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Institutions of farmer participation and environmental sustainability: a multi-level analysis from irrigation management in Harran Plain, Turkey

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Abstract: This paper examines the relationship between farmer participation and environmental sustainability from an institutional perspective in the context of Harran Plain, one of the newest and largest irrigated areas in Turkey. Harran Plain undergoes social, economic and institutional change due to the expansion of large-scale irrigation and the establishment of irrigation associations. These changes, however, trigger an environmental change in the form of waterlogging and soil salinisation. The concepts of 'institutional scale' and 'institutional alignment' are applied to critically analyse the narratives regarding the causes of excessive water use, which is a collective action problem playing a significant role in increased waterlogging and soil salinity in Harran Plain. Empirical findings demonstrate that a low degree of institutional alignment among the rules at different levels constitutes an obstacle against taking actions to prevent excessive water use. Major issues are identified as the lack of water rights at plot and district levels; the exclusion of farmers from the planning of irrigation seasons; the inefficient monitoring of irrigation frequencies and fee collections, and the lack of mechanisms to monitor the operations of irrigation associations. The application of institutional scale and institutional alignment also contribute to the understanding of social-ecological systems by facilitating the systematic analysis of institutions and the identification of areas for institutional change.

Key words: Common-pool resources; environmental sustainability; farmer participation; Harran Plain; institutions; irrigation management; multi-level analysis; Turkey

1. Introduction

Since the 1950s, many countries have been investing in large-scale irrigation with the main objectives of economic growth, food security and poverty alleviation (Molden 2007). Despite the considerable success in achieving these economic and social objectives, irrigation also resulted in negative environmental impacts such as the pollution and degradation of water and soil resources (van Schilfgaarde 1994; Pimentel et al. 2004; Falkenmark and Galaz 2007; Molden 2007). The coupled problems of waterlogging and soil salinisation constitute a major negative impact that threatens environmental sustainability (Umali 1993; Dougherty and Hall 1995; Postel 1999). A well-maintained drainage infrastructure is vital particularly for large-scale irrigation systems in arid and semi-arid areas that are prone to waterlogging and soil salinisation (Scheumann and Freisem 2002; Abdel-Dayam et al. 2004, 2005; Pimentel et al. 2004). The alleviation of negative environmental impacts require integrated approaches to irrigation management that both incorporate economic, social and environmental objectives, and consider drainage requirements in the planning and management of irrigation systems.

Irrigation systems are, in most cases, common-pool resources: water is subtractable, potential users cannot be easily excluded, and the infrastructure is prone to degradation (Ostrom 1992; Tang 1992). Farmers are the major users of the irrigation systems and the environmental resources used for irrigation, which mainly include water and land. Therefore, the collective action of farmers is needed to ensure the sustainability of the irrigation system and environmental resources. In the recent decades, farmers have acquired a more significant role through their increasing involvement in irrigation management. Water user organisations are established as a collective actor of farmers in many countries where participatory irrigation management or irrigation management transfer programmes are implemented (Meinzen-Dick 1997; Garces-Restrepo et al. 2007). The functions of water user organisations involve processes such as distributing the irrigation water, setting and collecting the irrigation fees, enforcing sanctions against the violation of collective rules, and operating and maintaining the irrigation system. Farmers can participate in these processes individually through direct involvement in operation and maintenance and/or financial contribution, or collectively by being involved in the decision-making processes of water user organisations.

Benefits expected from farmers' participation in irrigation management include fostering collective action through individual and collective learning, building a sense of resource ownership, incorporating local knowledge to devise equitable and efficient rules and improving rule compliance (Ostrom 1990; Ostrom et al. 1994; Baland and Platteau 1996; Meinzen-Dick 1997). Achieving these benefits can also contribute environmental sustainability by solving the collective action problems regarding resource use and thereby alleviating the negative impacts on environmental resources. However, investigating the linkage between farmers' participation in irrigation management and environmental sustainability is a cumbersome task, particularly for large-scale irrigation systems that involve multiple actors and complex physical and institutional structures. This paper aims to improve the understanding of this linkage by analysing the relationship between farmers' participation in irrigation management and the impact of large-scale irrigation on environmental sustainability. The theoretical framework of the paper builds on the institutional design principles of common-pool resource management (Ostrom 1990, 2005) and the conceptual framework of social-ecological systems (Anderies et al. 2004). The framework is applied in the case of Harran Plain, a large-scale irrigated area in southeastern Turkey. Harran Plain constitutes a relevant case, as the introduction of large-scale irrigation and farmer participation in the 1990s has been accompanied by negative environmental impacts, mainly in the form of waterlogging and soil salinisation.

Several scholars examined the relationship between irrigation management and environmental sustainability in Harran Plain, or in the general context of the southeastern region of Turkey. The topics examined include the awareness of farmers about soil salinity (Adaman and Özertan 2007), the conflict between the notions of economic, social and environmental sustainabilities (Harris 2002), and the implications of diverging narratives about the causes of environmental problems (Harris 2009). This paper contributes to these studies by analyzing farmer participation from an institutional perspective and examining the relationship of institutions with the environmental impact of large-scale irrigation. To analyse the institutions of farmer participation, the concept of 'institutional scale' (Kiser and Ostrom 1982) is further developed for the case of farmer participation, and the novel concept of 'institutional alignment' is proposed. Both concepts are applied with empirical data from Harran Plain by reflecting on the multi-level rules that exist in the participatory management of the large-scale irrigation system in Harran Plain. The findings from this case study can contribute to the alleviation of the negative environmental impacts in Harran Plain, and to the prevention of similar impacts in the to-be-irrigated areas in Turkey and elsewhere.

2. Theory: institutional scale and institutional alignment to analyse farmer participation

In this paper, farmer participation is analysed on the basis of institutions, i.e. the formal and informal rules of action. Institutions influence actions in multiple ways: They define the permitted, prohibited and allowed actions, provide structure to interactions, and create a common meaning for actions and outcomes (North 1990; Ostrom 1998). The institutions of farmer participation are operationalised using a three-tier institutional scale with zero-order, first-order and second-order levels (Özerol 2012). As Table 1 shows, the zero-, first- and second-order levels follow the institutional scale that includes the hierarchical levels of operational, collective-choice and constitutional-choice levels proposed by Kiser and Ostrom (1982). These institutions are examples of nested-rules, i.e. higher-level rules shape how the lower-level rules are devised and changed (Ostrom 1998).

Table 1: The institutions of farmer participation in decisions about water use.

Level	Questions	Rules about water use
Zero-order	What?	• Requirements to have permission to use water • Periods that the water can be used • Irrigation methods that the users are permitted (or obliged) to use • Basis to determine the amount of water to be used • Basis to determine the irrigation fee to be paid • Prohibited actions • Sanctions for prohibited actions
First-order	Who decides? How?	• Permissions to use water • Periods to use water • On-farm irrigation methods • Basis to determine the irrigation fee • Prohibited actions • Sanctions for prohibited actions • Monitoring of compliance to rules
Second-order	What?	*(For each first-order rule)* • Possible reasons to change the rule • Type and proportion of users that participate in changing the rule • Proportion of rule changes that involve the users • Phase(s) of the rule-changing process that the users participate in • Timing that non-participant users are informed about the changes • Means to inform the non-participant users about the changes • Means to take and respond to non-participant users' inquiries

Source: Adapted from Özerol (2012).

Zero-order institutions are the operational rules regarding the farmers' actions about water use. First-order institutions include the collective-choice rules about farmer participation in the definition, enforcement and monitoring of the operational rules. Finally, second-order institutions are about the involvement of farmers in changing the first-order rules. The second-order rules are defined for each first-order rule.

The institutional scale and its levels build on two complementary theoretical lenses. First lens is the institutional design principles of sustainable common-pool resource regimes, namely, clearly defined boundaries, proportional equivalence between benefits and costs, collective-choice arrangements, monitoring, graduated sanctions, conflict-resolution mechanisms, minimal recognition of rights to organise and nested enterprises (Ostrom 1990, 2005). The second lens is the conceptual framework of social-ecological systems, which includes the entities of common-pool resource, resource users, public infrastructure, infrastructure providers, institutional rules, external environment and the links between these entities (Anderies et al. 2004).

In this paper, the term 'institutional alignment' is coined to address the alignment among the rules at different levels of the institutional scale. The degree of institutional alignment is a result of the top-down and bottom-up interactions of rules. If higher-level rules inhibit the application or revision of lower-level rules, this implies a low degree of alignment. For instance, regarding the first-order rule about "monitoring of compliance to rules", if a second-order rule envisages that "only the top management of the water user organisation can change the rule", this implies a low degree of alignment since the farmers that do not have the power to be involved in the top management cannot revise the first-order rule. On the other hand, a high degree of alignment is associated with the solution (or prevention) of collective action problems. For instance, problems with the application of a lower-level rule can trigger a new rule or a rule change at higher levels towards solving the collective action problem.

It is argued that a low (high) degree of institutional alignment is among the factors that can cause (solve) sustainability problems in social-ecological systems. This argument builds on 'institutional fit', which calls for the alignment of institutions with the physical entities of social-ecological systems (Ostrom 1990; Young 2002). If the degree of institutional fit is low (i.e. institutions are not aligned with the dynamics of social and ecological entities), problems are experienced at the system level. Institutional alignment extends this argument to the alignment between the rules at different levels. The influences of rules and their alignment on environmental sustainability can be explained based on the institutional design principles.

Zero-order rules affect environmental sustainability by regulating who is permitted to use water, how much, when and with which irrigation methods, whereas first-order rules describe the scope (*by whom*) and mechanisms (*how*) of participation in the definition and revision of zero-order rules. The influence of first-order rules on environmental sustainability relies on the effectiveness of monitoring and sanctions, which are among the design principles of sustainable irrigation systems (Ostrom 1992). Community structure is a key factor regarding the enforcement of monitoring and sanctioning. For instance, a non-hierarchical and homogeneous community can enforce monitoring and sanctioning by facilitating the equal distribution of the costs and benefits of collective action (Ostrom 1992; Bardhan and Dayton-Johnson 2002). On the other hand, the heterogeneity in terms of cultural, social and economic conditions can have implications for the collective action problems (Baland and Platteau 1996). Disadvantaged groups such as landless and smallholder farmers, tail-end water users and women often suffer from the unequal distribution of benefits and costs. However, these groups lack the power and resources to enforce or change the rules (Tang 1992; Bardhan and Dayton-Johnson 2002). The accountability of farmer organisations to their farmers is another factor of effective sanctions, particularly in large-scale irrigation systems (Merrey 1996).

As compared to the zero- and first-order rules, the second-order rules have a less direct, yet crucial, effect on environmental sustainability. In the existence of environmental problems, if the users can apply second-order rules to change the lower-level rules, the threat on environmental sustainability can be relieved. However, the second-order rules are prone to a second-order collective dilemma: All the users can benefit from the new rules, even if they are not involved in the crafting of the rules (Ostrom 1990). Long-term interactions among the users can solve this dilemma by establishing trust and reciprocity, whereas path dependency can function as an historical-institutional variable (Heinmiller 2009), which limits the future choices about higher-level rules that can solve the collective action problems by modifying the lower-level rules.

3. Method: case study on farmers' participation and irrigation practices in Harran Plain

3.1. Large-scale irrigation in Harran Plain

Harran Plain is a semi-arid agricultural area in the Şanlıurfa province of Turkey. The Plain is in the southeastern region of Turkey, which is home to the South-Eastern Anatolia Project (*Güneydoğu Anadolu Projesi*, hereafter GAP), the country's largest regional development programme. Covering approximately 10% of both the total area and population of Turkey, the southeastern region is less developed than the other regions according to key socio-economic indicators such as income per capita, literacy and infant mortality (Ünver 1997). Through projects in multiple sectors, the major goal of the GAP is to improve the social and economic conditions of the region, which is accomplished to a certain extent (Ünver 1997; Miyata and Fujii 2007). Irrigation is one of the two key sectors of the GAP, the other one being hydropower development. Since the 1980s, investments were made with the ultimate goal of irrigating 1,058,000 hectares of land, of which Harran Plain contains approximately 150,000 hectares (DSI 2012).

In the last two decades, the nature of irrigation management and practice fundamentally changed in Turkey. For Harran Plain, this change occurred through two major interventions: Switching from small-scale irrigation with groundwater to large-scale irrigation with surface water, and the introduction of participatory irrigation management to involve the farmers in irrigation management. Starting from 1994, the Directorate General of State Hydraulic Works (*Devlet Su İşleri*, hereafter DSI) stipulated the establishment of irrigation associations[1]. The right to manage irrigation systems were transferred to the irrigation associations, which became responsible for the distribution of water to the farmers, the operation and maintenance of irrigation canals and the collection of irrigation fees. Irrigation associations are legal entities comprising local authorities and the representatives of farmers. The decisions of irrigation associations are made by the top management that consists of a council and a board. Farmers can participate in the decision-making processes indirectly through voting at irrigation association elections and directly by being elected as a council member. As discussed further

[1] Irrigation associations are the most common type of water user organisations in Turkey, both in terms of numbers (368 out of 863) and transferred irrigation area (1.92 out of 2.14 million hectares) (DSI 2012). The other types of water user organisations are irrigation cooperatives, village legal entities, municipalities and research organisations.

in the following sections, the farmers also participate in the management of the irrigation system, for instance by distributing the water at the tertiary level.

The social structure in Harran Plain is characterised by two key features, namely, hierarchy and heterogeneity. Both features are the legacy of nomadic tribes (aşiret) that existed in the eastern and southeastern Anatolia for centuries and have been sedentarized by the Ottoman Empire in nineteenth century (Erhan 1997). The potential implication of the tribal structure on irrigation is inequality related to land size and participating in decision-making processes. Several scholars argue that the tribal relations in southeastern Turkey have been resolving after the introduction of large-scale irrigated agriculture and participatory irrigation management (Akşit and Akçay 1997; Miyata and Fujii 2007). However, there is also scepticism regarding the contribution of large-scale irrigation and participatory irrigation management to "democratisation", for instance, through involving the women and smallholder farmers in decision-making processes (Harris 2005; Kadirbeyoğlu 2008; Kadirbeyoğlu and Özertan 2011). The differentiation in terms of gender, ethnicity and landownership is seen particularly problematic due to the unequal distribution of the benefits from large-scale irrigation (Harris 2008).

In addition to the social, economic and institutional changes in the last two decades, Harran Plain witnesses environmental change too. This change is, however, mainly in the form of negative environmental impacts of irrigation on water and soil resources. Major impacts are waterlogging and soil salinisation (Kendirli et al. 2005; Aydemir et al. 2008; Bahçeci and Nacar 2009; GAP-RDA 2010), whereas groundwater pollution has been recently reported (Yeşilnacar and Güllüoğlu 2008). Even before the intensive irrigated agriculture started in the 1990s, waterlogging and soil salinity existed in the central and southern parts of the plain, but they increased dramatically in less than a decade (Kendirli et al. 2005). A recent assessment indicates that waterlogging affects 50,000 hectares of irrigated land, whereas salinisation threats the fertility of approximately 17,800 hectares of land (GAP-RDA 2010).

3.2. Data collection and analysis

Farmers' irrigation practices and participation in the management of irrigation systems in Harran Plain were examined through an in-depth case study. Data sources included documents and semi-structured interviews. The documents constituted the main source of data about the rules "on paper". The major types of documents included the laws, bylaws and regulations about irrigation management and reports of relevant public organisations about the development and outcomes of irrigated agriculture in Harran Plain. The fieldwork was conducted between December 2009 and December 2011, and involved semi-structured interviews with respondents that represent various types of actors. Semi-structured interviews aimed at identifying the perspectives of actors regarding the practices and problems about water and soil resources, and the rules about (participatory) irrigation management.

Out of the 27 irrigation associations in Şanlıurfa, 7 irrigation associations from various parts of Harran Plain were included in the analysis. Interviews with the farmers were mainly conducted during the author's visits to villages and the offices of irrigation associations. In addition, the manager of each irrigation association and several members of staff and top management were interviewed. In total, 72 farmers from 31 villages were interviewed. Representatives from the DSI's regional directorate, which is responsible for the co-management of irrigation systems in Harran Plain with the irrigation associations, were also interviewed. Based on the data collected through the interviews and examination of documents, the multi-level rules of farmer participation in irrigation management were described, the degree of alignment among multiple rule levels was analysed and the implications of institutional alignment on water and soil sustainability were investigated.

4. Results and discussion: excessive water use and institutional alignment

Excessive use of irrigation water is a major collective action problem of irrigation management in Harran Plain and a key reason for waterlogging and soil salinisation[2]. In relation to the actions of farmers and irrigation associations, the following narratives regarding the causes of excessive water use are voiced by many respondents and observed by other scholars (Adaman and Özertan 2007; Kadirbeyoğlu 2008; Harris 2009):

- "Farmers apply inappropriate irrigation practices."
- "Farmers do not adopt water-saving irrigation methods."
- "Irrigation associations do not use irrigation fees to reduce water use."
- "Irrigation associations do not enforce sanctions against excessive water use."

These four interrelated narratives address the farmers' decisions at individual and collective levels. On the one hand, the first and second narratives are about the individual decisions of farmers about irrigation practice and on-farm irrigation methods. On the other hand, the third and fourth narratives are related to the decisions made by the irrigation associations, which are the collective entities formed by the farmers. Table 2 summarises these narratives and the related zero-, first- and second-order rules of farmer participation in water use decisions. In the subsections below, each narrative is discussed by further explaining the rules and the alignment between the rules at the same or different institutional levels.

[2] The semi-arid climate, low-slope topography and lack of drainage infrastructure are also key factors that cause waterlogging and salinisation in Harran Plain (Kendirli et al. 2005; Aydemir et al. 2008). However, for the sake of focus and brevity, this paper focuses on excessive water use and elaborates on these factors only when they are directly related to the institutions of farmer participation.

Table 2: Narratives about excessive water use and related rules of farmer participation.

Narrative about excessive water use	Rules of farmer participation in water use decisions		
	Zero-order	**First-order**	**Second-order**
"Farmers apply inappropriate irrigation practices."	Farmers that cultivate land in an irrigation district are permitted to use water.	The Irrigation Associations Law defines the 'water user' status.	Farmers cannot secure any water rights at plot or district level.
	Farmers are permitted to withdraw water from the tertiary canals during the irrigation season.	DSI and irrigation associations plan the irrigation season.	Farmers implement the irrigation turns, but cannot plan the irrigation seasons.
"Farmers do not adopt water-saving irrigation methods."	Farmers are permitted to apply the irrigation method that they prefer.	Irrigation associations charge lower irrigation fees for water-saving technologies.	Farmers cannot switch to water-saving irrigation methods due to open canals.
"Irrigation associations do not use irrigation fees to reduce water use."	Irrigation fee is based on the crop type and the size of the irrigated area.	Top management of the irrigation associations set the parameters and the level of irrigation fee.	Irrigation associations cannot introduce 'water quantity' or 'irrigation frequency' as a fee parameter.
"Irrigation associations do not enforce sanctions against excessive water use."	There are sanctions for prohibited actions.	The irrigation associations define the sanctions with little monitoring and sanctioning.	Disadvantaged farmers cannot participate in management nor can they 'audit' irrigation associations.

4.1. "Farmers apply inappropriate irrigation practices"

When irrigated agriculture results in negative environmental impacts, it is common to attribute them to the inappropriate irrigation practices of farmers such as irrigating the crops too frequently or withdrawing excessive water. An easy explanation for these practices is the ignorance or illiteracy of farmers. The need to train the farmers and raise their awareness about "sustainability" is an ongoing rhetoric in the southeastern region of Turkey (Adaman and Özertan 2007). This approach is persistent in many irrigation projects, which neglect the technical and administrative obstacles that the farmers encounter and blame the farmers for being ignorant about irrigation practice (Merrey et al. 2007). However, as also demonstrated by Harris (2009), the opinions and local knowledge of the farmers in Harran Plain are undervalued against the technical knowledge of government officials and researchers. Findings from this case study confirm that most of the farmers are aware of the problems as well as the underlying causes. Most of the farmers, who talked about the causes of waterlogging and soil salinity, mention excessive water use as one of the major causes of waterlogging and soil salinity, regardless of whether they experience a problem or not. Many farmers also acknowledge that they used water excessively when they first had irrigation water in the 1990s, and learnt in time by observing what the other farmers do or by experiencing the waterlogging or salinity problems themselves. The examination of rules regarding water use shows that the low degree of alignment between the rules at different levels also results in “inappropriate” irrigation practices.

The major zero-order rule regarding water use is the boundary rule about ‘the requirements to have permission to use the irrigation water’. This rule is defined for two levels, namely the irrigation districts and the farming plots. Water in the main canal is shared among irrigation districts that cover the plots to be irrigated with water conveyed through secondary and tertiary canals. DSI identifies the boundaries of each irrigation district, which is managed by one irrigation association. The plots in the irrigation districts are owned or rented by farmers. The boundary rule at the plot level is that every farmer cultivating land in an irrigation district is permitted to use water. This permission is granted through a “water user” status in the Irrigation Associations Law, which defines the water user as “a natural or legal person that irrigates or will irrigate land in the irrigation district”[3]. According to this definition, the farmers do not have to be the landowners to use water; farmers that rent the land can also be water users. Thus, the first-order rule regarding the “permissions to use water” is defined by the law, which has been enacted and implemented by DSI. Although not explicitly mentioned in the law, farmers are permitted to withdraw water only from tertiary-level canals and both DSI and irrigation associations prohibit withdrawing water from the main or secondary canals as well as the drainage canals. However, the farmers that have land outside the irrigation district pump water directly from the main or secondary canals. Respondents mention that although this is a rare case, it is experienced in high-slope areas where the water cannot be transmitted through the gravity-fed irrigation canals. Water distribution between upstream and downstream users is more problematic, since the farmers at the tail-end have difficulty in accessing water during the irrigation season. The tail-end farmers sometimes withdraw drainage water from drains by installing pumps, which is forbidden since drainage water is brackish, causing soil salinisation and pollution. Nevertheless, irrigation associations cannot stop the farmers from using drainage water, since allowing the farmers to use the polluted water is better than supplying no water at all.

Having a water user status does not grant farmers or irrigation associations any “water rights” that can be applied as a second-order rule to change the relevant lower-level rules such as the periods to use water and the basis to determine the amount of water to be used . Irrigation season, the period during which the farmers can irrigate their land, is annually planned by DSI, which can be understood both as a continuation of state intervention in irrigation management (Harris 2009) and as co-management by DSI and irrigation associations. The irrigation season is usually between April and September, i.e. the dry period in Harran Plain. Before irrigation seasons start, DSI requests water demand estimations from

[3] Article 2, subclause 1-i of the Irrigation Associations Law enacted on March 22, 2011.

each irrigation association. The irrigation associations request from the farmers to declare the area of the land that they will irrigate and the type of crops that they will cultivate. According to the size of land and the crop water requirements, each irrigation association calculates how much water would be needed during the irrigation season. This irrigation plan, however, is not entirely recalled during the irrigation season since the actual amount of water withdrawn at the secondary and tertiary canals is not monitored. Furthermore, the farmers can change their crop decisions, which can significantly change their water demand. When the irrigation season starts, the irrigation associations are allocated water, starting from the upstream canals. The water diverted to the main canal is transmitted to the secondary and tertiary canals. At the tertiary level, the irrigation associations allow the farmers to plan how to share the water. So, the farmers that use water from the same tertiary canal plan and implement “irrigation turns”. When the water is available in the tertiary canal next to their field, farmers can withdraw water by turns. Regarding the monitoring of water withdrawals, the existence and enforcement of rules differ between the main and secondary levels and the tertiary level. DSI monitors the quantity of water diverted to each main and secondary canal, whereas it is technically impossible to meter the usage from secondary to tertiary level. Therefore, neither DSI, nor the irrigation associations know how much water each farmer uses. Consequently, individual water use is not metered, neither aggregated to monitor the water use at the district level. As a result, the frequency and duration of irrigation are not arranged according to crop water requirements, which are included in the plans made prior to the irrigation season. Thus, the second-order rules that do not grant the farmers water rights and allows only DSI to plan the irrigation seasons are not aligned with the first- and zero-order rules regarding water withdrawal from irrigation canals. Furthermore, the lack of second-order rules that could involve the farmers in planning the periods of water use and monitoring the amount of water use reduces farmers’ incentives to be more cognizant about their water use practices.

4.2. “Farmers do not adopt water-saving irrigation methods”

There is no zero-order rule that obliges the farmers in Harran Plain to apply a certain irrigation method at the farm level. Like all other regions of Turkey, most of the farmers choose to apply surface (furrow or flood) irrigation in Harran Plain (DSI 2012). Farmers prefer surface irrigation since it is a simple method, and requires farm levelling but no on-farm investment by the farmers. There is an ongoing debate about the low water use efficiency caused by surface irrigation and the need to switch to methods such as drip or sprinkle irrigation, which save water substantially as compared to surface irrigation. Accordingly, the diffusion of water-saving irrigation methods has been promoted in the recent years. The incentives of the ministry of agriculture and irrigation associations intend to facilitate farmers’ adoption of these methods. The ministry of agriculture provides grants and no-interest credits to subsidise the cost of installing drip or sprinkle irrigation. Furthermore, as a first-order rule regarding the basis to determine the irrigation fee, irrigation associations charge lower irrigation fees to those farmers who install these technologies. However, neither the ministry of agriculture nor the irrigation associations interfere with the individual decisions of farmers through proactively informing them about these methods.

Despite these economic incentives to use water-saving irrigation methods, the open canal system creates a path dependency in terms of the irrigation method that the farmers can actually choose. In the 2000s, DSI started to construct closed (piped) systems, which can facilitate the use of water-saving methods by eliminating the extra energy costs. However, almost all the irrigation canals in Harran Plain are open (gravity-fed) canals, which were built by DSI in the 1980s and 1990s[4]. With the open canal system, farmers find it too costly to switch to drip or sprinkle irrigation, since both methods require pressurised water, meaning that the farmers have to incur extra electricity or fuel costs to pump the water from the open canals. Consequently, most of the farmers feel constrained to surface irrigation although they know that this method often implies excessive water use and lead to waterlogging and soil salinisation.

The open canal system is a reasonable excuse for the lack of the diffusion of water-saving methods. Due to other obstacles, however, the situation is not different with closed (piped) systems, either. One of the irrigation associations included in the case study was established in 2004 and has a closed system. However, the farmers of that irrigation association do not switch to drip or sprinkle irrigation, and prefer to use the surface irrigation methods. The crop pattern is also an obstacle, since the crops that the farmers know how to cultivate (cotton, wheat and maize) are difficult to irrigate with drip irrigation. A final important determinant of farmers' water use decisions is, as discussed below, the basis to determine the irrigation fee.

4.3. "Irrigation associations do not use irrigation fees to reduce water use"

This narrative builds on the assumption that as long as irrigation fees are set high enough, the farmers will use water efficiently by withdrawing less water or by switching to water-saving methods[5]. In Harran plain, it is stated by many respondents that the irrigation fees are too low (about 3–5% of farmers' total costs) to reflect the investment and operation costs incurred to bring the water to the fields. However, even if the irrigation associations set reasonable irrigation

[4] The semi-arid climate of Harran Plain brings about high evaporation rates during the irrigation season. A respondent from DSI regional directorate in Şanlıurfa states that approximately 15% of the water evaporates during the transmission of water from the dam reservoir to main and secondary canals. These evaporations further reduce water use efficiency at the system level.

[5] See also van Steenbergen et al. (2006) for a comprehensive set of factors that need to be taken into account in setting and applying irrigation fees and Molle (2008, 2009) for a critique of the supposed influence of pricing on the efficient use of water.

fees, turning the irrigation fees into an instrument to reduce water use is not straightforward.

Like in many other regions of Turkey, the irrigation fee that each farmer has to pay is accrued based on two parameters, namely the crop type and the area of irrigated land. Irrigation associations cannot set "the quantity of water used" as a parameter of irrigation fee since, as explained in section 4.1, it is difficult for them to monitor the water use at the plot and farm level. Although the amount of water released from the dam reservoir and diverted to the main and secondary canals is known[6], water-metering is not possible from secondary to tertiary level. Therefore, crop type is used as a proxy for the quantity of water used per hectare. For example, irrigation fee is higher for cotton than for wheat or maize, since cotton is a more water-demanding crop. Some respondents suggest that "the frequency of irrigation" can be added as a third parameter. This parameter is, however, also difficult to use for the irrigation associations in Harran Plain. Since the system is large-scale, monitoring how many times each farmer irrigates her/his land is costly. More importantly, the farmers do not trust the irrigation associations that they would effectively monitor the irrigation frequency. As explained in the next subsection, this lack of trust is associated with the weak administrative management that the irrigation associations suffer from.

The collection of irrigation fees from their farmers is crucial for a strong financial management of the irrigation associations. As the irrigation associations are non-profit organisations, each year they set the irrigation fees just to cover the administrative expenses for personnel and other overhead, and the costs of operation and maintenance of the irrigation canals. The operation and maintenance costs accrue due to the use of inputs such as labour, machinery, equipment and fuel for the activities such as monitoring, cleaning and repairing the canals. Since the irrigation systems are large scale, the irrigation associations do not rely on the individual contributions of farmers for the operation and maintenance of canals. The necessary workforce for operation and maintenance is supplied by seasonal workers that are hired by the irrigation associations, whereas the farmers contribute to the operation and maintenance by paying the irrigation fee. However, many respondents have doubts as to how much irrigation fee is accrued and collected from the farmers and how the collected fees are spent by the top management. Indeed, most of the irrigation associations in Harran Plain have tax and social insurance premium debts due to the personnel that they employ. Some respondents also claim that the actual spending, especially for the repair of the irrigation canals and the cleaning of the drainage canals, is much lower than the budgeted levels, whereas the costs shown on the budget are sometimes not actually incurred, such as the fuel costs for the machinery and equipment. These financial accountability problems are exacerbated by the improper functioning of irrigation associations in terms of enforcing mechanisms against rule violence.

[6] Each main and secondary canal has a certain capacity, and several respondents state that the canals usually work full capacity when the water is diverted during the irrigation season.

4.4. "Irrigation associations do not enforce sanctions against excessive water use"

The monitoring and sanctioning mechanisms of the irrigation associations in Harran Plain are limited. The major monitoring activity is done by the "water distribution technicians" that are temporarily hired by the irrigation associations to monitor the distribution of water among the farmers. The manager of the irrigation association oversees the water distribution technicians. However, the farmers themselves resolve most of the conflicts at the tertiary level, since they implement the above-mentioned irrigation turns at this level. If the conflict cannot be resolved by the involved farmers, there is tendency to consult the elderly in the villages or the manager of the irrigation associations.

Despite the efforts made for monitoring, the enforcement of sanctions is not effective. The irrigation associations have sanctions for prohibited actions, such as failing to pay the irrigation fee, violating the irrigation turns, damaging the infrastructure and stealing water. However, they cannot enforce the sanctions, including those against excessive water use. One reason is the heterogeneous and hierarchical community structure and the heterogeneity regarding land ownership. The landless and smallholder farmers, who are among the disadvantaged groups along with women, express their struggle with inequality in terms of access to political, financial and physical resources to participate in the management of irrigation associations. The heterogeneous and hierarchical structure manifests itself also through nepotism and elite capture.

Nepotism is observed because of the unwritten tribal rules that continue infusing into irrigation management (Harris 2005). Powerful tribe members prioritise kinship and friendship ties over formal relationships, and exploit these ties to get things done, not only by the irrigation associations but also by other organisations. Such relations obstruct the enforcement of sanctions on the farmers that engage in prohibited actions, and leads to feeling of injustice, as expressed by disadvantaged farmers. Elite capture, on the other hand, is a result of the occupation of the top management of irrigation associations by the local elites, such as the local administrators (headmen in villages and mayors in towns) and the powerful large landowners, who are usually tribe leaders. As opposed to the disadvantaged groups, the local elite can mobilise resources to influence the decisions and inhibit the enforcement of sanctions (Harris 2005; Kadirbeyoğlu and Özertan 2011).

Due to inequality, nepotism and elite capture, the disadvantaged groups do not trust in the fairness of the decisions of the top management. However, there are no second-order rules that could enable the disadvantaged groups to examine – or "audit" – the operations of irrigation associations that neglect the relevant first-order rules (e.g. about monitoring the distribution of water and the maintenance of canals). This situation is also attributed to the fact that the top management of irrigation associations is not accountable to individual farmers, but to DSI and the ministry of interior.

The newly-enacted Irrigation Associations Law seems to decrease, at least, the elite capture by changing the legal status of irrigation associations from local administration unions to public legal entities. This implies that local administrators can no longer be the "natural" members of the council. However, the law also contains an article that worsens the inequality between smallholder and large-scale farmers in terms of voting rules. According to the law, the size of the (rented or owned) land will determine how many votes each water user will have during the irrigation association elections. If their land is larger than the average (total irrigated area/number of water users), the water users will have up to five votes[7]. Hence, additional questions are raised about "democracy", which was supposed to be brought to the region through the establishment of irrigation associations (Ünver 1997).

5. Conclusions

In this paper, the relationship between the institutions of farmers' participation in irrigation management and the impact of large-scale irrigation on environmental sustainability is examined in the context of Harran Plain. As demonstrated by the critical analysis of the four narratives regarding the collective action problem of excessive water use, the degree of institutional alignment among the rules of farmers' participation is low in most respects and this has implications on environmental sustainability. Farmers' participation in irrigation management is mostly limited to the application of zero- and first-order rules such as voting at irrigation association elections, paying the irrigation fee and distributing water at the tertiary level. Most of the farmers have either no opportunity or unequal opportunities in participating to devise or change the first- and second-order rules. Main areas of concern are the lack of water rights at plot and district levels, the exclusion of farmers' from the planning of irrigation seasons, the inefficient monitoring of irrigation frequencies and fee collections, and the lack of mechanisms to monitor the operations of irrigation associations. Involving the farmers in crafting and changing the first- and second-order rules can improve the degree of institutional alignment and alleviate the problem of excessive water use. Being the collective actor that represents the farmers, irrigation associations can play a better role in fulfilling the "democratisation" objective, by introducing rules that give voice to disadvantaged groups, who are under-represented in the top management of irrigation associations. This institutional change, however, is difficult to realise since the advantaged farmers have been enjoying the benefits of the existing institutional structure.

The findings from Harran Plain can also be explained in terms of the design principles and the entities of the social-ecological system. On the one hand, the degree of institutional alignment is high in three principles, namely the boundaries of the resource system, conflict-resolution mechanisms and the rights to organise.

[7] Article 6, subclause (6) of the Irrigation Associations Law enacted on March 22, 2011.

The boundaries of the resource system are clear and agreed upon by all the actors. Similarly, the conflict-resolution mechanisms are limited yet functioning. The rights of farmers to organise are also recognised, despite the recent development that favours the large-scale farmers in voting rights. On the other hand, the degree of institutional alignment is low and can be improved in terms of the other five principles, namely, the equivalence between benefits and costs, collective-choice agreements, monitoring, graduated sanctions and nested enterprises. Except the nested enterprises, the common factor that explains the low degree of alignment in four principles is the social structure that excludes the disadvantaged groups from the decision-making processes and limits their opportunities to monitor the activities of other users as well as the operations of the irrigation association. Regarding the nested enterprises, the low degree of alignment is due to the lack of organisations that could act at higher jurisdictional levels than the irrigation district. Since the contemporary history of large-scale irrigation in Harran Plain dates back to only 1994, this period can be seen as a learning phase.

The concepts of institutional scale and institutional alignment contribute to the understanding of social-ecological systems in two ways. Firstly, the multi-level character of institutional scale and institutional alignment facilitates the systematic analysis of the interactions among institutions and the implications of those interactions on environmental sustainability. Secondly, by incorporating the characteristics of resource users and natural resources at multiple institutional levels, the identification of areas for institutional change in the social-ecological system are facilitated. Thus, both concepts can be appropriate for the analysis of other social-ecological systems.

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