Water Resources and Economics xxx (2017) 1–15

Contents lists available at ScienceDirect

Water Resources and Economics

journal homepage: www.elsevier.com/locate/wre

Improving on-farm water use efficiency: Role of collective action in irrigation management☆

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ARTICLE INFO

Keywords:
Peer effects
Irrigation Management Transfer
Devolution
Indus Basin Irrigation System
Khal Panchayat
Pakistan

ABSTRACT

Do better performing water user associations improve on-farm water management? Using data from Pakistan, we find that better water user association performance in a community is associated with higher water use efficiency of member farmers. Mean on-farm water use efficiency is higher for farmers belonging to communities that more broadly participated in watercourse maintenance, voted to elect their representatives in upper-tier management, participated in water charge collection, and were involved in dispute resolution. While these results provide a sanguine view of the outcome of devolution of irrigation management for water management success, we argue that this may not be interpreted as impacts of water user association performance. Results suggest that underlying community characteristics and/or social interactions may be driving both the performance of water user associations and on-farm water use efficiency.

1. Introduction

'Good water management is less of a farm-plot concept than it is an among-farm concept'

Bromley et al. [9].

The above quote reminds us that the social aspects of irrigation, e.g. compliance with rules to share water equitably or collective efforts to maintain canals, are just as, if not more, important for on-farm water management than the technical aspects of irrigation. In this paper we examine this link statistically. We explore the link between performance of farmer groups in managing their local irrigation-related public goods and the water use efficiency achieved by member farmers.

The social organization of irrigation is changing. Farmer groups have been asked to manage their irrigation systems as national and subnational governments have decentralized irrigation systems and given greater responsibility to farmers in its management [6,31,34]. Under the reforms, known variously as Irrigation Management Transfer (IMT), Participatory Irrigation Management (PIM), or Farmer Managed Irrigation Systems (FMIS), responsibility is transferred from governments to famers or groups of farmers within water user

☆ The data used in this paper were collected by the International Water Management Institute (IWMI) with financial support of the Embassy of The Netherlands, Islamabad, Pakistan. The views presented here are those of the author and do not necessarily represent the views or policies of the International Water Management Institute or the Embassy of the Netherlands. This manuscript has benefited from comments and suggestions received from Randall Bluffstone, Kalyn Coatney, John Eckalbar, Ardian Harri, Priti Kalsi, Hasan MacNeil, Arnab Nayak, Ruben Sargsyan, Jesse Tack, and Pete Tsournos. Comments received from the participants of the Oregon Resource and Environmental Economics (OREE) Workshop, seminar at the Department of Agricultural Economics at Mississippi State University, and 12th Annual Meetings of IWREC held at the World Bank, Washington D.C. were also useful in improving the manuscript. Also the organizers of the Center of Water and Environment (CWE) Lecture, and the Anthropology Forum (both as CSU, Chico), are acknowledged for providing a platform for constructive discussion. I am extremely grateful to Aatika Nagrah for her efforts in collecting and processing the data, and her contributions to the earlier versions of this work. All errors are my own.

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http://dx.doi.org/10.1016/j.wre.2017.06.001
Received 1 December 2016; Received in revised form 11 June 2017; Accepted 12 June 2017
Available online xxxx

associations to actively manage local irrigation-related resources, collect water charges to finance system maintenance, and coordinate water use with higher structures in the irrigation system. This social and institutional reorganization of irrigation gives us a framework to assess the collective action of farmer groups, typically organized in water user associations, in managing their local irrigation systems.

IMT is taking place in a context where agricultural productivity gains from the green revolution have petered out [32]. Particularly for Pakistan, our case study here, there is concern that Pakistan will not be able to meet the demands of its growing population because of its low agricultural productivity and overall poor water management. A key reason cited for low agricultural productivity is the deterioration of irrigation management [36]. There are also concerns that current problems will only be exacerbated as non-agricultural water uses grow and compete for already short supplies for agriculture, and the melting of the western Himalayan glaciers reduce the long term availability of water [18]. In fact, a strong need for improvement in irrigation management was one of the arguments for IMT [36]. But have those desired gains in water management materialized?

There is evidence that communities, under differing circumstances and conditions, are sometimes able to cooperate to successfully manage the commons [1,29,31]. Evaluation of farmers' performance in their newly appointed irrigation management tasks, as well as the factors that contribute to better performance, has received some attention. For example, higher degree of cooperation was found in smaller communities because transactions costs in terms of communication and enforcing agreements were lower [3,5,24]. The degree of water scarcity faced by the community members, i.e. salience of the resource, was found to be very important; very high or very low relative water scarcity lowered community participation [3,24]. Also, a persistent feature of communities performing better in managing local irrigation-related public goods was that they had good leaders [13,21,26]. Nagrah et al. [29], studying the Pakistani context, found a similar pattern: presence of educated leadership, better state of irrigation infrastructure, and higher water scarcity improved community participation.

These studies compare community collective action outcomes for a variety of resource user characteristics, resource characteristics, and governance structures and have helped identify several important determinants of successful collective action in irrigation systems. But the issue of whether and how water user association performance translates into improved on-farm outcomes for farmers has received little attention so far. This is the main focus of our paper. Our first objective is to examine whether the performance of local water user associations has provided on-farm water use efficiency gains. We use purpose-collected, primary data from eastern Punjab in Pakistan. These data were also used in Nagrah et al. [29]. In this paper we use a subsample of water user associations studied by Nagrah et al. [29] and append data collected by additional survey instruments. Like Nagrah et al. [29], we measure collective action of farmers in managing their irrigation systems along five domains, each of which relates directly to the responsibilities awarded to farmers and their appointed water user association since IMT. These include maintenance of watercourse channel, dispute resolution within the watercourse community, collecting seasonal water charges, holding internal meetings, and electing farmer representatives. One of our main results is that we find a positive association between irrigation management by the water user associations and mean water use efficiency in wheat production in the community.

It is difficult to measure the *impact* of collective action on farmer outcomes because it is very difficult to find an instrument for community's collective action that is not correlated with farmer's on-farm performance. Both are inextricably linked. Moreover, the timing and location of IMT was not randomly selected but based on political and administrative feasibility. An *ex post* study of the impact is plagued with selection bias. Keeping this difficulty in mind, and while understanding the need to evaluate the IMT through an on-farm water management lens, we take the next step. Our second objective is to explore the mechanism behind the observed positive association between water use efficiency and collective action. We find that farmers' water use efficiency in a community is strongly and positively correlated i.e. farmers achieve water management success like their peers in the watercourse community. This finding ties directly to the literature on peer effects (discussed in section 3.2.) which helps us understand the various mechanisms that could generate this result: Could it be that farmers are learning from and imitating each other in how they manage water on their private farms (endogenous peer effects), or is it that the community's shared context e.g. a shared watercourse (contextual effects), that drives both collective action and water use efficiency? Due to data limitations, we cannot separate the effects of endogenous peer effects and contextual effects on water use efficiency. Our results suggest that both mechanisms are likely and therefore a causal interpretation of the role of community collective action in individual outcomes should be treated with caution.

This paper contributes to a relatively thin literature on the effects of community collective action on on-farm outcomes. We combine ideas from separate strands of litreature on production efficiency, peer effects, and natural resource governance. The focus on water use efficiency is highly relevant for a broader and important policy reason. Freshwater is highly scarce in this part of the world and it is important to consider whether and how reorganization of irrigation management has played a role in achieving better water management.

The next section presents a brief outline of the studies that have examined similar questions. Section 3 outlines a conceptual model. Section 4 describes the relevant details of the irrigation management system in Pakistan and data collection. Section 5 presents the econometric specification, and the results are given in Section 6. Section 7 concludes with a brief recap of the shortcomings of this study.

2. Does community collective action in irrigation management bring on-farm benefits?

As the quote from Bromley et al. [9] at the beginning of the article reminds us, on-farm water management success can be affected by inter-farmer relations. This is especially true when water distribution among farmers and management and maintenance of local water infrastructure is the responsibility of the community and its appointed representatives. Yet the literature on exploring the effect of community's performance action on individual's outcome remains relatively thin and the results are mixed.[1]

[1] Effects of change in governance regimes on household production is important in other resource systems, most notably in forestry. Here we focus on studies related to effects of irrigation management on on-farm outcomes.