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Exploring the Governance of Traditional Water Reservoirs in the Mazandaran Province, Northern Iran

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LIST OF ABBREVIATIONS

AVE	Average Variance Extracted
CFA	Confirmatory Factor Analysis
CR	Composite Reliability
EFED	Effectiveness Dimension
EFID	Efficiency Dimension
FAO	Food and Agriculture Organization
GWP	Global Water Partnership
IFAP	International Federation of Agricultural Producers
OECD	Organization for Economic Co-operation and Development
SD	Standard Deviation
SEM	Structural Equation Modeling
TED	Trust and Engagement Dimension
ULS	Unweighted Least Squares

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EXECUTIVE SUMMARY

This study explores the governance of water reservoirs in the Mazandaran province, Northern Iran, from the perspective of public and private sectors at the regional level, as well as local stakeholders within the communities. Although water management in Iran has been frequently investigated, research which specifically addresses the governance of water reservoirs in the Mazandaran province from perspective of various stakeholders is not existent. The traditional water reservoirs in the Mazandaran province called *Ab-bandan* are used to collect the precipitation during autumn and winter seasons to be used for irrigating rice fields during the growing seasons (spring and summer). In spite of these reservoirs, a significant amount of precipitation runs off into the sea through rivers and only less than 10% of precipitation is being stored in *Ab-bandans*. This is due to the challenges in governing these water reservoirs such as lack of strategic planning of administrative bodies. This draws attention to the poor governance of water reservoirs in the Mazandaran province, which presents a major challenge to ensure the security of water supply, and in particular for rice production. Thus, the objectives of this study are: 1) to identify gaps in the governance of *Ab-bandans*, 2) to identify and assess the policy instruments for the improvement of the governance of *Ab-bandans*, and 3) to investigate the influence of social capital components on the governance of *Ab-bandans* among local stakeholders. These objectives form the papers of this cumulative Ph.D. dissertation.

The first paper reveals water governance gaps with the focus on *Ab-bandans* using the 'OECD's Multi-level Governance Framework' as a conceptual basis. This framework is a guideline for policy-makers in all countries in order to distinguish public governance gaps regardless of the institutional setting. Identifying the gaps could provide an input for policy-makers in order to prioritize options to strengthen the governance of *Ab-bandans*. A modified Delphi technique was used to identify these gaps by face-to-face interviews and ranking round. Interviews were conducted with individuals working in public agencies and the private sector pertaining to water management. The results show that the lack of a specific law for *Ab-bandans* is perceived as the most acute gap. However, the significant issue is that there is interdependence among all the gaps and they can strengthen one another. Therefore, a holistic perspective is needed to understand and resolve the gaps in the governance of *Ab-bandans*. There is no magic or 'one-size-fits-all' approach to overcome the gaps and a mix of solutions is required.

The second paper refers to identify relevant water policy instruments and assessing the suitability of these multiple instruments in an integrated way towards good governance of *Ab-bandans*. Water policy instruments are tools, strategies, and mechanisms for policy-makers to overcome governance obstacles in water policy; for instance, involving sub-national governments in designing water policy beyond their roles as implementers is a policy instrument to foster effective water management. An exploratory sequential design was realized as a mixed methods approach (qualitative and quantitative) for the purpose of research. The results reveal that policy instruments identified properly contribute to the improvement of the governance of *Ab-bandans*. Participation and collective action among farmers have the highest priority for the improvement of water governance. Therefore, it can be seen as the starting point for the desired transformation. Moreover, the policy instruments are interdependent and shouldn't be addressed in

isolation. The improvement of the governance of *Ab-bandans* should be systematic and it is not possible to apply a single policy instrument without considering the impact of other policy instruments. It is necessary to adopt the policy instruments in a holistic way to solve difficulties in the governance of *Ab-bandans*.

The third paper explores aspects of social capital in the governance of *Ab-bandans* seeking explanations as to how and why components of social capital among various local stakeholders influence the water reservoirs-related interactions within the communities. Social capital is an important factor, which facilitates collective interaction of the local community' members for water system sustainability. Therefore, this study investigates key social capital components (i.e. trust, co-operation, social network cohesion, leaders and their roles, and conflict resolution) affecting the governance of *Ab-bandans* among local stakeholders. The qualitative method was applied to achieve the purpose of research. Semi-structured, face-to-face interviews were conducted with a range of local key stakeholders of *Ab-bandans*. The study shows that the level of social capital and its importance can differ depending on which component is under investigation. According to the results, mechanisms for conflict resolution are the most important aspect of social capital which plays a significant role for the other components. Social relationships and cohesion are being reduced due to the conflicts in water management and lack of appropriate mechanisms for resolution. Therefore, resolution of conflicts can bring people together in the group events to communicate and address their common issues and promote their co-operation for collective decision-making and planning. The results of the study support the idea that the management of *Ab-bandans* in a collective manner at the local level in the Mazandaran province needs to take all components of social capital into consideration. This would enable local communities to be more resilient in the face of collective action problems.

Overall, it can be concluded that managing water reservoirs in the Mazandaran province, Northern Iran requires collaborative efforts between various stakeholders within and between the local communities. The government should undertake the role of facilitator rather than governmentality, by using participatory and bottom-up processes for decision-making, planning, and resolving conflicts among local stakeholders. The government should establish effective strategies of governance to engage farmers in management decisions and empower and integrate them to be able to solve their problems in water-related issues. There is also an urgent need for co-operation and participation not only between local stakeholders and responsive public agencies at the regional level, but also among public agencies in charge of water policy design and implementation. As the government is the owner and manager of water resources, better management and utilization of *Ab-bandans* will only succeed if accompanied by a shift in public governance through the engagement of all relevant actors.

ZUSAMMENFASSUNG

Diese Studie untersucht die ‚governance' von Wasserreservoirs im Nordiran und in der Provinz Mazandaran aus der Sicht des öffentlichen und privaten Sektors auf regionaler Ebene sowie der lokalen Akteure in den Gemeinden. Obwohl die Wasserwirtschaft im Iran bereits häufig untersucht wurde, gibt es keine Forschung, die sich speziell mit der Steuerung und dem Management von Wasserreservoirs in der Provinz Mazandaran aus der Sicht verschiedener Interessengruppen befasst. Die traditionellen Wasserreservoirs in der Provinz Mazandaran, genannt *Ab-bandan*, werden verwendet, um den Niederschlag während der Herbst- und Wintersaison zu sammeln, der für die Bewässerung von Reisfeldern während der Vegetationsperiode (Frühjahr und Sommer) verwendet wird. Trotz dieser Stauseen fließt ein erheblicher Teil der Niederschläge über Flüsse ins Meer und nur weniger als 10% der Niederschläge werden in *Ab-bandans* gespeichert. Dies ist auf die Herausforderungen bei der Bewirtschaftung dieser Wasserreservoirs zurückzuführen, wie z.B. das Fehlen einer strategischen Planung der Verwaltungsbehörden. Dies macht auf die schlechte Verwaltung der Wasserreservoirs in der Provinz Mazandaran aufmerksam, die eine große Herausforderung darstellt, um die Sicherheit der Wasserversorgung zu gewährleisten und die Reisproduktion zu unterstützen. So sind die Ziele dieser Studie: 1) Lücken in der Governance von *Ab-bandans* zu identifizieren, 2) die politischen Instrumente zur Verbesserung der Governance von *Ab-bandans* zu identifizieren und zu bewerten, und 3) den Einfluss von Sozialkapitalkomponenten auf die Governance von *Ab-bandans* unter lokalen Interessengruppen zu untersuchen. Diese Ziele bilden den Untersuchungsgegenstand der einzelnen Papiere dieser kumulativen Dissertation.

Das erste Papier zeigt Lücken in der Wasserbewirtschaftung auf, wobei der Schwerpunkt auf *Ab-bandans* liegt und das "OECD Multi-level Governance Framework" als konzeptionelle Grundlage dient. Dieser Rahmen ist eine Leitlinie für politische Entscheidungsträger in allen Ländern, um Lücken in der öffentlichen Verwaltung unabhängig vom institutionellen Umfeld zu erkennen. Die Identifizierung der Lücken könnte einen Beitrag für die politischen Entscheidungsträger leisten, um Optionen zur Stärkung der Governance von *Ab-bandans* zu priorisieren. Eine modifizierte Technik der Delphi-Methode wurde verwendet, um diese Lücken durch persönliche Interviews und eine Ranking-Runde zu identifizieren. Es wurden Interviews mit Personen durchgeführt, die in öffentlichen Einrichtungen und der Privatwirtschaft im Bereich der Wasserwirtschaft tätig sind. Die Ergebnisse zeigen, dass das Fehlen eines spezifischen Gesetzes für *Ab-bandans* die größte Lücke ist. Das wesentliche Problem ist jedoch, dass eine Interdependenz zwischen allen Defiziten besteht und diese sich gegenseitig verstärken können. Daher ist eine ganzheitliche Perspektive erforderlich, um die Lücken in der Governance von *Ab-bandans* zu verstehen und zu schließen. Es gibt keinen ‚magischen' oder "one-size-fits-all"-Ansatz, um die Lücken zu schließen, sondern es ist ein Mix von Lösungen erforderlich.

Das zweite Papier bezieht sich auf die Identifizierung relevanter wasserpolitischer Instrumente und die Bewertung der Eignung dieser verschiedenen Instrumente auf integrierte Weise für eine gute Governance der *Ab-bandans*. Wasserpolitische Instrumente sind Instrumente, Strategien und Mechanismen für politische Entscheidungsträger, um Governance-Hindernisse in der Wasserpolitik zu überwinden; beispielsweise ist die Einbeziehung subnationaler

Regierungen in die Gestaltung der Wasserpolitik über ihre Rolle als Umsetzer hinaus ein politisches Instrument zur Förderung einer effektiven Wasserwirtschaft. Ein exploratives sequentielles Design wurde als gemischter Methodenansatz (qualitativ und quantitativ) für Forschungszwecke umgesetzt. Die Ergebnisse zeigen, dass die identifizierten politischen Instrumente ordnungsgemäß zur Verbesserung der Governance von *Ab-bandans* beitragen. Die Beteiligung und gemeinsame Aktionen der Landwirte haben höchste Priorität für die Verbesserung der Wasserwirtschaft. Sie kann daher als Ausgangspunkt für die gewünschte Transformation angesehen werden. Darüber hinaus sind die politischen Instrumente voneinander abhängig und sollten nicht isoliert betrachtet werden. Die Verbesserung der Governance von *Ab-bandans* sollte systematisch erfolgen, und es ist nicht möglich, ein einziges politisches Instrument anzuwenden, ohne die Auswirkungen anderer politischer Instrumente zu berücksichtigen. Es ist notwendig, die politischen Instrumente auf ganzheitliche Weise anzuwenden, um Schwierigkeiten bei der Verwaltung von *Ab-bandans* zu lösen.

Das dritte Papier untersucht Aspekte des Sozialkapitals bei der Verwaltung von *Ab-bandans* und sucht nach Erklärungen, wie und warum Komponenten des Sozialkapitals zwischen verschiedenen lokalen Interessengruppen die wasserspeicherbezogenen Interaktionen innerhalb der Gemeinschaften beeinflussen. Sozialkapital ist ein wichtiger Faktor, der die Interaktionen in der lokalen Gemeinschaft für die Nachhaltigkeit des Wassersystems ermöglicht. Daher untersucht diese Studie die einzelnen Komponenten des Sozialkapitals (d.h. Vertrauen, Zusammenarbeit, Zusammenhalt der sozialen Netzwerke, Führungskräfte und ihre Rollen sowie Konfliktlösung), die sich auf die Governance von *Ab-bandans* unter den lokalen Interessengruppen auswirken. Teilstrukturierte, persönliche Interviews wurden mit einer Reihe von lokalen Schlüsselfiguren von *Ab-bandans* durchgeführt. Diese Studie zeigt, dass das Niveau des Sozialkapitals und seine Bedeutung je nachdem, welche Komponente untersucht wird, unterschiedlich sein können. Den Ergebnissen zufolge sind Mechanismen zur Konfliktlösung der wichtigste Aspekt des Sozialkapitals, der für die anderen Komponenten eine wichtige Rolle spielt. Die sozialen Beziehungen und der Zusammenhalt werden durch die Konflikte in der Wasserwirtschaft und das Fehlen geeigneter Lösungsmechanismen beinträchtigt. Daher kann die Konfliktlösung als Prozess Menschen in Gruppenveranstaltungen zusammenbringen, um zu kommunizieren und ihre gemeinsamen Themen anzusprechen und die Zusammenarbeit bei gemeinsamen Entscheidungen und Planungen zu fördern. Die Ergebnisse der Studie unterstützen die Idee, dass das kollektive Management von *Ab-bandans* auf lokaler Ebene in der Provinz Mazandaran alle Komponenten des Sozialkapitals berücksichtigen muss. Dies würde es den lokalen Gemeinschaften ermöglichen, bei Problemen mit kollektiven Maßnahmen widerstandsfähiger zu sein.

Insgesamt lässt sich sagen, dass die Bewirtschaftung von Wasserreservoirs im Nordiran und in der Provinz Mazandaran eine Zusammenarbeit zwischen verschiedenen Interessengruppen innerhalb und zwischen den lokalen Gemeinschaften erfordert. Die Regierung kann die Rolle des Moderators und nicht der Gouvernementalität übernehmen, indem sie partizipative und Bottom-up-Prozesse zur Entscheidungsfindung, Planung und Lösung von Konflikten zwischen lokalen Interessengruppen einsetzt. Die Regierung kann effektive Governance-Strategien entwickeln, um die Landwirte in Managemententscheidungen einzubeziehen und sie zu befähigen und zu integrieren, damit sie ihre Probleme in wasserbezogenen Fragen lösen können. Daher besteht auch dringender Bedarf an Zusammenarbeit und

Beteiligung nicht nur zwischen lokalen Interessengruppen und öffentlichen Stellen auf regionaler Ebene, sondern auch zwischen öffentlichen Stellen, die für die Gestaltung und Umsetzung der Wasserpolitik zuständig sind. Da die Regierung Eigentümer und Verwalter der Wasserressourcen ist, wird eine bessere Verwaltung und Nutzung der *Abbandans* nur dann erfolgreich sein, wenn sie von einer Veränderung der öffentlichen Verwaltung durch das Engagement aller relevanten Akteure begleitet wird.

Chapter 1

Introduction

1 Introduction

"The consequences of water shortage are costly today, but will be exponentially more expensive in the future"

(Jim Yong Kim, World Bank Group President, 2016)

Water is the main component required for the production of food supplies (Kumar, 2003). The key message of the International Federation of Agricultural Producers (IFAP, 2005: 3) is "without water, there is no agriculture". The world's population will reach 9.8 billion by 2050 which will lead to the need for further food production in the future, and consequently, the demand for water will increase by more than 40% (Nazari et al., 2018). By 2025, 1.8 billion people will live in regions where there is absolute water scarcity and currently, 768 million people are suffering from lack of access to water (Islam and Susskind, 2015). Therefore, the water crisis is listed as the largest global risk and is becoming a threat to the sustainable development of human society due to increasing demand (Mekonnen and Hoekstra, 2016). The Middle East is one of the most affected regions of water stress and is presently in an alarming situation, in terms of serious consequences for human development (Islam and Susskind, 2015). Since 1950, freshwater availability has decreased by 75% in the following three Middle Eastern countries: Iran, Iraq, and Saudi Arabia and an additional 50% will be added to this reduction by 2030 (Procházka et al., 2018). In developing countries like Iran, over 90% of the total renewable water resources are used in the agricultural sector which is the greatest consumer of water; therefore, effective water resource management in this sector plays a critical role in water security and satisfactory productivity (Samian et al., 2015).

OECD (2011) noted that many water-related crises are not related to water shortage, because sufficient water is available for all people everywhere, even in areas where there is a temporary shortage of water, but the water crisis is caused by the mismanagement and crisis in governance. Orr et al. (2009) pointed out that water-related problems are normally due to a complex interaction of social, economic, and environmental determinants, and not a lack of precipitation. The Global Water Partnership (GWP) observed that "The water crisis is mainly a crisis of governance" (GWP, 2000: 16). OECD (2011) reported that "The current water crisis is not a crisis of scarcity but a crisis of mismanagement, with strong public governance features". The crisis of water governance is due to the lack of clear allocation of roles and responsibilities, lack of stakeholder participation, asymmetric and unshared information, inadequate capacity to tackle the risks, etc. (Romano and Akhmouch, 2019). Hamdy (2012) stated that the failure of institutions to manage water resources is the main reason for the water governance crisis. Achieving effective water governance requires "an enabling environment and appropriate institutional structures that allow stakeholders to work together for effective water management. Financial practices must be realigned to support the sustainable use of water resources" (GWP, 2000: 16). These aims can be achieved through powerful administrative organization in water management, a legally embedded system of water law, an adequate financing system, systematic planning, and the participation of stakeholders (Havekes et al., 2013). This information draws attention to design empirical research on water governance in Northern Iran which is currently encountering a serious water crisis.

1.1 Problem background

Iran is located in an arid and semi-arid area of the world and average annual precipitation is about 250 mm, approximately one-third of the world's average precipitation of 814 mm, which occurs mostly from October to March (Amiri and Eslamian, 2010; Karandish and Hoekstra, 2017; Lehane, 2014; Madani, 2014). The annual precipitation varies greatly across the country from about 1,800 mm over the Western Caspian Sea coast, to less than 50 mm over the Eastern deserts (Amiri and Eslamian, 2010). Most regions receive less than 100 mm precipitation per year, and 75% of the precipitation occurs in only 25% of the country's area (Karandish and Hoekstra, 2017). In Northern Iran, the Caspian Seashores have an annual precipitation of about 500 mm in the East to 1800 mm in the West, which is considerable in comparison to other parts of the country (Amiri and Eslamian, 2010). Furthermore, 75% of the precipitation occurs during autumn and winter when it is not required in the agricultural sector and also summer precipitation occurs only in the Caspian Sea coast, northwest and southeast part of the county (Madani, 2014). Accordingly, precipitation in Iran does not have spatial and temporal uniformity (Raziei et al., 2008).

Currently, Iran is suffering from an acute water crisis and facing unprecedented water-related problems such as the shrinkage of a significant number of lakes and rivers, declining groundwater, floods, droughts etc. (Madani et al., 2016). Although the climate has varied over the centuries, Iran has always been located in an arid and semi-arid region; therefore, it should not be assumed (as is often the case) that water is scarce in Iran (Yazdanpanah et al., 2013). Undoubtedly, ancient Iranian people were successful in developing innovative methods of regulating, withdrawing, transferring, redirecting, and distributing water to establish an appropriate socio-economic and regulatory setting for effective water management in this arid area of the world where water availability is seasonal (Madani, 2014; Madani et al., 2016). However, modern day Iran is not able to put these historically familiar facts into practice, due to the current structure of the water governance system and the absence of a comprehensive understanding of the root causes of the problem (Foltz, 2002; Madani et al., 2016).

About 97% of the country is experiencing drought conditions (Shahi, 2019). Lake Urmia (the largest lake in the Middle East and one of the world's largest hypersaline lakes), has shrunk significantly as a result of frequent droughts, aggressive upstream water use, diversion, and storage. The water stand is only 10% of its volume and it will literally turn into a desert within the next 15 years (Ashraf Vaghefi et al., 2019; Madani, 2014; Navabi, 2017). Hamun Lake in east Iran, the Parishan and Shadegan lakes in the south, and the Zayandeh-Rud River in the center of Iran are also at risk of disappearing (Ashraf Vaghefi et al., 2019). The main source of water used for domestic and agricultural purposes in Iran is groundwater and this is also in a critical condition due to overexploitation (Ashraf Vaghefi et al., 2019; Jafary and Bradley, 2018). Furthermore, many villages have become deserts, and rural people have migrated to cities. Some officials predict that over the next 25 years, 50 million Iranians will migrate due to the ecological conditions in the country (Shahi, 2015). Iran is becoming a country of "ghost towns" due to massive environmental migration (Navabi, 2017). This shows that Iran's main enemy is not Israel, Saudi Arabia, the United States etc. but the real enemy is within the country and this is the environmental challenges, mainly water bankruptcy (Shahi, 2015). This leads to the question: What has caused this situation in Iran, despite the familiarity with its historical reality?

The Iranian government claims that the current water crisis is caused by climate change, frequent droughts, and international sanctions to conceal the inefficient water management system. These exogenous issues are only crisis

catalyzers, not the main cause of the water crisis (Madani, 2014). Many Iranian experts claim that the most significant cause of the water crisis is failure in water governance (Foltz, 2002), which includes planning, managerial, political, and institutional problems (Madani, 2014). Water governance is a set of collective activities to secure the water systems viability and integrity and to achieve common goals with the help of diverse stakeholder groups (Wiek and Larson, 2012). Unfortunately, water experts and policymakers in Iran have a different understanding of the causes of the water crisis, which prevents comprehensive planning for effective water management. Ultimately, local communities have other definitions, plans, and solutions to solve the water crisis (Jafary and Bradley, 2018).

Decision-makers ignore long-term goals and aim at achieving short-term and immediate economic benefits during their administration. They are not looking for fundamental solutions or resolutions to the main causes of these problems but try to eliminate the signs of the problems and prevent the emergence of them until the end of their power (Madani, 2014). Many government schemes to improve water management are in strong contrast with the socio-ecological conditions of the communities due to lack of cooperation between local water users and authorities (Jafary and Bradley, 2018). Water conflicts and dissatisfaction among the people are rising and they are demonstrating against systemic corruption, nepotism, mismanagement, and unaccountability; they see the government as their enemy (Shahi, 2019). The lack of co-operative behavior between groundwater users causes some environmental issues i.e. water exploitation from aquifers and land subsidence. There are many illegal wells in aquifers and there is no adequate supervision regarding water withdrawals which increases pressure on the groundwater resources (Moridi, 2017). National statistics in Iran shows that about 500,000 wells are operated by local farmers, and many of them do not have a license or permission (Karandish et al., 2018). Due to various difficulties in water governance, there is an absolute need to investigate this issue in order to understand challenges in water governance, and to find solutions for ensuring effective water governance. Since Iran is facing a water crisis, this research could provide useful information for optimizing the use of limited water resources.

1.2 Problem statement

The total surface water in Iran is approx. 92 billion m3, of which approx. 11.65 billion m3 belongs to the three Northern provinces of the country (i.e. Mazandaran, Gilan, and Golestan) (Ministry of Agriculture Iran, 2016). The average storage of surface water in the three Northern provinces is less than 10% and the Mazandaran province has the worse conditions for storing surface water (Ministry of Agriculture Iran, 2016). The Mazandaran province has a potential of 6.8 billion m^3 of water resources, of which 4.9 billion m^3 is surface water. Only 2.2 billion cubic m^3 of this surface water is used and the rest either runs off into the sea through rivers and streams, or it causes water-logging or flooding which reduces soil fertility and negatively affects rice production (Ejlali et al., 2012; Ministry of Agriculture Iran, 2016). The Mazandaran province is the second wettest province in Iran, but it faces water shortage during the growing seasons, although rice fields are saturated with water during the rainy seasons, which leads to a decrease of oxygen to the roots and consequently reduces the fertility of fields (Ministry of Agriculture Iran, 2016).

There are traditional water reservoirs in the Mazandaran province called *Ab-bandan* which are used for the collection of precipitation during autumn and winter. This water is used for irrigating rice fields during the growing seasons (spring and summer) (Abbasian et al., 2014). Typically, these have been constructed by local farmers since around 3000 years based on available materials and indigenous engineering knowledge. The *Ab-bandan* is built by digging the land and compressing the soil to construct a wall around the excavated pond (Ejlali et al., 2012; Ghoddousi, 1999; Rahimi Farahani et al., 2012). In spite of these reservoirs, a significant amount of precipitation runs off into the sea through rivers and less than 10% of precipitation is being stored in *Ab-bandans* (Azmoodeh et al., 2009). This draws attention to the poor governance of water reservoirs in the Mazandaran province which presents a major challenge in insuring a secure water supply and support of rice production.

A number of studies have explored the management process seeking different water resources, as well as strategies for their improvement, especially regarding the groundwater in Iran. For example, Nazari et al. (2018) conducted research on the factors that affect planning, designing, and implementing water management agendas in the Moghan Plain, in Northwest Iran by applying SWOT. The results of the SWOT analysis showed 40 critical factors that influence irrigation water management in the research area. They found that the highest priorities in the weaknesses factors are: 'failure to establish co-operative water management institutions', 'poor social capital', and 'low effectiveness of extension services'. In the threats factors, 'limited control over groundwater abstraction' should be considered as one of the key drivers for inefficient irrigation water management, followed by 'populist actions of decision makers' and 'declining water resources and land subsidence'. The opportunities factors showed that 'promotion of agro-based industries', 'improving rural tourism', and 'improvement of water markets' have the highest priority. Finally, the strength factor with the highest priority is 'diversification of agricultural products and incomes', followed by 'considering food security as a national priority' and 'planning for the development of resilient water management system'. Based on the PESTLE analysis, they concluded that legal, social, technological and political factors are major reasons for the failure of irrigation water management in the research area. They also provided a set of strategies to solve the present water problems and rehabilitate the failed schemes in the agriculture sector by the TOWS matrix. Re-thinking the role of the development of intensive agriculture, along with raising the awareness and attitude of decision makers towards the risks of shortsighted water resource development plans, and the promotion of agro-based industries and developing integrated plans to improve water efficiency are strategies to improve management of irrigation water in Iran.

Moridi (2017) by using the DPSIR framework highlighted the fact that climate change and periodic droughts can worsen the quantity and quality of water resources in Iran. However, the water crisis in Iran is mainly due to human activities and mismanagement such as limited power of government in controlling water withdrawal and pollution sources, uneven distribution of the population and economic activities, inadequate monitoring of pollution sources, lack of suitable co-operation among relevant governmental and non-governmental organizations, and inadequate guidelines and standards.

Jafary and Bradley (2017) in their study analyzed main challenges in groundwater irrigation management and practices in Kashan, Central Iran from the perspective of local farmers. They argued that the government introduces water scarcity problems mainly in technological-related issues, while the challenges in local social, cultural, and biophysical context are more important. According to their research, the main challenges are management transfer,

inappropriate technological solutions, and incompatibility of proposed irrigation schemes with the biophysical, social-cultural and economic status of the region. The result of their research showed that local knowledge and solutions are ignored when making management decisions and that water management should be developed by engaging farmers as key stakeholders. By considering social and cultural factors in water management and recognizing barriers of farmers' participation in government programmes, it would be possible to develop a more integrated approach to irrigation management. They concluded that the government shouldn't be as a final arbitrator for groundwater irrigation management and collaborative efforts among different actors are necessary.

Mirnezami et al. (2018) explored why local communities in the Rafsanjan Plain in Southern Iran have been inactive in the conservation and management of groundwater, although they have experienced successful community-based management in the past. They explained that according to the law, people have no power to intervene in the management and decision-making process and the government is responsible for all planning, monitoring, implementing, and controlling. The unilateral illusory solutions and decisions made by the government have destructive impacts on collective action in groundwater resources management. They found that corruption and inequity are also critical factors which lead to chaos in groundwater management. Nabavi (2018) addressed the key aspects which cause mismanagement of groundwater at the national level and over-abstraction at the local level. These challenges are rapid population changes, policy myopia, government's technological and infrastructural biases in future thinking, pro-agricultural investment and subsidies of rural public goods, self-sufficiency rhetoric, lack of robust water accounting and measurement, lack of participation and deliberation at local levels in the process of law- and policymaking, lack of understanding of the incentives and local actors' behavior, overlooking indigenous water knowledge, and lax enforcement. Vosoughi and Mohammadi (2013) in their research on the management of *Ab-bandans* reported that the government is the main actor and decision-maker in the management process which leads to the elimination of interaction among villagers. They found that the socio-economic balance of communities and collective management for irrigating rice fields has been eliminated due to government intervention in the use of the potential of Ab-*bandans*.

Although many studies have been done on water resources in different regions of Iran, there is little evidence on *Ab-bandans* in the Mazandaran province. Since water management is highly dependent on context, comprehensive research on *Ab-bandans*, with respect to all related actors, is necessary in order to achieve an effective governance of *Ab-bandans*. It is essential to recognize the public governance challenges in terms of political, institutional and administrative rules, practices, and processes and to consider appropriate management strategies and solutions to improve the related challenges in the governance of *Ab-bandans*. Furthermore, it is crucial to integrate local stakeholders' perspectives in the governance of *Ab-bandans*. Therefore, the purpose of this study is to provide empirically supported information on the governance of water reservoirs in Northern Iran from the public and private actors perspective at the regional level, as well as stakeholders at the local level, to reflect on their respective roles within the governance system which is useful in planning for effective utilization and maintenance of *Ab-bandans* (Fig. 1).

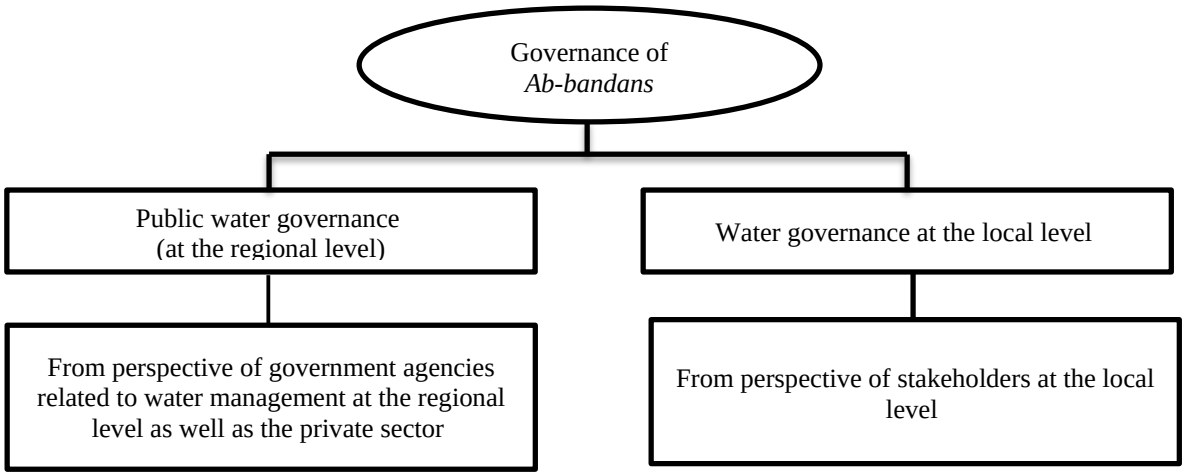

Fig. 1. General structure of the research

1.3 Objectives and research questions

1.3.1 General objective

The overall purpose of this study is to investigate the governance of water reservoirs in Northern Iran, and particularly in the Mazandaran province, from the perspective of public and private sectors at the regional level, as well as local stakeholders within the communities. Conducting research related to improving water governance in the Iranian context could raise awareness of water sustainability challenges and help decision makers to rehabilitate the failed schemes for water utilization and conservation.

1.3.2 Specific objectives and research questions

In order to reach the overall purpose, the following research questions and objectives are considered:

Question 1: What are the key gaps in the public governance of *Ab-bandans* at the regional level in the current situation with a focus on the OECD's Multi-level Governance Framework?

Objectives: 1) Identifying gaps in *Ab-bandans* governance, 2) Classifying the gaps into categories by applying the 'Multi-level Governance Framework', 3) Prioritizing the gaps in each category, and 4) Prioritizing the categories.

Question 2: What water policy instruments are necessary to overcome the gaps and improve the public governance of *Ab-bandans*?

Objectives: 1) Identifying policy instruments for the improvement of the governance of *Ab-bandans*; 2) Clustering these instruments on three OECD reinforcing dimensions of water governance; 3) Assessing how and to what extent the instruments grouped in each dimension contribute to the improvement of the governance of *Ab-bandans*.

Question 3: How and why components of social capital among various local stakeholders influence the water reservoirs-related interactions within the communities.

Objectives: 1) Identifying key components of social capital among local stakeholders of *Ab-bandans*; 2) Investigating how these components of social capital affect and relate to the governance of *Ab-bandans*.

1.4 Description of the study area

1.4.1 Mazandaran Province

Iran is located between latitudes 25° and 40° N, and longitudes 44° and 63° E (Abbaspour et al., 2009) and has a total area of 1,640,195 km2, which is divided into 30 provinces (Karandish et al., 2018). The annual average precipitation is 244 mm, but the south-eastern parts of the country (Sistan and Balouhestan provinces) receive much less precipitation (104 mm) than northern parts (Mazandaran, Gilan, and Golestan provinces) (1033 mm) (Karandish et al., 2018). The present study is conducted in the Mazandaran province of Northern Iran. This province is located on the southern Caspian coasts and central regions of the Alborz highlands in northern Iran with an area 23,842 km^2 (Gholami et al., 2010; Sarvi et al., 2016). This study area is located between latitude 35° 46' and 36° 58' north and longitude 50° 21 and 54° 8' east (Fig. 2) and it is bordered clockwise by the Golestan, Semnan, and Tehran provinces (Shahbazi and Esmaeili-Sari, 2009). Mazandaran is geographically divided into two parts: The coastal plains and a mountainous area with an average temperature of 25° C in summer and 6° C in winter (Shahbazi and Esmaeili-Sari, 2009). The average annual precipitation in the region is 749.9 mm which ranges from more than 1000 mm in the west to 300 mm in the east of the province. About 33% of all precipitation falls as snow in the mountainous area and the snowmelt period usually begins in mid-April and continues until late April to early May (Nosrati, 2011). Precipitation occurs mainly in the wet period, with a maximum quantity in November and December (Shahbazi and Esmaeili-Sari, 2009). All rivers in the region originate in the Alborz Mountains, south of the study area (Nosrati, 2011). With 37% (199,000 ha) of the land under rice cultivation, the Mazandaran Province is the main rice production region in the country (Ministry of Agriculture Iran, 2015; Nosrati, 2011). The population of the province has been steadily growing during the last 50 years. According to the census of 1996, the population of the province was 2,602,008 of which 45.89% were registered as urban dwellers and 54.1% as villagers (Shahbazi and Esmaeili-Sari, 2009).

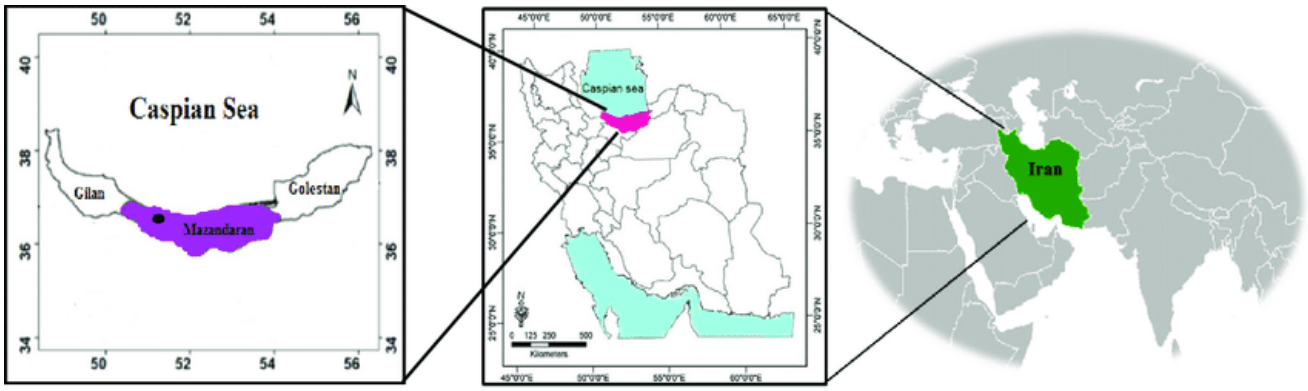

Fig. 2. The location of study area
Adopted from Soleimani et al. (2019)

1.4.2 The concept of *Ab-bandan*

Ab-bandans are man-made water storage reservoirs of different sizes ranging from 3 to 1000 hectares and generally do not have any geometrical shapes (Abbasian et al., 2014). They were typically constructed by local farmers about 3000 years ago, by digging the land and compressing the soil to construct a wall around the excavated pond; this was based on available materials and indigenous engineering knowledge (Fig. 3) (Ejlali et al., 2012; Ghoddousi, 1999; Rahimi Farahani et al., 2012). *Ab-bandans* are used by local farmers to store water during rainy seasons, for rice farming and the livelihoods of local people are dependent on these water reservoirs (Rahimi Farahani et al., 2012). *Ab-bandans* have various functions, of which the water supply for rice cultivation is the most important. Other functions are: recharging underground water and wells, collecting drainage water, aquaculture, habitat for birds and plants, and the provision of leisure areas (Vosoughi and Mohammadi, 2013). There is an estimated total of 880 *Ab-bandans* in the Mazandaran province with an area of around 17,000 hectares, and depths varying from 1.5 m to 4 m (Mazandaran Regional Water Authority, 2016). As shown in Fig. 4, they are distributed throughout 13 counties in the Mazandaran province.

The total area under rice cultivation in Iran is estimated as 539,000 hectares. The Mazandaran province with 37% (199,000 hectares) under rice cultivation has the highest rank of rice production in the country, and 41.73% of this staple food is produced in this province (Ministry of Agriculture Iran, 2016). *Ab-bandans* supply 331 million m^3 of water for 51,736 hectares of rice fields in the province which is a considerable amount in comparison to the volume of large dams (304 million m^3) in this area (Mazandaran Regional Water Authority, 2016).

Fig. 3. Water reservoirs in Mazandaran Province

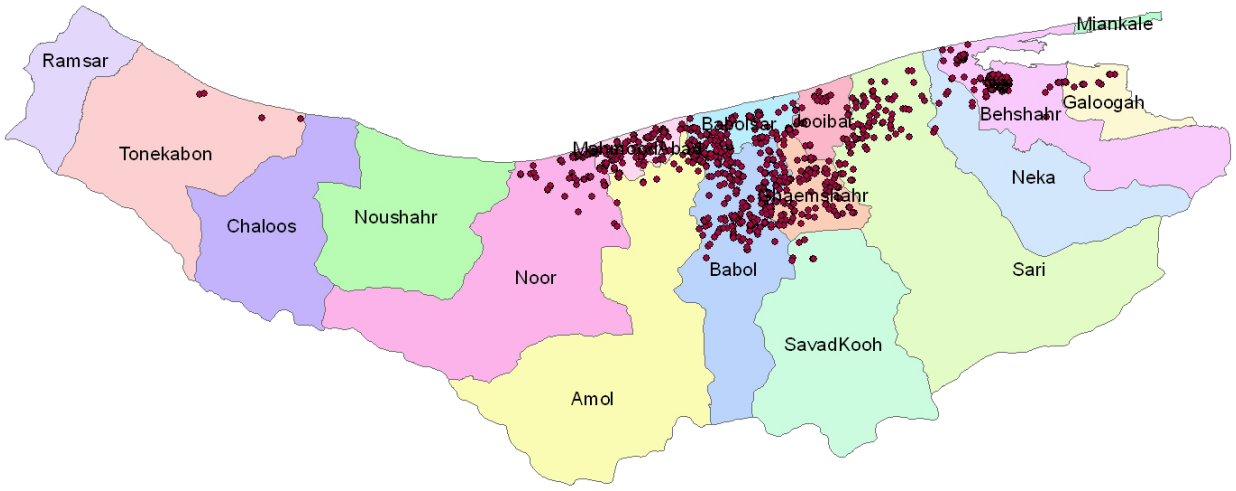

Fig. 4. Distribution of *Ab-bandans* in the Mazandaran province

1.5 Methodology

This study applied both qualitative and quantitative methods for the collection of empirical data and we employed separate methodology for each objective. The first paper reveals water governance gaps with the focus on *Ab-bandan*s using the 'OECD's Multi-level Governance Framework' as a conceptual basis. A modified Delphi technique was used to identify these gaps using face-to-face interviews (brainstorming round) and ranking round.

The Delphi technique is an appropriate tool for collecting information and achieving consensus among a panel of experts on a certain issue (Landeta, 2006; Tonni and Oliver, 2013). Dalkey (1969: 415) defined Delphi as, "a rapid procedure and efficient way to cream the tops of the heads of a group of knowledgeable people". Linstone and Turoff (1975) described Delphi as a research method for enabling group communication processes among experts so that they can participate in research and solve complex problems anonymously. Using the Delphi technique is efficient and practical in cases where there is no consensus, knowledge, information or certainty in a research subject (Powell, 2003; Giannarou and Zervas, 2014; Hasson et al., 2000).

The Delphi technique is carried out with the participation of individuals, who have knowledge and expertise on the research subject, as a panel of experts (Adler and Ziglio, 1996; Skulmoski et al., 2007). We used a modified Delphi technique, which relied on face-to-face interviews (brainstorming) for the first round in order to collect initial data. Based on purposive and snowball sampling, thirty semi-structured, face-to-face interviews were conducted with individuals working in public agencies and the private sector pertaining to water management. All the interviews were recorded and transcribed verbatim. We reviewed the transcripts to extract gaps in the governance of *Ab-bandans*, and 34 different gaps were identified after comparison of similar cases and the removal of duplicates. Then, the 'ranking round' was conducted to assess consensus among the participants using the gaps provided in the first round. A structured questionnaire was designed based on the gaps. We then distributed the questionnaires to the participants and asked them to rate the importance of each gap. Ultimately, a high consensus on 29 out of 34 gaps was reached.

The second paper refers to the identification of relevant water policy instruments and assessment of the suitability of these multiple instruments in an integrated way to achieve good governance of *Ab-bandans.* For reaching research

purposes, an exploratory sequential design was followed as a mixed methods approach (qualitative and quantitative) for the purpose of research. In an exploratory sequential design, qualitative data is first collected and analyzed, and themes are used to drive the development of a quantitative instrument i.e. questionnaire to further explore the research problems (Berman, 2017). In the qualitative phase, we used semi-structured, face-to-face interviews to collect qualitative data. Interviews were conducted with individuals who work in public agencies and private companies pertaining to water management at the regional level. Initially, we applied purposive sampling, starting with eight interviewees who were known to the researchers. Then, we asked them to suggest other possible interview partners. Finally, 30 people were asked to answer the main questions regarding different instruments and strategies required for improving the governance of *Ab-bandans* and overcoming related barriers. All the interviews were recorded and transcribed verbatim. We reviewed the transcripts to extract policy instruments for the improvement of the governance of *Ab-bandans*, and 31 different policy instruments were identified. Ultimately, the instruments identified were clustered and grouped according to three reinforcing OECD dimensions of water governance (effectiveness, efficiency, trust and engagement) (OECD, 2015). The results from the qualitative phase were applied to build a questionnaire for the quantitative phase. Afterwards, we distributed the questionnaires to a large sample of participants through snowball sampling and asked them to rate the importance of each policy instrument to improve the governance of *Ab-bandans.* A Confirmatory Factor Analysis (CFA) was conducted to analyze the quantitative data. This was useful for the assessment of how and to what extent the policy instruments identified can logically and systematically represent three reinforcing dimensions of the governance of *Ab-bandans*. Based on the CFA, 28 out of 31 policy instruments were identified which would contribute to the improvement of the governance of *Ab-bandans.*

The third paper explores aspects of social capital in the governance of *Ab-bandans*, seeking explanations as to how and why components of social capital among various local stakeholders, influence the water reservoirs-related interactions within the communities. The qualitative method was applied to achieve the purpose of research. Semi-structured, face-to-face interviews were conducted with a range of local key stakeholders of *Ab-bandan*s i.e. farmers, fishermen, informal leaders (elders, *Mirab*, farmers' representatives), and official leaders (members of rural councils). Interviews are about listening to and gaining an understanding of people's stories, and the individual participant's life experience. Indeed, interviewees can express the viewpoint of participants, in private, without a framework imposed by the researcher (Bolderston, 2012). Interviews initially began with a set of stakeholders who were known to the researchers (i.e. purposive sampling), and then a snowball sampling approach was used to identify additional interviewees, who also had experience, ability, and readiness to provide the required data. Ultimately, 29 local stakeholders were interviewed and all the interviews were transcribed verbatim. NVivo was used to code the transcripts through the identification of relevant themes, concepts, ideas, and relationships.

1.6 Theoretical framework of the study

Early thinking about water governance was based on highly centralized systems that emphasized the role of government in water management (Cooley et al., 2013). Today, however, water governance refers to "the range of political, institutional and administrative rules, practices, and processes (formal and informal) through which decisions are taken and implemented, stakeholders can articulate their interests and have their concerns considered, and decision-makers are held accountable for water management" (OECD, 2015: 5). Rogers and Hall (2003: 7) described water governance as "a range of political, social, economic and administrative systems that are in place to develop and manage water resources and the delivery of water services at different levels of society".

OECD (2011) reported that the water crisis is a governance crisis, which includes: fragmented institutional structures, multiple and interdependent stakeholders across levels of government, lack of capacity of sub-national governments, weak institutional, integrity and regulatory frameworks and patchy financial management. It means that formulating and implementing the water-related policies requires not only the engagement of society, but also involvement of political and administrative organizations at different levels. In order to govern water, all authorities, whether regional, state or national authorities, and even international organizations have to work together in harmony (Akhmouch and Correia, 2016). Therefore, public water governance as a political, institutional, and administrative framework for integrated water resources management, through a range of public actors across ministries, departments and public agencies, and various levels of government plays a critical role in providing incentives to different groups of users to engage in water-sustainable practices (OECD, 2011). Rogers (2006: 17) pointed out that "governance aspects overlap with the technical and economic aspects of water, but governance points us to the political and administrative elements of solving a problem or exploiting an opportunity".

Understanding the difficulties in public water governance and its contribution to effective design and implementation of water policies, and better managing relations across all levels of government is now considered a prerequisite for achieving water security (OECD, 2011). The OECD 'Multi-level Governance Framework' (OECD, 2011) can be a powerful diagnostic tool in order to reveal gaps in public water governance. This analytical framework is a diagnostic tool for policy makers to distinguish and anticipate common gaps hindering water governance. The OECD Multi-level Governance Framework identified seven categories of governance gaps in the water sector which are relevant to all countries regardless of their institutional organization, water availability and demand, and degree of decentralization (OECD, 2011). It used several perception and fact-based indicators to assess the performance of water governance in 17 OECD member countries (OECD, 2011) and 13 Latin American countries (OECD, 2012), as well as focusing more at the national level in the case of Mexico (2013), Netherlands (2014a), Jordan (2014b), Tunisia (2014c), and Brazil (2015b). It is also used to analyze the analytical background water governance in cities (2016), stakeholder engagement (2015), and integrity (2014d). Seven categories of water governance gaps are presented in Fig. 5 and Table 1. Taking everything into account, the first objective of this research (corresponding 1rd paper) refers to understanding key gaps in public governance of *Ab-bandans* in the Mazandaran province, from the perspective of a range of actors across government agencies related to water management at the regional level as well as private actors (i.e. private firms) who are involved in the water-related planning and decision-making.

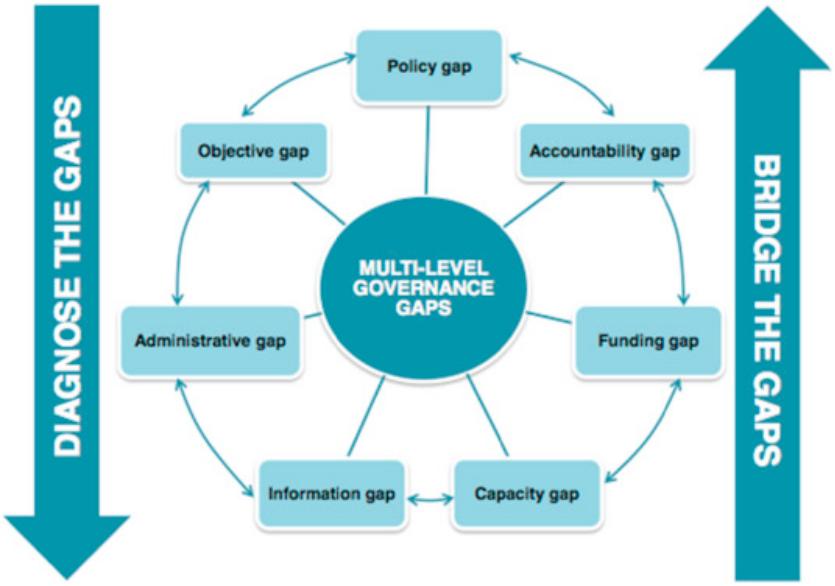

Fig. 5. Water governance gaps
Adopted from Akhmouch and Correia (2016)

Table 1 Seven key gaps hindering water governance

Gap	Description
Policy gap	Overlapping, unclear allocation of roles and responsibilities
Administrative gap	Mismatch between hydrological and administrative boundaries
Information gap	Asymmetries of information between central and sub-national governments
Capacity gap	Lack of technical capacity, staff, time, knowledge and infrastructure
Funding gap	Unstable or insufficient revenues of sub-national governments to effectively implement water policies
Objective gap	Intensive competition between different ministries
Accountability gap	Lack of citizen concern about water policy and low involvement of water users' associations

Adopted from OECD (2011)

There is a need to bridge the gaps of public water governance in order to achieve water security; OECD (2015) suggested a set of policy instruments and good practices for overcoming these gaps in the water sector. OECD (2015) has formulated 12 principles to assist governments at all levels to strengthen water governance to suit current and future water challenges. These principles seek to enhance water governance and manage "too much", "too little" and "too polluted" water in a sustainable, integrated, and inclusive manner with acceptable costs and reasonable time-frames (Akhmouch and Correia, 2016). These principles were developed by the OECD Water Governance Initiative, a multi-stakeholder platform of over 100 delegates from public, private, and non-profit sectors to scale up governance responses to water challenges. A preliminary step to developing these principles consisted in preparing an inventory of tools, guidelines, and principles on water governance to take stock of what already exists. This document comprises 108 governance tools among which 55 are specific to the water sector. These principles were grouped into three dimensions (i.e. effectiveness, efficiency, trust and engagement) and approved by the OECD Regional Development Policy Committee through a written procedure on 11 May 2015 (OECD, 2015) (Fig. 6).

Water governance is good, if it can help to solve key water challenges through using a combination of bottom-up and top-down processes, while fostering constructive state-society relations (Akhmouch and Correia, 2016; OECD, 2015). "Governance is bad if instead of focusing on solving problems effectively and efficiently, it ends up generating unnecessary bureaucracy with the corresponding transaction costs and ultimately not responding to the real place-based needs" (Akhmouch and Correia, 2016: 18). Based on this, the second objective (corresponding 2rd paper) takes a close look at relevant policy instruments and practices which could be applied by public authorities for solving challenges and improving the governance of *Ab-bandans*.

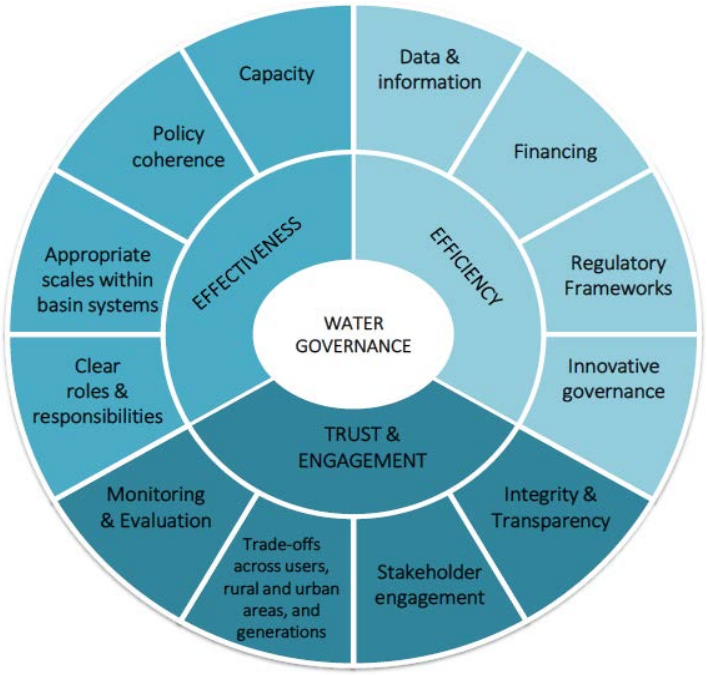

Fig. 6. Overview of the principles and three mutually reinforcing OECD dimensions of water governance. Adopted from OECD (2015) and Akhmouch and Correia (2016)

Effective and good water governance is not only related to the decisions of water managers and administrators to solve the water problems of today and in future, but also addresses how societies can manage their water resources in a wise manner (Hoekstra, 2011). Governance refers to all processes of governing undertaken, not only by the government, but also by informal institutions such as families, tribes, or local communities (Bevir, 2013). Therefore, water governance at the local level considers the capability of various social stakeholders to manage water resources in a collective manner (Solanes and Jouravlev, 2006). Kelly et al. (2017) argued that social capital is an important factor, which facilitates collective interaction of the local community for the governance and conversation of water resources. There are stronger possibilities of enhancing collaborative governance of natural resource management at the local level when social capital is forthcoming within the communities e.g. trust, reciprocity, and cooperation (Musavengane and Simatele, 2016). Musavengane (2019) mentioned that challenges of social capital, which mainly influences collaborative environmental management at the community level, are: power structure, the exclusion of stakeholders in decision making, lack of feedback, lack of transparency, lack of trust, and divergent interests. There is no doubt that, in order to find sustainable solutions to the water crisis, the issues of community co-operation and

empowerment in water resource management have to be promoted (Tantoh and Simatele, 2017). Musavengane (2019: 46) argued that "community participation is at the heart of environmental governance, as it facilitates and promotes a sense of ownership in any decision making and social development issues of a society". Lopez-Gunn (2003) pointed out that farmer self-governance in the management of water resources is based on key principles such as participation, adequate level of action, and empowerment. Therefore, in the third objective (corresponding 3rd paper), five central components of social capital i.e. trust, co-operation, social network cohesion, leaders and their roles, and conflict resolution mechanisms are used to examine how social capital can be implemented as an instrument for promoting collective interaction among local stakeholders for self-governance of *Ab-bandans*. Fig. 7 illustrates schematically the general framework in this dissertation.

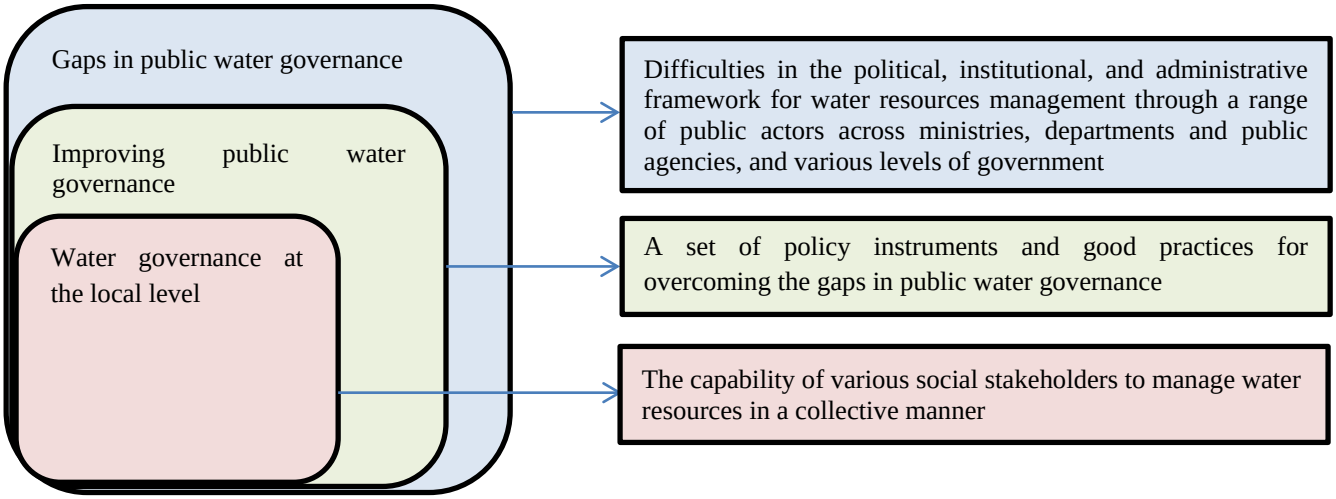

Fig. 7. General structure of the research objectives

1.7 Outline of the dissertation

This dissertation consists of three papers which are based on the research objectives. All three papers have been submitted to reputable international peer-reviewed journals, two of which have been published. These papers form the basis of this cumulative Ph.D. dissertation. The current Chapter (Chapter 1) includes: introduction, research problem, research questions and objectives, and theoretical framework), Chapter 2, 3, and 4 present these three papers. The first and second papers have already been published in the Journal of "*Environmental Science and Policy*" and "*Agricultural Water Management*", respectively. The third paper has been submitted to the "*Human Ecology*". Finally, Chapter 5 concludes with a summary of the main results and discussion, limitations, significance and contribution of the research, and policy recommendations for the improvement of the governance of water reservoirs in Northern Iran. Fig. 8 summarises the outline of this cumulative Ph.D. dissertation.

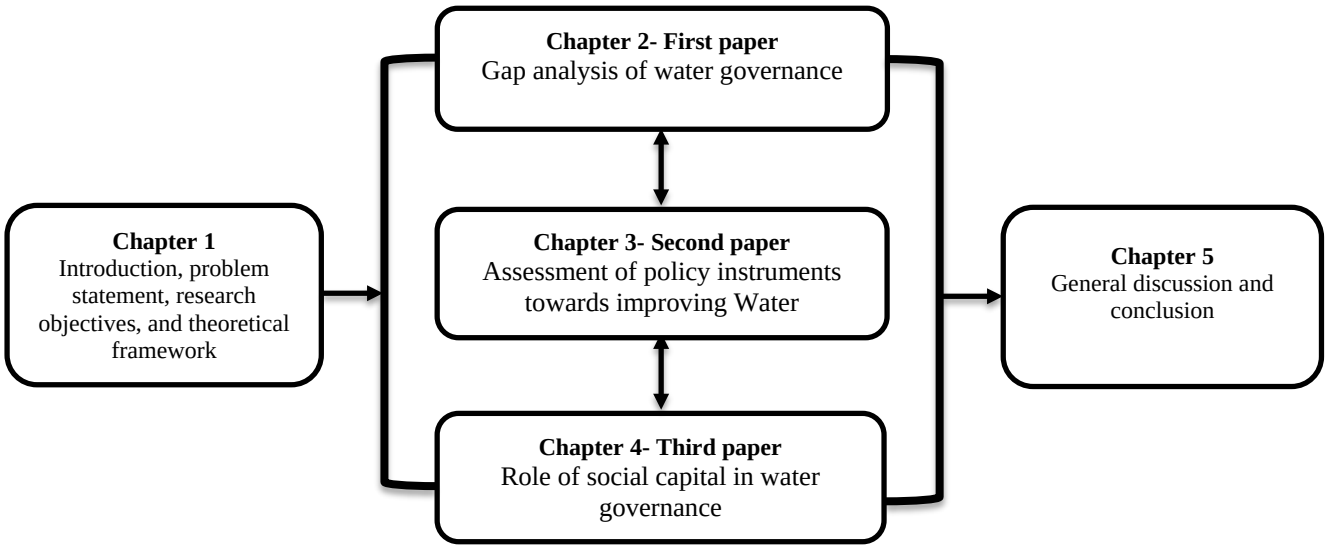

Fig. 8. Outline of the cumulative Ph.D. dissertation

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Chapter 2

Gap analysis of water governance in Northern Iran: A closer look into the water reservoirs

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Gap analysis of water governance in Northern Iran: A closer look into the water reservoirs

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ABSTRACT

The amount of rainfall in Mazandaran province of Northern Iran is high. Mazandaran has man-made water reservoirs called *Ab-bandan*, to collect rainfall for irrigating rice farms during the growing seasons. However, rice farms face water scarcity because only a small amount of rainfall is being stored in *Ab-bandans*, while either the remaining water runs off into the sea, or causes water-logging or flooding. This research addresses *Ab-bandans* governance gaps in the Mazandaran province, using the 'Multi-level Governance Framework' introduced by the Organization for Economic Co-operation and Development (OECD). A modified Delphi technique with face-to-face interviews and a ranking round is used to identify *Ab-bandans* governance gaps. The identified gaps are classified into seven categories by applying the OECD's framework. In each of the categories there is one most important gap: the lack of a specific law for *Ab-bandans*, lack of long-term and strategic planning, low recognition of *Ab-bandans* at the national level, insufficient budget, lack of water user associations, lack of research in practice, and lack of using technology. The findings show that lack of a specific law for *Ab-bandans* in the country's water law is the most acute gap of all. In addition, the analysis highlights the fact that the policy category is the most critical one. The identified gaps are interlinked and exacerbate each other, therefore, a holistic perspective is needed to understand and resolve them. This study recommends a reform in the country's water law, improved linkage between levels of government, co-operation among organizations involved in *Ab-bandans* management, and participation of local stakeholders in planning.

1. Introduction

Water is the main component required for the production of food supplies to feed the increasing population (Kumar, 2003). The key message of the International Federation of Agricultural Producers (IFAP) (2005: 3) is "without water, there is no agriculture and therefore no food security". Consequently, water conservation and efficient use of water resources are the main challenges in the 21st century (Samian et al., 2015).

Iran is a semi-arid country with an average annual rainfall of approximately 250 mm. However, due to the adjacent Caspian Sea and mountain ranges of Alborz, the amount of rainfall in Mazandaran province of Northern Iran is exceptionally high, with an average annual rainfall of 749.9 mm (Ministry of Energy Iran, 2015; Modarres, 2006). Moreover, 37% (199,000 ha) of the land in Mazandaran is used for rice cultivation, which is the staple food in Iran (Ministry of Agriculture Iran, 2016).

In Mazandaran, there is a 'traditional water harvesting system' called *Ab-bandan* (Ghoddousi, 1999). In fact, *Ab-bandans* are man-made 'water reservoirs' or 'artificial wetland' with different sizes ranging from 3 to 1000 ha (Abbasian et al., 2014). The main purpose of these water reservoirs is the collection of rainfall during the rainy seasons (autumn and winter) for irrigating rice farms during the growing seasons (spring and summer) (Abbasian et al., 2014). However, rice farms face water scarcity during the growing seasons as less than 10% of rainfall is being stored in *Ab-bandans*. The remaining water either runs off into the sea through rivers and streams, or causes water-logging or flooding, which reduce soil fertility and negatively affects the rice production (Ministry of Agriculture Iran, 2016). This leads to the question: why do rice farms in the rainy province of Iran encounter water stress although *Ab-bandans* have a huge potential to harvest the rainfall and drainage water?

As stated by the Second World Water Forum in the Netherlands "Water crisis is mainly a crisis of governance" (GWP, 2000: 16). The

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water crisis is not due to water shortage because sufficient water exists for all people, even in areas where there is a temporary shortage of water. It is caused by the mismanagement and public governance crises (OECD, 2011). Moreover, Madani (2014) underlined that water scarcity in Iran is rooted in managerial, political, and institutional challenges rather than engineering and technical issues and that the country is suffering from challenges in the water governance. This draws attention to the factors hindering effective governance in the case of *Ab-bandans*.

Using the 'Multi-level Governance Framework' (OECD, 2011) as a conceptual basis, this study identifies water governance gaps with the focus on *Ab-bandans* in the Mazandaran province of Northern Iran. Identifying the gaps could provide input for policy-makers in order to prioritize options to strengthen *Ab-bandans* governance.

This paper contributes to the empirical literature on water governance by: 1) Identifying gaps in *Ab-bandans* governance; 2) Classifying the gaps into categories by applying the 'Multi-level Governance Framework'; 3) Prioritizing the gaps in each category; and 4) Prioritizing the categories. The paper is structured as follows: The theoretical background is discussed in Section 2; the research area and *Ab-bandans* characteristics are described in Section 3; followed by the methodology in Section 4; Results and discussion in Section 5; and Conclusion in Section 6.

2. Theoretical background

Food security plays a significant role in the national security of a country and nowadays providing food security is the most serious challenge for human society (Kang et al., 2017; Meskhia, 2016). The Food and Agriculture Organization (FAO) emphasized that food security without water security cannot be achieved (Bertilsson, 2012). Water management is the main component of water security in the agricultural sector and is necessary for the achievement of food security by increasing the production of three stable foods i.e. wheat, maize, and rice in the world (USAID, 2015).

The United Nations introduced integrated water resource management in the late 1990s as an ecosystem-based approach. This approach considers the relationship among natural resource systems, biophysical processes, and socio-economic systems as a whole for water management (UNDP, 2004). Implementing integrated water management needs a new approach with significant changes in existing interactions between politics, laws, regulations, institutions, private sector, and civil society, which lead to the formation of the concept of water governance (Rogers and Hall, 2003).

Water governance includes processes, actors, and institutions involved in making decisions for development and management of water resources as well as water service delivery in political, social, economic, and administrative dimensions at different levels (international, national, and regional) (FAO, 2014; GWP, 2000; Rogers and Hall, 2003). According to OECD (2015a: 5), water governance is "the range of political, institutional and administrative rules, practices, and processes (formal and informal) through which decisions are taken and implemented, stakeholders can articulate their interests and have their concerns considered, and decision-makers are held accountable for water management".

OECD (2015a) clarified water governance as good governance if it applies a combination of bottom-up and top-down processes to resolve water challenges while fostering constructive state-society relations. However, bad governance causes increasing social and political risks, institutional failure, and reduces the capacity to deal with related problems (Rogers and Hall, 2003).

Addressing governance challenges in water policies is crucial in terms of achievement of 'right' governance in the water sector (OECD, 2011; Tropp, 2007). The Organization for Economic Co-operation and Development (OECD) identified governance gaps in water policies by applying the 'Multi-level Governance Framework'. OECD (2011) stated that a multi-level approach is required for water governance because the water sector involves a multiplicity of political and administrative organizations at different levels i.e. local, regional, national, international, and in addition, citizens, private actors, end users, service providers, etc.

This analytical framework is a guideline for policy-makers in all countries in order to distinguish public governance gaps regardless of the institutional setting (OECD, 2011). It has already been employed in 17 OECD member countries (OECD, 2011) and 13 Latin American countries (OECD, 2012), as well as focusing more at the national level in the case of Mexico (2013), Netherlands (2014a), Jordan (2014b), Tunisia (2014c), and Brazil (2015b).

The OECD's framework categorizes water governance gaps into seven categories (policy, administrative, information, accountability, objective, funding, and capacity):

1) The policy category is due to fragmentation of roles and responsibilities in the water-related policies. Water policy coherence relies on institutional settings and allocation of tasks at the different levels of government.
2) The administrative category refers to the mismatch between administrative zones and territorial organizations. This gap deters integrated and territorially customized planning for effective water management. The type and number of public agencies involved in the water-related processes are also elements, which should be addressed in the administrative category.
3) The information category includes a weakness in producing information and the inability of governments to share the existing water data. Moreover, this category indicates that most governments are suffering from the scattering of the water data across ministries and agencies.
4) The accountability category is generated when governments are not able to provide transparent and trustable evidence in water policy performance. Ensuring accountability is not possible without the monitoring of procedures and actions by governments and citizen participation.
5) The objective category is about the unclear objectives of water governance and conflicts among them in the context of economic, social, and environmental issues.
6) The funding category addresses a lack of sufficient budget to be able to undertake required activities for water management such as the construction and maintenance of infrastructure.
7) The capacity category is considered to be the insufficient knowledge, lack of human resources, and obsolete infrastructure and technology.

3. Research area description and *Ab-bandans* characteristics

Mazandaran Province with an area of 24.000 km^2 (1.46% of the total area of Iran) is one of the green provinces in the Northern plateau of Iran adjacent to the Caspian Sea. The climate of the area is divided into two parts: Mountainous and moderate (Kheyroddin and Hedayatifard, 2017; Khoshbakht and Hammer, 2006).

Ab-bandans are constructed by digging the land and compressing the soil to construct a wall around the excavated pond for collecting water during the rainy seasons (Ejlali et al., 2012). There are 880 *Ab-bandans* in Mazandaran with an area of around 17,000 ha and depths varying from 1.5 m to 4 m (Mazandaran Regional Water Authority, 2016). Although accurate information on the history of *Ab-bandans* is not available, it is assumed that they are 3000 years old (Kamali and Mahdiyan, 2001; Rahimi Farahani et al., 2012).

The potential for storing water in *Ab-bandans* is 331 million m^3, which is a considerable amount in comparison to the volume of large dams (304 million m^3) in this area (Mazandaran Regional Water Authority, 2016). Although the main purpose of these water reservoirs is the storage of water for rice cultivation, they also play an important role in recharging underground water and wells, collecting drainage

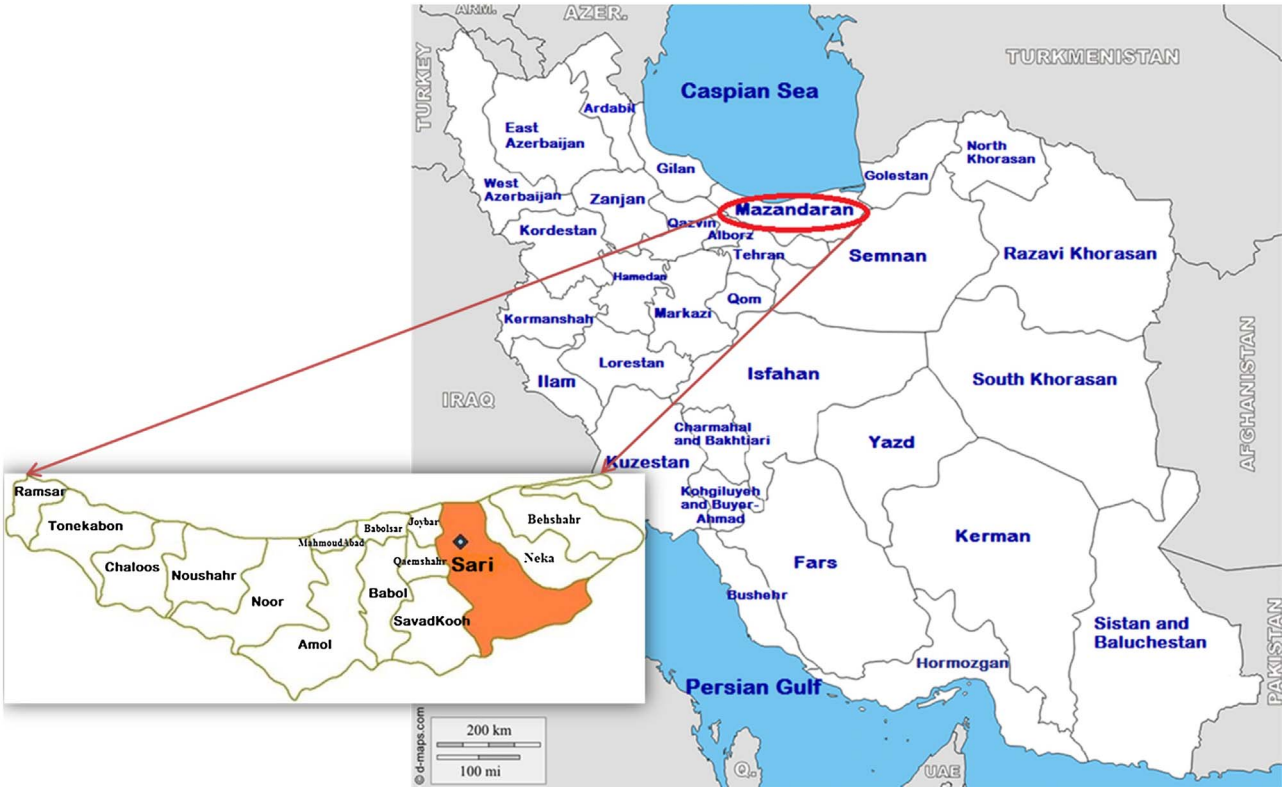

Fig. 1. Geographical location of the research area.
Adopted from: http://www.d-maps.com

water, aquaculture, habitat for birds and plants, attracting tourism, creating jobs, and preventing the migration of rural people to the cities (Salabi, 2010) (Fig. 1).

4. Methodology

This study aims to reveal *Ab-bandans* governance gaps in the Mazandaran province of Northern Iran by applying a Delphi technique. Originally the Delphi technique was developed by Dalaki, Helmer, and Ryshr at the RAND Corporation (Santa Monica, California) in the 1950s for forecasting technological issues in the future (Hasson et al., 2000; Keeney et al., 2011). The classical Delphi technique is defined "to gain consensus through a series of rounds of questionnaire surveys (usually two or three), where information and results are fed back to panel members between each round" (Hanafin, 2004: 4). Rowe and Wright (1999) characterized the classical Delphi technique by the anonymity of Delphi participants, iteration, controlled feedback, and statistical aggregation of group responses.

The Delphi technique has been commonly utilized in a broad range of research when the purpose of a study is to forecast, develop, identify, and validate the subject under investigation (Skulmoski et al., 2007). This approach is appropriate when there is contradictory information, uncertainty or lack of knowledge on a subject (Giannarou and Zervas, 2014; Hasson et al., 2000; Powell, 2003). As the Delphi technique is "a rapid and efficient way to cream the tops of the heads of a group of knowledgeable people" (Dalkey, 1969: 415), this technique was considered to be suitable to identify *Ab-bandans* governance gaps.

The Delphi technique is carried out with the participation of individuals as a panel of experts who have knowledge and expertise on the research subject (Adler and Ziglio, 1996; Skulmoski et al., 2007). In our case, persons who are working in public organizations and the private sector pertaining to *Ab-bandans* were selected as Delphi participants (see Fig. 2).

Although different stakeholders at the local level e.g., farmers, farmers' representatives, fishermen, and local officials play an equally important role in *Ab-bandans* governance, this paper focuses on the public water governance. Therefore, we addressed the public actors at the regional level. Additionally, we considered private actors who influence public governance issues.

We used purposive and snowball sampling to select the Delphi participants and started with eight candidates who one researcher knew. A consent form, invitation letter, and a study information sheet were given to the candidates in person. This documentation included information on the research topic and objective, description of the OECD's water governance gaps, and the approximate total time span required for the research. Additionally, we asked for other possible candidates and finally, 30 people agreed to act as Delphi participants.

We used a modified Delphi technique, which implied having face-to-face interviews for the first round (Davidson, 2013). The collection of qualitative data through interviews helps to ensure the content validity and a more reliable conclusion by triangulation (Atieno, 2009). Moreover, the individual ranking is vital to assess consensus among panel members (Schmidt, 1997). Therefore, we employed a 'ranking-type' of modified Delphi techniques which generally involves three rounds: Brainstorming, Narrowing-down, and Ranking (El-Gazzar et al., 2016; Poba-Nzaou et al., 2016; Schmidt et al., 2001). In our case, the 'Narrowing-down Round' was skipped (Poba-Nzaou et al., 2016) since the number of extracted gaps from the first round was manageable for the next round (El-Gazzar et al., 2016). As shown in Fig. 3, the modified Delphi technique was conducted in two rounds as follow:

In the 'Brainstorming Round', we used 'semi-structured face-to-face' interviews (Delbari et al., 2016; Hasson et al., 2000; Lai et al., 2015) with 30 participants in order to collect initial data and to attract maximum participation. The average time of interviews was 60 min (45–75 min). We conducted the interviews in the form of dialogue using probing questions based on the OECD's water governance gaps to create a guideline for the interviewees to make deeper consideration regarding *Ab-bandans* governance gaps.

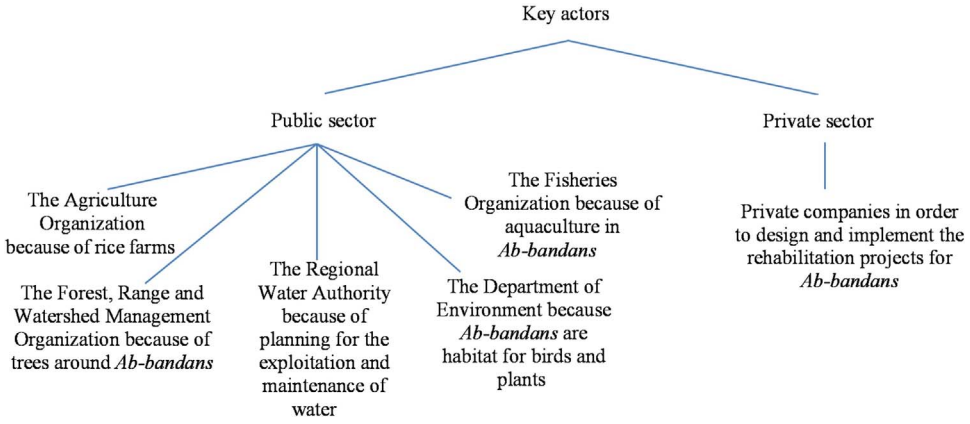

Fig. 2. Key actors in *Ab-bandans* governance at the regional level.

All the interviews were recorded and transcribed verbatim. To confirm the credibility and rigor of the interviews, a copy of the transcripts was returned to the participants for their approval. Therefore, the majority of participants were involved in the interpretive process of the initial data and this improved mutual understanding. We reviewed the transcripts to extract *Ab-bandans* governance gaps and we identified 34 different gaps after combining similar cases and removing duplicates.

Then, we conducted the 'Ranking Round' to assess consensus among the participants on the gaps provided in the brainstorming round. A structured questionnaire was designed based on the gaps with a five-point Likert scale (from very low = 1 to very high = 5). Afterwards, we distributed the questionnaires to the participants and asked them to rate the importance of each gap.

We applied the Standard Deviation (SD) to estimate the level of consensus among the participants (Duncan et al., 2008; Rayens and Hahn, 2000; Schmidt, 1997). The level of consensus is high if SD is equal or smaller than one (Henning and Jordaan, 2016). The results of ranking round showed that a high consensus was reached on 29 out of 34 gaps. It is necessary to note that the results are 'participants' consensus', and that does not mean 'best' or 'correct' responses have been found. However, in order to illustrate these aggregated consensus gaps, we make use of selected quotations from the interviews in the results section, indicating the interviewee with a participant's number.

Achieving a consensus is not meaningful if researchers do not consider stability/internal reliability of responses (Von der Gracht, 2012). Stability of responses means "the proportional consistency of variance among raters" (Murphy et al., 1998: 60). The Wilcoxon Signed-Rank test is appropriate to examine the stability of responses (Poba-Nzaou et al., 2016; Trevelyan and Robinson, 2015; Von der Gracht, 2012). To determine the stability of responses, the ranking round was repeated with the consensus gaps. The Wilcoxon test indicated that there is no significant difference between the responses of the first and second ranking for 24 out of 29 gaps. This means that the results are stable and reliable.

Further analysis was done by ordering the consensus gaps into the seven categories of OECD's water governance gaps; in addition, we used the Mean to show the priority in each category to determine the more acute gaps. Ultimately, the Friedman test was applied to rank the categories.

5. Findings and discussion

Table 1 indicates *Ab-bandans* governance gaps in the seven categories of OECD's water governance gaps and the Mean shows the priority of gaps in each category. The following subsections include a discussion of each of the gaps.

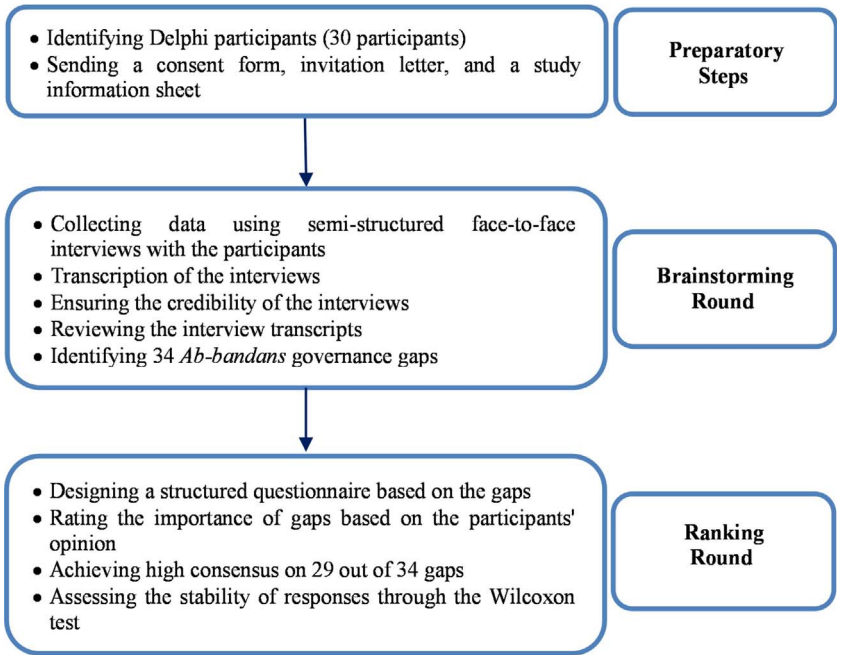

Fig. 3. Consecutive steps of the modified Delphi technique.

Table 1
Prioritizing *Ab-bandans* governance gaps in the categories (n = 30).

Category	Gaps	SD	Mean	Rank
Policy	Lack of a specific law for *Ab-bandans*	0.37	4.92	1
	Fragmentation and overlapping of tasks across organizations involved	0.67	4.64	2
	Unclear ownership status of *Ab-bandans*	0.69	4.50	3
	Interference of influential and political individuals	0.70	4.14	4
	Lack of legal support or authority to enforce general legislations	0.63	4.03	5
Objective	Lack of codified, long-term, and strategic planning at the regional level	0.57	4.46	1
	Lack of comprehensive planning for simultaneous use of *Ab-bandans* functions	0.76	4.07	2
	Water issue is not a priority for the central government	0.66	4.00	3
	Lack of technical instructions	0.62	3.89	4
	Lack of environmental guidelines	0.92	3.42	5
	Diverging or contradictory objectives and interests	0.91	3.39	6
Administrative	Low recognition of *Ab-bandans* at the national level	0.59	4.71	1
	Lack of a specific agency for *Ab-bandans*	0.62	4.39	2
	Less attention paid to the importance of *Ab-bandans* compared to dams	0.54	4.17	3
	Lack of attention to benefits and potentials of *Ab-bandans*	0.62	4.10	4
Funding	Inadequate funding for *Ab-bandans* rehabilitation	0.69	4.42	––
Accountability	Lack of water user associations	0.65	4.28	1
	Government ignorance of local participation	0.74	3.96	2
	Lack of monitoring and evaluating *Ab-bandans* rehabilitation	0.78	3.78	3
	Conflicts between local stakeholders and government	0.76	3.71	4
	Corruption in rehabilitation projects	0.61	3.67	5
	Unwillingness of farmers to take active participation	0.83	3.50	6
Information	Lack of research in practice	0.59	4.14	1
	Lack of accurate and clear statistics/information	0.84	3.75	2
Capacity	Lack of using technology	0.62	4.10	1
	Technical problems	0.54	4.00	2
	Lack of farmers' knowledge and perception toward the water conservation	0.81	4.00	3
	Not taking into account the ideas of experts	0.74	3.96	4
	Lack of an appropriate extension system	0.70	3.85	5

5.1. Policy category

The lack of a specific law for *Ab-bandans* is the most acute gap (M = 4.92), not only in the policy category but also in all the gaps identified. The majority of participants mentioned that there is no legal status for *Ab-bandans* because they are just restricted to Northern Iran. They explained that underground water resources (called *Qanat*) could be found in most parts of Iran but *Ab-bandans* do not exist anywhere in the country except in the Northern areas. Document review of the approved laws by Iran's parliament confirms this result Among approved laws, there are 12 acts related to the environment and 84 acts related to the water issue, which have been adopted at the national level. Examples are the Law on Preserving Groundwater Resources, 1966; Nationalization of Water Resources Act, 1968; Water Equitable Distribution Law, 1982; Law on Crop Water Price Fixation, 1990; and Law on Promotion of Investment in Water Projects, 2002. The above-mentioned laws do not refer to *Ab-bandans* and to their regulations.

Another policy gap is the unclear ownership status of *Ab-bandans*. "*The ownership status of Ab-bandans is not clear and there are no official documents or evidence to prove legal ownership in villages*" (participant 26). Participants believed that farmers upstream and downstream of the reservoirs, or even users of a common reservoir, claim ownership and utilization which leads to social conflicts. It seems that the claim to ownership is due to the uncertainty of the farmers whether they have reliable access to the water. Subsequently, the use of the water reservoirs for other purposes e.g., fishing could be difficult. Bayat et al. (2015) mentioned that due to lack of clear water rights, increasing demand for limited water resources causes conflicts and tensions among different users.

Furthermore, there is no legal support or authority to enforce general regulations to prevent farmers from destroying the reservoirs. "*Ab-bandans close to the rice farms with no clear boundary and geometric shape are gradually being grabbed by farmers*" (participants 19, 30). Participants stated that the economic value of land in Northern Iran is high and this motivates farmers to enter the boundaries of *Ab-bandans*. However, the government does not take trespassing by farmers seriously. As Costa Barbosa et al. (2016) expressed the absence of authority and commitment by government representatives are the important reasons for lawlessness.

Another identified policy gap is fragmentation and overlapping of tasks across organizations involved. "*Decision-making and planning processes for Ab-bandans are scattered among several organizations*" (participant 17). *Ab-bandans* suffer from a sectorial perspective across organizations involved, and the multiplicity of public actors is not coordinated. Roles and responsibilities are not clearly allocated across various governmental agencies. Formulation of water policies is more than finding relevant technical solutions to space, time, quantity, quality, availability, and water needs (Akhmouch and Correia, 2016). The first step for water policy reforms would be to arrange 'comprehensive institutional mapping' in order to understand who decides, what decisions are made and at which level (OECD, 2011, 2013).

The next gap is "*political representatives interfere in the management of Ab-bandans, for instance; interference in water pricing or budgeting for Ab-bandans rehabilitation*" (participants 22, 30). Participants noted that political representatives mainly seek influence over the water-related decision-making and planning with the intent of achieving local and regional political power and interests. It seems that the water issue is turning into a political tool in the research area. OECD (2015b) already mentioned that interference of influential groups is an important challenge in water governance.

5.2. Objective category

Lack of codified, long-term, and strategic planning at the regional level is identified as the most important objective gap. "*The regional state does not attempt to prepare a systematic and long-term plan for Ab-*

bandans" (participant 21). Participants cited that the management of *Ab-bandans* is not based on long-term targets and territorialized planning in consistence with the ecological, economic, and social features, which are typical for the area. Likewise, integrated planning for simultaneous use of various potentials of the reservoirs is being neglected.

It seems that the absence of strategic planning is not restricted to the water reservoirs in Northern Iran. As two participants highlighted "*there is no comprehensive and long-term approach to deal with the water crisis at the national level of management and also delay occurs in the enforcement of general plans*" (participants 21, 22). Participants believed that despite the importance of water, it is not a priority in the country and no broad and expertise visions exist regarding the water crisis at the national level. OECD (2011) reported that objective gaps focus on governance problems in terms of strategic planning and regional development of water policy. The policies in the water sector should focus mainly on the long-term actions including pre-evaluation, advisory system, implementation, post-evaluation, stakeholders' participation, and a time frame for all activities.

Lack of instructions for designing, exploitation, rehabilitation, and maintenance of *Ab-bandans* is considered to be an objective gap. Participants stated that parameters relevant to the construction and rehabilitation of other hydraulic structures e.g., dams, cannot be used for *Ab-bandans*, and specific parameters regarding the climate condition and soil type in the area are necessary.

There is also a lack of guidelines on environmental issues. "*Urban and rural rubbish is left around the reservoirs and landfill leachate comes into the water*" (participant 28). Participants believed that pesticide contamination of the water and rise of non-native plants e.g., water hyacinth are additional problems, due to the lack of certain environmental guidelines. As might be expected, developing environmental regulations depends on the extent to which legislators at the national level are familiar with *Ab-bandans* and their characteristics. Kjeldsen et al. (1999) concluded in their study that inattention to environmental considerations in water policies could be an important risk for sustainable water resource management.

Diverging or contradictory objectives and interests is another objective gap. "*Each organization wants to implement its own policies, objectives, and perspectives*" (participant 19). Participants mentioned that each organization is aware of its own priorities, but is not willing to take the priorities of other organizations involved in *Ab-bandans* manamgent into consideration. For instance, the Department of Environment has opposed dredging because most *Ab-bandans* are a habitat for birds and plants, and natural habitats could be destroyed by dredging. However, dredging is required to increase the water storage capacity. Thus, coherence planning cannot be approached due to the contradiction between relevant actors' decisions. Chereni (2007) believed that the integration of objectives can only be improved through relationship and co-ordination between the organizations involved.

5.3. Administrative category

Low recognition of *Ab-bandans* at the national level is the most significant administrative gap. "*Government and regulatory officials at the national level are not aware of the local water resources in the Northern areas*" (participants 30, 23). Participants believed that the lack of accurate recognition of *Ab-bandans* by the central officials might be a major reason why there is a lack of law for *Ab-bandans* in the country's water law.

Lack of a specific and single agency in charge of *Ab-bandans* at the regional level is the next administrative gap, which raises difficulties for effective management. A number of participants pointed out that the responsibility for managing the water reservoirs over the years has been transferred between two organizations: the Agriculture Organization and the Regional Water Authority. Since their management period is temporary, they do not tend to design long-term and comprehensive plans. Saleth and Dinar (1999) said that water administration, as the hardware ingredient in the water sector will be empowered through law and policy as the software ingredient for the water sector.

Further administrative gaps include paying too little attention to the importance of *Ab-bandans* compared to dams, and the lack of attention to benefits and potentials of *Ab-bandans*. "*Non-experts recommend construction of dams as a solution for the water crisis due to financial or political interests without paying attention to the technical and environmental considerations*" (participants 26, 22). Participants believed that *Ab-bandans* are small-scale reservoirs based on the indigenous knowledge of farmers and are compatible with the local ecosystem. A considerable amount of water can be stored and the cost for their construction and maintenance is trivial in comparison to dams. Moreover, *Ab-bandans* from the perspective of participants have a high level of multi-functionality. Molden et al. (2001) noted that institutions in the water sector should change their manner from a development of technical solutions (construction of infrastructure) to enhance the optimum use of water resources.

5.4. Funding category

"*The budget allocated by the government for the rehabilitation of Ab-bandans is unstable and insignificant considering the high number of Ab-bandans in the area*" (participant 30). Although the rehabilitation of reservoirs is necessary after several years of use (between 5 and 10 years), according to the participants, the central government does not allocate sufficient budget due to the low recognition of the water reservoirs and lack of regulations for them. Dinar (2000) stressed that a close relationship exists between financial circumstances and water service quality.

5.5. Accountability category

Lack of water user associations is the major gap in the accountability category. "*The government does not attempt to create water user associations and engage local stakeholders in all stages of decision-making, planning, construction, exploitation, and maintenance*" (participant 28). The government does not see local participation as an opportunity to improve the management of *Ab-bandans*. Since the water reservoirs are located in villages, attention to the role of local stakeholders is inevitable. Yazdanpanah et al. (2013) argued that the current water crisis in Iran resulted from a top-down process. Policy-makers could consider participatory water governance and collaborative decision-making as a part of a more decentralized process. Akhmouch and Correia (2016) stated that participation of users in water management builds public trust as a governance principle.

The next gap is "*the culture of participation and collective action is weak among farmers and they are not willing to take active participation*" (participant 27). Participants explained that farmers seek individual and short-term interests, particularly in the time of farm irrigation without considering the benefits of other farmers.

Furthermore, there are conflicts for the revenues of *Ab-bandans* between farmers and public organizations. "*On the one hand, farmers claim that the reservoirs have been located in their villages for many years, so all the benefits must belong to the villages. On the other hand, Ab-bandans have recently become appealing to the government due to the economic interests*" (participant 19). The government claims that according to the Water Equitable Distribution Law, all the water resources belong to them and they are responsible for administration, authorization, and controlling. Bijani and Hayati (2015) called these kinds of disputes 'open conflict' and they documented that the top-down water management by governments is a reason for increasing conflicts.

Another accountability gap is corruption in the rehabilitation projects. The majority of participants from the private sector agreed that the selection of private companies by the government for rehabilitation projects is not based on expertise and experience, but on collusion,

bribery, and lobby with the government officials in order to obtain the projects. Angelsen et al. (2009) and Welsch (2002) concluded that poor management by organizations, lack of proper planning and policy-making, lack of democracy, low capacity of accountability and transparency as well as the power of officials at top level and their economic motivations are the main reasons for corruption in environmental management.

Moreover, findings indicate that there is no monitoring system to evaluate the quality of *Ab-bandans* rehabilitation. Participants highlighted that many engineering standards are neglected during *Ab-bandans* rehabilitation. According to UNESCO (2015), a governance system needs a strong commitment for good accountability.

5.6. Information category

Lack of research in practice is the most significant information gap. "*The academic community does not have a correct understanding of the realities and problems related to Ab-bandans*" (participant 24). According to the participants, most academic research does not have enough applicability in actual practice. This is attributed to preferences of academics to publish their research in journals and improve their scientific background and/or to obtain research funding, rather than focusing on real difficulties in rural areas. The solutions for current and future water problems have to be based on 'science' and this requires a multi-disciplinary and interdisciplinary approach (Jury and Vaux, 2005).

"*Statistics and information about Ab-bandans e.g., number, size, boundaries, storage volume, the size of farms being supplied, number of users, quantity and quality of runoff, history, etc. are missing or scattered among different organizations and existing information is not updated regularly*" (participants 24, 17). Participants emphasized that in absence of a coherent mapping and precise information on *Ab-bandans*, farmers simply can trespass on *Ab-bandans* boundaries without the option to prove this by the state. Obviously, accurate qualitative and quantitative information could provide a basis for useful planning for the water reservoirs.

5.7. Capacity category

Lack of using technology is the major capacity gap. "Since '*flow meter' is not being used, the volume of water entering and leaving the reservoirs is not measured*" (participant 28). Participants explained that water consumption in farms cannot be estimated because there is no technology to measure the rate of water being supplied to the farms. Lack of using technology e.g., flow meter, modern gate, pump station, concrete canal, etc. prevents the efficient use of stored water. As Jury and Vaux (2005) said applying advanced technology in on-farm water management plays a vital role in dealing with water scarcity.

Another important capacity gap is "*the water reservoirs are old hydraulic structures and suffer from technical problems like the accumulation of sediments, wall subsidence, leakage, shallow depth, poor drainage, etc*." (participant 25). These problems reduce the water storage capacity and a large volume of stored water escapes. According to the participants, insufficient budgets for *Ab-bandans* rehabilitation and lack of attention to the engineering standards in rehabilitation e.g., inadequate soil compaction have a dramatic impact on the technical defects.

The next gap is "*many farmers assume that water is a free commodity with no economic value. They are not aware of the real value of water*" (participants 30, 25). According to the approved water tariffs by Iran's parliament, users of historic hydraulic structures are exempted from payment of water charges. Therefore, participants believed that farmers do not appreciate stored water in the reservoirs and cannot see a necessity for the optimum use of water. In addition, lack of farmers' knowledge regarding the maintenance of water reservoirs affects the low efficiency of water usage.

Lack of an appropriate extension system is considered as a capacity gap. "*Extension service for water management is only nominal*" (participant 22). The provincial extension system does not have any training programs to highlight the importance of water and encourage local stakeholders to participate in the sustainable management of water reservoirs. However, there is evidence that encouraging sustainable water management in agriculture needs targeted extension interventions and social learning among the various actors concerned (Ison et al., 2007; Berglund and Dworak, 2010).

A further capacity gap is "*the view of politicians is more important than knowledge and ideas of experts in the water-related decisions. Top managers do not welcome the ideas of thoughtful experts*" (participant 21). Due to this, experts lose their motivation and interest in sharing their knowledge, and they carry out only mandatory requirements for their job. According to Berg (2013), participation and support of staff are required for setting goals and a top-down approach is not efficient for illustration of successful governance.

5.8. Prioritizing categories

As a result of the analyses, we conclude that a number of gaps can be placed in two or more categories simultaneously. As an example, fragmentation of tasks across organizations involved can be classified in the policy and administrative categories. If we assume that the gaps stand only in the mentioned categories, then we could rank the categories by applying the Friedman test. The results of the test indicate that the policy category (M = 5.53) is the most critical one (Table 2). The lack of a specific law for *Ab-bandans* as the most important gap among all the gaps identified highlights the policy category. The absence of a law for *Ab-bandans* in the country's water law leads to other gaps e.g., unclear ownership, conflicts, financial problems, and lack of guidelines and instructions.

It is necessary to note that water governance challenges are often interrelated and can exacerbate each other (OECD, 2011). In the current study, there is interdependence among the gaps in different categories. For instance, insufficient budget from the central government (funding category) results from not only the lack of a specific law for *Ab-bandans* (policy category) but also because of the low recognition of *Ab-bandans* at the national level (administrative category). Furthermore, due to insufficient budget (funding category) and lack of monitoring and evaluating *Ab-bandans* rehabilitation (accountability category), the water reservoirs face technical defects (capacity category).

6. Conclusion

The lack of a specific law for *Ab-bandans* is the most acute gap, not only in the policy category but also in all the gaps identified. Lack of long-term and strategic planning is considered to be the most important gap in the objective category, which is rooted in the absence of a comprehensive approach for water management at the national level. Low recognition of *Ab-bandans* at the national level is the most challenging gap in the administrative category, which can strengthen the lack of law for *Ab-bandans*. The financial gap emerges from the unstable and insignificant budget from the central government. Lack of water user associations is identified as the most significant gap in the accountability category. A poor connection between academic research

Table 2
Prioritizing the categories.

Category	Mean rank	Rank	N	Chi-Square	df	Sig
Policy	5.53	1	30	74.41	6	0.000
Administrative	5.40	2				
Funding	5.35	3				
Information	3.40	4				
Capacity	3.15	5				
Objective	2.75	6				
Accountability	2.42	7				

and the actual problems related to *Ab-bandans* is addressed as the main gap in the information category. Lastly, lack of using technology is the major gap in the capacity category, which prevents the efficient use of stored water in the reservoirs.

The analysis also showed that the policy category is the most critical category among all. However, the significant issue is that there is interdependence among all the categories and they can strengthen one another. Therefore, a holistic perspective is needed to understand and resolve *Ab-bandans* governance gaps. There is no magic or 'one-size-fits-all' approach (OECD, 2011) to overcome the gaps and a mix of solutions is required. This is imperative to note that one solution can help to solve several gaps, and conversely, a single gap may need several solutions.

Reforming and updating the country's water law and determining the legal status of *Ab-bandans* in the water law can be a response to some gaps e.g., unclear ownership status of *Ab-bandans*, lack of technical instructions and environmental guidelines, inadequate funding, and conflicts. A water law for the entire country would not be effective without special regulations for local water conditions. To reform the water law, it is necessary to transfer information regarding the water reservoirs from the government at the regional level to the central government and regulatory officials. In other words, the relationship between levels of government is required to bridge the gaps in *Ab-bandans* governance.

Co-operation of all relevant organizations at the regional level could be a solution to prevent fragmentation of tasks and contradictory objectives. Additionally, organizations involved should agree that *Ab-bandans* governance runs into trouble if planning is only restricted to the government. Therefore, the participation of local stakeholders in the water-related processes could be considered to solve the gaps.

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Chapter 3

Assessment of policy instruments towards improving the water reservoirs' governance in Northern Iran

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Assessment of policy instruments towards improving the water reservoirs' governance in Northern Iran

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ABSTRACT

Man-made water reservoirs called *Ab-bandan* in Mazandaran province, Northern Iran are used to collect precipitation for irrigating rice fields. In spite of their importance, *Ab-bandans* face governance difficulties such as the lack of a specific law, the lack of long-term and strategic planning, and low recognition of these reservoirs at the national level. Therefore, water policy instruments are argued to be needed in order to overcome the barriers and improve water governance. This paper aims to identify and assess relevant policy instruments for the improvement of the governance of *Ab-bandans* by conducting an exploratory sequential research design. Based on interviews with 30 regional experts, 31 policy instruments are identified and grouped into three reinforcing dimensions of water governance; effectiveness, efficiency, and trust and engagement. Afterwards, these policy instruments are assessed by a larger sample of participants through snowball sampling (n = 169). Confirmatory Factor Analysis reveals that, in survey participants' opinion, 28 out of 31 policy instruments identified properly represent three reinforcing dimensions of water governance. The results indicate that the enhancement of collective action among farmers is the policy instrument which contributes more to the improvement of governance. Furthermore, the dimensions are positively related to one another. Therefore, the policy instruments are interdependent and should be addressed in a holistic way.

1. Introduction

Water is the main component required for most activities in human society. All societies need water for basic survival and economic development (Chenoweth, 2008). Thus, the water crisis is one of the key problems of global relevance in the 21 st century (Orr et al., 2009). The water crisis is not due to water shortage because sufficient water exists for all people, even in areas where there is a temporary shortage of water, but a crisis of governance e.g. fragmented institutional structures, and weak regulatory framework result in or exacerbate problems of water availability (OECD, 2011). Scholars in the water sector highlighted the fact that enhancing water governance is the solution to the water crisis (Akhmouch, 2012; Araral and Yu, 2013; Biswas and Tortajada, 2010; OECD, 2015; Rogers and Hall, 2003; Saleth and Dinar, 2005).

The government of Iran blames the current water crisis on the changing climate, frequent droughts, and international sanctions in order to hide the inefficient water management system in the country (Madani, 2014). Many Iranian experts claim that a failure of water governance is the more significant cause of water crisis (Foltz, 2002). Madani (2014) pointed out that the water crisis in Iran is rooted in managerial, political, and institutional determinants rather than engineering and technical issues. Although the climate has varied over the centuries, Iran has always been located in an arid and semi-arid region; therefore, it should not be assumed (as is often the case) that water is scarce in Iran (Yazdanpanah et al., 2013). The average annual precipitation of the country is approximately 417 billion cubic meters (bcm), of which 117 bcm of the precipitation is directly accessible, of which 92 bcm flows as surface water resources, and 25 bcm infiltrates into groundwater resources (Ardakanian, 2005).

In contrast to most provinces, the Mazandaran province located in Northern Iran, which is the most important region for rice production in

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the country, has a high annual average precipitation of 749.9 mm (Ministry of Agriculture Iran, 2015; Ministry of Energy Iran, 2015). A considerable amount of the precipitation in Mazandaran occurs during the non-growing seasons (autumn and winter) (Azmoodeh et al., 2009). In order to collect this precipitation to be used for irrigating rice fields during the growing seasons (spring and summer), there are man-made reservoirs called *Ab-bandan* (Abbasian et al., 2014). In spite of these reservoirs, a significant amount of precipitation runs off into the sea through rivers without being stored (Azmoodeh et al., 2009), sometimes even causing water-logging or flooding (Ministry of Agriculture Iran, 2016). This province has a potential of 4.9 billion m^3 as surface water resources, and of which around 2.2 billion m^3 is being stored and the remaining water flows into the sea (Ejlali et al., 2016). According to a number of regional experts, *Ab-bandans* are not well governed due to the lack of a specific law, the lack of long-term and strategic planning of administrative bodies, low recognition of *Ab-bandans* at the national level, financial problems for rehabilitation of *Ab-bandans*, lack of water user associations, little relevance of academic research on *Ab-bandans* to practice, and poor use of water technology (Mirzaei et al., 2017).

The Organization for Economic Co-operation and Development (OECD) states that practical water policy instruments for local and national governments are needed to overcome barriers (OECD, 2011). Policy instruments refer to the tools used by governments and public authorities to address related problems and achieve a public policy goal (Linder and Peters, 1989). In fact, water policy instruments are tools, strategies, and mechanisms for policy-makers to overcome governance obstacles in water policy; for instance, involving sub-national governments in designing water policy beyond their roles as implementers is a policy instrument to foster effective water management (OECD, 2011). The main purpose of water policy instruments is to enhance water conservation and efficient use of water resources, and a comprehensive evaluation of policy instruments is essential to achieve sustainable agricultural water management (Feike and Henseler, 2017). A lot can be said about different types of policy instruments in general, their respective effectiveness and efficiency, although they have to be adjusted to regional condition (Akhmouch, 2012; Akhmouch and Correia, 2016; Araral and Yu, 2013; OECD, 2015; Rogers and Hall, 2003). Since water governance is highly contextual, water policy instruments have to be appropriate for different places (OECD, 2015).

Although there is literature related to water management in Iran, research which specifically addresses policy instruments for the improvement of the governance of *Ab-bandans* is not existent. Therefore, this paper adds additional value to the scientific and empirical evidence by identifying relevant water policy instruments and assessing the suitability of these multiple instruments in an integrated way towards good governance of *Ab-bandans* in the Mazandaran province of Northern Iran. This paper aims 1) to identify policy instruments for the improvement of the governance of *Ab-bandans*; 2) to cluster these instruments on three OECD reinforcing dimensions of water governance; 3) to assess how and to what extent the instruments grouped in each dimension contribute to the improvement of the governance of *Ab-bandans*. In this paper following the introduction, Section 2 details the theoretical background, explaining the OECD dimensions and principles on water governance; Section 3 introduces the study area; Section 4 describes the sequential exploratory method for collecting and analyzing data; Section 5 presents findings and is followed by a discussion and conclusion of the research findings in Sections 6 and 7, respectively.

2. Theoretical background

Water governance is a broader concept than water management (Moench et al., 2003). It encompasses the political, social, economic, and administrative systems involved in making decisions for management of water resources, as well as water service delivery at different levels of society (Global Water Partnership, 2003). Rogers and Hall (2003: 16) noted that the governance for water is “the ability to design public policies and institutional frameworks that are socially accepted and mobilize social resources in support of them”.

OECD (2015a: 5) defines water governance as “the range of political, institutional and administrative rules, practices, and processes (formal and informal) through which decisions are taken and implemented, stakeholders can articulate their interests and have their concerns considered, and decision-makers are held accountable for water management”. As public authorities are in charge of water resources management in Iran (Ardakanian, 2005), it is crucial to understand their role with regard to the governance of *Ab-bandans* through the effective design and implementation of water policies. This paper focuses on public authorities’ roles for water governance and their involvement in political, institutional and administrative issues; therefore, it takes a close look at water policy instruments which can be applied by public authorities for solving challenges of the governance of *Ab-bandans*.

Governance is considered as ‘good governance’ when it is able to solve challenges for achieving results in a fair and comprehensive manner. Good governance in the water sector leads to sustainable water management for ensuring water security which is consistent with the goals legitimately established by a society (Akhmouch and Correia, 2016). OECD (2015a) clarified water governance as good governance, if a combination of bottom-up and top-down processes is applied to tackle water challenges and resolve conflictive issues related to water resources, while fostering constructive state-society relations. Good or effective governance systems provide processes and structures to facilitate actions for all actors involved in water management and do not create development obstacles (Rogers and Hall, 2003).

Good water governance cannot be achieved with the use of blueprints from outside of the given regions or countries and it has to be aligned with territorial specificities (Batchelor, 2007). However, OECD (2015a) has formulated a menu of principles based on three mutually reinforcing and complementary dimensions of water governance. The OECD principles consider different policy instruments which can be applied by governments at all levels to strengthen water governance to fit for current and future water challenges. The principles were developed by the OECD Water Governance Initiative, a multi-stakeholder platform of over 100 delegates from public, private, and non-profit sectors to scale up governance responses to water challenges. A preliminary step to developing the principles consisted in preparing an inventory of tools, guidelines, and principles on water governance to take stock of what already exists. This document comprises 108 governance tools among which 55 are specific to the water sector. These principles were grouped into three dimensions (i.e. effectiveness, efficiency, trust and engagement) and approved by the OECD Regional Development Policy Committee through a written procedure on 11 May 2015. Each of the dimensions and related principles are explained as follows:

1) The dimension of effectiveness refers to a clear definition of water-related goals and targets at all government levels, so that the goals are well implemented and the expected targets are obtained. The dimension of effectiveness consists of the following four principles:

Principle 1: Clear allocation of roles and responsibilities across levels of government for policy making, policy implementation, operational management, and regulation and enforcement, at the same time fostering effective co-ordination across levels of government.

Principle 2: Managing water at the appropriate scale(s) to reflect local conditions, therefore ensuring an appropriate hydrological management and promoting strategies based on national policies and local conditions.

Principle 3: Encouraging policy coherence through effective cross-sectoral co-ordination mechanisms and recognition and mitigation of conflicts among authorities involved.

Principle 4: Promoting technical, financial, and institutional capacity through training water professionals and stakeholders and hiring public officials and professionals based on required competencies.

1) The dimension of efficiency includes maximizing the benefits of water resource management with minimal costs for society. The dimension of efficiency consists of the following four principles:

Principle 5: Producing, updating, and sharing water-related data and information in a timely, consistent, and comparable manner to guide, assess, and improve water policy. Sharing information with stakeholders and encouraging their engagement in producing information is necessary in order to foster transparency, trust, and comparability.

Principle 6: Promoting governance arrangements that help water organizations across levels of government raise the necessary revenues to meet their mandates and allocate financial resources in an efficient, transparent, and timely manner.

Principle 7: Enforcing appropriate regulatory frameworks effectively so as to achieve water policy objectives and encourage long-term planning.

Principle 8: Promoting innovative water governance practices across levels of government and stakeholders through pilot-testing on water governance, lessons from success and failures, social learning, and scientists' involvement.

1) The dimension of trust and engagement addresses building trust in public organizations and policy instruments and ensuring the involvement of all stakeholders through democracy and fairness for society. The dimension of trust and engagement consists of the following four principles:

Principle 9: Promoting integrity and transparency practices across authorities involved to enable clear accountability and transparent decision-making and implementation.

Principle 10: Promoting stakeholders engagement for designing and implementing water policies through identifying different stakeholders, and their responsibilities and interactions, paying attention to vulnerable groups e.g. women and youth, and mitigating the power of over-represented groups.

Principle 11: Ensuring equity across water stakeholders, rural and urban areas, and generations through non-discriminatory participation, empowering local officials and water stakeholders, promoting public discussions to raise awareness, and assessing the consequences of water policies on citizens, stakeholders, and different areas.

Principle 12: Promoting regular monitoring and evaluation of water policies through dedicated and independent institutions for monitoring and evaluation, developing reliable mechanisms for reports, assessing achievement of intended targets, and sharing results with the public in a timely and transparent manner.

In order to have an effective and long-term water management, a combination of principles should be used for designing water policies (OECD, 2011). An overview of the three mutually reinforcing OECD dimensions of water governance is illustrated in Fig. 1.

3. Study area: geography and *Ab-bandans* characteristics

The Mazandaran Province is located in Northern Iran along the southern coast of the Caspian Sea (53°6′ E, 36°23′N) with an area of 24.000 km^2 (1.46% of the total area of Iran) (Kheyroddin and Hedayatifard, 2017) (Fig. 2). The climate of the area is divided into two types: (1) moderate Caspian weather with hot and humid summers, mild and humid winters, (2) cold mountainous weather with long freezing winters and short cool summers, especially in the mountains (Khoshbakht and Hammer, 2006). It has a high production capacity of agriculture due to humid temperate climate and suitable soil

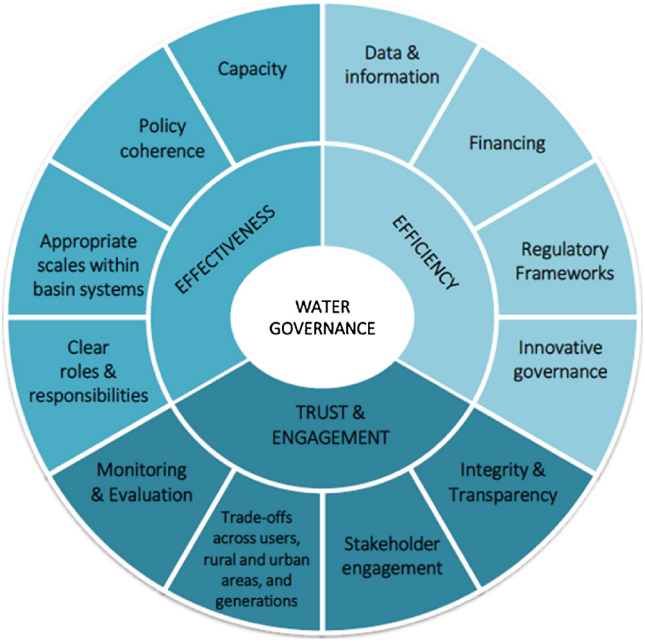

Fig. 1. Overview of the three mutually reinforcing OECD dimensions of water governance.
Adopted from OECD (2015a) and Akhmouch and Correia (2016).

(Khoshbakht and Hammer, 2006). Mazandaran plays an important role in food security in Iran because it ranks first with 41.73% of rice production as a staple food (Ministry of Agriculture Iran, 2015).

There are 880 *Ab-bandans* in Mazandaran with an area of around 17,000 ha, depths varying from 1.5 m to 4 m and sizes ranging from 3 ha to 1000 ha (Mazandaran Regional Water Authority, 2016). It is assumed that *Ab-bandans* are about 3000 years old (Rahimi Farahani et al., 2012). They are traditional water harvesting systems (Ghoddousi, 1999), which are constructed by digging the land and compacting the soil to construct a wall around the excavated pond (Ejlali et al., 2012). Water per hectare of *Ab-bandans* can supply water requirements for 6 ha of rice fields in this area (Mazandaran Regional Water Authority, 2016). In addition to storing water for rice cultivation, *Ab-bandans* can play a significant role in recharging underground water and wells, collecting drainage water, aquaculture, habitat for birds and plants, attracting tourism, creating jobs, and preventing the migration of rural people to the cities (Salabi, 2010).

4. Material and methods

An exploratory sequential design was followed as a mixed methods approach for the purpose of research. Mixed methods research involves both quantitative and qualitative research for a deeper understanding of a phenomenon (Johnson et al., 2007). Specifically, we employed an 'instrument development' variant of the exploratory sequential design, in which researchers first gather the qualitative data in order to explore the research topic with a few participants, and then the qualitative data is used to develop a quantitative instrument for a large sample (Creswell and Plano-Clark, 2007) (Fig. 3). This design is suitable when researchers want to build and test an instrument, to identify unknown variables, to study a phenomenon in more depth, and also to generalize results to a large group (Creswell and Plano-Clark, 2007).

In the qualitative phase, we used semi-structured, face-to-face interviews to collect qualitative data. Interviews were conducted with experts who are working in public administration and in private companies pertaining to water management at the regional level. We initially applied purposive sampling and started with eight interviewees who were known to the researchers. Then, we asked them for other

Fig. 2. Geographical position of the study area.
Adopted from http://www.d-maps.com.

possible interview partners. Finally, 30 people were asked to answer the main question about different instruments and strategies required for improving the governance of *Ab-bandans* and overcoming related barriers. Interviewees from the public sector (19 interviewees) included individuals from the Agriculture Organization, the Forest, Range and Watershed Management Organization, the Regional Water Authority, the Department of Environment, and the Fisheries Organization. Interviewees from the private companies (11 interviewees) were technical engineers who are involved in the design and implementation of rehabilitation projects for *Ab-bandans*. Investigating the views of people in the wide range of public and private entities involved in water management at the regional level increased the credibility of the research (Shenton, 2004). We conducted the interviews in dialogue form, using tailored questions based on the OECD principles. All the interviews were recorded and transcribed verbatim. We reviewed the transcripts to extract policy instruments for the improvement of the governance of *Ab-bandans*, and we identified 31 different policy instruments. Ultimately, the instruments identified were clustered and grouped according to the OECD dimensions (Fig. 1).

The results from the qualitative phase were applied to build a questionnaire for the quantitative phase in a way that each of the three dimensions included 9, 12, 10 items (i.e. policy instruments), respectively with a numerical 10-point scale (see Table 1). "The use of numerical scale helps to discover the presence of measurement continuum and to avoid the semantic interpretation, a typical problem related to verbal scales" (Schifini et al., 2004: 2). Andrews (1984) showed that increasing the number of scale categories improve data quality due to making better validity and reducing residual errors.

In order to maximize the content validity of the questionnaire, we selected 4 of the interviewees as a panel of judges and asked them to revise the relevance of items to the constructs being measured and the clarity and conciseness of the items. The final decision whether to accept or reject the recommendations was the responsibility of the researchers, as the scale developers (DeVellis, 2003). Based on the result of Cronbach's alpha using SPSS software (0.76 for effectiveness, 0.79 for efficiency, 0.86 for trust and engagement), we decided to retain all the items in the questionnaire. Afterwards, we distributed the questionnaires to a large sample of participants through snowball sampling and asked them to rate the importance of each policy instrument to improve the governance of *Ab-bandans* from 1 to 10. A score of 1 refers to no importance and a score of 10 to high importance of the instruments. Finally, 169 questionnaires (n = 169) were collected and analyzed (Fig. 4).

A Confirmatory Factor Analysis (CFA) was conducted using LISREL software to analyze the quantitative data. The CFA helped to assess how and to what extent the policy instruments identified (i.e. observed

Fig. 3. Exploratory sequential design: Instrument development model.
Adopted from Creswell and Plano-Clark (2007).

Table 1
Policy instruments identified and clustered on three OECD dimensions.

Dimensions (latent variables/constructs)	Label	Policy instruments (observed variables)	Label
Improvement of Effectiveness Dimension	EFED	Establishing a commission at the national government level for *Ab-bandans*	A1
		Establishing a provincial commission with participation of all public and private actors, and local stakeholders	A2
		Determining a single agency in charge of *A-bandans* at the regional government level	A3
		Setting water-related regulations based on territorial specificities	A4
		Promoting meritocracy in administrative procedures to carry out duties	A5
		Training and raising the awareness of water-related professionals	A6
		Training farmers regarding conservation and optimal use of water	A7
		Training farmers for acceptance of new projects regarding multiple functions of *Ab-bandans*	A8
		Reconstruction and modernization of *Ab-bandans*	A9
Improvement of Efficiency Dimension	EFID	Approving a particular law for *Ab-bandans* along with the law enforcement requirements	B1
		Encouraging local water market by public authorities	B2
		Imposing water charges from farmers	B3
		Allocating grants for rehabilitation of *Ab-bandans* from the central government	B4
		Developing a data bank for *Ab-bandans* accessible for all public and private entities, and local stakeholders	B5
		Long-term and comprehensive plans for water resource management at the national and regional levels	B6
		Including courses related to different traditional water harvesting systems of the country e.g. *Ab-bandans* in the universities	B7
		Providing rural people with loans at low-cost interest rates in order to create jobs using the potentials of *Ab-bandans*	B8
		Encouraging non-governmental bodies by public authorities to invest in potentials of *Ab-bandans*	B9
		Conducting experimentation and pilot projects on various potentials of *Ab-bandans*	B10
		Registering *Ab-bandans* as national heritage	B11
		Using social media to create social network for water conservation	B12
Improvement of Trust and Engagement Dimension	TED	Improving the attitudes of public officials about the importance of local participation in the management of *Ab-bandans*	C1
		Mitigating conflicts among local stakeholders through reinforcing local councils and a culture of dialogue	C2
		Developing trust in public officials through addressing farmers and their needs in water-related decisions and planning	C3
		Ensuring the transparency of public officials' performance in the water sector through mass media	C4
		Enhancing participation and teamwork among farmers through improving their attitude towards collective action in the management of *Ab-bandans*	C5
		Establishing water user associations	C6
		Ensuring legal authority of water user associations	C7
		Determining the complementary role of *Ab-bandans* as traditional water harvesting system in modern irrigation networks	C8
		Developing independent institutions with participation of non-governmental bodies and local stakeholders for monitoring and evaluating issues related to *Ab-bandans*	C9
		Involving local graduates of water-related disciplines to cooperate in the management of *Ab-bandans*	C10

variables) can logically and systematically represent three reinforcing dimensions of the governance of *Ab-bandans* (i.e. latent variables/constructs). The CFA is a type of Structural Equation Modeling (SEM) to test the relationships between observed variables (a variable that can be directly measured) and latent variables (a variable that is a theoretical concept and cannot be observed directly) (Brown, 2006). In the CFA, researchers postulate relations between the observed variables and the underlying latent variables a priori and then test this hypothesized model statistically (Byrne, 2010). In this paper, we assumed the hypothesized model as positive relations between the policy instruments identified and their related dimensions.

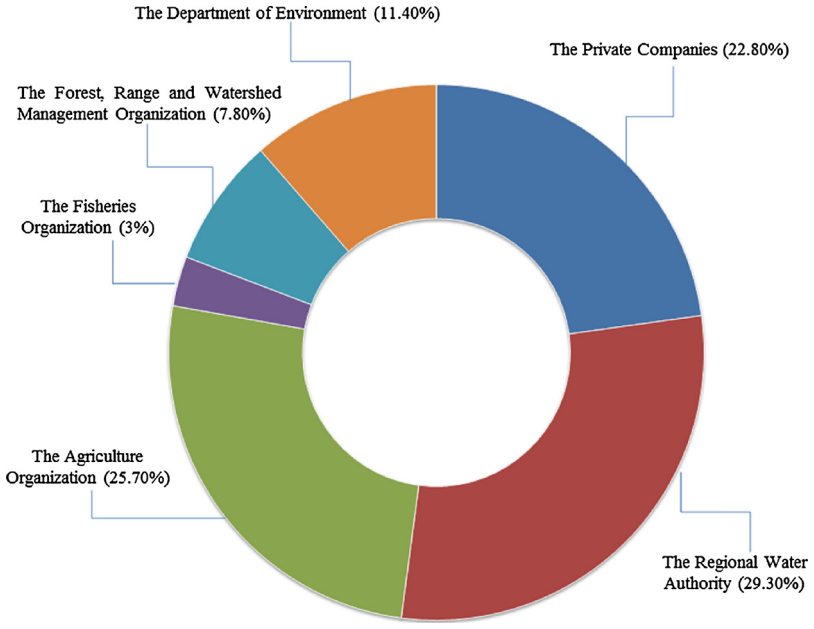

Fig. 4. The percentage of survey participants in the quantitative phase.

Table 2
Criteria for the goodness-of-fit indices.

Indices	Shorthand	Recommended criteria	Modified model	Source
Ratio of X^2 to df	X^2/df	$2 < X^2/df \leq 3$	1.493	Schermelleh-Engel et al. (2003)
Normed Fit Index	NFI	$0.90 \leq NFI < 0.95$	0.930	Schermelleh-Engel et al. (2003)
Tucker-Lewis Index	TLI	TLI ≥ 0.95	0.973	Brown (2006)
Comparative Fit Index	CFI	CFI ≥ 0.95	0.976	Brown (2006)
Incremental Fit Index	IFI	IFI ≥ 0.95	0.976	Schreiber et al. (2006)
Relative Fit Index	RFI	RFI > 0.90	0.923	Hu and Bentler (1999) Meyers et al. (2006)
Goodness of Fit Index	GFI	$0.90 \leq GFI < 0.95$	0.947	Schermelleh-Engel et al. (2003)
Adjusted Goodness of Fit Index	AGFI	AGFI ≥ 0.90	0.937	Hooper et al. (2008)
Root Mean Square Of Approximation	RMSEA	$0.05 < RMSEA \leq 0.08$	0.054	Schermelleh-Engel et al. (2003)
Parsimony-adjusted Normed-Fit Index	PNFI	PNFI > 0.50	0.846	Meyers et al. (2006)

5. Findings

Table 1 presents the policy instruments mentioned by the 30 interviewees in the qualitative phase as well as the classification of these instruments on three OECD reinforcing dimensions (effectiveness, efficiency, trust and engagement) of water governance.

Afterwards, the CFA was performed to evaluate the goodness-of-fit of the hypothesized model. A number of requirements for conducting the CFA were checked. First of all, the linear interpolation method was used for replacing missing values (Runkler, 2016). The result revealed that there were no systematic missing values. Furthermore, data screening showed that the observed variable of A3 should be removed from the data due to a number of extreme values. Then, the normality assumption was tested and the result indicated that the data were not normally distributed. This fact led to the adoption of the Unweighted Least Squares (ULS) estimation method which does not depend on a normality distribution assumption (Schumacker and Lomax, 2016).

To assess the fitness of the hypothesized model, various indices were calculated (Table 2). It was found that the hypothesized model revealed a poor fit to the data in some indices (X^2/df=3.826; RMSEA=0.130). Therefore, modification indices were applied by freeing error covariance between "A1 and A2″, "B7 and B8″, "C6 and C7″, and "C7 and C8″, respectively. Additionally, B3 and B4 with a factor loading of less than 0.30 were excluded from the hypothesized model (Brown, 2006; Tabachnick and Fidell, 2013). After modifications, as the goodness-of-fit indices indicate in Table 2, an acceptable fit to the data was achieved. As a result, all 28 remaining observed variables within the modified model properly represent three latent variables. Table 2 provides an overview of criteria for goodness-of-fit indices of the modified model.

Convergent validity was assessed in order to examine construct validity. The convergent validity is the correlation between two or more measures of a specific construct (Westen and Rosenthal, 2003; Hair et al., 2010), and it is assessed based on the Standardized Factor Loading (λ), Average Variance Extracted (AVE), and Composite Reliability (CR). The factor loadings values should be equal or greater than 0.3 (Brown, 2006; Tabachnick and Fidell, 2013) and the acceptable values of the AVE and CR were considered to be ≥0.5 and ≥0.7, respectively (Hair et al., 2010). The results confirmed that all factor loadings are greater than 0.3 and the values of CR range from 0.808 to 0.866 indicating the adequate internal consistency of the constructs. The AVE was below the adequate value, nevertheless, Fornell and Larcker (1981) noted that if AVE is less than 0.50, the variance due to measurement error is larger than the variance captured by the construct. However, based on the composite reliability alone, researchers may conclude that the convergent validity of the construct is adequate, even though more than 50% of the variance is due to the measurement error. Therefore, as shown in Table 3, the modified model had good convergent validity.

The results of the Correlation Matrix/Phi (i.e. intercorrelations among all latent variables) indicated that the constructs of "EFED", "EFID", and "TED" were positively related to one another (Fig. 5). This means that changes in one observed variable of a given construct are associated with proportional changes in the other constructs (Hair et al., 2010). The results also showed that the t-values of all paths between observed variables and their underlying constructs were statistically significant (Table 3, Fig. 5). Therefore, these observed variables play a significant role in representing the three constructs. Moreover, observed variables with higher factor loadings are representative of the construct (Hair et al., 2010) (Table 3). In other words, factor loadings indicate the correlation of each observed variable and the construct, and they give us an idea about how much the variable has contributed to the construct (Yong and Pearce, 2013). Hence, those observed variables (i.e. policy instruments) which are highly related to their constructs play more roles in representing the construct and are more contributed to their construct. Based on the larger factor loadings, the following policy instruments are more contributed to the improvement of the governance of *Ab-bandans*:

Policy instruments in the improvement of effectiveness dimension

Table 3
Convergent validity for the latent variables (n = 169).

Latent variables	Observed variables	t-value	Standardized Factor Loadings (λ)	Standard Error (SE)	Composite Reliability (CR)
EFED	A1	13.503	0.465	0.059	0.808
	A2	RV[a]	0.583	RV	
	A4	14.874	0.542	0.062	
	A5	15.466	0.602	0.066	
	A6	15.349	0.592	0.066	
	A7	15.844	0.679	0.073	
	A8	14.967	0.593	0.068	
	A9	15.869	0.639	0.069	
EFID	B1	15.270	0.559	0.060	0.814
	B2	15.138	0.565	0.062	
	B5	14.027	0.481	0.057	
	B6	15.523	0.607	0.065	
	B7	14.917	0.532	0.059	
	B8	14.977	0.560	0.062	
	B9	13.693	0.462	0.056	
	B10	15.750	0.598	0.063	
	B11	15.495	0.556	0.059	
	B12	RV	0.601	RV	
TED	C1	18.654	0.718	0.051	0.866
	C2	18.712	0.735	0.052	
	C3	RV	0.748	RV	
	C4	18.622	0.720	0.051	
	C5	19.608	0.779	0.053	
	C6	14.445	0.479	0.044	
	C7	12.632	0.410	0.043	
	C8	15.955	0.554	0.046	
	C9	16.779	0.572	0.045	
	C10	15.581	0.513	0.044	

[a] A reference variable is used for scaling up the latent variables through fixing one of the relevant paths to 1.0.

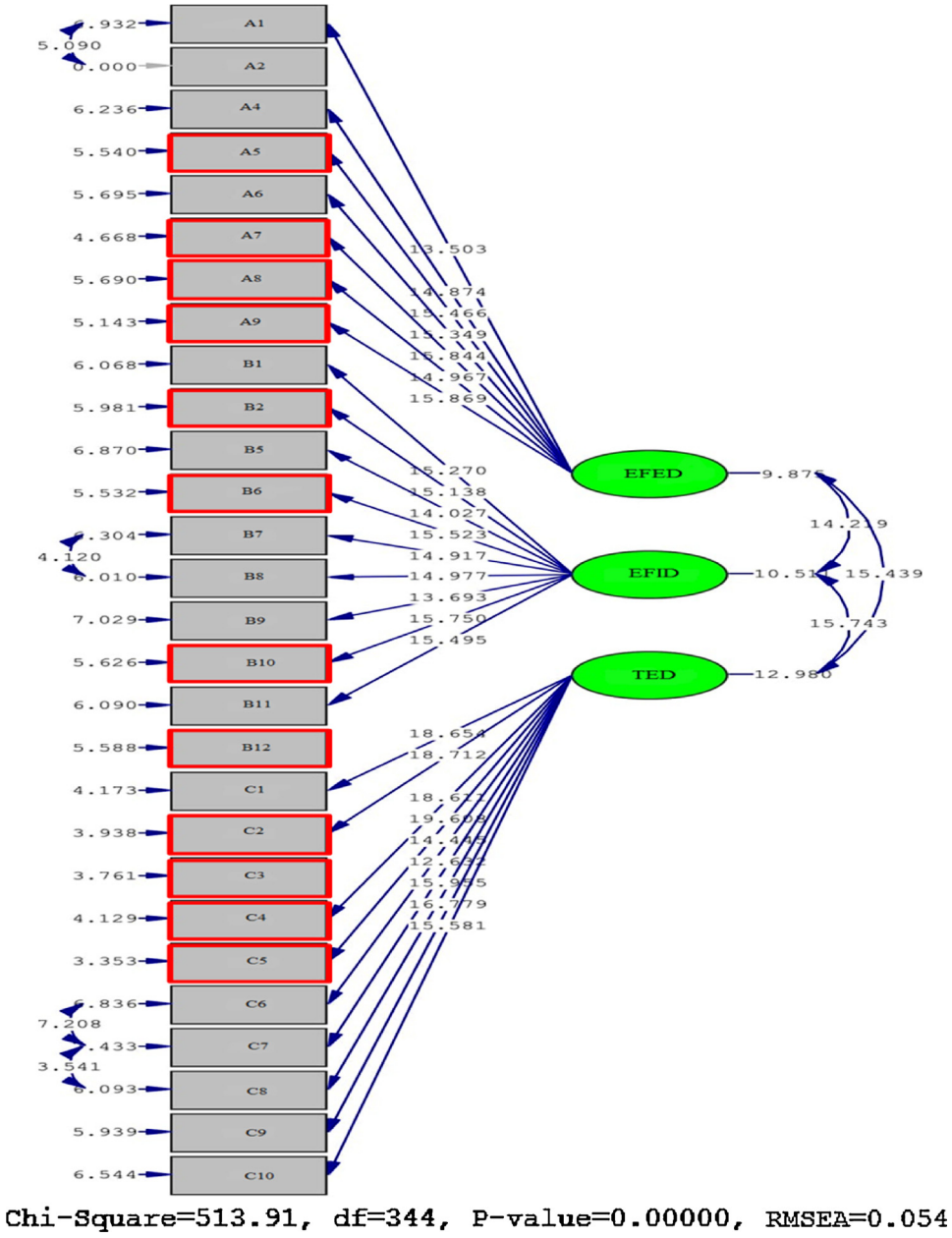

Fig. 5. The modified model of the improvement of *Ab-bandans*' governance.

A7 (λ = 0.679): Training farmers regarding conservation and optimal use of water

A9 (λ = 0.639): Reconstruction and modernization of *Ab-bandans*

A5 (λ = 0.602): Promoting meritocracy in administrative procedures to carry out duties

A8 (λ = 0.593): Training farmers for acceptance of new projects regarding multiple functions of *Ab-bandans*

Policy instruments in the improvement of efficiency dimension

B6 (λ = 0.607): Long-term and comprehensive plans for water resource management at the national and regional levels

B12 (λ = 0.601): Using social media to create social network for water conservation

B10 (λ = 0.598): Conducting experimentation and pilot projects on various potentials of *Ab-bandans*

B2 (λ = 0.565): Encouraging local water market by public authorities

Policy instruments in the improvement of trust and engagement dimension

C5 (λ = 0.779) (the highest factor loading among all): Enhancing participation and teamwork among farmers through improving their attitude towards collective action in the management of *Ab-bandans*

C3 (λ = 0.748): Developing trust in public officials through addressing farmers and their needs in water-related decisions and planning

C2 (λ = 0.735): Mitigating conflicts among local stakeholders through reinforcing local councils and a culture of dialogue

C4 (λ = 0.720): Ensuring the transparency of public officials' performance in the water sector through mass media

6. Discussion

In this study, public instruments for the improvement of the governance of *Ab-bandans* were identified and grouped into three OECD dimensions. Based on the CFA, the modified model which consisted of 28 policy instruments properly represents three reinforcing dimensions. The following subsections include a discussion of the policy instruments

which are more contributed to the improvement of the governance of *Ab-bandans*.

6.1. Improvement of effectiveness dimension

6.1.1. Training farmers regarding conservation and optimal use of water

Interviewees believed that it is not possible to improve knowledge and perception of farmers regarding optimal use of water without adequate training and raised awareness. For instance, farmers have to be aware that storing water above the maximum storage level and keeping a reservoir full, can destroy the reservoirs due to the generation of high waves. Thus, training and building the capacity of farmers as end-users for the protection of *Ab-bandans* is necessary. It is imperative to note that the training approach should be based on a participatory learning process and knowledge sharing among farmers. This is a totally different approach from simply delivering knowledge, and it aims to strengthen the problem-solving skills of farmers by fostering participation, self-confidence, dialogue, joint decision making, and self-determination (Röling and van de Fliert, 1994). This training approach increases farmers' knowledge and empowers them to change their perspectives and behavior in order to be active in altering the current condition to a desired one (Hjorth, 2003).

Interviewees added that training is not limited to farmers, but water professionals and public officials have to be aware of the economic, environmental and social values of *Ab-bandans*, the importance of local stakeholders' participation, optimal utilization and management of water, and related engineering and technical issues. Since the capacity of an organization strongly depends on the capabilities of its personnel, training approach for professionals is a crucial policy for capacity building across the full range of water organizations. It could be performed through specially designed courses, modification of university courses, in-service modules, seminars, and workshops (Global Water Partnership, 2017).

6.1.2. Reconstruction and modernization of Ab-bandans

Based on the interviewees' opinion, the infrastructure of *A-bandans* has to be improved using advanced technology. For instance, installing modern gates and digital meters can control the volume of water entering and leaving the reservoirs and prevent water wastage. When this has been done, *Ab-bandans* as traditional water harvesting systems which are consistent with indigenous knowledge and culture can be integrated with modern irrigation networks (i.e. dams), and their interaction with dams in irrigation system could be determined. The interviewees added that farmers should know the purpose and benefits of adopting water technology as well as the usage, so that they are willing to participate in the adoption and maintenance of a given technology. In this way, *Ab-bandans* will be considered as small dams within rural communities which not only improve the economic conditions but also strengthen social cohesion and motivation to remain in the village. As Evans and Sadler (2008) mentioned technology-oriented policies (e.g. advanced irrigation systems) are appropriate tools for a more water-efficient management as this protects and uses less water which in turn increases crop productivity and ultimately achieves an economic advantage for farmers. Akhmouch (2012) stated that new technologies and innovative water processes are effective for approaching cost-effective objectives and water security which require the transfer of know-how at the regional and local level, especially when service delivery is not managed by the private sector. Levidow et al. (2014) also concluded that proper use of technology is more important than technological investment which depends on applied research, demonstration activities, outreach, farmers' training, and skills development.

6.1.3. Promoting meritocracy in administrative procedures to carry out duties

Interviewees stated that employing professionals in the water-related public administration should be based on capabilities and competencies regardless of political orientation. Water professionals could carry out their tasks properly and play an effective role in the success of water organizations, if they possess the necessary knowledge and skill in their job. Furthermore, interviewees mentioned that top managers should regard thoughtful and knowledgeable professionals as an opportunity for water organizations and provide an atmosphere which aims at the acquisition of creative ideas. Meritocracy is one of the most basic aspects of organizational culture which emphasizes the link between individual merit and career without being biased against gender, race, class or any other non-merit factors (Castilla and Benard, 2010). OECD (2015a) highlighted that the most vital resource of each organization is its employees; therefore, employing public officials and professionals in the water sector should be merit-oriented, transparent, and independent of political cycles.

6.1.4. Training farmers for acceptance of new projects regarding multiple functions of Ab-bandans

According to the interviewees, farmers should be involved in the process of studying, designing, and implementing new projects regarding multiple functions of *Ab-bandans*, and they should be trained with regard to the importance and benefits of these projects during the process. Otherwise, not only the project objectives cannot be achieved, but these projects could also lead to conflicts and confrontation among different groups of beneficiaries, and distrust of the government. It must be kept in mind that the goals of rural development projects are not merely reaching economic benefits, but also creating social products e.g. upgraded local leadership, a culture of enterprise and innovative action, increased engagement capacity among people to overcome problems, and effective use of opportunities. Therefore, the provision of educational policies for adoption of development programs seems to be necessary (Lowe et al., 1999). OECD/Noya and Clarence (2009) also reported that all members of the community should be empowered to cooperate in rural development through the enhancement of knowledge, skills, and competencies.

6.2. Improvement of efficiency dimension

6.2.1. Long-term and comprehensive plans for water resource management at the national and regional levels

Interviewees believed that a comprehensive and long-term national plan for the sustainable conservation of water resources in consistence with the ecological, economic, and social features should be addressed. Moreover, regional water management with respect to the role of *Ab-bandans* and the sustainable use of their various potentials should also be included in this national planning. Ardakanian (2005) believed that long-term policies and strategies are required for water resource management in Iran, and establishing a comprehensive national water management system based on all elements of water cycle should be considered in water management policies. In addition, this system needs to be strongly linked to a "national spatial strategy plan" based on the natural water basins of the country (Ardakanian, 2005), because water management and spatial planning are directly related to each other (Woltjer and Al, 2007). In other words, regional plans for development, exploitation, and conservation of water resources have to be designed under the umbrella of national and comprehensive watershed-based plans (Ardakanian, 2005).

6.2.2. Using social media to create social network for water conservation

"Social media can be useful as a tool for turning water threats into a social and inclusive concern, as well as creating a public space to discuss them" (statement of one interviewee). This is due to the fact that the application of social media as one of the most innovative means of information and communication technology has been widely welcomed recently (Boon and Sinclair, 2009). It allows certain slogans, contents, and ideas to spread rapidly as the main social media feature is its viral nature (Nalewajek and Mącik, 2013). In this way, public officials can

convey their messages to people and unite them for a common purpose (Terracina-Hartman et al. (2013)). The study of Roshandel Arbatani et al. (2016) on Zayandeh-Rood River in Iran showed that social media strongly influenced the environmental behavior of citizens and improved their knowledge, attitudes, emotions, and behaviors regarding environmental protection. Moreover, social media led citizens to consider environmental hazards which were of no concern to them before membership in the virtual environmental groups, and to participate financially in environmental protection. In addition, it provides a facility in which citizens are able to criticize the government's environmental policies.

6.2.3. Conducting experimentation and pilot projects on various potentials of Ab-bandans

A simultaneous use of various functions of *Ab-bandans* should be tested in a number of cases and its social, economic, and environmental consequences should be carefully investigated. Interviewees believed that in advance of a wider introduction, visiting pilot projects by farmers is an effective way of building trust in the government and increasing participation and awareness among farmers on the integrated use of potentials. As political tools the pilots provide a good opportunity for policies and strategies to be tested before extensive implementation, but also generate knowledge that can be transferred to the community (Vreugdenhil and Slinger, 2008; Vreugdenhil et al., 2010). The pilot projects are widely used to introduce government policies and plans (Nair and Howlett, 2015), and managers in the water sector regularly apply pilots as instruments for testing innovations and implementing policies on a small scale (Vreugdenhil et al., 2010).

According to the interviewees, after ensuring that the pilots can be implemented on a large scale, it is possible to continue by providing local people with loans at low-cost interest rates in order to create jobs based on the potentials of *Ab-bandans* in the form of groups and associations, and consequently improving income and livelihood in the communities. *Ab-bandans* can be used as an income source for rural households in different ways e.g. a place for spending leisure and recreation time, attracting tourists through building floating restaurants, organizing fishing and boating tournaments, etc. Creating sustainable jobs based on the potentials of *Ab-bandans* not only enhances a sense of ownership and participation in exploitation and maintenance processes, but also contributes to the rural development and so prevents the migration of rural people, especially new generations, to the cities.

6.2.4. Encouraging local water market by public authorities

A number of interviewees pointed out that recently farmers who are users of *Ab-bandans* sell water to other farmers within the village through the informal market when *Ab-bandans* have more water than they require. This type of water market includes an informal agreement between neighboring farmers about how to share supplied or extracted water for mutual benefit. Based on the local agreement, one farmer who allows access to his water to another farmer receives economic benefits (Nikolakis et al., 2013). However, Faruqui (2001) emphasized that governments must undertake studies for water markets and make necessary legal, institutional, and economic reforms through involving multi-stakeholders. Moreover, Nikolakis et al. (2013) added that market-based approaches in natural resource governance only have social legitimacy if they are consistent with the values of local stakeholders, in addition, “a slow evolution of farmers mentality is required” (Go´mez-Limo´n and Martı´nez, 2006: 334).

6.3. Improvement of trust and engagement dimension

6.3.1. Enhancing participation and teamwork among farmers through improving their attitude

This instrument plays more roles in the governance of *Ab-bandans*, not only in the trust and engagement dimension but also in all dimensions. According to one interviewee, "participation of farmers has to be the result of their intellectual development and internal desire and motivation". Encouraging farmers’ participation requires the promotion of their attitude towards collective preferences rather than individual and short-term benefits. If farmers have a positive attitude towards collective action, they can see that participation in water-related processes is beneficial both for themselves and for their society. Otherwise, it is impossible to force them to actively engage; the development of their attitude and willingness is an effective component for enhancing participation among farmers. According to Dungumaro and Madulu (2003), fostering the sense of cooperation and participation in local communities through their involvement in the assessment and solving of water problems can also be effective for resolving conflicts. This in turn can build trust between local stakeholders and water organizations which would lead to a sense of ownership and responsibility among local communities (Dungumaro and Madulu, 2003).

Interviewees highlighted the fact that public officials should also have a positive attitude towards the participation of farmers in the management of *Ab-bandans*. It is important to understand that design and management of development projects outside rural areas which are then introduced into rural communities for implementation, cannot be successful. Thus, the attitude of the government that they know everything while rural people are inexperienced and not knowledgeable, should move towards bottom-up development and putting people first (Oakley, 1991). Based on interviews conducted, it was revealed that the government should undertake the role of a facilitator in the management of *Ab-bandans*, rather than administrator and executor and should conduct participatory management for *Ab-bandans*. Interviewees emphasized that the management of *Ab-bandans* should be given to farmers in the form of water user associations. Wanga et al. (2006) believed that farmers are the key decision makers and should decide on their roles as well as the activities and roles which they want their managers and leaders to perform. Indeed, farmers are able to participate in a collective manner in all aspects of water management including physical, financial, decision making, evaluation, and monitoring aspects (Wanga et al., 2006).

6.3.2. Developing trust in public officials through addressing farmers and their needs in water-related decisions and planning

Collective attitudes and participatory behavior of farmers are essential for water management, but trust in the government is also important for successful participatory governance because if farmers do not trust government officials, the likelihood of their participation is reduced (Lubell, 2004). According to one interviewee, “building trust in the government can lead to the participation of farmers in the adoption of new projects regarding the various potentials of *Ab-bandans*”. In fact, farmers should feel that meeting their needs is the main concern of the government in the management of *Ab-bandans* so that they can trust the government and show participatory and peaceful behavior. Most water conflicts in the agricultural sector in Iran are between government (as an administrator of water management) and farmers (as users) (Bijani and Hayati, 2011), therefore building public trust in the government through democratic legitimacy and fairness plays a vital role as a principle in water governance (OECD, 2015).

6.3.3. Mitigating conflicts among local stakeholders

One interviewee cited that “farmers have to reach social maturity and social acceptance of each other”. It appears that the achievement of an agreement among local stakeholders and the admittance of each other are crucial in order to solve barriers and create a participatory approach to the governance of *Ab-bandans*. According to the interviewees, water policy should be based on conflicts resolution among local stakeholders using mechanisms such as strengthening rural dispute resolution councils, promoting a culture of dialogue, and unbiased government intervention. Swatuk et al. (2008) said that promoting effective communication and collaboration in spite of diverse interests, identifying the causes of conflicts, building trust, and planning in a

participatory manner should be considered in the management of conflicts. This should include the employment of various methods e.g. negotiation, mediation, conciliation, and consensus building (Swatuk et al., 2008). Bijani and Hayati (2011) argued that change from governmentality to governance is the best way to reduce and eliminate water conflicts in Iran which need cultural enhancement, public participation, government support (without being authoritative), and training of local stakeholders. It should be considered that water conflicts cannot be solved simply through a series of fixed and written laws, but people and their participation should be implemented for overcoming contradictions. In this way, in addition to conflicts management, social capital in rural communities is improved and local traditions and social institutions are regenerated (Bijani and Hayati, 2011).

6.3.4. Ensuring the transparency of public officials' performance in the water sector through mass media

Interviewees stated that there should be some conditions in the water sector where criticism and comments about the performance of responsible authorities does not lead to punishment or retaliation, but is rather seen as an opportunity to correct mistakes. They emphasized that freedom of speech with regard to criticism and assessment of the performance of public authorities and their policies in mass media plays a crucial role in the promotion of accountability and transparency. Dunu (2013) noted that institutions and governments should be accountable and transparent for their policies and performance because according to Ashraf (2014) people must know what their governments are doing. Consequently, policy failures, maladministration, corruption, and scandals in public administration and their related entities can be highlighted through mass media in order to promote responsiveness and transparency among all citizens (Ashraf, 2014). The fact is that all aspects of good governance including accountability, transparency, participation, rule of law, efficiency, effectiveness, etc. are facilitated by using a strong, pluralistic, and independent media within the society (Dunu, 2013).

7. Conclusion

The result showed that 28 out of 31 policy instruments identified properly contribute to the improvement of the governance of *Ab-bandans.* However, the enhancement of participation and collective action among farmers due to the highest factor loading among all the instruments in three dimensions is more contributed to the improvement of water governance; therefore, it can be seen as the starting point for the desired transformation. “Even if participation cannot be seen as the new orthodoxy, it is clear that participation has become one of the central influences in mainstream development thinking” (Parfitt, 2004: 537). Consequently, farmers’ willingness to participate in management processes and their collective action can be seen as a panacea for enhancing the governance of *Ab-bandans*. To this end, the top-down paradigm of government should be changed into a bottom-up paradigm and participatory governance, and the government should undertake the role of a facilitator rather than governmentality in the governance of *Ab-bandans*. Moreover, the significant issue is that each dimension in the improvement of the governance of *Ab-bandans* interacts with the other dimensions; therefore, the policy instruments are interdependent and shouldn’t be addressed in isolation. The improvement of the governance of *Ab-bandans* should be systematic and it is not possible to apply a single policy instrument without considering the impact of other policy instruments. It is necessary to adopt the policy instruments in a holistic way to solve difficulties in the governance of *Ab-bandans.*

This study has some limitations including the sample size in the quantitative phase. Furthermore, water governance is strongly dependent on context, *Ab-bandans* are just restricted to Northern Iran, so these policy instruments cannot be generalized in respect of other areas in Iran. Nevertheless, these instruments can be used as a basis for other case studies in the country with reference to rivers, lakes, underground waters.

Although the results of this study are a good starting point for creating a positive change in the governance of *Ab-bandans*, further research could be conducted to assess the ex-ante or ex-post effect of each policy instrument in the improvement of the governance of *Ab-bandans*. It calls for further data and analysis in which the viewpoints of farmers can be covered.

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Chapter 4

The Role of Social Capital in Water Reservoirs Governance: Evidence from Northern Iran

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Abstract

Water is the main resource required for the production of agricultural crops. Traditional water reservoirs called *Ab-bandan* in the Mazandaran province, Northern Iran are used to collect precipitation for irrigating rice fields. However, the collective way of governing *Ab-bandans* by local communities is gradually disappearing. Although social capital is an important concept which facilities collective interaction of the local communities dealing with water management. This paper aims to explore how and why components of social capital (i.e. trust, co-operation, social network cohesion, leadership roles, and conflict resolution) among various local stakeholders influence the water reservoirs-related interactions. Qualitative method is carried out by using semi-structured, face-to-face interviews with a range of local key stakeholders of *Ab-bandan*s (29 interviews). NVivo software is used to code the interview transcripts through the identification of relevant themes. The results show that leaders are the key individuals, who play a crucial leadership role in promoting and facilitating co-operation and conflict resolution. Conflicts within the communities are usually resolved by the leaders through negotiation and conciliation mechanisms. However, these mechanisms are only a temporary solution for conflict resolution between different local communities. The conflicts in water management have decreased social relationships within and between the communities. Collective water-related decisions often fail due to conflicts and difficulties in dialogue and debate among stakeholders. Overall, the level of social capital and its importance can differ depending on which component is under investigation. However, appropriate mechanisms for conflict resolution are the most important aspect of social capital which plays a significant role for the other components.

Keywords: Water management, Leadership, Conflicts, Social cohesion, Co-operation, Trust, Mazandaran

1. Introduction

Demand for water is increasing and the world is expected to face a 40% global water shortage by 2030 (UNESCO WWAP, 2015), this situation potentially leads to water wars around the world (Serageldin, 2009). Iran is located in an arid and semi-arid region of the world with an average annual precipitation of 228 mm which is 72% less than the global average of 814 mm (Karandish and Hoekstra, 2017). Due to poor water resource management in agriculture which consumes more than 90% of the water, there is a drastic water crisis in Iran (Karandish and Hoekstra, 2017). Many Iranian experts claim that the most significant cause of the water crisis is the failure in water governance (Foltz, 2002), which includes managerial, political, and institutional problems (Madani, 2014). Water governance refers to "the range of political, social, economic, and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society" (Rogers and Hall, 2003: 16). Water governance involves a range of actors and structures in water policy formulation and implementation (Akhmouch and Correia, 2016), and includes a set of collective activities to secure the water systems viability and integrity and to achieve common goals with the help of diverse stakeholder groups (Wiek and Larson, 2012).

The Mazandaran province located in Northern Iran has an annual average precipitation of 749.9 mm which is high in comparison with other provinces in the country (Ministry of Energy Iran, 2015). A considerable amount of the precipitation occurs during the non-growing seasons in autumn and winter (Azmoodeh et al., 2009). There are traditional water reservoirs in this province called *Ab-bandan* which are used to collect precipitation during the non-growing seasons (Mirzaei et al., 2017; 2019). These were typically constructed by local farmers about 3000 years

ago, based on available materials and indigenous engineering knowledge by digging the land and compressing the soil to construct a wall around an excavated pond (Ejlali et al., 2012; Ghoddousi, 1999; Rahimi Farahani et al., 2012). Utilization and maintenance of these water reservoirs are carried out by local farmers for irrigation of rice fields (Vosoughi and Mohammadi, 2013). At the local level, other actors e.g. local leaders and fishermen, play an important role in the water reservoirs-related interactions (Mirzaei et al., 2017).

There is evidence that the formerly relatively collective way of governing *Ab-bandans* within local communities is gradually disappearing which has led farmers to an increasing tendency towards seeking individual and short-term benefits and the withdrawal of more water than is actually available (Vosoughi and Mohammadi, 2013). Mirzaei et al. (2017) discussed the fact that farmers upstream and downstream of the water reservoirs, or even users of a common reservoir, claim ownership and utilization due to the uncertainty whether they have reliable access to the water; this leads to social conflicts and failure in the collective interaction within local communities. Valizadeh et al. (2018; 2019) highlighted that the present orientation of Iranian farmers is to maximize their water use with less attention to participatory behaviour which is considered as one of the most significant reasons for the emergence of water-resource problems. Local users' success or failure in the governance of the common good of the community is directly interrelated with the ability of users to work together (Rasmussen and Meinzen-Dick, 1995), which is called social capital (Putnam, 1995; Ostrom and Ahn, 2002). Social capital is "an attribute of individuals and their relationships that enhance their ability to solve collective-action problems" (Ostrom and Ahn, 2002: 4). Kelly et al. (2017) argued that social capital is an important factor which facilities collective interaction of the local community for water system sustainability.

Therefore, this study explores aspects of social capital in the governance of *Ab-bandans* seeking explanations as to how and why components of social capital among various local stakeholders influence the water reservoirs-related interactions within the communities. Although there is scientific evidence related to social issues in water management in Iran, empirical research which specifically addresses components of social capital and their roles in the management of water reservoirs in the Mazandaran province has not been carried out. Therefore, this paper contributes to science by establishing empirical evidence for collective interaction based on social capital as a pre-condition for effective water governance at the local level. This paper has two aims: 1) To identify key components of social capital among local stakeholders of *Ab-bandans*; 2) To investigate how these components of social capital affect and relate to the governance of *Ab-bandans*.

2. Theoretical background

The concept of governance is broader than government because it focuses not only on the state and formal institutions but also on social actors and engages various stakeholders from different sectors at the local, regional, national, and international levels (Bevir, 2013). Water governance addresses political, social, economic, and administrative dimensions at various levels to develop policies and institutions in the water sector (Rogers and Hall, 2003). According to OECD (2015: 5), water governance is "the range of political, institutional and administrative rules, practices, and processes (formal and informal) through which decisions are taken and implemented, stakeholders can articulate their interests and have their concerns considered, and decision-makers are held accountable for water management". Therefore, governance refers to all processes of governing, whether undertaken by the government or an informal

institution such as family, tribe, or the local community (Bevir, 2013). So, water governance is here defined as the capability of various social stakeholders to manage water resources in a collective manner at the local level (Solanes and Jouravlev, 2006). Effective water governance is not only related to the decisions of water managers and administrators to solve the water problems of today and the future, but also addresses how societies can manage their water resources in a wise manner (Hoekstra, 2011).

The concept of social capital has been suggested as an important factor affecting governance and conversation of natural resources (Bodin and Crona, 2008). Social capital is defined as "networks, norms, and trust that enable participants to act together more effectively to pursue shared objectives" (Putnam, 1995: 664). Fukuyama (1997, as cited in Adler and Kwon, 2002: 20) described social capital as "the existence of a certain set of informal values or norms shared among members of a group that permit co-operation among them". Nahapiet and Ghoshal, (1998: 243) found social capital as "the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit". Social capital is the missing link for development and this is what holds societies together (Grootaert, 1998). It is a resource that individuals stand to benefit from by virtue of membership in social networks, structures, and relations (Bisung and Elliott, 2014; Portes, 1998).

Social capital as networks, norms of reciprocity, and trust provide a solution to the challenges of co-ordinated action for the effective management of common resources (Dahal and Adhikari, 2008). As social capital is a multidimensional concept (Claridge, 2004), based on the review of related literature, we considered five central components of social capital i.e. trust, co-operation, social network cohesion, leaders and their roles, and conflict resolution. Figure 1 illustrates schematically these components which are assumed to be related to the governance of *Ab-bandans* within the local communities.

Trust is a social capital component which could be relevant in a natural resource context. It refers to the extent to which people can rely on relatives, neighbours, colleagues, and even strangers for support and assistance (Dudwick et al., 2006). Trust is "expectation or belief that one can rely on another person's actions and word and/or that the person has good intentions toward oneself" (Dirks, 2000). General trust as well as trust in institutions constitutes an important aspect of social capital (Hunecke et al., 2017). General trust is defined as trust in people within the surrounding society e.g. family members, friends, neighbours, and colleagues (Hunecke et al., 2017). This is a vital aspect of social capital which facilitates the communities' governance and economic well-being (Yamagishi et al., 2015). Trust in institutions in water-related issues is about trust in government at different levels and its agencies, community officials, politicians, and associations (Hunecke et al., 2017; Narayan and Cassidy, 2001; Polyzou et al., 2011). Trust in government and public institutions as a significant principle in water governance leads to the involvement of all stakeholders through democracy and fairness for society (OECD, 2015).

Co-operation is another critical component of social capital. The investigation of co-operation builds a deeper understanding of how people work with others within the community on a common project and/or how they respond collectively to a problem or crisis (Dudwick et al., 2006). Local participation and co-operation is an essential element for successful collective action and natural resource governance (Uphoff, 1999). Effective management of common resources is facilitated by the encouragement of co-operative behaviour to achieve collective goods (Anthony and Campbell, 2011). Local participation can be seen as a central issue for enhancing water governance and a co-operative manner in water-related processes can be beneficial both for local stakeholders and society (Mirzaei et al., 2019).

Social capital is also generated from social network cohesion and interactions. Therefore, research on social capital concentrates on interactions and networks. Social network cohesion is considered to be social connections and relations between societal units e.g., individuals, groups, and associations (Berger-Schmitt, 2000). It is the vertical and horizontal interaction and connectedness among members of society which includes trust, a sense of belonging, and the willingness to participate in social activities (Chan et al., 2006). It can be seen in community events e.g. weddings and funerals or other activities which promote solidarity, communication, and a sense of collectiveness and consciousness (Dudwick et al., 2006). Fostering social relations among various stakeholders can increase the chances of collaboration and joint action (Bodin and Crona, 2009). These social interactions lead to the formation of groups and networks and so consequently the development of social capital (Leahy and Anderson, 2010).

Bodin and Crona (2008) addressed leaders and influential actors as a latent stock of social capital which can produce a flow of benefits. "Leadership can be understood as social capital that collects around certain individuals –whether formally designated as leaders or not- based on the acuity of their social perceptions and the structure of their social ties" (Balkundi and Kilduff, 2006: 421). Leaders are people who can form social networks within and between communities and play the role of legitimizers (often prominent citizens with prestige) and/or effectors (professionals or technicians) in society (Gray et al., 2005). They can share information, provide advice and support and have a great influence on collective action (Hoppe and Reinelt, 2010).

Furthermore, mechanisms for conflict resolution are often thought to be an essential component for common resource management, but these mechanisms are rarely included in empirical studies of social capital (Bodin and Crona, 2008). Water can indirectly produce tension and conflict because it is a basic element in agriculture and the rural livelihoods are dependent on it (Carius et al., 2004). In most cases, water conflict is not due to the lack of water, but it is caused by the inefficient manner in which resources are governed (Carius et al., 2004). If these conflicts are constantly ignored, they intensify and exacerbate the degradation of natural resources, erosion of social and human capital and ultimately, result in problems for rural livelihoods (Sanginga et al., 2007). Therefore, in developing countries where the use of common resources is essential for rural livelihoods, applying strategies for peace building, conflict prevention, and long-term social-ecological resilience should be seen as prerequisites for successful natural resource management (Ratner et al., 2014).

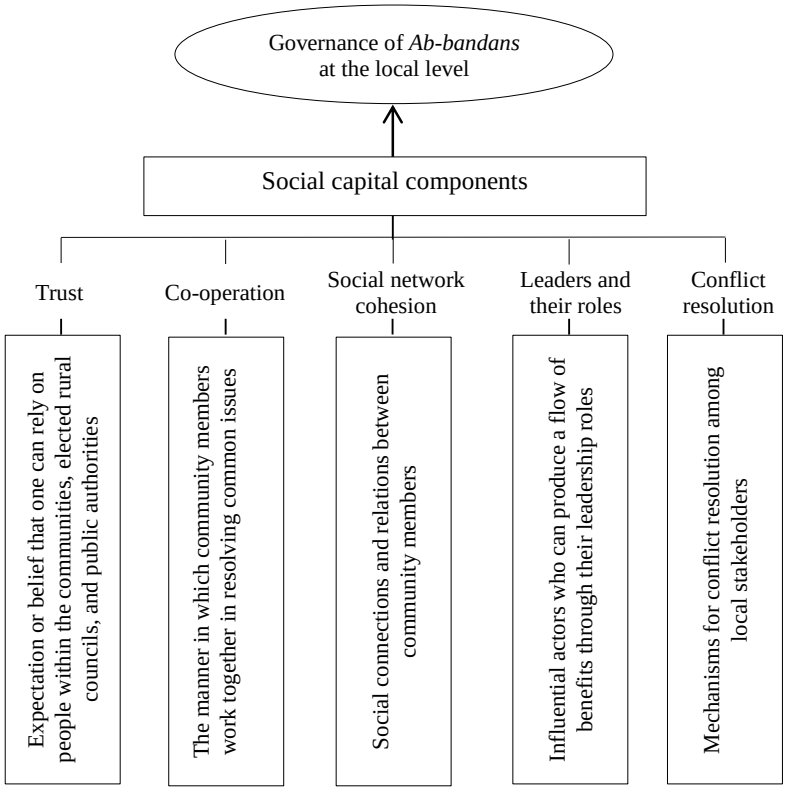
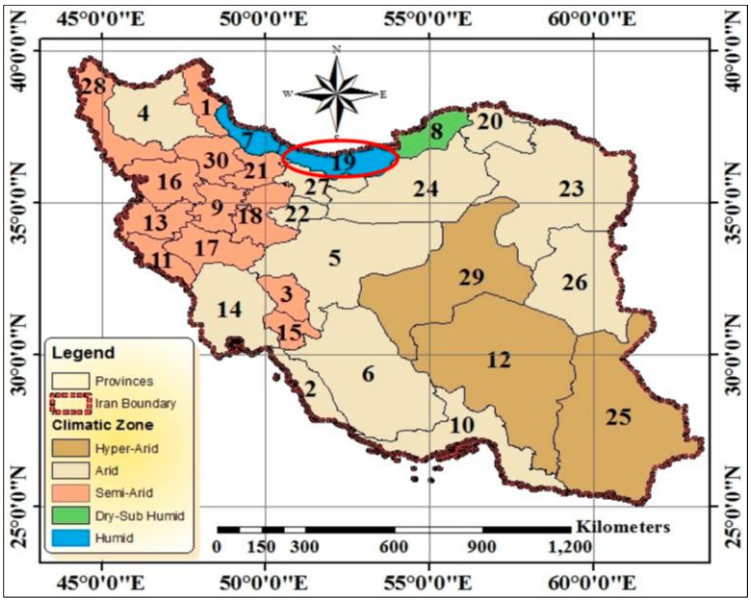


Fig. 1. Theoretical background guiding this research

3. Study area and *Ab-bandans*

This study was carried out in the province of Mazandaran, Northern Iran. Mazandaran is a geographical area of 24.000 km2 (1.46% of the total area of Iran) and is adjoined to the Caspian Sea to the north and the Alborz Mountains to the south (Kheyroddin and Hedayatifard, 2017). This province extends between latitude 35° 46' and 36° 58' north and longitude 50° 21 and 54° 8' east (Shahbazi and Esmaeili-Sari, 2009) (Fig. 2). Mazandaran is geographically divided into two parts: The coastal plains and a mountainous area with an average temperature of 25° C in summer and 6° C in winter (Shahbazi and Esmaeili-Sari, 2009). It has a high production capacity for agriculture due to the humid temperate climate and suitable soil (Khoshbakht and Hammer, 2006). Moreover, 37% (199,000 ha) of the land in Mazandaran is used for rice cultivation which is the staple food in Iran and *Ab-bandans* are the most important water resources for irrigating rice fields during the growing seasons (Ministry of Agriculture Iran, 2016). *Ab-bandans* are man-made 'water reservoirs' or 'artificial wetland' with different sizes ranging from 3 to 1000 hectares (Abbasian et al., 2014). There are 880 *Ab-bandans* in Mazandaran with an area of around 17,000 hectares and depths varying from 1.5 m to 4 m (Mazandaran Regional Water Authority, 2016). They are multi-functional and can play a significant role in recharging underground water and wells, collecting drainage water, aquaculture, habitat for birds and plants, and attracting tourism (Salabi, 2010) (Fig. 3).



1	Ardabil	16	Kordestan
2	Bushehr	17	Lorestan
3	Charmahal	18	Markazi
4	East Azerbaijan	19	Mazandaran
5	Isfahan	20	North Khorasan
6	Fars	21	Qazvin
7	Gilan	22	Qom
8	Golestan	23	Razavi Khorasan
9	Hamedan	24	Semnan
10	Hormozgan	25	Sistan and Baluchestan
11	Ilam	26	South Khorasan
12	Kerman	27	Tehran
13	Kermanshah	28	West Azerbaijan
14	Kuzestan	29	Yazd
15	Kohgiluyeh	30	Zanjan

Fig. 2. Geographical position of the study area
Adopted from Karandish and Hoekstra (2017)

Fig. 3. A water reservoir in Mazandaran Province
Image provided by the first author

4. Methodology

The qualitative research approach was applied to investigate key social capital components affecting the governance of *Ab-bandans* among local stakeholders in the Mazandaran province, Northern Iran. Qualitative research provides findings based on understanding peoples' everyday lives and their viewpoints under different circumstances (Yin, 2016), and it is suitable when researchers want to recognize the "why" behind people's behaviour or actions (Rosenthal, 2016).

In this research, semi-structured, face-to-face interviews were conducted from July to mid-September 2018. Interviews were performed with a range of local key stakeholders who are directly related to *Ab-bandan*s i.e. farmers, fishermen,

informal leaders (elders, *Mirab*, farmers' representatives), and official leaders (members of rural councils) who have been formally elected by the villagers. The wide range of stakeholders involved, achieved a rich image of the views of the people and thus increased the credibility of the research (Shenton, 2004). Three different *Ab-bandan*s/villages were selected according to the previous research experience of the first author with the study site (Table 1). Initially, interviews began with a set of stakeholders who were known to the researchers (i.e. purposive sampling), and then a snowball sampling approach was used to identify additional interviewees who also had experience, ability, and readiness to provide the required data (Rosenthal, 2016). The researchers continued sampling and interviewing until the data revealed that there were no new insights on the subject under investigation (Charmaz, 2006). Indeed, achieving theoretical saturation is a criterion of data validity (Elo et al., 2014). Ultimately, 29 local stakeholders were interviewed, all these interviewees were male (Table 1). The main stakeholders of *Ab-bandans* are men; therefore, women's perception as indirect stakeholders was not addressed.

Table 1 Description of selected *Ab-bandans* and local stakeholders interviewed

Ab-bandan/village name	Shorthand	Local stakeholders			
		Farmers	Fishermen	Informal leaders	Official leaders
Panbeh Zar Kooti	PZK	4	1	4	2
Gol Neshin	GN	4	1	2	2
Abasali Kash	AK	3	1	3	2
Total = 29		11	3	9	6

During the interviews, participants gave their oral consent and received information on their voluntary participation, protection and confidentiality of the research data. In addition, participants were informed that they could withdraw from the interview at any time (Flick, 2009; Forsgren et al., 2016). Interviews were conducted and recorded by two members of the research team (the first and fourth author) in dialogue form and for an average of 60 minutes. The interviewers had the advantage of being familiar with the native language, so that they were able to communicate directly with the local stakeholders. In addition, the interviewers recorded their observations and impressions about each interview during the research (Hancock et al., 2009).

The interview questions were primarily open-ended which provided opportunities for both interviewer and interviewee to have a detailed discussion of the topic under investigation (Hancock et al., 2009). Before final application, the interview guide questions were tested among several Ph.D. students, as well as local stakeholders, to identify any potentially unclear and biased questions (Rosenthal, 2016). The interviews began with an opening question and continued with a range of related questions following an interview guide (Table 2). The researchers encouraged the interviewees to provide more detailed information by asking short questions such as 'Can you explain more?', 'What do you mean?', and 'Can you give an example of your experience?'

Table 2 Interview guide

Opening question	Guide questions	Follow up questions
Could you please tell us a bit about your *Ab-bandan*?	How do you see trust among different stakeholders in your community?	To whom do you go when you need cash to solve your financial problem? How do the rural councils and public authorities work?
	To what extent do people collaborate with one another in the issues related to *Ab-bandan*?	How are the decisions related to *Ab-bandan* taken? How is the role and involvement of individuals in the decision-making process? Do you contribute if the government demands your financial or physical participation for *Ab-bandan*?
	How is your interaction with individuals in your community?	In which events do people come together?
	Who plays a leadership or mobilizing role regarding *Ab-bandan*?	How are the leaders selected? What are the main characteristic and role and responsibilities of leaders?
	Do you experience any conflicts in your community regarding *Ab-bandan*?	Who are the key actors involved in the conflicts? What are the frequency, intensity, and duration of conflicts? What are the causes of conflicts? How do you resolve these conflicts? Have these worked?

Data from this research study included interview transcripts and field notes from observations. All the recorded interviews were transcribed verbatim. Data was analyzed by the same researchers who conducted and transcribed the interviews. NVivo software (version 10) was used to code the transcripts through the identification of relevant themes, concepts, ideas, and relationships. As Sutton and Austin (2015) noted "this process enables the researcher to begin to understand the world from each participant's perspective". After coding the data independently, the two researchers presented and discussed any similarities and differences in their codes and reached decisions on final themes. This process resulted in the revision of the codes and helped to clarify and confirm the research findings (Sutton and Austin, 2015). We highlighted the results with direct quotes from the interviewees and the researchers' interpretations of the themes and concepts.

5. Findings

5.1 Leaders and leadership roles

The results from all three villages indicated that the official leaders of *Ab-bandans* are actors who play a key role in decision-making and planning related to local water management. The official leaders are a group of 3 to 5 people (five members in villages with more than 1,500 inhabitants), who have been formally elected by the villagers for a period of four years. These official leaders are called rural council (*Shura*) and are legal representatives of the government in the villages. According to Iran's constitution (article 100), "for the quick promotion of social, economic, development, health, cultural, educational, and welfare programs, the administration of each village must be carried out under the supervision of a rural council". Therefore, all activities related to local water management have to be made with the approval and under supervision of the rural councils e.g. attempts to obtain budgets from the regional government for the rehabilitation of *Ab-bandans*, plans to lease *Ab-bandans* to any qualified person for aquaculture,

dredging of canals, farm routes improvement etc. The rural councils also play a role in motivating co-operation among farmers for collective action in the villages. For example, the collection and mobilizing of money, labour, and equipment needed for dredging the canals takes place under the order and co-ordination of the rural councils. Minor conflicts among farmers are also resolved by the rural councils.

In addition, elders, *Mirab*, and farmers' representatives are informal leaders in the villages. The elders enjoy influence and are socially respected people in rural society. They are trust-worthy persons who, together with the rural councils, mediate among farmers in order to solve disagreements. Farmers bring their claims to the elders and rural councils for judgment, and they respect and enforce their mandates.

Mirab, the water master also co-operates with the rural councils in the management of *Ab-bandans*. At the beginning of each growing season, two or more individuals are selected by farmers as *Mirab*. Under the supervision of the rural councils, they are responsible for storing water in the reservoirs during the rainy seasons, maintenance of the reservoirs, and distribution of water among farmers in the growing seasons. The use of water in rice fields is carried out in co-operation with the farmers. So, when each farmer has completed irrigation, they are obliged to direct the water to the adjoining field, this is supervised by the *Mirab*, so that the rice fields are irrigated in turn. At the end of the growing season, *Mirab* receives a portion of the farmers' crop in payment (6 kg rice per hectare), but sometimes these fees are paid in cash. The presence of *Mirab* is very important for the fair distribution of water among farmers, especially in dry years.

Farmers' representatives are also actors related to *Ab-bandans* who are influential, experienced, reliable, and well-known farmers, who usually represent different family groups. These people usually associate with the rural councils in decision-making and resolution of conflicts among farmers and the important decisions about *Ab-bandans* are usually legitimated in agreement with this group.

Summarizing the various activities and roles attributed to the leaders (table 3), it seems that members of the rural councils as official leaders play a more important role in legitimization and implementation of water-related decisions than the informal leaders due to their legal authority.

Table 3 Sub-categories identified in the component of leaders and their roles

Category	Sub-category	Description
Leaders and their roles	The role of rural councils with regard to *Ab-bandans*	• Decision-making and implementation of water-related decisions • Attracting farmers' participation • Resolving minor everyday conflicts among farmers
	Influence of elders	• Mediation in solving minor conflicts among farmers
	The role of *Mirab*	• Storing water during rainy seasons in the water reservoirs • Maintenance of the water reservoirs • Distribution of water among farmers during the growing seasons
	Co-operation of farmers' representatives in water management	• Legitimize decisions • Resolution of conflicts among farmers

5.2 Conflict resolution

The results from the villages investigated showed that there are different conflicts among local stakeholders within the communities. One interviewee from PZK explained that "*The conflicts between farmers are ordinary and inevitable. For example, a farmer may cultivate a common border between his farm and the adjacent one to produce more crops which leads to protest from the neighbouring farmer*". One interviewee from GN also stated that "*Conflicts among farmers are exacerbated with water scarcity. Last night a farmer wanted to steal water. He secretly attempted to alter the flow of water into his farm*". The interviewees noted that in rural areas, norms are more effective than legal rules; therefore, the majority of the contradictions and claims among farmers are usually resolved through the intervention of rural councils and informal leaders.

Using the potential of *Ab-bandans* for fish breeding also creates a conflict between the fishermen and farmers. One fisherman remarked that "*My fish are dying. When they come to the margins of the reservoirs, they get stuck there because the water level is too low. Therefore, they cannot return to the reservoirs*". Although the revenues from the lease of *Ab-bandans* are used for maintenance and protection of the reservoirs and development of the rural area, when there is a shortage of water, farmers prefer to withdraw more water from *Ab-bandans*. But the fishermen prevent the farmers from doing so because that would be a threat for their fish. The rural councils try to manage this conflict in a friendly way by meeting and negotiating between the fishermen and farmers. However, sometimes the fishermen sue the public authorities in order to find a solution to the problem.

There are opposite views and disagreements not only among the members of the rural councils, but also among this group and farmers' representatives, so that each person or group wants to enforce their own opinion. These conflicts are usually resolved through negotiation and conciliation, but grudges remain on both sides.

There are not only conflicts within the local communities, but also between different communities and these are more intense. The interviews in GN showed that there is a serious conflict between farmers in this community and the upstream village. The winter runoff passes through the upstream village in order to enter and be stored in the *Ab-bandan* in GN. However, local people in the upstream village have changed the water route and they do not allow storage of water in the reservoir. One interviewee from GN explained that "*This conflict goes back to a long-standing grudge among our grandfathers which has been passed on to their children and grandchildren and has continued until now*".

Farmers from AK should obtain part of their required water from a common *Ab-bandan* located in the adjacent village. However, the farmers in the adjacent village prevent the AK farmers using the water. "*The water war among us started many years ago. They (people in the adjacent village) are mostly young and say that this water belongs to them, and that they would prefer to use it for fish breeding. But since ancient of days, we have been using this water for agriculture*" (Interviewee from AK). These conflicts sometimes lead to mass violence, and local meetings, negotiations, and conciliation are only short-term, temporary mechanisms to solve these problems. The interviewees stated that there is no local mechanism to resolve disputes between different communities and so they are referred to the public authorities e.g. government agencies related to water management, court, police; but these disputes still remain unresolved over many years.

The government has not only failed to resolve the conflicts between different local communities, but it is also part of the conflicts. There is a conflict between the farmers from PZK and the government at the regional level. The

government claims that according to the water law, all water resources belong to the government and therefore they are the main decision-makers for administration, authorization, and control of the water reservoirs. One interviewee from PZK pointed out that "*Our Ab-bandan is near the main road, it is a good place for leisure and recreation activities, and would be an attraction for tourists. Therefore, the government claims ownership and wants to decide independently in regard to the different projects in our Ab-bandan. However, this Ab-bandan has been in our village for hundreds of years and our grandfathers built it, therefore, we are the real owners. It is our asset and we want to make this decision independently*". Due to the geographical location and various economic potentialities, it seems that this *Ab-bandan* has been considered by the government at the regional level. Villagers are afraid of losing their resources which they have been using for agricultural purposes over generations and if they lose this, they will lose their livelihood. Another interviewee from PZK highlighted that "*In one of the villages in Mazandaran, the government undertook the administration of Ab-bandan and claimed ownership. Gradually they changed the use of Ab-bandan and built a residential complex there*". This dispute has been brought to court over many years and as long as this conflict is not resolved, farmers are not allowed to use the water for other functions except irrigation. Table (4) provides a summary of various conflicts and the mechanisms for resolution in the research area.

Table 4 Sub-categories identified in the component of conflict resolution

Category	Sub-category	Description
Conflict resolution	Resolving conflicts within the communities: - among farmers - among fishermen and farmers - among leaders	• Mediation of the rural councils and informal leaders by local meetings, negotiations, and conciliation • Negotiation and conciliation among leaders
	Resolving conflicts between different communities	• No local mechanism
	Resolving conflicts between communities and government	• Remaining unresolved over many years

5.3 Social network cohesion

Although interactions and relationships in the villages have decreased in the past years, still weddings, funerals, and religious ceremonies are held in a collective manner. Many described that the villagers support each other in difficult circumstances such as sickness and death. For example, if someone loses one of their family members, all the villagers go to their house as a group to offer their condolences and they try to pay the funeral expenses jointly. Therefore, most of the communication and visits between local stakeholders within and between the communities occur as the group events.

However, many of these events are affected by conflicts in water management. For example, consideration to the religious values is one of the most effective elements in relationships and solidarity within and between local communities. But this religious solidarity is being reduced due to conflicts in water management. In the villages investigated, the local people gather in mosques and religious places and carry out the related customs and practices collectively during Ramadan (month of fasting) and Muharram (the first month of the Islamic calendar). However, one interviewee from PZK explained that "*This year during Ramadan, some people did not come to the mosque because they had some problems with the rural councils regarding water-related issues*". Another interviewee from AK also

suffers from the mounting division between different communities; he said "*Every year during the Muharram, our neighboring village used to come to our village to perform the associated rituals. But this year, they didn't come and our annual religious ceremonies were cancelled due to the contradictions in association with Ab-bandan*". So, these conflicts and disagreements in water management have disrupted the group events and social network cohesion. Table (5) shows a brief description of the component of social network cohesion.

Table 5 Sub-categories identified in the component of social network cohesion

Category	Sub-category	Description
Social network cohesion	Social interactions and relationships	• Participation in group events such as weddings, funerals, and religious ceremonies and performing them in a collective manner • Consideration of the religious values

5.4 Co-operation

The results from all three villages indicated that the issues related to *Ab-bandans* e.g. dredging, reparation, and maintenance are conducted with the co-operation of farmers. This co-operation takes place in the form of collection of money, providing equipment and machinery needed, and manual labour. For example, the rural councils invite farmers to participate in cleaning canals as a labour force. Although all farmers may not be present, dredging will be ultimately conducted with the people who are available. Farmers who are absent must participate in other related activities upon request of the rural councils.

The results also showed that decision-making in all villages is officially the responsibility of the rural councils. However, important decisions such as the lease of *Ab-bandans* are made collectively with the participation of stakeholders. For example, water reservoirs are being auctioned for aquaculture by the rural councils. Afterwards, the rural councils invite people to a meeting in the mosque to select a qualified person from among various candidates (this person can be from inside or outside of the village) as the winner of the auction. All interested stakeholders can attend this meeting and the decisions are taken based on majority voting. Finally, all the people are informed of the decision through a megaphone in the villages or social media. Collective decision-making is very difficult due to conflicts and opposite views, and it requires a lot of time and energy. This leads to delays in making decisions and their implementation. One interviewee from PZK reported that "*The public meetings are not efficient because there are too many comments which cause conflicts among different groups. Those people (usually farmers' representative), who are against the rural councils give comments based on their personal hostility. This leads to a delay in decision-making, longer meetings or even cancellation of meetings*".

Many interviewees stated that they are willing to actively participate in projects for solving water problems in co-operation with government agencies involved in water management. For example, they are willing to participate financially and physically in canal lining and rehabilitation of *Ab-bandans*. According to interviewees, in case of implementation of these projects, it would be possible to prevent water loss, store more water, and use the water reservoirs for other functions. Table (6) illustrates different sub-categories identified in the component of co-operation.

Table 6 Sub-categories identified in the component of co-operation

Category	Sub-category	Description
Co-operation	Farmers' co-operation in dredging and maintenance of *Ab-bandans*	• Collection of money, providing equipment and machinery needed, and manual labour
	Making decisions related to *Ab-bandans*	• Performing meetings with the participation of stakeholders
	Farmers' willingness to co-operate with government agencies for solving water problems	• Financial and physical co-operation for canal lining and rehabilitation of *Ab-bandans*

5.5 Trust

The results indicated that in case of financial difficulties, interviewees firstly ask their family and relatives and then friends and neighbours. However, they described that the trust network among people has collapsed in the past years due to economic difficulties, the reduction of relationships, and negative experiences in the past. One interviewee from PZK expressed that "*Trust among people existed before our houses were fenced off*". Although general trust in case of financial difficulties within the communities is relatively high, the trust of the local stakeholders in rural councils has reduced dramatically.

According to the results, although the members of rural councils are elected by the people, they distrust them and are pessimistic with regard to financial matters. The rural councils do not give feedback regularly and financial statements on how to spend the revenues from the lease of *Ab-bandans*, or their reports do not have the required transparency. According to one interviewee from PZK "*The rural council does not spend all the money on the village, they keep some of it and present false invoices*". The interviewees argued that farmers do not make an effort to request and receive regular reports. "*People are just talking about the rural council but they do not demand a direct explanation about what they do with the money*" (Interviewee from GN). The farmers ignore requests for reporting because of family ties, in addition, they are too busy with everyday life and its problems and do not have time to question the rural councils and request reports. However, the rural councils are legally obliged to report to the public.

The eligibility of candidates for the rural councils' election is determined by the relevant government bodies, but there is not much rigor in determining competencies and a lot of the criteria are ignored when choosing the candidates. Additionally, family relationships are more important than merit for the election of the rural councils within the communities. Villagers try to vote for their own relatives, as a result, any candidate who belongs to a larger tribe has more votes. One interviewee from GN said that "*People want to send their relatives to the rural council so that they can use their family connections for more support"*. The candidates gather votes among poor and low-income groups within the community by donating money or food.

Local stakeholders also protested about the government at the regional level because they overlook or postpone their promises such as canal lining and rehabilitation projects of the water reservoirs and this causes distrust. One interviewee from AK emphasized that "*The government officials are thinking of their own pocket rather than farmers. We have reservoirs in this area which are filled with water in winter time and the extra water flows into the sea and is wasted. But, the government does not make any arrangements for storing this extra water".* If dredging and rehabilitation would be carried out, more water could be stored in *Ab-bandans* during the rainy season and other resources such as a dam or well would not be necessary to irrigate the rice fields. Another interviewee from AK also argued that "*Water canals are constructed with soil. If the government conducts the project of canal lining, water will*

not be wasted, and then there will be enough water for both irrigation and fish breeding. In my opinion, there is no water shortage; we ourselves are the cause of it". The members of the rural councils are also dissatisfied with the government's promises as well as the long-term administrative procedure.

Interviewees distrust the parliament's representatives from the region. According to them, the political representatives gather votes in the region through advertisements and promises to solve problems such as rehabilitation of the reservoirs and resolution of disputes among communities; however, once they are elected in the parliament they don't fulfill their promises. One interviewee from GN argued that "*The representatives, despite their promises, do not make an effort to resolve disputes among us and the upstream village. They are too afraid of losing the votes of upstream people for the next round because they have a larger population than us*". Table (7) shows the result of villages investigated regarding the component of trust.

Table 7 Sub-categories identified in the component of trust

Category	Sub-category	Description
Trust	Trust among local stakeholders in case of financial needs	• Relying firstly on family and relatives, then friends and neighbors
	The rural councils accountability	• Lack of reporting regularly • Low transparency in the reports
	Transparency in the process of the rural councils' election	• Low accuracy in determining competencies • Election of the rural councils based on family relationships
	The government performance at the regional level	• Dissatisfaction with the government's promises
	The trust of local stakeholders in the parliament's representatives	• Dissatisfaction with the promises of parliament's representatives for solving water problems

6. Discussion

This study provides a detailed picture of the role of social capital components in the governance of *Ab-bandans* by the local key stakeholders i.e. farmers, fishermen, informal leaders (elders, *Mirab*, farmers' representatives), and rural councils. We considered five central social capital components i.e. trust, co-operation, social network cohesion, leaders and leadership roles, and conflict resolution. We discuss these components below.

We found that elders, farmers' representatives, *Mirab*, and especially rural councils are the key individuals and leaders who play a crucial leadership role in promoting and facilitating collective action in the utilization and management of *Ab-bandans* through co-operation and conflict resolution. They can decrease the water-related problems through mediation and negotiation within the community and manage local conflicts through customary laws and norms derived from ethical, social, and religious values. The results also indicate that the rural councils play a more important role in the management of *Ab-bandans* than the informal leaders due to their legal authority. In contrast, Bodin and Crona (2008) found that leaders who are elected traditionally, have a central and powerful position in the village and are firmly attached to village social networks in comparison with formally elected leaders with official authority. Dahal and Dev Bhatta (2008) demonstrated that leaders solve the problems in the interest of both sides through assessment of the causes of conflicts, engagement in arguments, exchange of information, and identification of the common points. They play a significant role in convincing people to take collective action and making culprits aware of their mistakes

(Dahal and Dev Bhatta, 2008). Local leadership can "mobilize energies, generate trust, give vision, and support the collective finding of a clear direction in a multiparty process" (Pahl-Wostl et al., 2007: 8).

Conflicts within the communities could be resolved by leaders through mediation, negotiation, and conciliation. However, these local mechanisms are not effective in the prevention of conflicts and mass violence between different local communities in regard to water usage. It seems that an institutionally more comprehensive approach is required. Increasing disputes and lack of appropriate solutions lead to the reduction of social interactions and relationships for the utilization and maintenance of *Ab-bandans*.

It is interesting to note that many interviewees argued that intervention and facilitation by public authorities is necessary to solve the conflicts between different communities. However, government agencies related to water management have not only failed to provide an appropriate mechanism for resolving conflicts, but they are also part of the conflicts due to their preferences for independent and top-down decision-making and planning for *Ab-bandans*. The government agencies related to water management would prefer to act as an administrator rather than a facilitator in the management of *Ab-bandans*. As water is a public commodity in Iran and the government is the owner and manager (Hayati and Bijani, 2011), neutral intervention by the public authorities through facilitation and strengthening of the culture of dialogue and negotiation can be seen as a policy mechanism for conflict resolution in the management of *Ab-bandans* (Mirzaei et al., 2019). Tyler (1999) concluded that government policies in conflict management enable local stakeholders to act successfully in assessing their needs, negotiating and discussing with other users, evaluating the technical quality of resources, and reaching consensus-based solutions.

According to the results, many ceremonies in the villages are performed collectively and people try to keep their local values and customs. These local ceremonies and group events could be a way for people to come together and address common issues related to their *Ab-bandans*. But many social interactions and relationships within and between the communities, and the willingness to carry out local ceremonies, have been reduced due to the conflicts in water utilization. This leads to a reduction of opportunities for participatory action and communication within and between the communities in order to solve common problems related to their *Ab-bandans*. Relationships in social networks can improve collaborative governance through the generation and diffusion of environmental knowledge, mobilization and allocation of key resources for effective governance, commitment to the common rules among actors, and dispute resolution (Bodin and Crona, 2009). It is important to note that social ties within local communities foster trust, mutual assistance, and ultimately social relationships and cohesion which are essential for consensus building and conflict resolution in the governance of natural resources. Social ties between local communities play a critical role in access to any external resources and encouragement of collective action (Bodin and Crona, 2009).

Co-operation of farmers in water-related activities takes place in the form of the collection of money, providing equipment and machinery needed, and manual labour. Water reservoirs-related decisions are also made collectively with the participation of stakeholders who are interested in the involvement of water-related meetings. Although the co-operation of each farmer in decision-making is useful for collective management and leads to the more legitimacy of decisions, in practice, most farmers participate in the decision-making process through their representatives, and so not all are involved. However, often collective water-related decisions do not reach a definitive conclusion and the main subject of the meetings may be forgotten due to conflicts and difficulties in dialogue and debate among the local

stakeholders. This leads to the failure of decision-making and planning for the water reservoirs in a co-operative manner.

We found that local stakeholders are eager to collaborate with government agencies related to water management. It can be seen as an opportunity for government agencies to consider the willingness of farmers and ask them for their ideas on the management of *Ab-bandans*. Co-operation of stakeholders with government agencies and the utilization of their knowledge for solving water problems could have a significant impact on the sense of belonging and willingness to participate in the management of *Ab-bandans.*

Although general trust within the communities is relatively high, farmers trust in the rural councils has been reduced due to the lack of accountability and transparency. The rural councils act as a grassroots institution and play an effective leadership role in the water sector progress through decision-making and planning for the water reservoirs, motivating farmers for participation, and using the other leaders within the community. However, lack of transparency in the process of the rural councils' election and lack of reports and information regarding how *Ab-bandans* revenues are used, has greatly reduced the local trust in the rural councils. Transparency in the processes and accountability of rural councils could play a key role in building trust within the communities. This is a necessary aspect for solving collective action problems in activities related to water reservoirs. The presence of accountable and transparent rural councils as the most important leaders within the communities could contribute to successful water management. Furthermore, trust in the government and political representatives has been ruined over the years due to their failure to keep promises that they have made. It is important to note that the local trust in the government and its agents can increase the motivation of stakeholders to provide solutions aligned with territorial specificities for overcoming water problems. Mirzaei et al. (2019) described that farmers can trust the government and its agents when they see that their needs regarding the usage and maintenance of *Ab-bandans* is the main concern of the government as an administrator of water management.

7. Conclusion

The findings achieved in this study contribute to current literature regarding the role of social capital components seeking a collective way of governing *Ab-bandans* among local stakeholders. Social capital components at the local level play an effective role in the management of *Ab-bandans*. Certainly, neglecting the social capital components (i.e. trust, co-operation, social network cohesion, leaders and their roles, and conflict resolution) leads to the failure of collective action in the management of water reservoirs.

This study shows that the level of social capital and its importance can differ depending on which component is under investigation. For example, while many events are held jointly within and between the communities which indicates a high level of social relationships in group events, the use of mediation, negotiation, and conciliation mechanisms by leaders, to resolve conflicts between different communities, is only a temporary solution. It seems that appropriate mechanisms for conflict resolution are the most important aspect of social capital which plays a significant role for the other components. According to the results, social relationships and cohesion are being reduced due to the conflicts in water management and lack of appropriate mechanisms for resolution. Furthermore, conflicts and disagreements lead to the failure of collective interaction among local stakeholders in water reservoirs-related decision-making and planning. Therefore, resolution of conflicts can bring people together in group events to communicate and address

their common issues and promote their co-operation in public meetings for collective decision-making and planning. The government can play a key role in conflict resolution at the local level as it is in charge of water management in Iran. The government could undertake the role of a facilitator rather than governmentality, by using participatory governance for decision-making, planning, and resolving conflicts.

However, the results of the study support the idea that the management of *Ab-bandans* in a collective manner at the local level in the Mazandaran province, needs to take all components of social capital into consideration. Therefore, a better understanding of social capital components influences stakeholders' participation in the collaborative governance of water reservoirs and is vital to help policymakers to design programmes for water usage and management. The government should establish effective strategies of water governance to empower and integrate local stakeholders, so that they are able to solve their water-related problems independently. This would enable local communities to be more resilient in the face of collective action problems.

Although the result of this research is only restricted to the villages investigated, and cannot be generalized in respect of other *Ab-bandans*, it can be used as a basis for other related studies in the Mazandaran province. The focus of this research was not to discuss exogenous factors e.g. quantitative and qualitative reduction of water, sudden droughts, increased cultivation, international sanctions etc. Although we assume that these factors are catalyzers of the water crisis, not the main factor, this does not mean that social capital alone will be sufficiently successful in the governance of *Ab-bandans*.

Conflict of Interest

The authors declare no conflict of interest.

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Chapter 5

Discussion and Conclusion

5 Discussion and Conclusion

As seen in the chapters 2, 3 and 4, this PhD research explored the governance of water reservoirs in the Mazandaran province, Northern Iran, from the perspective of public and private sectors at the regional level, as well as local stakeholders within the communities. This research aims to identify and assess gaps in the public governance of *Ab-bandans* as well as seeking relevant policy instruments for overcoming these gaps in order to attain effective public water governance. In addition, this research investigated the role of social capital components in the governance of *Ab-bandans* in a collective manner at the local level. This concluding chapter summarizes the main findings and discussions, limitations, significance and contribution of the research, and policy recommendations.

5.1 Summary of the main results and discussion

The identification of challenges in the governance of *Ab-bandans* showed that the most acute gap, of all the gaps identified, is the lack of a specific law for *Ab-bandans*. The absence of a law for *Ab-bandans* in the country's water law leads to other gaps e.g., unclear ownership, conflicts, financial problems, and lack of environmental guidelines and technical instructions. As Navabi (2017) mentioned water-related laws in Iran have gradually lost their legal effectiveness. Fani et al. (2016) revealed major challenges in water resources in Iran which are affected by the geographic location, natural conditions in Iran and anthropogenic and management issues. Natural factors such as the lack of precipitation cannot be controlled by humans, but with proper management, most of the shortcomings could be eliminated. The most important problem in the management of water resources is the lack of enforcement of recognized legal cases related to water. The water-related laws of the country show that, in most cases, the existing laws are not fully implemented. Lack of long-term and strategic planning, low recognition of *Ab-bandans* at the national level, an unstable and insignificant budget from the central government, lack of water user associations, and absence of the use of technology are other important gaps in the governance of *Ab-bandans*.

It is important to note that water governance challenges are often interrelated and can exacerbate each other (OECD, 2011). There is interdependence among the identified gaps. The lack of sufficient budgeting from the central government (funding gap) results, not only in the lack of a specific law for *Ab-bandans* (policy gap), but also low recognition of *Ab-bandans* at the national level (administrative gap). Furthermore, due to insufficient budgeting (funding gap) and the lack of monitoring and evaluation of the rehabilitation of *Ab-bandans* (accountability gap), the water reservoirs face technical defects (capacity gap). Therefore, a holistic perspective is needed to understand and resolve the governance gaps of *Ab-bandans*. There is no magic or 'one-size-fits-all' approach (OECD, 2011) to overcome the gaps and a mixture of solutions are necessary.

Multiple policy instruments identified in this research properly contribute to the improvement of the governance of *Ab-bandans*. Among all the policy instruments, the enhancement of participation and collective action among farmers make the most important contribution to the improvement of water governance. "Even if participation cannot be seen as the new orthodoxy, it is clear that participation has become one of the central influences in mainstream development thinking" (Parfitt, 2004: 537).

Furthermore, all the policy instruments are interdependent and should not be addressed separately. The improvement of the governance of *Ab-bandans* should be systematic; it is not possible to apply a single policy instrument without considering the impact of other policy instruments. There is a necessity to adopt the policy instruments in a holistic way to solve difficulties in the governance of *Ab-bandans*.

Sustainable integration of water resources is not only dependent on formal institutional factors e.g. legislation and organizational structure, but also refers to the ability of the social system to mobilize energies in a coherent manner (Solanes and Jouravlev, 2006). The result showed that various local stakeholders are failing to manage *Ab-bandans* in a collective manner at the local level, due to challenges in the issues related to social capital components. We found that the management of *Ab-bandans* in a collective manner at the local level has to take all components of social capital into consideration. This would enable local communities to be more resilient in the face of collective action problems. Appropriate mechanisms for conflict resolution are the most important aspect of social capital and play a significant role for the other components. Resolution of conflicts could bring people together in group events to communicate and address their common issues and promote their co-operation in public meetings to attain collective decision-making and planning. Musavengane and Simatele (2017) pointed out that several key social capital components including fairness of rules, dispute resolution procedures, inclusivity, sociability, and open dialogue are important for the acquisition stakeholder participation in community-based resource management schemes.

Overall, it can be concluded that managing water reservoirs in the Mazandaran province requires collaborative efforts between various stakeholders within and between the local communities. Consequently, local stakeholders must be empowered and encouraged to identify water-related problems in their communities and be able to design and develop strategies to address these problems. Therefore, a better understanding of social capital dimensions influences stakeholder participation in collaborative management of water reservoirs and is vital to help policy-makers to design programmes for water usage and management, which would be more attractive to local stakeholders. The government should undertake the role of facilitator, by using participatory and bottom-up processes for decision-making, planning, and resolving conflicts among local stakeholders. The government should establish effective strategies of governance to engage farmers in management decisions, to empower and integrate them, so that they are able to solve their water-related problems independently. There is also an urgent need for co-operation and participation not only between local stakeholders and responsive public agencies at the regional level, but also among public agencies in charge of water policy design and implementation. As the government is the owner and manager of water resources, better management and utilization of *Ab-bandans* can only succeed if accompanied by a shift in public governance through the involvement of all relevant actors.

5.2 Limitations and research outlook

Methodological challenges should be mentioned as a limitation of the research. According to the terminology in the Delphi method, the participants who are involved in the research (first paper) are called 'experts'. Therefore, the results are 'experts consensus', and that does not necessarily mean that the 'best' or 'correct' responses have been found. Furthermore, construct validity of the results (second paper) can be increased by involving a larger sample of participants in the quantitative phase of the research.

Also, this research is limited to the water reservoirs in the Mazandaran province, Northern Iran. So, the results cannot be generalized in respect of other areas in Iran. Nevertheless, the findings can be used as a basis for other case studies in the country with reference to rivers, lakes, and underground waters.

Although the policy instruments identified for improving the governance of *Ab-bandans* are a good starting point for creating a positive change in the governance of *Ab-bandans*, further research could also be conducted to assess the ex-ante or ex-post effect of each policy instrument. Further research could also explore the relevant tools and instruments to enhance the governance of *Ab-bandans* from the viewpoints of farmers and other local stakeholders. Further studies for the assessment of water-related challenges and relevant strategies for improvement of water resources, at different levels of government, (which can influence each other), are also recommended.

5.3 Significance and contribution of the study

This research has significance and contribution for the following reasons:

- The unique contribution of this study is the way in which different research methodologies (modified Delphi method, statistical analysis, mix methods, etc.) were applied to analyze the water governance issues. As Seelen et al., (2019) have already cited, our second paper in the methodology section of their research regarding public awareness of water usage in Europe, could also be used by other researchers following the same procedures of this study, in order to analyze natural resource management.
- Furthermore, the OECD's framework has already been employed in 17 OECD member countries and 13 Latin American countries, focusing more at the national level in the case of Mexico, Netherlands, Jordan, Tunisia, and Brazil. It is important to note that, this study is the first attempt to use the OECD's framework in the case of Iran; therefore, this research could provide inputs for international organizations, which are interested in water governance issues in Middle Eastern countries.
- The main significance of this study is to provide valuable information about water governance in the Mazandaran province, which could be used to provide a solution to the challenges in the water sector in Iran. This research provides inputs for policy-makers to prioritize options to strengthen the governance of *Ab-bandans*. If the new knowledge created in this study would be applied, related challenges in the governance of *Ab-bandans* could be reduced. Many Iranian researchers (Raeisi et al., 2018; Valizadeh et al., 2018; Valizadeh et al., 2019) have already cited the first paper in their water-related research. Identifying water governance gaps and policy interments for improvement, as well as analysis of social capital at the local level will contribute to the new knowledge not only in Iran but also to expand water studies in other countries with similar water resources.

5.4 Policy recommendations

The hierarchy of policy instruments which are determined in the second paper could be applied as a road-map and policy advice for public authorities when making decisions regarding *Ab-bandans*. Based on this, the following policy recommendations are proposed:

- The government should adopt strategies for the governance of water reservoirs to ensure that local stakeholders are encouraged and empowered to participate in the maintenance of *Ab-bandans* and related planning and decision-making. The top-down paradigm of government should be changed into a bottom-up paradigm by using participatory processes for decision-making, planning, and resolving conflicts among local stakeholders. Fostering co-operation and participation between local users through their involvement in the assessment and solving of water problems could also be effective for resolving conflicts within and between the communities.
- A comprehensive and long-term national plan for the sustainable conservation of water resources in consistence with the ecological, economic, and social features should be addressed. Moreover, regional water management with respect to the role of *Ab-bandans* in irrigating rice fields and the sustainable use of their various potentials should also be included in this national planning.
- Training and building the capacity of farmers as end-users for the protection of *Ab-bandans* is necessary. It is imperative to note that the training approach should be based on a participatory learning process and knowledge sharing among farmers. This is a totally different approach from simply delivering knowledge, and it aims to strengthen the problem-solving skills of farmers by fostering participation, self-confidence, dialogue, joint decision making, and self-determination. This training approach can increase farmers' knowledge and empower them to change their perspectives and behavior in order to be active in altering the current condition to a desired one.

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