

Women, irrigation and social norms in Egypt: ‘The more things change, the more they stay the same?’

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Abstract

This paper explores how women and men participate in irrigation activities in Egypt, drawing from a survey administered to 200 men and 202 women and qualitative information from 150 interviews. Women participated in irrigation activities in 78% of the 402 households surveyed, suggesting that women are far more actively engaged in irrigation efforts in Egypt, and possibly in the wider MENA region, than is generally assumed. The diffusion of certain irrigation technologies such as drip, sprinkler and *tatweer* in recent years has made irrigation more socially acceptable for women to perform although some women had also been irrigating land long before these technologies became available. We identify land ownership, educational attainment, institutional support from government, donors and NGOs, and access to training in irrigational technologies as factors that enable women to optimally undertake irrigation. These factors enabled women to participate meaningfully in public institutions related to irrigation, such as water user associations (WUAs). Finally, we discovered that desire and ability to participate in WUAs declined dramatically for both women and men when institutional support was withdrawn or eroded. Thus, the paper concludes that we must look at a variety of social categories and relationships to understand women’s involvement in irrigation and to identify ways to strengthen it.

Keywords: Egypt; Gender; Irrigation; Social norms; Technologies; Women

Introduction

This paper examines the involvement of women and men in irrigation in two regions in Egypt, the Old Lands (represented in our study by the community of Kafr Sheikh) and New Lands (represented in our study by the community of Noubariya (see [Figure 1](#)). These two regions have common

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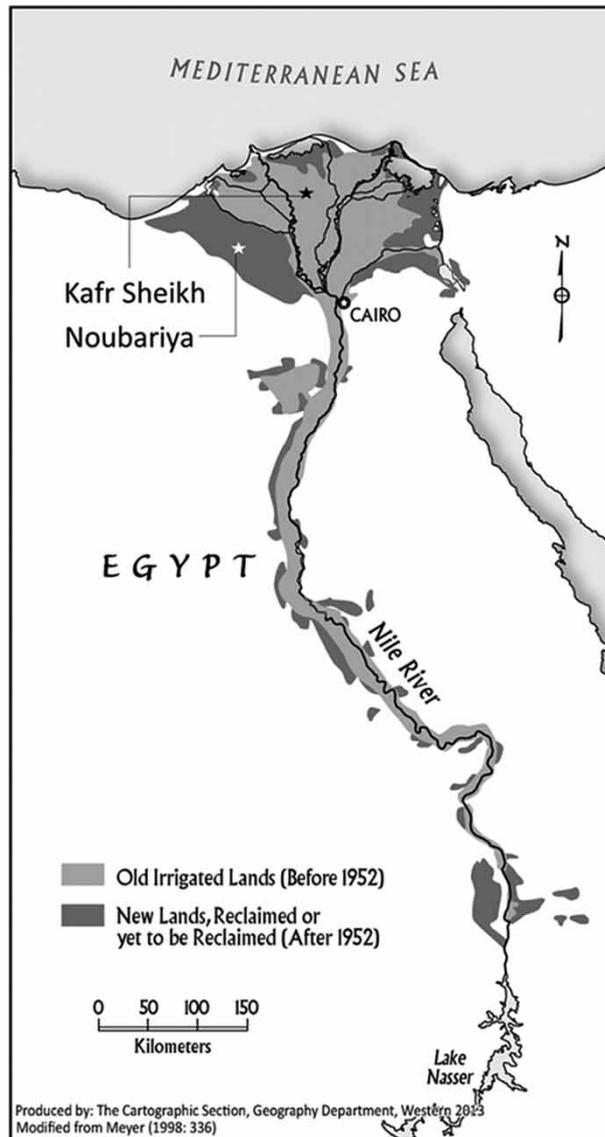


Fig. 1. Study locations in Egypt.

socio-cultural, historical and economic ties but differ significantly where these relate to women's land ownership and participation in public life (Sukkary-Stolba, 1985; Adriansen, 2009). While the primary objective of this study was to understand similarities and differences between how women and men participate in irrigation in Egypt, conducting fieldwork in both Old and New Lands of Egypt enabled us to also explore and understand how women's desire and ability to participate in irrigation activities may be influenced by the social, economic and political roles and responsibilities that women and men are accustomed to holding in specific contexts as well as institutional recognition of and support for women's rights and gender equality.

The New Lands are desert lands that have been reclaimed and cultivated since the Revolution of 1952 in Lower Egypt and the building of the High Aswan Dam. The Noubariya settlement in the New Lands was only reclaimed in the 1990s by the Mubarak Resettlement Scheme (MRS) implemented by the Ministry of Agriculture and Land Reclamation (Bush, 2007). Irrigation in the New Lands is based primarily on drip and sprinkler systems. The Old Lands, on the other hand, had been irrigated by the natural overflow of the Nile river and settled for thousands of years before the High Aswan Dam was built. Flood irrigation continues to be a common method of irrigation in the Old Lands although certain villages in Kafr Sheikh also had an irrigation system called *tatweer*, which enabled the distribution of water to agricultural land via a network of lined canals, thereby reducing water loss and ensuring more equitable distribution of water to farmers (Molle et al., 2015). *Tatweer* also allows for more control over irrigation scheduling and reduced dependence on low quality drainage water (Molle et al., 2015). To make our research as diverse and representative as possible of women's experiences as irrigators in Egypt, we included women from both the New and Old Lands in this study. We examined three different irrigation systems (drip, sprinkler and *tatweer*), different institutional contexts in the Old and New Lands, and their implications for women's roles as irrigators.

While the Noubariya settlement in the New Lands has a 20% landownership rate for women, the Old Lands are known to have a much lower landownership rate for women of only 2–6% (USAID, 2010; ICF International, 2015). The Noubariya settlement was of particular interest to our study because the World Food Program (WFP) provided food aid to settlers in the area on the condition that women received 20% of the distributed land titles. Each distributed parcel of land was either 2.5 or 5 acres. Settlers who held a university degree or diploma were allowed access to 5 acres of land and a homestead in a nearby village. The rationale behind this was that endowing educated unemployed people with land might motivate them to take up farming or to open businesses to support themselves.

In addition to requiring that women receive one-fifth of the land titles in the New Lands, the WFP also insisted on the inclusion of women in leadership positions on formal land-related committees such as water user associations (WUAs) and local agricultural cooperatives (LACs). The WUAs are responsible for scheduling water use, resolving conflict over water use, and providing irrigation training. The LACs are responsible for the distribution of inputs such as fertilizer and microcredit, enforcing crop rotations, and providing agricultural training. The International Fund for Agricultural Development (IFAD) and the MRS training program provided formal leadership training to both male and female graduate settlers during the early 1990s. Taken together, these interventions created important and visible roles for women in agriculture in the New Lands. This is quite different from the Old Lands of the Egyptian delta (including our study community, Kafr Sheikh) where women are far less likely to own agricultural land, attend training, or to participate in public life, even when they own or manage land (El-Tobshy, 2005; Barnes 2013).

Plot sizes are smaller in the Old Lands. In Kafr Sheikh, they are on average less than an acre. Consequently, people in Kafr Sheikh tend to farm multiple parcels of land (two or three on average). While farming in Kafr Sheikh is subsistence oriented with a focus on rice and wheat production, farming in Noubariya is export-oriented and more lucrative, with a focus on fruit production. Nonetheless, livestock and sugar beet plantations may also be lucrative enterprises in Kafr Sheikh.

Most settlers in the New Lands are originally from the Old Lands and many continue to maintain strong ties with family and friends in the Old Lands. During the early years of settlement, many settlers left their children with extended family members in the Old Lands because schools had not yet been set up in the New Lands. Since public services such as healthcare centres and government offices as well as

private businesses such as grocery, household goods and clothing stores are better established in the Old Lands, many settlers in the New Lands continue to visit the Old Lands to access such services.

There tends to be a higher demand for agricultural labour in the New Lands since settlers relocated there as nuclear families, obtained relatively large parcels of land and started farming commercially (Dixon, 2017). The higher demand for labour – including women's labour – in the New Lands, combined with the fact that settlers do not live in multigenerational extended families and have not known their neighbours for a long time, may have led to less rigid social norms about what men and women can do in agriculture, and less social control over women's roles and movements in general. As our findings will demonstrate, these differences affect women's participation in irrigation management.

The existing scholarly and practitioner literature on women's participation in irrigation in Egypt suggests that although women participate quite actively in irrigation and water management, their contributions are poorly understood and undervalued by land owners (typically men in their own families and communities) as well as by irrigation engineers and extension agents (Ibrahim, 2006; Barnes, 2014). By identifying and describing women's contributions to the irrigation sector and making recommendations for improving women's access to irrigation technologies and participation in water governance, this paper seeks to make a modest contribution toward improving women's visibility in irrigation in Egypt. In this study, we attempted to discover what barriers and opportunities women encounter if they participate in irrigation activities as well as how these may be related to land ownership status, education, class background, access to training, type of technology, and social norms of the community they reside in. Because irrigation is often perceived as a masculine activity, women's involvement in irrigation may challenge gender norms (Zwarteveen, 2008, 2011; Barnes, 2013; Carreta, 2015). Therefore, this study also attends to the question of how women who irrigate challenge or comply with patriarchal gender norms and the extent to which women who irrigate may be able to influence gender norms over time. Findings from this research contribute to a better understanding of three important topics of interest for social and natural scientists, namely gender norms and irrigation, technology adoption, and participation in water management.

Irrigation, gender norms, technologies and participation

Irrigation is typically seen as a masculine activity and male irrigation engineers are the most visible professional workers associated with this sector. However, the study of irrigation management has evolved over time to include non-engineering disciplines and an emphasis on participatory management or Integrated Water Resources Management (IWRM), which 'emphasizes the pivotal role of women as providers and users of water' (Ongsakul *et al.*, 2012, p. 580). Although women's roles in water management are better recognized today, perhaps because of over four decades of research and scholarship on gender and development, gender issues continue to 'remain under-theorized and marginal in much water literature' (Laurie, 2011, p. 172–173). Meinzen-Dick & Zwarteveen (1998) call for detailed and comparative research in different world regional contexts on the major factors that affect women's participation in irrigation management and control over irrigation resources. They emphasize that it is particularly important to ensure equitable participation of women in irrigation since control of water resources is increasingly being transferred from centralized entities such as water boards and utilities to community institutions such as local WUAs.

Other researchers, including those writing specifically about Egypt, note that the increased participation of women as farm managers (often because of male outmigration) should be matched with increased participation of women in irrigation management (Zwarteveen & Neupane, 1996; Ibrahim, 2006; Gunchinmaa *et al.*, 2011; Ongsakul *et al.*, 2012; Gouda, 2013; Barnes, 2014). They assert that in practice, the opposite appears to be true: the numbers of women participating in WUAs often decline even as more women take up farming out of choice or necessity.

Gouda (2013) reports that women's management of farms in Egypt has increased since the 1970s due to the oil boom in the Gulf States which fueled male outmigration. Existing studies on gender and irrigation identify gendered social norms as the major reason why women's engagements with and contributions to irrigation are ignored or undervalued (Van Koppen & Hussain, 2007; Gunchinmaa *et al.*, 2011; Zwartveen, 2011). Gender norms refer to gender dimensions of social norms, or the societal expectations of how men and women ought to behave in their everyday lives. Social norms also 'structure social interactions in ways that allow certain social actors to gain the benefits of joint activity. And they determine in significant ways the distribution of the benefits of social life' (Knight & Ensminger, 1998, p. 105).

Zwarteveen (2011) argues that feminist inquiries into power and irrigation must go beyond making women 'fit' in irrigation, and instead look to how gendered norms in irrigation are produced, particularly those that deem to be irrigation naturally masculine. Indeed, men have historically been overrepresented in leadership roles in most irrigation schemes (Hulsebosch & Ombara, 1995; Carreta, 2015) and gendered ideas about how women interact with and use irrigation water determined the ways in which project coordinators, for example, understood and responded to women's concerns (Ge *et al.*, 2011; Laurie, 2011; Barnes, 2013). The same studies show that even when women had opportunities to participate in WUAs, their domestic water needs were perceived as more legitimate than their irrigation water needs. And since most WUAs do not have a mandate to address domestic water needs, women's participation in WUAs was often just tokenistic. Even when women articulated an interest in irrigation and in participating in WUAs as irrigators, they were either ignored or relegated to marginal roles (Najjar 2015). Barnes (2013) shows how norms related to roles determined the conditions of participation and eventually the actual nature and extent of women's involvement in WUAs.

Several researchers have emphasized the importance of land ownership as a precondition for optimizing women's participation in irrigation management. Since women seldom owned land and were rarely perceived as irrigators, they were almost never presented with opportunities to serve on WUAs and other irrigation management institutions. Harris (2006, p. 211) suggests that irrigation planners should consider alternative solutions to addressing gender inequality that challenge 'rather than entrench existing social differentials'. Ahmed (1999) argues that women's inclusion in water management institutions might be enhanced by adopting a variety of strategies that can provide them with training, ensuring that domestic duties such as childcare are not barriers to participation and not basing participation in irrigation management on land ownership.

Gender norms also play an important role in determining adoption of technologies. While pedal pumps were deemed beneficial for men in sub-Saharan Africa, they were deemed inappropriate or even shameful for women to use in the same contexts (Theis *et al.*, 2018). The literature on this topic suggests that the role played by gender norms in enabling or disabling women's ability to adopt irrigation technologies is under-researched and so are the benefits and constraints following the adoption of specific irrigation technologies. Very few studies explore gendered patterns of irrigation technology adoption and women's ability to benefit from them. The existing research on gender and technology adoption is based in South Asia and sub-Saharan Africa (see, for example, Njuki *et al.*, 2014; Theis *et al.*, 2018). There is

no published literature on this topic in the context of the MENA region. Our study hopes to contribute modestly to addressing this knowledge gap. In this study, we examine women's access to improved irrigation technologies (drip, sprinkler and *tatweer*) and subsequent outcomes for women's visibility in, and ability to benefit from, irrigation roles and technologies.

Although gender norms play an important role in technology adoption, it is important to simultaneously emphasize that gender norms are never static. They are constantly being reproduced, adapted, contested and negotiated as part of everyday social interactions (Jackson, 1998). Migration and resettlement, for example, may play an important role in changing gender norms. Ge *et al.* (2011) look at how gender norms and other social hierarchies are simultaneously reproduced and adapted by male and female return migrants in a water management project in rural China. They question the extent to which any influx of new ideas, relationships and practices acquired from migrant experiences necessarily destabilizes power and authority in the village in any meaningful way. By contrast, writing specifically about Egypt, Adriansen (2009) and Sukkary-Stolba (1985) emphasize that gender norms have been transformed through resettlement in the New Lands in Egypt due to the targeted distribution of land titles to women through the MRS, women's assumption of new economic roles, labour shortages, new commercial farming systems, and institutional support for women's participation in public life. Adriansen (2009, p. 670) notes: 'Here the social norms and rules of the old lands can be negotiated and redefined. Hence, by granting land to women, the "Mubarak Project" has enabled rural women to participate actively in shaping their society.' Very little research has been conducted on changing social norms in the New Lands even as desert land reclamation has continued to be an important national policy in Egypt (Alary *et al.*, 2018). By locating part of our research in the New Lands in Egypt, we also understand if resettlement in new communities might create opportunities for women to participate in irrigation and water management.

Study methodology

A survey was administered to a total of 402 respondents (200 men and 202 women) in the Old and New Lands. Additionally, a total of 120 semi-structured interviews were conducted with survey respondents (60 interviews in each region). Another 30 interviews were conducted with water engineers and other officials responsible for irrigation (15 in Kafr Sheikh and 15 in Noubariya). While the survey findings offered a broad overview of roles in irrigation, and adoption of irrigation technologies and techniques, the interviews enabled us to understand women's contributions to irrigation in the two communities as well as the challenges and opportunities they faced in more nuance, depth and detail. We also used participant observation during our fieldwork to triangulate our findings about women's roles in irrigation management. Survey data were analyzed in SPSS and interview data were analyzed using theme identification and explanation building.

While the 200 men and 202 women the survey was administered to were not from the same family, participants in semi-structured interviews were sometimes from the same family. Fieldwork was completed in 13 villages in Kafr Sheikh and 13 villages in Noubariya. Some villages in Kafr Sheikh had *tatweer* irrigation, while others were still awaiting the installation of *tatweer*. Survey respondents were identified by extension engineers who oversaw the agricultural cooperatives in each village. They knew all farmers in the community because they were responsible for enforcing crop rotations and distributing fertilizer, and because they were themselves members of the village communities.

Extension engineers were asked to identify farmers who owned land, farmers who rented land, and to ensure equal numbers of male and female respondents. Because very few women owned land independently in the Old Lands, we included women who worked on land owned jointly with their spouses, or by their extended families. The first group of interview participants in both communities was selected randomly from survey respondents. Subsequent interview participants were selected through snowball sampling, i.e. by asking those who interviewed to identify other male and female farmers in the area who were willing to be interviewed.

The interview questions were designed to enable us to understand the irrigation roles and responsibilities of women and men on (1) their own farms or on family farms, (2) as hired labourers and (3) on WUAs. We asked questions about the nature, extent, barriers and opportunities for women's participation in WUAs, their ability to adopt new irrigation technologies as well as the associated benefits and drawbacks.

The interviews also enabled us to understand how gendered social norms influenced women's and men's interactions with irrigation officials. Because gender is relational, we also tried to understand how others in the community respond to women's participation in irrigation and WUAs, as well as their adoption of irrigation technologies. Interviews with water engineers and other professionals in the irrigation sector in the Old and New Lands enabled us to understand how these officials interact with male and female farmers and respond to their needs.

Findings and discussion

We have organized findings from this study along three dimensions: gender roles, norms and changes; technology adoption, approach and impacts; and participation on WUAs. These three dimensions are interrelated and influence one another. For example, we found that training women in technological aspects of irrigation is directly related to their ability to participate in WUAs. Survey data are presented as percentages. Qualitative data are summarized, and insightful quotes are reproduced verbatim.

Irrigation roles and norms: disruptions, contradictions and continuities

Irrigation officials in Kafr Sheikh (Old Lands) estimated that 30% of farmers and irrigators in the area were women. While irrigation officials acknowledged women's contribution to irrigation, researchers at the Agriculture Research Center (ARC) and some male farmers were quick to deny or dismiss any involvement of women in irrigation. The following are verbatim responses from male farmers in Kafr Sheikh to a question about women's participation in irrigation activities.

'Women cannot irrigate because irrigation comes in monawba [rotations]. If the water comes at 2 am, how would a woman go?'

'Men fight over water and might beat each other. What will a woman do in such a situation?'

'How can a woman possibly irrigate? It would require her to roll up her clothes.'

A male researcher at the ARC emphasized that 'women in Egypt do not irrigate'. A female researcher informed us that attempting to study women's roles in irrigation was a futile endeavour since Egyptian women do not participate in irrigation.

Social norms that regulate women's decorum, propriety and mobility as well as the perceived need for physical strength to carry out irrigation activities were frequently cited as the reasons for women's inability or unwillingness to participate in irrigation. Similar findings are reported by Barnes (2013) and an Arabic-language documentary entitled 'She Cultivates, She Irrigates' (1998) produced in the mid-1990s by the Dutch-Egyptian Advisory Panel on Water Management to render women's contributions to agriculture and irrigation in the MENA region more visible. The documentary effectively demonstrates the blurriness between what women are not supposed to do (ploughing and irrigating, for example) and how they end up navigating social norms to do them anyway, either by choice or out of necessity.

Assumptions about women's inability to irrigate are certainly not borne out by our survey findings: 87% of respondents in Kafr Sheikh (Old Lands) reported that women participate in irrigation activities on their families' lands. Of these respondents, 6.5% believed that women and men contributed equally to irrigation on family farms. In Noubariya (New Lands), 68.8% of respondents reported that women participate in irrigation on their farms and 2.5% believed that women and men contributed equally to irrigation on their own farms. Along the same lines, female respondents reported 48% and 16% more visits by agricultural extension agents than men in Kafr Sheikh and Noubariya, respectively. When consulted about these findings, officials in both areas explained that women are often the ones farming during the day and as such are more likely to interact with extension agents. Water engineers, on the other hand, are less likely to tour the fields and more likely to be visited by farmers in their offices. This was borne out in our survey findings: female farmers reported 22% and 40% fewer visits to water engineers than male farmers in Kafr Sheikh and Noubariya, respectively.

When presented with extensive evidence of women's participation in irrigation in both areas, officials and farmers suggested that women who participated in irrigation did so out of necessity – because there were no men available to help them. 'Women heads of households have no option but to irrigate,' explained a farmer from a relatively better-off community in the Old Lands. Several irrigation officials suggested that women who participated in irrigation belonged to a lower social class and were either illiterate or had little education and did not know how to ask for help. The fact that they rarely, if ever, interacted with or tried to find out what women farmers needed was never mentioned. 'For sure there is no man in the house, for a woman to irrigate or clean a drain, she is obliged,' explained a water engineer in the Old Lands. Women who undertook irrigation activities often also articulated that they did so because they had no other options. 'I irrigate at night. I irrigate anytime. There are no jobs. I have to rent land. I have to teach my children. Sometimes I do not like how the renter is treating me. I leave him and go to the next one. He wanted me to clean the canal. I cannot clean the canal,' explained a widowed female farmer in Kafr Sheikh.

In our interviews, all male and female respondents suggested that men were better irrigators than women due to their physical strength, knowledge, and experience. Although physical strength presented very few actual barriers for participation in irrigation, specific irrigation techniques were deemed more difficult than others and even considered exclusive to men. Irrigation using the '*hawal*' method or furrows, for example, was deemed difficult for women to carry out since it required speed and experience. This method was used to irrigate cotton and sugar beet during the early growth stages. It entailed opening and closing furrows quickly to moisten the soil. If too much water is applied during this stage, the crop may be destroyed. Since women were systematically excluded from learning this technique, they obviously never acquired either speed or experience. Our observations during fieldwork and interviews with farmers revealed that men cannot irrigate alone either; their wives helped them irrigate using the '*hawal*' approach.

Night irrigation was deemed socially inappropriate for women to carry out. It was considered an exclusive activity for men although women who did not have any male support frequently also irrigated at night. The interviewees also all emphasized that only men can clean water canals. However, during our field visits, we met female renters or women farming their family land who explained that they clean the canals themselves. These local social norms about what women and men can or cannot do have negative consequences for women's ability to rent land, which, due to land fragmentation, is a common livelihood practice in the Old Lands (Bush, 2007). Landowners, who are much more likely to be men, preferred to rent their lands to a man and not to a woman: 'Even if the woman [the wife] will be the one farming, I prefer to rent the land to a man,' explained a landowner in Kafr Sheikh. 'I have a hard time finding a piece of land to rent. Landowners prefer to rent their lands to men. They want their water canals to stay clean,' explained a woman renter in Kafr Sheikh. The social perception of women's inability to clean canals was obviously a greater barrier than their actual ability to do so since women who did not have male support did clean canals. This contributed to the preference for male renters. Because of these perceptions and norms, women were also disadvantaged in remuneration in agriculture. Survey findings reveal that women were never hired as wage workers for irrigation tasks. Cleaning water canals and other tasks deemed exclusively male were paid a much higher daily wage (60 EGP) than tasks such as harvesting, weeding, and transplanting rice for which women were typically hired at 40 EGP a day.

To understand gender roles and norms in irrigation, Theis et al. (2018) emphasize that it is important to find out whether control over income from irrigated agriculture corresponds with contributions of labour by women and men. We discovered that 15% of women in Noubariya and 7% of women in Kafr Sheikh exercised exclusive control over income from irrigated farming; 31% of women in Noubariya and 23% of women in Kafr Sheikh reported jointly controlling income with their spouses. The fact that more women in Noubariya have control over income from irrigated agriculture than in Kafr Sheikh may be attributable to higher levels of land ownership among women in Noubariya. We simultaneously discovered that 47% of men in Kafr Sheikh and 69% of men in Noubariya exercised exclusive control over income from irrigated agriculture. Some men (8% in Noubariya and 2% in Kafr Sheikh) reported controlling income from irrigated agriculture with other men (brothers, fathers, uncles, for example) in their families. These findings suggest that despite some differences in women's and men's control over income earned from irrigated farming in Noubariya and Kafr Sheikh, women may not be benefitting equitably with men from their labour contributions to irrigated farming in either community.

As reported previously in research conducted in the region (see, for example, Barnes, 2013; Gouda, 2013) and reinforced by our findings, women who irrigated in the Old Lands were heads of households. They were widowed, divorced or separated women, or they were married to men who had migrated elsewhere in search of better economic opportunities. Agriculture is becoming increasingly unprofitable in Kafr Sheikh, and in the Old Lands more generally, because of decreased subsidization of agricultural inputs, land fragmentation due to inheritance, and decline in cotton exports.

Women in Kafr Sheikh often cultivate the land for subsistence purposes (producing rice and wheat for household consumption as well as fodder for animals) even when their husbands also live on the farm because men can earn higher incomes from working in non-farm activities or even as hired labour on other farms. These men often irrigate the land if they are around and if the water arrives at night. Nonetheless, married women who contributed significantly to irrigation often explained that they were 'helping their husbands' when it seemed to be the other way around. The perceptions of women as helpers to their husbands instead of as workers in their right is documented elsewhere in

the literature in Egypt (Barnes, 2013; Gouda, 2013; Najjar et al., 2017) and identified as a major barrier for women's optimal participation in agriculture.

Women were generally described as helpers to their husbands rather than workers in their own right in both the Old Lands and the New Lands, even though women often had sole title to their land in the New Lands. Interviewees in the New Lands also more frequently explained women's involvement in irrigation as a consequence of labour shortages: 'In the Old Lands there are many men in the household. Here it is only you, your husband and children. Women have far more work to do here,' explained the wife of a graduate landholder in Noubariya, 'There were no labourers when we first arrived here in 1994. Only 70 people came here. Women had to also work on the land. My mother encouraged me to stand by my husband.'

Social norms and perceptions about what women could and could not do were quite different in the Old and New Lands. Women who participated in irrigation activities in the Old Lands were described as illiterate or uneducated, and it was assumed that they participated in irrigation because of a lack of male support and other options for livelihood generation. By contrast, women who participated in irrigation in the New Lands were more likely to be described as experienced and knowledgeable even though many of them were, like the women in the Old Lands, also divorced or widowed and had no male support. As graduate settlers, women in the New Lands acquired rigorous training in irrigation and agricultural management over a span of several years. They knew when to irrigate, when to stop irrigating, and how many times to irrigate their crops. 'There was training in Noubariya on how to operate the water pumps and use filters, and women were among the recipients of filters and training,' explained a woman graduate landholder. Their educational attainment and training specific to agriculture and irrigation made a big difference in shifting social norms and perceptions for women in the New Lands. 'We got the training: we know which irrigation technique to use on what. Trees require drip and field crops require sprinklers. We know that we must stop irrigating the trees before they flower. We know which pesticide works on which disease, aphids, mildew,' explained two other women landholders in Noubariya. These women appear to have been legitimized in these roles because they acquired formal training. 'We got irrigation training from IFAD. There was a quiz afterwards. I won first place and as a reward won a water filter for the irrigation pump,' recalls a woman landholder in Noubariya.

Whereas irrigation officials in the Old Lands described female irrigators in Kafr Sheikh in condescending terms, as illiterate and low class, for example, their counterparts in Noubariya spoke very differently about educated and trained women in the New Lands. 'Our women are educated. Our women here are trained on how to irrigate,' explained a village engineer in Noubariya. 'A woman graduate here is like any man. She has a degree just like the men; she got land and so did he,' explained another irrigation official in the New Lands.

Not only were women validated in irrigation roles because of the training they had received, they also appeared to enjoy more decision-making power in managing their farms. Women landholders who acquired training and pioneered technology adoption in the New Lands continued to make key decisions such as when to irrigate and how much water was required for a given crop even when their sons grew up and took on more of the irrigation tasks. The status of women irrigators in Noubariya appeared to have been elevated on a more permanent basis because of their educational attainment and training in irrigation management. A graduate woman irrigates and manages the land 'just like a graduate man', explained a graduate woman landholder in Noubariya.

Some women also received irrigation training in the Old Lands, but the training women received was very different from the training received by men. While women learned about not throwing garbage or

washing dishes in the river, men were trained to maintain water canals and operate pumps (Barnes (2013) and Gouda (2013) report similar findings from other regions in Egypt). We did find that in Kafr Sheikh, both men and women were informed about irrigation schedules and crop rotations. This suggests that irrigation officials were aware that women were farming and irrigating, but the training for women was more heavily tailored for domestic responsibilities.

It is important to mention that not all women who got land in the New Lands farmed it. Some sold the land, rented it out, or handed it over to their husbands to farm and never participated in any irrigation activities. The women landholders who did farm the land they had received felt that the land also gave them the strength to irrigate, including occasionally at night, and to stand up for their water rights. Since water is scarce, farmers were often in conflict over water use and female farmers had to assert their water rights (see Barnes (2014) for similar findings). ‘In the beginning I took the land as a challenge; I wanted to prove to myself that I can manage my farm like a male farmer. And I succeeded... There is a lot of conflict over water here. If you do not stand up for yourself, people would find it easy to take your water rights, they would say she is a woman,’ explained a female graduate landholder in Noubariya. ‘You have to be strict and refrain from joking. If you are not strict and firm, others would take your water rights,’ explained another woman landholder. The same woman has reportedly beaten up a man for taking her water turn. ‘I wanted to prove to others that I can farm. Otherwise people would say look she took the land and she did not farm it. The land made us who we are. If we were in the Old Lands, our husbands would get us the food and we would stay in the house. But here, you must fight for what is yours,’ explained two other women landholders in Noubariya. Women also face significant challenges asserting their entitlement to water in the Old Lands. Women who served on a WUA in Kafr Sheikh informed us that female farmers were frequently bullied and had their water turns taken by male farmers.

The fact that most families moved to the New Lands as nuclear households rather than as multigenerational extended families may have also led to more flexible social norms for women. Many of the single female settlers came into the New Lands with their fathers. As their lands became more productive, their fathers left, and these women took over the farming of the land. During the initial stages of resettlement in the New Lands, one of the women landowners worked with her husband as a daily labourer in irrigating other people’s lands. In the Old Lands, women would almost never be hired for irrigation tasks. A settler in Noubariya explained that ‘here in the New Lands, everyone has to work. I help my husband with all tasks on the farm, including irrigation. No one else is looking out for us here.’ Given the labour shortages in the New Lands, partly because of the absence of extended family members, many female settlers continued to irrigate the land even after the land became profitable, often just to save money by not hiring additional labour.

Although women in the New Lands enjoyed more social status and visible roles in irrigation, they did also have to endure some social stigma and reputational damage. ‘You cannot trust a woman who does not have a man and comes and goes as she pleases,’ a local settler remarked about a woman landholder who fully manages her land, including irrigating at night. Another woman landholder was accused of meeting up with a male graduate settler late at night while irrigating the land. ‘When there is a woman and a man, there is always a third entity in between them which is the devil,’ explained a local female settler. Such gendered social norms and prejudices, which women themselves often reinforce through their behavior and comments about other women, limited their ability to benefit optimally from their landowning status, education, training and irrigation roles.

Some graduate women settlers found ways of managing social norms while also protecting their reputations and continuing with their irrigation activities. ‘In our culture it is shameful for women to irrigate

at night. To sleep where strange men also sleep. I did it because I had to. I took my small son with me to avoid gossip,' explained a graduate woman settler in Noubariya. We found that this strategy of taking young children to the field was also adopted by other female farmers in the New Lands. Other women navigated social norms and neutralized sexual connotations of being out late at night by casting themselves in familial roles of daughter, sister, mother, and grandmother while interacting with male farmers: 'I call the young farmers "sons" and the older farmers "brothers".'

The women landholders in the New Lands did not see a future for their daughters in agriculture. They wanted their daughters to pursue higher education instead. Probably because of the hardships and reputational damage they had endured in establishing themselves in the New Lands, most landholding mothers were even opposed to the idea of their daughters marrying into farming families. Unlike the early stages of settlement in the New Lands, farming had become much more profitable in Noubariya in recent years and landholding women were much more likely to involve their sons or hire labour than to rely on the labour of their daughters.

We found that most of the land distributed specifically to women in Noubariya had already reverted, or would eventually revert, to sons and not to daughters upon inheritance. This resonates with other researchers' findings (see, for example, Baruah, 2010) who emphasize that even when women are potentially able to acquire land and property through either inheritance, purchase in the market, or distribution by the state, they are unwilling or hesitant to assert the equal inheritance rights of sons and daughters. Most women landholders in Noubariya expressed a clear preference for sons as inheritors, employing the entrenched logic that a son would support them in their old age while a daughter would leave the family after marriage. We found an apparent contradiction between landholding women's agreement that no other asset but land could bring them the same sense of self-worth, security, or respect within the community and the women's reluctance to give land to their daughters. In part, this was due to pragmatic concerns about whether daughters who had moved away to marry could manage the land they were given. However, it was also due to concerns that in transferring land to their daughters, mothers could place them at risk of reprisals from in-laws who do not share a commitment to transferring land to women. Women who hesitated to endow daughters with land may just be taking the practical step of working with patriarchal social norms in some ways while subverting them in other ways. As an example, landholding mothers in the New Lands expressed no hesitation in investing significant financial resources into their daughters' education and professional development even though they did not intend to leave them their land.

Irrigation technologies: adoption and impacts

Both male and female landholders ranked irrigation as the most important innovation introduced in the Old and New Lands in the past ten years. At the time of this research, *tatweer* was not available in all communities in the Old Lands because all irrigation development projects had been halted after the Egyptian Revolution of 2011. In areas where *tatweer* was installed, women identified electrified collective pump stations and pressurized irrigation as most important technologies for alleviating their workloads: 'By pressing a button, you irrigate the land.'

Most women did not know how to use the individual pumps prevalent in areas lacking *tatweer* and were often afraid of them. These pumps were often deemed dangerous for women to use (see Najjar, 2015). Many of the women who irrigated their lands in areas where there is no *tatweer* asked men who were passing by to turn the water pumps on for them. 'I am very scared of the water

pump. I do not know how to turn it on. I ask someone passing by to operate it for me when I want to irrigate,' remarked a woman farmer whose husband works in Saudi Arabia. *Tatweer* was identified as an important innovation by women because it was easier and faster than irrigating with the wheel barrows, which preceded the mechanized pumps. Land owners could independently make the decision to install certain irrigation technologies, such as drip irrigation, on their own property (see also Van Koppen et al., 2012). Other technologies such as *tatweer* required government support, but they could be made available to farmers regardless of ownership of the land. Women who farm rented land in the Old Lands also benefit from *tatweer*. This highlights the importance of institutional support and not just land ownership in enabling access to and adoption of irrigation technologies.

New irrigation technologies not only reduced drudgery for women, but also afforded women greater visibility and social acknowledgement for their roles as irrigators. New irrigation technologies were identified by men as having enabled women to adopt irrigation roles. 'Women can farm more independently here. They can irrigate using drip irrigation. They cannot do so by using flood irrigation as in the Old Lands. Here they just click a button and the land gets irrigated,' explained the headman of one of the settlements in the New Lands. However, cleaning water canals in the Old Lands continues to be a job that men are deemed best at doing, usually due to the perceived need for physical strength. This is ironic, considering that machines that clean water canals have been introduced recently in Kafr Sheikh and other communities in the Old Lands and have been reported to alleviate male farmers' workloads.

Both male and female farmers and irrigation officials deemed irrigation by *tatweer* more socially acceptable for women because it does not require women to get clothing wet, or to roll up or take off any article of clothing – thereby exposing bare skin. Water officials also remarked that since *tatweer* could be scheduled during the day, women did not have to irrigate at night. This was seen as having optimized women's ability to participate in irrigation. Some of the other new irrigation technologies (electric *tatweer*, drip irrigation, and sprinkler irrigation) reduce the drudgery of manual irrigation, but do occasionally require irrigating at night. The social taboos for women regarding night irrigation persisted in both regions even as many women found ways to work around them.

Survey findings in the New Lands revealed that 12% of men and 6% of women reported adopting improved irrigation technologies of sprinklers and drip. Women graduate landholders in the New Lands were particularly noteworthy in this regard. They cultivated profitable cash crops and access to financing enabled them to install drip and sprinkler irrigation technologies on their farms. Using their land title as collateral, women in Noubariya accessed microcredit of up to 15,000 EGP for installing drip and sprinkler irrigation in their fields. This, in turn, led to changes in the crops cultivated: from field crops to fruit trees. Fruit trees are up to four times more profitable than field crops.

Some 11% of female respondents and 13% of male respondents in Kafr Sheikh ranked *tatweer* as the most important innovation that had entered their community in the past ten years, while 11% of male respondents and 5% of female respondents ranked drip and sprinkler irrigation as the most important new technologies to have entered Noubariya during the same period. Newer irrigation technologies such as *tatweer* and drip and sprinkler systems were valued highly by female farmers because they were less laborious compared to the earlier irrigation methods of movable pipes, the use of which was both tedious and time consuming. 'Now life is much easier, we used to carry those heavy aluminum rods to irrigate and we also had to move the sprinklers. Now there is drip and fixed sprinklers for irrigating the land. This has made irrigation far less difficult,' explained a woman landholder. Other women graduate landholders in the New Lands said similar things 'We have seen difficult days when we first

got here. We used to irrigate in the freezing early mornings. We used to carry those heavy rods. Drip irrigation has made irrigation much easier.’

Participation in WUAs

Of the 402 individuals (200 men and 202 women) who responded to our survey, only 20% participated in formal public institutions. In turn, only 12.5% of this 20% were women. Like findings reported by Sukkary-Stolba more than three decades ago (in 1985), we found that these women were mostly active in the social development committees. Only one-fifth of the women who served on other public institutions and committees participated in WUAs. We could identify only two women among survey respondents, both landowners in Noubariya, who were on WUAs. We did eventually find and selectively interview more women on WUAs in the New Lands and the Old Lands, but the survey findings are indicative of how low the participation is of women on WUAs.

Women were urged by donors and NGOs like IFAD, CARE and WFP to participate in WUAs in both the Old and New Lands but under different terms and conditions (Adriansen, 2009; Barnes, 2013; Najjar, 2015). While women in the Old Lands represented domestic water users on WUAs, women in the New Lands represented irrigation water users on WUAs. There are no domestic WUA representatives in the New Lands. However, we found that eventually both women and men lost interest in serving on the WUAs as these associations lost support from development agencies.

The WUAs in the Old Lands represent two types of water users: agricultural water users and residential water users. While these categories are not gender-specific in and of themselves, they came to be understood as such by local officials (Barnes, 2013). On WUAs, residential water users are a much smaller group, adding up to only 10–20% of agricultural water users, and always represented by women. Thus, women were a minority to begin with on WUAs in the Old Lands. As Barnes (2013) also reports, women seldom participated on these committees as irrigators. Water engineers explained women’s unwillingness or inability to participate in WUAs as a consequence of their lack of education and low social status, and these views were often expressed by women themselves. Most male members of WUAs were comparatively affluent and socially or politically influential in their communities. WUAs also included technical operators of the collective pumps, who were always exclusively men. These operators were trained to operate pumps and paid a monthly salary. Women never received the opportunity to play these roles. Although female members of WUAs in the Old Lands were exclusively relegated to representing residential water users, they did often also mitigate conflict over water use not just for other residential water users but also for women who were irrigators in the Old Lands. Although women on the WUAs were not responsible for adjudicating irrigation water use, they were able to negotiate fairer terms (by scheduling water use, for example) for female farmers in the Old Lands. While focusing on women’s household use of water has resulted in some allocation of water for domestic use and women’s participation on WUAs, it obscures the fact that women ‘almost everywhere use water both for productive and domestic purposes’ (Zwarteveen, 1997, p. 1337). These findings echo those of other researchers who emphasize that informal means for obtaining irrigation services are less secure because they rely on the discretion of pump operators, or on the agency and assertiveness of individual women irrigators (Meinzen-Dick & Zwarteveen, 1998).

We interviewed three women members on a WUA in Kafr Sheikh (Old Lands) who represented residential water users. The international NGO, CARE, was supporting this WUA by providing training on gender, women’s rights and rural development. However, the male members of the same WUA

explained that unlike them, the female members of WUAs had no voting rights because the mandate of WUAs relates to irrigation water use, whereas the female members were representing domestic water users. Even female irrigation engineers were skeptical that women could be effective representatives on WUAs in the Old Lands since they were unable to acquire training, knowledge, political skills and voting rights at par with male members of WUAs.

In the New Lands, women's involvement on WUAs was substantively different than in the Old Lands. We found that women in Noubariya were very interested in serving on WUAs, particularly during the initial stages of settlement. These women had received land titles through the MRS as well as irrigation training and microcredit to secure water pumps. Because they had also received training from IFAD and WFP about serving on public institutions, they were familiar with the role of WUAs and willing to serve on them. A combination of factors including educational attainment, land ownership, irrigation training and donor support for women's participation in public institutions enabled women's participation in WUAs in the New Lands in the early years of settlement.

Unlike the Old Lands, women in the New Lands, especially if they were also landholders, were also more likely to be familiar with interacting with agriculture and irrigation officials. 'Women here who own land have to come to the agricultural cooperative and take fertilizer and take into their own hands any issues related to land matters. In the Old Lands, even without a power of attorney, I used to sign on behalf of my sister in law. But here no one knows anyone, and no one trusts anyone. We have to go the formal route all the time,' explained one male farmer in Noubariya.

Female landholders who participated in public life in the New Lands were also looked up to by other women in their community. The wife of a graduate male settler in Noubariya notes, 'I own land in the Old Lands. It is like I own nothing, but here women who own land have opinions and they know how to get their rights. People listen to them; they know how to talk. Here, their status is higher than the rest of us.'

Having spouses who were supportive of women's participation in public institutions was also frequently mentioned as an important factor in enabling women to serve on WUAs. A male farmer whose wife was a graduate landholder and WUA representative emphasized, 'My wife is a man amongst you. She represents me amongst you.' A female landholder whose husband did not support her decision to serve on a WUA noted that educated husbands were more likely to be supportive of their spouses' service on WUAs: 'The husband of this landholder is educated. He has colleagues at work who are women engineers. He is fine with his wife participating on committees.'

Although several women identified lack of spousal support as a reason for not serving on WUAs, they simultaneously emphasized other reasons for not participating on committees: 'Women landholders are educated, and they know how and from where to get their rights,' explained a woman landholder who was the president of a WUA in Noubariya. Her husband was not supportive of her participation on WUAs or other committees, but she explained that she withdrew primarily because the WUAs were no longer as functional as they had been in the early stages of settlement in the New Lands and not because of her husband's disapproval. This finding resonates with those of other researchers who remind us not to ignore the role women's agency can play in resisting and challenging existing norms and relations of power (Jackson, 1998; Girard, 2014). Through their acts, note Bossenbroek & Zwarteveen (2014), women can challenge power relations and existing behavioral norms, and the investments that people make in ensuring that they can access water. This involves complex relationships of interdependence and building and maintaining interpersonal networks at the household level and beyond.

Other reasons for women not participating on WUAs which were frequently cited in both areas included heavy workloads and the understanding of WUAs as masculinist spaces that were not welcoming to women. Many male members of WUAs were operators of water pumps hired by the Ministry of Irrigation and Water Resources. Some WUAs' members were also members of *majlis orfi*, a local resolution council whose members are exclusively men. 'I'm a water engineer, and even I cannot enter these councils,' explained a female irrigation official in Kafr Sheikh. The few women who were members of WUAs in Kafr Sheikh explained that they were not always able to attend meetings and trainings held by the WUAs because it was not possible for them to be away from their families for hours or days at a time.

Lack of education was also cited in both areas as an impediment for women's participation on WUAs, which require that members are able to read and write. 'When women attend an irrigation training, they are quiet; they do not discuss or ask any questions,' remarked an irrigation official in Kafr Sheikh. 'I do not join any cooperatives or WUAs because I am not educated,' remarked a settler in Noubariya.

Many public institutions in Egypt lost their effectiveness in the aftermath of the 2011 Revolution. Our findings revealed that farmers in both the New and Old Lands started bypassing WUAs entirely and going directly to water officials to negotiate their water rights and entitlements. This diluted the role and relevance of WUAs. By the time we conducted this research, many interviewees in both regions did not know what WUAs were supposed to do or who their members were. One woman who presided over a WUA did not even know the name of the water engineer she was supposed to interact with. She wanted to dissolve the WUA she was leading and liquidate its bank account. We interviewed four women landholders in Noubariya, who were members of WUAs during the early stages of settlement in the New Lands, when these organizations were still functional. They emphasized that WUAs were functional during those years because they were new institutions and because they enjoyed institutional support in the form of training and financial resources from donors and NGOs. Eventually both male and female settlers in the New Lands also grew frustrated with WUAs because of the inadequacy of the water, inconsistent scheduling, and the lack of response from officials to their complaints. That donors like IFAD and WFP had reduced their support for WUAs, either because they were focusing on other areas in Egypt or because their institutional mandates had shifted, also contributed to their decline and loss of effectiveness. These findings echo those of others (Hulsebosch & Ombara, 1995; Girard, 2014) who emphasize that meaningful participation of women and men on WUAs and other local public institutions can indeed be secured but only through the formulation and implementation of long-term, consistent and comprehensive institutional support, policy and practices.

Conclusions

Findings from this study suggest that women are far more actively engaged in irrigation roles in Egypt, and possibly in the wider MENA region, than is generally assumed and documented in the literature on the topic. Our findings resonate with those of other researchers who conclude that although women's invisibility in irrigation may be a consequence of their lower status and association with the domestic sphere (as in the Old Lands in Egypt), it is more often a consequence of the continuing association of irrigation with masculinity (Bossenbroek & Zwarteveen, 2014; Carreta, 2015; Cole et al., 2015).

Our findings from the New Lands in Egypt suggest that land ownership for women, especially when supported by higher levels of educational attainment, training in irrigation technologies, and institutional support for participating in local governance institutions, such as WUAs, appears to optimize women's participation in irrigation management and adoption of irrigation technologies. Land ownership has also been identified by other researchers as a useful means for strengthening women's participation in irrigation in Asia and South America (Deere & Leon, 1998; Agarwal, 2003; Gunchinmaa *et al.*, 2011), but educational attainment, access to training in irrigation technologies, and support from governments and donor institutions for women's participation in irrigation user institutions have not been identified previously as key factors in optimizing women's participation in irrigation activities and adoption of irrigation technologies. Our findings further resonate with those of Harris (2006) who concludes from her research in southeastern Anatolia that gender is contingent upon other social categories such as class, education and training and as such, she recommends analyzing women's role and potential in irrigation management within the context of other processes, entitlements and inequalities.

Like Jackson (1998), our findings demonstrate that irrigation roles can simultaneously be both burdensome and rewarding for women. While women were able to reap benefits from participating in WUAs, particularly in the early stages of resettlement, and gain access to resources and training, they also had to endure increased workloads and reputational damage. Our findings simultaneously suggest that participating in WUAs does not always lead to enhanced productivity and income as reported elsewhere in the literature (van Kopper & Hussain, 2007). Our study in the New and Old Lands of Egypt reinforced some established findings about women and participation in water governance, for example, that women are unable to participate in WUAs due to heavy workloads and social norms, which resist recognizing and validating women in their roles as irrigators. We identified other issues that are less well established in the literature on gender and water governance. For example, we discovered that participation in WUAs does not always optimize or validate women's roles in irrigation, and that under certain circumstances such as political unrest and erosion of institutional support, participation in WUAs can be of limited utility for both women and men. We also found that changes in household structure and composition, such as going from living in multigenerational extended families to living in nuclear families, can present challenges in the form of labour shortages but also opportunities in the form of more flexibility in gender norms. These issues are not well documented in the existing research on gender and irrigation.

Like Jackson (1998) and Girard (2014), we found that female irrigators can maneuver social norms but still be affected negatively by them. The comparison between the Old and New Lands provided some important insights about the ways in which extended families may reinforce gender norms while resettlement as nuclear families may create opportunities for loosening of social norms. These insights may also be relevant for understanding women's participation in irrigation in other countries in the MENA region.

Finally, although our findings suggest that women's meaningful participation in irrigation can be attained through long-term institutional support and supportive policies (as demonstrated by our findings in the New Lands), we also conclude that gender relations cannot be transformed solely through such measures. Like the findings of several others (Ongsakul *et al.*, 2012; Barnes, 2013, for example), our research in the New and Old Lands of Egypt demonstrates that in the absence of wider political awareness among women and men about the value to society of greater gender equity, women's optimal participation in irrigation, and in social, economic and political realms, more generally, can only be partially fulfilled through legal measures and policy interventions.

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