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Solving one problem by creating a bigger one: The consequences of ecological resettlement for grassland restoration and poverty alleviation in Northwestern China

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ABSTRACT

Modernization has been regarded as the best way to solve ecological and poverty problems in many arid and semi-arid areas around the world, but is inevitably accompanied by changes in land-use patterns that can lead to new socio-ecological feedbacks. How people and ecosystems of an area respond to such feedbacks determines whether the changes sustainable or not. In this paper, we describe resettlement of nomadic pastoralists in Alxa Left Banner of western Inner Mongolia. We identified the dominant biophysical limiting factor in this region (water resources), and used amount and efficiency of water use as indicators of the ecological impacts of pastoralism before and after resettlement. We also conducted semi-structured interviews with households to collect information about household income, expenditures, and agricultural production risks caused by water shortages to analyze the impacts of resettlement on their livelihood. We found that resettlement greatly increased the usage of water resources, reduced the efficiency of water use, and exacerbated regional water shortages. Although household income increased after settlement, subsistence costs also increased because water shortages increased production costs and risks. Our results suggest that in this arid grassland area of China, ecological resettlement policy is ecologically and economically unsustainable, and may exacerbate local ecological and social problems.

Introduction

Drylands cover about 41% of Earth's land surface and sustain more than 38% of total global population of 6.5 billion (MEA, 2005). Annual precipitation is typically very low and highly variable, and evaporation is generally several times the precipitation level (Reynolds et al., 2007). In these areas, primary productivity is low and exhibits strong spatial and temporal heterogeneity, and often, nomadic pastoralism has developed as the main way for human populations to use natural resources. Mobile pastoralism facilitates use of resources subject to rapid spatial and temporal variability and has been sustained over hundreds or thousands of years in such areas because it allows us of pasture resources while maintaining ecosystem stability and biological diversity (Fernandez-Gimenez and Le Febre, 2006; Hesse and MacGregor, 2006; du Toit, 2011; Nelson, 2012). However, due to climatic, demographic, economic, and institutional change, ecosystem degradation and poverty have become common problems in such areas around the world, and especially in some developing countries and regions (Grepperud, 1996; Reynolds et al., 2007; Wrobel and Redford, 2010). Proposed solutions to such problems have generally involved intensification and modernization of traditional pastoralism, inevitably accompanied by changes in land-use patterns. For example, government planners encourage nomadic pastoralists to establish permanent settlements ("sedentarization") where they can cultivate crops to increase forage production, to import exotic high-performance breeds to improve animal productivity, and to concentrate their populations so as to improve their access to social services.

In China, ecological resettlement has been widely applied in ecologically fragile or degraded rural areas in recent two decades (Doos, 1997; MEA, 2005; Warner, 2005; Adamo, 2010). Large numbers of nomadic pastoralists were resettled in permanent communities ("sedentarization") to raise their animals in intensive animal husbandry system and modernize their agriculture. According to "The 12th Five-year National Plan (2011–2015) for Implementation of Nomad Settlement Project" (NDRC, 2012), all formerly nomadic pastoralists will be moved to permanent

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settlements by the end of 2015. Ecological Resettlement Projects are embedded in the government's "building a new countryside" program (Long et al., 2009, 2010) which aims to promote rural development and poverty alleviation. They are also a key strategy to combat grassland degradation, as overgrazing due to increasing population pressure is considered to be the main cause of grassland degradation (State Council, 2002). However, the outcomes of such projects are highly debated among scholars. Most researchers believe that relocation of pastoralists promotes grassland recovery due to decrease of grazing pressure (Dongribu, 2000; Liu, 2002), and improve access to infrastructure, education, and health care in resettlement areas (Dong, 2006; Liu and Wang, 2010). However, there are also a significant amount of studies which have gained contrary conclusions (Xu, 2001; Dickinson and Webber, 2004; Chu and Meng, 2006; Jiao et al., 2008; Yeh, 2009). Some researchers pointed out these policies all aim at artificially increasing the number of people or economic output per hectare rather than on identifying a sustainable level of development (Batchelor et al., 1994; Fratkin, 2001; Galvin, 2009; Bossio et al., 2010; Priess et al., 2011). This approach subverts traditional land-use patterns, leading to development of new socio-ecological feedbacks, and it is crucial to learn whether ecologically fragile arid areas can sustain these feedbacks (Lambin and Meyfroidt, 2010; Fan et al., 2013). Therefore, the key point when evaluating the proposed changes is to determine whether new utilization of natural resources is suitable for the ecosystem's characteristics, and whether it can lead to development of a sustainable relationship between social and ecological systems.

In the present study, we suggest that ecological resettlement involves more than just changes in the location of a population; more importantly, it involves a large change of lifestyle and modes of production, and therefore radically alters interaction between people and the resources that sustain them. We used two ecological resettlement villages in Alxa Left Banner of China's Inner Mongolia Autonomous Region as a case study of the consequences of ecological resettlement. We focused on utilization of local water resources, as water is the key limiting factor in arid regions such as the study area, to quantitatively assess the effects of the ecological resettlement project. Our goal was to determine whether ecological resettlement was a potentially effective way to improve ecological condition and livelihoods of the displaced herders, or whether it had only replaced one problem with another.

Methods

The study area

Alxa Left Banner is located in Inner Mongolia Autonomous Region, west of the Helan Mountains (Fig. 1). Grassland covers 46,000 km^2 of the region, and mainly comprises desert and semi-desert steppes. Two large deserts cover this region: the Tengger Desert and the Ulan Buh Desert. The region is a typical temperate arid zone, with annual precipitation ranging between 80 and 220 mm, versus annual evaporation of 3000 mm.

Herders own a diverse group of livestock, including goats, sheep, horses, cattle, camels, and cows, and have a long history (many centuries) of pastoralism in this region. In 1949, the total population of Alxa Left Banner was 25,692; Mongolian and Han peoples accounted for 48.3 and 42.2% of the population, respectively. During 1959–1960, there were three years of natural disasters, which forced many people to leave their homes in surrounding regions, and a large number of the victims moved into Alxa Left Banner. By the end of 1960, the population had reached 62,927, an increase of 78.0% compared with the 1958 level (ALBACC, 2000). In the 1990s, ecological problems became significant, and due to the deterioration of grassland and poor living conditions, a large number of ecological migration projects were implemented. From the 1990s until 2009, almost 25,000 people were relocated to farmland areas irrigated by extraction of groundwater or by water pumped from the Yellow River. The government plans to resettle an additional 18,000 pastoralists in this area.

The local government selected eight locations where they believed that sufficient water could be supplied to support agriculture, and resettled many herders in these places. We chose two of the eight sites (A and B; Fig. 1) for our case study. A is in south-central of Alxa Left Banner, 2739 pastoralists in 744 households have been relocated here as farmers since 2002, after being forbidden to graze. The area of cultivated land in A is 6000 ha with irrigation from ground water. B, an Ecological Resettlement Project demonstration area managed by Alxa government, is on the south of Alxa Left Banner. 7533 ha grassland has been converted to crop fields since 1994, and more than 8000 pastoralists have been resettled in this area. The main irrigation source in B is a big water-raising project on the Yellow River in the south.

The relocated pastoralists had formerly lived, widely dispersed, in a vast pastoral area, and we selected one village that remained in this area (C in Fig. 1) as an example of a pre-resettlement site for the pastoralists who had moved to sites A and B. Concentrating our resources on Village C allowed in-depth analysis of the natural environment, lifestyle, and production modes in this area.

Surveys

We obtained data from 2008 to 2011 by means of proportional stratified random sampling. We selected one settlement site that uses groundwater (A, Fig. 1), and one that receives water pumped from the Yellow River (B, Fig. 1). We conducted semi-structured interviews that focused on modes of production, income, costs, types of water usage, and environmental change. In addition, we interviewed local government officials to obtain relevant policy information, including 3 officials in charge of resettlement work at Banner level, two officials in A and one official in B in charge of agriculture. To permit a cost–benefit analysis and comparison of water resource utilization between former pastoralism and current agriculture, we obtained data from 2009 to 2010 by interviewing 16 households from the pre-resettlement site (C) and 17 households from the resettlement areas ($N = 7$ for A and $N = 10$ for B). The two study years can be considered representative of normal conditions because no unusual climate, market, or political events happened during this period. In our study, we defined water resource as that from developed sources (i.e., excluding natural rainfall), such as drilling wells to water livestock and water diversion from the Yellow River in adjacent Ningxia Province.

Analytical framework

We assessed effects of resettlement in this arid area on ecological conditions and livelihood of relocated people from the perspective of utilization of the region's water resources. We confirmed that available water resource is the key factor for sustainable use of the arid ecosystem (see Section "Primary Constraint in Arid Areas: the Water Resource" for details), and that constraints on this resource limit regional socioeconomic development. Resettlers were closely connected with water resources before and after the project, because both pastoralism and agriculture in arid regions depend directly on the water resources. Next, we used a survey of water resource utilization before and after resettlement to calculate total usage of water and water-use efficiency per household, and used this to assess the ecological and socioeconomic effects of resettlement. For the latter, we compared household incomes and expenditures before and after the project. Furthermore, we