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Analysis

The effects of rules and communication in a behavioral irrigation experiment with power asymmetries carried out in North China

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ABSTRACT

In our field experiment carried out with stakeholders from the Chinese Haihe River Basin, a group of five players located along an irrigation channel first decide on the amount they would invest in a public fund for channel maintenance. In the next step, they choose the amount of water to withdraw from the channel to irrigate their plots of land. We compare the effects of different rules of water distribution and communication on three types of group participants: farmers, water administrators and students.

The power asymmetry in the location along the irrigation channel was the most important factor affecting players' investment and water harvest decisions. The introduction of rules of water distribution only weakly altered the effect of power asymmetry but communication and the ability to modify the rules did reduce the effects. This result was strongest among the students and administrators and weakest among the farmers. In addition, farmers tended to break the rules more frequently and withdraw more water than agreed upon.

1. Introduction

Northern China is facing a dramatic water shortage with water conflicts intensifying over recent years. The dryer climate is only partially to blame; land use and socio-economic changes, with increasing water demand in agricultural and industrial production, are equally, if not more important (Cai, 2008; Liu and Xia, 2004; Yang and Tian, 2009). An outstanding situation occurs in the Haihe River Basin with tributaries that used to flow through the two megacities of Beijing and Tianjin. In recent years large parts of the river have remained permanently dry or have only flowed seasonally. Agriculture is the largest water user in the basin consuming almost 70% of water resources, of which approximately 96% is used for irrigation purposes. The competition for water resources between different water users is increasing giving rise to regional conflicts over the allocation of water. Local governments upstream, where there are few alternatives to agriculture for generating income, capture surface water for irrigation purposes to compensate for lower precipitation (Möhring and Otto, 2012). Many dams and reservoirs in the river basin that were built in the past as flood protection measures are currently used to redistribute surface water in drought conditions (HWCC, 2012; Map 1).

Irrigation management in China is primarily concerned with the technical aspects of water projects, while organizational aspects are rarely considered (Barnett et al., 2006). The provision of irrigated water is mostly organized through irrigation district commissions—sub-branches of local governments (Wang et al., 2013). Nevertheless, there are numerous worldwide theoretical and empirical studies stressing the importance of cooperation and collective action for water management (e.g. Cardenas et al., 2012; Ostrom, 1990, 2005; Theesfeld, 2004). Some authors suggest that irrigation systems governed by farmers can perform better than government managed systems (Cox and Ross, 2011; Janssen et al., 2012; Lam, 1998; Ostrom and Gardner, 1993), can contribute to achieving a higher level of equity among the water users (Joshi et al., 2000; Pretty and Ward, 2001), and can additionally reduce the budgetary burden on the state (Abernethy, 2010; Nickum, 2010).

In this article we investigate the impact of different rules and benefits of communication on cooperation in the provision and distribution of irrigation water. We use a behavioral experiment with upstream–downstream power asymmetries and carry out the experiment with water users in the Haihe River Basin. This involved testing the water appropriation behavior of three different groups of participants: farmers, water administrators, and students. Following Ostrom (2005: 93), we selected different types of participants for the experiment since we wanted to test whether experienced villagers who are heavily dependent on irrigated water would behave in a similar manner to students and water administrators.

Laboratory and field experiments as a research method in the study of common pool resources have been extensively used by Elinor Ostrom and her colleagues from the Workshop in Political Theory and Policy Analysis at the Indiana University in Bloomington. Some of the most acknowledged examples of their application are Ostrom et al. (1994), McGinnis (2000), Ostrom and Walker (2003), and Poteete et al. (2010). Field experiments often show that "real" resource users take different decisions to students in laboratory experiments. The main difference is usually that the resource users behave more cooperatively, as a result of the different context in which they take decisions. This

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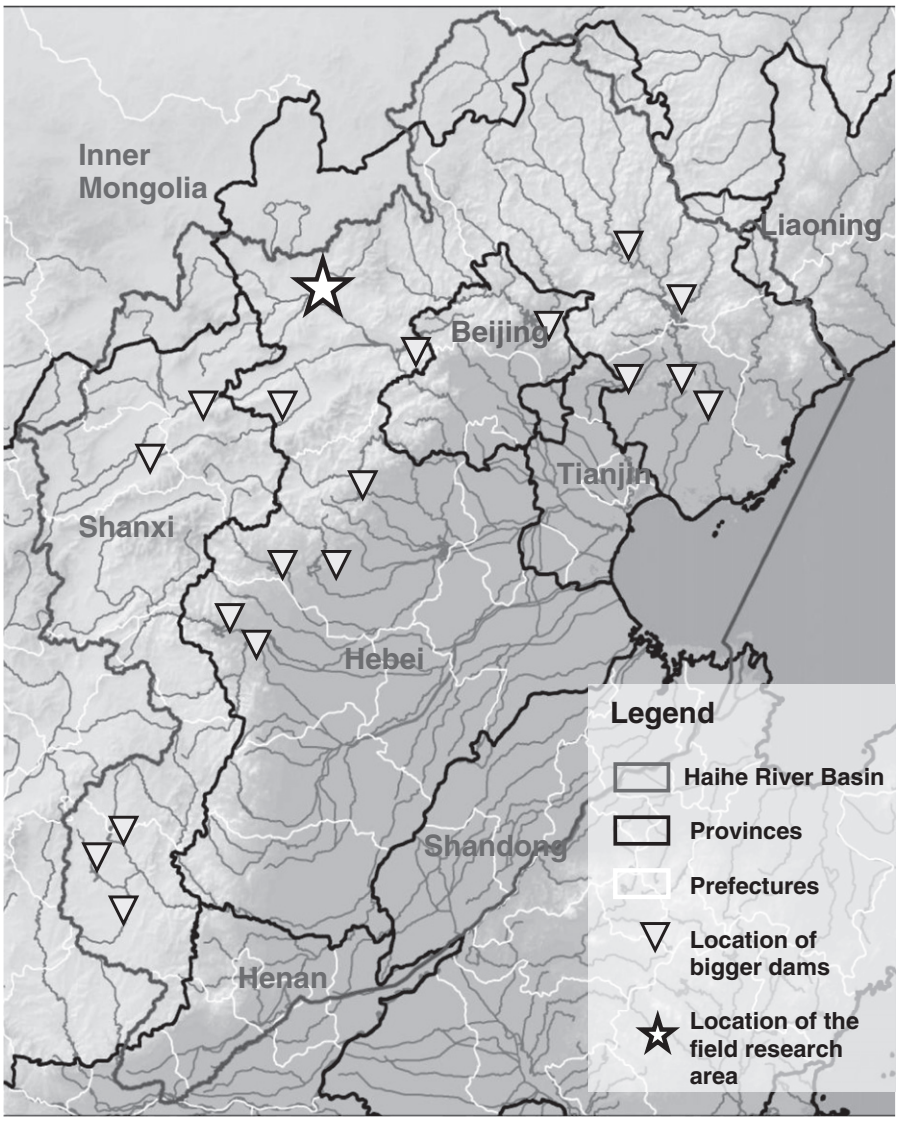

Map 1. Location of the Haihe River Basin and the field research area.

primarily relates to their experience in managing common pool resources and their dependence on the resource (e.g. Fehr and Leibbrandt, 2008; Ostrom, 2010).

The experimental design that we use in our research was originally developed by Cardenas et al. (2008) and further modified by Zikos et al. (2010) and Zikos and Sorman (2011). The design was chosen since it includes power asymmetries in the relationship between upstream and downstream players and at the same time can be used as a paper–pencil game, making it easier to apply in field conditions. Each experiment group consisted of five players who had to manage their hypothetical land plots located along an irrigation channel. The players individually had to decide how much money to invest in the maintenance of the irrigation channels. The cumulative investment by all five players in the group corresponded to the subsequent flow of water in the channel. The amount of water that players individually withdrew corresponded to the amount of earnings from their land. In the second stage of the game the players could choose a rule for regulating the water withdrawal and players who broke the chosen rule could be punished. In the third stage the players could communicate and modify the rules. All game participants received an attendance fee and a monetary reward analogous to the amount of game credits they earned. This increased the authenticity of the choices they faced.

Due to a lack of resources and logistic constraints we could only recruit a limited number of farmers and water administrators for the experiment. In many aspects (age, sex, education) our samples could be biased due to the small size. Nevertheless, the results we report are intriguing compared with results of similar experiments carried out in other countries and we hope this publication will help us to attract more research funding and local partners to enable us to continue our work.

The paper is organized as follows. Section 2 presents the detailed design of the experiments and Section 3 describes the experimental setting and the selection of participants. Section 4 presents the results of the experiment and analyses factors affecting participants' investment and harvest decisions. Section 5 discusses the experiment results and their implications. Finally, Section 6 concludes.

2. Design of the Irrigation Experiment

The design of the experiment closely follows that of Cardenas et al. (2008), Janssen et al. (2011a), Janssen et al. (2011b) and modifications introduced by Zikos et al. (2010). The modifications of Zikos et al. (2010) relate to the extra punishment for illegal withdrawal of water, and the adding of a third stage in the game where players can