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Agro-pastoralism under climate change: Institutions and local climate adaptations in northern China

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ABSTRACT

The livelihoods of resource-dependent peoples are vulnerable to climate variability. This study focuses on how local climate adaptations, which have been sustained through long-term interactions with local ecologies, have changed in the face of the challenges caused by climate change and policy interventions. Case studies were conducted in two agro-pastoral counties of northern China, a region that confronts frequent drought and that has experienced extensive institutional changes over recent decades. Based on the exploration of four adaptation strategies, the field results show that both counties have experienced an acceleration of livelihood diversification, an increase in storage and market exchanges, and a dramatic reduction in previously common pooling. The findings reveal that these adaptations are not a direct result of coping with climate risks but rather are indicative of livelihood strategies that result from the combined impacts of institutional, socioeconomic and climatic changes. Current institutional arrangements have negative impacts on local climate adaptations. This is particularly true for those with limited livelihood options, and such arrangements may therefore foster an increase in inequality with regard to household adaptive capacities over the long term. Therefore, this study recommends flexible policies that facilitate local arrangements rather than the current one-for-all policy.

1. Introduction

Climate adaptation is being increasingly studied in various disciplines, and this research has mostly been associated with the concepts of vulnerability and adaptive capacity (Adger et al., 2005; Kelly and Adger, 2000; O'brien et al., 2004). A fundamental tenet of the existing literature, whether analyzed with regard to institutional roles in vulnerability or resilience or by determining the elements influencing adaptive capacities, is that institutions matter (Adger 1999, 2000; Næss et al., 2005). There are also other factors that influence adaptation at the local level, including market access, social capital, access to resources, networks, and agro-ecological settings (Adger 2003; Adger et al., 2009; Deressa et al., 2009). These determinants do not function in isolation but interact differently in different contexts (Smit and Wandel, 2006). However, there is little agreement regarding the processes through which institutions interact with these other important factors in affecting local climate adaptations. In addition, despite the increasing literature on climate adaptation worldwide, studies focusing on Chinese farmers' climate adaptations and their determinants based on local-level examinations are currently still limited (Jin et al., 2015; Tian and Che, 2014). Climate adaptation presents a complex systemic problem for which case studies with space specificity are particularly important (Berkes and Jolly 2002; Eakin 2005; Smit and Wandel, 2006).

This study focuses on resource-dependent communities in which the local people perceive that their livelihoods are dependent upon the natural resource. In these communities, agricultural production and harvests are based on the use of natural resources and are sensitive to climate conditions, making these communities vulnerable to climate change (Agrawal 2010). The study focuses on local climate adaptations based on case studies conducted in two agro-pastoral counties of northern China, a region where climate—in particular, the temporal and spatial distribution of precipitation—has a profound impact on land productivity and local livelihoods. Since the 1970s, the region has experienced extensive institutional changes centered on the de-collectivism of pastureland and restraints on pastoral resource use. The uniqueness of the research area allows an exploration of the research question regarding how institutional change influences local adaptations to climate change across communities with different biophysical and economic characteristics but that face similar situations with regard to climate and institutional change.

The agro-pastoral transition area of China is characterized by a typical temperate, semi-arid climate and is located between arid and semi-arid pasturelands to the northwest and a humid farming

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region to the southeast (Liu et al., 2011). The region experiences considerable variations in seasonal and inter-annual precipitation (Yang et al., 2005). The communities here are not nomadic but rather are composed of clusters of agro-pastoralist families settled in permanent buildings. Their livelihoods are heavily dependent on the use of pastureland and farmland. In several communities, locals manage rain-fed farmland that is extremely sensitive to climatic variability and to drought in particular. Those who manage irrigated farmland are less dependent on climatic conditions for successful harvests but face higher costs (e.g., irrigation and labor) in response to drought. Total annual rainfall levels in most parts of this region, which average approximately 400 mm/yr, have decreased, while temperatures have increased over the second half of the 20th century (Liu et al., 2011). Changes in the long-term climatic patterns have negatively affected vegetation growth and livestock production levels (Tan et al., 2009; Wang et al., 2013). Meanwhile, since the late 1970s, a series of policies have been implemented to address the mounting environmental problems. During the 1980s, pastureland de-collectivization was instituted in pastoral communities due to assumptions made based on the "tragedy of the commons" (Hardin 1968). Through these reforms, rights to use pastureland were allocated on a household basis through long-term leases, whereas land ownership rights remained with the collective. However, this change did not stop the ongoing environmental degradation (Li et al., 2007; Williams 1996). Several explanations have been proposed as causes of this degradation, such as the large-scale cultivation of pastureland over the last century (Hill 1994; Lichtenberg and Ding 2008). Nevertheless, overgrazing was cited as the primary cause of the continuous grassland degradation by the government. Consequently, a grazing ban that was designed to improve grassland environments by "retiring livestock and restoring pasture" was issued in 2001 by the Chinese government and subsequently adopted in the major pastoral provinces, together with increased state investments in environmental protection and accelerated grassland-tenure reforms (Dong et al., 2007; Wang et al., 2005). Although this institutional initiative is often claimed as a success for alleviating land degradation in government reports (MOA, 2014, 2015), there have been challenges to its long-term negative impacts on pastureland ecosystems, such as biodiversity losses (Bian et al., 2008; Gu and Li 2013; Xu et al., 2008) and numerous negative social and economic impacts on local communities (Yeh 2009; Yu and Farrell 2013).

This article proceeds as follows: In Section 2, the conceptual basis that is used in the study is introduced, followed by a presentation of the empirical background in Section 3, including a general description of the research site and a detailed introduction of the field methods and data. Section 4 then relates local residents' perceptions of climate risks with meteorological records to generate more relevant information on climate change impacts. Section 5 presents the local climate adaptation strategies used in the two counties in the face of institutional changes and compares these strategies across communities. Section 6 discusses how institutions enable or prevent households from addressing climate challenges in conjunction with other factors over time and across communities. Section 7 concludes that current policies, whether targeted for climate adaptation or not, exert negative impacts on local climate adaptations, particularly for those with limited livelihood options. Hence, the study provides policy recommendations and sheds light on studies of other resource dependent communities.

2. Conceptual basis

Agricultural losses caused by climate events are likely to increase as a result of climate change, particularly given that both the frequency and intensity of natural hazards are predicted to increase (IPCC, 2001). However, despite cumulative evidence showing that the climate is changing (Dessai et al., 2007), there is still great uncertainty regarding the specifics of the process and its impacts in different places. This uncertainty hampers local-specific analyses of adaptations to climate change (Marin 2010). The integration of local perceptions of climate change into these analyses could help to reveal which climate threats are most relevant to local livelihoods and thus significantly reduce such uncertainty (ibid). In addition, perceptions play an essential role in motivating individuals to take adaptive action, and they shape the way locals adapt (Grothmann and Patt, 2005; Traoré and Amara 1998; Vignola et al., 2010). Differences in perceptions and adaptations are related to the sets of beliefs and concepts through which people understand the situation and thus generate initiatives to solve problems (Otto-Banaszak et al., 2011). As individuals estimate risks by recalling memories of similar events that have occurred in the past (Tversky and Kahneman 1974), this study examines local observations recorded by resource-dependent people in combination with official meteorological records to explore the weather events that are of the greatest concern to the local resource-dependent population prior to the main analysis of the locals' adaptive strategies.

As one of the strategies employed to cope with climate risks (Adger et al., 2003), effective adaptations help to "reduce the vulnerability of natural and human systems against actual or expected climate change effects" (IPCC, 2007). At the local level, resource-dependent populations have engaged in diverse strategies in response to climate variability through long-term interactions with pastoral ecology (Silvestri et al., 2012). Agrawal (2009) proposed a framework with five types of adaptive strategies for analyzing local climate adaptation measures: (1) mobility, which addresses climate risks in space; (2) storage, which mitigates and prevents climate risks across time; (3) diversification, which distributes risks across the assets and resources of multiple households and collectives; (4) common pooling, which pools risks across households; and (5) market exchange, which substitutes for the first four when and where market access is facilitated. This framework has proven to be relevant and useful for the analysis of local adaptation strategies in pastoral communities (Wang et al., 2013). This study adapts the framework to the local situation analyzed in the following ways. (1) The category *mobility* is omitted. Although mobility constitutes the most common strategy that pastoralists employ when faced with environmental risks (Agrawal, 2009), it is not observed in the study area. Unlike nomads, agro-pastoral communities do not move frequently with their livestock to different pastures. (2) A large number of households have now shifted to rearing livestock in sheds by feeding them with fodder or forage in this region (Yu and Farrell, 2013). Although these conditions do not clearly fall under any of Agrawal's categories, the study includes it in the analysis of the *storage* category because, unlike the requirements of previous livestock grazing techniques, raising livestock in sheds requires the use of fodder or forage that is purchased from markets or harvested from the farmland. The other adaptive strategies examined in the study, diversification, common pooling and market exchange, exactly follow Agrawal's definitions.

These types of adaptations never occur in an institutional vacuum; instead, institutions—and other social factors—jointly affect households' adaptive capacity and influence societal vulnerability to risks (Agrawal, 2010; Næss et al., 2005). Institutional change can enhance such adaptations when it functions by providing a proper subsidy and insurance scheme, promoting livelihood diversification or establishing risk forecasting systems (Silvestri et al., 2012). On the other hand, it also might weaken local adaptive capacity, for example, when it marginalizes small-scale producers (Eakin, 2005). Adaptive capacity here refers to "preconditions that enable actions and adjustments in response to current and future external changes" (Nelson et al., 2007). Institutional changes,