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Does output market development affect irrigation water institutions? Insights from a case study in northern China

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ABSTRACT

The main aim of this paper is to examine the impact of changing external conditions on irrigation water institutions in northern China. To this end, we perform a case study analysis of the impact of output market development on irrigation water transactions, using survey data collected among 315 households in Minle County, Zhangye City, Gansu Province, covering the year 2009. Households in this region possess tradable water use rights. Moreover, a major agro-processing company has recently been established and the local government intervenes in the allocation of water to stimulate farmers to grow a cash crop for that company. Despite these favourable enabling and driving factors, we find that market water trade is virtually absent. Instead, we observe that reciprocal water use arrangements (water swaps) have emerged at a limited scale. We argue that factors other than an improvement in the output market (such as producer ignorance, centrally set prices, trust) need to be considered, if improvement in the market for irrigation water is to occur.

1. Introduction

China is a country with substantial water resources, but their regional distribution is highly unequal. Water availability in the north (757 m^3 per person in 2003) is almost 25% below the internationally accepted water scarcity threshold of 1000 m^3 per person, while water availability in the south (3208 m^3 per person in 2003) is relatively abundant (Shalizi, 2006).

The water resources available for agricultural production in China are rapidly declining due to increased water demand for industrial use and household consumption. The use of water in agriculture as a share of total water use has steadily declined from around 80% in 1980 to 61.3% in 2011 (Shalizi, 2006; National Bureau of Statistics of China, 2012). Technical innovations as well as water policy and management reforms are required to improve water use efficiency in agriculture to meet growing food demands (Rosegrant and Cai, 2002; Yang et al., 2003). The Ministry of Water Resources of the PR China has initiated a number of pilot projects to gain experience with the development of water-saving irrigation systems. The first of these pilot projects was initiated early 2002 in Zhangye City, an oasis with rich agricultural resources in Gansu Province in northern China. Measures taken under this project include the construction of an engineering system that optimizes the water distribution and an innovative system of water resources property rights allocation and trading.

Zhang (2007) and Zhang et al. (2009) examine the water property rights system that was implemented in Zhangye City. These studies find that high transaction costs in some parts of the region, and management, legal, administrative and fiscal barriers in cases where transaction costs are low, discourage farmers from saving and trading surplus water. As a result, trading of water use rights is almost non-existent in this pilot project area.

Induced institutional innovation theory suggests that new institutions, such as tradable water use rights and non-market institutions, may emerge when resources become more scarce due to growing population density, commercialization of agriculture, or exogenous technological change (Hayami and Ruttan, 1985; Platteau, 1996). Although the theoretical literature elaborating the gains from institutional changes is vast and growing (Bromley, 1989; Saleth and Dinar, 2000), empirical studies examining drivers of institutional change are scarce due to lack of suitable data sets. Appropriately chosen case studies can provide deeper insights into the role of changing external conditions in stimulating institutional change, and may be used to formulate hypotheses on driving forces of institutional change that can be tested at a larger scale.

In Minle County, one of the six counties in Zhangye City, a large potato processing factory was established in 2008. The factory is owned by Aviko Gansu Potato Processing Co., Ltd., a joint venture of Aviko – one of the four largest potato processing companies in the world – and the local government of Minle County. To meet

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the demand of this factory, the area grown with potatoes in Minle County is rapidly being expanded at the instigation of the local government. Potatoes need a relatively large amount of water, but the water should be applied at a later stage in the season than many other crops grown in the region. A detailed examination of the changes in the allocation of water to farm households and the trading of water by households that occurred since 2008 in Minle County may add to a better understanding of the impact of output market development on water institutions. Given the fact that Minle County is located within the water-saving pilot area of Zhangye City, such research may also provide important insights into further policy reforms that are needed for establishing an efficient system of water resources property rights allocation and trading.

The objective of this paper is to examine the changes in water institutions that took place in Minle County, northern China after the establishment of a large potato processing company in 2008, and the driving forces of these changes, and to use the resulting insights to formulate policy recommendations on ways to improve the functioning of water institutions. To this end, we use data collected for the year 2009 among 315 households to assess the frequency of water exchanges after the company was established, and to examine factors affecting water exchanges between households. We find that despite the development of the output market, no significant water trading emerged. Information asymmetry between government and water users severely constrains the water use rights exchanges in the region, while low levels of non-kinship trust among villagers entail that most observed exchanges take the form of water swapping instead of market exchanges. We conclude that without addressing these bottlenecks, output market development is unlikely to boost the development of a tradable water use rights markets.

In the next section we present the theoretical framework, focusing in particular on efficiency gains obtained by market and non-market water institutions, the role of transaction costs, and the impact of exogenous and endogenous factors on water management institutions. Recent developments in irrigation water management in China are briefly summarized in Section 3, while the research area (Minle County, Zhangye City) and the data collection method are introduced in Section 4. In Section 5, we use the survey data and insights gained through informal field visits to examine water exchanges that occurred in the year 2009 and to explain the very limited development of market and non-market water institutions in the region. The conclusions of our study and recommendations for further research and for policy making in this field are presented in Section 6.

2. Theoretical framework

Water is used for many purposes such as irrigation in agriculture, hydropower generation, domestic consumption, industrial use and for environmental purposes. Water has an economic value in all its competing uses and should therefore be treated as an economic good (ICWE, 1992). Due to its physical attributes, however, natural water is not a standard (private) economic good. Due to its fluid nature, exclusion is frequently impossible or may be obtained at high costs. The consumption of water is considered by humans as non-rival and non-exclusive when it is available in abundant quantities. It stops being a pure public good when the consumption or use by one person affects the utility or production possibilities of others. But, like many other environmental resources, it tends to remain non-exclusive long after it first became rival (Ellis, 1993, pp. 259–260).

With rising water scarcity, due to population growth, economic development or other factors, the need for social investments in barriers to access rises. Appropriate water institutions (such as well-defined water rights and water markets) are required to achieve an efficient allocation of water over its users such that the total net benefits of water are maximized. Water institutions can be defined as the humanly devised constraints that regulate water development, allocation and utilization. Different institutions are combined in reality for water management, and continued public sector participation is required to deal with the common property character of water and to address externalities[1] (Griffin, 2006). As a result, various types of water institutions have been established in different areas around the globe.

According to the first welfare theorem, Pareto efficient allocations of water can be achieved by establishing water property (use) rights and water markets, provided transaction costs are zero and a number of additional conditions, such as absence of externalities, are satisfied. A resource being managed as a transferable property will cause a market to arise and the market will produce a resource-conserving signal, namely its price (Griffin, 2006). When individual agents possess property rights in (natural) water, they will be able to exchange water for money or other property.

Water trading means the exchange of water rights by willing buyers and sellers. Water trading is a scarcity-addressing strategy to achieve Pareto efficiency because water can be used to its highest value, when the conditions under which the first welfare theorem holds are met (e.g. Zhu and Van Ierland, 2012). Economic theory suggests that, in a perfect market with full information, trading of water takes place until the marginal net benefits of all users are equalized. When a water trading scheme is implemented, the amount of water being transferred therefore depends on the differences between the marginal net benefits of different users. With a relatively large difference in marginal net benefits, water users are expected to trade water (transfer water rights). If there exist only small differences between the marginal net benefits, the traded amounts are expected to be small.

The existence of imperfect information in water market operations, however, contributes to high costs of searching, bargaining and other transaction costs that can pose a serious hurdle for direct market exchanges. Under such conditions, water transactions may take place through non-market institutions. The transaction cost approach in the so-called new institutional economics (NIE) provides an appropriate tool to understand market and non-market exchanges under non-zero transaction costs (Williamson, 1979, 2007; Jia and Huang, 2011). Several basic forms of (market and non-market) water transactions can be distinguished, including exchanges in kind, temporary rentals, permanent sales of rights, and various forms of option contracts (Young, 1986).

From the transaction costs perspective, the difference between two traders' marginal benefits of water evaluated at their initial holding levels must be large enough to offset the marginal transaction costs involved in water trading under market institutions. If transaction costs are high, especially when they exceed the differences in marginal benefits for many potential traders, they may become an obstacle to water trading. In such cases, non-markets institutions can serve as market substitutes for better resource allocation by economizing on transaction costs; well-known examples of non-market institutions that have developed to reduce transaction costs in insurance, credit and labour markets include share cropping, contract farming, and reciprocal labour sharing (Hubbard, 1997; Gilligan, 2004; Williamson, 2007; Jia and Huang, 2011; Takasaki et al., 2012). In transaction cost economics, "economizing on transaction cost is taken to be the cutting edge, [. . ..]:

[1] In this study, we focus on the functioning of a water market which is an important element of the water-saving pilot project in Zhangye City. Potential externalities such as salinity of water are neglected, because the main water source in this region is surface water.