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Potential gains from water rights trading in the Aral Sea Basin

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ABSTRACT

Increasing water demand due to population growth, irrigation expansion, industrial development, and the need for ecosystem improvement under mounting investment costs for developing new water sources calls for the efficient, equitable and sustainable management of water resources. This is particularly essential in the Aral Sea Basin (ASB) where ineffective water management institutions are the primary reason of intersectoral and inter-state water sharing conflicts and lack of incentives for improving water use efficiency. This study examined market-based water allocation as an alternative option to the traditional administrative allocation to deal with water scarcity issues in the ASB. Potential economic gains of tradable water use rights were analyzed based on a newly constructed integrated hydro-economic river basin management model. The analysis differentiates between inter-catchment and intra-catchment water rights trading. The results show that compared to a baseline with fixed water use rights, inter-catchment water rights trading can increase basin-wide benefits by US$ 373–476 million. Under intra-catchment trading, gains are still US$ 259–339 million, depending on relative water availability. Gains from trade are larger under drier conditions. However, water rights trading carries a series of transaction costs. We find that in case transaction costs exceed US$ 0.05/m^3 of water traded there is no additional economic gain from water rights trading. Enforcement of the rule of law, infrastructural improvements, participation of representatives of key water stakeholders in decision making processes, and mutual trust and cooperative relationships among the riparian countries are suggested as means for reducing transaction costs of water rights trading contracts.

1. Introduction

Lack of water resources in the arid and semi-arid regions of the world adds pressure to growing water needs for direct human consumption, irrigation, industrial processes and environmental systems. Currently more than 20% of the global population faces water shortages and this share is expected to reach 33% by 2025 (UNWATER, 2007). This challenges governments to undertake measures to prevent or reduce potential adverse consequences of water shortages both at national and global levels. Secure water availability for food production, drinking needs, and the environment are essential for achieving the Millennium Development Goals (UN, 2000) to decrease malnutrition, to eradicate poverty, to improve sanitary conditions, and to ensure environmental sustainability (Von Braun et al., 2003, 2009).

As measures of increasing water supply through the construction of reservoirs and exploitation of groundwater storage is reaching limits in many river basins of the world, water demand management measures have often become the more viable options to deal with water availability issues (Harou et al., 2009; Randall, 1981). These water demand management measures include options such as creating economic incentives for wider implementation of water conservation technologies (Bekchanov et al., 2010), transforming economies toward less water intensive production structures (Bekchanov et al., 2014), and improving water management institutions and governance (Dinar and Saleth, 2005). As irrigated agriculture accounts for 70% of global water withdrawals (WRI, 2005) and irrigation efficiency is estimated to be less than 40% at the global level (Pimental et al., 1997), the sector seems to have a huge potential for reducing water use.

This study illustrates the potential for water demand management in the Aral Sea Basin (ASB), a dryland area where water is a critical resource for environmental sustainability and agricultural and economic development. The tremendous expansion of irrigation and cotton production since the 1960s combined

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with unbalanced water resources management in the ASB led to the destruction of the ecosystems in the delta zone and the gradual desiccation of the Aral Sea, once the fourth largest lake of the world with a surface area of 68,000 km^2 and a total water volume of 1100 km^3 (Micklin, 2007). The shrinkage of the Sea is viewed as one of the worst manmade disasters globally (UN, 2010). Despite this fact, willingness to divert more water has been increasing for achieving national food and energy securities and, according to Smith (1995), nowhere is potential for conflicts among riparian states over water use more evident than in the ASB.

Tensions between up- and downstream users over sharing water resources and over water release regimes from reservoirs fueled inefficient use of water resources after the emergence of five independent Central Asian states following the collapse of the Soviet Union in 1990s (Wegerich, 2004a; Spoor and Krutov, 2003; Dukhovny and de Shutter, 2011). During the Soviet times these conflicts also existed, but did not exacerbate due to centralized control measures of Moscow (Spoor and Krutov, 2003). Upstream reservoirs were built to increase irrigation water availability downstream in the summer, chiefly for cotton production, and to collect water during the non-growing season (Wegerich, 2008; O'Hara, 2000). Hydropower stations were jointly operated so that the reservoirs could produce energy during the summer to meet electricity needs of both upstream and downstream countries; whereas the downstream countries compensated upstream regions through delivering fossil fuel during the winter (Wegerich et al., 2007; Wegerich, 2008). However, following the disintegration of the Soviet Union, such centralized basin management which had been facilitated through the Ministry of Water Resources (*Minvodkhoz*) collapsed; and consequently, the Central Asian countries followed nationalistic development paths ignoring the interests of other countries in the basin (Wegerich, 2008). The so called "barter system of water and energy" between the upstream and downstream countries disappeared due to new economic circumstances characterized by high fossil fuel prices and degradation of trust among the riparian countries (Wegerich et al., 2007). As a result, upstream countries increased hydropower production by releasing more water from the reservoirs during the winter season, causing flooding and damage to irrigation infrastructure downstream. Water availability during the summer months was insufficient to satisfy irrigation needs. Even though the riparian countries agreed on the continuation of centralized basin management through the establishment of various organizations such as the International Council for the Aral Sea (ICAS), the International Fund for Saving the Aral Sea (IFAS), and the Inter-state Commission for Water Coordination (ICWC) and developed annual agreements over water allocation following the collapse of the centralized system governed by Moscow, the countries often fail to follow their water allocation agreements, consequently fueling the elements of mistrust (Weinthal, 2001). Poor transboundary water management is also due to the fact that inter-state laws on water allocation and water use rights were not adequately reflected in or not recognized by national legislations. Therefore, inter-state organizations do not have legitimacy and authority to exercise power to allocate water resources (O'Hara, 2000; Weinthal, 2001).

Furthermore, centralized investments to maintain irrigation infrastructure were eliminated accelerating the deterioration of the irrigation infrastructure while reducing conveyance and water application efficiency levels (Bekchanov et al., 2010). At the same time, state orders for cotton production characterized by fixed and low cotton prices and strict production quotas continued in Uzbekistan, Turkmenistan, and Tajikistan and did not provide any economic incentives to adopt more efficient water-saving technologies (Spoor and Krutov, 2003; Bekchanov et al., 2010). Command-and-control based approaches for water management, inherited from the Soviet system, continued to prevail preventing empowerment of individual water users and local governments to deal with water scarcity issues (Weinthal, 2002).

The prevention of potential conflicts over water and further environmental degradation largely depends on more effective alternative water institutions that create incentives for efficient, equitable, and sustainable use of water resources for the entire basin simultaneously considering the interdependence of all water users within the basin (Ringler et al., 2004). To this end, this study highlights the analysis of the potential gains from introducing water rights trading as an alternative to the current water allocation that is based on bureaucratic (at national level) and "use it or lose it" (at national and basin scales) water management approaches (O'Hara, 2000; Wegerich, 2008). Implementation of market-based water allocation mechanisms could provide incentives for less productive water users to release water to those users who obtain larger benefits from water in return for compensation for the release (Rosegrant and Binswanger, 1994). Trading can increase welfare and water productivity for the entire basin as water is generally transferred from lower-valued to higher-valued uses (Howe et al., 1986; Easter et al., 1998; Ringler, 2001). Market-based water allocation would not only promote water reallocation from its lower to higher-valued use but also incentivize users to reduce water overuse and invest in efficient technologies if market prices are sufficiently high (Dinar et al., 1997; Wang, 2012).

Efficiency of water rights trading was extensively analyzed in developed countries such as the US and Australia (Grafton et al., 2011) where market-based institutions are more common. Other case studies of formal or quasi-formal water markets include Chile (Rosegrant et al., 2000; Bauer, 2004) and China (Grafton et al., 2011). Empirical results of introducing water rights trading differ across river basins given their different political, institutional, and economic backgrounds. For instance, in the US, where markets have been the basis of many transactions over time, water markets have helped significantly reduce the impact of severe droughts (Grafton et al., 2011). In Australia the volume of tradable water use rights increased over time as infrastructure improved, understanding of the water market mechanism increased and water shortages became larger (NWC, 2011). However, in many developing countries, such as China, water markets are in infancy (Grafton et al., 2011), and assessments largely focus on potential gains from markets (Wang, 2012).

Despite the positive outcome of the functioning water markets in the US and Australia, and positive assessment of mostly informal market-based water allocation in many developing countries, opinions still vary about the effectiveness of water markets. For example, water rights trading in Chile has been frequently praised as a success story (Holden and Thobani, 1995; Hearne and Easter, 1995) but Bauer (2004) showed that water markets in Chile are limited in scale and scope. Negative effects of water rights trading on third parties were also pointed out by earlier studies (Dellapenna, 2005). Other studies focused on the conditions for water market performance. For example, water markets can be effective only when different water users in the basin have different marginal water productivities and there is water scarcity in the basin (Debaere et al., 2014). Moreover, water rights trading should be carefully designed to reduce or prevent third-party effects and other negative externalities (Debaere et al., 2014). Additionally, transaction costs of trading water use rights should be sufficiently lower than the gains-from-trade (McCann and Easter, 2004; McCann et al., 2005). While there are many studies on the institutional, political and economic systems supporting or hindering water markets, to the best of our knowledge, this study is a first attempt to analyze opportunities of market-based resource allocation in the context of transition countries. The implications of the study should therefore contribute to the discussion of improving bureaucratic water management systems