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Small private irrigation: Enhancing benefits and managing trade-offs

Meredith Giordano[a,*], Charlotte de Fraiture[b]

[a] International Water Management Institute, P.O. Box 2075, Colombo, Sri Lanka
[b] UNESCO-IHE, P.O. Box 3015, 2601 DA Delft, The Netherlands

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ABSTRACT

Millions of smallholder farmers in sub-Saharan Africa and South Asia benefit from readily available and affordable irrigation technologies. The rapid uptake of small private irrigation in South Asia had a proven positive effect on poverty alleviation. In sub-Saharan Africa similar trends are emerging and several studies point to considerable upscaling potential. Achieving this potential would substantially boost smallholder incomes and food security. However, the spread of small private irrigation poses several challenges related to equity, efficiency, and sustainability. Women and resource poor farmers face challenges accessing affordable technologies; market inefficiencies and policy frameworks negatively affect farmer decision-making and technology access; and the unregulated spread of private irrigation may lead to over-abstraction, pollution, and conflicts. In this paper we argue that carefully designed intervention strategies and policy engagement are needed for two reasons. First, there is a need to address potential adverse effects of the ongoing, unregulated spread of small private irrigation while safeguarding its proven benefits on food security and poverty alleviation. Second, relatively straightforward measures can extend the benefits to a broader group of smallholders, including women and the poor, while at the same time ensuring sustainable use of the resource. Based on empirical evidence from case studies in six countries, we identified four elements of such an approach: (1) enhancing technology access; (2) catalyzing smallholder value chains; (3) fostering supportive policies; and (4) strengthening institutional capacity to manage potential trade-offs at the watershed scale.

1. Introduction

The Comprehensive Assessment of Water Management in Agriculture identified individual and small-scale investments in irrigation and groundwater use as a major trend in agricultural water management (Molden, 2007). In parts of Asia individuals or small groups of farmers are a driving force behind recent investments in groundwater and surface water abstraction and the expansion of the area under irrigation (Shah et al., 2007; Turral et al., 2010; Molden et al., 2005). In India specifically, small private irrigation[1] already dominates the irrigation landscape, where smallholders with individually owned wells outnumber those relying on public irrigation facilities (Molden et al., 2007; Shah, 2009). More recently, in sub-Saharan Africa private ownership of irrigation equipment and small structures is likewise expanding (Lankford, 2005; Takeshima et al., 2010a,b; Abric et al., 2011), and the smallholder irrigation sector overall is now the fastest growing segment of irrigation (Burney and Naylor, 2012).

Existing research suggest that investments in small-scale water management technologies generate positive productivity and economic impacts including increased net farm incomes, improved land and labor productivity, and important indirect economic benefits (Adeoti et al., 2007; Shah et al., 2000; Kumar et al., 2005; Dillon, 2011; Burney and Naylor, 2012). Farmers directly benefit when they grow more staple and high-value crops, as they can potentially increase their own consumption and sell any surplus, thereby improving household food security and income. More reliable access to water and growing domestic, regional and international markets, also give farmers the confidence to invest in productivity-enhancing fertilizers, agricultural management strategies and agrochemical inputs, thus supporting intensification and diversification. In addition, investments in irrigation can increase the scope for creating wage-paying jobs in farming, reduce poverty indirectly by increasing non-agricultural rural and urban employment, and buffer farmers from climate variability risks (Castillo et al., 2007; Mangisoni, 2008; Tesfaye et al., 2008; Namara et al., 2010; Takeshima and Yamauchi, 2012).

However, the small private irrigation sector remains largely under the radar screen of policy makers, donors and the research

* Corresponding author.
E-mail addresses: m.giordano@cgiar.org (M. Giordano), c.defraiture@unesco-ihe.org (C. de Fraiture).

[1] Small private irrigation differs from public irrigation in that it is initiated, financed, owned and managed by individual farmers or small informal groups.

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Table 1
Typology of small-scale irrigation interventions examined.

Field and community level studies	Burkina Faso	Ethiopia	Ghana	Tanzania	Zambia	India (West Bengal and Madhya Pradesh)
Number of interviews with farmers, government officials, technology dealers, community leaders and other key informants	785	1182	14,343	406	2404	1523
Water lifting and application: manual and motorized pumps, drip irrigation, well drilling, groundwater/surface water use and potential	X	X	X	X	X	X
Water storage: In situ/ex situ rainwater harvesting, small reservoirs, inland valleys	X	X	X	X	X	X
Financing: Micro-credit, linkages with poverty programs			X	X	X	X
Supply chain: Equipment supply chain, agriculture/energy nexus, produce markets, outgrower schemes		X	X	X	X	X
Gender dimensions: Gendered farming systems			X		X	

community (Molle et al., 2003) and is not included in most official irrigation statistics, public policies or agricultural support systems (Namara et al., 2010). The sector's growth is thus largely proceeding in an un-regulated and unplanned manner (Shah et al., 2007; Shah, 2009), posing significant challenges and risks, including issues of equity, efficiency and environmental externalities. Many small-scale irrigation programs, for example, tend to allocate irrigated land and target irrigation technologies to the male "heads of household," ignoring the critical roles of women in food production and their preferences for and the related impacts of different irrigation technologies (Merrey and Baviskar, 1998; Van Koppen, 2002; Quisumbing, 2003; Awulachew et al., 2005; Meinzen-Dick et al., 2012).

Investment cost can be a hurdle, particularly for smallholder farmers. While prices of small-scale irrigation equipment are declining, direct and indirect transaction fees can add significantly to the overall investment cost (Takeshima et al., 2010a,b). Moreover, issues of market access, price volatility and lack of transport and storage facilities create additional risks and can discourage adoption of productivity-enhancing technologies among the poor (Namara et al., 2010; Burney and Naylor, 2012). Finally, taking water from its natural course for irrigation nearly always has impacts on downstream users and the environment, and their many dispersed points of water extraction can be more difficult to control and regulate than a few large users. Unchecked proliferation of pumps can lead to declines in water quantity, unauthorized use of protected lands, soil fertility loss, and pollutants due to over- or inappropriate application of agro-chemicals. In some cases conflicts between water users occur due to competition between public and private schemes and/or upstream and downstream users (Molden et al., 2007; Shah, 2009; Garg et al., 2012; Bouma et al., 2011; McCartney et al., 2007; Alemayehu et al., 1998).

This paper is based on the findings from the AgWater Solutions Project, carried out between 2009 and 2012.[2] The project—implemented in the African countries of Burkina Faso, Ethiopia, Ghana, Tanzania, Zambia, and in the Indian states of Madhya Pradesh and West Bengal—examined interventions in small-scale irrigation for sustainable and equitable improvements in rural livelihoods. More than 30 field- and community-scale case studies of existing small-scale irrigation technologies, policies and programs, involving more than 20,000 interviews, were carried out across the project countries. The case studies covered a range of farmer-initiated irrigation activities and externalities (Table 1).[3] The field- and community-level research was complemented by (1) watershed-scale analyses of the current and potential hydrologic, environmental and socio-economic impacts of small-scale irrigation and the institutional capacity to manage trade-offs (see de Bruin et al., 2010, 2012a); (2) national-scale assessments to examine where promising small-scale irrigation technologies would best "fit" within the social and physical landscape (FAO, 2012); and (3) regional-scale modeling to quantify the potential for small-scale irrigation technologies in terms of application area, the number of people reached, net revenue derived, and water consumption (see Xie et al., 2013).

The AgWater Solutions project provides additional empirical evidence that small private irrigation is widespread, is profitable for individual farmers, and has significant positive impacts on rural incomes and livelihoods. The project also finds examples of inequities in access, inefficiencies in the market chain and policy constraints, and conflicts over resources and overexploitation, all of which threaten the long-term benefits and sustainability of the sector (Giordano et al., 2012). In this paper we argue that carefully designed intervention strategies and policy engagement in small private irrigation are needed for two reasons. First, there is a need to address observed or potential adverse effects of the ongoing, unregulated spread of small private irrigation, while safeguarding its proven benefits on food security and poverty alleviation. Second, relatively straightforward measures can extend the benefits to a broader group of smallholders, including women and the poor, while at the same time ensuring sustainable use of the resource.

2. Small private irrigation

Small private irrigation is a vibrant and growing sector providing income to millions of smallholder farmers in South Asia and sub-Saharan Africa. In India more than half of all irrigation is drawn from pumps owned by smallholder farmers (Shah, 2009). In sub-Saharan Africa, we estimate that more than 5 million smallholder farmers use small-scale technologies to irrigate more than 1 million ha; and in some countries, such as Ghana, small private irrigation is already more important than public irrigation schemes in terms of land area, the number of people served, and income (de Fraiture and Giordano, 2013; Namara et al., submitted for publication). The results from the project case studies overall demonstrate substantial economic and productivity gains for farmers who have invested in small private irrigation technologies. Farmers are earning larger incomes from both staple crops and dry season vegetable production and through expanded agricultural opportunities. In Ghana, for example, farmers with access to water-lifting technologies (manual or motorized) obtain higher mean gross margins (income less variable costs) than canal irrigators and rainfed farmers. In the wet season, farmers with pumps and buckets earn 2-3 times more than canal and rainfed irrigators (Namara et al., 2011). In the dry season, not only are crop yields and net incomes generally higher for small private irrigators than canal irrigators (Namara et al., 2011), but dry season irrigation has also created additional labor demand. In an analysis of shallow groundwater irrigation in the

[2] A summary of the project findings overall can be found in Giordano et al. (2012). Project results published in other outlets are referenced accordingly, and all project publications, including the findings related to community-managed irrigation, can be found on the AgWater Solutions project website at http://awm-solutions.iwmi.org/publications-1.aspx.

[3] The case studies were selected based on information gathered through literature reviews, initial scoping studies and stakeholder consultations in each project location.