point from upstream groundwater basin by gravity) by Persian farmers (Wulff 1968) made it possible

[2] According to Kerman Regional Water Company (http://www.krrw.ir).

Table 1 Governance assessment tool including elements and their qualities (Bressers et al. 2013) And the Guiding criteria for evaluation of qualities as used within this paper

Dimensions	Value	Extent	Coherence	Flexibility	Intensity
Levels and scales		How many levels are involved and dealing with an issue? Are there any important gaps or missing levels?	Do these levels work together, trust each other? Is the mutual dependence among levels recognized?	Is it possible to upscale and downscale the issue at stake?	Is there a strong push toward behavioral change or management reform?
	Good	Most relevant levels of the general administrative body are involved; The hydrological scales are considered in decision-makings	Effective inter-relation between different levels that enables shared decision-making and enriches social capital	Ability to change the order of levels in decision-making, and change the scale of management	Various levels can influence others in the decision-making process
	Poor	Insufficient involvement of the relevant levels	Unconstructive inter-relations and central decision-making	Rigidity in changing the order of levels in decision-making and changing the scale of management	Lack of influence from any level on the others
Actors and networks		Are all relevant stakeholders involved? Are any stakeholders not involved or even excluded?	Do the stakeholders have experience in working together? Do they trust and respect each other?	Can new actors be included or can the lead shifts from one actor to another? Do the actors share in social capital and support each other's tasks?	Is there a strong pressure from an actor or actor coalition toward behavioral change or management reform?
	Good	Inclusion of all relevant actors in the decision-making process	Effective inter-relation between different actors that enables shared decision-making and enriches social capital	Ability to change the actors' roles, behaviors and network based on possible benefits	High influence of an actor on the others in decision-making
	Poor	Exclusion of effective actors	Lack of inter-relations or unconstructive inter-relations between actors	Rigidity in actors' roles, behaviors and network	Lack of influence from any actor on the others

Table 1 (continued)

Dimensions	Value	Extent	Coherence	Flexibility	Intensity
Problem perspectives and goals ambitions		To what extent are the various problem perspectives taken into account?	Do the various perspectives and goals support each other, or are they in competition or conflict?	Are there opportunities to reassess or integrate goals?	How different are the goal ambitions from the status quo or business as usual?
	Good	Holistic view including social, political, environmental, technical, cultural aspects in decision-making, and having both demand and supply-oriented perspectives for water management	Unbiased approach to water issues and existence of a balanced and effective interrelation between different perspectives	Ability to change the perspectives or framing of the causes and solutions	Goals have fundamentally different approaches from the business as usual
	Poor	Exclusion of the above aspects	Unconstructive emphasis on one view of the problem and ignoring the other aspects	Rigidity in frames about the causes and solutions	Goals are on the same track of the business as usual
Strategies and instruments		What types of instruments are included in the policy strategy? Are there any excluded types? Are monitoring and enforcement instruments included?	Is the incentive system based on synergy? Are trade-offs in cost benefits and distributional effects considered? Are there any overlaps or conflicts of incentives?	Are there opportunities to combine or make use of different types of instruments?	How strongly do the instruments require and enforce this?
	Good	Inclusion of all possible types of instruments (both regulative and incentive)	Uncontrolled priorities of water-saving and water use policies	Ability to change the strategies and instruments	Intense follow of the instruments
	Poor	Biased instruments that only regulate, or a complete lack of instruments and strategies	Unconstructive priorities of the relevant policies	Rigidity in the strategies and instruments	loose follow up of the instruments

Table 1 (continued)

Dimensions	Value	Extent	Coherence	Flexibility	Intensity
Responsibilities and resources		Are all responsibilities clearly assigned and facilitated with resources?	Do the assigned responsibilities create competence struggles or cooperation? Are they considered legitimate by the main stakeholders?	Is it possible to pool the assigned responsibilities and resources?	Is the amount of allocated resources sufficient to implement the measures needed for the intended change?
	Good	Sufficient and clear responsibilities and resources assigned for sustainability	Constructive distribution of responsibilities and resources	Ability to pool resources or redistribute the responsibilities and resources between different actors	Resources are dominantly provided for water sustainability purposes
	Poor	Insufficient responsibilities and resources assigned for sustainability	Misdistribution of responsibilities and resources which leads to competence and conflicts	Resistance to pooling resources or redistribution of responsibilities and resources	Resources are not distributed in line with the sustainability goals

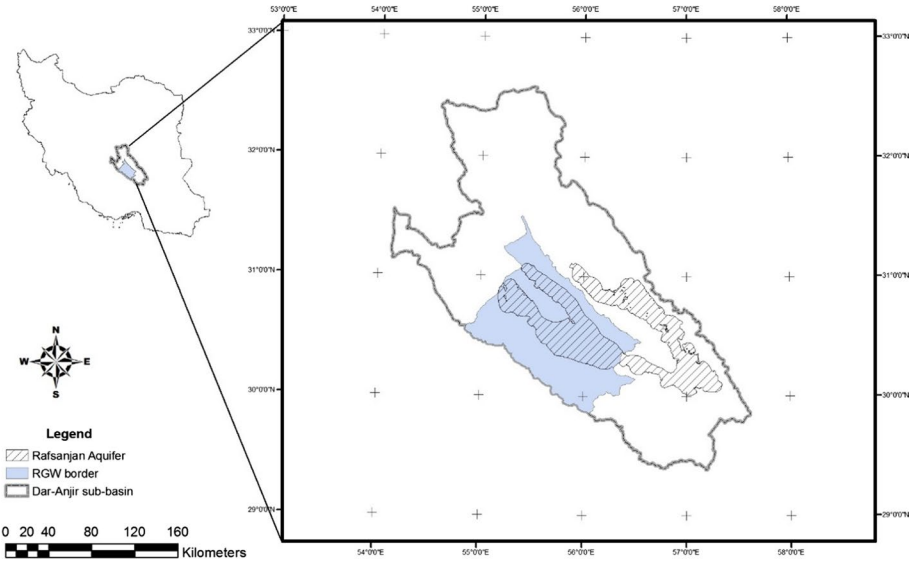

Fig. 1 Location of Rafsanjan aquifer

for such people to live in these dry regions by facilitation of irrigation to produce at least their own basic food, in the absence of modern mechanical energy.

Abtahi (1998) argues that pistachio became the dominant agricultural production of RP in the 1950s and gradually the residents gave up farming other crops, due to the high economic value of pistachio. According to the national reports, the area of pistachio orchards in RP reached 110,000 hectares in 2006 (JAMAB 2010). The desirability of pistachio production led to it becoming the major agricultural water user. Pistachio irrigation makes up 95% of all extractions (IWRMC 2006).

Pumping wells appeared in the late 1950s, and their number reached about 900 before the Revolution in 1978, which is about two-thirds of the current number (Fig. 2a). There are also unauthorized wells which are not considered in the reports. According to this rocketing increase in the number of wells and the imbalance between water input and output (yearly 150 MCM), the aquifer has been continuously dropping (Fig. 2b) and all Qanats have dried up.

The range of salinity in RP is between 1210 and 18,000 μs/cm (IWRMC 2006). Groundwater quality in the recharge zones (east and southeast) is good for agricultural use, but on average, the water quality in the aquifer is far beyond the irrigation water quality standards (Ayers and Westcot 1985). Now the water crisis of RP has become undeniable due to the existence of dried Qanats, drying wells, land subsidence, and high salinity (Jafari 2012). Lack of water has led to the decrease in the orchards area to about 80,000 hectares (JAMAB 2010).

The government has always defined its role as the single responsible authority for water management and has devised plenty of policies and means for its sustainability. In Table 2, we have summarized the main institutional changes and reforms targeting water resource conservation in Iran. As is shown in Table 2, since 1968 Iran has experienced different forms of provisions for water conservation in terms of laws, administrations, policies, plans, etc. However, the effectiveness of these efforts is questionable.

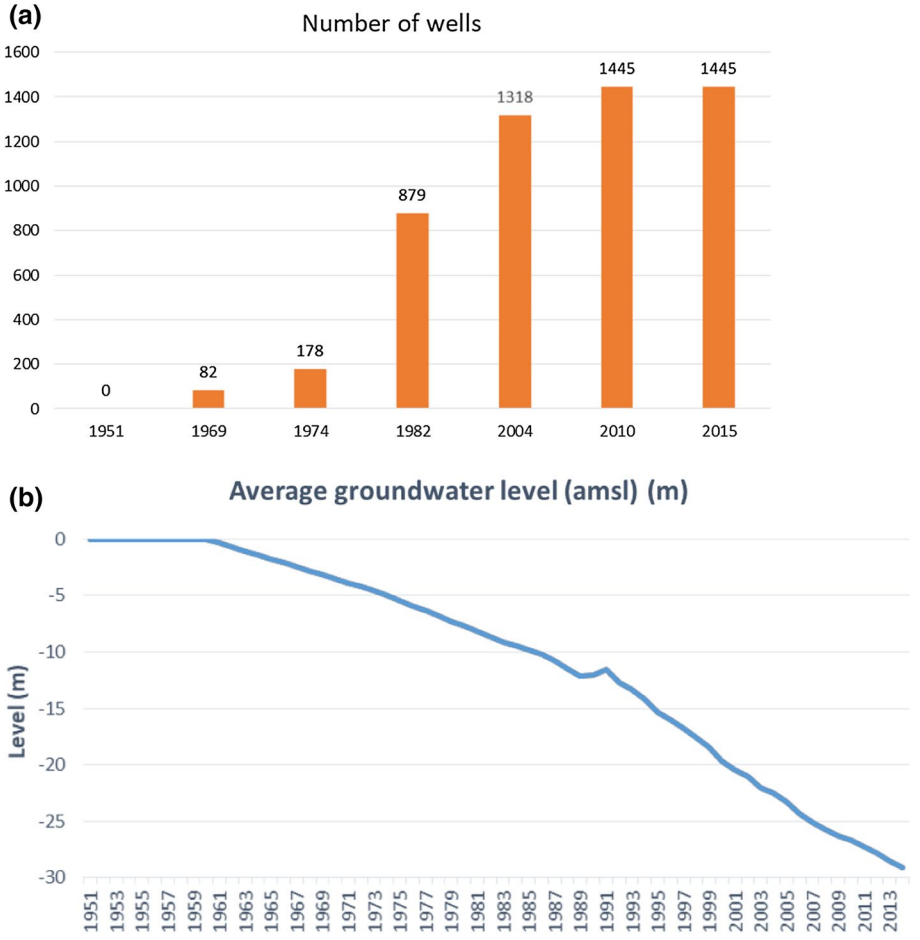

Fig. 2 **a** Increase in the number of wells; **b** Decrease in the groundwater level due to overexploitation (Zera'at-kaar and Gol-kaar 2016)

The aim of this research was to analyze the governance system for understanding why the groundwater conservation policy has not been implemented and the groundwater level has been dropping constantly. In the next section, we will explain the data sources and methods used for answering the questions as developed for groundwater conservation in Table 1.

4 Data and methods

To find the answers for questions in Table 1, we conducted a comprehensive qualitative inquiry. The source of data used in this research includes secondary data from technical reports, legal texts including laws, policies, strategies, and national development plans

Table 2 Different institutional efforts at the national level to conserve water resources in Iran

Type of intention	Intention	Year of enactment	Type of emphasis on water sustainability
Laws	Law on "Water and the way of nationalizing it"	1968	Explicit
	Law on "Just distribution of water"	1980	Explicit
National vision and plans	20-year vision of Iran	2003	Implicit
	5-year development plans	1989	Increasing trend
Constitutions	Ministry of Energy	1963	Explicit
	Water Supreme Council	2000	Explicit
	Iran Water Resources Management Company	2003	Explicit
	Regional Water Companies	1991	Explicit
National related policies	Natural resources	2000	Explicit
	Natural disasters	2005	Implicit
	Usage pattern correction	2010	Explicit
	Land use planning	2011	Explicit
National water policies	National water sector policies (5 policies)	2000	Explicit
	Ministry of Energy water sector vision, mission and strategies	2012	Explicit
National agricultural policies	Ministry of Agriculture policies (9 policies)	2005	Explicit
	Agricultural productivity enhancement	2010	Explicit
Groundwater management plan	Evolution in groundwater resource management	2004	Explicit

(Table 3), as well as news articles and official Web sites of organizations. Also a number of semi-structured interviews were undertaken (as primary data) with informant RP farmers (74 interviewees) as well as the national, regional, and local authorities (Table 4). A semi-structured questionnaire (as primary data) was also designed and filled by the majority (90%) of parliament members in the water and agricultural commission to collect data from the legislative body.

Key informant farmers were selected for interviews from different types of farmers (according to their age, modernity of farming system, and the land properties) with the guidance of a locally active non-governmental organization. The interviews were made both in the form of individual (20 interviews) and group meetings (9 meetings) during the field visits in 2014 and 2015. The number of interviews was defined according to the saturation rule, known as snowball sampling (Tracy 2011). The access to informant people with regard to our questions identified in Table 1 was a limiting factor for the number of interviews.

For each element of the conceptual framework, we first gathered all relevant data from documents available and after compiling the document analyses and coding the concepts and themes, we used interviews (and the semi-structured questionnaire) to strengthen and extend our understanding of each element. In other words, the main part of the answers to the questions in Table 1 was produced through documents analysis,

Table 3 List of legal documents

Years	Title
2005	20-year National Outlook of IRI
1979	Constitution of IRI
2000	Law on Establishment of the Ministry of Jahad-Agriculture
2000	The national macro policies for the water sector
2000	The national macro policies for the natural resources
2005	The national macro policies for prevention and mitigation of natural disasters
2010	The national macro policies for modification of consumption pattern
2011	The national macro policies for the land use planning
2015	The national macro policies for the environment
2005	The Cabinet Statute on Strategies for the Water Sector
1982	Law on Just Distribution of Water
2010	Law on adjudicating the illegal wells
1990	Law on Agricultural Water Price
1959	Law on Land reform
1962	Law on Nationalization of Forests
1964	Law on the Conservation and Appropriation of Forests and Rangelands
1980	The Cabinet Statute on Land Transfer and Restoration in the Government of IRI
1994	Law on Refinement of the Article 34 of the Law on the Conservation and Appropriation of Forests and Rangelands
2017	Law on Punishment of Illegal water, Electricity, Telephone, Sewerage and Gas Users
2006	Law on the Prevention of Agricultural Land Fragmentation and Establishment of Technically and Economically Feasible Parts
2004	The Cabinet Statute on the Criteria of Land Use Planning
2010	Law on Increasing Productivity in Agricultural and Natural Resources
1983	Law on Insurance of Agricultural Products
2000	Law on Compensation of Damages and Preventing Impacts of Drought
1989	Law on Guaranteed Purchase of Strategic Crops with a Certain Price
2001	The Establishment Statute of the Agricultural and Natural Resources Engineering Organization

Table 4 Number of interviews with governmental authorities

	Water authorities	Agricultural authorities	Department of Environment	Management and Planning Organization	Governors and mayors
National level	34	9	10	4	–
Provincial and local level	9	2	2	2	2

and the interviews were used to produce thick descriptions of the elements and verify the findings from the documents analysis (Patton 2002).

As shown in Table 1, the scale for assessment of the governance qualities has two levels (poor and good), and the authors have valued each quality in comparison with the good and poor states defined in Table 1. It is important to note that the individual values are not in

Table 5 Governmental organizations and their branches at different levels. Adopted from the MOE[a] and MOA[b] official Web sites

Level	Governmental Organizations		
National	Supreme Council of Water	Iran Water Resources Management Company (Ministry of Energy)	Deputy of Water Soil and Industry (Ministry of Agriculture)
Provincial		Regional Water Companies	Provincial Agricultural Organizations
Municipal		Water Affairs Offices	Municipal Agricultural Organizations
Local			Agricultural Service Centers

[a]https://goo.gl/e39SXh

[b]https://goo.gl/foqDGN

themselves highly meaningful and that a set of qualities in concert can better indicate the state of governance as to whether it is enhancing or hindering the policy implementation.

5 Results

5.1 Levels and scales

Ministry of Energy (MOE), as the main actor who is responsible to implement water conservation policies, is comprised of multiple levels from national to the local levels. Management and control of water resources in Iran, according to the law on "Just Distribution of Water," is delegated to the MOE. The hierarchical structure of this actor is mostly based on the public governance in the country. According to this structure, the national level comprises of Deputy of Water and Wastewater Affairs (DWWA) responsible for policy-making within the MOE, and Iran Water Resources Management Company (IWRMC) as an executive subsidiary to DWWA.

While MOE addresses policy-making issues, Iran Water Resources Management Company (IWRMC), as a national body associated with MOE, is in charge of water resources management operations and planning at national as well as local levels. According to its constitution,[3] this company is in charge of the execution of the water law in different aspects of studies, development, conservation and operation of hydraulic and hydroelectric infrastructures as well as for monitoring of the investments. IWRMC is formally the holding company of Regional Water Companies at the provincial level. Since agricultural water use has the biggest share (95% according to IWRMC 2006) in this case, the Ministry of Agriculture (MOA) is also included in this study. The Deputy of Water, Soil and Industry in MOA is responsible for agricultural water management affairs. In general, water resources management is the main mission of the MOE. MOA, on the other hand, helps farmers to manage water use. These administrations have sub-branches at the provincial, municipal and local levels (Table 5). In addition to these two ministries and their administrations, the Supreme Council of Water (SCW), is formed at the national level, which is chaired by the President of Iran, and its members are the ministers of agriculture, energy, industries and mines, the heads of National Management and Planning Organization and

[3] https://goo.gl/RW2ZZj.

Environmental Protection Organization (Department of Environment). This council makes strategic decisions about water-related issues, which are mandatory for all related authorities according to the national constitution.

The spatial distribution of water management administration is organized according to the political boundaries and is not based on hydrological units. The six primary and 30 secondary river basins in Iran are shared between different provincial Regional Water Companies. Of course, aquifers do not usually coincide with the river basins but the alluvial aquifers, like RP, are recharged from their related river basins. Thus, the administrative scale of water management is a challenge for aquifers. In the case of RP, water administration bodies include Rafsanjan Water Affairs Office (municipal level), Kerman Regional Water Company (provincial level) and IWRMC (national level).

In 2004, fewer RWCs which were almost covering main river basins in the country became provincial and a law was passed in the parliament, obligated all provinces to establish their own RWC. The logic behind this, as the former Minister of Energy (as an advocator for this reform) stated in a news brief was to make RWCs as the third and the lowest level of water governance under the second or basin level organizations known as River Basin Organizations (RBOs). While the provincial RWCs formed rapidly, establishment of the RBOs which were planned to get established in Tehran, has been delayed for more than a decade.

The local administrations are mainly steered by the higher levels (according to their constitutions) and they suffer from a lack of effective local decision-making mechanism (command and control). The lower level organizations have some formal authority to act on their own, though depending on the case, it can be difficult to deploy their authority. The assessment results for the levels and scales element are depicted in Table 6.

5.2 Actors and networks

Many actors are parts of the water use arena in RP (Ghafouri Fard et al. 2015); however, the farmers are considered as the main actors in this study. The Water Affairs Office (WAO) is the governmental organization, which is in charge of implementing the MOE plans and policies in this area. The Agricultural Organization (AO) has more an extension role for farmers to train and encourage them to make the best use of water. Finally, the political stakeholders are the actors that have high authorities and can make decisions related to the water use. They include the governor and the parliamentary members of RP.

Groundwater sustainability is generally considered as the government's duty, which is currently being taken care of by WAO. This has happened during the last few decades through the exclusion of farmers from decisions made on water allocation. About 40–50 years ago, when irrigation water was mainly supplied by Qanats and no governmental organizations existed in RP, the farmers played the main role in sustainability and protection of the groundwater resource. Direct governmental interventions in water allocation, like giving permission to new users or authorization of the unauthorized wells, are among the areas where the farmers were not actively involved in sustainability of water resources.

Overexploitation is currently affecting the production of pistachios. Using satellite images, Farzaneh et al. (2016) showed the decrease in the area of cultivation as a consequence of groundwater depletion and salinization. All actors are affected by the dramatic change in groundwater resources, since a large percent of the region's population is served by pistachio production. There is a new movement emerging in

Table 6 Summary of assessment results for the water governance dimensions in Rafsanjan Aquifer

Dimensions	Extent	Coherence	Flexibility	Intensity
Levels and scales	Mediocre	Poor	Mediocre	Mediocre
	Hierarchical structure from the national to local levels; Hydrological scale is not considered in the management of the groundwater resources	Lack of an effective mechanism for inter-relation between levels	Desirable changes in the scale of management are expected but at a very slow rate	The hierarchical structure enables intensity from the higher to the lower levels, but with regard to the groundwater sustainability the intensity is poor
Actors and networks	Poor	Poor	Poor	Mediocre
	Farmers are excluded from the groundwater sustainability process and there is a huge gap (lack of legitimacy) between farmers and governmental organizations	The governmental actors, e.g., the Water Affairs Office and Agricultural Organization have no constructive interactions and blame each other for the current state of groundwater resources	Water Affairs Office does not welcome farmers to take serious roles in water management	Water Affairs Office is intense on sustaining groundwater resources, but has limited legitimacy
Problem perspectives and goal ambitions	Poor	Poor	Mediocre	Mediocre
	Problem is considered from supply side and the roots of increased overexploitation are not addressed; Technocratic and engineering approaches to the problem are prevailing and a political and social framing is lacking	The short-term perspective is contrary to demand-oriented solutions that require social involvement	Lack of hope and knowledge has shaped the rigid situation; the changes in perspectives occur at a very slow rate	Goals proposed by farmers do not have a significant difference from the concurrent approach of the government that has not involved farmers in management

Table 6 (continued)

Dimensions	Extent	Coherence	Flexibility	Intensity
Strategies and instruments	Poor	Poor	Poor	Poor
	The instruments are mainly regulative and technical; The strategies are government-oriented and based on governmental funds; There are very few incentive instruments, but they are not taken up.	Insufficient attention is paid to the groundwater sustainability policies in comparison with the policies that lead to water exploitation.	Despite the observed ineffectiveness of the available strategies and instruments, they are still being pushed forward.	The populistic approach has always challenged the intensity of regulative instruments. Corruption is another reason for the poor intensity.
Responsibilities and resources	Good	Poor	Poor	Poor
	Existence of WAO with defined responsibilities and resources for sustainability	Because the farmers are excluded from the resources and responsibilities of sustainability, they have better developed their resources in the negative force of overexploitation instead	The overall perspective to the role of WAO as the protector of water resources is rigid and the farmers do not advocate a change in this regard	WAO lacks sufficient resources for groundwater sustainability activities

the region due to the scarcity of water; those who have enough financial resources have started pistachio production in other suitable regions of Iran. In addition, those who do not have enough financial resources have started to immigrate to other regions as skilled workers. In the Rafsanjan region, 90% of pistachio orchards belong to the small landholders and just 10% belong to large landholders who are very rich. Generally speaking, many of the local residents are connected to pistachio production. The consequences of the impacts of groundwater degradation have intensified the prevalent gap between the farmers and the WAO.

Various types of conflicts occur among different actors. For example, when some farmers decide to illegally drill new wells, a conflict may emerge among the farmers or between the farmers and WAO. Conflicts also occur among governmental levels. For example, the local AO's decision regarding investment in a specific type of irrigation method may not be acknowledged at the national level.

MOA and MOE need to have coordination, but they usually do not. They have formal connections, but in reality, they do not cooperate. The reason for this lack of interaction, which usually becomes evident in their meetings, is mainly because of their contradicting organizational objectives. An increase in agricultural production is one of the main goals of MOA. MOE and MOA are the main actors which have to act in harmony to guarantee the food and water securities. Establishment of Supreme Water Council (SWC) according to the Law on establishment of Ministry of Agriculture was an idea for integrating the policies in water-related issues.

The establishment of SWC has not worked effectively to integrate the policies and the organizations. The major reason for the current groundwater situation, as stated by interviewees in both ministries, is known as "mismanagement" of the other actors. Interviewees in MOE not only blame MOA for advocating agricultural development in this arid country, but also for the mismanagement in land use control and organizing the farmer unions. Interviewees in MOA blame MOE for unmeasured water allocation which is making productive use of groundwater resources impossible.

SWC has tried to address the lack of coherence between MOE and MOA, but it seems that the efforts are very obligatory and expected to solve the problems in a very short time without questioning the main drivers. For instance, at the first session of SWC in 2013, a great deal of attention was paid to groundwater problems. As a result, MOE were assigned to prepare a plan as soon as possible. About 1 year later, in the 15th session of SWC in 2014 a program was prepared which were known as the plan for Restoration and Balancing of Groundwater Resources (RBGR). The plan comprised of 15 project packages to be carried out in the action level. All relevant governmental and state actors got obligated to do their best with regard to the projects. Many of those projects have not yet initiated, while there were clear time tables for all actions. Even the financial support of those projects got completely out of priority in the second year (2016) of action, and near-to-zero financial resources were allocated.

The assessment results for the actors and networks element are depicted in Table 6.

5.3 Problem perspectives and goal ambitions

According to the constitution of Islamic Republic of Iran, attention to the environment is essential and even obligatory, since any activity that negatively impacts the environment is prohibited (Principle 50). Also in the constitution, relational effect of activities on the other individuals is criminalized and negatively impacting activities are prohibited (Principle

43). More interestingly, the justly distribution of natural resources at the provincial and regional scales are obligated (Principle 48).

National policies delineate the objectives and goals for the whole country, and interestingly there are many policies created since the last 25 years. "General Water Policies" (2000) are among the first published national policies after the Islamic revolution (1979). Groundwater resources are one of the main water supplies in the country and at that time (2000) the groundwater resources were under pressure of overuse in most of the areas; however, there is no sign of respecting conservation of groundwater resources in these policies. But surprisingly, there is direct attention to some marginal issues. National policies are still published, and in more recent policies, i.e., "General Use Pattern Reform Policies" (2011) and "Environmental Policies" (2016), there is an increase in attention to groundwater resources in terms of "Balancing" of overexploited aquifers.

Iran has also its national strategies on water resources. In 2004, the government of Iran issued "Long-term Water Strategies" after a few supporting studies inspired by "National Water Master Plans". Water Master Plans are studies that basically set to update the information on the state of water resources in different river basins every 10 years and build roadmaps for water-related development projects. Regarding these studies, in Long-term Water Strategies, there is an attention toward the balancing of overexploited aquifers.

In 5-year national development plans, which are suggested from the government and passed by the parliament, there is a lack of attention to the groundwater resources till the 4th plan started in 2005. Comparing the terminology of water-related items in the 4th national plan and the Long-term Water Strategies, one can understand that the plan was highly inspired by the water strategies. Therefore, balancing the overexploited aquifers has been advocated after the 4th and 5th development plans.

Water-related laws are another line for understanding the attention toward groundwater resources. For this, we tracked the related documents about two big problematic Use Entitlements and Monitoring Payments. Use entitlements after the Islamic revolution has been reflected in the form of a well-known Article (No. 3) in the Law on Just Distribution of Water which was initially passed in 1983. According to that article, those who have illegally drilled wells and exploited illegally, could be judged by two experts assigned by Ministry of Energy and upon their judgment, a license could be awarded to the well owners. This temporally open-ended article, in addition to the existing corruption in the process of assessment and license issuing, has let a lot of wells be legalized and drilled throughout all the aquifers. The concept behind that article has been repeated during the last 30 years. In its latest version, the same concept has again appeared in terms of the Law on Regulating Unlicensed Wells in 2010. Monitoring of various activities, e.g., well drilling and water abstraction, is also reflected in the Law on Just Distribution of Water in Article 33, which has cleared a financial mechanism for monitoring. According to this article, users should pay annually for the monitoring costs based on their production tonnage (referring to the Act on Monitoring Payments issued in 1993). Since the groundwater use is not measured, the practical effect of the related act is to motivate the users to produce more by subsidizing and being exempted from the monitoring charges.

The interviews showed that agricultural development has been the main reason led to groundwater problems. While the attention is eminent in the documents to securing groundwater resources, still this fact is not included in decisions practically. From the constitution to the laws, all demonstrate the continuous misunderstandings about the groundwater problem and still pushing for more agricultural development.

According to the Iranian constitution (principle 43), national policies (Agricultural Policies) and national development plans (from the beginning) self-sufficiency in production

of strategic agricultural crops are advocated. Self-sufficiency is an unstudied target which has not yet constantly been achieved. On the other side, there are some facts which confirm the historical attitude toward agriculture. For example, the 2nd national development plan (1995–1999) is totally built upon agricultural development to ensure national economic development and therefore there were too many subsidies devised to encourage agricultural production. On the other side, looking at the land use laws (mainly passed after the Islamic Revolution in 1979) it becomes evident that there has been a tendency toward increasing agricultural activities to justly distribute natural resources like water, soil, etc., among people. Interestingly, terminology of such legal documents reveals the mental frame over agricultural activities. For instance, the lands which are not cultivated are called dead-lands, and therefore, cultivation is considered as an action which revives the dead-lands.

Another fact that can confirm the hypothesis of general tendency toward agricultural development could be seen in the evolution of Monitoring Payments. As explained before, these payments have been designed to ensure the sustainability of monitoring activities. Start of droughts in 2000 led to an Act by the government to exempt the affected farmers from Monitoring payments. Enlarged period of drought made the government to generalize this goal and finally stop Monitoring Payments all around the country from 2005, and instead a centralized budget was approved to be allocated in order to compensate the financial requirements for monitoring activities.

The solutions for groundwater conservation are tracked in multiple national documents. The results show a misinterpretation of the problem or even the political interest which favor the technical solutions. In the Long-term Water Strategies, there is an evident approach for compensating the pressure which results from balancing groundwater resources. In these strategies, it is mentioned that groundwater abstraction rate should not increase anymore and instead a 9% increase in diversion rate from surface water resources is targeted (in a 20-year period) to satisfy increasing demands. And this is important to note that interestingly no inter-relation is considered between surface and groundwater resources. It is also mentioned that the share of agricultural water use (from the whole national water resources) should decrease from 92% to 87%, and at the same time, the agricultural demands should get satisfied through enhancement of irrigation efficiency and allocation of water resources to high-value crops (to ensure economic efficiency). There is a same approach again evident in the 4th and 5th national development plans. In the 4th development plan, which is the first time that the groundwater problem is reflected in the national plans, this is targeted to improve the state of aquifers (25% improvement of the negative balance in aquifers) during a 5-year period by extension of modern irrigation systems (improving irrigation efficiency). This is an ambitious goal to reach in 5 years and also there is no supporting research behind that. This type of solution making is again repeated in the 5th national development plan, and the artificial recharge and watershed management is also considered to achieve this goal. But finally, nothing has happened and the drawdown of groundwater resources has persisted as before.

In Rafsanjan, there is a gradual concern that is increasing among the actors that Rafsanjan's catchment will not survive much longer and it will completely dry up within 5–20 years. Farmers, who desire more water, believe that the government should solve this issue by transferring water from outside of the basin. Most farmers confess to overexploitation (Abdolahi 2012), but unanimously they blame the government for causing this situation. They believe that the government should have taken care of water resource management and have stopped overexploitation. Some of the farmers, in reaction to the prevailing crisis, are willing to stop their overexploitation. This is not feasible, because not all of them agree.

While a great number of farmers know that the only solution to the crisis is to reduce the amount of groundwater abstraction, which they do not do, they believe that the government should fix the whole problem with technical approaches not related to eventual water use reduction (Mirnezami et al. 2018). There are two technical approaches, which are believed to be able to fix the problem, by most farmers. The first is water transfer from outside of the basin, which has to some extent been abandoned. High costs and social concerns related to this solution make it difficult. These types of water transfer projects have raised many concerns in the country (like the Zayandeh-rud inter-basin water transfers studied by Gohari et al. 2013), and the government is aware that water resource management is not just a financial problem.[4] The discourse for the transfer of water has had a great impact on the Rafsanjan groundwater resources. It caused the farmers to think that there would be more water in the future and thus they increased the area of their pistachio orchards. Every time the parliamentary election time arrives (according to an economic theory of democracy by Downs 1957), the discourses for water transfer get promoted. This occurs even though most people have found that this idea is impractical.

The other technical solution is modernization of the irrigation system in the region. A large part of the region is irrigated by inefficient flood irrigation method. Researchers have not yet reached a common agreement about whether the wasted water would return back to the aquifer or evaporate (Torabi et al. 2014), and thus it is not clear how effective this solution could be. Pressurized irrigation is highly recommended by the engineers but there are four reasons blocking its implementation. Firstly, water in the Rafsanjan region is extremely salty, thus, it is not appropriate for drip irrigation. Secondly, the farms are mostly fragmented and it is not really efficient to implement expensive irrigation systems for small farms. Thirdly, there are some legal restrictions as well. For example, most of the lands in this region are not entitled to use governmental subsidies for implementing pressurized irrigation, according to their property ownership restrictions. Fourthly, those who have implemented this type of irrigation system complain of the poor quality of the instruments supplied by the market.

Overall, all technical solutions should be based on solid data about the quality and quantity of the aquifer and its inflows and outflows. Lack of data (both soft and hard) is a common problem that makes it difficult to act, due to the uncertainties even on the physical consequences.

Such farmers' expectations are rooted in the general approach of the government to fix the wicked issues, like groundwater drawdown, with simplistic methods that usually rely on heavy financial investments. Mirnezami et al. (2018) explained how megaprojects throughout the country, like restoration of Lake Urmia, have led to foster the farmers' expectation that the government will intervene to fix these types of problems.

The government is sensitive to discontent only when it could result in likely risks to the national or local security. There are no long-term insights for this and when the problems reach the phase of exposure it gets invoked to react. People have become desensitized to the emergence of natural disasters like drying up wetlands and increasing aerosols in Iran (Madani 2014). It seems that both government and people are more biased toward devising short-term solutions, which have been shown in some cases to back fire (Gohari et al. 2013) and lead the whole resource system into an undesirable state. The assessment results for the problem perspectives and goal ambitions are depicted in Table 6.

[4] Head of IWRMC regarding the inattention to the groundwater resources said "… the reason behind this issue, has been the management problems… lack of attention to social issues has led us to this point now". (refer to www.magiran.com/n3686477).

5.4 Strategies and instruments

Five years before the revolution in Iran (i.e., in 1974), the aquifer in RP was prohibited from further use according to the law enacted in 1968 (Table 2). This prohibition happened because of the hydrological studies started at that time by the government. Water use was more than the recharge rate of the aquifer even at that time. Nevertheless, the government started to give permissions for drilling new wells. This was said to be done as a support to the poor, to realize the social justice goals. The previous well owners, who considered the new wells as a threat to their rights, started to oppose the new water allocation schemes, and the government not only ignored that but also suppressed their oppositions. The government subsidizes agricultural inputs, energy and machinery for the sake of development and self-sufficiency in agricultural production. Still, the water itself is free of charge and the users should only pay for the energy consumed for pumping, which is also subsidized.

That led to a period of unlimited water resource abstraction and the existence of many encouraging factors for agricultural activities, specifically for the pistachio (the price of which also increased after the revolution). Various instruments were also devised for controlling water demand, such as investment in the pressurized irrigation methods, extension for local water use associations, devising some restrictive rules on well-deepening or replacement, establishment of a water police, but they have not been effective and wells are still being drilled/deepened or replaced that have negative impacts.

Obviously, the state has had a tendency toward mechanistically controlling mechanisms to secure groundwater sustainability. Mechanisms of "banning overexploited aquifers," "use right entitlement," "displacement and deepening of dried wells," "monitoring of pumps, digging facilities and representative experts," "prevention of polluting acts," and "punishment of violators" are all considered in the water law. But, none of those mechanisms has been effectively successful in reality which shows that the formal institutions set for controlling groundwater use are defeated by the informal institutions.

While this demotivating situation exists for the farmers, motivating mechanisms are almost ignored by the state. There has been a project in RGBR for buying inefficient wells from farmers; however, it has not yet been successful. Groundwater use is still free of charge and the farmers have to just pay for the energy consumed for groundwater pumping, which is of course highly subsidized. Of course, it should be noticed that agricultural production cannot tolerate a shock in the prices.

Cooperative mechanisms for conservation of groundwater resources are also missing in reality. While recent programs are addressing communicative and participatory mechanisms, there is no sign of attention in the undertaken efforts by the state actors, and it looks more like a symbolic reaction. One of the interviewees in DOE depicted the situation in his words: "I have not seen anyone who disagrees with participatory management… But the reality is that our organizational structures, budgeting mechanisms, our behavior, our interests, etc.… none of those seriously supports the participatory approach". The MOE, as the only (governmental) organization which is responsible for water resources protection, believes in technical and regulative approaches for sustainability of water resources and that other approaches are not effective. In spite of the current locked-in situation of water management in Iran, due to the depletion of water and the financial resources, the required transition in governmental decisions and the strategies for saving water resources is not evident. It is not obvious yet which direction this transition will take, and it may very well remain unchanged.

The assessment results for the strategies and instruments element are depicted in Table 6.

5.5 Responsibilities and resources

The WAO at the local level monitors water resources by measuring groundwater levels, water quality and discharge rate of pumping wells, issuing permissions for well replacement, clogging unauthorized wells and in general controlling the use of water resources. However, monitoring is being implemented in a very poor manner. For example, metering the discharge rates is done every 5 years, and it is not clear now how much water the farmers pump out. In addition, as explained before, the enforcement of shutting off unauthorized wells has also been poor.

The WAO has the authority to stop illegal activities, since they are supported judicially. The WAO does; however, confront issues such as corruption, insufficiency of laws, mismanagement, and populism. These factors in concert do not lead to an efficient and effective use of their power to realize groundwater sustainability.

The municipal level of the agricultural organization and its service centers at the village level are the other relevant organizations, which have no direct responsibility for sustainability of water resources. They are, however, somehow engaged in terms of agricultural extension activities for better farm management. This organization has the responsibility for irrigation and contamination issues, not abstraction of groundwater. The agricultural organization used to be responsible for distributing subsidized governmental pesticides and fertilizers; at that time farmers were obedient to it.

In practice, the farmers and the governmental organizations work separately and do not have an effective relationship. To make a better understanding of the responsibilities and resources, the current state of distribution of resources is presented in Table 7. The current distribution of responsibilities and resources shows how the network of agents in the case of RP is being promoted toward the overexploitation of groundwater resources. The WAO has shouldered the entire burden for sustainability activities and the users are excluded from the intrinsically social affairs associated with groundwater conservation. At the same time, the other actors, like the AO or political actors, do not have a proper relationship with the WAO and the farmers in order to pursue sustainability enhancing activities.

The described situation of low coherence among different actors (in the actors and networks subsection) is a sign of low resources in general; however, in this part, we are focusing upon other resources for implementation of mechanisms including human, information, and financial resources.

Deficiency in information is a tricky issue. While most interviewees believe that data are available and sufficient for water conservation efforts, they do not refer to the social and economic information which is essential for dealing with groundwater overexploitation problems. For example, the usual uproars against controlling efforts, like clogging unlicensed wells, are not being investigated to understand the reasons behind them. Therefore, such actions are interpreted in terms of subjective and mostly biased personal opinions and no systematic study happens to find out the different layers of reasons. Deficiency in information is limited not only to socioeconomic aspects, but also to the hydrological and technical information. For example, if we want to know how possible it is to restore an aquifer, there is not enough information available. As far as we know, and based on interviews with few well-known national researchers, the return flow rate of different uses is randomly assumed in water balance studies. Thus, it is not clearly known how different decisions,

Table 7 Summary of responsibilities and resources of different actors

	Responsibilities	Resources
Water Affairs Office (WAO)	Groundwater monitoring and conservation	Lack of access to sufficient financial resources
Agricultural Organization (AO)	Agricultural water use management	Budgets for financing drip irrigation systems
Farmers	The user of water	Lack of social capital, and access to power for pursuing self-interested activities and overexploitation of groundwater resources
Political actors	Controlling the social disturbances	Having intrinsic power

such as expansion of pressurized irrigation systems or reducing cultivated areas, can help the restoration of aquifers in reality. This uncertainty is a big problem ahead of practitioners and policy-makers, and this issue is not addressed in the political agendas at all.

Lack of financial resources is one of the main excuses for ineffective groundwater conservation policies that some interviewees proposed and some others did not. For example, human force for inspections around the villages (monitoring), clogging unlicensed wells (renting trucks for disposal of pumping devices and shutting off the wells), installing measurement instruments (monitoring usage and also groundwater levels), etc., are all different costs which have always been supported poorly in financial terms. According to the law on Just Distribution of Water, most of those costs should be paid by farmers as the end users (except for the monitoring costs which was explained before) but they do not comply with such expenditures (based on interviews) and there is a problem in paying back such costs. At the same time, the investments in infrastructural development in the last decades have demonstrated that lack of financial resources for groundwater conservation is a matter of inattention to groundwater resources. That can serve as evidence to support the corresponding hypothesis proposed in the first analytical component.

Overall, the assessment results for the responsibilities and resources element are depicted in Table 6.

6 Discussion

The governance elements of groundwater conservation in Rafsanjan Plain are assessed here by four criteria, i.e., extent, coherence, flexibility and intensity (clarified in Table 1). Extent and coherence reflect the integration of the groundwater governance, and the flexibility and intensity indicate the adaptability for facing the upcoming changes and shocks in the future.

The extent of the scales and levels and also the responsibilities and resources are evaluated as having mediocre and good qualities; however, the overall extent of the water governance in RP seems poor. It appears that the government has tried to further its extent by taking on more roles and responsibilities and ignoring the non-governmental bodies. However, while engagement of users in decisions and planning is considered as an ideal situation for groundwater governance, it can imply some limitations like sustaining the participants' interests in a frustrating process (Varady et al. 2016), but transparent, open, and fair mechanisms can help overcome such limitations. Easy access to financial resources for the government, has led to the unabated "governmentalization" of the governance system (dominance of government), and this situation has enlarged the potential for pursuing supply-oriented solutions without a serious consideration of demand management alternatives. The findings by Molle et al. (2017) in the MENA (Middle East and North Africa) countries show that the top-down application of instruments has proven difficult and "the reality on the ground is often very far from what governments like to proclaim" (ibid p.543). Therefore, "the use of technology and the provision of additional resources are seen as the most conflict-free management options" (ibid p.538).

Not only the extent, but also the coherence of the governance system is poor, and in combination, this leads to fragmented groundwater governance, which cannot support conservation policies. Incoherent policies are of high significance since groundwater conservation can be seen as a limitation for rural economic development or national food security (Allan 2007; Molle et al. 2017). This interpretation of water conservation would

unsurprisingly lead to stalemates. Also the coherency in the network of actors, which could be termed as social capital, is a critical factor for mobilizing the communities to advocate for their long-term benefits in groundwater systems which are inherently a common pool resource (see López-Gunn 2012). The lack of coherency between users and the government, or the mistrust between people and the state, can negate many efforts which are taken for the benefit of the communities. As reported by Molle et al. (2017), a lack of trust between state and citizens can even limit the efficacy of the attempts at participatory management of groundwater, therefore the issue of coherency in RP can even hinder the improvement of the quality of extent.

Flexibility shows the capacity of the governance system to change, after realizing the shortcomings of ordinary settings. The governance can be very sensitive and cautious when receiving the signals of inefficacy, or it can react unresponsively to the ongoing tragic trends. In the case of groundwater conservation policy in RP, while some changes are taking place, the rate of change does not correspond to the state of the problem. Therefore, the overall quality of the governance system from this perspective is mediocre to poor. This situation is partly related to the issue of power relations and the benefits, since groundwater conservation is a zero-sum game. Mollinga (2008) argues that water management is inherently a political process since any intentional change to the hydrological cycle and the distribution of water is a form of water control. In the case of groundwater conservation, for the sake of the future generations, the distribution of water for most users would need to change. Therefore, perhaps expecting the necessary flexibility in the governance for groundwater conservation is not realistic.

While the intensity was expected to have a good condition in such a top-down hierarchical governance structure, the reality is substantially different. With regard to the groundwater conservation policy, the intensity of the governance system is mediocre to poor. It seems that the intensity is highly inter-related with the coherence. While part of the government argues that it wants to conserve groundwater resources, there are much more powerful (governmental) actors on the opposite side who are not advocating for a decrease in groundwater use and/or are more inclined to increase water supply. This incoherence is exacerbated by the general culture of populism and corruption, which promotes the negative forces against groundwater conservation and finally has resulted in the lack of intensity (refer to Smith and Walpole 2005).

This configuration of a governance system that has poor or mediocre to poor qualities, is not likely to enhance the implementation of groundwater conservation policies. The exclusion of farmers is the main reason for the poor extent and coherence. While the governmental organizations have excluded the farmers and simultaneously failed to conserve water resources, the farmers' conception of their responsibility to conserve groundwater resources have negatively changed, and now the lack of support for conservation by the all farmers has left the government confused and encourages the perpetuation of its previous approach.

7 Conclusion

Rafsanjan Plain is an example of a critical case of water resources governance that has become trapped in an overexploitation cycle. The ongoing depletion of groundwater due to overexploitation has been observed in the last few decades, while simultaneously organizations were working toward improving sustainability. To understand the reasons

for this failure, we focused on the water governance system as the structural aspect of the water system.

Conservation of groundwater resources is a social movement and its implementation requires a supportive context. The water governance system, as the structural part of the context, can make conditions suitable for pursuing water conservation or restrict the required actions for that aim. Understanding the conditions of the governance system and its desirability for sustainability goals can help the organizers to align their efforts in a more effective direction and prioritize the investments for the improvement of water conservation process in order to prevent irreversible undesired situations.

To make an assessment of the governance system in the RP, we adopted the Governance Assessment Tool. This tool is based on the CIT, which is a public policy theory for conceptualization of the context for analyzing policy implementation. According to CIT, the governance system is part of the external context that affects the interaction of actors involved in the policy implementation and reflects five elements consisting of scales and levels, actors and networks, problem perspective and goal ambitions, strategies and instruments, and responsibilities and resources.

The governance system of water conservation in RP is considered poor for all relevant qualities. The governance system treats the farmers as target actors that should not get involved, yet respect the decisions that are made; the government has not organized its own organizations and policies very coherently and it seems that sustainability (with the intention to stop overexploitation) does not have a high priority. The lack of coherence has led to the ineffectiveness of conservation efforts and the loss of social capital for taking serious actions collaboratively. The flexibility of the governance system has been low and the current reactions of the government to solve the problems also prove to be poor. Inflexibility is demonstrated by the low capacity of the governance system to learn from the ineffectiveness of previous command and control approach to groundwater sustainability. Insufficient intensity of the governance system, due to the high level of resources of undesirable informal powers and the current populism situation, has troubled the implementation of groundwater sustainability efforts. This research shows how the underestimation and exclusion of farmers' roles in sustainability of water resources and construction of a monocentric governance has led to the current situation which is not desirable for groundwater sustainability.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

References

Abdolahi, M. (2012). *Investigating willingness to participate of Rafsanjan Plain pistachio growers in the national planting plan*. Rafsanjan: Iran Pistachio Research Institute. **(in Persian)**.

Abtahi, S. M. (1998). *Economic history of Rafsanjan*. Rafsanjan: Tavakol Publications of Rafsanjan. **(in Persian)**.

Allan, J. T. (2007). Rural economic transitions: Groundwater uses in the Middle East and its environmental consequences. In M. Giordano & K. Villholth (Eds.), *The agricultural groundwater revolution: Opportunities and threats to development* (pp. 63–78). Colombo: International Water Management Institute.

Ayers, R. S., & Westcot, D. W. (1985). *Water quality for agriculture*. Rome: Fao Rome.

Bressers, H. (2009). From public administration to policy networks: Contextual interaction analysis. In S. Nahrath & F. Varone (Eds.), *Rediscovering public law and public administration in comparative policy analysis: Tribute to Peter Knoepfel* (pp. 123–141). Milan: PPUR Presses Polytechniques.

Bressers, H., Bressers, N., & Larrue, C. (2016). *Governance for drought resilience, land and water drought management in Europe*. Berlin: Springer.

Bressers, H., de Boer, C., Lordkipanidze, M., Özerol, G., Vinke-de Kruijf, J., Furusho, C., Lajeunesse, I., Larrue, C., Ramos, M.-H., Kampa, E., Stein, U., Tröltzsch, J., Vidaurre, R., & Browne, A. (2013). *Water governance assessment tool with an elaboration for drought resilience*. Drop Governance. The Netherlands. INTERREG IVB.

Casiano Flores, C., Özerol, G., & Bressers, H. (2017). "Governance restricts": A contextual assessment of the wastewater treatment policy in the Guadalupe River Basin. *Utilities Policy, 47,* 29–40.

Closas, A., & Molle, F. (2016). *Groundwater governance in the Middle East and North Africa region*. Colombo: IWMI.

de Boer, C. L. (2012). *Contextual water management: A study of governance and implementation processes in local stream restoration projects. CSTM*. Enschede: University of Twente.

de Boer, C., & Bressers, H. (2011). *Complex and dynamic implementation processes: The renaturalization of the Dutch Regge River*. Enschede: University of Twente, in Collaboration with the Dutch Water Governance Centre.

Downs, A. (1957). An economic theory of political action in a democracy. *Journal of Political Economy, 65*(2), 135–150.

Famiglietti, J. S. (2014). The global groundwater crisis. *Nature Climate Change, 4*(11), 945–948.

FAO. (2016). *Global diagnostic on groundwater governance. Groundwater governance: A global framework for action*. Rome: FAO.

Farzaneh, M. R., Bagheri, A., & Momeni, F. (2016). A system dynamics insight to institutional context analysis of groundwater resources in Rafsanjan Plain. *Iran Water Resources Research, 12*(2), 67–82. **(in Persian)**.

García, M., Smidt, E., & de Vries, J. J. (2017). Emergence and evolution of groundwater management and governance. In K. G. Villholth, E. Lopez-Gunn, K. Conti, A. Garrido, & J. Van Der Gun (Eds.), *Advances in groundwater governance* (pp. 33–55). Leiden: CRC Press.

Ghafouri Fard, S., Bagheri, A., & Shajari, S. (2015). Stakeholders assessment in water sector (case study: Rafsanjan area). *Iran Water Resources Research, 11*(2), 16–28. **(in Persian)**.

Giordano, M. (2009). Global groundwater? Issues and solutions. *Annual Review of Environment and Resources, 34*(1), 153–178.

Giordano, M., & Villholth, K. G. (2007). The agricultural groundwater revolution: Setting the stage. In M. Giordano & K. Villholth (Eds.), *The agricultural groundwater revolution: Opportunities and threats to development* (pp. 1–4). Colombo: Cabi.

Gohari, A., Eslamian, S., Mirchi, A., Abedi-Koupaei, J., Massah Bavani, A., & Madani, K. (2013). Water transfer as a solution to water shortage: A fix that can backfire. *Journal of Hydrology, 491,* 23–39.

IWRMC. (2006). *Synthesis of studies and water balance, analysis of water statistics, data and balance*. Tehran: Halil-Ab Consulting Engineers [3-3,4,5]. **(in Persian)**.

Jafari, F. (2012). *The effect of overusing of ground water on quantity and quality of water resources in Rafsanjan plain; According to socioeconomics problems Watershed management*. Maybod: Islamic Azad University. **(in Persian)**.

JAMAB. (2010). *Soil and water resources assessment for the agricultural sector of Dar-Anjir-Saghand river basin*. Tehran: Office of Water and Wastewater Macro Planning [9]. **(in Persian)**.

Jamali-Jaghdani, T. (2012). *Demand for Irrigation water from depleting groundwater resources: An econometric approach*. Göttingen: Niedersächsische Staats-und Universitätsbibliothek Göttingen.

López-Gunn, E. (2012). Groundwater governance and social capital. *Geoforum, 43*(6), 1140–1151.

Madani, K. (2014). Water management in Iran: What is causing the looming crisis? *Journal of Environmental Studies and Sciences, 4*(4), 315–328.

Matland, R. E. (1995). Synthesizing the implementation literature: The ambiguity-conflict model of policy implementation. *Journal of Public Administration Research and Theory, 5*(2), 145–174.

Mirnezami, S. J., Bagheri, A., & Maleki, A. (2018). Inaction of society on the drawdown of groundwater resources: A case study of Rafsanjan Plain in Iran. *Water Alternatives, 11*(3), 725–748.

Molle, F., Closas, A., & Al-Zubari, W. (2017). Governing groundwater in the Middle East and North Africa Region. In K. G. Villholth, E. Lopez-Gunn, K. Conti, A. Garrido, & J. Van Der Gun (Eds.), *Advances in groundwater governance* (pp. 527–553). Leiden: CRC Press.

Mollinga, P. P. (2008). Water, politics and development: Framing a political sociology of water resources management. *Water Alternatives, 1*(1), 7–23.

Motagh, M., Walter, T. R., Sharifi, M. A., Fielding, E., Schenk, A., Anderssohn, J., & Zschau, J. (2008). Land subsidence in Iran caused by widespread water reservoir overexploitation. *Geophysical Research Letters*, *35*(16), 1–5.

Mousavi, S. M., Shamsai, A., Naggar, M. H. E., & Khamehchian, M. (2001). A GPS-based monitoring program of land subsidence due to groundwater withdrawal in Iran. *Canadian Journal of Civil Engineering, 28*(3), 452–464.

Mukherji, A., & Shah, T. (2005). Groundwater socio-ecology and governance: A review of institutions and policies in selected countries. *Hydrogeology Journal, 13*(1), 328–345.

OECD. (2015). *Drying wells, rising stakes: Towards sustainable agricultural groundwater use*. Paris: OECD Publishing. https://doi.org/10.1787/9789264238701.

O'Toole, L. J. (2000). Research on policy implementation: Assessment and prospects. *Journal of Public Administration Research and Theory, 10*(2), 263–288.

Özerol, G., Bressers, H., & Coenen, F. (2012). Irrigated agriculture and environmental sustainability: An alignment perspective. *Environmental Science & Policy, 23,* 57–67.

Patton, M. Q. (2002). *Qualitative evaluation and research methods*. Thousand Oaks: SAGE Publications, Inc.

Pressman, J. L., & Wildavsky, A. B. (1973). *Implementation: How great expectations in Washington are Dashed in Oakland; or, why it's amazing that federal programs work at all*. Berkeley: University of California Press.

Shah, T. (2014). *Groundwater governance and irrigated agriculture*. Stockholm: GWP.[19].

Smith, R. J., & Walpole, M. J. (2005). Should conservationists pay more attention to corruption? *Oryx, 39*(3), 251–256.

Theesfeld, I. (2010). Institutional challenges for national groundwater governance: Policies and issues. *Ground Water, 48*(1), 131–142.

Torabi, S., Mousavi Pour, S., & Rezaie, A. (2014). *Sustainability of groundwater resources: Case study of Rafsanjan (with emphasis on uncertainty sources in calculation of groundwater balance)*. Tehran: IWPRI. **(in Persian)**.

Tracy, S. J. (2011). *Qualitative research methods: Collecting evidence, crafting analysis, communicating impact*. Hoboken: Wiley.

Varady, R. G., van Weert, F., Megdal, S. B., Gerlak, A., Iskandar, C. A., & House-Peters, L. (2015). Groundwater governance synthesis report. Groundwater Governance: A Global Framework For Action. FAO.

Varady, R., Zuniga-Teran, A., Gerlak, A., & Megdal, S. (2016). Modes and approaches of groundwater governance: A survey of lessons learned from selected cases across the globe. *Water, 8*(10), 417.

Vinke-de Kruijf, J., Kuks, S. M. M., & Augustijn, D. C. M. (2015). Governance in support of integrated flood risk management? The case of Romania. *Environmental Development, 16,* 104–118.

Wijnen, M., Augeard, B., Hiller, B., Ward, C., & Huntjens, P. (2012). *Managing the invisible: Understanding and improving groundwater governance*. Washington: The World Bank.

Wulff, H. E. (1968). The qanats of Iran. *Scientific American, 218*(4), 94–105.

Zera'at-kaar, H., & Gol-kaar, E. (2016). *Water use in Rafsanjan Plain from 1951 till now. 51*. Kerman: IWPRI (Iran Water Policy and Research Institute). **(in Persian)**.