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Research article

Farmers' attitudes toward mandatory water-saving policies: A case study in two basins in northwest China

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ABSTRACT

China began to implement stringent water-saving policies in 2012. Mandatory water-saving measures implemented in arid inland river basins include the measures of allocating surface water among upper, middle and lower beaches, restricting household agricultural water use, closing wells, reducing farmland and increasing water prices. These measures have negative influences on the agricultural production of farmers. This study aimed to reveal the demographic and psychological correlates of farmers' attitudes toward these policies. The participants included 672 farmers in the Heihe River Basin and the Shule River Basin in northwest China. Structural equation analyses showed that farmers' awareness of the beneficial consequences of restricting household agricultural water and their perception of policy enforcement had significant relationships with their attitudes toward water-saving policies, whereas the effects of the New Ecological Paradigm and collectivism on farmers' attitudes were mediated through their awareness of beneficial consequences and their perception of policy enforcement. Multivariable regression analyses revealed that as a whole, there were no significant correlations between demographic variables and farmers' attitudes. Policy implications include propagandizing these policies among local farmers, strengthening open and fair policy enforcement, and cautiously using water prices as an instrument to control irrigation water.

1. Introduction

Water shortage is a key factor preventing sustainable social and economic development in China (Jiang, 2009). To mitigate water shortage and pollution, the National State of China began to implement stringent water resource-management regulations in 2012. Three key aspects of water resource management are to control the total amount of water consumption, to improve water use efficiencies and to control the total amount of pollutants discharged into rivers and lakes (National State of China (2012)). The main targets in 2030 include the following: Water consumption should be controlled within 700 billion m^3, the efficient use coefficient of irrigation water should reach 0.6, and water quality in at least 95 percent of water functional areas should reach required standards. Measures for controlling the total amount of water consumption include strict planning management and water-resource evaluation, the control of water consumption in each region and watershed, water-use permission, paid use of water, strict management and protection of underground water, and a unified allocation of water resources. Measures for improving water-use efficiencies include improved management, the introduction of water quotas and the expansion of water-saving technologies, whereas measures for controlling pollutants discharged into rivers and lakes include the management of water functional areas, the protection of drinking water-source areas and the protection and restoration of aquatic ecological systems.

The water shortage problem is much more severe in arid inland river basins in northwest China than in other regions. The middle and lower reaches of inland river basins are normally very dry. Mountainous regions in upper reaches, whose runoff is derived from rainfall, snowmelt and glacier melt, provide surface water and groundwater for whole basins, particularly for middle reaches, where most of the oases and the population are distributed. The rapid expansion of oases, industries and cities in inland river basins has led to severe ecological problems, such as a rapid drop in the groundwater table, an increase in mineral content in the groundwater, vegetation degradation, soil salinization and land desertification (Ji et al., 2006; Zhao et al., 2013). To mitigate such ecological

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problems, the policy of building a water-saving society was introduced in Zhangye City of the Heihe River Basin in Hexi Corridor of Gansu Province as early as 2001. In 2006, integrated water management measures were introduced in the Shiyang River Basin in Hexi Corridor, where some farmers in lower reaches migrated out as ecological refugees due to water scarcity and the deteriorating environment (Kang and Zhang, 2011). The main water resource-management measures adopted in the Shiyang River Basin and the Heihe River Basin are in line with those put forward by the National State in 2012, and such measures were gradually implemented in other inland river basins.

The key targets of stringent water resource management in inland river basins are a reduction in agricultural water consumption and an increase in ecological water consumption. Surface water resources will be reallocated among upper, middle and lower reaches of basins so that surface water discharged into lower reaches will increase, and lower and middle reaches will depend less on groundwater. Each farmer will have a fixed amount of farmland, and their excessive farmland will not be allowed to be farmed in the future. A reduction in farmland and an increase in surface water can reduce the exploitation of groundwater, and some wells will be closed. Irrigation water quotas will be introduced. Surface water prices will be increased, and a groundwater resource levy will be imposed. Irrigation water available for a household with normal prices is decided by irrigation water quotas and farmland area of the household, and households have to pay much higher water prices for additional water. In addition to mandatory measures of reallocating surface water, restricting household agricultural water use by irrigation quotas and farmland area, closing wells, reducing farmland and increasing irrigation water prices, voluntary agricultural water-saving measures, such as the expansion of agricultural water-saving technologies and the planting of more water-saving crops, has been introduced.

Positive results such as more vegetation and reductions in agriculture water use, groundwater exploitation and high-water-consuming crops have appeared in the Shiyang River Basin in recent years (Zhu and Li, 2014). These achievements can be largely attributed to mandatory agricultural water-saving measures (Yang, 2012; Chang et al., 2016; Hu et al., 2014). However, it is reported that local farmers in the Shiyang River Basin have given relatively low support for such mandatory water-saving measures, which has had a negative influence on policy enforcement (Hu et al., 2014). Low support for mandatory agricultural water-saving measures might be partly due to their negative influences on agricultural production. First, the measure of reallocating surface water has reduced water supply for farmers in the middle reaches, and one obvious negative influence is the forbidding of double cropping in this area. Surface water discharged into the lower reaches has increased, and agriculture there is less dependent on groundwater. However, surface water prices are normally higher than groundwater prices, and the agricultural production costs of farmers in the lower reaches have increased. Second, the farmland of some farmers has decreased due to the measures of closing wells and reducing farmland, and this has had negative influences on their agricultural production and income. Third, one negative influence of irrigation quota management is that many local farmers have had to give up planting high-water-consuming crops such as wheat. Another negative influence is that crops have died in dry years because the allocated water cannot meet the demands of crops. Fourth, higher water prices have increased farmers' agricultural production costs and made their livelihood more difficult because their income is generally low.

Public support is often a prerequisite for governments at all levels to enact water-saving projects and policies (Stoutenborough and Vedlitz, 2014). Public education, information and awareness instruments played a crucial role in making the public appreciate the importance of saving water (Tortajada and Joshi, 2013). Perceptions of the water problem definition, its causes, effective management strategies and responsibility attribution may stand as barriers to sustainable water management (ElSawah et al., 2013). Public opinion surveys in the United States indicated that the public is willing to support government efforts to manage water, but not if they negatively affect the environment or agriculture (Stoutenborough and Vedlitz, 2014). Mandatory agricultural water-saving policies conducted in arid inland river basins in China could have negative influences on farmers, which could cause some farmers to oppose these policies. To promote the enforcement and effectiveness of such policies in water conservation, it is necessary to reveal factors influencing farmers' attitudes toward these polices.

Stoutenborough and Vedlitz (2014) revealed that public attitudes toward voluntary and mandatory conservation are inconsistent. Previous studies have focused on the socio-demographic and psychological factors that influence voluntary household water conservation intentions and behaviors (e.g., Corral-Verdugo et al., 2003; Trumbo and O'Keefe, 2005; Chang, 2013). Studies on mandatory water conservation measures have primarily addressed the effectiveness of such measures (e.g., Kenney et al., 2004; Tortajada and Joshi, 2013), whereas there have been few studies concerning the possible relationships among socio-demographic and psychological factors and mandatory water conservation. An exception is a study by De Oliver (1999), who found that people of higher socioeconomic classes had different responses to voluntary and mandatory water conservation. As for irrigation water conservation, previous studies have focused on the adoption and diffusion of water-saving technologies (e.g., Negri and Brooks, 1990; Han and Tan, 2004; Liu et al., 2008; Li and Zhang, 2011; Zhang et al., 2013; Zhou et al., 2014). Yazdanpanah et al. (2014) exceptionally analyzed the voluntary water-saving irrigation behaviors of farmers in Iran and found that normative inclinations and perceptions of risk are important for actual water conservation behaviors. The reasons for public support for mandatory water conservation measures in general and for mandatory irrigation water conservation in particular needs further study. Based on 672 questionnaire surveys in the Heihe River Basin and the Shule River Basin in Hexi Corridor of Gansu Province, this study filled this literature gap by analyzing the demographic and psychological factors that influence farmers' attitudes toward mandatory agricultural water-saving policies.

2. Factors influencing farmers' attitudes toward mandatory agricultural water-saving policies

Three categories of influencing factors were involved in the study. The first category was related to values and norms, including the New Ecological Paradigm, collectivism and subjective norms. The second category was policy related, including awareness of beneficial consequences and perception of policy enforcement. The last category refers to demographic variables sex, age, education and experience as non-agricultural floating worker.

2.1. Values and norms

2.1.1. New Ecological Paradigm

The New Ecological Paradigm is an ecocentric view of the relationship between humanity and nature, in contrast to the dominant social paradigm in Western societies, which views nature as distinct from humanity, designed to serve the needs of humanity and even subject to human control (Dunlap et al., 2000). It is argued that this New Ecological Paradigm has emerged from