

# *Inclusive participation, self-governance and sustainability: current challenges and opportunities for women in leadership of communal irrigation systems*

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Imburgia, L., Osbahr, H. ORCID: <https://orcid.org/0000-0002-0130-2313>, Cardey, S. ORCID: <https://orcid.org/0000-0001-8504-8027> and Momsen, J. (2021) Inclusive participation, self-governance and sustainability: current challenges and opportunities for women in leadership of communal irrigation systems. *Environment and Planning E: Nature and Space*, 4 (3). pp. 886-914. ISSN 2514-8486 doi: 10.1177/2514848620934717 Available at <https://centaur.reading.ac.uk/90941/>

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# **Inclusive participation, self-governance and sustainability: Current challenges and opportunities for women in leadership of communal irrigation systems**

**Imburgia, L., Osbahr, H., Cardey, S. (2020) Final Author Copy Accepted for publication in Environment and Planning E: Nature and Space**

## **Abstract**

Genuine inclusive participation in the self-governance of communal irrigation systems remains a challenge. This article analyses the mechanisms of participation in irrigation water users' associations (WUAs) with focus on women as leaders of those organizations by drawing on cases from a comparative, multicase mixed-method study in Ethiopia and Argentina. After having being a topic for decades in gender and development debates, in many irrigated areas of the world WUAs continue to be male dominated at all levels, especially in influential positions. Findings in this article suggest that despite large socio-economic and cultural differences, the current water management systems in both research locations reinforce problems of unequal gender participation; women have more obstacles and constraints in establishing equal access in membership, participation and decision making in irrigation management. The lack of inclusive participation and the low representation of women in leadership roles lead to WUAs being poorly rooted in their community of users. Incomplete social rootedness of WUAs jeopardizes their effectiveness and equality in water management and, as a result, affects long-term sustainability. Through analysis of empirical data of communal small-scale irrigation systems in both countries, the article discusses who participates, how and why they participate, and the reasons for low numbers of women in leadership roles within the WUAs. Finally, the article reflects on possible enabling conditions that could foster inclusive participation, increase the quantity and capacity of women in management and leadership roles, and the benefits this may bring to sustainable irrigation systems.

## **Keywords**

Inclusive participation, agricultural irrigation, water users' associations, women's leadership, social rootedness.

## **Introduction**

Participation of users in irrigation water management has been adopted as the underlying principle of decentralization in the irrigation water sector worldwide (Meinzen-Dick, 1997), and it has been particularly emphasized in neoliberal approaches to irrigation water governance

(Ahlers and Zwarteveen, 2009; Harris, 2009). From the 1980s, water users' associations (WUA) were adopted as the core institutions through which to operationalize participation in the process of decentralization and devolution of communal irrigation management in many countries of the global South. The necessity to include farmers in the decision-making process in communal self-governed irrigation governance structures, i.e., WUAs, has been well documented. Participation has been used to explain enhanced efficiency, a sense of ownership of irrigation infrastructure, and financial and environmental sustainability (Ostrom, 2011; Senanayake et al., 2015; Tang and Ostrom, 1993).

As participatory entities of community-based agricultural water management, there is evidence that WUAs have a positive role in leading to more equitable involvement of farmers. WUAs have delivered effective management and improved access to water in some cases, and thereby led to improved food security and new opportunities in agricultural livelihoods for large numbers of smallholders (Domènech, 2015; Namara et al., 2010; Senanayake et al., 2015). Moreover, WUAs can play a fundamentally important role for the survival of small-scale irrigation agriculture, ensuring - in some cases - equality in access and participation of less powerful, more vulnerable users, especially women (Imburgia et al., in preparation-b).

However, obstacles to genuine inclusive participation in WUAs still remain. Most originate in the replication of unequal power relations that already exist among the community of users, in the structure of the WUA; diverging interests of users not being appropriately addressed by WUAs' leadership, and an unequal share of decision-making power, particularly with vulnerable water users (Harris, 2005; Meinzen-Dick and Zwarteveen, 1988). In addition, incomplete decentralization processes that lead to discrepancies between the expected benefits of implementing a "participatory model" and the realities in operating the WUAs in local contexts have also been recognized as limitations of WUAs to deliver increased and more equitable participation of water users (Aarnoudse et al., 2018; Harris, 2006; Senanayake et al., 2015; Upadhyay, 2003). This creates the risk of deepening existing social asymmetries and inequalities (Zwarteveen et al., 2010).

Gender differences and inequalities in the water management sector remain significant. Increasing the equitable inclusion of women in water management continues to be particularly problematic in many countries, not only in the agricultural irrigation water sector (Aarnoudse et al., 2018; D'Exelle et al., 2012; Yami, 2013), but also in the WASH (water for drinking, sanitation and hygiene) sector (Adams et al., 2018; Harris et al., 2015; Morinville and Harris, 2014; Sultana, 2015).

The general debate of the equitable representation of women in governance and government has been the driving force behind sector policies aiming to strengthen the role of women in agriculture. However, mitigating unequal participation of women in community-based irrigation water management remains a challenge (Lefore et al., 2017; Van Koppen, 2017). Despite being a topic for decades in gender and development debates, in many irrigated areas of the world -both in lower- and higher-income countries-, WUAs continue to be male dominated at all levels (Bennett et al., 2005; Upadhyay, 2003; Wallace and Coles, 2005; Zwarteveen et al., 2010), but especially in influential positions (Buisson et al., 2017; Udas, 2014; Yami, 2013).

Scholarship on women and irrigation water has tended to focus on the reasons why women are not equally represented in WUAs. However, to date the specific effects of increased women's participation and decision-making in local irrigation water governance, in particular when women occupy leadership positions, has not received commensurate attention. Not enough studies provide tangible examples of women leading irrigation WUAs to assess the changes that result in governance.<sup>1</sup> In other sectors, such as in community forest management, various case studies were able to draw on larger numbers of women in leading governance roles, allowing to study the effects of enhanced female representation in NRM in a more quantitative manner (Agarwal, 2015, 2010). In the irrigation sector, behavioral experiments have been conducted as proxies to study the effect on equality of women managing the water resource (D'Exelle et al., 2012), by comparing how women and men of low and high social status share communal self-governed irrigation water in conditions of water abundance and shortage. D'Exelle et al. (2012) found that women of both high and low status tend to share more fairly than men, in conditions of water abundance. When water was scarce, men and women ensured first their own supply, however women were more inclined to fairness.

Against this background, this article considers whether improving the participation of women as independent members of WUAs, and in particular allowing more women to occupy leadership positions, would strengthen self-governance of communal irrigation, and provide a positive effect on the sustainability of small-scale irrigation systems (SSIS). The article aims to explore these issues by drawing on empirical evidence to elucidate the incomplete participation of water users in water management. Of specific interest is the question of whether low representation of women in management and leadership affects the rootedness of WUAs in their community of users.<sup>2</sup> This is important because the literature suggests that poorly socially rooted WUAs jeopardize effectiveness and equality of water management and, as a result, the sustainability of the organization. The paper specifically seeks to answer the

following questions: (a) what are the participation mechanisms of women and men in WUAs; (b) what are the reasons for low participation of women in leadership of WUAs, and (c) what are the opportunities and enabling conditions for increasing the involvement of women in water governance structures?

The article is organized as follows: first, it reviews relevant scholarship and presents an adapted participation typology to characterize forms of participation in the self-governance of SSIS. This typology helps to describe the social interactions identified and how there may be different patterns of participation within different groups of men and women. The research was conducted as a comparative, trans-regional study in two countries, Ethiopia and Argentina, in which issues of gender participation in irrigation water governance were analyzed. The goal was to compare their manifestations, similarities and differences in diverse socio-economic and cultural settings (Bryman, 2012). Using empirical data on participation of women and men in SSIS in Ethiopia and Argentina, the article reflects on the implications of participation and decision-making patterns for the social rootedness of WUAs. Furthermore, the article discusses conditions for the active involvement of women in leadership roles, and the association of increased female leadership with sustainability of irrigation systems. Final reflections on policy and practice implications are provided.

## **Participation in irrigation and gender equality**

Historically, barriers to participation, such as rules of entry, intrinsic social stratifications and customary norms have resulted in low participation of women in WUAs (for example in the Andes, as described by Bastidas, 2005; and in South Asia, as discussed by Meinzen-Dick and Zwarteveen, 1998). This happens even in those cases where women have a prominent role in agriculture and irrigation (Upadhyay, 2003). For many rural women, structural inequalities are mainly driven by embedded social relations of power and material inequalities, which are difficult to overcome (Morales and Harris, 2014; Vera Delgado, 2005). Socio-cultural and economic barriers prevent involvement in WUAs not only of women but also of other disadvantaged social groups (Harris, 2006). These systemic inequalities are then reproduced in the participatory mechanisms used by resource management institutions (Morinville and Harris, 2014), especially when those mechanisms fail to consider the existing “intra-group” social relations and power asymmetries (Agarwal, 2015) and the influence of contextual power dynamics on community organizations (Brisbois and de Loë, 2016; Morales and Harris, 2014).

Although the irrigation sector has been traditionally restricted to men in terms of practice, extension, leadership and education of irrigation (Ongsakul et al., 2012; Zwarteveen, 2008), increasing the participation of women in water resource management is critically important to address a broad range of development goals, including equality, social justice, adherence to democratic values (Cornwall and Edwards, 2015), and more rational design and implementation of water projects, as articulated within the Sustainable Development Goals (UNESCO WWAP, 2019).

Identifying solely men as being in charge of irrigation water management can lead to inadequate water project design and planning due to the misrepresentation of the roles of women in agriculture, irrigation, access to information, and training for irrigation maintenance and governance (Buechler, 2005; Cleaver, 1998; Momsen, 2020). However, exclusion of women from leadership roles in irrigation management has been seen as the social norm in many socio-cultural contexts, for instance, in Peru (Vera Delgado, 2005) and in India (Raha et al., 2013). The gender segregation in leadership is partly explained by male domination in the engineering and irrigation professions in many countries of the global South (for example, Liebrand, 2014; Ongsakul et al., 2012; Zwarteveen, 2011); the skills attributed to do irrigation work (i.e., physical, mental and technical competences considered to be needed by “good irrigation professionals”) have been more typically associated with men normalizing *masculinity* in irrigation (Zwarteveen, 2008). This male over-representation in the irrigation sector reinforces the exclusion of female farmers from irrigation management and that of female irrigation professionals in the design of the systems (Chancellor, 2005; Vera Delgado and Zwarteveen, 2017).

Development and water policies, sector irrigation institutions, and implementing organizations have invested in addressing these issues but yielded mixed results. Scholars have highlighted how some projects have led to a process of legitimizing inclusive participation by women, especially initiatives set up by external international organizations. Examples are found in Bolivia (Mehta et al., 2012); and in other Andean countries (Boelens and Zwarteveen, 2002); as well as in Sri Lanka (Aladuwa and Momsen, 2010) and in India (Raha et al., 2013). By contrast, Vera Delgado (2005) highlights the issue of external agents with often an incomplete understanding of local dynamics designing and implementing water projects that exacerbate the disadvantages for women and lead to a concentration of project benefits in few, mainly male, hands.

Existing and intersecting differences between water users (i.e., gender, age, socio-economic and cultural background) explain differences in terms of water use, personal interests and

resulting wealth within a community (Harris, 2015; Sultana, 2015) and are reflected in the dynamics of participation in WUAs (Masanyiwa et al., 2014; Mustafa et al., 2016), thus, who is willing or allowed to participate, as well as why and to what degree.

In this paper, inclusive participation is understood as “a voluntary process by which people, including the disadvantaged (in income, gender, caste, or education), influence or control the decisions that affect them.” (Saxena, 1998: reproduced in Cornwall 2011: 31). The mechanisms of participation by water users will be determined here by: (a) inclusion and exclusion factors to the collective management; (b) the forms and levels of participation; and (c) interest in participating.

Inclusion and exclusion of women in water governance structures, as well as other community participation organizations, are shaped by four intertwined sets of factors: institutional governance factors; personal factors and attributes; the contextual dynamics of social relations, including gender relations (Agarwal, 2010; Masanyiwa et al., 2014; Raha et al., 2013); and the complex and “uneven” interactions (Collard et al., 2018) between physical characteristics of the resource (“nature”) and society (Sultana, 2009). Agarwal (2001) suggests that more women would be empowered if they were included in more equitable numbers and through equitable forms of governance. This has been confirmed, for example, in irrigation systems in Tigray (Ethiopia) and Mendoza (Argentina), where the formalization of WUAs and the implementation of clearer rules and regulations have helped many women **gain** formal and independent access to water, allowing agriculture as a secured livelihood strategy of their choice (Imburgia et al., in preparation-a). In contrast, institutions that are participatory by definition can exclude certain users due to structural factors (e.g., formal and informal rules of entry) and produce what Agarwal defines as “participatory exclusions” (Agarwal, 2001). Such exclusions can worsen the condition of disadvantaged women and other vulnerable irrigation water users (Harris, 2008).

The forms and level of participation of people in organizations has been usefully described by Agarwal (2001) as: nominal, passive, consultative, activity-specific, active, and interactive. According to this typology, participation is considered “effective” if it goes beyond nominal participation, i.e., when members of an organization attend meetings, have a voice, and influence decisions (Agarwal, 2010, 2001). Higher levels of participation described in this typology consider some social dynamics within the groups (e.g., which groups speak up in front of others) and outside (e.g., how cultural norms restrict women holding office positions). The analysis of these social dynamics is an entry point to understand the effect of social relations on participation outcomes (Agarwal, 2010).



The typology proposed by White (1996) describes participation according to the level of interest in participating: nominal, instrumental, representative and transformative. Each category is described by the top-down interest of organizations or projects; bottom-up interest of participants or beneficiaries of projects; and the function or instrumental use of participation. In practice, these forms overlap because the people involved will have a “mix of interests which change over time” (White, 1996: 8). People’s interest to participate, and the interest of those holding power, may not necessarily converge (White, 1996), and thus some degrees of participation do not necessarily imply challenging structurally-embedded local power relations.

To explore the mechanisms of participation of irrigation water users in communal water resource management, this paper adapts a typology (Table 1) that includes elements of the Agarwal typology of participation and uses these categories according to the degree in which participants exercise their rights and voice (Arnstein, 1969; Cornwall, 2003), and the degree of fulfillment of their shared responsibilities within the organization. To make this typology relevant to irrigation management, water rights will be used as inclusion and exclusion factors. This adapted typology will also include leadership as a type of participation with transformative effects; that is, having the potential to “empower” participants (White, 1996).

**Table 1.** Typology of participation in irrigation self-governance according to rules of entry into WUAs.

Rules of entry to WUAs	Type of participation	Characteristics of participants
Non-water right holder (non-registered member)	Non-authorized water use	Use of a communal water resource without agreement of community of users.
	Authorized water use	Operational right (Schlager and Ostrom, 1992) to use the resource, granted by family relationships, tenancy or sharecropping arrangements.
Water right holder (registered member)	Nominal	Water right owner; no exercise of collective rights and obligations.
	Minimum	Minimum exercise of collective rights and obligations to avoid losing the water right, e.g., payment of water fees.
	Passive	Limited exercise of collective rights and obligations, voice or influence in decisions is not guaranteed.
	Activity-specific	Partial exercise of collective rights and obligations; no official positions held.
	Interactive	Full exercise of collective rights and obligations, with influence on relevant decisions; hold management positions.
	Transformative (leadership)	Full exercise of collective rights and obligations; hold the leadership position with full decision-making power.

Source: Adapted by the authors based on Agarwal (2010) and White (1996).

## Methodology

To study how gender roles and relations in leadership of irrigation governance manifest in diverse contexts, the research selected a comparative, trans-regional approach, which provides a high degree of physical and socio-cultural diversity. To allow for diversity in the study of SSIS governance, a well-developed irrigation context in a mid-income country, Argentina, and a less developed irrigation context in a low-income country, Ethiopia, were selected. These two countries are characterized by widely diverging human development and gender equality backgrounds. Ethiopia exhibits one of the lowest levels of human development in the world, positioning the country at 173 out of 189 countries and territories in the UNDP Human Development Index (HDI) for 2018 (UNDP, 2019). By contrast, Argentina is considered as a country with very high human development, at rank 48 in 2018 (UNDP, 2019). Likewise, gender inequalities remain critical in Ethiopia, ranking at 123 out of 189 countries when assessed by the UNDP Gender Inequality Index (GII) in 2018; on the other hand, Argentina ranked at position 77 (UNDP, 2019). The data used in this paper were collected in Raya Valley in Tigray, northern Ethiopia, and northern Mendoza Basin, in Mendoza Province, center-west Argentina during 2016-2018. Diversity of evidence and methods was obtained through a multicase mixed-method approach that included a stratified cross-sectional survey, focus group discussions (FGD), in-depth interviews and direct observations (Figure 1). The multicase (Merriam, 2009) or multiple-case (Yin, 2003) study design involves by definition the analysis of more than one case study. This allows a general understanding of the issues under investigation despite the specificity of the particular case studies included and the diversity of their contextual characteristics (Yin, 2003).

[Insert Figure 1.]

The study focused on communal small-scale irrigation systems in these two countries because under the current conditions of socio-economic and environmental vulnerability of many rural areas, irrigation agriculture is seen as a key strategy to overcome poverty and to cope with increasingly unreliable rainfall. In the study locations selected for this research, like in most low- and mid-income countries, SSIS represent the large majority of agricultural water users (Imburgia, 2019). Women, within the SSIS, are important users of irrigation water (Wallace and Coles, 2005; Bennett et al., 2008). Therefore, the study of communal SSIS presents an opportunity for examining the diverse and complex interactions between the

technical and social dimensions of participation in water resource management, including those of gender.

In both countries, survey participants (Table 2) were male and female irrigation smallholders, members of WUAs. In-depth interviews were conducted with a purposeful sample of female and male informants, including farmers, WUA leaders, irrigation and agricultural experts, and water administration officials. Direct observations included participation in water management-related events and water users' assemblies. Data were evaluated using coding and thematic analysis for the qualitative data, and descriptive statistics for the quantitative data.

**Table 2.** Characterization of the survey respondents of Tigray and Mendoza.

Characterization of survey respondents	Tigray		Mendoza	
	Male	Female	Male	Female
<b>Average age total (n)</b>	40.5 (50)	39.5 (21)	53.2 (42)	46.8 (37)
<b>% Marital status (n)</b>				
Married	96.1 (49)	19 (4)	83.3 (35)	83.8 (31)
Single	2 (1)	19 (4)	7.1 (3)	5.4 (2)
Widowed	0	23.8 (5)	2.4 (1)	5.4 (2)
Divorced	0	38.1 (8)	7.1 (3)	5.4 (2)
No answer	2 (1)	0	0	0
<b>% Household type (n)</b>				
Male-headed household	98 (50)	19 (4)	81 (34)	43.7 (16)
Female-headed household	0	81 (17)	0 (0)	17.1 (6)
Dual household	0	0	19 (8)	35.1 (13)
No answer	2 (1)	0	0	5.4 (2)
<b>% Education level (n)</b>				
No education	33.3 (17)	81.0 (17)	0	0
Primary incomplete	41.2 (21)	14.3 (3)	19 (8)	29.7 (11)
Primary complete	11.8 (6)	4.8 (1)	33.3 (14)	45.9 (17)
Secondary	5.9 (3)	0	23.8 (10)	10.8 (4)
Technical/Vocational	2.0 (1)	0	7.1 (3)	0
Higher education	0	0	14.3 (6)	8.1 (3)
No answer	5.9 (3)	0	2.4 (1)	5.4 (2)
<b>% Cultural background of survey respondents (n)</b>	Tigray		Mendoza	
	Highlands	Lowlands	Perennial crops	Annual crops
Tigrayans	100 (28)	100 (44)		
<i>Criollos</i> *			96 (43)	56 (19)
<i>Norteños</i> **			2 (1)	26 (9)
Migrants from Bolivia			2 (1)	18 (6)
Total respondents (n)	28	44	45	34
<b>Average household size total (n)</b>	4.79 (28)	4.77 (43)	3.32 (44)	4.44 (34)

Source: Survey of farmers. Note: (\*) born in Mendoza and of European origin; (\*\*) migrants from northern Argentina.

### ***Study sites: Context for participation in WUAs in Tigray and Mendoza***

Tigray is one of the poorest regions in Ethiopia, with an agricultural-dependent economy. Raya Valley, in southern Tigray, has a semi-arid climate with a bimodal rainfall pattern; as rainfall is erratic and insufficient to sustain livelihoods relying on rainfed farming, supplementary

irrigation has traditionally been a common practice in the area (Yazew et al., 2010). In the last two decades, the expansion of irrigated agriculture has been supported by governmental and international cooperation programs as a key priority to improve food security (Gebrehiwot et al., 2015); this effort has included the modernization of irrigation systems and rapid growth of groundwater use for irrigation.

All the surveyed farmers from Tigray obtained incomes from crop sales, supplemented by livestock incomes. Men and women smallholders were found growing similar crops and therefore having similar irrigation water needs. In the irrigated plots, surveyed farmers mostly grew vegetables, cereals, pulses and fruits; in the rainfed plots, farmers grew cereals and pulses. All farmers interviewed used traditional low input farming practices and produced within very low margins of profit. In the highlands, all irrigation water used comes from surface water, distributed and accessed through a variety of hydraulic infrastructure, including shallow boreholes, hand-dug wells, earthen and lined channels, and water reservoirs. In the lowlands, farmers use groundwater for irrigation lifted by electric pumps and distributed by furrows and pressurized irrigation systems (sprinkle and drip). Small-scale irrigation schemes are managed in various types of formal and informal WUAs. In the highlands, registration of WUAs to manage surface water was found to be voluntary; once a WUA is established, however, anybody who wants to irrigate land in the command area of the organization must become a member. In the lowlands, the groundwater (drawn from deep wells constructed by the government and collectively managed by users), was only accessible by compulsory membership in the corresponding WUAs.

A complementary study found that farmers owning irrigated plots in the study areas of Tigray were considered better-off than those only owning rainfed land (Imburgia et al., in preparation-a). Interestingly, irrigation farming benefited particular groups including women on their own as they could secure decent incomes and obtain financial autonomy. Moreover, a recent policy change in 2014 allows the registering of land in the joint names of husband and wife, modifying the previous rule of registering land in the household head's name only, usually the husband (Bezabih et al., 2016). This policy change has allowed more women secure irrigation water and farming livelihoods (Imburgia, 2019). On the other hand, small-scale irrigation farming in Tigray face severe constraints, mostly related to the cost of access to water due to infrastructure maintenance (highlands); electricity costs of groundwater use (lowlands), and distorting governmental farming policies, e.g., the compulsory purchase of fertilizers (sold by the government) required to receive irrigation water.

Community activities are strongly rooted in the rural communities of Tigray. People are accustomed to supporting each other through informal organizations, typically related to savings, rotational loans and mutual support (Yami, 2013). Voluntary community gatherings are therefore common and people meet collectively for religious celebrations, burials, weddings, and to support families in distress or to solve conflicts. In addition, local government frequently calls all adult neighbors for political matters or to request labor contribution, for example, for the maintenance of watersheds in the highlands, as was observed during fieldwork.

By comparison, the Province of Mendoza is a traditionally prosperous agricultural region of Argentina. The Northern Mendoza Basin has an arid climate and agriculture is only possible under irrigation. In the perennial crop areas, most surveyed farmers grew wine grapes (76%) and stone fruits; in the annual crop areas, surveyed farmers cultivated vegetables in several rotations per year. Water resources from the Mendoza and the Lower Tunuyán Rivers are the backbone of the socio-economic development of this basin in terms of household use, agriculture, agro-industries, a growing tourism sector related to rural and natural environments, and hydro-electric power production. Water resources in the region are also affected by rapid urban growth, as well as groundwater overdraft and contamination of irrigation canals by solid waste (DGI, 2016; 2015).

All landowners with a registered irrigation water right are compulsory members of the WUA of their land's jurisdiction. Those WUAs are non-governmental, decentralized self-governed organizations responsible for the administration and maintenance of secondary and tertiary canals. Most of the conveyance and distribution systems consist of irrigation canals constructed in natural or compacted earth. This entails significant challenges for management such as infiltration and loss of irrigation water. Most SSIS use furrow and basin surface irrigation.

The agricultural production sector of Mendoza has been severely affected by fluctuating political and economic conditions, unfavorable foreign exchange rates and very high levels of inflation for decades. In the last decade, input costs grew exponentially while market prices stayed very low for farmers. This difficult situation, exacerbated by a prolonged drought since 2005, has created a severe sector profitability crisis that has particularly affected the small and medium scale farming sectors (Montes de Oca, 2018; Saieg, 2017). A large proportion of agricultural water users are now operating under precarious conditions, and the entire provincial water management sector faces serious threats to sustainability. In the survey, the majority of women and men smallholders interviewed were managing their farms with a minimum of inputs, old or already obsolete farming tools and equipment, and increasingly,

minimum maintenance work. As a result, an increasing number of farmers must rely on non-agricultural incomes to make ends meet. A parallel study reported a relatively lower involvement of women in irrigation agriculture than in the past due to in part, the current financial crises of small-scale farming (Imburgia, 2019). Many women now favor less physically demanding jobs with more economic security; however, it appears to be more challenging for rural women to find appropriate off-farm jobs in the rural areas. In our study, 52% of the men and 27% of the women surveyed reported a complementary (non-farming) income activity. This may be an important constraint for women in access to capital to invest in irrigation.

Rural areas in Mendoza are experiencing rapid change, both in demography and in socio-economic composition. There is an aging rural population, with most farmers having prioritized education for their sons and daughters who then rarely return. On the other hand, over the last three decades, the farming sector of Mendoza has received large numbers of seasonal and permanent migrants from Bolivia and northern Argentina. These migrants, both women and men, usually bring strong farming traditions. In addition, many rural areas located near to the large urban areas of Mendoza, have attracted real estate businesses. This has resulted in significant shift of soil and water resources to recreational and peri-urban uses.

Overall, the analysis of the interactions of irrigation access, irrigation practice and gender in these two diverging country contexts allows for a better understanding of the implications in the livelihood processes that in turn affect the long-term sustainability of self-governed SSIS. Framed by these complex and dynamic environmental, socio-economic and technological contexts, the remainder of this article explores the mechanisms of gendered participation in the management and leadership of communal self-governed irrigation schemes of Tigray and Mendoza, and the effect on sustainability.

## **Participation in self-governed irrigation systems of Tigray and Mendoza**

### ***Gendered mechanisms of participation in WUAs***

In both Tigray and Mendoza, land tenure rights and associated water rights are the most important determinants of inclusion and exclusion in WUAs. In both research locations, fieldwork findings revealed a number of additional interrelated factors defining the who, why and how of participation in SSIS governance. The motivations and level of involvement in WUAs' activities are useful proxies to characterize the effectiveness of the participatory process to enforce compliance with obligations and responsibilities, and to exercise decision-

making power in collective governance. This section will characterize participation by presenting results and findings according to: (1) rules of entry to the collective management of water, (2) the level of involvement, and (3) the reasons and motivations for participation.

*(1) Who participates in WUAs? – Inclusion and exclusion factors*

In both countries, by law, farmers with land in the command area of an irrigation scheme are entitled to use irrigation water (in proportion to the size of their land holding) through their WUA membership (MWIE, 2014; Pinto et al., 2006). The formal WUA membership is thus based on land tenure rights. Although Argentina and Ethiopia have land policies that allow men and women equal access to land ownership, in both study locations, and despite the socio-cultural and political differences, women were found to have less independent land rights than men, and therefore, less independent membership in WUAs. In addition, women who were registered members of WUAs did not always assert their membership rights. For example, in Mendoza, even in households with husband and wife present, the man would act as the household representative in the WUA. This was evident even though the land was registered in either the women's name or jointly (Figure 2). A similar situation was reported from Nepal (Van Koppen et al., 2001).

[Insert Figure 2.]

In Ethiopia, the recent land policy changes allow more women to have independent access to land. However, in the study locations of Tigray, fieldwork revealed that WUAs continued to register membership according to the household head – traditionally a man. As a result, in households that indicated owning a joint land certificate, the husband tended to identify himself as the WUA member (Figure 3). Most women households' heads were found to be exercising their WUAs' membership rights (except two women whose older sons were the indicated members).

[Insert Figure 3.]

In both countries, only registered members of the WUAs exercise formal participation rights. However, authorized (non-rights holders) water users - usually family members of the rights holder, tenants or sharecroppers -, are allowed to attend meetings, claim their water share

or inform of problems or conflicts with other water users. In Mendoza, 53% of the survey respondents were registered members of WUAs, and 47% were authorized water users. Of those non-member farmers, the majority were relatives of the landowner (75%), and the rest were tenants (8%) and sharecroppers (17%). In Tigray, the situation differed with 92% of survey respondents being water rights holders, while the remainder (8%) were family members authorized to use the irrigation water. This information is important to define the type of participation those respondents are allowed to have in the WUA. It also may indicate a relatively lower direct involvement in farming of the actual water rights holders in Mendoza, contrasting with the higher direct involvement of water rights holders in irrigation and farming in Tigray.

By not exercising their rights to independent membership in WUAs, many women in both research locations do not exercise autonomy to participate and decide; they also miss opportunities for attending training, acquiring skills and abilities in the irrigation management sector, and socializing with peers. As a result, those women do not enjoy the “empowering effect” that an active participation has the potential to provide (Cornwall, 2003; White, 1996). These issues reinforce the (misleading) concept that irrigation management is *not* a matter for women. In addition, it adds layers of difference and inequality that compound the structural socio-economic and gendered-based constraints already faced by many rural women, including poor access to education, technology, credit and markets.

## *(2) How do small-scale water users participate?*

In both Tigray and Mendoza, the formal mechanisms of farmers’ participation in registered WUAs were attendance to users’ meetings; labor and financial contribution; electing WUAs’ authorities; and holding office positions, which included leadership of associations. Among the dominant factors shaping how people participate, the analysis found the following: organizational and system rules, role of farming in the livelihood strategy of the household, and motivations to participate. The results also revealed the intersecting effect of social differentiating factors (personal, cultural, and socio-economic conditions) that determine people’s participation. These mechanisms and factors will be discussed in the rest of this section.

The most basic form of participation in WUAs is attendance at users’ meetings. These meetings are important because they are venues for accessing information, exercising one’s voice and making formal decisions regarding water management, including approving budgets,



and evaluating the water committee's (WCs) performance. In Mendoza, the central water agency establishes that WUAs must conduct two official water user assemblies per year, one for agreeing on the WUA's budget and the other to assess the cash flow. Key informants indicated that participation was usually very low with no sanctions for non-attendance. Results from the survey showed that 41% of farmers never attended meetings. Of the 59% who attended, there was a clear difference between men and women, with 84% men; 15% women, and the remainder 1% couples indicating they both attended. These results were corroborated by observations in a sample of 15 WUA's assemblies in the entire Province (2016). They showed that only 13% of attendants were women. Male dominance in WUA meetings attendance reinforces the gender gap in water management knowledge: more men understand better the functioning of the water schemes, and more men take part in the social networks established for the water activities. Access to knowledge and participation remains disproportionate for women.

In registered WUAs in Tigray, rules prescribe weekly planning and monthly monitoring meetings. Farmers requiring water were allowed to participate in the weekly meetings and make their water requests. Key informants interviewed indicated that women farming on their own were allowed to be absent from these meetings because of their heavy workloads with domestic and farming tasks, while this would not be the case for most men. In addition, WCs conduct monthly or bimonthly monitoring meetings, where broader issues related to irrigation performance, production, marketing of products or irrigation related conflicts are discussed. These meetings include an annual evaluation of the WC's performance and cash flow; also, water leaders are confirmed in or removed from their position by election of all members. Those farmers who do not attend these meetings are sanctioned with a fine that may cost the equivalent of up to one daily labor payment. The position in the household of women and men was an important element influencing gender participation. Most male and female heads of households indicated that they attended these meetings. Married women only attended if their husbands were unavailable or if they held their own land certificates.<sup>3</sup>

Likewise, farmers usually must comply with labor and financial contributions to the collective management and infrastructure maintenance. In Mendoza, farmers must contribute labor to clean a portion of tertiary canals. Women farming on their own have to pay labor to perform this task. Problematic compliance with this responsibility and the poor capacity of WUA leaders to enforce rules are usually the most contentious issues discussed in WUAs. All farmers must pay water service fees proportionally to their land size. Failing to pay for more than two monthly periods gives WUA leaders the authority to suspend water delivery. In

Tigray, farmers must contribute labor to canal cleaning and infrastructure maintenance where surface water and furrow systems are used. Farmers pay a monetary sanction for not cleaning their portion of the canals. WUAs usually charge a membership fee and a monthly fee contribution. Delays in payments also cause monetary sanctions. Similar to Mendoza, women in Tigray farming on their own must have the financial capacity to pay for labor to clean and repair field channels.

Registered members of the WUAs are allowed to hold managerial positions in the WCs, including being elected as WUA leader (called *inspector* in Mendoza, and *abomay* in Tigray). WCs were usually composed of the WUA leader with assistance of a directory of 3 to 12 members. The positions of WUA leader and the proposed WC members are democratically elected by all WUA members.<sup>4</sup> Each WC hires one or more water guard in charge of controlling water distribution and some maintenance work.

In both countries, WUA rules determine that only registered members can be elected as WUA leaders. Additionally, candidates in Mendoza must have the financial capacity to pay the water fees on time. Most of the people who nominated themselves to be inspectors had the available time to dedicate to the activity and had a strong interest in the sector. Education level or technical training were not required to occupy this position. Successful candidates usually had influence and social connections in their community and were skillful at lobbying. Anecdotal evidence indicated that in a few cases, power groups within the water management system promoted the election of instrumental candidates for particular interests of those groups. In Tigray, in addition to being registered members of WUAs, respondents indicated that selected *abomays* should be respected, influential and trusted persons in their communities. They should also have some level of education (usually primary school completed).

By applying the typology of participation as described in Table 1, it was possible to characterize qualitatively and quantitatively the participation of the survey respondents according to their type and level of involvement in WUA activities. While participation of registered members may be any of the six types included in the typology, participation of the authorized water users (non-rights holders) can only be minimum, passive or activity-specific participation because they cannot participate at the same level as rights holders. Participation was quantified by assigning 0 (nominal participation) to 5 (leadership), based on the roles water users play in the WUAs, the activities they undertake, and the level of reported involvement in the WUAs.<sup>5</sup> These values were estimated by assessing responses of each interviewee to the following survey questions: attendance at users' meetings, labor contribution, and holding office positions in the WC including leadership. In the case of Mendoza, having voted in the

last election of the WUA leader was also considered. The criteria were cross-checked against multiple types of responses in the questionnaire to ensure consistency and to obtain valid responses.

By applying this quantitative characterization, it was shown that the type of participation of the entire household may not coincide with the type of participation of the individual member. Gender differences were identified. These results confirm the critical importance of disaggregating water related data by gender (Miletto et al., 2019). When considering the household participation in WUAs, the low participation of some family members is masked by the participation of those more involved. This characterization revealed that in Tigray, for the majority of farmers (both women and men), participation is passive; they comply with all compulsory requirements of the WUAs, but have a limited share of decision-making power (see Table 3). This may at least in part be explained by the hierarchical, top-down managerial approaches of Tigray as also observed by Yami (2013).

**Table 3.** Type of participation of surveyed water users in WUAs of Tigray according to their level of involvement.

Type of participation	Characteristic of the farmer participants within the sample	Proportion in sample at household level % (n)	Proportion in sample at the respondent level % (n)	Proportion within women at respondent level % (n)	Proportion within men at respondent level % (n)
Nominal	Member owns the land and has a water right, but does not exercise collective rights and obligations.	3 (2)	3 (2)	10 (2)	0
Minimum	Farmer is an authorized water user but does not hold a water right; usually is a wife who sporadically replaces her husband in meetings when he is not available.	4 (3)	6 (4)	19 (4)	0
Passive	Fulfills compulsory obligations to avoid sanctions; does not perform other WUA activities and does not hold office positions.	63 (45)	63 (45)	52 (11)	67 (34)
Activity-specific	Fulfills all duties and responsibilities, attends meetings, performs additional (voluntary) activities in the WUAs (e.g., as guard; cluster leader), but does not hold office positions.	14 (10)	13 (9)	10 (2) <sup>a</sup>	14 (7)
Interactive	The member fulfills all duties and responsibilities and holds a position in the WC (e.g., vice, accountant, secretary, financial management).	8 (6)	8 (6)	5 (1)	10 (5)
Leading /transformative	In addition to exercising all rights and duties, the member is the leader of the WUA.	8 (6)	8 (6)	5 (1)	10 (5)
<i>Total sample % (n)</i>		<i>100 (72)</i>	<i>72 (100)</i>	<i>(100) 21</i>	<i>(100) 51</i>

Source: Survey of farmers in Tigray, January-February 2016; March 2018. Notes: <sup>(a)</sup> All belong to an irrigation cooperative.

In Mendoza, according to the level of involvement of water users - either members or authorized water users -, participation of male respondents was mostly distributed between minimum, passive, activity-specific or interactive involvement, with more frequent occurrence of passive participation (see Table 4). On the other hand, most women had minimum participation, followed by passive participation. The role that farming plays in the livelihood structure of the households appears to have an impact on the level of participation of farmers in Mendoza. Farmers participate less in WUAs when incomes from farming are marginal. In other cases, landowners hire a permanent employee or a sharecropper to manage all issues related to irrigation, including communication with the water guard and inspector. This is usually the case of *criollo* landowners that have farming as a complementary income activity, including many women farming on their own. This has been also found in the case of migration of male farmers in central Mexico (Buechler, 2005). Employees or sharecroppers –most frequently being men- rarely attend meetings, and if they do, they are not entitled to vote. Landowners from Bolivia mostly use family labor for all farming tasks.

The cultural background of farmers was also an important source of differences between women's involvement in irrigation management. Although female migrants from Bolivia were more involved in all sort of farming duties than local *criollo* women, Bolivian women hardly participated in WUA's meetings, due to cultural norms that limit their participation in public activities other than their traditional community gatherings.

**Table 4.** Type of participation of water users in WUAs of Mendoza according to their level of involvement.

Type of participation	Characteristic of the farmer participants within the sample	Proportion in sample at household level % (n)	Proportion in sample at the respondent level % (n)	Proportion within women at respondent level % (n)	Proportion within men at respondent level % (n)
Nominal	Member owns the land and has a water right, but does not exercise collective rights and obligations.	0	0	0	0
Minimum	Minimum exercise of collective rights and obligations to avoid losing the water right, e.g., payment of water fees. May clean canals.	28 (21)	39 (29)	57 (20)	23 (9)
Passive	Fulfills compulsory obligations to avoid sanctions, may vote for authorities (registered members) but infrequently participates in communal activities, such as WUA meetings.	32 (24)	36 (27)	34 (12)	38 (15)
Activity-specific	Fulfills all duties and responsibilities, attends meetings but does not hold office positions. May be involved in voluntary support activities.	24 (18)	13 (10)	6 (2)	20 (8)
Interactive	The member fulfills all duties and responsibilities, participates in the WC and in other community activities, such as social WUA events or communal infrastructure maintenance activities.	15 (11)	11 (8)	3 (1)	18 (7)
Leading /transformative	In addition to exercising all rights and duties, the member is the leader of the WUA.	1 (1)	1 (1)	0	3 (1)
<i>Total sample % (n)</i>		<i>100 (75)</i>	<i>100 (75)</i>	<i>100 (35)</i>	<i>100 (40)</i>

Source: Survey of farmers in Mendoza, July-December 2016; May-June 2017.

### *(3) Why do water users participate?*

Despite the obvious environmental, socio-cultural and economic differences between Tigray and Mendoza, the foremost reasons for participating in WUA activities **in both cases** were to ensure timely and reliable access to water, and to solve any household or farm-specific water-related problems (e.g., to request repairing a broken bridge or water gate). However, a key difference in the reasons why farmers participate in Tigray as compared to Mendoza, is the mechanism of participation enforcement. Fieldwork results show that in Tigray, participation is by coercion, thus, farmers participate to avoid sanctions. In contrast in Mendoza, monetary sanctions are less significant (and the society is less hierarchically organized than in Ethiopia); thus, participation appears to be linked to the type of leadership of the inspector, whether he or she was effective at maintaining the good condition of the hydraulic infrastructure and at

enforcing rules. While in some cases, this motivated farmers to attend meetings, in other cases, WUA leaders expressed disappointment with the low attendance of farmers. For example, one WUA leader from Mendoza explained that when an irrigation scheme works “well” (i.e., farmers receive the water they need), some people attend assemblies less frequently. On the other hand, he indicated, “when there are problems, people come ‘*en masse*’”.<sup>6</sup> This corroborates previous findings elsewhere (Muchara et al., 2014).

Participation in Mendoza appeared also linked to personal characteristics of users (e.g., age, gender, cultural background, and family and socio-economic status) and to the type of social relationships between users and the inspector. For example, according to key informants, farmers increase their (usually low) participation if they have a good relationship with the inspector (they attend meetings to support the WUA’s work). Those farmers with fewer social ties to the WUA, e.g., Bolivians farming in Mendoza or water users not living on the farm, participated in meetings less frequently.

In both study regions, interviews with women and men revealed gendered-specific motivations for participation. In Mendoza, although all farmers (regardless of their gender) attend meetings to record problems, some male members indicated attending meetings to socialize and to maintain contact with neighbors. This was particularly observed among older male farmers, reflecting the traditional rural pattern of more men performing public activities and women remaining at home. On the other hand, women expressed interest in participating mainly to voice practical problems, which were most frequently related to uncleaned canals and water being wasted.

In Tigray, men and women did not always understand the participation of women in the same way. For instance, FGDs with women heads of household revealed the willingness of many women to participate in WUA meetings, despite male leaders indicating that women “don’t want [to attend meetings] because they are too busy.”<sup>7</sup> There were also variations among different groups of women. For example, when women household heads were asked about the usefulness of meetings, they replied that attending was important for them: “If we participate, we can decide.”<sup>8</sup> However, a group of married women said they did not need to attend as they can get the information from their husbands. Interestingly, women in FGDs in Kara Adishebo *kebele*, a predominant Muslim community, explained that women household heads usually attended WUA meetings and were as vocal as the men in speaking up and complaining. This contrasts with their more muted behavior when they attended other compulsory community meetings. These findings corroborate previous research indicating that the severity of resource constraints is one of the most influential factors for women to participate and voice their claims

regardless of personal conditions or cultural constraints (Agarwal, 2010). It implies that the level of pressure to find solutions, conditions the way women frequently respond to traditional barriers to participation.

By comparing the results of both countries, the study reveals that if women are not equally or appropriately represented, they cannot address their water needs; they are unable to sustain water management costs and as a result, are forced to leave the sector. This shows a failure in the WUAs' performance and participatory objectives. Interestingly, this happens in a similar way in both the well-organized irrigation systems of Mendoza and in the more precarious irrigation systems of Tigray. In both countries, findings show that women as users of irrigation water are not equally represented in WUAs. Moreover, they are extremely underrepresented in the leadership of WUAs; reasons for this gap in leadership will be discussed in the remainder of this section.

### ***Women in leadership of WUAs***

At the time of conducting research in both countries, the participation of women in leadership of WUAs was extremely low. Out of the 23 registered associations in the two *kebeles* in the highlands of Tigray, there were only two female-led WUAs (8.7%). In the lowlands, none of the 15 registered WUAs (by 2016) had a female *abomay*. Of the 142 WUAs in Mendoza Province, only two women were *inspectoras* (1.4%); and only one of them was validated in her position and re-elected (in 2018).

Four illustrative cases of women in leadership in Tigray and Mendoza offer insights to women's motivations and constraints to holding leadership positions in WUAs (see Box 1). The most frequently-mentioned reasons why women did not occupy leadership positions included: membership requirements (inclusion/exclusion factors); workload and time availability; education and technical training levels to perform water management work; the self and others' perceptions of the capacity of women to lead WUAs; the (perceived and actual) physical and technical difficulties to do the work; and the social and power relations of gender persistent in the irrigation sector. These factors will be discussed next.

**Box 1 – Four illustrative narratives of women in leadership positions in Tigray and Mendoza**

*Embahaste kebele, Tigray.* Mrs. F. was elected as the first female *abomay* in the sub-district by mid-2016. She is a widow with five children. She reached grade fifth of primary education. She manages a group of 24 farmers, of which 16 are women. They are allowed to irrigate during the day.

Men were doing a good job leading the WUA here. The work is not difficult, we have our rules. If we respect them, there is no problem. But the women farming in the community started to ask “why women cannot be *abomay*?” From the Agricultural Office they supported that women were selected. [...] Men complain that I am too strict with respecting rules. This is the only problem I have now (15/03/2018).

*Tsibet kebele, Tigray.* Mrs. C. was elected as the first female *abomay* in the sub-district by the end of 2017. She is a widow and lives with three grown-up children. Her management area is owned by 17 members, of which about half were women heads of household. All of the men and three women voted for her to be *abomay*. The rest of the women members had their land rented out and therefore they did not vote. The local Agricultural Office also supported her nomination. By the time of the interview, the lady was having conflicts with farmers because they were unwilling to raise the salary of the water guard, who for this reason left his job.

I want to leave the position. But the other women push me to stay. This is difficult. Men don’t accept what I tell them. They don’t respect the rules (16/03/2018).

*Canal Matriz Lunlunta, Mendoza River Basin, Mendoza.* In 2018, Mrs. E. was re-elected for her third consecutive four-year mandate as *inspectora de cauce* (WUA leader). She is married with two small children. In 2016, the WUA had 649 water users in an irrigation scheme of 1,640 hectares.

I was born here, all my family has farmed [here]. It is what I love to do. But it hasn’t been easy. All my colleagues are men, some support my work but I have to fight. Some people wanted me to leave. Last year, the water office did a financial audit because of rumors of mismanagement. I had to resist and to show that all was being managed appropriately. I stayed because farmers came to my house and told me to resist. Last year, I was re-elected with more than 70% of votes (04/04/2019).

*Hijuela Pampa, Upper Tunuyán River Basin, Mendoza.* Mrs. S. was elected WUA leader in 2006 and was in the position for eight consecutive years. She is a divorced, mother of two grown-up men. She has a university degree. In 2016, the WUA had 31 members and 525 hectares.

I started farming alone in the 1990s when I got divorced. I had to survive with my children. I was accepted as the only female member of a technical association of powerful large landholders that were producing for the export market. We wanted to install a modernized irrigation scheme in this area, a large water reservoir that could supply naturally pressurized water to the farmers. That’s why I nominated myself as *inspectora*. I wanted to improve the association. But after the two periods, I had enough. You cannot change the system (17/10/2016).

The fact that women in Tigray and Mendoza have significantly less independent membership in WUAs than men is a structural barrier for women willing to become WUA leaders. The next most typical reason mentioned by men for low female presence as leaders is lack of time due to the heavy domestic and production workloads of women. For example, in Tigray, male members of the WCs of the highlands said: “Women do not want to participate. They have a lot of work burden at home. It is difficult for them”<sup>9</sup>. Another *abomay* of the lowlands also explained: “For women, being in the WC and coming to meetings is a burden. They don’t need to participate”<sup>10</sup>. Although in these two locations women are clearly involved in most of the farming work and in charge of most of the domestic responsibilities, some



women indicated willingness to participate. Furthermore, illustrative cases demonstrate that women have the ability to organize their time and workload to fulfill all those tasks (see Box 1). Nevertheless, those women face multiple challenges, as explained by the only woman inspector in the Mendoza River Basin:

You may be needed at the middle of the night if there is a problem or a water robbery. You have to be prepared and have a supportive management structure and trustworthy water guards. Most women do not want to do this job, or they just cannot.<sup>11</sup>

Another common explanation given by respondents for the under-representation of women as WUA leaders was that the operation of the irrigation schemes is physically difficult for women. However, the women leaders interviewed in both countries said that a well-organized irrigation scheme, the modernization of irrigation systems, and the implementation of effective enforcement mechanisms allowed them to perform the work equally as men. This study found that hydraulic infrastructure improvements that reduce the drudgery of maintenance work such as lining irrigation canals in Mendoza, and the installation of pressurized irrigation systems in the lowlands of Tigray, reduced the irrigation workload and management difficulties for all, and, according to informants, it had helped women farming on their own, in particular. Similar experiences were reported from Egypt where the installation of drip irrigation especially facilitated the involvement of women in irrigation (Najjar, 2015). It is worth noting that in Tigray, the “heavy physical effort” identified as an obstacle to women taking up leadership roles is at odds with a government practice observed during the fieldwork. Frequently, rural women and men were called to fulfill watershed management work, which included both genders lifting heavy rocks and moving soil manually.

When the irrigation water has to be distributed at night, the work becomes particularly challenging for women due to security and cultural norms. Nevertheless, in the cases where the community of users were willing to have women lead, the WUA was found to accommodate women’s needs. For instance, in the WUA of Embahaste *kebele*, in the highlands of Tigray, the community supported the female *abomay* distributing water during the day to other women. In other cases, having a strong family support system and more openness to changing traditional masculinity patterns is vital to allowing the continued participation of women:

My husband helps me a lot. He doesn't complain if I have to be out for long hours, he takes care of the kids. He even convinced me to continue when I wanted to resign. I wouldn't have been able to stay without his support.<sup>12</sup>

Women's low participation in water management leadership roles is in many cases linked to the type of household obligations they have related to for example, childbearing (Bastidas, 2005), which usually involves a third layer of work burden for them (Moser, 1992; Raha et al., 2013). Three of the four illustrative cases presented in Box 1 showed widowed or divorced women with grown-up children, and thus with relatively fewer domestic responsibilities than women with small children. The case of the married inspector of Lunlunta illustrates how the equal share of the domestic workload in the household is a determinant factor of participation. Thus, it makes evident that the typical, and mostly uncritical, association of irrigation work with a masculine identity is strongly linked to the traditional gendered division of labor and water control, by means of gendered relations of power. This is on no accounts an unchangeable reality (Zwarteveen, 2008).

A clear barrier for some women to take part in managerial positions was their lack of knowledge about the irrigation system management, which was linked to their lower education levels, and limited access to extension service and technology (Ongsakul et al., 2012; Theis et al., 2018). In Tigray, women were on average less well educated than men (see Table 2) and this may constrain most women from holding office positions that require basic literacy and numeracy skills. It also hinders their self-confidence to hold leadership roles. Just as important is that only few women, namely, heads of households, attended irrigation management meetings and were called for training. This gap reinforces women's lack of knowledge and self-confidence on one hand, and the reinforced identification of irrigation with a masculine activity on the other. Interestingly, despite men and women in Mendoza having similar educational levels, there is a similar pattern of underrepresentation of women in leadership to that seen in Tigray. In the case of Mendoza, this may be associated to the fact that male experts and managers have traditionally dominated water resource science and practice, and provincial water bureaucracy.

In addition to these factors, fieldwork revealed underlying socio-cultural reasons why it is harder for women to be WUA leaders. These reasons were related to gendered social relations of power, as generally, women in leadership positions disrupt the status quo (Meinzen-Dick and Zwarteveen, 1998) and interpellate the traditionally established irrigation masculinities. Despite their diverse cultural backgrounds, women in FGDs in Tigray and in Mendoza

perceived that men found it hard to be led by women, or that for many men it was difficult to accept that women may have more knowledge than them. Although in Mendoza, open forms of gender discrimination are no longer accepted and are penalized, subtle forms of exercising power were mentioned. For example, women irrigation and agronomy professionals in FGDs explained that it was sometimes problematic for them to interact with male peers if they knew more than men. This was particularly the case with older generations of male professionals. In Tigray, traditional norms based on religion influence women's willingness to access to leadership positions. For instance, in Kara Adishebo *kebele*, when women in FGD were asked if they would like to be part of a WC, a woman head of the women's affairs *kebele* department explained: "This is a Muslim community. Men and women cannot sit together in a meeting. Women don't even like to sit in meetings with men."<sup>13</sup>

Overall, the gender differences and asymmetries identified in Tigray and Mendoza related to who participates, how and why, become extremely acute when WUA leadership is considered. The patterns observed in both contrasting countries suggest the explicit need to support women in access to transformative forms of participation, if the ultimate goal is to adhere to equality and sustainability goals. The next section will discuss conditions and opportunities for more inclusive policy and practice interventions in the irrigation management sector.

## **Discussion and conclusions: Opportunities for more women in leadership**

Both in Mendoza and Tigray, WUAs are threatened by a series of factors and processes evolving due to demographic changes, political and economic instability, changes in land use, climate variability and loss of profitability in the agricultural sector. Nonetheless, in both places, WUAs have a strong legal mandate and represent most irrigation water users in their localities. By applying a gender perspective to the analysis of participation and leadership of WUAs, this article has identified gender differences and constraints to participation for women, how women are able to access leadership positions, and the challenges to stay in those positions. Findings show how legal factors (rules of entry), personal characteristics, technical dimensions of the irrigation management practice, and social interactions of power all lead to participation mechanisms presenting more challenges to women than to men. Participation of women in irrigation system management is directly linked to their participation in farming, which is constrained by cultural norms and traditions, but also by heavier domestic workloads. This has been described by the scholarship on gender and irrigation (for example, Harris, 2006;

Centrone et al., 2017; Lefore et al., 2017) and confirmed by our findings of Tigray and Mendoza.

Similar observations and conclusions on the gendered mechanisms of participation in irrigation WUAs have been described in the past (Meinzen-Dick and Zwarteveen, 1998; Upadhyay, 2003; Van Koppen et al., 2001) and continue to be observed, for example, in Ethiopia (Yami, 2013), in Egypt (Najjar, 2015) and even in matrilineal societies in Malawi (Mapedza et al., 2017). The present study reveals that mechanisms of participation in current water management systems in both Mendoza and Tigray reinforce problems of unequal gender participation, with the direct result of weakened sustainability of WUAs.

The analysis of findings explains that the mechanisms and levels of users' participation in WUAs, and the type of leadership of those associations determine social rootedness of WUAs in the community of users, as conceptualized in Figure 4. Participation of water users, as explained by who can participate, how, and why they participate, is critical to defining the social representation of those users in the self-governance of the water resource. Improved participation is iteratively influenced by effective leadership. Findings suggest that the type of leadership of a WUA is due to the technical capacity and managerial abilities of WUA leaders. These aspects become increasingly important when irrigation systems are modernized and become more sophisticated. Leadership is also determined by the personal characteristics of a leader and the type of incentives that the system offers to attract skillful, motivated and accountable leadership.

[Insert Figure 4.]

The incomplete participation of users in WUAs results in organizations being poorly “rooted” in the community of water users. This affects the effectiveness of the self-governance of the irrigation system (because a poorly rooted WUA has difficulties in enforcing rules, collecting fees and therefore maintaining the hydraulic infrastructure, which is the key requirement for secure water distribution). As a result, often fragile WUAs have the responsibility to manage a vital resource in increasingly difficult and complex circumstances. The comparative study has shown that most women experience more constraints to equal access to membership, participation and decision making. These are clear factors highlighting incomplete participation in the self-governance of the irrigation water resource.

It is not straightforward to gauge the effects of increased female participation in irrigation scheme management as in both locations (like in many other countries as well) the participation

of women in leading positions is extremely low. However, evidence from this study shows that the interviewed women, regardless of their cultural background, have a particularly strong interest in the long-term maintenance of the irrigation infrastructure, cleaning canals and supporting the fair distribution of water. This is noteworthy and deserves further investigation, as it suggests a certain long-term perspective often found in women in countries of the global South (Bennett et al., 2005; Perkins and Walker, 2015). From the selected illustrative cases of Tigray and Mendoza (Box 1), the very few female-led WUAs were able to greatly improve the transparency of budget allocation, compared to their male predecessors, and they were active WUA leaders in fighting corruption in water distribution related issues. This was confirmed by other WUAs' female members, as well as the male and female irrigation experts interviewed in both countries.<sup>14</sup> The idea of fair distribution of water and equitable enforcement of rules in female-led WUAs were recurrent issues discussed in interviews with women participants. Women in FGDs in both Tigray and Mendoza also spoke of feeling more motivated to participate if a woman was leading them. D'Exelle et al. (2012) found water was shared equitably when women were in charge of water management.

These findings add evidence and reinforce the policy call for active improvement of opportunities for female participation in view of the slow tangible progress seen in achieving equality in the irrigation sector. They also constitute a strong argument for legal and institutional mechanisms that make explicit the inclusion of women in the irrigation management sector. Two key aspects must be addressed to deliver inclusive participation: first, it is necessary to quantitatively increase the participation of women. There is evidence that increasing the number of women in a communal group of resource management has a positive effect on the participation of other women who become more confident to take part and voice their needs (Agarwal, 2015, 2010; Mommen et al., 2017; Van Koppen et al., 2001). For this to happen, the broadly recognized need of formal access to land tenure of irrigable land for women both for subsistence and for livelihoods is of urgent resolution (Van Koppen 2017). It is also essential in order to achieve the human right-based approach to agricultural water for smallholders and vulnerable farmers, including many rural women (Mehta and Langmeier, 2019; Van Koppen et al., 2017). Second, there is a need to improve the capacity of women to manage water and to lead effectively by acknowledging their existing knowledge (Buechler, 2005) and by providing appropriate capacity development. These two aspects can be addressed by imposing rules of entry (quotas), but only if they are complemented with the provision of technical water knowledge also to women; raising the awareness of the importance of more

women in leadership, and establishing specific conditions to facilitate the participation of those women willing to be involved in irrigation management.

Nevertheless, a genuine gender-inclusive participation in irrigation management will only happen if persistent asymmetrical gendered social structures and social hierarchies are challenged (Harris, 2006; Upadhyay, 2003; Vera Delgado and Zwarteveen, 2017). Attempts at changing cultural obstacles to equitable representation of women are notoriously difficult; however, without the understanding of the specific interacting social *and* technical issues that women face, their failure is inevitable. The transformation of current water management systems requires political will to invest in water infrastructure and technology adapted to the needs of different groups of users, and water institutions with adequate knowledge and skills to respond to the complex requirements of more egalitarian water governance. In the traditionally male-dominated water institutions of Tigray and Mendoza, there is a clear need to educate water management officials to recognize the capacity of women in technical and management positions in water governance. More women need to be trained and employed in water agencies at higher hierarchical levels. To place more women in these positions will be only possible through a cultural change fostered by explicit and effective policy frameworks. In Tigray, there is clear evidence that effective policy (e.g., land registration policy) and the proactive gender awareness efforts made by the government and international cooperation programs, have positively influenced the sector and resulted in the inclusion of more women in management and leadership of WUAs. Similar positive evidence is provided by Najjar (2015) from Egypt when governmental policies supported women irrigating on their own with modern, “women-friendly” pressurized irrigation schemes. However, this willingness to increase participation of women must be continuously reinforced, most importantly, at the local administration and irrigation scheme levels, where the real societal changes happen, and where discrepancies between policy and implementation are most evident due to poor dialogue between policy makers, academia and implementation; weak institutional structures; underfunded gender integration actions, and prevalent gender unequal customary rules. Otherwise, participation of women appears to be hard to consolidate, as shown by the examples from Mendoza. More explicit and better-informed gender integration policies and practices within the irrigation water sector are imperative and urgent. They continue to be missing on the ground, but are needed to overcome exclusions that affect self-governed, communal SSIS in most low and medium income countries and to effectively improve the security of livelihoods of large rural communities.

## Notes

1. For analyses of the specific issues of women in leadership of irrigation WUAs, see Van Koppen et al. (2001), for a case study from Nepal, and Upadhyay (2003), for a review of cases from Nepal, India and South Africa.
2. By “well-rooted” WUAs this paper describes WUAs with greater representativeness of the members, and that are trusted and respected in the community of users; therefore, there is greater community ownership than in “poorly-rooted” WUAs.
3. Due to the recent implementation of land policy changes in Tigray, only young married women were found holding their own land certificates. Source: Fieldwork, March 2018.
4. In Mendoza, elections of inspectors are conducted every four years. In Tigray, the performance of the *abomay* is evaluated annually by all members. Members are then confirmed or removed from the position.
5. The person, who is leader of the WUA, receives a score of 5; those who are not leaders but are members of the WC, receive a score of 4; those who fulfill all or most of duties and responsibilities including attending meetings and may fulfill additional (voluntary) WUA’ activities, receive a score of 3; those who fulfill WUA’s compulsory duties and responsibilities to avoid sanctions, receive a score of 2; those who mentioned fulfilling a minimum amount of WUAs’ activities, receive a score of 1; and those who are only registered members but do not fulfill members’ responsibilities receive a score of 0.
6. Interview, WUA leader, Mendoza River (male) 18/08/2016.
7. FGD, WUA leaders (male), highlands 03/02/2016; interview, WUA leader (male), lowlands 06/02/2016.
8. FGD, female heads of household 14/03/2018.
9. FGD, male *abomay* and members of WC, highlands 03/02/2016.
10. Interview, WUA leader, lowlands of Tigray (male) 06/02/2016.
11. Interviews, WUA leader, Mendoza River (female) 20/04/2016; 04/04/2019.
12. Interview, WUA leader, Mendoza River (female) 04/04/2019.
13. FGD, female farmers, head of household, lowlands of Tigray 14/03/2018.
14. Tigray: FGD, female farmers, highlands of Tigray: heads of household 13/03/2018; non-heads of household 15/03/2018; interviews, female irrigation experts, 02/02/2016, 04/02/2016, 13/03/2018. Interviews in Mendoza: manager 2<sup>nd</sup> grade WUA (male) 28/07/2016; DGI Mendoza River Delegate (male) 29/08/2016.

## References

- Aarnoudse E, Closas A and Lefore N (2018) Water user associations: a review of approaches and alternative management options for sub-Saharan Africa. IWMI Working Paper 180. Colombo, Sri Lanka.
- Adams EA, Juran L and Ajibade I (2018) “Spaces of Exclusion” in community water governance: A Feminist Political Ecology of gender and participation in Malawi’s Urban Water User Associations. *Geoforum* 95: 133-142.
- Agarwal B (2001) Participatory exclusions, community forestry, and gender: An analysis for South Asia and a conceptual framework. *World Development* 29(10): 1623-1648.
- Agarwal B (2010) Does women’s proportional strength affect their participation? Governing local forests in South Asia. *World Development* 38(1): 98-112.
- Agarwal B (2015) The power of numbers in gender dynamics: Illustrations from community forestry groups. *The Journal of Peasant Studies* 42(1): 1-20.
- Ahlers R and Zwarteveen M. (2009) The Water Question in Feminism: Water Control and Gender Inequities in a Neo-Liberal Era. *Gender, Place & Culture* 16(4): 409-426.
- Aladuwa S and Momsen J (2010) Sustainable development, water resources management and women's empowerment: the Wanaraniya Water Project in Sri Lanka. *Gender and Development* 18(1): 43-58.

- Arnstein SR (1969) A ladder of citizen participation. *Journal of the American Institute of Planners* 35(4): 216-224.
- Bastidas E (2005) Women and water in the Northern Ecuadorian Andes. In: Bennett V, Dávila-Poblete S and Rico MN (eds) *Opposing currents: The politics of water and gender in Latin America*. Pittsburgh, USA: University of Pittsburgh Press.
- Bennett V, Dávila-Poblete S and Rico N (2005) *Opposing currents: The politics of water and gender in Latin America*, Pittsburgh, USA: University of Pittsburgh Press.
- Bezabih M, Holden S and Mannberg A (2016) The role of land certification in reducing gaps in productivity between male- and female- owned farms in rural Ethiopia. *The Journal of Development Studies* 52(3): 360-376.
- Boelens R and Zwarteveen M (2002) Gender dimensions in water control in Andean irrigation. In: Boelens R and Hoogendam P (eds) *Water rights and empowerment*. Assen, The Netherlands: Koninklijke Van Gorcum, pp.75-109.
- Bryman A (2012) *Social research methods*, Oxford: UK: Oxford University Press.
- Brisbois MC and de Loë RC (2016) Power in collaborative approaches to governance for water: A systematic review. *Society and Natural Resources* 29(7): 775-790.
- Buechler S (2005) Women at the helm of irrigated agriculture in Mexico. The other side of male migration. In: Bennett V, Dávila-Poblete S and Rico N (eds) *Opposing currents: The politics of water and gender in Latin America*. Pittsburgh, USA: University of Pittsburgh Press.
- Buisson M, Curnow J and Naz F (2017) The gender gap between water management and water users: evidence from Southwest Bangladesh. *South Asian Water Studies* 5: 28-41.
- Centrone F, Mosso A, Busato P, et al. (2017) Water gender indicators in agriculture: A study of horticultural farmer organizations in Senegal. *Water* 9(12): 972.
- Chancellor F (2005) Enabling women to participate in African smallholder irrigation development and design. *Gender, Water and Development*: 155-172.
- Cleaver F (1998) Choice, complexity, and change: Gendered livelihoods and the management of water. *Agriculture and Human Values* 15(4): 293-299.
- Collard R, Harris L, Heynen N and Mehta, L (2018) The antinomies of nature and space. *Environment and Planning E: Nature and Space* 1(1-2): 3-24.
- Cornwall A (2003) Whose voices? Whose choices? Reflections on gender and participatory development. *World Development* 31(8): 1325-1342.
- Cornwall A (2011) *The Participation Reader*, London: Zed Books.
- Cornwall A and Edwards J (2015) Introduction: Beijing+ 20—where now for gender equality? *IDS Bulletin* 46(4): 1-8.
- D'Exelle B, Lecoutere E and Van Campenhout B (2012) Equity-efficiency trade-offs in irrigation water sharing: Evidence from a field lab in rural Tanzania. *World Development* 40(12): 2537-2551.
- DGI (2015) Balance Hídrico Tunuyán Inferior [Water demand and supply analysis Lower Tunuyán River Basin]. Presentación en Boletín Oficial: 18/07/2016. Mendoza, Argentina: Departamento General de Irrigación.



- DGI (2016) Balance Hídrico Río Mendoza y Cuenca del Río Mendoza [Water demand and supply analysis Mendoza River Basin]. Presentación en Boletín Oficial: 10/01/2017. Mendoza, Argentina: Departamento General de Irrigación.
- Domènech L (2015) Improving irrigation access to combat food insecurity and undernutrition: A review. *Global Food Security* 6: 24-33.
- Gebrehiwot N, Mesfin K and Nyssen J (2015) Small-scale Irrigation: The Driver for Promoting Agricultural Production and Food Security (The Case of Tigray Regional State, Northern Ethiopia). *Irrigation and Drainage Systems Engineering* 4(2): 1000141.
- Harris L (2005) Negotiating inequalities: Democracy, Gender, and Politics of Difference in Water User Groups of Southeastern Turkey. In: Ashgate A and Aldershot U (eds) *Environmentalism in Turkey*. Aldershot, UK and Burlington, VA, USA, pp.185-200.
- Harris L (2006) Irrigation, gender, and social geographies of the changing waterscapes of southeastern Anatolia. *Environment and Planning D: Society and Space* 24(2): 187-213.
- Harris L. (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 L. (2009) Gender and Emergent Water Governance: Comparative Overview of Neoliberalized Natures and Gender Dimensions of Privatization, Devolution and Marketization. *Gender, Place & Culture* 16(4): 387.
- Harris L (2015) Hegemonic waters and rethinking natures otherwise. In: Harcourt W and Nelson I (eds) *Practising Feminist Political Ecologies*. London: Zed Books, pp.336.
- Harris L, Kleiber D, Darkwah A, et al. (2015) Intersections of gender and water: Comparative approaches to everyday gendered negotiations of water access in underserved areas of Accra, Ghana and Cape Town, South Africa. *Journal of Gender Studies* 26(5): 561-582.
- Imburgia L (2019) Irrigation and equality: A gender-analytical approach for water governance with examples from Ethiopia and Argentina. *Water Alternatives* 12(2): 571-587.
- Imburgia L, Osbahr H and Cardey S (in preparation-a) Irrigation agriculture: A driver of social differentiation and an empowering livelihood option for rural women.
- Imburgia L, Osbahr H and Cardey S (in preparation-b) Rural development and the role of water users' associations in overcoming inequalities and sustaining small-scale irrigation agriculture.
- Lefore N, Weight E and Mukhamedova N (2017) Improving gender equity in irrigation: Application of a tool to promote learning and performance in Malawi and Uzbekistan. Colombo, Sri Lanka: International Water Management Institute (IWMI).
- Liebrand, J (2014) *Masculinities among irrigation engineers and water professionals in Nepal*. PhD Thesis, Wageningen University, The Netherlands.
- Mapedza E, Tagutanazvo EM, van Koppen B and Manyamba, C (2017) Agricultural water management in matrilineal societies in Malawi: Land ownership and implications for collective action. *Water Governance and Collective Action*. Routledge, pp.82-95.
- Masanyiwa ZS, Niehof A and Termeer CJ (2014) Gender perspectives on decentralization and service users' participation in rural Tanzania. *The Journal of Modern African Studies* 52(1): 95-122.
- Mehta L, Veldwisch GJ and Franco J (2012) Introduction to the special issue: water grabbing? Focus on the (re) appropriation of finite water resources. *Water Alternatives* 5(2): 193-207.

- Meinzen-Dick R (1997) Farmer participation in irrigation – 20 years of experience and lessons for the future. *Irrigation and Drainage Systems* 11(2): 103-118.
- Meinzen-Dick R and Zwarteveen M (1998) Gendered participation in water management: Issues and illustrations from water users' associations in South Asia. *Agriculture and Human Values* 15(4): 337-345.
- Merriam S (2009) *Qualitative Research: A Guide to Design and Implementation*. Somerset: Wiley.**
- Miletto M, Pangare V and Thuy L (2019) Gender-responsive indicators for water assessment, monitoring and reporting (Vol 1), Paris: UNESCO Publishing.
- Mommen B, Humphries-Waa K and Gwavuya S (2017) Does women's participation in water committees affect management and water system performance in rural Vanuatu? *Waterlines* 36(3): 216-232.
- Momsen JH (2020) *Gender and Development*, 3rd edition, London: Routledge.
- Montes de Oca A (2018) ¿Se acaba el campo frutihortícola en Mendoza? [Is perennial fruit production over in Mendoza?] *Mendoza Post*, 6 January.
- Morales MC and Harris L (2014) Using Subjectivity and Emotion to Reconsider Participatory Natural Resource Management. *World Development* 64(0): 703-712.
- Morinville C and Harris L (2014) Participation, Politics and Panaceas: Exploring the Possibilities and Limits of Participatory Urban Water Governance in Accra, Ghana. *Ecology and Society* 19(3):36.
- Moser CO (1992) Adjustment from below: Low-income women, time and the triple role in Guayaquil, Ecuador. In: Afshar H, Dennis C (ed) *Women and adjustment policies in the Third World*. London: Palgrave Macmillan, pp.87-116.
- Muchara B, Ortmann G, Wale E, et al. (2014) Collective action and participation in irrigation water management: A case study of Mooi River Irrigation Scheme in KwaZulu-Natal Province, South Africa. *Water SA* 40(4): 699-708.
- Mustafa D, Altz-Stamm A and Scott L (2016) Water user associations and the politics of water in Jordan. *World Development* 79: 164-176.
- MWIE (2014) Irrigation Water Users' Associations Proclamation N° 841/2014. In: Council of Ministers Ethiopian Water Resources Management (ed). Addis Ababa: Federal Negarit Gazeta No. 74, 20th year, 26th September, 2014, 36.
- Namara R, Hanjra M, Castillo G, Ravnborg, H, Smith, L and van Koppen B (2010) Agricultural water management and poverty linkages. *Agricultural Water Management* 97(4): 520-527.
- Najjar D (2015) Women's contributions to climate change adaptation in Egypt's Mubarak Resettlement Scheme through cactus cultivation and adjusted irrigation. In: Buechler S and Hanson A (eds) *A Political Ecology of Women, Water and Global Environmental Change*. Oxon, UK: Taylor & Francis, pp.141-161.
- Ongsakul R, Resurreccion B and Sajor E (2012) Normalizing masculinities in water bureaucracy in Thailand. *International Journal of Public Administration* 35: 577-586.
- Ostrom E (2011) Reflections on "Some unsettled problems of irrigation". *The American Economic Review* 101(1): 49-63.

- Perkins P and Walker P (2015) International partnerships of women for sustainable watershed governance in times of climate change. In: Buechler S and Hanson AM (eds) *A Political Ecology of Women, Water and Global Environmental Change*. London: Routledge, pp.144-166.
- Pinto ME, Rogero GE and Andino MM (2006) Ley de Aguas de 1884. Comentada y concordada [Water Law 1884. Commented and agreed], Mendoza, Argentina: Irrigación Edita.
- Raha D, Osbahr H and Garforth C (2013) Does watershed development implemented through public private partnership empower women? A case review from Rajasthan, Western India. *Journal of Cleaner Production* 60: 18-33.
- Saieg L (2017) Fruticultura: sólo quedan 100 productores de pera y manzana en la provincia [Perennial horticulture: There are only 100 pear and apple producers left in the Province]. *Los Andes*, Mendoza, 2 December.
- Saxena N (1998) What is meant by People's Participation? *Journal of Rural Development - Hyderabad* 17: 111-114.
- Schlager E and Ostrom E (1992) Property-Rights Regimes and Natural Resources: A Conceptual Analysis. *Land Economics* 68(3): 249-262.
- Senanayake N, Mukherji A and Giordano M (2015) Re-visiting what we know about irrigation management transfer: A review of the evidence. *Agricultural Water Management* 149: 175-186.
- Sultana F (2009) Community and participation in water resources management: gendering and naturing development debates from Bangladesh. *Transactions of the Institute of British Geographers* 34: 346-363.
- Sultana F (2015) Rethinking Community and Participation in Water Governance. In: Coles A, Gray L and Momsen J (eds) *The Routledge Handbook of Gender and Development*. London: Routledge, pp.261-272.
- Tang SY and Ostrom E. (1993) The governance and management of irrigation systems. An institutional perspective. *Irrigation Management Network*. Overseas Development Institute. UK: ODI.
- Theis S, Lefore N, Meinzen-Dick R, et al. (2018) What happens after technology adoption? Gendered aspects of small-scale irrigation technologies in Ethiopia, Ghana, and Tanzania. *Agriculture and Human Values*: 1-14.
- Udas P (2014) *Gendered participation in water management in Nepal: Discourses, policies and practices in the irrigation and drinking water sectors*. PhD Thesis, Wageningen University, Netherlands.
- UNDP (2019) 2019 Human Development Report. New York: United Nations Development Programme. Available at: <http://hdr.undp.org/en/2019-report/download> (accessed April 15 2020).
- UNESCO WWAP (2019) World Water Assessment Programme (UNESCO WWAP). Available at: <http://www.unesco.org/new/en/natural-sciences/environment/water/wwap/water-and-gender/> (accessed June 10 2019).
- Upadhyay B. (2003) Water, Poverty and Gender: Review of Evidences from Nepal, India and South Africa. *Water Policy* 5: 503-511.
- Van Koppen, B (2017) Rural women's rights to water for health, food, and income. Expert paper EGM/RWG/EP 7, 20-22 September. Rome: UN Women, IFAD, FAO, WFP Expert Group Meeting.

- Van Koppen, B, Hellum, A, Mehta, L, Derman, B and Schreiner, B (2017) Rights-based freshwater governance for the twenty-first century: Beyond an exclusionary focus on domestic water uses. In: Karar, E (ed) *Freshwater Governance for the 21st Century*. New York, USA: Springer International Publishing, Volume 6, pp.129–143.
- Van Koppen B, Van Etten J, Bajracharya P and Tuladhar, A (2001) Women irrigators and leaders in the West Gandak Scheme. Nepal. Working Paper 15. Colombo: International Water Management Institute.
- Vera Delgado J (2005) Irrigation management, the participatory approach, and equity in Andean community. In: Bennett V, Dávila-Poblete S and Rico N (eds) *Opposing currents: The politics of water and gender in Latin America*. Pittsburgh, USA: University of Pittsburgh Press, pp.109-122.
- Vera Delgado J and Zwarteveen M (2017) Queering Engineers? Using history to re-think the associations between masculinity and irrigation engineering in Peru. *Engineering Studies* 9(2): 140-160.
- Wallace T and Coles A (2005) *Gender, water and development*, Oxford: Berg.
- White SC (1996) Depoliticizing development: the uses and abuses of participation. *Development in Practice* 6(1): 6-15.
- Yami M (2013) Sustaining participation in irrigation systems of Ethiopia: What have we learned about water user associations? *Water Policy* 15(6): 961-984.
- Yazew E, Gebru T, G/Egziabher T, et al. (2010) Spate irrigation system in Raya Valley, Ethiopia. Overview Paper 13 Spate Irrigation, Spate Irrigation Network, Ethiopia.
- Yin R (2003) *Case study research. Design and Methods*, 3rd edition, California: Sage.
- Zwarteveen M (2008) Men, masculinities and water powers in irrigation. *Water Alternatives* 1(1): 111-130.
- Zwarteveen M (2011) Questioning Masculinities in Water. *Economic and Political Weekly* XLVI(18), 30 April, 40-48.
- Zwarteveen M, Udas P and Vera Delgado J (2010) Gendered dynamics of participation in water management in Nepal and Peru: Revisiting the linkages between membership and power. In: Berry KA and Mollard E (ed) *Social Participation in Water Governance and Management: Critical and Global Perspectives*. London, UK: Earthscan, pp.69-92.