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HOW DO FARMERS ALIGN WITH THE AGRI-ENVIRONMENTAL CHANGES IN IRRIGATED AGRICULTURE? A CASE STUDY FROM THE HARRAN PLAIN, TURKEY[†]

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ABSTRACT

Irrigated agriculture has a significant potential for food security and poverty reduction, while it is also associated with broader agri-environmental changes. These changes include agrarian change in terms of the intensification, globalization and neoliberalization of agriculture, and environmental change due to the pollution, degradation and exploitation of water and soil resources. Farmers are key actors in irrigated agriculture, since they are both the users of water and soil resources and the target groups of policies. This paper aims to improve the understanding of the relationship between farmers' decisions on irrigated agriculture and the agri-environmental changes that result from irrigated agriculture, and to explain how farmers differ in terms of their alignment with these changes. We develop a conceptual model by building on natural resources governance and farmer decision-making, and apply the model through a case study in Harran Plain, an agricultural area in Turkey. Our findings indicate that farmers are differentiated in terms of their degree of alignment. This differentiation results mainly from the attributes that relate to what the farmers have, such as land, financial capacity, power attribution and network range, and it affects the farmers' decisions about resource use and crop production. Copyright © 2016 John Wiley & Sons, Ltd.

KEY WORDS: agri-environmental changes; farmer decision-making; irrigated agriculture; natural resources governance; Turkey

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RÉSUMÉ

L'agriculture irriguée a un potentiel important dans la sécurité alimentaire et la réduction de la pauvreté, alors qu'il est également associé à des changements agro-environnementaux plus larges. Ces changements comprennent bien entendu le changement agraire en termes d'intensification, de mondialisation et de néolibéralisation de l'agriculture, mais aussi l'évolution de l'environnement en raison de la pollution, de la dégradation et de l'exploitation des ressources en eau et du sol. Les agriculteurs sont des acteurs clés dans l'agriculture irriguée, car ils sont à la fois les utilisateurs du sol et des ressources en eau et les cibles des politiques. Ce document vise à améliorer la compréhension de la relation entre les décisions des agriculteurs sur l'agriculture irriguée et les changements agro-environnementaux qui résultent de l'agriculture irriguée, et d'expliquer comment les agriculteurs diffèrent en fonction de leur alignement avec ces changements. Nous développons un modèle conceptuel en misant sur la gouvernance des ressources naturelles et des agriculteurs la prise de décision, et d'appliquer le modèle à travers une étude de cas dans Harran Plain, une zone agricole en Turquie. Nos résultats indiquent que les agriculteurs sont différenciés en fonction de leur degré d'alignement. Cette différenciation résulte principalement des attributs qui se rapportent à ce que les agriculteurs ont, comme la terre, la capacité financière, le pouvoir d'attribution et la portée du réseau, le tout affectant les décisions des agriculteurs sur l'utilisation des ressources et la production agricole. Copyright © 2016 John Wiley & Sons, Ltd.

MOTS CLÉS: changements agro-environnementaux; prise de décision par l'agriculteur; l'agriculture irriguée; ressources naturelles de gouvernance; Turquie

INTRODUCTION

Irrigated agriculture is a key policy intervention in many countries due to its potential contribution to food security and poverty reduction (Hall, 1999; Rosegrant *et al.*, 2009). Farmers are key actors in irrigated agriculture, since they

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[†]Comment les agriculteurs s'alignent sur les changements agro-environnementaux de l'agriculture irriguée? Une étude de cas dans Harran Plain, Turquie.

are both users of water and soil resources and target groups of policies that often have divergent objectives regarding water, agriculture and the environment. Therefore, in order to ensure the sustainability of irrigated agriculture, it is crucial to improve the understanding of how farmers' characteristics and their decisions on water and soil resources are shaped (McGregor *et al.*, 2001; Molden, 2007). This paper focuses on the characteristics and decisions of farmers in the Harran Plain, one of the largest irrigated areas in Turkey, which has been shifting to large-scale irrigated agriculture since the 1990s.

Many of the factors that influence farmers' decisions stem from agri-environmental changes that involve the coupled agrarian and environmental changes occurring in irrigated agriculture. At the same time, farmers' decisions and practices also contribute to shaping the agri-environmental changes. The development of irrigated agriculture is part of the agrarian change that involves the intensification, globalization and neoliberalization of agriculture. Since the 1960s, many countries witnessed the 'green revolution', which implied increases in food productivity through irrigation and high-yielding crop varieties (Evenson and Gollin, 2003). Modern agricultural practices such as the use of fertilizers, pesticides, machinery and equipment have been a crucial element of this development. However, irrigated agriculture also requires ecosystem alterations that lead to environmental change, which often implies negative impacts such as the pollution, degradation and overexploitation of water and soil resources (Umali, 1993; Postel, 1999; Falkenmark and Galaz, 2007; Molden, 2007). Although the environmental change that results from irrigated agriculture is often experienced at the local level, it is rooted in multiple, and often higher, levels at which the water and land resources are governed (Kijne *et al.*, 1988; van Schilfgaarde, 1994; Wichelns and Oster, 2006). As the processes of natural resource governance are also modified through agrarian change, the interdependence of the agrarian and environmental changes associated with irrigated agriculture becomes inevitable.

Political economy scholars have extensively studied the implications of agrarian change for farmers by analysing the social relations and the dynamics of production, property and power (Borras, 2009). It is established that there is a transition to agrarian capitalism, implying the penetration of the capitalist system into farming and the gradual elimination of peasantry (Bernstein, 2010). A further implication of this transition is the differentiation of farmers that become capitalist farmers, medium farmers or poor peasants depending on how they can reproduce themselves by means of capital and labour. Although the political economy perspective enriches understanding of the social and economic dimensions of agrarian change, the ecological dimension needs to be incorporated. In the scholarly literature on irrigated agriculture, there are few studies that examine the agri-environmental changes through examining the interrelated social, political and ecological processes (Mollinga, 2010; Faysse and Petit, 2012). This paper aims to contribute to these studies by analysing farmers' decisions on irrigated agriculture in relation to the broader agri-environmental changes. For this purpose, we develop a conceptual model, which is presented in the following section. Then we provide background information on irrigated agriculture in Turkey and in the Harran Plain. In the next section, we apply the conceptual model to the case of the Harran Plain and examine the differential relationship in terms of the *alignment of farmers with agri-environmental changes*, which we define as 'the adjustment of farmer decision-making processes to the changes in agricultural and ecological processes'. Then we discuss the differentiation of farmers based on the empirical results. Finally, we draw our conclusions in the last section.

CONCEPTUAL MODEL: FARMERS' DECISIONS AND AGRI-ENVIRONMENTAL CHANGES

Various approaches have been developed regarding farmers' decisions. On the one hand, quantitative approaches aim to provide 'universal' explanations of how farmers make decisions. Examples include five-point scales of farmers' attitudes, goals and behaviours (Willock *et al.*, 1999); multi-attribute utility modelling of farmers' decisions (Gomez-Limon *et al.*, 2004) and responses to policy change (Gomez-Limon *et al.*, 2007); decision-support systems for farmers' decisions (Merot *et al.*, 2008) and point-score analysis of farmers' crop choice (Briggs, 1985; Greig, 2009). On the other hand, qualitative approaches emphasize the role of contextual factors and the relationships among multiple factors, both of which are sometimes overlooked in quantitative studies. Decision-tree modelling (Gladwin, 1989) and its extensions with personal-construct theory (Murray-Prior, 1998; McGregor *et al.*, 2001) are two examples of the qualitative approach. This paper adopts a qualitative approach by developing a conceptual model that incorporates concepts from natural resources governance and farmer decision-making. The elements of the model and their relationships are illustrated in Figure 1.

Like all natural resource users, farmers act in a social-ecological system, which contains societal and environmental units that interact interdependently and can contain subsystems (Anderies *et al.*, 2004). We conceptualize irrigated agriculture as two subsystems, namely, the *governance system* and the *agroecosystem*. Farmers' decisions regarding *crop production* and *water and soil use* constitute inputs to these systems. The governance system and the agroecosystem result in respective *agrarian* and *environmental* changes, which influence farmers' characteristics and

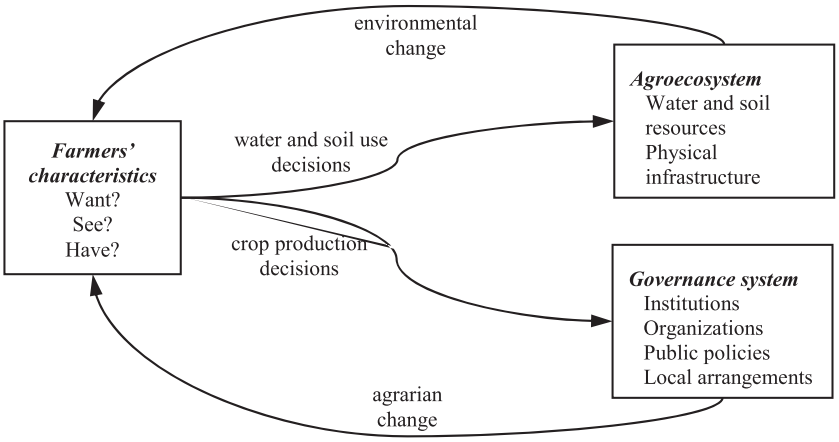

Figure 1. Conceptual model of the relationship between agri-environmental changes and farmers' characteristics and decisions in irrigated agriculture.

decisions. In the sections below, we explain the elements of the model in more detail.

Farmers' characteristics

As Figure 1 illustrates, farmers' characteristics constitute the focal element of the model, since the analysis focuses on farmers as the key actor of the social-ecological system of irrigated agriculture. Answering the questions as to what the farmers 'want', 'see' and 'have' provides a complete set of the factors that characterize a farmer as an actor (Röling, 2003; Bressers, 2009).

The questions in Table I address three complementary and interrelated aspects of farmer decision-making. The first question refers to what the farmers want to achieve in short- and long-term horizons. Whether called aspirations, goals, ideals, or something else, these 'wants' entail social, economic and ecological dimensions on which the farmers develop their farm household. The second question particularly reflects how the farmers perceive and interpret the agroecosystem conditions in relation to their decisions. Understanding these perceptions and interpretations is necessary, since they can differ both within farmer groups and between farmers and other actors. Finally, the third question is about farmers' financial, physical and social resources. These three aspects of farmers' characteristics are interrelated. For instance, what the farmers see can affect how they want to respond to environmental change, or how they allocate their limited resources between social, economic and environmental objectives.

Governance system and agrarian change

There are various approaches to defining governance such as considering it as a system, process or mechanism (Lautze *et al.*, 2011). In this paper, we adopt the system approach and define governance as 'a social, economic and political system that includes institutions, organizations and public policies' (Merrey *et al.*, 2007). Institutions are comprised of the property rights on resources as well as the rules-in-use about resource use and management (Ostrom, 1992). Organizations can cover a wide range such as governmental and non-governmental organizations and private companies. Public policies include the legal, economic and social interventions that aim to solve policy problems. Local arrangements are required to implement the policies and institutions, such as granting subsidies and distributing irrigation water. Liberalization, expansion and intensification constitute the main changes in the governance system of agriculture and they are grouped under the *agrarian change* element of the model. Agrarian change influences farmers' decisions through relations, which are based on exchanging capital and labour for agricultural production.

Agroecosystem and environmental change

The agroecosystem provides the water, soil and other environmental resources necessary for irrigated agriculture (Falkenmark and Galaz, 2007; Gordon *et al.*, 2010). Physical infrastructure such as irrigation and drainage canals and storage facilities are also parts of the agroecosystem. Irrigated agriculture causes an environmental change, which results from the interactions between farmers and the agroecosystems. A significant part of the irrigation-induced environmental change results from the modifications that other actors such as governmental organizations or private companies make. These modifications mainly include the construction of irrigation canals and dams, and they can occur before the irrigation starts and lead to impacts such as biodiversity loss, land inundation and soil erosion. Since the paper focuses on farmers' decisions, this second type of environmental impacts and the interactions of other actors with the agroecosystem are not elaborated on further.

Table I. Questions to analyse farmers' characteristics

Analysis question	Factors that shape farmers' characteristics
What do the farmers want?	Aspiration, goal, ideal, motivation, objective, preference
What do the farmers see?	Awareness, beliefs, cognition, judgement, knowledge, perception
What do the farmers have?	Asset, capacity, capital, land, money, power, resources, social network

Farmers' decisions about water and soil use influence the quality and quantity of water and soil as well as the physical infrastructure. The changes in the agroecosystem occur with a time lag, implying that farmers cannot immediately observe the impacts of their decisions about water and soil use. The agency of the environment plays a role in this complex human–environment interaction. For example, soil salinization, a major environmental impact of irrigated agriculture, develops both by human- and environment-induced factors. Excessive water use in irrigation can cause salt accumulation in soil, whereas the high degree of evaporation under arid climate conditions and the impermeable soils such as clay can also accelerate salt accumulation.

Farmers' decisions and alignment

Farmers' agency in the social-ecological system is mediated through their decisions about crop production and resource use. When practising irrigated agriculture, farmers make decisions about the type of crops to cultivate, the methods of sowing, irrigating and harvesting the crops, and the agrochemicals to apply. Our focus is on two key decisions: choosing the crop type and the on-farm irrigation method.

Crop choice is a key decision, since the crop type determines additional decisions on agricultural inputs. The crop type also constitutes a part of farmers' alignment with agrarian change. Farmers can choose crops that are marketed easily or promoted by agricultural subsidies, or alternative crops, which entail the risk of not finding a market and giving up the subsidies. Since different crops have different water requirements, crop choice also has environmental implications. By choosing a water-demanding crop under (semi-)arid conditions, farmers increase the risk of impacts such as excessive water use and soil salinization. Choosing the on-farm irrigation method is also a key decision as it determines how, when and how much the farmers withdraw water. Similar to the crop type, the chosen irrigation method has economic and environmental implications. The farmers can decide to apply low-cost flood irrigation, to prepare furrows with additional effort, or to invest in drip or sprinkle irrigation. Drip and sprinkle irrigation can fundamentally change irrigated agriculture practices by increasing water use efficiency (Postel, 1999).

The decisions regarding crop type and on-farm irrigation method are also indicators of farmers' alignment with environmental change. For instance, farmers can align with soil salinization by changing the crop type (e.g. by switching to salt-resistant or salt-tolerant crops) or by changing their on-farm irrigation method (e.g. by switching to an irrigation method that saves water). However, the very nature of environmental change can differentiate the farmers in terms of their degree of alignment. It can be expected that all farmers would want to protect the land from salinity and to act when salinization occurs. However, they can have divergent perceptions about the severity of the problem and lack the ownership or capability to solve the problem. Similarly, farmers with large sizes of land are likely to be less vulnerable to the economic impacts of salinized soils than the smallholder farmers, who usually lack working capital that can be used as back-up.

CASE STUDY BACKGROUND

Agriculture in Turkey: from developmentalism to neoliberalism

Turkish agriculture has been undergoing a transition from developmentalism to a free-market economy. This transition affects all stakeholders of agriculture, and implies changing conditions for farmers, especially smallholders, who are the majority of agricultural producers in Turkey. There are about 3.1 million agricultural holdings, 70% of which are smaller than 5 ha (TurkStat, 2010).

During both the Ottoman era (until 1923) and the early republic era (between 1923 and 1950), the smallholders remained independent, since the land was an abundant source (Keyder, 1983a). The independence of the peasantry during the Ottoman era is explained by the state's choice to protect its fiscal base and political legitimacy (İslamoğlu-İnan, 1991), as well as an underlying motive to prevent the formation of 'rival nodes of authority' such as landlords (Keyder, 1991). This independent peasantry idea is, however, inapplicable to eastern and south-eastern regions of Turkey, where the landlords (called *ağa* in Turkish) have always been dominant due to feudal class relations. As the empirical analysis in the following sections reveals, the legacy of these relations persists today.

The Turkish state adopted national developmentalism between 1950 and 1980 (Keyder and Yenal, 2011). During this era, investments in irrigation began and the State

Hydraulics Works (Devlet Su İşleri, hereafter DSI) was established with the mandate of developing water resources. In the 1980s, neoliberal ideas were introduced in terms of irrigation management and agricultural production. Changes in agricultural production included eliminating subsidies on inputs and credits, and restructuring or privatizing the parastatal agencies and cooperatives (Aydın, 2002, 2010; Keyder and Yenal, 2011). Governments, however, still continue to support farmers through several financial instruments, such as the direct income support, 'deficiency payments' to increase the production of crops with a supply deficit, 'compensatory payments' to encourage shifting from crops with a supply surplus to other crops, and the area-based payments for soil analysis and agricultural inputs.

The neoliberal turn in Turkish agriculture can be seen as a deagrarianization process, implying the decline of share of agriculture in national income (Aydın, 2010; Keyder and Yenal, 2011). Despite the ongoing support policies, farmers increasingly face the capitalist system through their involvement in multiple markets, such as buying agricultural inputs and selling their harvest. The welfare of farmers, especially smallholders, has been deteriorating since input costs increase under free-market conditions, whereas crop prices do not increase proportionally (Aydın, 2002; Keyder and Yenal, 2011). Furthermore, farmers have suffered from unequal exchange relations such as price fluctuations and uncertainties in foreign markets (Keyder and Yenal, 2011). Aydın (2010) argues that through liberalization and globalization, Turkish agriculture favours capitalist producers, such as agribusinesses, rather than smallholders.

In sum, Turkey's neoliberal discourse emphasizes economic growth that is applied to the agricultural sector by a transformation to intensified production and expanded irrigation. However, the long-term consequences on the economy and society are ignored (Aydın, 2002). Additionally, the expansion and intensification of irrigated agriculture lead to negative environmental impacts, which increasingly worsen, yet remain neglected (Oskam *et al.*, 2004; Organization for Economic Cooperation and Development (OECD), 2008). The environmental dimension of sustainability often gets lost within the fragmented sectoral policies, which is also demonstrated by the low degree of alignment among the relevant policy sectors of irrigated agriculture (Özerol *et al.*, 2012).

Irrigated agriculture in the Harran Plain

Harran Plain is 225 000 ha in area (Isgin, 2006), and has average annual rainfall of 364 mm and evaporation of 1884 mm (Kendirli *et al.*, 2005). This vast semi-arid plain witnessed the rise and fall of many Mesopotamian civilizations that relied on irrigated agriculture for survival (Hillel, 2000). The abundant waters and the fertile soils of the Euphrates and Tigris rivers gave life to those civilizations. However, none of them could escape collapse due to the devastating consequences of their irrigation practices, particularly sedimentation and soil salinization (Jacobsen and Adams, 1958; Postel, 1999). Despite the historical disasters experienced after ignoring the negative impacts of irrigated agriculture, recent developments indicate that the farmers and the soils of the Harran Plain may take the same undesirable path once more.

Since the 1980s, investments have been made to introduce surface irrigation within the scope of the South-eastern Anatolia Project (Güneydoğu Anadolu Projesi, hereafter GAP), a multi-sectoral regional development programme implemented in the south-eastern region of Turkey (See Figure 2). The region covers 10% of both the total area and population of Turkey as well as 20% of the total irrigable land. A significant portion of the Kurdish and Arabic communities in Turkey lives in this region, while Kurds are the majority ethnic group (Akşit and Akçay, 1997; Harris, 2006).[1]

In terms of socio-economic indicators such as income per capita, literacy and infant mortality, the south-eastern region was considered as less 'developed' than the other regions (Ünver, 1997). Therefore, closing the socio-economic development 'gap' with the other regions of Turkey was a major motivation behind GAP, which was designed to encourage large-scale intensive agriculture by state-driven technical change in multiple sectors (Morvaridi, 1990).[2] Irrigated agriculture is a key investment sector for the state that maintains the legacy of developmentalism in the GAP region. The ultimate goal is to construct infrastructure to irrigate 1 066 000 ha of land, of which 147 887 ha are included in the Harran Plain (DSI, 2014).

The irrigation water is supplied from the Atatürk Dam, which is on the Euphrates River and is the largest dam in Turkey. Construction of the Atatürk Dam was completed in 1992 and irrigation with surface water began in 1995. Water is distributed through a large-scale irrigation network of concrete canals. Most irrigation canals are open, despite the high evaporation rates in the region. However, starting from 2000, subsurface piped systems, which increase construction costs, yet improve water use efficiency, were constructed by the DSI. Regarding on-farm irrigation, the most common methods are flooding and furrow, but a few farmers installed drip and sprinkle systems after the Ministry of Agriculture introduced in 2005 a subsidized credit for these water-saving irrigation methods.

The transition from small-scale rain-fed agriculture to large-scale irrigated agriculture led to many changes. Before the spread of large-scale irrigation, the primary crops were wheat, lentils and barley, and many farmers had supplemental or alternative sources of income such as sheep and goat herds (Harris, 2008). Cotton was hardly cultivated before large-scale irrigation was introduced (Ünver, 1997). However, it became the

Figure 2. Map of Turkey and the south-eastern Anatolia region. Source: Adapted from Kendirli *et al.* (2005)

dominant crop, followed by wheat and maize, although the planners of GAP had foreseen its share as 25% (Devlet Planlama Teşkilatı (DPT), 1989). At the regional level, income levels increased and social conditions improved (Ünver, 1997; Miyata and Fujii, 2007). A major social change, which is partly attributed to GAP and to participatory irrigation management, is the gradual dissolution of tribalism and landlordism, both of which entailed a hierarchical and unequal social structure that had prevailed in the region for centuries (Akşit and Akçay, 1997; Miyata and Fujii, 2007). The increasing number of middle-size farmers, who own 15–40 ha of land, and the decreasing number of landless farmers indicate this social change (Akşit and Akçay, 1997; Miyata and Fujii, 2007). However, social differentiation in terms of gender, landownership and ethnicity has also increased after switching to large-scale irrigation, implying that certain groups such as women, landless farmers and Kurds feel left out of the decisions and benefits associated with irrigation (Harris, 2006, 2008).

While the irrigation water and infrastructure remain state property, the DSI encourages participatory irrigation management by transferring the operation and management responsibility to the water user organizations (WUOs). Despite their promises for farmers' involvement in decision-making, the contribution of large-scale irrigation and participatory irrigation management to 'democratization' is questioned, for instance, due to a lack of involvement by disadvantaged groups such as women and smallholder farmers (Harris, 2005; Kadirbeyoğlu, 2008). The effective functioning of WUOs is also hampered by multiple meanings given to 'participation', such as financial contributions and taking on responsibilities, and by the lack of earlier experience in participatory management mechanisms (Özerol *et al.*, 2013).

As a result of expanded and intensified irrigated agriculture, negative impacts on water and soil are also experienced. The major problems are waterlogging and soil salinization (Kendirli *et al.*, 2005; Bahçeci and Nacar, 2009; Güneydoğu Anadolu Projesi—Regional Development Association (GAP-RDA), 2010). Groundwater pollution has recently also been observed (Yeşilnacar and Güllüoğlu, 2008). Although waterlogging and soil salinity existed in the central and southern parts even before intensive irrigated agriculture, they have increased dramatically and rapidly after irrigated agriculture started in 1995 (Kendirli *et al.*, 2005). Currently, waterlogging affects 50 000 ha of irrigated land, whereas soil salinity threatens the fertility of 18 000 ha (GAP-RDA, 2010). To solve these problems, the Ministry of Agriculture started to implement a subsurface drainage project in 2009 (Bahçeci and Nacar, 2009). A recent analysis of the relationship between these problems and the multi-level institutions of participatory irrigation management demonstrates that most of the farmers have little opportunity to change the higher-level rules of irrigation management that can be conducive to alleviating the impacts (Özerol, 2013).

Case study methodology

An in-depth case study was conducted in the Harran Plain. Major data sources included semi-structured interviews, informal conversations and direct observations. Additionally,

publicly available official reports and scholarly literature were examined. The unit of analysis was the farm household, rather than the individual farmer, since the household is both the principal social unit of farming (Bernstein, 2010) and an appropriate unit of analysis for farmer decision-making (McGregor *et al.*, 2001).

For on-site data collection, the first author conducted seven site visits to Şanlıurfa, the province where the Harran Plain is located, between December 2009 and December 2011. Based on earlier collaboration that took place within the scope of a capacity-building project, seven WUOs (out of the total 27) were contacted and 31 villages were selected to reach farmers from all parts of the plain. The contact persons at the WUOs were informed about the goals of the interviews with farmers and the importance of having a representative sample in terms of all relevant attributes such as age, location, farm size, landownership, crop choice and experiences with water and soil problems. From each village, two to four farmers were interviewed either individually or as groups. In total, 72 farmers were interviewed. Since men are typically the household head, the interviewed farmers were all men except for one woman, who was the wife of a village head and joined a group interview with her husband. The opinions and knowledge of the chairpersons, managers and personnel of WUOs were also elicited through interviews and informal conversations. Table II summarizes the WUOs, villages and farmers involved in the case study.

Before the interviews, an interview guide was designed and translated into Turkish by the first author, who is a native Turkish speaker.[3] The interview guide included 45 open-ended questions that were formulated based on the factors that influence farmers' characteristics and the decisions on water and soil use (see Table I for the list of factors). Some of the questions were optional ones that could be asked or skipped depending on the earlier answers of the interviewee. Notes were taken during the interviews through filling out the tables that were prepared for each interview. After the interviews were completed, the tables were consolidated into a matrix with rows for the interviews, columns for the questions and entries for the answers. Data from the interviews with WUOs, the informal conversations and the direct observations were also used for cross-checking the farmers' answers and incorporating any additional information. After organizing the collected data, the potential answers, which were categorized during the design of the interview guide, were revised by rereading the responses to each question. The revised categories were used to code the answers. Then the characteristics, decisions and differentiation of farmers were analysed by reviewing and comparing all the answers to each question. Finally, the findings were translated into English by the first author.

RESULTS: FARMERS' CHARACTERISTICS AND DECISIONS

What do the farmers want?

Protecting the land and raising children. Land protection is a common goal for many farmers, as they inherit the land from their ancestors and therefore they want to protect the land, while maintaining its productivity, and to leave it to their children: 'The most important thing for me is to protect my fields. My children and grandchildren will live here, too. We want to have high yields without damaging the fields'; 'My goal is to get the best harvest from my field … to adapt to modern agriculture … to protect my land.'

The households are typically large, sometimes including more than 10 children. Most of the farmers, in particular the smallholders and landless farmers, want their children to be independent and to have a decent job in the city. Since they think this is possible through education, their primary concern is the education of their children. A farmer, who shares 50 ha with nine brothers, expresses his willingness for his children to receive education, which might lead them

Table II. Overview of the WUOs, villages and farmers involved in the case study

WUO code	Location in the plain	Location in the main irrigation canal	Irrigation system	Number of villages[a] (included/total)	Number of farmers[b] (interviewed/total)
WUO-1	Middle	Downstream	Open	3/14	11/600
WUO-2	North-west	Upstream	Open	4/9	13/800
WUO-3	West	Downstream	Open	5/19	9/400
WUO-4	North	Downstream	Open	5/22	12/1100
WUO-5	South	Downstream	Open	5/31	8/2700
WUO-6	East	Downstream	Open	6/18	10/650
WUO-7	North	Upstream	Closed	3/13	9/1600

[a]Values for the total number of villages were provided by the WUO managers, and may not match with the exact figures. Several WUOs also have irrigated land in one or two towns, which are also counted as local units.
[b]Values for the total number of farmers were provided by the WUO managers, and may not match with the exact figures. The number of interviewed farmers includes the members of WUO staff and top management, who are farmers at the same time.

to quit farming: 'I am just a caretaker of the soil. My children are more important than anything else is. If only they can get an education and stand on their own feet … Farming is not a settled system. How far can it go?'

Earning more income. As Figure 3 shows, 55% of the farmers have crop production as their only income source, whereas many farmers also have additional income sources such as a trade, salary from other jobs, retirement pensions, seasonal work and livestock.[4]

To earn more income from crop production, farmers maximize their revenue and minimize their costs (Gomez-Limon *et al.*, 2004). The revenue from crop production depends on the type of the crops cultivated and the price of the crop. Regarding crop type, farmers are free to cultivate any crop, except those with regional quotas, such as sugar beet, tobacco and opium. As Figure 4 shows, the crop pattern is dominated by cotton, wheat and maize, whereas barley and lentil are chosen by a much smaller number of farmers. The remaining crops included in the 'other' category consist mainly of vegetables, such as tomatoes and peppers, and perennial crops such as pomegranates, olives and grapes, with one farmer practising arboriculture.

Crop-based agricultural supports, which directly increase farmers' income, influence the crop pattern. Farmers receive deficiency payments for maize, wheat and cotton, and area-based supports for inputs such as fertilizer and fuel. As explained by a farmer, the deficiency payments for cotton, which can be sufficient to pay the costs of major inputs, makes cotton the dominant crop in the plain: 'We wouldn't cultivate cotton if there was no [agricultural] support. The [agricultural] supports cover the costs of fertilizers, pesticides, fuel, seeds and the irrigation fee. In the past, we used to have nothing left after paying for the inputs.'

Figure 3. Additional income sources.

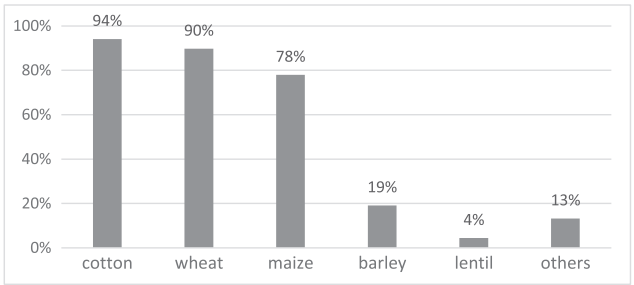

Figure 4. Crop choices.

Through their crop choice, farmers align with free-market conditions, as the crop prices in a given year affect the farmers' choice for the following year. Since they cannot influence prices, farmers maximize their revenue by cultivating the crop(s) that are eligible for the deficiency payment in the current year and had a high price in the previous year and applying for all the available agricultural supports. A farmer explains his crop-choice rationale, with which many others agree: 'We calculate and choose whichever brings more money. This year [the price of] cotton has risen. We will cultivate cotton next year.'

Besides responding to crop prices, farmers align with free-market conditions also by managing the marketing risk. When deciding on which crop to grow, they avoid the risk of being unable to sell the harvest. Almost all the farmers cultivate crops that they can sell in Şanlıurfa. They tend to choose seasonal and annual crops (such as cotton, cereals and maize) over perennial crops (such as fruit trees), since the former brings income within a year, whereas investing in the latter may require waiting for 4–5 years before the first harvest. A few farmers grow orchards or practise arboriculture, which also imply higher risks in terms of both marketing and climate conditions. Therefore, it is usually the landowners that make such investments and demonstrate risk-accepting behaviour in their crop choices. Landownership status also affects the farmers' choice between perennial and non-perennial crops (Fraser, 2004). It is impossible, in particular for the smallholder and landless farmers, to switch to perennial crops such as olives and pomegranate, which bring higher incomes compared to many seasonal and annual crops.

What do the farmers see?

Quantitative indicators vs qualitative judgements. Farmers in the Harran Plain have qualitative judgements that can be as valuable as the quantitative monitoring of water and soil indicators by governmental agencies. Farmers are, however, not informed about the results of the monitoring activities conducted by governmental agencies. A farmer explains the situation: 'The groundwater table is higher compared to before. In the old artesian wells, the level is six meters. DSI measures [the groundwater table level]. It is said that the DSI does it. They come unannounced and control the levels and the salinity.'

Since the amount of water used by each farmer is neither metered nor used to calculate the irrigation fees, the farmers do not monitor how much water they use (Özerol, 2005). However, the farmers keep track of their irrigation frequency. For instance, some farmers state that they used to irrigate the cotton 10–12 times before, whereas they have irrigated fewer times over the recent years. These farmers attribute the decrease in their irrigation frequency to their increased awareness of the adverse effects of excess water use, which they gain by observing the waterlogging and soil salinity problems in the fields. Similarly, farmers observe the change in groundwater quality. Some farmers state that the groundwater became bitter after they started to use surface water for irrigation and they attribute this change to the pollution of water due to salt intrusion. Some of them also experience lower yields, which they attribute to the rise of the groundwater table and/or salinization.

'Knowing' vs 'owning' the problems. A recent survey among the cotton producers in the Harran Plain revealed that education and training influence their awareness of the relationship between water use and salinity, and the degree of awareness influences the capacity to engage in collective action to address the salinity problem (Adaman and Özertan, 2007). Another study demonstrated that farmers and state agents agree on the existence of negative environmental impacts, whereas opinions about the causes diverge; state agents and large landowners attribute the impacts to farmers' illiteracy and lack of training, whereas other farmers associate the impacts with incomplete on-farm development and drainage services (Harris, 2009).

Almost all the farmers interviewed know that waterlogging and salinity problems partly result from excessive water use and that drip and sprinkle irrigation can reduce the impacts. They also know that these methods cannot be applied with the existing open canals, since the pressure which is needed to extract the water from the canal and to transfer it to pipes, requires an additional investment. However, they do not associate these problems with their crop choices, although especially cotton is a highly water-intensive crop, and choosing crops with lower water requirements could save water. Two other factors that influence farmers' water use are the provision of water without monitoring water use at the plot and farm levels and the accrual of irrigation fees based on crop type and irrigated area (Özerol, 2013). Thus, even if the farmers are aware of the problems, the current system for water monitoring and pricing does not create any incentives for farmers to save water.

Despite their awareness about the water and soil problems, most of the farmers do not see themselves as the owner of those problems. When asked the questions 'Who is capable of solving your problems about farming?' and 'Who is responsible for sustaining irrigated agriculture?' most of the farmers mention the state or governmental organizations. This is also demonstrated by their lack of involvement in relevant efforts such as the subsurface drainage project that was implemented by the Ministry of Agriculture. Subsurface drainage is a collective activity requiring farmer participation and contribution (Ritzema *et al.*, 2008). However, the farmers in the Harran plain are detached from the decision-making processes and financial burden of the project. Although they are aware of the need for adequate on-farm drainage, they expect solutions from the state, in particular the Ministry of Agriculture, which has always been protectionist towards the farmers, and the DSI, which holds the property rights of irrigation infrastructure.

Contextualizing the technical knowledge. One of the reasons for cotton becoming the most preferred crop is farmers' technical knowledge of growing cotton. Some farmers, especially the smallholders and the landless, worked in other regions of Turkey, such as Çukurova, which is another vast plain irrigated since the 1960s, with cotton being the major crop. Akşit and Akçay (1997) report that 45% of the farmers in the GAP region gained knowledge in Çukurova while working there as labourers to grow cotton. Farmers can apply the knowledge they acquired in their region. However, soil characteristics and climate conditions are significantly different in the Harran Plain, which is more prone to waterlogging and salinization. With the threat of soil salinity, training and extension services to inform farmers are essential in modifying crop choices and cropping intensities (Kijne *et al.*, 1988; Adaman and Özertan, 2007). Some farmers acknowledge this need: 'If the officials from the Ministry of Agriculture come to our village and install demonstration fields and show us how to grow other crops, we can believe that it is possible to grow those plants here.'

What do the farmers have?

Land. In the GAP region, land is unequally distributed; approximately 40% of farmers are landless and 66% of them own fewer than 10 ha (GAP-RDA, 1999). Within the scope of the agrarian reform, which has been implemented since the 1970s, state-owned land was sold to landless and smallholder farmers for a nominal price and on a long-term repayment scheme. Some farmers, especially in the southern parts of the plain, purchased land through this scheme, which significantly decreased the number of landless farmers. However, the size of the land these farmers can acquire is limited to a maximum of 5 ha per family, which is insufficient even for subsistence farming levels.

After irrigated agriculture expanded, various sharecropping and land-renting arrangements developed in the region (Akşit and Akçay, 1997). Landless and smallholder farmers, who need additional land to have sufficient income, usually rent land from landlords. Thus, they are 'tenant farmers'. Sharecropping is a viable option for landless farmers as they can get 30–40% of the income from the land that they work on. Another common option is to work as a seasonal worker. Neither sharecroppers nor seasonal workers have a say about crop choice, whereas tenant farmers can choose between seasonal and annual crops. Regarding the decision about on-farm irrigation method, only the landowner can choose to shift to drip or sprinkle irrigation, since it implies a long-term investment.

As Bernstein (2010) suggests, 'landless labour', 'tenant farmers' and 'small peasants' are fluid and ambiguous categories, since people can quickly switch between being a labourer and a tenant, or belong to two categories at the same time. In the Harran Plain, smallholders often cultivate leased land, which is sometimes larger than their own land. Furthermore, many sharecroppers and tenant farmers do not own any land, yet cultivate varying sizes of land every year. Thus, the size of 'owned' land is sometimes significantly different from the size of 'cultivated' land. Figure 5 summarizes the landownership status of the interviewed farmers, demonstrating that 41% of the farmers are landowners, whereas 7% of them do not own any land, and therefore they rent land from other farmers or do sharecropping, The remaining 52% of farmers are both landowners and rent additional land and/or do sharecropping. Since some of the farmers rent land and do sharecropping irregularly, the proportion of farmers that are in this 'mixed' category can change from one year to another.

In addition to the dynamic conditions related to renting and sharecropping, approximately 30% of the farmers interviewed are members of households where the parents and a number of siblings, which varies from 2 to 20, do farming together. Additionally, many families have more than five children, implying that if they stay in farming for another generation, the land size per farmer will be too small to continue economically. Due to the difficulty of determining the land size owned by each farmer, the distribution of land size is calculated per household, which is shown in Figure 6.

As Figure 6 shows, the highest proportion of households (22%) is those owning land of size less than 5 ha. The proportion of farmers that own less than 10 ha amounts to a total of 39%, which is significantly lower than the regional average of 66% (GAP-RDA, 1999).

As the size of the owned land increases, farmers benefit from 'economies of size', which means that compared to smallholders the large landowners receive higher incomes and incur lower costs per hectare (Thompson *et al.*, 2007, p. 33). These economies of size are also valid in the Harran Plain. Large landowners can cultivate both perennial and annual crops or do rotational cropping by cultivating multiple crops in several plots and rotating the crop type in successive years. This way they create a 'multi-crop basket' and lower the loss risk in a given year. On the other hand, crop rotation is usually impossible for smallholders. If the price of a crop is low in a given year, the loss risk is higher for cultivating that single crop than cultivating multiple crops. Consequently, crop rotation is limited to rotating between cotton and wheat, and sometimes including maize as a second crop after wheat.

Financial assets. Farmers' main financial assets include working capital, credits, social insurance and the agricultural machinery and equipment that they own. In the Harran Plain, farmers' financial assets are directly related to the size of the land that they own. None of the large landowners suffers poor financial conditions or lack machinery and equipment. Many large landowners have supplementary income sources such as livestock farming, rent income from real estate, other businesses in the town or city, and retirement pensions. Conversely, farming is the only income source for many smallholder and landless farmers and they have difficulty in

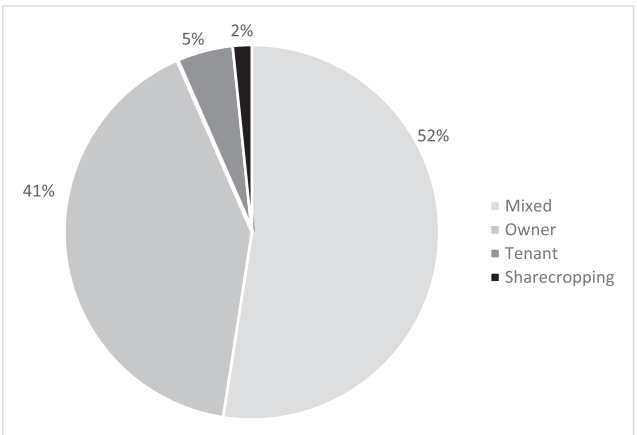

Figure 5. Landownership status.

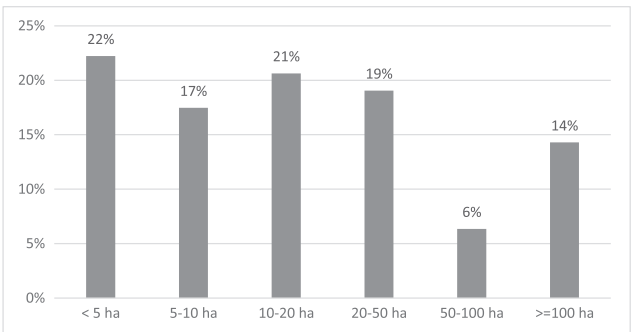

Figure 6. Land size per household.

getting finance and usually have debts. A smallholder farmer summarizes how he manages cash flow: 'What comes from the [agricultural] supports goes to the debts.'

The Ministry of Agriculture provides subsidized credits for drip and sprinkle irrigation systems. However, few farmers apply for these credits. Incentives are necessary to convince the poor farmers in particular to invest in such water-saving technologies, since they tend to be risk-averse and not willing to invest if the payback period is longer than a year. Tenants do not invest in drip and sprinkle irrigation, because they neither own the land nor expect the investment to pay off during the tenancy period. Since renting land implies additional costs, the tenants are also financially disadvantaged. The landowner might choose to receive the supports by not making an official lease contract, since the tenant is eligible for the supports only if the landowner and the tenant make a lease contract.

Farmers can apply for the ordinary agricultural credits or the subsidized credits for drip and sprinkle irrigation systems, organic agriculture, good agricultural practices, and agricultural machinery and equipment. For both credit types, accessibility is low, in particular for smallholders and landless farmers, who rarely own sufficient assets to use as collateral. Usurers cover the working capital deficit of many farmers by lending to them at a higher interest rate than the banks.

Power relations and social networks. The power that the farmers attribute to themselves and the power that they attribute to other farmers or actors are the two aspects of power. These aspects are manifested in the power asymmetry among the farmers in terms of both their access to resources such as water, money, information and public services as well as the size and diversity of their social network (Amichi *et al.*, 2012).

In the GAP region, the social structure has been shifting from a tribal hierarchy to peer relationships (Miyata and Fujii, 2007). Most of the landless and smallholder farmers can access governmental organizations, whereas the landlords, who are in some cases the leaders of local tribes, have easier access to resources. A landless farmer expresses his frustration regarding his lack of power in terms of access to financial means and relations with the WUO: 'The poor cannot get any credit; but the mafia and those who have an uncle … We have soil problems, mostly salinization. No measures are taken. It gets worse. There should be drainage. They did it on the other side [of the canal]. The irrigation association [WUO] has the machinery, but when we want it, they don't bring it until we get sick and tired.' Similarly, a smallholder farmer, who purchased land with the agrarian reform in the south (downstream) part, adds his concern over unequal access to water, which is attributed to the existence of powerful landlords: 'Water is not sufficient. We withdraw water from the discharge [canal]. Even if it is sufficient, there are many ağas.'

The size and diversity of social networks are manifestations of social power, and farmers also differ in terms of these aspects. The network of landlords extends to all levels of decision-making, whereas the smallholder and landless farmers have difficulty in reaching the higher levels. A landless farmer complains: 'The government says they opened the doors, but they have a hundred excuses.'

DISCUSSION: THE ALIGNMENT AND DIFFERENTIATION OF FARMERS

Answers to the three questions on characteristics show that the farmers of the Harran Plain constitute a heterogeneous group in terms of their characteristics and alignment with agri-environmental changes. However, the degree of differentiation among the farmers is not the same for all three characteristics.

In terms of 'what they want', the farmers possess similar features, with slight differentiation on their risk assessments. They have common goals such as earning more income, protecting their land and raising their children. Few farmers find their conditions sufficient to achieve their goals, whereas others complain about the lack of attention from governmental organizations and the unfair situation that some can get 'whatever' they want, whereas others cannot. Many smallholder and landless farmers do not see a better future in farming and prepare the next generations to shift from a rural to an urban life, whereas none of the large landowners consider such a shift an option. According to their motivations, farmers are also slightly differentiated. For almost all farmers, the objective of earning more income leads to choosing high-price crops. Regarding their risk attitude in crop choice, most of them are risk-averse and stick to the easily marketable and state-supported crops, whereas a few farmers take risks, for instance by growing fruit trees or practising arboriculture.

Farmers are also similar in terms of 'what they see', despite differences in terms of their feeling of ownership about solving water and soil problems. Most of the farmers have a qualitative judgement about the indicators of waterlogging and salinity. If these judgements are taken into account, the results from monitoring of sustainability indicators, such as the groundwater table level and the salinity of water and soil, can reflect farmers' perspectives and create opportunities for learning through the communication of monitoring and evaluation results (Pannel and Glenn, 2000). Local arrangements such as the lack of water-use monitoring at the farm and plot levels and the accrual of irrigation fees based on crop type and irrigated area (rather than water quantity), distort farmers' perception regarding water scarcity. Given

the transboundary nature of the Euphrates River and the ongoing irrigation projects in other parts of the GAP region, it is likely that less irrigation water will be available in the long term. However, the farmers do not reflect on how water availability may change in the future. Although they are aware of water and soil problems, most of the farmers demonstrate little ownership of the solutions, which they often expect from the state. This can be seen as a legacy of state-driven development in the region, which excludes farmers from planning and decision-making processes (Harris, 2009).

Despite the comparably homogeneous characterization in terms of what they want and see, the farmers are significantly differentiated as to 'what they have'. Clear divisions can be identified in terms of financial capacity, power attribution and network range. Farmers with a diverse set of financial assets and supplementary income sources often have no debts and maintain a good financial status, and therefore are more likely to decide to invest in water-saving methods or perennial crops, or to grow salt-resistant or salt-tolerant crops. Such decisions imply better alignment with agri-environmental changes than the decisions of farmers that lack diverse financial assets or supplementary income sources. Similar differentiation mechanisms regarding power attribution and network range are revealed. These two aspects differentiate the farmers with regard to access to resources such as water, money, information and public services as well as to the actors at higher decision-making levels. In particular, landlords are differentiated from the other farmers, who see the former as capable of solving their problems themselves or getting support from actors at higher levels of decision-making.

Although the characteristics of landlords are different from other farmers, caution is needed when using land size as an indicator of further differentiation. Regarding financial assets, access to credit and to information about credit options is important especially for smallholder farmers to prevent them losing their land, which is their only income source (Hedden-Dunkhorst, 2002). However, landless and smallholder farmers have limited access to credit due to the strict requirements and they tend to borrow from usurers. Farmers' indebtedness is increasing in other regions of Turkey (Keyder and Yenal, 2011). It is also common in the Harran Plain and can lead to chronic financial problems. Overcoming such asymmetric power relations is not straightforward as long as some farmers benefit from them (Theesfeld, 2011). However, both national policies and local arrangements neglect the power asymmetry that works against disadvantaged farmers.

Farmers' differentiation resonates in their decisions about crop type and on-farm irrigation method. The probability of choosing the market/supported crops is high for almost all farmers. However, a few of them that have technical knowledge, financial assets and land can choose alternative crops. These farmers can allocate one or more plots to alternative crops or rotate between multiple crops. Regarding on-farm irrigation methods, switching to water-saving methods, which can alleviate waterlogging and salinity problems, is easier for farmers that are able to plant different crops on different plots. However, it is out of question for most farmers to switch to drip or sprinkle irrigation due to the difficulty of making a long-term investment under conditions of insufficient working capital and credit. It should be noted that the economic incentive to switch to water-saving methods is low for all farmers, since the quantity of water used at farm level is neither monitored nor incorporated into the irrigation fee. According to the differentiation of farmers with respect to their degree of alignment with agrarian and environmental changes, the following categorization is proposed:

- unaligned farmers that have a low degree of alignment with agrarian change, environmental change or with both types of changes;
- transient farmers that have a medium level of alignment with agrarian change and environmental change;
- aligned farmers that have a high degree of alignment with agrarian change and environmental change.

Easily observable criteria, such as age and education level, are not used to create the above categorization. Instead, the three aspects that shape farmers' decisions are taken into account, i.e. what the farmers have, want and see. As the farmers' degree of alignment with agrarian change increases by being integrated into the capitalist system of agricultural production, the factors regarding 'what the farmers have' become the key drivers of differentiation. Farmers that own large sizes of land and sufficient financial assets are also often advantaged regarding power relations and social networks, making them more likely to be among the aligned farmers, whereas the smallholders, who often also rent land and do sharecropping, are likely to be in the transient category. The landless farmers, on the other hand, are likely to be unaligned with agrarian and environmental change, as they often have limited financial assets and are disadvantaged regarding power relations and social networks.

The other two aspects ('what the farmers want' and 'what the farmers see') are also relevant for farmers' alignment. More importantly, they constitute the stepping stones of farmers' differentiation in terms of aligning to environmental change. This happens through two mechanisms. Firstly, the farmers can adapt to negative environmental impacts by switching to alternative crops or water-saving irrigation methods. Secondly, they can be involved in the processes for preventing further water and soil degradation, such as the construction and maintenance of subsurface drainage systems. Facilitating these mechanisms would require both economic and knowledge-based incentives for different

types of farmers. For instance, cultivating alternative crops would imply modified water-use behaviour and diversified income opportunities, along with risks related to the growing and marketing of those crops. In order to change their crop patterns towards alternative crops, some farmers, especially smallholders, who do not have multiple plots, and families that have been growing the same crops for generations, need both additional economic incentives, such as subsidies, and additional technical knowledge for mitigating production and marketing risks.

A final word of caution about the three categories is that they should not be seen as mutually exclusive. There can be overlaps and exceptions, particularly in transient farmers, who are likely to share certain characteristics of the other two categories, and can fall into another category in the future. Nevertheless, an aligned group, that has access to resources and information and is resilient to negative environmental impacts, and an unaligned group, bound to less environmentally sustainable crop choices and irrigation methods, can be discerned. The transient farmers deserve particular attention since the farmers in this category are likely to shift towards sustainable choices about crops and irrigation methods, once they have improved conditions. Given that many farmers expect their children to shift to a non-farming activity, these farmers can also aim for intensification and increased productivity. Accordingly, the three categories can be utilized as a comparative scheme of how various compositions of farmers' characteristics lead to varying decisions about crop production and resource use, in particular choosing crop type and on-farm irrigation method.

CONCLUSIONS

This paper analysed farmers' characteristics and their decisions in irrigated agriculture in relation to broader agri-environmental changes, and assessed the farmers' differentiation in terms of their alignment with these changes. Three categories are identified in terms of farmers' degree of alignment: unaligned, transient and aligned. These categories are based on farmers' interactions with the governance system and the agroecosystem through their decisions about water and soil use and crop production.

In his analysis of the Turkish agrarian structure between 1950 and 1980, Keyder (1983b) identified three transformation paths: subsistence farming, subordinate commercialization, and family farms. He defines capitalist farming as the fourth *transitional* path, which is specific to eastern and south-eastern Turkey due to the existence of landlords. Keyder (1983b) predicted that capitalist farming would dissolve into family farms due to the mismanagement of farms and the fragmentation of land through inheritance. Keyder's prediction came partly true, since there are still landlords as well as landless farmers in the region, and many farmers became sharecroppers or seasonal workers (Akşit and Akçay, 1997). Our empirical findings from the Harran Plain indicate that after switching to large-scale irrigation in the 1990s through state investment, there is a transition to an even more capitalist farming. This type of farming involves exposure to free-market conditions, reliance on irrigation, agrochemicals, machinery and equipment for intensive production, and finally the prevalence of economies of size that favour large-scale agricultural production. This agrarian change implies increased differentiation in terms of access to physical, financial and social resources. As a result, farmers with different degrees of alignment with agri-environmental changes tend to have different relations with the capitalist system. Aligned farmers benefit from large-scale irrigation and possess the power and resources to continue capitalist farming under agri-environmental changes, whereas unaligned farmers experience limited benefits from agrarian change and are vulnerable to the long-term impacts of environmental change. Many farmers in the 'unaligned' category also lack optimism about reaching their goals. Policy instruments such as subsidized credits for drip and sprinkle irrigation, organic agriculture and good agricultural practices aim to alleviate the negative environmental impacts of irrigated agriculture. However, the unaligned farmers have very limited alternatives regarding crop type and on-farm irrigation method. The policies that neglect farmers' differentiation implicitly exclude the unaligned farmers from their target population. If their alignment with agri-environmental changes cannot be improved, these unaligned farmers are likely to shift to non-farming activities in the near future.

The findings of this paper pinpoint the differential relationship between agri-environmental changes and farmers' decisions, which implies a significant contribution to the analysis of the political and ecological aspects of irrigated agriculture. From the political perspective, it can be concluded that the farmers are differentiated in terms of the distribution of the costs and benefits of agrarian change. This differentiation is mainly attributed to the factors regarding 'what the farmers have', namely landownership status, land size, access to financial resources, power attribution and network range. The paper also reveals how the farmers are differentiated in terms of the relationship between their decisions and the environmental change. Apart from the significant role of the factors related to 'what the farmers have', one factor related to 'what the farmers want', i.e. risk attitudes, and two factors related to 'what the farmers see', i.e. problem ownership and technical knowledge, play a role in this second type of differentiation that implies a variety in the degree to which the farmers align with environmental change. Such an analysis is valuable for evaluating national policies that often underestimate the differential implications of agri-environmental changes at the local level by

promoting and emphasizing the aggregate benefits at regional and national levels.

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REFERENCES

Adaman F, Özertan G. 2007. Perceptions and practices of farmers towards the salinity problem: the case of Harran Plain, Turkey. *International Journal of Agricultural Resources, Governance and Ecology* **6**: 533–551.

Akşit B, Akçay A. 1997. Sociocultural aspects of irrigation practices in south-eastern Turkey. *Water Resources Development* **13**(4): 523–540.

Amichi H, Bouarfa S, Kuper M, Ducourtieux O, Imache A, Fusillier JL, Bazin G, Hartani T, Chehat F. 2012. How does unequal access to groundwater contribute to marginalization of small farmers? The case of public lands in Algeria. *Irrigation and Drainage* **61**(S1): 34–44.

Anderies JM, Janssen MA, Ostrom E. 2004. A framework to analyze the robustness of social-ecological systems from an institutional perspective. *Ecology and Society* **9**(1): 18.

Aydın Z. 2002. The new right, structural adjustment and Turkish agriculture: rural responses and survival strategies. *The European Journal of Development Research* **14**(2): 183–208.

Aydın Z. 2010. Neo-liberal transformation of Turkish agriculture. *Journal of Agrarian Change* **10**(2): 149–187.

Bahçeci İ, Nacar AS. 2009. Subsurface drainage and salt leaching in irrigated land in south-east Turkey. *Irrigation and Drainage* **58**: 346–356.

Bernstein H. 2010. *Class Dynamics of Agrarian Change*. Fernwood Publishing: Halifax and Winnipeg/Kumarian Press: Sterling,VA.

Borras SM Jr. 2009. Agrarian change and peasant studies: changes, continuities and challenges—an introduction. *Journal of Peasant Studies* **36**(1): 5–31.

Bressers H. 2009. From public administration to policy networks: contextual interaction analysis. In: *Rediscovering Public Law and Public Administration in Comparative Policy Analysis: Tribute to Peter Knoepfel*. Nahrath S, Varone F (eds). Haupt Verlag: Lausenne/Berne; 123–142.

Briggs J. 1985. An exploratory study of farmers' choice of crops in Central Sudan. *Transactions of the Institute of British Geographers* **10**(2): 170–180.

Devlet Planlama Teşkilatı (DPT). 1989. *The Southeastern Anatolia Project Master Plan Study—Final Master Plan Report*. DPT: Ankara, Turkey.

Devlet Su İşleri (DSI). 2014. *2014 Yılı Faaliyet Raporu* (Annual Report for 2014). http://www.dsi.gov.tr/docs/stratejik-plan/dsi-2014-faaliyet-raporu.pdf?sfvrsn=2

Evenson RE, Gollin D. 2003. Assessing the impact of the green revolution, 1960 to 2000. *Science* **300**: 758–762.

Falkenmark M, Galaz V. 2007. Agriculture, water and ecosystems. Swedish Water House Policy Brief 6. Stockholm International Water Institute.

Faysse N, Petit O. 2012. Convergent readings of groundwater governance? Engaging exchanges between different research perspectives. *Irrigation and Drainage* **61**(S1): 106–114.

Fraser EDG. 2004. Land tenure and agricultural management: soil conservation on rented and owned fields in southwest British Columbia. *Agriculture and Human Values* **21**: 73–79.

Gladwin CH. 1989. *Ethnographic Decision Tree Modelling* Qualitative Research Methods, **19**. Sage: London.

Gomez-Limon JA, Riesgo L, Arriaza M. 2004. Multi-criteria analysis of input use in agriculture. *Journal of Agricultural Economics* **55**(3): 541–564.

Gomez-Limon JA, Berbel J, Arriaza M. 2007. MCDM farm system analysis for public management of irrigated agriculture. In: *Handbook of Operations Research in Natural Resources*. Weintraub A, Romero C, Bjørndal T, Epstein R, Miranda J (eds). Springer: New York; 93–114.

Gordon LJ, Finlayson CM, Falkenmark M. 2010. Managing water in agriculture for food production and other ecosystem services. *Agricultural Water Management* **97**: 512–519.

Greig L. 2009. An analysis of the key factors influencing farmer's choice of crop, Kibamba Ward, Tanzania. *Journal of Agricultural Economics* **60**(3): 699–715.

Güneydoğu Anadolu Projesi—Regional Development Association (GAP-RDA). 1999. *South-Eastern Anatolia Project Social Action Plan*. Ankara, Turkey.

Güneydoğu Anadolu Projesi—Regional Development Association (GAP-RDA). 2010. *Harran Ovası Tuzluluk Haritasının Oluşturulması Ve Tuzlulaşmanın Bitkisel Verim Kayıplarına Etkisinin Tahmini* [Salinity Mapping of Harran Plain and the Estimation of the Salinity Effect on Plant Yield Losses]. Şanlıurfa, Turkey.

Hall AW. 1999. Priorities for irrigated agriculture. *Agricultural Water Management* **40**: 25–29.

Harris LM. 2002. Water and conflict geographies of the Southeastern Anatolia Project. *Society & Natural Resources* **15**(8): 743–759.

Harris LM. 2005. Negotiating inequalities: democracy, gender, and politics of difference in water user groups of southeastern Turkey. In: *Environmentalism in Turkey: Between Democracy and Development*. Adaman F, Arsel M (eds). Ashgate: Aldershot, UK; 185–200.

Harris LM. 2006. Irrigation, gender, and social geographies of the changing waterscapes of southeastern Anatolia. *Environment and Planning D: Society and Space* **24**: 187–213.

Harris LM. 2008. Water rich, resource poor: intersections of gender, poverty, and vulnerability in newly irrigated areas of southeastern Turkey. *World Development* **36**(12): 2643–2662.

Harris LM. 2009. Contested sustainabilities: assessing narratives of environmental change in southeastern Turkey. *Local Environment* **14**(8): 699–720.

Harris LM. 2012. State as socionatural effect: variable and emergent geographies of the state in southeastern Turkey. *Comparative Studies of South Asia, Africa and the Middle East* **32**(1): 25–39.

Hedden-Dunkhorst B. 2002. Institutional change in smallholder irrigated agriculture: a case study from South Africa. In: *Reforming Institutions for Sustainable Water Management* Neubert S, Scheumann W, van Edig A (eds). German Development Institute: Bonn.

Hillel D. 2000. *Salinity Management for Sustainable Irrigation: Integrating Science, Environment and Economics*. World Bank: Washington, DC, USA.

Isgin T. 2006. Harran Ovası sulu tarım işletmelerinde arazi ve gelir dağılımı [Income and land distribution among farm households operating under the irrigated conditions of the Harran Plain]. *Tarım Ekonomisi Dergisi* **12**(2): 59–68.

İslamoğlu-İnan H. 1991. Peasants, commercialization and legitimation of state in sixteenth century Anatolia. In: *Landholding and Commercial Agriculture in the Middle East* Keyder Ç, Tabak F (eds). State University of New York Press: Albany, NY, USA; 57–76.

Jacobsen T, Adams RM. 1958. Salt and silt in ancient Mesopotamian agriculture. *Science* **128**: 1251–1258.

Kadirbeyoğlu Z. 2008. Decentralization and democratization: the case of water user associations in Turkey. PhD thesis, Department of Political Science, McGill University, Canada.

Kendirli B, Çakmak B, Uçar Y. 2005. Salinity in the Southeastern Anatolia Project (GAP), Turkey: issues and options. *Irrigation and Drainage* **54**: 115–122.

Keyder Ç. 1983a. The cycle of sharecropping and the consolidation of small peasant ownership in Turkey. *Journal of Peasant Studies* **10**(2–3): 130–145.

Keyder Ç. 1983b. Paths of rural transformation in Turkey. *Journal of Peasant Studies* **11**(1): 34–49.

Keyder Ç. 1991. Large-scale commercial agriculture in the Ottoman Empire? In: *Landholding and Commercial Agriculture in the Middle East* Keyder Ç, Tabak F (eds). State University of New York Press: Albany, NY, USA; 1–13.

Keyder Ç, Yenal Z. 2011. Agrarian change under globalization: markets and insecurity in Turkish agriculture. *Journal of Agrarian Change* **11**(1): 60–86.

Kijne JW, Prathapar SA, Wopereis MCS, Sahrawat KL. 1988. How to manage salinity in irrigated lands: a selective review with particular reference to irrigation in developing countries. SWIM Paper 2. International Irrigation Management Institute: Colombo, Sri Lanka.

Lautze J, de Silva S, Giordano M, Sanford L. 2011. Putting the cart before the horse: water governance and IWRM. *Natural Resources Forum* **35**(1): 1–8.

McGregor MJ, Rola-Rubzen MF, Murray-Prior R. 2001. Micro and macro-level approaches to modelling decision making. *Agricultural Systems* **69**: 63–83.

Merot A, Bergez J-E, Capillon A, Wery J. 2008. Analysing farming practices to develop a numerical, operational model of farmers' decision-making processes: an irrigated hay cropping system in France. *Agricultural Systems* **98**: 108–118.

Merrey DJ, Meinzen-Dick R, Mollinga P. 2007. Policy and institutional reform: the art of the possible. In: *Water for Food, Water for Life: a Comprehensive Assessment of Water Management in Agriculture* Molden D (ed). Earthscan: London and International Water Management Institute: Colombo; 193–232.

Miyata S, Fujii T. 2007. Examining the socioeconomic impacts of irrigation in the southeast Anatolia region of Turkey. *Agricultural Water Management* **88**: 247–252.

Molden D (Ed) 2007. *Water for Food, Water for Life: a Comprehensive Assessment of Water Management in Agriculture*. Earthscan: London and International Water Management Institute: Colombo.

Mollinga P. 2010. The material conditions of a polarized discourse: clamours and silences in critical analysis of agricultural water use in India. *Journal of Agrarian Change* **10**(3): 414–436.

Morvaridi B. 1990. Agrarian reform and land use policy in Turkey: implications for the Southeast Anatolia Project. *Land Use Policy* **7**(4): 303–313.

Murray-Prior R. 1998. Modelling farmer behaviour: a personal construct theory interpretation of hierarchical decision models. *Agricultural Systems* **57**(4): 541–556.

Organization for Economic Cooperation and Development (OECD). 2008. *Environmental Performance of Agriculture in OECD Countries since 1990: Turkey Country Section*. Paris.

Oskam A, Burrell A, Temel T, van Berkum S, Longworth N, Vílchez IM. 2004. *Turkey in the European Union, Consequences for Agriculture, Food, Rural Areas and Structural Policy*. Wageningen University.

Ostrom E. 1992. *Crafting Institutions for Self-governing Irrigation Systems*. Institute for Contemporary Studies Press: San Francisco.

Özerol G. 2005. Effectiveness of indicators for sustainable water use in agriculture. MSc thesis, University of Osnabrück, Germany.

Özerol G. 2013. Institutions of farmer participation and environmental sustainability: a multi-level analysis from irrigation management in Harran Plain, Turkey. *International Journal of the Commons* **7**(1): 73–91.

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

Özerol G, Özen-Tacer A, Islar M. 2013. Public participation as an essentially contested concept: Insights from water management in Turkey. In: *Water Governance, Policy and Knowledge Transfer: International Studies on Contextual Water Management* de Boer C, Vinke-de Kruijf J, Özerol G, Bressers H (eds). Routledge: London and New York; 128–147.

Pannel DJ, Glenn NA. 2000. A framework for the economic evaluation and selection of sustainability indicators in agriculture. *Ecological Economics* **33**: 135–149.

Postel S. 1999. *Pillars of Sand*. Norton & Company: New York and London.

Ritzema HP, Satyanarayana TV, Raman S, Boonstra J. 2008. Subsurface drainage to combat waterlogging and salinity in irrigated lands in India: lessons learned in farmers' field. *Agricultural Water Management* **95**: 179–189.

Röling N. 2003. From causes to reasons: the human dimension of agricultural sustainability. *International Journal of Agricultural Sustainability* **1**(1): 73–88.

Rosegrant MW, Ringler C, Zhu T. 2009. Water for agriculture: maintaining food security under growing scarcity. *Annual Review of Environmental Resources* **34**: 205–222.

Theesfeld I. 2011. Perceived power resources in situations of collective action. *Water Alternatives* **4**(1): 86–103.

Thompson J, Millstone E, Scoones I, Ely A, Marshall F, Shah E, Stagl S. 2007. Agri-food system dynamics: pathways to sustainability in an era of uncertainty. STEPS Working Paper 4. STEPS Centre: Brighton.

TurkStat. 2010. *Statistical Indicators 1923–2009*. TurkStat: Ankara, Turkey.

Umali DL. 1993. Irrigation-induced salinity: a growing problem for development and the environment. World Bank Technical Paper 215. World Bank: Washington, DC, USA.

Ünver HO. 1997. Southeastern Anatolia Project (GAP). *Water Resources Development* **13**(4): 453–483.

van Schilfgaarde J. 1994. Irrigation—a blessing or a curse. *Agricultural Water Management* **25**(3): 203–219.

Wichelns D, Oster J. 2006. Sustainable irrigation is necessary and achievable, but direct costs and environmental impacts can be substantial. *Agricultural Water Management* **86**(1–2): 114–127.

Willock J, Deary IJ, McGregor MM, Sutherland A, Edwards-Jones G, Morgan O, Dent B, Grieve R, Gibson G, Austin E. 1999. Farmers' attitudes, objectives, behaviors, and personality traits: the Edinburgh study of decision making on farms. *Journal of Vocational Behavior* **54**: 5–36.

Yeşilnacar MI, Güllüoğlu MS. 2008. Hydrochemical characteristics and the effects of irrigation on groundwater quality in Harran Plain, GAP Project, Turkey. *Environmental Geology* **54**: 183–196.

ENDNOTES

1. The ethnic composition of the Harran Plain does not represent the whole GAP region, since 80% of villagers in the Harran Plain are Arabic-speaking and 20% are Kurdish-speaking (Harris, 2006).
2. For the sake of focus, the paper does not elaborate on the relationship between the GAP and the Kurdish issue in south-eastern Turkey. This has been extensively analysed, among others, by Harris (2002, 2012).
3. Although their native language is Arabic or Kurdish, all the respondents were fluent in Turkish. Therefore, the interviews were conducted in Turkish.
4. The total exceeds 100%, since some farmers have two or more additional income sources.