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Title: Impacts of Institutional arrangements on the adaptive capacity of the Urmia Lake basin

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**Impacts of Institutional arrangements on the  
adaptive capacity of the Urmia Lake basin**

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## Summary

The water crisis is a global challenge, which is caused by natural climate changes or human activities. The impact of mismanagements and poor institutions on the ability of socio-ecological systems to react to the stresses imposed on them is emphasized in the literature (Pahl-Wostl, 2009, Madani and Mariño, 2009). Fragile institutions can decrease the ability of a socio-ecological system to adapt to the changes (Pahl-Wostl, 2009). Urmia Lake basin in Iran is one of the regions which has experienced severe environmental degradation during the last four decades. The aim of this thesis is to investigate the impacts of institutional changes in water management on the adaptive capacity of the Urmia Lake basin as a socio-ecological system. The main research question is: *to what extent institutional arrangements have influenced the adaptive capacity of the Urmia lake basin?* In order to analyze the institutional arrangements, Östrom design principles are used as the common characteristics of robust institutions. The adaptive capacity is investigated by using the asset-based approach. This is an explanatory research, and single case study is used as its research strategy.

In this study, it is concluded that adaptive capacity is affected by actions which are outcomes of the decisions made by a fragile institutional arrangement. Lack of clear boundaries, lack of congruence between rules and local context, low public participation, weak monitoring and sanctioning mechanisms, absence of local institutions and absence of bottom-up movements have made the governance system fragile. The fragile institutional arrangements have led to a considerable decrease in the natural capacity of the system, which the decrease in the Urmia Lake's level of water proves it. The economic capacity of the system has decreased because of the wrong decisions, which were not based on the context and capacities of the system. The physical capacity is not developed properly since the governance regime was not paying attention to increasing the efficiency of the agriculture sector. The human capacity also has decreased because of the lack of opportunities for the community to participate in the management of their environment and also lack of opportunities for the young and educated people to use their abilities.

In addition, the role of social capital is emphasized in this research. The social capital and institutional arrangements are in a dynamic relationship and they are continuously affecting each other. The changes in the institutional arrangements have affected the social capital and the changes in the social capital have affected the abilities of the governance system to manage the resources properly. In addition, social capital is affecting the adaptive capacity of the basin. For instance, social capital is required for sharing knowledge between users and different actors which has affected the physical capacity and also the human capacity of the system.

In this study, the importance of local institutions is emphasized which can be a proper policy to improve the governance system. These institutions can be highly effective in clarifying the boundaries, decreasing the gap between rules and the context, enhancing the public participation, monitoring the resources from the local level and solving the conflicts in user level. The central government should provide opportunities for bottom-up movements and enable the local institutions to participate effectively in the decision making process.

## Keywords

Institutional arrangements, Adaptive Capacity, Östrom design principles, Urmia Lake Basin

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## Abbreviations

CPR	Common Pool Resource
DOE	Department of Environment
EA	East Azerbaijan
FWD Act	Fair Water Distribution Act
IHS	Institute for Housing and Urban Development
IWRM	Integrated Water Resource Management
MOA	Ministry of Agriculture
MOAJ	Ministry of Agriculture Jihad
MOE	Ministry of Energy
MP	Members of Parliament
RWC	Regional Water Company
SES	Socio-Ecological System
ULRP	Urmia Lake Restoration Program
WA	West Azerbaijan

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# Chapter 1: Introduction

In this chapter, the background information, problem statement, research aim and questions, importance of study and its scope and limitations are discussed to give a general picture of the study.

## 1.1 Background Information

“Water scarcity may be temporary and related to drought conditions or other accidental situation, or may be permanent and due to deeper causes such as excessive demand growth, lack of infrastructure for water storage or transport, or constraints in water management” (Martin-Carrasco, Garrote, et al., 2013, p.1693). Water is a common resource and seen as a vital component for good quality of life (Biswas, 2009) and water scarcity as a global issue has highly affected the human life and natural environment. The Middle East region is more vulnerable to water scarcity than other parts of the world (Seckler, Barker, et al., 1999) and Iran as one of the biggest countries in this region is under high water shortage risk (Madani, 2014). The dramatic water crisis in Iran is rooted in decades of mismanagement. “Iran has suffered from a symptom-based management paradigm, which mainly focuses on curing the problem symptoms rather than addressing the main causes” (Madani, 2014, p.320).

The water crisis is the greatest threat to the Middle East—“greater even than political instability or unemployment” (World bank, 2018, p.xxv). Over 70 percent of the region’s GDP comes from its driest areas while it is 22 percent in the global scale (World bank, 2018). “The complexities of the water-food-energy nexus, climate change, droughts and floods, water quality, transboundary water management, and the management of water in the context of fragility, conflict, and violence compound the challenge of water scarcity” (World bank, 2018, p.xxv). Based on the literature, water scarcity usually has led to water conflicts and migration in this region (Selby and Hoffmann, 2012). Water conflicts and mismanagements are even more pronounced in transboundary basins, where a high number of stakeholders with contrasting interests make coordination and management process highly challenging. However, the main point, which is usually ignored, is how water conflicts and weak water governance can lead to or accelerate the water scarcity process.

Population Growth, Socio-economic development, and climate change impose stresses on water resources. These stresses can be diluted to a great extent by water resources naturally, but when the stresses pass the adaptive capacity of the system, the degradation of the water system will begin. Adaptation in fact “refers to the ability of society and ecosystem to handle their water resources” (Pandey, Babel, et al., 2011, p.480). Adaptive capacity can change over time. In fact, the ability of the systems to sustain in facing the climate change impacts can change. To study the adaptive capacity of each water system the contextual conditions of that region plays an important role.

Managers and policymakers are responsible to react to the stresses on water resources rapidly. However, current institutional arrangements are usually insufficient to manage these challenges (Huntjens, Lebel, et al., 2012). Finding a blueprint for institutional arrangements to enable them to face uncertainties in different contexts efficiently, is impossible (Huntjens, Lebel, et al., 2012), but Östrom design principles can be mentioned as common characteristics of sustainable institutional arrangements which have proved to be robust over time (Ostrom, 1990).

Prior to Östrom, Garret Hardin (1968) in his article ‘Tragedy of Common’ argued that users consume limited resources based on their self-interests without any limit, although he did not consider the role of collective actions in controlling the users’ consumption. Östrom believes that communities can manage the resources sustainably with collective actions. She believes collective actions can happen in the context of a robust institutional arrangement (Ostrom, 1990). Östrom believes that robust resource governance systems are characterized by eight design principles (Ostrom, 1990).

Changes in the adaptive capacity and social and ecological performance of systems can be linked to their institutional arrangements (Ostrom and Cox, 2010). This study has tried to link the changes in the adaptive capacity of a socio-ecological system in Iran to its institutional arrangements by using Östrom design principles.

## **1.2 Problem statement**

Iran is a country with an arid or semiarid climate with low annual precipitation (Ghasemi and Khalili, 2008). Urmia Lake is located in the north-west of Iran between provinces of East Azerbaijan, West Azerbaijan and Kurdistan. This lake with approximately 5,000–6,000 km<sup>2</sup> area is the largest lake in Iran (Hassanzadeh, Zarghami, et al., 2012). “It is a UNESCO biosphere reserve and a Ramsar wetland” (Asem, Mohebbi, et al., 2012, p.1). There are 21 cities located in this basin. 11 cities are in east Azarbijan, 9 cities are in west Azarbijan and 1 city is in Kurdistan. During the recent decades, the lake’s water is saturated with salt and a considerable area of nearby lands have been turned to salt marshes which have made several problems for the citizens in the basin like air pollutions because of the diffused dust from the lake (Asem, Mohebbi, et al., 2012). As can be seen in figure 1, the drought process has started in the 1970s and it is accelerated from the late 1990s. The lake has lost 80% of its surface water, which not only has affected the ecosystem of the area negatively but also has made serious health issues for residents living close by (Shadkam, 2017). “If the lake completely dries up, which can happen in less than 10 years from now, a vast amount of salt will be released into the region resulting in an ecological, agricultural, and social catastrophe not only in Azerbaijani cities of Iran, but also in neighbouring countries such as Turkey, Iraq and Azerbaijan” (Vaheddoost, Zare, et al., 2014, p.3).

Urmia Lake Basin has been registered on the public agenda since 2000. Since the late 1990s several research projects have been conducted with international partners to analyze the causes of drought and possible responses to it. Based on these projects the main reasons for the water crisis in the lake are the construction of dams, poor water management policies, and construction of a primitive-type (gravel) causeway diving the lake into two sub-lakes in north and south, with almost no connectivity (Garousi, Najafi, et al., 2013). During the recent decades, the main priority of the provinces around the lake basin was to grow in agriculture sectors. During this period, dam constructions accelerated the drought process (Hassanzadeh, Zarghami, et al., 2012).

There are some governors who believe the water crisis in this region is caused by climate change and human activities did not have a considerable impact on the ecosystem of this region. While as Shadkam (2017) and Hashemi (2008) have argued, decrease in the level of water of the lake is not consistent with the decrease in the level of precipitation during the last three decades and climate change cannot be the only cause of the environmental crisis (Hashemi, 2012).

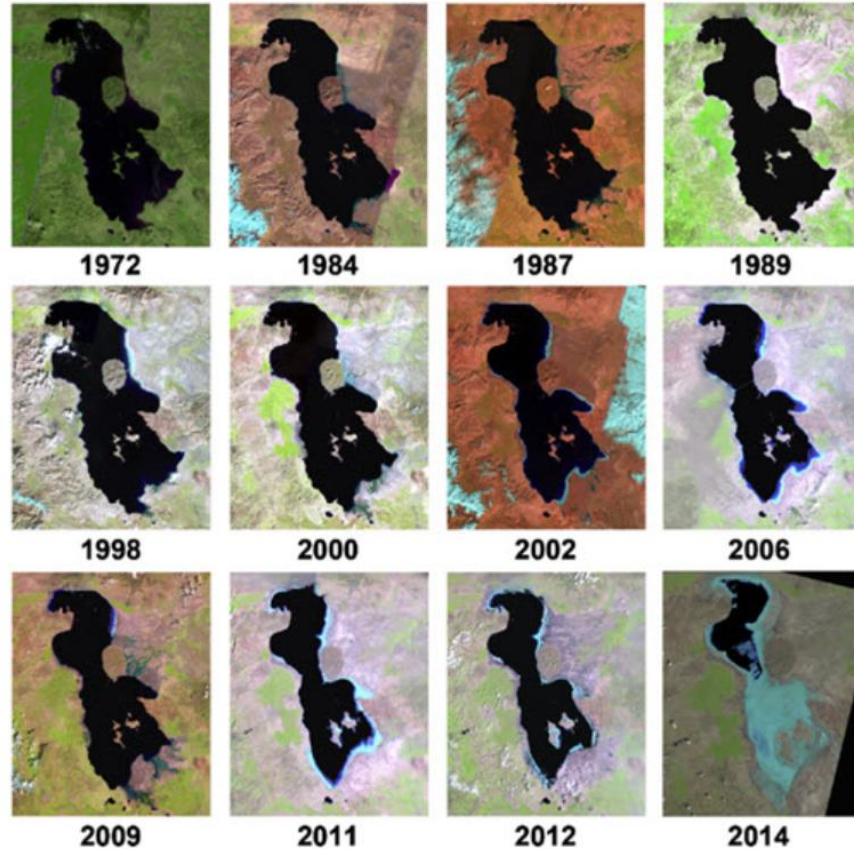


Figure 1. Urmia lake degradation process from 1970s

Source : (AghaKouchak, Norouzi, et al., 2015)

Different attempts and policies have been made in recent decades to increase the adaptive capacity of the lake such as IWRM plan. From 2005, integrated water resource management is under consideration of the government and ministry of Energy (Hashemi, 2012). Several acts have been done align with the IWRM idea, but the required vertical and horizontal collaboration among stakeholders and decision makers have not happened (Hashemi, 2012). However, the main issue, which has hampered implementation of policies and is affecting the adaptive capacity of the lake, is the presence of an unsustainable governance system in this region (Hashemi, 2012).

### 1.3 Research aim

The aim of this research is to identify specific principles in institutional arrangements that are influencing the adaptive capacity of the Urmia lake basin and to clarify which factors should be changed in the water governance system of Urmia lake basin to increase its adaptive capacity. The aim of this study is not to cover all the aspects of water governance since it is out of the scope of this research.

### 1.4 Research Questions

The main research question is to what extent institutional arrangements have influenced the adaptive capacity of the Urmia lake basin.

The sub-questions are:

- What is understood by the institutional arrangement in the Urmia lake basin?
- How can the Urmia Lake basin be characterized through the lens of the common pool resources theory?
- How has the level of adaptive capacity in the Urmia Lake basin changed and which factors have affected it?

## **1.5 Significance of the study**

First of all in the context of Iran usually for responding to the water problems the structural actions such as interbasin transfers are under consideration and there are not much research discussing non-structural factors which have led to the water crisis. Secondly, looking at institutional arrangements from the perspective of common pool resource theory is comparatively a new approach and to find the possible answers for having a robust institutional arrangement, researching in different contexts is required. Besides, there are not many studies, which have focused on the relationship between institutional arrangements and the adaptive capacity. In recent years to increase the adaptive capacity, the focus was on using technology and construction activities and impacts of institutional arrangements are mostly ignored. Therefore, this research can give an understanding regarding the possible non-structural factors, which have affected the adaptive capacity of water resources.

## **1.6 Scope and limitations**

The scope of this study is limited to investigating the relationship among institutional arrangements and the adaptive capacity of the Urmia lake basin. However, analyzing institutional arrangements, which include a large number of contextual factors affecting the water resources, is limited to the variables chosen based on the literature, interviews and researcher scope. The data collection period for this research, human and financial resources were limited and studying the institutional arrangements is limited only to Östrom design principles.

## **Chapter 2: literature Review / Theory**

### **2.1 Lake Basin Management**

Lake basins are areas where bodies of water drain. Basins collect the precipitations and contribute to the flow of water in rivers or lakes. Lakes are important for human development since they contain 90 percent of the freshwater on the earth's surface (ILEC, 2005). Lakes have three main characteristics, which separate them from other water bodies. First of all, inputs to a lake are from various sources (precipitations, flows from rivers and other channels). Secondly, they are slow to respond to changes, they absorb pollutants and floodwater without immediate changes in them. Finally, they have complex response dynamics and their responses to changes are not linear (ILEC, 2005).

Because of the availability of freshwater, lakes attract human settlements to their basins and human activities affect them considerably. By changes in land use, the evapotranspiration process will be affected, and by overuse of water, the level of groundwater and surface runoff can decrease (Foley, Defries, et al., 2005). In fact, acting based on self-interests instead of public interests is the main factor, which has hampered sustainable water management and also has accelerated the water crisis. These reasons along with climate change have led to drought in rivers and lake basins, which is threatening not only the ecosystem but also the human life and economy. In fact, when stresses, which has been imposed on the water systems by socio-economic development and climate change, pass the adaptive capacity of the systems, the water resources will degrade.

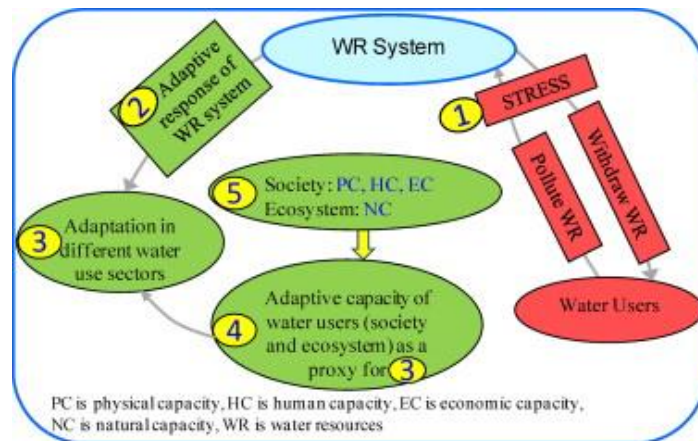
### **2.2 Adaptive Capacity**

In recent years, the efforts to control the impacts of unpredictable climate changes on natural resources are affected by the debates on the necessity of paradigm shift from technocratic management approaches, which neglect the complexity of human dimensions (Pahl-Wostl, 2009). There are a growing number of terminologies and research on management of socio-ecological systems but the adaptive management of water resources has not been considered properly (Pandey, Babel, et al., 2011). According to the adaptive water management theory, to manage water resources efficiently not only it is required to study the availability of the resources but also to assess the adaptive capacity of the socio-ecological systems (Pandey, Babel, et al., 2011).

Adaptation is defined as the changes in the ecological, social or economic structure of a system to respond to changes or pressures imposed by climate changes (Adger, Arnell, et al., 2005). The adaptation in one side can be considered as the process of empowering actors in a community to adapt to changes and generating the adaptive capacity. On the other side, it can be seen as the process of transforming adaptation strategies into actions and use the opportunities provided through increasing the adaptive capacity to improve the social and ecological performance of the system (Adger, Arnell, et al., 2005). Pahl-Wostl (2009, p.355) defined adaptive capacity as "the ability of a socio-ecological system to first alter processes and if required convert structural elements as the response to experienced or expected changes in the societal or natural environment". Pandey, Babel, et al. (2011, p.480) have stated "The adaptation in the water resources sector refers to the capabilities of societies and ecosystems to handle their water resources base and hence the adaptation is essentially a local issue as it stems from the fact that what is stressful in one environment may not be a problem in another". In figure 2, the conceptual framework for adaptive capacity and adaptation in water systems is introduced.

According to the literature various methods have been used to measure and study the adaptive capacity of socio-ecological systems (Bohensky and Lynam, 2005, Folke, Hahn, et al., 2005, Pahl-Wostl, 2009, Pandey, Babel, et al., 2011). Based on the aim of the studies each one has used specific type of variables. Pahl-Wostl (2009) has considered the learning capacity as the main variable for adaptive governance, Folke, Hahn, et al. (2005) has focused on social aspects of adaptive capacity and the role of ‘bridging organizations’ in increasing the adaptive capacity and etc. The approach, which is used in this study, is called asset-based approach. This approach enables the researcher to look at social and ecological variables of a system simultaneously (Jones, Ludi, et al., 2010). Usually, communities which have lesser access to the assets, are more vulnerable to changes. Assets include both tangible and intangible capitals. “Lack of availability and access to appropriate resources may significantly limit the ability of a system to cope with the effects of climate change and wider development pressures. Equally, an effective asset base depends on the extent to which components within the system are substitutable in the case of disruption or degradation of one component. As a result, asset diversity, and the ability to access assets that are in some sense surplus and interchangeable may each be as important as simple ‘asset abundance’” (Jones, Ludi, et al., 2010, p.5). This approach is trying to assess the ecological capacity, available infrastructure affecting the system, the economic attributes that affect and are affected by the resource system and the social attributes which shows the potential of the actors and stakeholders in the system to adapt to changes and follow the adaptive strategies.

The asset-based approach studies the adaptive capacity of a system based on its Human Capacity, Natural Capacity, Economic Capacity and Physical Capacity (Pandey, Babel, et al., 2011). Human Capacity is looking for the capacity of actors to understand their roles and their impacts on the system, their ability to collaborate and innovate in determining the adaptive strategies. Natural Capacity analyzes the ecological performance of the system and its ability to provide the ecological services while struggling with climate changes. Economic Capacity shows the financial ability of the system to implement the adaptive strategies, and the capacity of the system to change according to the ecological changes. Physical Capacity assesses the availability and quality of infrastructures, which are required to manage and protect the resources from climate change impacts.



**Figure 2. Conceptual Framework for adaptive capacity in water systems**  
**Source :(Pandey, Babel, et al. 2011)**

Changes in the societal and natural environment are not usually considered in decision-making timeframes since they are mostly driven by slow variables (Carpenter and Turner, 2000). “More often the problems of interest in social-ecological systems have only a relatively short actual or recorded history” (Bohensky, 2008, p.19), but even by studying the changes in one or two decades, it is possible to find the changes in governance and management context of socio-ecological systems (Bohensky and Lynam, 2005).

In this study, it is argued that the adaptive responses to the climate changes can be explained by the ability of the management system to adapt itself to the changes. There is no blueprint respond to the optimal management structure which is proper to maintain and increase the adaptive capacity of the socio-ecological systems, but scientists agreed on Östrom principles as the characteristics of robust institutions (Ostrom, 2008). However, “not all principles need to be realized in all circumstances, but the prospects for sustainable governance tend to increase when more of these principles are in place” (McGinnis, 2011, p.180). These principles are not supposed to give a comprehensive picture of the governance system, but to show what possible factors are limiting the ability of the governance system to respond to the changes efficiently. To understand the Östrom’s principles the theory of ‘tragedy of common’ and common pool resource is discussed in the next section.

### **2.3 The tragedy of common and common pool resources**

Garret Hardin (1968) introduced the term ‘the tragedy of the commons’ for the first time. Hardin in order to clarify his idea discussed a pasture, which is ‘open to all’, and herders can benefit from it by selling their animals at a small cost of overgrazing. When the animals’ population is more than the capacity of the pasture, herders still want to add more animal since they will receive their benefit while the costs of overgrazing are shared. He concluded that “There in is the tragedy. Each man is locked into a system that compels him to increase his herd without limit – in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons” (Hardin, 1968, p.1244).

Hardin in his article deals with a class of resources, which are known as ‘common-pool resources’. As Östrom (1990, p.30) discussed “Common-pool resources yield finite flows of benefits (such as firewood, fish, and water) where it is difficult and costly to exclude potential users”.

As Hardin (1968) described, each person reduces the amount of resource, which is available to others by using the resource. He argued that users are trapped in this dilemma, and they cannot extract themselves from this situation. Therefore, by creating rules, which specify who is the authorized user and the roles of authorized user, public good will be created for stakeholders. “Getting out of trap itself is a second-level dilemma, and free-riding is predicted in governing a resource as a community of users” (Ostrom, 2008, p.1). National legislations have been passed in countries to manage the natural resources, but usually the results were not satisfactory and central regulations have accelerated resource depreciation in lots of cases accompanied with problems of corruption and inefficiency (Ostrom, 2008). However, in contrast, a large number of researches has demonstrated that users could get out of the trap and govern their own resources (Ostrom, 1990).

The experiments have shown that when the unlimited access to a common resource is available, individuals will substantially overuse it (Ostrom, 2008), but by enabling users to communicate with each other, agreements and sustainable common resource management can be achieved (Ostrom, Gardner, et al., 1994). Hardin, in fact, overlooked the role of collective actions in

managing a common resource while the societies have the ability to generate and enforce rules to limit the behavior of individuals.

There is not still a common language in defining ‘the common’ (Ostrom, 2008). “There are confusions regarding the differences between common-property and open-access regimes, common-pool resources and common-property regimes and a resource system and the flow of resource units” (Ostrom and Hess, 2010, p.6). The main difference between them is the ‘property right’. In open access regimes, no one has the property right but it can be used by everyone and common-pool resources are the systems that are rival and non-excludable. In table 1 the classification of goods by Ostrom (1994) is presented.

**Table 1-classification of goods**

		Subtractability	
		Low	High
Exclusion	Difficult	Public Goods	Common-pool Resources
		Free-to-air television	Fish stock, river basin
	Easy	Toll/Club Goods	Private Goods
		Cinemas	Food

Source: (Östrom, 1994)

Private goods are easy to exclude with high subtractability while public goods are completely opposite of the private goods. Common Pool Resources(CPR) share the difficulty of excluding beneficiaries with public goods and the characteristic that consumption of a person will decrease the resource available to others with private goods (Ostrom, Gardner, et al., 1994). Without an effective institutional arrangement, CPRs are the resources which are open access and easy to deplete. Common property regimes are “institutional arrangements in which a group of resource users shares rights and duties toward a resource for the cooperative (shared, joint, collective) use, management, governance and sometimes ownership of natural resources” (McKean, 2000, p.27).

As mentioned earlier, the user groups are able to manage the common resources through collective action (Ostrom, 1990). Collective actions can be defined as the action of groups of individuals (more than 2) to achieve a common goal (Wade, 1987). However, usually, most of the researches regarding the performance of natural resource management have not considered the multiple uses of resources, which are used by different groups of users with their specific usage patterns (Swallow, Meinzen-Dick, et al., 1997). Besides some of the resources’ usages are complementary, some are competitive. In addition, some of the user groups are mutually exclusive while some others are overlapping. Considering multiple use and users is highly critical in managing commons. As Östrom (2008) argued, in CPR existence of multiple users can increase the ‘transaction costs’ by increasing the free riding issues and weakening discussion about the optimal use. In the situation that multiple-use resources are used by multiple users with different interests, and it is managed by a combination of “property regimes”, collective action will become complicated, and rearrangement of institutions is required to minimize the negative externalities of access of new users to resources (Ostrom, 2008). Collective actions should be based on the decision-making arrangements and rules regarding control of resources. Collective actions should be organized by a robust institutional arrangement (Ostrom, 2008). The focus point of this research is on institutions that shape collective actions in a socio-ecological system. Östrom (1990) has



identified eight design principles for successful long-term institutions (Table2). Based on her empirical study, fragile institutions have only some of these principles while failed institutions have few of them (Ostrom, 2008).

To better understand the institutional design principles first, the terms ‘institution’ and ‘institutional arrangements’ should be clarified since they are broad terms which can be related to different aspects of governance.

## 2.4 Institutional arrangements

Based on the theory of neo-institutionalism, Institutional arrangements are known as the “rules of the game” which determines who should make decisions, who is the user and how much can use, and what are the limitations (Ostrom, 1990). Institutional arrangements shape and stabilize the human actions (Bandaragoda, 2000). In order to implement integrated water resource management successfully, institutional arrangements should encourage stakeholders’ participation, “water resource management on hydrological boundaries”, an organization set-up that includes “decision-making at the lowest appropriate level” and a specific system for water pricing and cost recovery (Jaspers, 2003, p.83). “The institutions cover both the organization of the team of players and how they should play the game” (Bandaragoda, 2000, p.5). Institutions both constraint and facilitate individual and collective actions. They limit antisocial actions and encourage beneficial actions (Bandaragoda, 2000). This dual function is of great importance in water resource management.

Most of the rules in the water sector are enacted to limit undesirable actions of individuals or groups which are based on their self-interests, while some other rules are enacted to encourage organized behaviors and equity (Bandaragoda, 2000). Institutional arrangements enable actors to put policy objectives into practice, allocate responsibilities and specify how goals should be achieved (Hamdy, Abu-Zeid, et al., 1998). Besides formal institutions, informal institutions also are of a great importance which includes social norms and affects the management through social expectations of resource access and use (Pahl-Wostl, 2009). Regarding this point, governance modes are classified into three categories of bureaucratic hierarchal, markets and networks. In the hierarchal mode, formal actors play the main role while the market is based on actions and decisions of both formal and informal institutions but the network is mainly governed by informal institutions (Pahl-Wostl, 2009).

Based on the discussed definition of institutional arrangements, Östrom institution design principles can be understood better.

**Principle1-Clearly Defined Boundaries:** This principle is divided into two section. First is clearly defined resource boundaries which discuss the clarity of ecological boundaries. Second is clearly defined community boundaries. As Östrom (1999, p.1) mentioned, “defining the boundaries of the CPR and of those authorized to use it can be thought of as a ‘first step’ in organizing for collective action”. Clear boundaries are required for managers to know what are their responsibilities and for whom they are managing. In addition, it is required for local users to be sure that the benefits they generate are not received by free riders (Ostrom, 1999).

**Principle 2- Congruence between rules and local context:** well-designed rules help for the perseverance of the common resources. Rules, which are established in national or regional scales, rarely can consider the attributes related to the specific context of a socio-ecological system (Ostrom, 1999). Based on this principle, robust institutions take these attributed into account while modifying the rules.

**Principle 3-Collective-choice Arrangements:** According to this principle, the institutions that generate and modify rules with the participation of individuals who are affected by those rules are more successful (Ostrom, 1999). The actors who are dealing daily with the physical world can modify the rules in a way that fit better with the local community requirements. However, being committed to the rules after they have been established is not an easy task and as Östrom (1999) has argued the successful institutions have proper monitoring and sanctioning mechanisms.

**Principle 4-Monitoring:** “Monitoring makes those who do not comply with rules visible to the community, which facilitates the effectiveness of rule enforcement mechanisms and informs strategic and contingent behavior of those who do comply with rules” (Cox, Arnold, et al., 2010, p.9). This principle examines the ability of the governance system to identify users from free riders.

**Principle 5- Graduated Sanction:** Users who violate the rules should receive sanctions. The sanctioning process in robust institutions usually are handled by the participants (Ostrom, 1999). External enforcement cannot explain the high commitment to the rules in sustainable socio-ecological systems. In these systems, users establish their own institutions to sanction the users who violate the rules (Ostrom, 1999).

**Principle 6- Conflict resolution mechanisms:** Implementing rules are usually along with conflicts. In long enduring institutions, existence of some mechanisms which actors are able to solve the conflicts with low cost is necessary (Ostrom, 1999). Rules can be interpreted in different ways and conflict resolution mechanisms are required to clarify these uncertainties and reduce free-ridings. These mechanisms are not always formal and sometimes are managed by the users themselves. “While the presence of conflict-resolution mechanisms does not guarantee that users are able to maintain enduring institutions, it is difficult to imagine how any complex system of rules could be maintained over time without such mechanisms” (Ostrom, 1999, p.5).

**Principle 7- Minimal recognition of the rights to organize:** The local users in sustainable socio-ecological systems usually establish their own institutions. However, unless the government does not give minimal recognition to these institutions and rules, they cannot endure for a long time (Ostrom, 1999). These institutions are necessary for sustainable resource management. Since not only they are able to help the governance system in managing and monitoring the resource but also they are important in generating social capital.

**Principle 8-Nested Enterprise:** According to this principle, in a sustainable system “governance activities are organized in multiple layers of nested enterprises” (Ostrom, 1990, p.90). “Nesting may occur either between user groups and larger governmental jurisdictions or between user groups themselves” (Cox, Arnold, et al., 2010, p.11).

First three principles are looking for clarifying the interaction between resource and users and defining users and free riders in the system. These three principles do not guarantee the sustainability of institutions since the rules are not self-enforced (van Ast, Widaryati, et al., 2014). The rule enforcement is discussed in 4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> principles. In addition, these principles can enhance the “common knowledge and agreement and they transform information about the state of the system into actions that can influence the system” (van Ast, Widaryati, et al., 2014, p.296). Principle 7 recognizes the right of the users to establish their local management institution and to directly participate in the daily management of the resources. Principle 8 shows multiple levels of institutions that ensure problems on various scales are addressed.

These eight principles usually can be seen in most of the sustainable CPR institutions. In contrast, unsustainable institutions are characterized by few or none of them. Although, there are other different factors affecting the robustness of institutions. The knowledge about the design principles is developed in the recent years. The dynamic relationships between the principles and contextual factors make the institutional analysis more complex than these eight principles. As Cox, Arnold, et al. (2010) have mentioned, the size of the user groups and the heterogeneity between them and also the type of the government regime are other important factors which can affect the robustness of the governance system. This complexity led to the development of ‘dual design principles’ (McGinnis and Ostrom, 2010) and ‘multitier framework to analyze social-ecological systems’ called the SES framework (Ostrom and Cox, 2010). However, the simplicity of the original framework is still important and the eight principles are valuable as a tool to analyze the sustainability of the institutional arrangements (van Ast, Widaryati, et al., 2014). Therefore, according to the scope of this research, these principles are used to conduct a comprehensive institutional analysis.

**Table 2-Östrom Design principles**

<b>Institution Design Principle</b>	<b>Explanation</b>	<b>Function</b>
<b>1. Clearly defined boundaries</b>	“Individuals or households with rights to withdraw resource units from the CPR and the boundaries of the CPR itself are clearly defined”	“Enables participants to know who is in and who is out of a defined set of relationships and thus with whom to cooperate”
<b>2. Congruence</b>	“a. The distribution of benefits from appropriation rules is roughly proportionate to the costs imposed by provisional rules”. b. “The rules governing the contribution required of each user must mirror local conditions”	“Enables the local rules-in-use to restrict the amount, timing, and technology and/or quantity of resource unit to be harvested”
<b>3. Collective choice arrangements</b>	“Participation by all affected individuals in deciding on and modifying operational rules should be possible”	“Enables most of the individuals affected by a resource regime participate in making and modifying their rules governing their commons”
<b>4. Monitoring</b>	“Either the local users themselves or persons accountable to the local user is responsible for monitoring the biophysical conditions and compliance with collective decisions”	“Enables users to keep an eye on resource conditions as well as on user behavior”
<b>5. Graduated sanctions</b>	“Sanctions should be graduated to reflect the severity, frequency, and context of resource use violation depending on the seriousness and context of the offense”	“Enables users who violate rules-in-use are likely to receive graduated sanctions from other users, from officials accountable to these users, or from both”
<b>6. Conflict resolution mechanisms</b>	“Low-cost and readily available conflict-resolution mechanisms must exist to mediate conflicts among resource users and between users and officials”	“Enables users and their officials have rapid access to low-cost, local arenas to resolve conflicts among users or between users and officials”
<b>7. Minimum recognition of rights to organize</b>	“Users must have recognition of their own rights to organize institutions”	“Enables users to devise their own institutions that are not challenged by external authorities, have long-term tenure rights to the resource”
<b>8. Nested enterprises</b>	“Appropriation, provision, monitoring, enforcement, conflict resolution and governance activities are organized in multiple layers of nested enterprises”	“Enables to understand governance activities that are organized in multiple layers of nested enterprises”

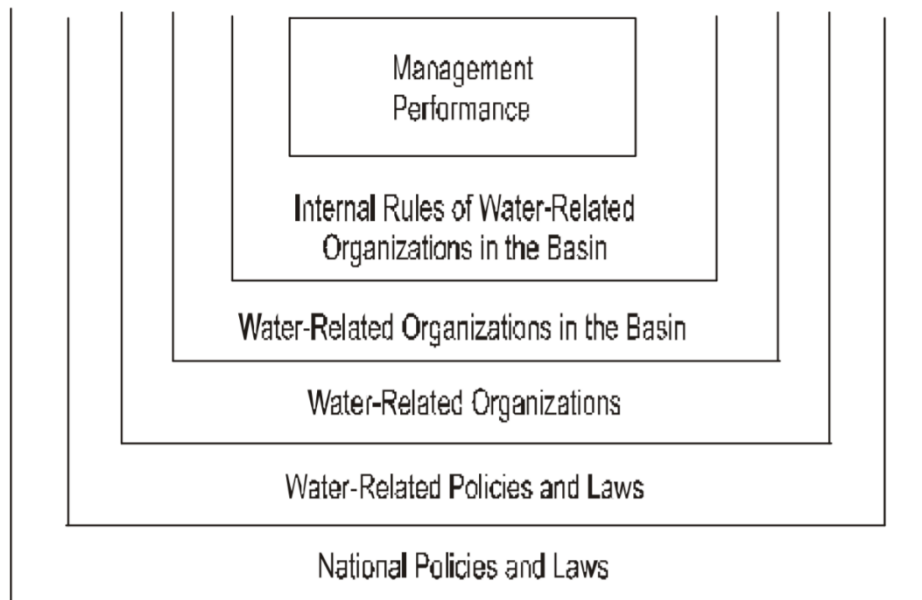
**Source: (Ostrom, 1990)**

## 2.5 Institutions and management performance

Institutions have four common characteristics. First of all, they go beyond individuals; “They involve collectives in structured and predictable interactions, based on specific relations among actors” (Hassenforder and Barone, 2018, p.3). Secondly, they stay almost stable over the time. Third, they affect the way that individuals act. Fourth, they make actors to interact and share values.

Poor governance is one of the main causes of the water crisis, especially in developing countries which corruption and lack of civil society have limited any kind of development (Pahl-Wostl, 2009). However, there is no general governance structure which makes the sustainable resource management in different contexts possible. However, during the worldwide discussions, the focus of scientists is on market actors, state actors and NGOs as actors that can help to move toward good governance (Lemos and Agrawal, 2006). Therefore, the effectiveness of management depends on the participation of high-level actors with local actors and making incentive for local communities to participate (Lemos and Agrawal, 2006).

Institutions affect the performance of individuals, organizations or even country. Institutions affect the transaction and transformation costs (Bandaragoda, 2000). It is required to separate the rules from actors in an organization. Actors try to achieve their objectives by being in the institutional framework (Bandaragoda, 2000). The link between institutions and performance can be identified in a nested framework. “Human actions are constrained and protected by a nested system of different layers of institutions” (Bandaragoda, 2000, p.8).



**Figure 3-Nested Framework**  
**Source: (Bandaragoda, 2000)**

The institutions affect the effectiveness of governance and determine the robustness of governance (Ostrom, 2008). The interaction between the institutional arrangements and governance is proved by Östrom and supported by several case studies (Ostrom, 2008).

According to the Östrom's Social-Ecological system framework, institutional arrangements determine the way collective actions affect the resources and collective actions will affect the social and ecological performance of the system. Therefore, it can be interpreted that institutional arrangements are affecting the socio-ecological performance of the system. The adaptive capacity is the concept, which is used in this study to explain the socio-ecological performance of the system.

## **2.6 Institutional arrangements and adaptive capacity**

The relationship between the institutional arrangements and adaptive capacity has been studied from different perspectives. For instance, Gupta, Termeer, et al. (2010) introduced the "adaptive capacity wheel" to clarify the institutional design of adaptive systems. Pahl-Wostl (2009) mentioned learning processes as a key issue in adaptive governance regimes. However, in this study, it is tried to find the impacts of institutional arrangements on the social and ecological performance of a system. Östrom Design principles are accepted as the institutional arrangements principles which are shared among adaptive common pool resources. Institutional arrangements whether directly or by the actions which are the outcomes of institutional arrangements, affect the adaptive capacity of the common pool resources.

The role of social capital in the relationship between the institutional arrangements and adaptive capacity should be emphasized. In several studies on adaptive capacity, the social capital is mentioned as a variable for adaptive capacity (Pelling and High, 2005, Brooks and Adger, 2005). Besides that, in studies on the institutional arrangement and adaptive governance, social capital is mentioned as a variable (Gupta, Termeer, et al., 2010). In the Östrom design principles, social capital is considered in the third principle, which emphasizes the importance of the public participation. Therefore, it is not possible to mention social capital as one of the variables of adaptive capacity, since there would be an overlap between the independent and dependent variable, which makes the study invalid. However, during this research, it is tried to consider the impacts of social capital on both independent and dependent variables. The social capital is considered as a variable which is affected by the institutional arrangements and also is affecting the efficiency of the governance system. In addition, the impacts of social capital on the adaptive capacity is investigated in this research.

It is necessary to define the concept of social capital. "Social capital is the goodwill available to individuals or groups. Its source lies in the structure and content of the actor's social relations. Its effects flow from the information, influence, and solidarity it makes available to the actor" (Adler and Kwon, 2002, p.23). The goodwill refers to the sympathy and trust between the actors of a community and the purpose of the goodwill is to have more productive collective actions. "collective action requires networks and flows of information between individuals and groups to oil the wheels of decision making. These sets of networks are usefully described as an asset of an individual or a society and are increasingly termed social capital" (Adger, 2003, p.389).

## 2.7 Conceptual Framework

The role of governance in increasing the adaptive capacity of common resources is emphasized in the literature. In Socio-Ecological systems, which are under pressure of climate change along with the failures in management, adaptive capacity is an important variable, which shows the ability of the system to respond to the changes. Plans like Integrated Water Resource Management (IWRM) is introduced to increase the adaptive capacity by integrating the structural and not structural aspects. However, the implementation of such this concepts, which needs paradigm shifts in management, is highly challenging especially in developing countries in which corruption and political barriers are affecting the common pool resources negatively. Östrom believes that the lack of effective and robust institutional arrangements is the main barrier to effective common pool resources governance and institutional arrangements can directly affect the adaptive capacity of a socio-ecological system (Pahl-Wostl, 2009).

Literature has emphasized the role of intuitional arrangements in water management. Institutional arrangements are defined as a mixture of laws, rules and regulations, policies, operational procedures, accountability and incentive mechanisms, traditions and the tools to control the consumption patterns. “institutions shape the choices made in water governance; they impose constraints on water policies, and drive behaviors related to water sharing and use. Understanding institutions and institutional dynamics are therefore crucial for researchers, policymakers and managers concerned with water” (Hassenforder and Barone, 2018, p.7). In the modern governance, management is not centralized. Resources are managed by different levels of power and effective management depends on the close relationships between different government levels. Therefore, horizontal and vertical linkages are vital for achieving good governance (Marks and Hooghe, 2003).

To analyze the situation of Institutional arrangements in the Urmia Lake basin, the Östrom design principles are used as the variables since these principles are the characteristics of governance system of adaptive common pool resources. To investigate the Adaptive Capacity, four variables are chosen which cover both social and ecological performance of the system.

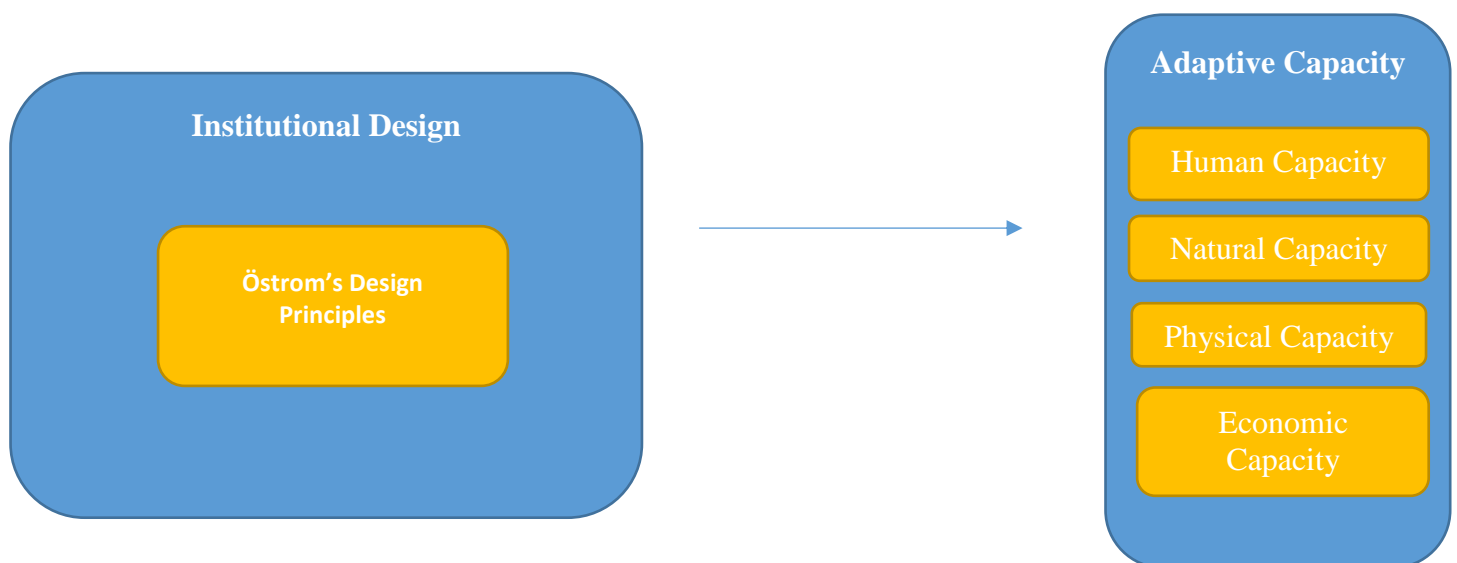


Figure 4. Conceptual Framework

## **Chapter3: Research Design and Methods**

### **3.1 Introduction**

In this chapter the research strategy, the used indicators to analyze the variables and the data collection methods are discussed.

#### **3.1.1 Revised Research Question**

The main research question is to what extent institutional arrangements have influenced the adaptive capacity of the Urmia lake basin.

The sub-questions are:

- What is understood by the institutional arrangement in the Urmia lake basin?
- How can the Urmia Lake basin be characterized through the lens of common pool resource?
- How has the level of adaptive capacity in the Urmia Lake basin changed and which factors have affected it?

#### **3.1.2 Research Type, Approach, and Strategy**

##### **3.1.2.1 Research Type**

This Research is an explanatory study since its aim is to explain the relationship between the institutional arrangements of a common pool resource and its adaptive capacity in the case of Urmia lake basin in Iran. The explanation of the institutional arrangement includes a description of its situation in the context of the case and how it has changed during the recent decades and analyzing the institutions according to the Östrom design principles. The explanation of the adaptive capacity includes the changes occurred in the variables of the adaptive capacity of the lake basin during the last decades. At last, the relationship between the institutional arrangements and adaptive capacity will be described.

##### **3.1.2.2 Research Strategy**

The research strategy, which has been chosen for this thesis is the single case study since it enables the researcher to study the case in-depth with high details while considering the interaction between the phenomenon and its context (Van Thiel, 2014). As there is only one case in this research and the number of study units is low while the number of variables is high, the case study is the best approach for this research. Besides, institutional arrangements need to be explained in details to give a valid understanding of the phenomena and to find its relationship with adaptive capacity. In this study, the aim is to investigate the impact of institutional arrangements on adaptive capacity during the last three decades.

As Yin (2003) has mentioned, case study is the preferred strategy when ‘how’ and ‘why’ of phenomena is asked by the research questions, the researcher has limited control over the event and when the research is focused on a contemporary phenomenon and its interaction with the context. Additionally, he argued that case study approach enables the researcher to combine different data collection methods effectively by triangulation to enhance the validity and reliability of the study.



### **3.1.2.3 Case study challenges**

Yin (2003) introduced the external validity and the ability to generalize the findings as the main challenge in case study since the number of units of study is low. Besides that, case study does not provide a good basis for quantitative analysis. The other issue which case study is criticised for is the influence of researcher assumptions on the study. However, as Flyvbjerg (2006) argued other research strategies also can be biased and be impacted by the researcher's opinions. In addition, the data gathered through interviews can be affected by the interviewees' opinions and since the number of respondents in in-depth interviews is not usually high, it can highly affect the results of the study. To increase the validity and reliability of the study, primary qualitative data is triangulated with the secondary qualitative and quantitative data. As Van Thiel (2014, p.52) mentioned triangulation is using more than one method in the study to "double or triple check the data collection and research results".

## **3.1.3 Operationalization: Variables and Indicators**

### **3.1.3.1 Operationalization**

#### **3.1.3.1.1 Institutional arrangements**

Östrom defines institutions as the "rules of the game" that facilitate, guide and limit the activities of individuals and organizations. These rules determine "who is eligible to make decisions in some area" (Jaspers, 2003, p.79). "Institutions may be seen as commonly understood codes of behavior that potentially reduce uncertainty, mediate self-interest, and facilitate collective action" (Ostrom and Cox, 2010, p.4-5). In this research, legal frameworks, informal rules and roles and responsibilities of different actors are analyzed by Östrom's eight design principles. These principles do not cover all aspects of the governance but clarify some of the main factors which have affected the efficiency of the governance system. In addition, they give an understandable picture of the resource management structure which is consistent with the scope of this research.

#### **3.1.3.1.2 Adaptive Capacity**

Adaptive capacity is defined as the ability of a socio-ecological system to adapt to the climate changes (Adger, Arnell, et al., 2005, Pahl-Wostl, 2009). In this study, the asset-based approach is used to determine the level of adaptive capacity and how it has changed over time. Based on this approach the adaptive capacity is determined by natural capacity, human capacity, physical capacity and economic capacity (Pandey, Babel, et al., 2011). Natural capacity considers the environmental aspects. In this case, the level of water of the Urmia lake can show the changes in the natural capacity since it is affected by both surface water and groundwater resources and its data is available for long periods. The physical capacity looks at the available infrastructure in the area. In this study, the percentage of agriculture lands with a modern irrigation system is used as the indicator for physical capacity. The human capacity identifies the ability and inclination of people to change their behaviors to protect the environment. Economic capacity is looking at the impact of the agriculture sector as the main water consumer on the economic development of the region.

### 3.1.4 Variables and Indicators

Table 3- Operationalization

Concept	Variables	Sub Variables	Indicators	Description	Data collection instruments
Institutional Arrangements	<b>Östrom Design Principles</b>	<b>Clearly defined boundaries</b>	<b>Clearly defined community boundaries</b>	The clarity of the roles and the rights to withdraw the resources is reflected in this indicator. This indicator can highlight the need for clear administrative arrangements for delivery of goods and monitoring	Semi-structured interviews/ Document analysis
			<b>Clearly defined resource boundaries</b>	The physical boundaries of resources and the administrative sectors which is responsible for the specific regions are reflected by this indicator.	
		<b>Congruence</b>	<b>Social-ecological fit</b>	This indicator shows whether appropriation (e.g., time, place, technology) and provision (e.g., labor, materials, and finances) rules reflect the local context of the region. Besides, it shows whether benefits of adhering to appropriate rules are aligned with costs users incur (provision guidelines)	Semi-structured interviews/ Document analysis
		<b>Collective choice arrangements</b>	<b>Participation in rule making</b>	This indicator implies the participation of stakeholders is modifying operational rules.	Semi-structured interviews/ Document analysis
		<b>Monitoring</b>	<b>Performance of Environmental monitoring</b>	Monitoring assures the commitment of actors to the rules and makes rule enforcement more effective.	Semi-structured interviews/ Document analysis
		<b>Graduated sanctions</b>	<b>The existence of sanction in case of violation</b>	This indicator shows the violation from rules and a mechanism to sanction actors who violated the	Semi-structured interviews/ Document analysis

				community rules according to severity or repetition of the violation	
		<b>Conflict resolution mechanisms</b>	<b>Existence of Conflict resolution mechanisms</b>	A conflict resolution mechanism is needed to maintain the collective action.	Semi-structured interviews/ Document analysis
		<b>Minimum recognition of rights to organize</b>	<b>External recognition</b>	Government authorities recognize and respect the rules created by local users	Semi-structured interviews/ Document analysis
		<b>Nested enterprises</b>	<b>Multiple levels</b>	Multiple levels or scales that influence or manage the resource system are involved in system rules. The existence of nested enterprises helps to facilitate “cross-scale cooperation”	Semi-structured interviews/ Document analysis
Adaptive Capacity	<b>Natural Capacity</b>		<b>Changes of the Lake’s level of water</b>	The ecological resilience of the system to face the climate changes	Document analysis/ Semi-structured interviews
	<b>Physical Capacity</b>		<b>Water use efficiency in the agriculture sector</b>	The infrastructure available to help the system to adapt to changes	Document analysis/ Semi-structured interviews
	<b>Human Capacity</b>		<b>Inclination of farmers to participate in water management</b>	The importance of the environment for the users and the sense of belonging to the region between them	Document analysis/ Semi-structured interviews
	<b>Economic Capacity</b>		<b>The impact of the agriculture sector on regional economic development</b>	The role of the agriculture sector in economic development in comparison to the other sectors.	Document analysis/ Semi-structured interviews

### **3.1.5 Data Collection Methods**

In this research, a combination of primary and secondary data collection methods are used.

#### **3.1.5.1 Primary Data collection**

Primary data is collected from the first-hand experience and usually is collected through semi-structured interviews, focus groups and/or observations. In this study, semi-structured interviews are used as the primary qualitative data collection method. In the semi-structured interviews, a manual or topic list is used as a guideline which includes the topics, which interviewer wants to discuss (Van Thiel, 2014). This method is proper for subjects, which there is some knowledge available on them, but there should be flexibility in the interviews to enable respondents to assert their ideas about a subject. The probing question is one of the methods that help the research to abstract more information from the respondents. The institutional arrangement is a concept, which there is general knowledge about it based on the literature. However, it is highly contextual and in each case, there are some aspects which cannot be found in the literature. Therefore, semi-structured interviews can be the best instrument for studying the institutional arrangements, since not only it helps the researcher to narrow down his/her questions to specific topics but also give the opportunity to investigate the subject deeper than the structured interviews.

In order to conduct the interviews, firstly an interview manual has been made. This manual includes two parts, which are an introduction and questions. In the introduction, the aim of the study, the way how the data will be used and the procedure of the interview have been mentioned. In the question part, the main questions and sub-questions are mentioned.

#### **3.1.5.2 Secondary Data**

The reports from the Ministry of Energy and the Urmia lake restoration Organization is used as the main secondary data sources. These data are divided into two quantitative and qualitative part. The quantitative data is used to assess the adaptive capacity during different periods. The secondary qualitative data has been used for the triangulation process in combination with primary qualitative data to increase the internal validity of the study. There are some other sources which have been used as the secondary data sources which are:

- Journal articles
- Newspaper reports
- Local documents produced by each province

#### **3.1.6 Sample Size and Selection**

Usually, it is not possible to include all of the units of study in the research, so a certain selection had to be made which is called sampling (Van Thiel, 2014). There are two main sampling methods which are probability and non- probability sampling. In this study, the non- probability sampling technique is used since it is highly important for the research to engage with the most relevant respondents and use their information as inputs to the study. Besides, because of limited time for data gathering and the research strategy used in this study (case study), non-probability sampling is the ideal method to choose a low number of respondents while the validity of the study is acceptable. There are four different methods for non-probability sampling that are purposive sampling, snowball sampling, quota sampling and self-selection sampling (Van Thiel, 2014). In this study, quota sampling is used. The potential respondents are stratified based on their role in water management of the basin. Respondents have been chosen from provincial water managers, national water managers, the regional office of ULRP, and local researchers. In addition, farmers as important actors in water management in this region are interviewed.

Finding people who are aware of the context of the area and its management structure was a highly problematic task in this study. During the last two years, environmental researchers have faced problems in data collection since there were some national security issues (Kamali Dehghan, 2018) which have made organizations to share data hardly. Therefore, managers and also farmers were not inclined to engage in the research process. This issue became even more challenging because of the presence of the researcher in a foreign country.

Respondents	No. of Respondents	Data Collection Method
Farmer	2	Semi-structured interviews
Regional Water companies	2	Semi-structured interviews
<ul style="list-style-type: none"> <li>• <i>Public Participation expert from WA</i></li> <li>• <i>Planning expert from EA</i></li> </ul>		
Ministry of Energy	3	Semi-structured interviews
ULRP	3	Semi-structured interviews
Water governance professor from Tabriz University	1	Semi-structured interviews
IHE Delft	2	Informational Interviews
FAO Iran	1	Informational Interviews
Integrated water management expert from Tarbiat modarres university.	1	Informational Interviews
sum	15	

**Table 4-List of Interviewed Respondents**

### 3.1.7 Validity and Reliability

It is not possible to generalize the findings of non-probability sampling to the whole population. However, the main goal of this research is to give a picture of the non-structural factors affecting the adaptive capacity of socio-ecological systems, which is a new perspective in the context of Iran. Since in Iran, the adaptive capacity is usually studied from the structural aspect by quantitative methods. Therefore, the knowledge about the interaction between the governance structure and the adaptive capacity is not developed properly in Iran.

Regarding the reliability and internal validity, the data gathered through semi-structured interviews are triangulated with the secondary data collected from the journal articles, the provincial water authorities' reports and the ministry of energy reports on the basin to assure the consistency of the findings. Besides, for the interviews, guidelines with clear questions are designed to minimize the impact of the prejudgment and socially desired responses in the study.

### 3.1.8 Data Analysis

The Qualitative data in this research is analyzed by using Atlas Ti<sup>®</sup> Software. This software can analyze a large number of texts, interview scripts, and notes. The interview scripts and notes are imported into the software and coded according to the indicators. Further analyses regarding the interpreting the data and connecting the two variables, is done by the researcher.

## **Chapter4: Research Findings**

In this chapter, the findings are presented to answer the research questions. First, the context of water management in Iran is discussed.

### **4.1 Context of the study**

#### **4.1.1 Water sector in Iran**

During the recent decades, water resources in Iran faced serious challenges caused by natural processes or human activities (Madani, 2014). Issues like population growth, climate change, land use changes, urbanization and lack of long-term visions are drivers of these challenges (Madani, 2014). These factors led to an increase in water demand, overconsumption of water resources and degradation of the resources. Before discussing the institutional arrangements in Urmia lake basin, it is required to have a minimum understanding about the main actors and regulations of water management in Iran during the last decades.

The main development acts in Iran started by introducing the national development plans. The main initiative of these plans was to make Iran a developed country as fast as possible by rapid constructions. From 1943 when development plans were about to start, institutional changes also happened in Iran. These changes are discussed based on the important periods in the history of development in the last century in Iran.

##### **4.1.1.1 Before the Islamic revolution (1943-1979)**

The first independent water management agency established in 1943 under the Ministry of Agriculture. This agency was responsible for monitoring and managing the irrigation networks and groundwater networks (“Qanat”) and wells. Later in 1962 when the second national development plan introduced, a new set of rules enacted which the most important one was the “Law of Land Reforms”. This law “aimed to redistribute lands owned by feudal landlords to poor rural peasants” (Nabavi, 2017, p.49). By increase in the groundwater abstraction and also increase in the number of dams in the 1950s and 1960s, the government established the Ministry of Water and Power (Later changed to Ministry of Energy) as the main actor in controlling water, groundwater and irrigation systems. The independent water management agency was combined with this ministry (Hashemi, 2012). In 1968, the “Nationalization of Water” act established which later became the basis for the fair water distribution act (Nabavi, 2017). During the 1960s and 1970s, rapid development without enough monitoring led to the over-abstraction of water by illegal wells and made various environmental challenges. Therefore in 1973, the “Department of Environment”(DOE) established as an organization that is focused on the protection of the environment. In 1974, the “Environmental Protection Act” introduced which enhanced the responsibilities and the political power of the DOE (Nabavi, 2017).

##### **4.1.1.2 After the Islamic revolution (1980 -2017)**

These 38 years can be divided into 5 main periods which were important in water management.

###### **Development and Justice (1980-1988)**

During this period, which was aligned with the eight-year war between Iran and Iraq, twenty-seven water rules were introduced and the government tried to control the water consumption and reorganize the water allocation. The most important water law in Iran (“Fair Water Distribution Act”) was introduced in this period (Heidari, Dabiri, et al., 2017). This act was looking for organizing water management and controlling the groundwater overconsumption by the private sector (Nabavi, 2017). According to this act, users who wanted to abstract the groundwater were required to apply for “water allocation permit”.

### **Redevelopment (1989-1997)**

After the war in this period, rapid development was the main goal of the government. Managing water for agriculture purposes became one of the main strategies of the government. During this period almost every 45 days, one dam was built (Nabavi, 2017). However, there was no monitoring mechanism to control the impacts of the construction activities on water resources (Hashemi, 2012).

### **Reorganizing (1998-2017)**

In 1998 the EIA act was introduced which made EIA a necessary part of any major plan. Because of the overlaps between the responsibilities of the Ministry of Jihad-e Sazandegi that was more powerful in rural areas and the Ministry of Agriculture, there were many conflicts between them. Therefore, in 2001 these two ministries were combined and the Ministry of Agriculture Jihad (MOAJ) established by the central government.

In 2003 the ministry of Energy adopted the Integrated Water Resource Management Concept. In the eighth development plan, the IWRM introduced as the basis for river basin management (Law of the Fourth Economic, Social and Cultural Development Plan of the Islamic Republic of Iran, 2005). According to this policy, water plays a pivotal role in the country's development and its social, economic and environmental values should be completely considered.

One of the most important changes in the water governance of Iran happened in 2005. Before 2005 the water resources in Iran were managed at the basin level. Each Basin in Iran was managed by an authority on the regional scale. In 2005, the MOE changed the water management structure based on the political boundaries of provinces with the aim of decentralizing and assigning more power to the lower levels (Nabavi, 2017). Therefore, the Urmia Lake Basin which before 2005 was managed by a single regional authority, after that divided between three provinces (EA, WA, and Kurdistan). A lot of managers and experts in Iran know this change as a challenging act, which occurred without considering the political context of Iran.

In sum, during the last decades, Iran has made tremendous efforts to increase the living standards of people by focusing on the development. Iran is the 5<sup>th</sup> country in terms of the number of dams and irrigation areas in the world (Nabavi, 2017). National development plans by focusing on higher economic development and living standards led to over-consumption of resources and degradation of environmental services. The institutional changes, which were under consideration since 1943, could not solve the water management problems. Since 1990, sustainable resource management became one of the focal points of the national policies. However, it remained on the paper and there was not required soft and hard infrastructure, to implement plans like IWRM practically. Political interactions play a highly important role in water resource management in Iran and one of the main outcomes of these interactions was the change that occurred in 2005 in water governance structure. This issue is discussed in more details in the coming sections but before that, it is needed to know the Urmia lake basin better and the reasons for the environmental problems in this region.

## **4.1.2 Water Management in the Urmia Lake Basin**

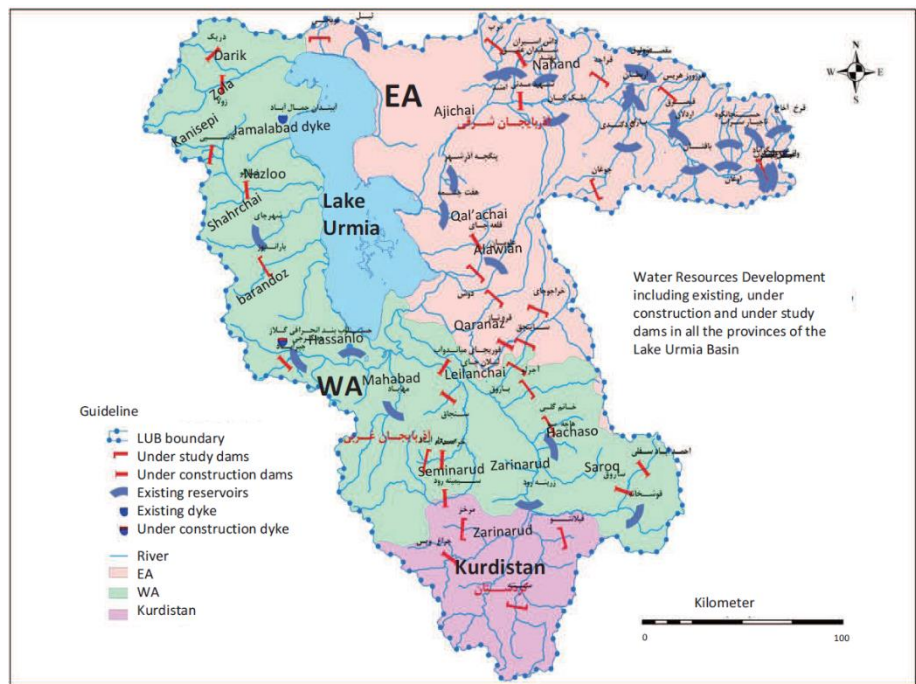
### **4.1.2.1 Urmia Lake Basin**

The Urmia Lake basin is located in the North-western part of Iran with the area of 51,876Km<sup>2</sup> (Shadkam, 2017). There are three provinces in this basin, which are West Azerbaijan, East Azerbaijan, and Kurdistan. It is a closed catchment which the Lake Urmia is the sink. The lake has the area of 5100km<sup>2</sup>. The total population of the basin in 2016 was about 6 million people who mainly live in urban areas and most of them are Muslims (Shadkam, 2017).



**Figure 5- Location of Urmia Lake Basin in Iran**

Source: (Google Maps, 2018)



**Figure 6- Urmia Lake basin**

Source : (Hashemi, 2012)

The Urmia lake basin has about 7% of Iran’s water resources (Garousi, Najafi, et al., 2013). To control this water and develop the agriculture activities, large-scale dam constructions and irrigation network programs have initiated since the 1960s (Hassanzadeh, Zarghami, et al., 2012). The lake has started shrinking since 1950 and from 2000 it has been registered on the



political agenda (Hassanzadeh, Zarghami, et al., 2012). The lake “now stands at only 10% of its volume and literally turned into desert within 15 years” (Nabavi, 2017, p.44).

#### **4.1.2.2 Causes of the Drought**

In this section, the main drivers of the water crisis in the Urmia lake basin according to the literature and interviews, are discussed.

##### **Urbanization**

The first move to organize the administrative structure of the country was “Law on State and Provincial councils” and the “municipality law” which were introduced in 1904 (Ahin, 2010). According to this law, Iran is divided into four main states (‘Azerbaijan’, ‘Fars’, ‘Khorasan’ and ‘Kerman’). Then in 1937 the “Law on Duties of Administrative Divisions and District Governors” was introduced which divided Iran into 10 provinces (Ahin, 2010). The last regulation regarding the administrative structure was introduced in 1983. A hierarchical structure was introduced by the 1983 act for administrative divisions, which from small to large is “villages, sub-districts, Municipality, District, Counties and Provinces” (Ahin, 2010, p.109). These divisions were according to the population, accessibility, and economic features (Ahin, 2010). Based on this rule when an area was recognized as an urban area, it received more financial support from the central government (Ahin, 2010). Therefore, this legislation encouraged urbanization and motivated the rural communities to modify their environment to be recognized as urban areas. It led to using wetlands to develop urban areas and overconsumption of resources (Nabavi, 2017).

The Urban areas in the Urmia lake basin have increased by around 500% between 1990 and 2000. Tabriz (main city of the EA) has become the 4<sup>th</sup> megacity of Iran with a population near to 1.6 million. This fast urbanization process not only has led to overconsumption of resources but also has increased conflicts between the provinces. For instance, the water of Tabriz is provided from the “Zarinarud Dam” which its water comes mostly from Kurdistan but because of the growing population, the Ministry of Energy proposed a plan to transfer water from the dam which was built in WA, which faced resistance of WA and Kurdistan governors and long delay in this plan.

##### **National Development Plans and Agriculture Development**

According to the focus of national development plans especially after 1970 on agriculture development to make Iran independent in supplying agriculture products, the number of Dams increased rapidly (Nabavi, 2017). To the extent that from 1970 to 2010, 37 dams were built in the Urmia Lake Basin (Hashemi, 2008).

Most of the water in this region is used by agriculture sector (94%), while the share of domestic water use is 5.6% and industries use 0.4 % of water (Shadkam, 2017). Most of the groundwater (87%) is used by private wells owners for agriculture purposes. Currently, most of the researchers and experts are emphasizing on developing the modern irrigation networks and change in cultivation pattern as a practical solution for the drought.

By development of agriculture activities, a large number of wetlands changed to cultivated lands. In addition, agriculture activities have affected the quality of groundwater because of pesticides used by farmers (Shadkam, 2017).

##### **Climate change**

From the perspective of a lot of governors, climate change is the main cause of the water crisis in Urmia Lake Basin. The impact of climate change can be analyzed best by referring to the study by Rasoli majd and Khalili (2014). They have conducted a comparative study between the Urmia Lake and the Van Lake in Turkey. The distance between these two lakes is 150 Km and have the same climate during the year. According to their study, both of the lakes have

experienced severe drought after 1998 because of a considerable decrease in the level of precipitation. However, after 2002 the level of precipitations has increased. In this period, the level of water in the Van Lake has increased and currently it is one of the main touristic centers in the east of Turkey, while Urmia Lake has degraded even after 2002. This comparative study did not deny the role of climate change but it showed that this fast decreased in the Lake's surface water cannot be only caused by natural changes.

### **4.1.3 Institutional Arrangement for water resource management in the Urmia Lake basin**

In order to analyze the institutional arrangements of the Urmia Lake Basin, actors who are engaged in water management are introduced and water management regulations in this area are discussed.

#### **4.1.3.1 Actors**

##### **Ministry of Energy (MOE)**

According to the Fair Water Distribution Act, MOE is the main responsible for managing and controlling the water resources. It is responsible for allocating water to the regions and provinces and monitoring the compliance of actors' activities with the rules (Fair Water Distribution Law, 1982). MOE in the recent decades has shown its inclination to follow the construction activities and the increased number of dams proves it.

The MOE has provincial offices, which are called regional water companies(RWCs). These offices are responsible for allocating water in the provincial level between different sectors. In addition, they are responsible for monitoring the water allocation and maintaining the infrastructures at the provincial level.

##### **Ministry of Agriculture Jihad (MOAJ)**

The MOAJ is responsible for monitoring the efficiency of farmers in water consumption, managing cultivation patterns and providing the required materials for farmers like fertilizers. Besides that, it has the right to construct small-scale dams for agriculture purpose.

The MOAJ is inclined to develop agriculture sector to achieve the objective of national development plans to make Iran an independent country in producing crops. The MOAJ had always put pressure on MOE for more water allocation to the agriculture sector. This actor is the main supporter of water and agriculture development plans. Its main initiative is to increase the agriculture efficiency by the modern irrigation system and change in crop patterns. An important point is that the MOAJ is not much against illegal water consumption by up-stream users.

##### **Department of Environment (DOE)**

The Department of Environment is active in WA, EA, and Kurdistan since 1974 (Shadkam, 2017). The lake is recognized as a national park and the WA's department of environment is responsible for it since the lake is located in this province (Shadkam, 2017). In recent years the main role of DOE was fighting for the lake's right of water. However, the political power of DOE usually was not enough to convince other actors to change their perspective in favor of the environment.

##### **Farmers**

Because of agricultural development, the role of farmers in water management has increased considerably. More than 90% of water in this area is used by the agriculture sector. Most of the farmers are low-income people who are working in this sector for more than 10 years (Soltani, 2013). In the recent years because of unreliable surface water resources and lack of trust between farmers and the government, the illegal water abstraction has increased.

### **Supreme Water Council**

This council, which is headed by the president, is determining the general water oriented development policies. During the recent years, the main priority of the council was agriculture development and increasing the quality of life to empower people of this region who are mostly poor with low literacy rate (Nabavi, 2017). In recent years, by increasing the environmental problems, the focus of the council was on changing the cultivation patterns and irrigation network development.

### **Provinces and Provincial governors**

EA is a developed province and Tabriz (its center) is the 4<sup>th</sup> megacity of Iran. During the last decades, this province has developed more than the two others, especially in the industrial and service sectors. WA is the province which has covered the majority of the basin. The main activity in this province is agriculture. Kurdistan is upstream of this basin. A small part of the basin is located in Kurdistan and this part is not developed properly, in comparison to EA and WA.

MPs of these three provinces in the recent years have become important actors in water management of this region. They have put pressure on the MOE for allocating more water to their provinces. Besides, they are supporting farmers especially the illegal water consumers (Soltani, 2013). Regional Water companies (provincial offices of MOE), is the place which MPs use to look for their demands.

### **ULRP**

From 2013 ULRP is established as a regional authority that has the role of facilitating the coordination between provinces and researching on the basin. At the beginning of its establishment, ULRP did not have enough power to convince the provincial governors to change their behavior. During the last 2 years, the supreme water council has given more power to this authority to control users' activities and to give strategic plans for sustainable water management in the basin.

#### **4.1.3.2 Rules**

In this section, the formal and informal regulations regarding the water management in the Urmia lake basin is discussed chronologically.

##### **Formal Rules**

In 1982 the "Fair Water Distribution Act (FWD)" introduced as the main policy for managing water and especially groundwater resources. According to this law, water is a common property and "groundwater belongs to the nation" (Nabavi, 2017, p.57), not to the private users who are able to drill wells. One of the main goals of this act was to control the groundwater consumption by presenting the water allocation permits. However, this act gave the private users who were using the groundwater resources illegally, a sort of legal protection. According to this law, the water allocation priority is first drinking, then industrial, agriculture and environment. This type of prioritizing the water allocation shows the lack of attention to the future impacts of over-consumption of water resources on the environment. This rule and its priorities is still a point of struggle between the DOE and MOE regarding the share of the environment from the available total water. However, the FWD act did not work effectively, therefore in 2010, a law, which was linked to the FWD was enacted. This regulation is called "taeen-taklif". According to this law, the Ministry of Energy was supposed to legalize the wells have been dug before 2005 (Nabavi, 2017). Enacting this law was because of pressures from the MPs on the MOE since they wanted to help people of their provinces who were using water resources illegally, by giving them a legal protection.

The water quota for each sector is given by the regional water companies (MOE) to the related organizations to allocate it to the users. For instance, the agriculture water quota is given to the MOAJ to allocate it. The water and wastewater companies were established in 1990 to allocated water to residential and industrial sectors. However, the rural areas were not controlled properly. Therefore, in 1998 the rural water and wastewater companies established to monitor and control the water allocation in rural areas.

In 2000 by combining the Ministry of Agriculture and the Ministry of Construction Jihad and establishment of the Ministry of Agriculture Jihad, the power of this Ministry increased to the extent that started building small-scale dams to supply the agriculture water demands (Hashemi, 2012). By this action, the Ministry of Agriculture Jihad tried to force the Ministry of Energy and regional water companies to allocate the required water for agriculture purpose. To solve the tensions between the Ministry of Agriculture Jihad and the Ministry of Energy, in 2003 the Water Allocation Directive introduced. According to this act, sustainable water resource management in basin-scale became the main approach in water governance. However, it had some difficulties. For instance, IWRM approach needed scientific simulations to support the decisions but in these simulations and studies, the provincial and local conflicts were not considered properly (Hashemi, 2012).

Before 2005, water management in Iran was at the basin level and each basin had one main authority. In 2005, the water governance structure changed from the basin level to the provincial level and more power was assigned to provinces. The MOE became responsible for establishing water authorities for the provinces, which did not have it before. These authorities, which are called regional water companies (RWC), are responsible for water allocation and ensuring the implementation of MOE's policies. In Urmia Lake Basin, there were water authorities in WA and EA since 1960 but the Kurdistan water authority established in 2006. This change in the management structure initially was designed to facilitate the management but later led to highly challenging conflicts between the provinces (Nabavi, 2017).

The level of water decreased significantly in the last decade which forced the decision makers to look for more effective ways to control and restore the lake. In 2013, a national 10-year program called "Urmia Lake Restoration Program" introduced. "The program's vision is to revive the life cycle of Urmia Lake and promote integrated water resource management (IWRM) and sustainable agricultural development in the basin" (Shadkam, 2017, p.75). According to this program in WA and EA as the provinces that are the main water users in the basin, the Lake Restoration authorities and a central office in Tehran (ULRP) established. The main role of this program was to facilitate coordination between the provinces and water users.

### **Informal Rules**

Prior to 1950 water resources were managed by people. Water management was mainly based on Islamic laws. Water supply and irrigation systems were mainly relied on "qanat" as underground canals. Persons who construct "qanat" or canals were the owner of the water and this water was considered as a property which was subject to the rule of inheritance (Gopalakrishnan, Tortajada, et al., 2005). The lake was considered as a public property, however, generally, upstream landowners had priority in water consumption to downstream users. In order to manage the water allocation, people were choosing a person among themselves at the beginning of spring as a water manager called "Mirab". Mirab was responsible for recording each farmer's water share in his notebook (Gopalakrishnan, Tortajada, et al., 2005). Each Mirab was responsible for two or three villages and he specified official in each village as local assistants. "Mirab" was responsible for monitoring the water consumption, maintaining the system and solving conflicts between users. In this type of management, the costs for water management were paid by all of the users and the ones who

were not paying were punished by restrictions on consumption. “Mirab” and his assistants were paid based on their performance and usually by share of water to their lands (Rahmanian and Mirzaee, 2013). People were monitoring each other’s activities in water consumption. The central government did not have an important role in water management during that time.

After the 1950s by an increase in usage of pumps and focus of the government on development and also assigning water management activities to the government, Mirabs gradually disappeared. Water management became a complete top-down process. However, still, Islamic rules in groundwater consumption are followed by the users.

The type of informal rules changed gradually in water governance. The main informal rules became the interactions between politicians in higher levels of management. Between MPs and local water governors, MPs and national managers, between managers from different MOE and MOAJ and between the provincial governors. It can be concluded that in the water governance in Iran informal rules were always in power. However, initially informal rules were at the local level but later changed to provincial or even national level and between politicians.

## **4.2 Institutional analysis by Östrom Design Principles**

In this section by using the data gathered from the interviews and analyzing the secondary data, the institutional arrangement of Urmia lake basin is analyzed by Östrom design principles. These principles are accepted characteristics of robust institutions. They are simple understandable criteria, which are proper to analyze the changes in institutional arrangements.

### **4.2.1 Clearly Defined Boundaries**

#### **4.2.1.1 Clearly Defined Resource Boundaries**

In the period from 1982 to 2005, water management was regional and the boundaries of the basin were defined based on its hydrological boundaries. After 2005 the basin management boundaries changed according to the administrative boundaries of the provinces to decentralize the water governance structure. However, the FWD rule was still the main rule that provincial water management companies (RWC) were working based on that. The FWD act did not cover the interaction between provincial agencies and the basin. This is important since the three provinces are also dealing with transboundary water management issues. The change in management structure led to increased responsibilities of the provinces, while there was not enough knowledge, experience, and infrastructure at the provincial level.

The tensions between the administrative and ecological boundaries can be seen not only in Urmia lake Basin but also in most of the basins in Iran. Since Iran has an arid and semi-arid climate which means resource availability change both spatially and temporally (Shadkam, 2017). Therefore, this incompatibility between the boundaries can impoverish some users and can lead to over-grazing in other parts.

#### **4.2.1.2 Clearly Defined Community Boundaries**

One of the goals of the FWD Act was to organize the groundwater consumption. Before the 1950s, the groundwater resources were managed by “Mirab”. The groundwater consumption right was based on land. Anyone who owned the land had the right to abstract the water from his/her land. After the 1950s by an increase in usage of pumps, the groundwater consumption increased and illegal water abstraction also enhanced. However, the government did not react to this issue until 1982.

In 1982, the FWD act introduced. Based on this rule, individuals and companies that want to use the groundwater should apply for the ‘water allocation permit’. However, giving this permit was not very strict and the main goal of the government was to encourage the users to register but their consumption was not monitored properly (Hashemi, 2012). Therefore, the number of

non-registered users did not decrease considerably. This act used the term “rational usage” to specify the amount of water that each user can abstract. This amount is calculated by the MOE. Defining the groundwater user boundaries is highly complicated and costly and until now the MOE could not clearly separate the users from free-riders. As the MOE’s expert mentioned *“for defining the users and calculating the rational usage for groundwater consumption we need piezometric head but the number of this measurement facilities are not enough for defining the users. We have only general data about changes in the level of groundwater. However, for surface water, the measurement facilities are much better and we have detailed data about the surface water consumption”*.

Another important issue is the boundaries between the roles and responsibilities of actors. Based on the FWD rule, the MOE is the main and only actor to manage and control the water resources. This Ministry is responsible for allocating water to the provinces and the provinces are responsible for allocating water to the users based on the pre-determined priorities. The determined priorities in FWD rule is drinking, agriculture, industry, and environment.

The FWD was not looking at the provincial actors and their roles. In 2005 when the water management became provincial, the challenge of unclear boundaries became more pronounced. Since the FWD did not consider the interaction between provinces and the basin. This unclear regulation made water allocation a political game. Each province that its members of parliament (MP) and governors could lobby more and put more pressure on the MOE, could receive more water. EA was more successful than the two other provinces in this political game.

#### **4.2.2 Congruence between rules and local context**

Before 1950s people were managing the resources themselves and “Mirab” was responsible for controlling the resource consumption. There was trust between “Mirab” and people and they had a sense of belonging to the region. For example, in dry seasons, “Mirab” was responsible to adjust the water consumption rate and people were acting based on the Mirab’s suggestions. Mirabs were aware of the ecological and social context of the area. However, after assigning the water management responsibility to the government, there was no trust between people and authorities and also between people themselves. Besides, the authorities did not have enough understanding about the context of the area, therefore, the region faced serious environmental and social problems.

By introducing the national development plans, economic development became the main concern of the provinces and also the national level. Dedicating water resources to agriculture purposes became the main aim of the government. In the process of budget allocation, MPs played an important role. As the ULRP expert mentioned *“MPs from EA always had high political power in the parliament. After the war, they could allocate a considerable amount of budget for the development of their province; dam constructions and to develop the city of Tabriz to become one of the economic centers of Iran”*. WA gradually developed its agriculture activities. However, Kurdistan, which was affected more than the two other provinces by the war, did not develop sufficiently. In order to organize the water allocation the MOE published a water allocation document for the Urmia basin. According to this document, water should be allocated mainly based on the population and the area of agriculture lands. The environment did unfortunately not have high priority. The ministry encouraged the agriculture sector, the main consumer of water, to develop more. From the perspective of Kurdistan, the water allocation (appropriation rule) was not fair. According to one of the ULRP’s experts who previously worked in the Kurdistan’s RWC: *“Governors and people of Kurdistan argue that during the war they did not have the opportunity to develop as province while EA and WA have constructed dams and use most of the water of the basin. This in spite of the fact that we are located upstream and have lots of potential for agriculture development”*. According to the

ULRP expert, this is one of the main reasons for increased illegal groundwater abstraction in the southern part of the basin where Kurdistan is located.

The gap between the rules and the context of the area became more pronounced by the end of the 1990s when the population increased drastically and the agriculture activities developed in high speed. As a consequence, ecological degradation increased fast and water scarcity became an important concern for managers and users. However, there was no serious plan to control it until 2013.

Before 2005, the regional management of water was a kind of barrier for the MPs to put pressure on the water management body since the water governors were responsible for different provinces with considerable political power. However, after 2005 the distance between the MP and the provincial governors decreased. As the ULRP expert mentioned, *“Before 2005 the distance between MP’s offices and the regional water management offices was high but after 2005 the offices became literally and figuratively near which facilitated the access of MP’s to RWC’s offices”*. As mentioned in the majority of the interviews, MPs are looking for the votes of the people and the agriculture community makes up a big part of the population in this region. Therefore, MPs are putting pressure on the water governors to force them to make decisions which are in favor of the agriculture society. Regarding this issue, an example was repeated by the interviewees. Zarinrud is a river which supplies 40% of the inflow to the Urmia Lake. In the 1990s the Bukan dam was built on it in WA to develop the agriculture activities and also to supply the water of Tabriz as the 4<sup>th</sup> megacity of Iran and the main city of EA. While this river is coming from Kurdistan mountains. According to the majority of the responses, the development of this dam led to an unfair water allocation and also one of the main causes of the Urmia lake degradation.

The lack of congruence led to the fast development of the agriculture sector and lack of opportunities for other sectors to develop. This issue is more pronounced in WA that covers the majority of the basin. While because of its geographical location and having boundaries with two countries, there was a high potential in this province for industrial and service sector developments.

### **4.2.3 Collective Choice Arrangement**

Traditionally, “Mirab” and his assistants were making decisions with the direct participation of people, which not only increased the trust between actors but also led to decisions, which were more compatible with the context of the area.

After enacting the FWD rule and full authority of the MOE on water resources, the regional water managers, and the MOE’s experts became the main and only actors who make decisions for modifying the rules. As one of the farmers from WA told, *“Governors take many decisions that affect our life’s without even realizing it. One day they urge us to cultivate wheat instead of beets without considering to whom we should sell the wheat and who is going to compensate us for the costs of changing the crop or the loss when such a change does not succeed”*.

This is a clear example of one-way decision making in which the interest of water users is hardly considered. Participation of the community leaders in provincial commissions was considered under the FWD act. However, in reality the number of these representatives participating in decision-making commissions was too low in comparison to other actors and their role was not considered serious. As a consequence, community leaders became reluctant to participate in commissions according to the ULRP experts and interviewees from RWCs.

After 2005, by decentralizing the power it was expected to increase the participation of users in modifying the operational rules. However, no change happened in decision-making structure and rules were made only by the government body. According to the interviews, there is a lack

of trust between water managers and people. The managers believe that people do not have enough knowledge and are thinking only about their own economic benefits. While people believe that managers are considering their own side's interests.

In this situation, the main way for people to change the rules and affect the decisions is using the political power of MPs. People put pressure on MPs and MPs use their political power to put the MOE under pressure, which is seen as one of the main causes of wrong decisions in the last three decades. As mentioned in the previous sections this issue became more considerable after 2005. Increased number of Dams and the inability of the government to control the illegal water consumption are seen as the consequences of these pressures.

#### **4.2.4 Monitoring**

Traditionally, the monitoring was performed by the collaboration of "Mirab" and users. Since people were considering themselves not only as the consumers but also guardians of the environment which God has given to them. They were monitoring their own and also other users' activities. "Mirab" also actively had the responsibility of monitoring the resource consumptions.

By enacting the FWD act, the responsibility of monitoring the water consumption and ensuring the conformity of users' behaviors with rules, assigned to the MOE. According to the FWD rule, the amount of consumption from surface water and groundwater should be 'rational' and calculating the rational amount is the Ministry of Energy's responsibility.

According to the interviews, the problem is not the availability of data but it is using the data to enforce the rules. During the 1980s and 1990s, the main goal of the country was to develop economically and become independent in food production. Therefore, there was an inclination for dam construction which led to a lack of attention to the environmental impacts of these activities. Besides, the price of water was too low and different subsidies were given to farmers and encouraged them to develop their activities without any effective monitoring system. During that period, there was no understanding about the future impacts of this fast consumption of water resources on the ecological performance of the system neither in the government body nor between users themselves. In 2005 by giving more power to the provinces, it was expected to improve the monitoring system. However, as the Policymaking expert of ULRP mentioned: "*giving power to provinces was only for facilitating the lobbying process for MPs to dedicate more resources to their provinces*".

Provincial governors mainly look for their local interests and monitoring the national regulations did not happen. Besides lack of cooperation between the national agencies like MOE and the MOAJ is another reason for weakness in monitoring. This issue can be recognized in monitoring the illegal groundwater abstraction. As the expert of the ULRP mentioned: "*the illegal wells are usually located in the agricultural lands and the MOE knows the MOAJ as the actor that should control it, while the MOAJ argues, the actor that is responsible for water management (MOE) should control it*". This issue until now has limited the ability of the management system to control the illegal groundwater abstraction.

Regarding the monitoring of CPRs, one important issue is the existence of self-enforced monitoring by users which is highly effective. There was no support for self-enforced monitoring until the last 5 years. During the last years, there is an inclination in government toward establishing user associations that have the responsibility of local monitoring but the impact of these institutions needs more time to be assessable.



#### 4.2.5 Graduated Sanction

Traditionally, people themselves were managing the sanctioning process. When somebody violated the rules which were defined by “Mirab” and the community, people with the collaboration of “Mirab” limited the access of the offender to water resources for a while. The Mirab and his assistance acted upon rules that were known to the people and therefore the sanctioning process was indirectly controlled by and violators were punished by the community itself. Social capital was playing an important role in the sanctioning process. The community was indirectly collaborating in sanctioning free riders since the free riding was in contrast with not only public interest but also with each individual's personal interest. The more water a free rider would withdraw, the less there would be available for the community and individual users. By means of this system and involvement in its functioning, people had a sense of belonging to the environment.

One of the sections in the FWD act deals with sanctioning and punishments of those who violate the laws. According to this law, the offenders should be punished based on the Islamic law. Offenders are defined as anyone who makes any change in water allocation, measurement tools, changes the direction of water illegally, uses others water quota illegally and digs illegal wells. Based on this rule, offenders in addition to paying money according to damage that they have imposed to the system should be punished by 15 to 50 lashes or from 15 days should be put in jail. Therefore, the rule for sanctioning is somehow clear, but as mentioned, the main weakness is in putting rules into practice. During the period that country was dealing with war and after that appetite to development, monitoring and sanctioning was not taken seriously, therefore, the number of illegal water users increased. As the ULRP expert mentioned, “*currently there are 54000 identified illegal wells in the region*”. According to the interviews, several reasons mentioned for the weakness in sanctioning in this period. First, users in this region are under the support of MPs and political pressures are forbidding the MOE to stop illegal water usage effectively. Second, social conditions like poverty make even judges be inclined to support the users.

In addition, the MOE has specified a financial punishment for the users who dig illegal wells. As the MOE's expert mentioned, “*The punishment is about 120000 Toman (30 Dollar) while based on the interviews the advantage which each farmer have from the illegal wells is about 20000000 Toman (5000 Dollar)*”. There no balance between the punishment and the advantage that users get from wells, therefore, it cannot prevent them from illegal water abstraction.

#### 4.2.6 Conflict Resolution Mechanisms

One of the main responsibilities of “Mirab” was to solve the conflicts between users. Conflict resolution was also efficient because of high social capital in the community. The trust between the “Mirab” and people usually was facilitating this mechanism. However, when there was an important and difficult case the head of the villages were responsible for solving the conflicts. By increase in the water consumption and lack of proper monitoring, the rate of conflicts decreased. Since water was available and people could use the water freely. However, it was not sustainable. From the 1980s and 1990s, the user level conflicts started to grow but there was no effective way of solving them.

The conflicts between provinces started in the 1980s. EA was developing faster than WA and Kurdistan and a large part of the water resourced was allocated to this province. This issue led to conflicts between the provinces since WA and especially Kurdistan knew the water allocation process unfair. However, the conflicts resolution process between them in the best case led to meetings between the provinces, MOE and MOAJ that were usually affected by the political power of actors.

After 2005 the conflict between the provinces increased to a large extent. Each province was looking for its economic development without thinking in the regional level and upstream-downstream conflicts heated up. However, there was no change in conflict resolution mechanism and as the policy-making expert of ULRP argued about the conflict resolution commissions: *“their decisions firstly is affected by the political power of provinces and MPs and also their decisions is not executed”*.

In 2013 the ULRP established as a regional office to facilitate the provinces’ relationships. One of the main aims of ULRP was to decrease the tensions between the provinces and control their interests. However, ULRP did not have enough political power to negotiate with provinces effectively.

#### **4.2.7 Minimal recognition of the rights to organize**

Before the 1950s people were organizing their institutions and the only role of government was to approve “Mirab” as the responsible person for water management (Gopalakrishnan, Tortajada, et al., 2005). But gradually when the government preferred to have the complete control over the resources, the public based institutions also disappeared.

The aim of the FWD was to offer a rigid and precise framework for managing water resources and knew MOE as the only actor with the power to organize. Role of people in managing the resources is not considered in this rule. Even in 2003 when long-term planning and IWRM became the main approach for water management, there was no precise rule that recognizes the users’ right to establish their own institutions.

As most of the interviewees mentioned the government is not inclined to empower local people to manage the resources. One of its main reason is the lack of trust between the government and users. As the MOE’s expert mentioned: *“government looks at farmers, as individuals who are looking for their economic benefits and do not care about resources”*. However, the policy-making expert of ULRP saw the problem from a larger scale and mentioned *“the problem is the general structure of government in Iran. It has a complete top-down structure which prefers to have complete control over people and does not want to provide claiming space for them”*.

However, in the recent years, there is a new movement in the government to establish user associations. These associations are planned to manage water consumption and allocate water to the users. Until now only in one region (Hassanloo) 3 of these associations are established as a pilot project. These projects are implemented in collaboration with Japan’s government. As the result showed there was 35 to 40 percent decrease in the agriculture water consumption in those areas (Irna, 2017). Therefore, the important role of these institutions is proven practically also. However, the government is not developing them fast since as the Tabriz university’s professor mentioned: *“the government does not want to provide a lot of demanding opportunity for people. The idea of these associations was there from 5-6 years ago but until now only a few of them are working”*.

#### **4.2.8 Nested Enterprise**

Previously, there were not many different levels in water management. The main actors were the people themselves and the provincial, regional and even national actors did not have many roles in water management. But gradually, the power of regional and national actors increased.

Both MOE and MOAJ are working in nested systems. The responsibilities are divided between different levels. Both are working in national, provincial and local levels. In 2005 by giving power to the provincial level the system became even more nested.

The ULRP expert mentioned: *“the water governance in Iran is at different levels. However, lower levels are only working based on the decisions made at higher levels”*. The provincial

level is responsible for receiving water from the national level and distribute it between the local actors. The distribution is occurred based on the priorities that the regional water companies have determined with the collaboration of provincial Agriculture Jihad and Department of Environment offices. However, the provincial offices do not have the ability to change their policies since the policies are imposed by the MOE from the National level. The local level is working based on the predetermined plans and implements the policies of the higher level. The local level actors are the only ones who are in direct interaction with the community and the environment and are familiar with the context. However, the bottom-up movement does not exist in the water governance of Iran and they do not have the power to affect the decisions and policies, which have impacts on the region.

### 4.3 Adaptive Capacity

As mentioned in the literature review, the adaptive capacity of a socio-ecological system can be measured by the economic, human, physical and natural capacity of the system.

#### 4.3.1 Natural Capacity

In the Urmia lake basin, the level of the lake's water has decreased to large extent. All the rivers in this area are ended to the lake, therefore, the level of water in the lake can be a good indicator for the overall natural capacity of the basin. As can be seen in Figure 7, the level of water is decreasing rapidly from the mid-1990s. Although the annual precipitation has decreased comparably, but this high speed in the decrease of the level of water cannot be caused only by climate change (Hashemi, 2008). The impact of management failures on the ecological performance of the system cannot be ignored.

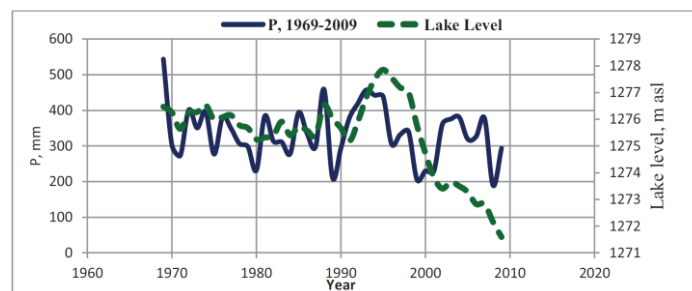


Figure 7-The average level of lake water and annual precipitation. Source : (Shadkam, 2017)

Climate change is a regional issue and covers a large area; therefore, comparing the neighbor areas can be a proper way to assess the impact of climate change. Rasoli and Khalili (2014) in their study, have compared the Van lake in Turkey and the Urmia Lake in Iran in the same period of time. The distance between the two lakes is 150 Km. They have compared the level of water in the two lakes from 1943 until 2009 (Figure 8). Before 2002, the fluctuation of the level of water in both of the lakes was the same. After 2002, the level of water in the Van Lake started to increase. While the level of water in Urmia Lake continuously decreased, which prove the degradation of the Urmia Lake cannot be only because of climate change.

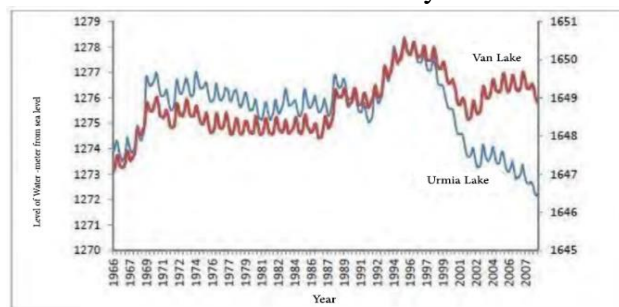


Figure8-Comparison of the level of water in Urmia Lake and Van Lake. Source:(Rasoli Majd and Khalili, 2014)

In figure 9 – the two lakes are shown in 2001 and 2011. As can be seen, there is no considerable change in the level of water in the Van lake while in the Urmia lake the level of water has decreased significantly.



Figure 9-Comparison of the level of water in Urmia Lake and Van Lake (2001 and 2011)

Source : (Rasoli Majd and Khalili, 2014)

In addition, as AghaKouchak, Norouzi, et al. (2015, p.3) have argued: “the region has experienced more severe drought events in the past (e.g., 1997–2002) that did not lead to a substantial change in the lake's surface area”. Therefore, the role of drought in disturbance of the lake’s water balance should not be overrated.

For finding the reasons behind the drought of the lake there are several hydrological and engineering studies. According to these researches, it is proven that dam constructions, development of agricultural activities and increased consumption of surface and groundwater resources are the main causes of drought (Shadkam, 2017). According to the ULRP expert “in the recent two decades, the farmlands area is increased from 300,000 hectares to 480,000 hectares and it has taken 1.8 billion cubic meters of the water that previously was entered to the lake”. There are 72 dams constructed on the rivers that end in the Urmia lake. In figure 10, the cumulative number of dams from 1970 until 2010 is shown.

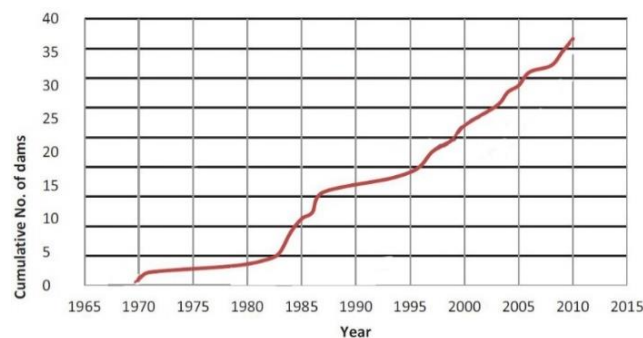
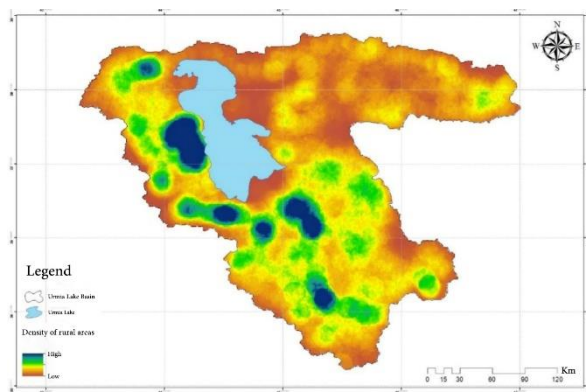


Figure 10-Number of constructed dams. Source: (Shadkam, 2017)

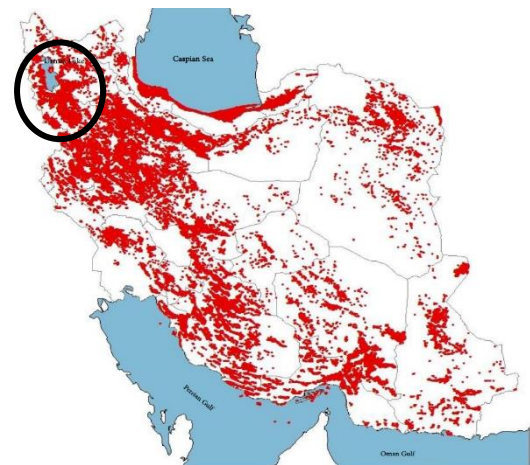
According to Ouria and Sevinc (2016), 43 dams led to the decrease of 7 meters in the lake’s level of water between 1995 and 2010. Azizi, Nazif, et al. (2016) showed that activities of the main dams in the basin have led to a 26% decrease in the level of water. As Jafari, Hatami, et al. (2018) have shown, groundwater abstraction is the other important reason for Urmia Lake’s drought. Between 2002 and 2016 the number of deep wells has increased by 70% and the number of semi-deep wells has increased 56% (Jafari, Hatami, et al., 2018). Majority of these wells are located in WA (Jafari, Hatami, et al., 2018). In figure 11, the density of illegal wells in Iran is presented. As can be seen the density in the south, and west of the lake, where most of the villages and agricultural lands are located there (figure 12), is extremely high. The impact

of illegal wells can be seen clearly in figure 9. South and west of the lake are the main parts, which are dealing with drought.



**Figure 12- Density of rural areas**

Source: (Jafari, Hatami, et al., 2018)



**Figure 11- Density of illegal wells**

Source: (Iran Water Management Company, 2017)

Therefore, the causes of the increase in groundwater consumption are the development of agricultural activities and the increased number of illegal wells. One of the main reasons for the increase in digging illegal wells by farmers is the lack of trust between people and the government. As one of the farmers from WA states *“Most of the groundwater abstraction takes place because people do not want to pay for water. It is mainly because people are afraid that government one day says we do not have water anymore. Is it because they don’t want to pay or because they are afraid that there is no water anymore like what happened to the farmers of Isfahan. As a consequence, people dig wells in order to secure themselves of a reliable source of water”*. As the farmer also mentioned in the case of Isfahan the government has limited the access of the farmers to water resources and has banned the rice cultivation (Euronews, 2018). This kind of actions by the government has gradually decreased the trust between farmers and water management regime. The impact of lack of trust between the users and the government on the number of illegal wells can be also seen in Kurdistan. There are serious conflicts between Kurdistan and the central government regarding the water allocation. As the ULRP expert mentioned *“People and governors of Kurdistan believe, during the last decades EA and WA have used most of the resources but Kurdistan did not have access to the resources. Now they think, they should have more access to the resource to develop their lands. However as the government is not giving the water quota that Kurdistan is demanding, users in this province start digging illegal wells”*. The high density of the illegal wells in the south of the basin where Kurdistan is located can be seen in figure 11.

### 4.3.2 Human Capacity

Water resources in the area are highly affected by farmers’ behaviors. According to the WA regional water company’s manager, *“45 percent of the water in the agriculture sector is wasted mainly because of the low education level of farmers”* (Mehrnews, 2009). Besides, in order to develop agricultural activities, farmers have relied on groundwater resources especially in WA and also they have put pressure on MPs, Ministries and local governors for more water allocation to this sector without knowing the long-term consequences of over-consumption of resources.

According to interviews with managers from MOE and ULRP, people in this region are poor people who are not inclined to collaborate in the sustainable resource management process. Because they are only concerned about their economic benefits. As (Yaghobi and Molan-

Nejad (2017) have mentioned in their study, the inclination to participate in water management of the Urmia lake basin is affected by the level of income, age, and literacy rate. However, when the expert of public participation in the WA regional water company was interviewed, this question rose up that whether the lack of participation is only because of weakness in the capacity of people or the government is not interested in empowering people.

WA is the 28<sup>th</sup> Province in the literacy rate ranking in Iran (Esmi, S., 2015). Therefore, this province which covers the majority of the basin and most of the agriculture lands are located in it, does not have a good condition in comparison to the average literacy rate of the country. In addition, as one of the farmers mentioned: *“The farmers I know who are still working on their lands have mostly inherited their lands and learned to practice agriculture from their fathers”*. This respondent’s remarks support the findings of Soltani (2013) who states that the number of farmers with more than 10 years of experience has increased in the last decades in the Urmia Lake basin. In the country level, 18% of the farmers have more than 10 years of experiences while at the Urmia lake basin this it is about 34% (Soltani, 2013). This is an indication that young people increasingly turn away from working in the agriculture sector, which in the long run can negatively impact the inclination of farmers to participate in water management (Yaghobi and Molan- Nejad, 2017).

On the other hand, there are some practical examples which show that the weak participation of farmers in water management can be stimulated by progressive government strategies. As mentioned in section 4.2.7, the pilot project which is implemented in the Hassanloo region shows that if there is an opportunity for users to collaborate, they will gradually become interested to participate in water management. Therefore, the impact of changes in the governance structure on the human capacity of the system is also considerable. As the Public Participation expert of WA’s RWC mentioned *“Previously people had a direct impact on decisions and they felt they were playing important roles in their community. Currently, people are only consumers. I see the cause for this problem in our management structure. In recent years we have intentionally removed people from decisions making processes”*. The farmer from WA remarks *“If the government provides agriculture water quota to the farmers and allows them to divide this quota by themselves, there would be fewer problems. Exactly like our fathers did. They were sharing the resources between themselves. Lands that were located in proximity to each other would use shared water sources and decisions were taken mutually. Not like nowadays, that each land has its own pump”*. From the perspective of this farmer there is still an inclination in people to participate in water management due to the lack of self-regulation and decision-making power.

The human capacity has a strong relationship with the social capital. In traditional water management sharing the social and ecological resources were making the community feel responsible for their environment. Sharing the knowledge also was increasing the human capacity of the system. The impact of lack of knowledge sharing can be seen on the physical capacity of the basin which is emphasized in section 4.3.4.

### **4.3.3 Economic Capacity**

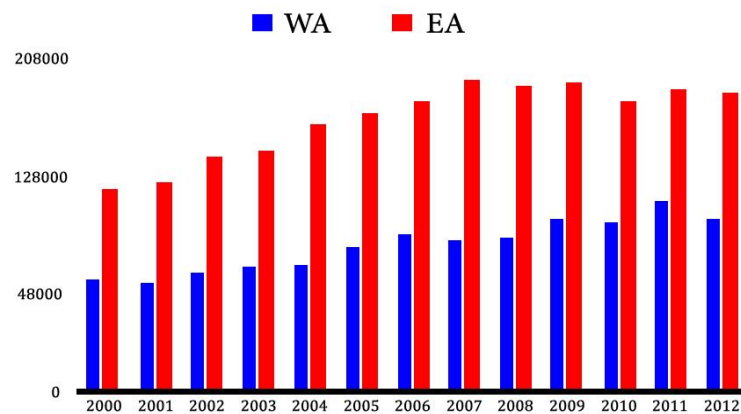
In Urmia lake basin 21% of people with a job, work in the agriculture sector, 31% in the industrial sector and 48% in the service sector. In comparison to the national average, in this region, there are more people in agriculture and industrial sectors and lesser in the service sector (Statistical Center of Iran, 2016). In WA, agriculture has more importance while in EA industrial sector is more important. In table 5, detailed statistics of employment in the region is presented. The economic statistics are published at the provincial level in Iran and only a small part of Kurdistan is located in the basin. Therefore, data from WA and EA is presented to give a more valid picture of the economic situation of the basin. Since the economy of

Kurdistan is affected by many other factors that is not related to the basin and cannot be used for this analysis.

	WA	EA	Urmia Basin	Country
Number of people with a job	606	861	1528	20547
The share of farmers from whole workers	27.8	21.3	20.9	19
The share of Industry employees from whole workers	24.3	33.7	31	29.2
The share of the service sector from whole workers	47.8	45	47.5	51.8

**Table 5-Number of people work in each sector. Source: (Statistical Center of Iran, 2016)**

In figure 13, the GDP of WA and EA between 2000 and 2012 is shown (Statistical Center of Iran, 2013). GDP of EA is increased between 2000 and 2007. However, after 2007 it has decreased. In WA, GDP is increased between 2000 and 2011 but it has decreased considerably in 2012.



**Figure 13- GDP of WA and EA from 2000 to 2012. Source: (Statistical Center of Iran, 2013)**

The average share of the agriculture sector from production in the country level is about 10% but 23% of production in WA as the province which is covered most of the basin, is from the agriculture sector. Therefore, the agriculture sector in this region is of great importance. In EA, 84% of provincial production is from the industrial and service sectors and that is mainly because of the presence of Tabriz as a developed and crowded city in this province. In EA, between 2000 and 2007, the industrial sector had grown 118% while agriculture sector had grown 3.1%. Between 2007 and 2012, the rate of growth in agriculture sector increased to 4.1% but there is a considerable decrease in industrial development rate in this period (Statistical Center of Iran, 2013). In this period, the average growth rate in the Industrial sector was about -3.1%. Therefore, the GDP is decreased in EA because of the industrial sector’s degradation as the sector with a large number of people working in it.

In WA, between 2000 and 2007, the industrial and service sectors had grown 5% and in the same period, the agriculture sector had developed 2.8%. Between 2007 and 2012, the agriculture sector had grown 6% while industrial sector had developed -0.3%. Therefore, it can be concluded that the development of the industrial sector led to economic development in this

region until 2007. However, after 2007 the focus on agricultural development led to degradation of the economy in the region.

In order to have a better understanding about the economic situation of the basin, the share of each province from the production of the basin in 2012 is discussed. The total added value in 2012 in the basin was about 322000 billion rial which is about 4.4% of the whole production in the country. The biggest share is for EA with 62%. The added value of the agriculture sector was about 44000 billion rial which is about 5.6% of added value in this sector in Iran. The added value of industrial and service sectors are 3.3% and 4.8% of the whole country. This statistics shows the importance of the agriculture sector in this region in comparison to the rest of the country. However, it can be also concluded that the industrial sector has high potential to grow in this region but it is degraded because of improper national policies.

#### **4.3.4 Physical Capacity**

During the last decades, the agriculture sector developed rapidly in Urmia lake basin. However, there was no organized irrigation system until the last 5 years and farmers were using traditional methods of irrigation, which were not efficient. During the development period, financial resources were allocated mainly to dam constructions and increasing the area of agriculture lands instead of increasing the efficiency of agriculture activities by installing modern infrastructures and educating farmers. From 2013, the MOE has determined a goal to 40% decrease the water consumption in the agriculture sector. The MOE has determined two main objectives to achieve this goal. First, change the cultivation pattern and second, develop modern irrigation networks in this region. The first objective seems highly challenging since the government has not provided proper alternatives to change the cultivation pattern and it has led to struggles between farmers and water managers. In addition, it should be mentioned that government has used a top-down approach to force farmers to change the cultivation pattern and in the interviews, it was mentioned as the main cause of the failure of this plan. Regarding the second objective, the government has assigned a budget for development of irrigation networks and based on the data given by the MOE until now 20% of agriculture lands have access to the modern irrigation system. This plan implemented successfully in most of the places since it is mainly funded by the government and also does not have negative impacts on the income of farmers. In some regions like 'Hassanloo', it also led to an increase in the participation of farmers to share the resources and coordinate to decrease the water consumption.

In addition, the role of knowledge and education in developing the physical capacity should not be ignored. Under the traditional water management scenario, knowledge was shared among the community and the role of "Mirab" as a person with knowledge of agriculture and irrigation was important. In due time, farmers' opportunities for learning decreased since there was no mechanism to share knowledge between actors. The role of social capital in the traditional system was clear. Users were sharing social and ecological resources and information and knowledge were transferred among them by means of specific mechanisms such as community meetings, neighbors meeting etc. Later, as one of the farmers mentioned: *"each land had its own pump and water abstraction facilities, so there was no resource sharing anymore and interaction between people also decreased"*. As a consequence, there was an increasing need and less opportunity to meet and share information and knowledge. This in its turn decreased the social capital and increased individualisms and mistrust.



#### **4.4 The relationship between institutional arrangements and adaptive capacity**

Analysing the institutional arrangements by using Östrom's design principles showed, water governance in Urmia Lake Basin has become fragile in the recent decades or as Östrom says, it is not robust anymore. The aim of this research was to clarify the impacts of the changes in the water governance structure on the adaptive capacity of the Lake basin. The interactions between the sub-variables of both dependent and independent variables are dynamic. All of the variables can affect each other. However, in this part, it is tried to give an understandable picture of the interactions between the independent and dependent variables.

As mentioned, there are no clearly defined resource boundaries especially after 2005. This issue led to increased tension between the provinces and empowered the provincial type of thinking between local governors and MPs. This type of thinking made resource allocation a competitive issue and provincial governors tried to use their political power to make national actors allocate more resources to their provinces. This issue is one of the main reasons for the rapid development of the agriculture sector and the construction of dams.

In addition, the community boundaries are not clear in this region. Users especially whom abstract groundwater resources are not identified properly and the water resources have faced the free-riding issue and increased consumption of groundwater resources. It has led to ecological problems like a decrease in the Lake's level of water, groundwater level, land subsidence and increase in the percentage of salt in water that has made many health issues and affected the agriculture products (Shadkam, 2017). Besides, the lack of clarity in responsibilities of actors is one of the main causes of the inability of authorities to control the free riding.

Weak congruence between rules and local context led to the increased development in the agriculture sector. National development policies in the last decades gradually led to the development of agriculture sector while did not pay much attention to the industrial sector especially in WA and Kurdistan. Long-term ecological and social impacts of these policies were not considered. Impacts of agricultural development on water resources were neglected. Besides, the lack of congruence gradually led to the increase in the groundwater abstraction in regions where users believed water allocation was not fair. This issue can be seen clearly in Kurdistan in the south of the basin. In addition, these policies led to the gradual migration of young and educated people to other provinces. Since the agriculture sector in Iran is not modernized and does not attract this group of people financially. Therefore, people working in this sector are mostly aged people who are economically weak and does not have any other option to earn money. The precipitancy in agricultural development also led to the lack of efficiency in this sector. The required infrastructure for modern agriculture was not provided and a huge amount of water wasted during the last decades.

Authorities in Urmia lake basin are not providing opportunities for users to participate in the decision-making process. Managers believe that there is not enough human capacity for participation, therefore, it is better to assign decision-making tasks only to experts. This issue has led to the lack of trust between the decision makers and people. As mentioned in the interviews the lack of trust is one of the main reasons for illegal water abstraction since users prefer to have a reliable alternative water source instead of relying only on sources provided and monitored by the government. However, it should be mention that there is still an inclination in people to participate in water management but the top-down type of management in Iran has slowed down this process.

One of the main problems in the basin is weak rule enforcement. It is not rooted in lack of data or monitoring facilities but in the lack of trust between people and authorities, a high priority of political concerns and impact of political pressures and informal rules in Iran. The monitoring and sanctioning in the traditional system were highly dependent on the social capital and the rules were supported and enforced by the community. However, gradually the sense of belonging to the environment decreased and the government was not able to monitor the local level properly, therefore, the illegal water abstraction was not controlled effectively after the 1970s.

Lack of organized conflict-resolution mechanism in this region made water consumption and water-related developments a competitive process between the provinces. The provinces could not coordinate properly to solve the upstream-downstream issues, therefore, each of them tried to develop their facilities and agriculture lands to use as much water as they can. In the case of the Urmia Lake basin, the lack of a conflict-resolution mechanism enhanced the gap between the rules and the context. Politically weaker provinces like Kurdistan were not able to negotiate properly to supply their demands. Therefore, the role of conflict-resolution mechanism in developments, which are not compatible with the local context, and illegal abstraction of water resources is considerable.

In CPRs, existence of institutions which are managed by users is vital. Since they will generate trust, human capacity, and an effective monitoring system. However, during the last decades developing these institutions was not considered by the government and the Parliament. While there was a good potential in the region to establish this kind of institutions since in recent two years a very few numbers of them are established and had a considerably good result. These institutions can enhance the social capital in the community, which can facilitate all the management processes and make the decisions more context oriented.

Water resources in Iran, especially after 2005, are managed at different levels. There are local, provincial, regional and national actors in water governance. There is a clear hierarchical relationship between these levels. However, the problem is in horizontal relationships between the actors of the same level. Provincial actors are not coordinating properly and even national actors are not working together effectively. In vertical relationships, the lower level actors also do not have freedom in decision-making. This issue is one of the main reasons that national policies like agriculture development were imposed to this region without considering the ecological and social context of this area since in national level there was not enough understanding about the context of the area and local actors did not have enough power to affect the development policies in the region.

It can be concluded that institutional arrangements led to some actions and changes in the behaviors of the community which resulted in the decrease of the adaptive capacity. The decisions to construct more dams and increasing the area of agriculture lands can be mentioned as the actions, which are the outcomes of a fragile institutional arrangement, and these actions have led to decrease in the adaptive capacity of the system. Besides, the weak governance regime was not able to control the resource consumption properly and the illegal water abstractions increased gradually which also affected the natural capacity of the basin. The institutional arrangements have affected the social capital in the basin to a large extent. The decreased role of people in decision-making and lack of trust between the government and the society, have decreased the sense of belonging to the environment and the social capacity of the community and decreased the human capacity of the system. The fragile institutional arrangements also affected the economic capacity of the socio-ecological system. Focus on agricultural development gradually led to the reduction of the industrial sector while the industrial sector was the main contributor to the GDP of the region and the majority of the

population were working in this sector. In addition, the impact of the government’s focus on agricultural development on the physical capacity of the system can be observed. Increasing the area of the lands without considering the required infrastructure is the main factor affecting the efficiency of the water consumption in the agriculture sector.

The role of social capital in the relationship between the institutional arrangements and adaptive capacity of the Urmia Lake basin is clear. Before the 1950s, social capital was playing a pivotal role in water management. Trust between different actors was facilitating the coordination of water-related issues among them. Users knew themselves as vital actors in the management of their environment. Knowledge and information on water-related issues were shared among users because of the dynamic interactions between users and “Mirabs”. In due time, the government ignored and denied the opportunities for communities to participate in water resource management. The interaction between the governance system and social capital is a very dynamic one. Through the years, changes in the institutional arrangements have affected social capital aspects of local water management, whereas on the other hand loss of social capital gradually eroded the efficiency of the water governance system. Social capital is affecting the adaptive capacity of communities. Under traditional water management systems, social capital facilitated knowledge sharing and made people feel responsible for their environment. With the decreased need for knowledge sharing and the decreasing sense of belonging, social capital was negatively affected and leading to a loss of adaptive capacity within the local system. There is a lot of potential in building adaptive capacity through social capital. Developing synergistic social capital with government institutions and make arrangements more legitimate for participation can reinforce the best out of traditional mechanisms and arrangements and help rebuilding adaptive capacity at the community level.

The relationship between the design principles and the adaptive capacity variables is highly dynamic. The impacts of the design principles on each other and the adaptive capacity variables on each other were mentioned in the previous section. For instance, the lack of clarity in boundaries is affecting the monitoring and sanctioning process. On the other hand, the economic capacity is affecting the human capacity. However, in this study, it is tried to give an understandable picture of the interactions between the institutional arrangements and the adaptive capacity of the system. In figure 14, it is tried to summarise the relationship between the variables and the actions which are connecting them.

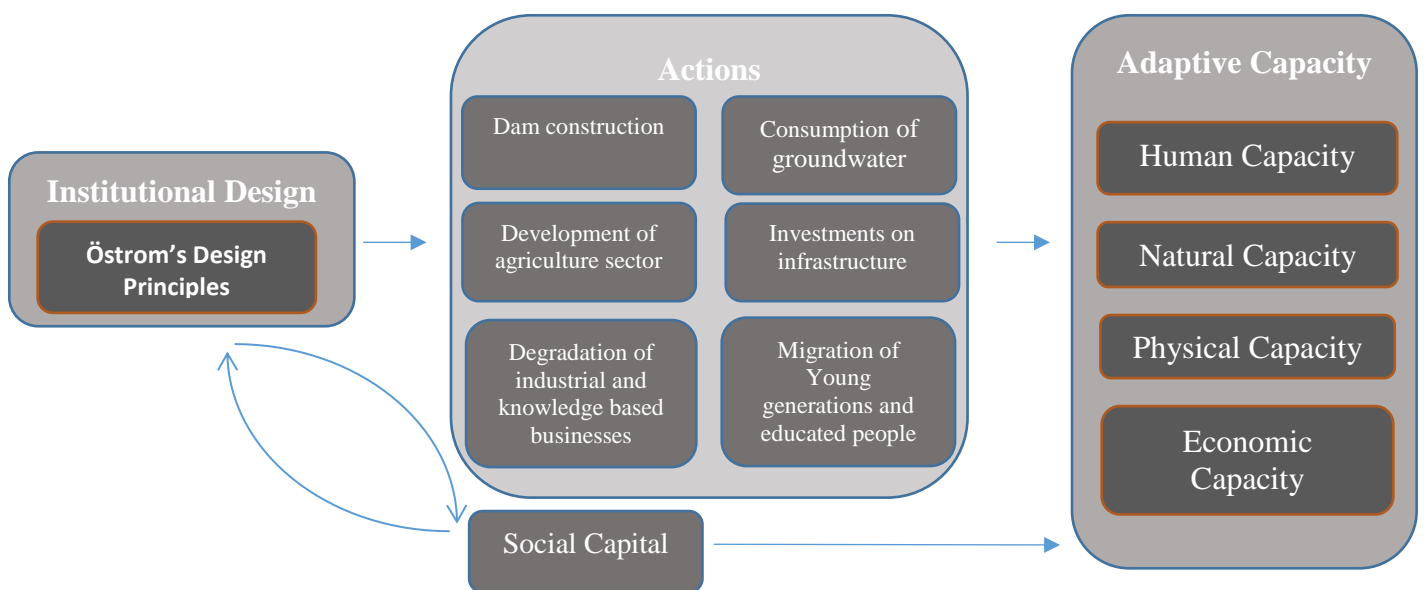


Figure 14- Relationship between variables

## **Chapter 5: Conclusions and recommendations**

In this chapter, the conclusion of the whole study is presented and the research questions are answered based on the findings.

### **5.1 Research Objective**

The aim of this research was to clarify the interactions between institutional arrangements and adaptive capacity in the Urmia Lake Basin during the last three decades. To achieve this objective, the institutional arrangements have been described based on the actors and rules that were in power during this period. To analyze the institutional arrangements, Östrom design principles are used as accepted characteristics of robust institutions. The adaptive capacity is investigated by using the asset-based approach. Then it is tried to describe the relationship between the variables of the institutional arrangements and adaptive capacity.

### **5.2 Research sub-question 1: What is understood by the institutional arrangement in the Urmia lake basin?**

According to the literature, institutional arrangements are defined as the “rules of the game”. In the traditional type of water management of Urmia Lake basin, informal rules were playing the main role. The trust between people and “Mirab” as the local water manager was the main facilitator of actions. However, gradually by introducing the national development plans, the role of the government became more in water management. In 1982 by introducing the FWD act, the MOE became the main responsible for water management. In water management MOAJ also played an important role since it was responsible for monitoring the farmers’ activities and had the right to construct small-scale dams for agriculture purposes. The water resources were managed in the basin level by regional branches of the MOE. In 2005, the water management became provincial and the RWCs were established in all of the provinces.

The type of informal rules gradually changed during the last decades. Before the 1950s the water management was based on the local informal rules and the social capital was playing the main role in the water management. However, later the informal rules changed to the relationships between MPs and water governors. The structural change that happened in the water governance system in 2005, facilitated the intervention of MPs in the decisions of the MOE. It can be concluded that water management changed from a local management with the direct participation of the community in the decision-making process to a top-down type of management which is highly dependent on political interactions.

### **5.3 Research Sub-question 2: How can the Urmia Lake basin be characterized through the lens of common pool resources?**

According to the Östrom (1990), most of the robust institutions have eight characteristics in common. These are known as Östrom design principles. The first principle looks at the clarity of resource and community boundaries. In traditional water management, the “Mirabs” as local managers were responsible for defining the boundaries. Because of the high level of trust between people and “Mirabs”, the defined boundaries were accepted by the community. However, later the government could not define the boundaries properly since the community was not accepting them and the government could not separate the users and free riders effectively especially in groundwater resources. The second principle looks for the congruence between rules and local context. In traditional water management, “Mirab” was a person who had enough knowledge about the social and ecological context of the region and people had trust on him. Therefore, the decisions which were made by him was based on the local context. Besides, people had direct participation in decision-makings which was helping to make

decisions best fit with the context. Later, the governors from higher levels who did not have enough understanding about the context of the region became responsible for water management. Therefore, decisions which affect the daily life of local people were made at the regional and national level without considering the local context. The third principle talks about the collective choice arrangements and the importance of users' participation in modifying the rules. This principle was present in the traditional water management however gradually the role of people disappeared. The impact of lack of participation on the other design principles and social and ecological performance of the system can be seen clearly. The fourth and fifth principles emphasize the importance of monitoring and sanctioning mechanisms to exclude the free riders. Traditionally, these mechanisms were managed by direct participation of users which were highly effective. However, later the government was not able to manage these mechanisms. Political pressures, lack of trust between people and managers and national policies are the main causes of the inability of the governance regime to monitor the system and sanction the free riders. The sixth principle considers the existence of organized conflict resolution mechanisms necessary for sustainable socio-ecological systems. Traditionally, conflicts were mainly at the user level and "Mirab" as a trusted person was responsible for solving them. However, later conflicts mainly were between provinces and even in national level between different sectors. Therefore, conflict resolution became a political process. The seventh principle emphasizes the importance of institutions organized by the community. Traditionally, people were choosing local managers and were developing their own institutions. However, later the government did not provide an opportunity for people to participate in managing the resources. The eighth principle considers managing the resources in different levels important for sustainable management. It can be argued that the system gradually has become more nested in Urmia Lake basin water management but the power of lower level has gradually decreased. The relationships in this nested system are mostly top-down and lower levels do not have decision making power.

By looking at the changes in the water management structure of Urmia lake basin and its impacts during the last century, one of the most striking examples is the loss of social capital. In traditional water management systems, societal aspects such as trust and bottom-up decision making were facilitating arrangements that together effectively pursued communities' water governance. Varying from the involvement of actors, defining water source boundaries, making context-based decisions, solving conflicts between users and, monitoring and sanctioning free-riders. Users directly participated in water management and institutions established by users were held responsible for water management. This type of resource management through direct participation of the community was empowering social capital in the community. Unfortunately, drastic changes in institutional arrangements by national government decreased social capital at the local level whereas the decrease of social capital resulted in fragile institutional arrangements. Institutional arrangements and social capital are in a dynamic relationship with each other that should be recognized and taken into consideration.

#### **5.4 Research Sub-question 3: How has the level of adaptive capacity in the Urmia Lake basin changed and which factors have affected it?**

Two types of reasons are mentioned as the causes of the decrease in the adaptive capacity of the Urmia Lake basin. First is climate change, which is mostly mentioned by the governors as the causes of the socio-ecological crisis. The second type of reasons is anthropogenic causes. The impacts of these activities on the ecological and social performance of the system are emphasized by researchers.

The adaptive capacity of the Urmia Lake basin is evaluated based on the asset-based approach by using human capacity, natural capacity, economic capacity and physical capacity as the variables. By looking at the changes in the Urmia Lake's level of water, it can be understood that the Natural Capacity of the Basin has decreased dramatically since the mid-1970s. The main causes of the degradation of the Urmia Lake are overdevelopment of agriculture activities, increased number of dams and overconsumption of groundwater resources. The Human capacity in this region is also decreased to a large extent. Before the 1950s, people had direct participation in water management and had a sense of belonging to their environment. However, gradually people became consumers of the resources who do not feel responsible for their environment. Besides, young generations and educated people have gradually migrated from this region, which has had a direct impact on the human capacity of the system. The impact of anthropogenic activities on the economic capacity of the region can be seen especially from 2007. The overdevelopment of the agriculture sector led to the lack of development in the industrial sector while there was a good potential in this region for industrial development. The impact of the high-speed development of the agriculture sector on the physical capacity of the region is also considerable. There was no attention to the required infrastructure for efficient agriculture until 2013. The impact of low physical capacity on the natural capacity of the basin is also important.

The impact of social capital on the adaptive capacity of the system is also considerable. By comparing the traditional water management with the modern type of management, it can be seen that social capital has affected the human capacity to a large extent. The trust between actors and the shared social and ecological resources between them were making users feel responsible about their environment while later the interactions between actors decreased and the gap between personal and public interest increased to a large extent. In addition, the impact of social capital on sharing the knowledge between actors is important which has affected the physical capacity of the system.

## **5.5 Main research question: To what extent institutional arrangements have influenced the adaptive capacity of the Urmia lake basin?**

Östrom in her socio-ecological system framework has shown the relationship between the institutional arrangements and the social and ecological performance of the systems. The decrease in the adaptive capacity of the Urmia Lake basin is mainly caused by anthropogenic activities. This study's aim was to find and describe the links between the changes in the adaptive capacity of a socio-ecological system and its institutional arrangements.

The main factors, which have affected the natural, economic and the physical capacity of the Urmia Lake basin, are increased number of dams, overdevelopment of agriculture sector, fast increase in agriculture land's areas and overconsumption of groundwater resources. These developments are the outcomes of lack of congruence between the rules and local context. Traditionally the ecological context of the region was considered by "Mirab" but later water managers were not familiar with and concerned about the ecological context of the region. Because the local managers did not have the power of decision making, although the water management in Iran is nested. Decisions were made by higher-level managers without the participation of the community and the local managers. In addition, the government was not able to exclude the free riders effectively. This inability is first rooted in lack of clear boundaries, second in the lack of a proper sanctioning mechanism, and monitoring on the groundwater resources. Traditionally "Mirab" had the responsibility of defining the boundaries, and sanctioning was performed by the participation of people. The trust between people and "Mirab", and the strong social capital in the community was the main facilitator of

these actions. However, later the decreased social capital not only made sanctioning and defining boundaries more challenging but also encouraged people to use groundwater resources as a reliable water source which is not controlled by the government, even illegally. The unresolved conflicts between actors were also drivers of these overdevelopments. Provinces were competing for more development and receiving more resources but there was no mechanism to make them collaborate. Traditionally conflicts were mainly in the user level and they were resolved by “Mirab”. However, later the government did not recognize the right of people to establish their own institutions to solve the conflicts locally and participate in managing the resources. These kind of institutions traditionally not only were directly affecting the resources but also were the place for distributing the knowledge about agriculture between the farmers. The knowledge, which was required for increasing the water efficiency of the agricultural activities. The impact of the lack of knowledge can be seen in the physical capacity of the region, which is not developed properly.

The human capacity of the system is affected by not only the institutional arrangements but also by the other adaptive capacity’s variables. First of all the lack of users’ participation in decision-makings which led to a decrease in social capital has affected the human capacity in the system. Traditionally users participated in water management directly but gradually their role has decreased and they changed from active actors in water management to water consumers. In addition, the impact of economic capacity on the human capacity of the system is considerable. Lack of opportunities for working in more knowledge-based sectors made the young and educated people migrate from this region since the agriculture sector did not have the potential to attract this group of people to the region.

The role of social capital in the relationship between the institutional arrangements and adaptive capacity should be emphasized. As mentioned institutional arrangements and adaptive capacity have a dynamic relationship with each other. The changes in the institutional arrangements have led to degradation of the social capital and the degradation of social capital has made institutional arrangements fragile. The governance regime has limited the capacity of the community for productive collective actions and the social capital is not developed properly in the community. Gradually, weak social capital has limited the abilities of the governance regime to manage the resources locally. In addition, the social capital is affecting the adaptive capacity of the socio-ecological system. Since the knowledge is not shared between the users and actors properly and the lack of trust between actors is limiting the ability of the governance regime to implement the adaptive strategies.

## **5.6 Recommendations**

In the current era, development is an unstoppable process. The demand for food, job and space are continuously increasing. Presence of a robust governance system is needed to make a balance between the society’s demands and the adaptive capacity of socio-ecological systems. Relying only on local resource management in this fast developing world is not logical since there are a large number of challenges, which should be solved by collaboration between people and experts and different levels are needed in water governance to manage the relationships between actors. However, the inefficiency of top-down governance regimes has been proved. Therefore, the governance system should be a combination of these two types of management. The government should provide opportunities for people to collaborate in decision-making and generate trust between the actors. As Östrom (1990) has emphasized, local institutions are necessary for sustainable resource management. The government should provide the opportunities for collective actions and enhancing the social capital. In the context of Urmia Lake basin establishing local institutions can help to increase the adaptive capacity of the socio-

ecological system. These institutions should be a part of the decision making process. They can make decisions more context-based and enhance the social capital and the human capacity of the system. In the multi-layer governance system, the role of local actors should be considered more and the opportunities for horizontal coordination between the national, provincial and local levels should be provided.

As has been mentioned in chapter 2 the Östrom design principles are not giving a comprehensive picture of the governance regime of the socio-ecological systems but it was sufficient according to the scope of this study. However, for further research, the institutional arrangements can be studied by using the dual design principles (McGinnis and Ostrom, 2010) and also from the lens of the adaptive capacity wheel (Gupta, Termeer, et al., 2010) to go more deeply into the important factors affecting the adaptive capacity of the system. Using these methods help the researcher to investigate the interactions between social capital and the adaptive capacity of the system more comprehensively.



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# **Annex 1:**

## **Interview Guideline for Government agencies**

### **Introduction**

I am Shahryar Ershad. I am a student of IHS, Erasmus University Rotterdam. This interview guideline is used as an instrument for research on “the impact of institutional arrangements on adaptive capacity of the Urmia lake Basin”. This interview will be used only for academic purposes.

Date and Time of the Interview:

Respondent:

- Name:
- Email:
- Position:
- Institution:

### **Questions**

#### **Institutional Arrangement (Independent Variable)**

1. Are the boundaries of the water resources between your provinces and the others, clearly defined?
2. Are your responsibilities clearly separated from the other provinces specially in controlling the boundary areas?
3. Have the costs and benefits of the local communities in your province been considered in rules?
4. Do the farmers, industries and residents who are the main water users collaborate in modifying the rules?
5. How are the rules enforced at the operational level and is there any integrated monitoring program for the basin?
6. How are the users who violate from the rules, sanctioned in your province?
7. Are there any conflicts over access to the water resources in your province and between the provinces?
8. How the prior conflicts have been solved? Is there any pre-determined way or institutions to solve the conflicts?
9. Do the users have the opportunity to generate their own institutions and does the government recognize this right?
10. Can local government and companies make decisions regarding water management and water allocation? Do the regulations support the local governments regarding this right?

#### **Adaptive Capacity**

1. What do you see as the main issues which have led to the lake’s drought? (structural and non-structural factors).
2. Has the informal water use affected the ecosystem? If yes, how it is managed in the last decades?
3. Is the modern irrigation system developed efficiently? Is there any barrier its development?
4. Are farmers concerned about the ecosystem conditions? If not whether the government has tried to educate them and empower them to be aware about their impact on ecosystem?
5. Are any other job opportunity available for farmers who are expected not to develop their agriculture activities?

## **Interview Guideline for Farmers**

### **Introduction**

I am Shahryar Ershad. I am a student of IHS, Erasmus University Rotterdam. This interview guideline is used as an instrument for research on “the impact of institutional arrangements on adaptive capacity of the Urmia lake Basin”. This interview will be used only for academic purposes.

Date and Time of the Interview:

Respondent:

- Name:
- Email:
- Position:
- Institution:

### **Questions**

#### **Institutional Arrangement (Independent Variable)**

1. Is it completely clear for you who is responsible for controlling the water use?
2. Are the rules based on your needs?
3. Have you ever collaborated in modifying the rules?
4. Do you know how much informal water use is there in agriculture sector?
5. How the authorities control the water consumption? Are they limiting your water consumption?
6. How the authorities react to the farmers who use water informally?
7. How do you see the role of other provinces in water crisis?

#### **Adaptive Capacity**

1. How do you see your role in water management? Is it considered important by the government and the society? Are you interested as a farmer to collaborate in management of your environment?
2. How do you think the farmers' quality of life has changed during the last decades?



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