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# Adaptation to changing institutional, market and bio-physical environments: the case of China's grasslands

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**Abstract.** In the modern world, small pastoral herder households living on grasslands in countries such as China face major challenges in adapting to changes in their institutional, market and bio-physical environments. In China, these changes have been profound over the last 30 years. Herders, their communities and others dependent on the grasslands have responded to these developments but not always as might be expected. In this paper, the sources of the macro-forces in China that have created the pressure for change at the grass roots are outlined and the micro-adjustments made by herders and others in response to these pressures are analysed. A longitudinal multidisciplinary perspective is employed to distil insights from studying the dynamics of these adjustments over the last three decades. The major finding is that macro reforms can create enormous pressure for micro adaptive initiatives by herders and others dependent on the grasslands. Most importantly, the responses of these actors are not always as predicted and may pose major threats to the future sustainability of pastoralism based on the grasslands.

**Keywords:** China, grasslands, pastoralism, institutions, markets, adaptation.

## Introduction

Herders and grassland communities operate within complex bio-physical, market and institutional environments that can change in unexpected ways. Furthermore, these complex systems often have both forward and backward interconnections so that a new development in one aspect can lead to unanticipated consequences for another aspect. Over the millennia traditional herders living on grasslands have learnt to adapt to these uncertain and changing environments. However, in recent times grassland communities in many countries have been subject to increasing pressures as the micro-environments they must manage have been buffeted by new macro-forces from outside. The dynamics of how herders, their communities and others involved with the management of the grasslands cope with these new macro-forces and the corresponding micro-level adaptations and feedbacks, is worthy of serious study. This paper examines this process in China where institutional, market and bio-physical changes relevant to grasslands have been profound over the last three decades. Furthermore adaptations to these changes have not always been straightforward nor as anticipated. Reflections on these changing environments and adaptations not only provide an understanding of these dynamics in China but also offer insights relevant for other countries.

## Changing environments

### *Institutional environment*

Institutional changes in China since the late 1970s have been remarkable. The transition from a centrally planned to a market-oriented economy and the subsequent burst of economic development has had major impacts in the vast grasslands of China. In particular, the application of the

household responsibility system (HRS) to pastoral areas saw a shift from the commune system to where households had ownership of the livestock, use rights to contracted grasslands and the freedom to make their own decisions about how to manage their farming and grazing systems. Longworth and Williamson (1993, Section 3.5), Brown *et al.* (2008, Chapter 4) and Banks *et al.* (2003) describe how some of these institutional changes flowing from the introduction of the HRS materialised in different parts of China's pastoral region.

A number of other economy-wide fundamental reforms exerted major impacts on herders and grasslands. Marketing reforms that commenced in the mid-1980s eliminated the monopoly of the sole procurement agencies of the central planning era and liberalised agricultural product markets (Longworth and Brown, 1995). Fiscal reforms from the late 1980s changed the incentives and wherewithal of cash-strapped local governments in pastoral areas to pursue development paths with profound effects on agri-processing activities and inter-regional product flows (Findlay, 1992; Brown and Longworth, 1992). Administrative reforms saw restructuring from smaller sector-specific and control-oriented agencies to larger cross-sectoral and facilitative agencies (although the Ministry of Agriculture has maintained its industry orientation). A large proportion of State-owned enterprises have been corporatised or restructured into shareholder companies with more accountability for their own profits and losses. One important consequence of these administrative reforms for the pastoral region was the closure of many of the larger formerly state-owned, inland wool textile mills set up during the central planning era to process wool grown on the grasslands (for more details see Brown *et al.* 2005, Chapter 5). State Farms, prominent

throughout the pastoral region, were reformed and restructured in the 1990s, enabling the state farms—and households within the farms—to pursue and be more accountable for their own decisions. As a consequence of both the closure of the inland wool textile mills and the new pressures on state farms to become more independent of the state, many state farms located on the grasslands of Xinjiang—and which had traditionally been prominent in fine wool production—abandoned fine wool production during the 1990s and 2000s.

Apart from the above mentioned reforms, and others that have had a direct impact on herders and grassland communities, there have been dramatic indirect effects flowing from the economy-wide, broadly-based reforms that have led to rapid economic growth in urban areas over the last 30 years. The growth of employment opportunities in urban areas, along with relaxation of the household registration system, have had an enormous impact on rural urban migration with the proportion of the Chinese population living in urban areas increasing from 20% in the 1970s to 50% in the 2010s. Off farm employment, temporary and permanent migration and remittances have impacted on pastoral households to varying degrees.

Apart from the over-arching macro institutional reforms, changing policy settings have been especially important since 2000. As discussed in detail in Brown *et al.* (2008) herders and grasslands are influenced by grassland policies that came to prominence in the 2000s and a suite of related livestock, market, structural adjustment, modernisation, resettlement and other policies. Furthermore, the policy changes have not all been the result of specific legislation such as the national Grassland Law. As pointed out in Brown *et al.* (2008) some of the most profound policy changes have been implemented following edicts (State Council Grassland Opinion) or by the establishment of new regulations and standards (Grassland Livestock Balance Management Method) or most importantly by the programs and projects (Reduce Livestock Return Grasslands Program). Indeed, the last decade has seen the emergence of an almost bewildering policy mosaic impacting on herders, grassland communities and others concerned about Chinese grasslands.

### *Market environment*

A key aspect of the changing institutional landscape has been the opening of agricultural product markets. By the 1990s, the dominance of individual traders in livestock and livestock products led to concerns over what was described as a “chaotic” and fragmented market environment. In practice, most product markets were not as chaotic as they seemed to a casual observer. Closer inspection revealed that these markets usually had well-defined hierarchical marketing channels or supply chains made up of larger and smaller private traders and collectors. Nevertheless, for herders the transition entailed a shift from the old regime of fixed margins and set prices to less certain and more variable spot markets. Furthermore, opening up the product markets not only broke the monopoly of the government sole procurement agencies but also eliminated the availability of a raft of industry services previously provided by these sole procurement agencies in the central

planning era (Longworth and Brown 1995). This created a vacuum in relation to the provision of many industry services that by 2010 had only been partly filled (Waldron *et al.* 2011).

The factors influencing the market vary by product. Cashmere and wool production is confined almost exclusively to pastoral and semi-pastoral areas. China is the largest cashmere producer in the world and the Chinese industry is increasingly influential in the international global value chain for cashmere (Waldron *et al.* 2013). China dominates the global wool processing industry, at least for worsted processing and trade. However, Chinese worsted mills source most of their raw material from overseas. Almost all wool grown in China is produced in grassland areas, but very little is used to make higher-value worsted apparel. Most domestically grown wool is of poor quality and is purchased from herders by small private traders in small ungraded lots. After passing along a chain of hierarchically organised traders, local poor quality wool is processed in the woollen sector or used for carpets. In contrast to cashmere and wool, beef and sheep and goat meat are produced throughout China and grasslands are a significant source of these products. Furthermore, these products are not imported nor exported to any significant extent and so are not interconnected with world global supply chains. Consequently, unlike cashmere and wool, the markets for these products are not subject to developments outside China. On the other hand, domestic Chinese policy influences on these products can be quite specific and dramatic. For example, in western pastoral provinces such as Xinjiang, these meats are treated as staple foods and so are subject to storage and price control policies. Despite the persistence of special measures in certain areas, the markets for these domestically produced and consumed meats have become increasingly integrated over time (Brown *et al.* 2002).

It is not only the institutional reforms that have impacted on the market environment of herders but also the combination of these reforms with other macro-developments in China and particularly growing affluence and urbanisation. For example, in the case of beef, sheep and goat meat, consumers have become much more sophisticated and they are now expressing their preferences, especially in relation to food safety (see Brown *et al.* 2002). It has become increasingly difficult for the traditional small herders living in remote grassland regions to participate in and benefit from, these increasingly demanding markets.

### *Biophysical environment*

China's 400 million hectares of grasslands have supported pastoral activities for millennia. However, in recent years, there has been widespread concern among policy makers in China about the level, severity and changes in grassland degradation and desertification. In the late 1990s, the SDPC (1996) and SEPA (1998) estimated that 90% of China's grasslands were degraded including 42% with moderate to serious degradation. Lu (2005) estimated that the total area of degraded grassland increased by 80% from the early 1980s to the early 2000s. Longworth and Williamson (1993) report significant but

varying levels of degradation in different parts of the pastoral region in the 1980s. Lu (2006) estimated that grass yields had more than halved between 1982 and 2003 in most parts of the pastoral region. Lu (2006) made estimates of actual stock numbers against theoretical stocking capacity based on a major grassland census in 1980 and livestock numbers from the 1990s. Brown *et al.* (2008, Table 2.7) refined and updated this analysis using data on livestock numbers for pastoral and semi-pastoral counties and for livestock numbers in the 2000s and found actual stock numbers well in excess of the theoretical stocking capacity. Nevertheless considerable debate exists both about the level of degradation and causes of degradation in China. The spatial and temporal mosaic and enormous diversity of the grasslands in China combined with the difficulty in the accurate assessment lie behind some of the conjecture.

Despite awareness of and concerns about grassland degradation in the early 1990s (Longworth and Williamson, 1993) the push to develop livestock industries and especially ruminant livestock in China saw escalating numbers of grazing livestock on seemingly already heavily utilised and possibly degraded pastures. Heightened awareness of grassland degradation by Central level officials towards the end of the 1990s led to the formulation of a new Grassland Law and an accompanying suite of new programs, including grazing restrictions. Thus herders have had to adapt not only to less productive grasslands but also to the curtailment of their grazing rights. The institutional response arose both from the growing recognition of the deterioration in the biophysical environment and from the increasing value being placed on non-market “public goods” (such as dust storm abatement in eastern cities) generated by improving the grasslands.

Qian *et al.* (2012) investigated changing weather patterns associated with climate change on herbage production over the period 1961 to 2007. Although they estimated a negative overall impact of changing weather patterns on grassland productivity, their results highlight the enormous spatial diversity of Chinese grasslands, with warmer and drier weather conditions in northern grassland areas and warmer and wetter conditions in western areas corresponding to different impacts on herbage production across the grassland regions. Fernandez-Gimenez *et al.* (2012) and Addison (2012) highlight the increased frequency of severe winters or dzuds in Mongolia, a phenomenon also experienced in many northern grasslands in China.

## **Adaptation**

### *Adaptation to resource conditions*

To help rehabilitate grasslands by implementing grazing restrictions and to maintain livestock industry development in the pastoral region, the state has promoted pen feeding of ruminant livestock and achieving a balance in feed supply and demand. Various studies (see, for instance, Kemp *et al.* 2011 and Michalk *et al.* 2011) have developed methods to increase livelihoods and livestock productivity by reducing stocking rates, improving nutrition, using warm sheds, selective culling, breed management and enterprise mix. The viability of these systems depends in part on efficient

access to relatively low cost feed. Fodder production and markets have developed rapidly throughout China especially in the 2000s but cost-effective movement and feeding in the more remote parts of the pastoral region remains elusive. Nevertheless, as Longworth and Williamson (1993, Chapter 5) highlighted, some of the most severe cases of grassland degradation have occurred in semi-pastoral and semi-agricultural areas (such as the Erdos and Keerqin grasslands in Inner Mongolia) due to the legacy of high human and livestock populations that placed intense pressure on grassland resources. Therefore, measures targeting these areas with better access to feed may yield substantial benefits. For other regions with less favourable access to feed, other strategies and adaptations are important. Many of these involve social relations among herders and are discussed below.

Herders manage the bio-physical uncertainties they face in various ways including creating opportunities to move livestock to new grazing and the purchase of feed to ensure survival of the core breeding flocks. Retaining as many livestock as possible is a very common traditional form of insurance against heavy losses in the event of a severe winter where high mortalities pose a major threat to the livelihoods of pastoral households. Under these circumstances, herders are understandably reluctant to adopt practices that may increase their exposure to bio-physical risks.

In recognition of the need to actively encourage herders to adopt more sustainable practices, government policies are now in place that provide incentives for herders to limit their livestock numbers and to aim to maximise value per unit of grazing pressure. However, accurate market signals/incentives are needed to prevent distortion of these policy created incentives and this is discussed in the following section.

While official emphasis has been on creating policy-based incentives for herders to adapt their grassland and livestock management practices to manage the grasslands more sustainably, changes in the market environment have had some remarkable positive implications for grassland resource use in some areas. For instance, the emergence of lamb in hot pot menus, means that hot pot restaurants need to source lambs more evenly throughout the year, especially leading into winter Waldron *et al.* (2007). Households that can induce early mating can grow lambs out on abundant feed in summer and sell them before feed resources diminish into winter. Similarly the development of infrastructure and a more regionalised and specialised beef cattle industry has increased the flows of feeder cattle from pastoral regions to be fattened in agricultural areas. Pastoral areas such as eastern Inner Mongolia have been well positioned to take advantage of these favourable market developments. Indeed the responses from herders has been sufficient to be reflected in official statistics which show large and growing differences in mid- and end-year aggregate livestock numbers (Brown *et al.* 2008, Section 6.2.3).

### *Adaptation to market prices*

The ability to respond appropriately to changing market conditions—as illustrated by the lamb and feeder cattle

examples just discussed—can have a favourable impact not only on herders income and livelihoods but also on the grasslands. To achieve this kind of positive outcome, herders need to receive the higher prices available for new and better quality products. That is, the premiums for quality must be accurately transmitted back to the herders. Unfortunately, there are often major impediments to this happening. For example, in the more remote pastoral areas, wool and cashmere provide two of the few sources of cash income but market prices for these products are volatile. Accurate prices at the “farm gate” are needed for herders to decide which activities to pursue and which production, handling and marketing systems to use.

Accurate prices depend on a number of factors including the means of price discovery, the capacity to accurately differentiate and measure product attributes and the level of competition. Although the marketing reforms introduced in the 1980s elicited a plethora of traders, there is often a spatial, temporal and ethnic dimension to the competition between these traders. For example, the wool shearing and buying season occurs at slightly different times in different localities in the grasslands but is very short in any particular locality (around 6 weeks). In any one locality, therefore, there may not be many traders buying wool; they may all belong to one ethnic group and a group different to that of the herder households; and none of them are likely to be specialist wool buyers since wool is only available for a few weeks each year. In localities where herders move their sheep and goats to summer pastures, shearing and sale of the wool to traders may occur on the summer pastures. The herders may also seek to sell surplus livestock to traders late in the summer before they head back to their winter pasture areas. Therefore, traders who travel to the summer pastures to buy wool or livestock, especially in poor years, are aware of the grassland conditions that herders face and they can exploit the pressure on the herder to sell.

Differences arise between large and small herders. In volatile cashmere markets, large herders often carry their cashmere over if they feel traders offer what they believe is too low a price. Small growers do not have that option and often accept lower cash prices to meet immediate cash flow needs. Interviews conducted by the authors with cashmere growers in Gansu Province revealed differentials in the prices offered for cashmere between small and large growers of up to a third of the product price.

Transaction costs are high in differentiated, premium markets where transactions are more specific in regard to quality. Price premiums increase the incentives for opportunistic or exploitative behaviour. Access to premium wool markets involves measurement long distances away from herders and production areas as well as delayed payments. This places high demands on informal institutions (trust between actors in the supply chain) and formal institutions (contract, accounting and credit systems). If these institutions are undeveloped, small herders will choose to sell to spot traders offering immediate payments, even if they are less lucrative than premium market channels. Measures that reduce the level of asset specificity such as more independent, timely and cost effective objective measurement, or macro-reforms that increase access to credit, may alter the nature of these

markets and the transaction costs of operating in them. Using an exchange and operational market efficiency framework, Brown *et al.* (2011) highlight the activities and improvements needed in the marketing system to engage small growers in premium wool markets. Trust and social relations are important as activities such as shearing and assembling the wool are often carried out on a collective basis building on social ties rather than through state-initiated wool associations (Waldron *et al.* 2011).

In adaptation to markets, consideration needs to be given to short- versus long-term responses. Experience with beef cattle and with meat sheep demonstrated that a state orchestrated “industry push” to develop these ruminant livestock industries led to very high prices initially, especially for breeding stock. However, these livestock prices (along with the corresponding product prices) corrected downwards as the government wound back from its support and as market imbalances emerged. Taking advantage of the opportunities from ephemeral gains in the early stages of industry development can be an important source of income in the short-term. However, longer term investment decisions and sustainable production systems (including policy and research support for particular systems) needs to be assessed against prices likely to prevail after the initial phase. Unfortunately, the development of ruminant livestock industries in China, in general, has been characterised by inappropriate official assessments with severe deleterious consequences for small herders and their longer term adaptation to markets and resource conditions.

### *Social embeddedness*

Many pastoral activities in China are dominated by ethnic minority groups including Mongolians, Kazakhs, Uyghurs, Tibetans, Hui and other minority groups (Longworth and Williamson 1993) especially in autonomous minority-nationality administrative regions. Long-established, enduring practices—including product exchange—play pervasive roles in pastoralism in Western China.

Adaptations to changes in the market and institutional environment are “embedded” in social relations and networks. Fligstein and McAdam (2011) highlight that markets can be defined as a social space with the interaction among challengers and incumbents and the State influencing all aspects of the market including the setting of standards. Social embeddedness may constrain or facilitate adaptation. In the case of beef and sheep and goat meat marketing and slaughter where Hui muslim networks are very influential, the co-ordination needed to adapt to growing interregional trade and rapidly changing meat markets has been facilitated by the strong social networks that exist within the Hui community (Brown *et al.* 2013a). In other cases, the dominance of the Hui networks at large interregional markets has constrained new developments and participants in the market. For instance, efforts by remote herders in north western Xinjiang to adopt a group marketing approach to selling their surplus sheep by organising transport to distant regional markets was thwarted by implicit collusion among Hui traders at these markets. The traders acted collectively knowing that the herder groups could not afford to take their sheep home and only offered very low prices.

In the case of wool marketing, the well-defined hierarchical networks of traders and supply channels that extend to woollen processors in eastern China (especially in southern Hebei and Shandong) are often based on social ties. Social networks and connections with officials are important both for traders to secure supplies and for producers in some regions to secure sufficient competition for their products.

Waldron *et al.* (2011) highlight the complex interactions that arise between the central state, local state, corporate entities, private entrepreneurs, collectives and households in the modernisation of the wool industry and wool supply chains in China. In particular, they highlight that private fine wool marketing companies have entered into particular parts of the sector including wool trading (dealing, broking, auctioning), transport and mechanical shearing largely at the expense of the state but do not have the incentive to provide 'industry-specific public goods' such as long-term research and development programs; training and extension programs; and grading, standards and testing services needed to sustain long term industry development. This may create pressure for changes in the way the social structure of these markets operate, especially in the way market information and other marketing services are provided and by whom.

Analysis of social embeddedness of markets helps explain not only adaptation to changes in the market environment but also to changes in resource conditions and policy settings. As mentioned, many of the summer grasslands in mountainous and transhumant grazing areas in north-west China are notionally contracted out to individual households. Yet in practice these grasslands are grazed by groups of households with kinship or other social ties in order to improve the management of the grassland and their flocks and to provide other support among households in these remote areas. Banks (2003) identified the importance of collective and group tenure and grazing systems. Addison (2012, Chapter 6 and Chapter 9) revealed how various informal arrangements between neighbouring herders in Inner Mongolia enable mobility to allow for efficient use of sparse grassland resources that is not possible within individual contracted areas. Brown *et al.* (2008) highlight how in transhumant systems in China, the maintenance of stock routes and control over spring and autumn grazing along these stock routes are governed more by social norms than by formal regulations that may or may not be in place but which are difficult to enforce.

### *Strategic compliance*

In responding to Central level directives and policy measures, a strong element of strategic adaptation or compliance both by local governments, agencies and households is evident. Local governments may seek their own interpretation and modify implementation of the Central level measures as their objectives and interests may differ from that of the Central government. Financially challenged local governments may take a more myopic, narrowly focussed view of local productivity and income impacts compared with the longer term perspective of central government where public-good resource flows from the grasslands (such as dust storm abatement) are of

interest. Given the diversity that exists in China, there is an appreciation that local agencies and officials may need a flexible interpretation of Central edicts and policies and this is also the case with grassland policies. Nonetheless, strategic compliance operates within bounds set explicitly or implicitly by the Central government while local-level agency compliance is also encouraged through the targeted funding of programs and through non-financial incentives on local cadres.

Households will exhibit aspects of strategic compliance especially in regard to grazing restrictions. Addison (2012) noted that compensation for grazing restrictions was the major source of income for herder households in the Inner Mongolian part of the Gobi. However, these payments only partly compensate for income loss from not being able to graze. Consequently there were strong incentives for herders to accept the compensation but to push the compliance boundaries on grazing restrictions and stocking rates.

The need on the one hand, for uniform national policies and on the other, for local interpretation is implicit in the idea of strategic compliance. Longworth *et al.* (2012) raise the notion of a "policy mirage" where stated policy intentions of officialdom differ from actual implementation on the ground—often to appease particular interests while allowing the flexibility to more-or-less achieve stated policy goals. Longworth *et al.* (2012) and Brown (1998) highlight several policy mirages related to ruminant livestock product markets in China including trade measures (operation of import quotas) and domestic marketing (application of 'mandatory' purchase grades and standards) but mirages also extend to production and resource management. The existence of policy mirages is neither unique to China nor to the agricultural sector.

### *Adaptation within industry value chain and industry policy*

Agribusiness actors have adapted to changing market and institutional environments in China. The agribusiness giants of the sole procurement, central planning era [the Supply and Marketing corporations (SMCs) and General Food Companies (GFCs)] faced new competition with the liberalisation of markets. Many local branches representing these government monopolies could not survive the reforms of the markets in which they operated. On the other hand, former employees of these grass root agencies used their local knowledge and networks to become part of the new network of individual traders.

In terms of herders receiving inaccurate prices for their wool, the change in local buyers was of little consequence. Both before the markets were liberalised and afterwards, prices were heavily averaged. The fixed margins and broad grades under the old SMC system gave way to broad grades and mixed average prices offered by the private (often ex-SMC) traders. These private traders were seeking to extract rents by purchasing on a mixed grade basis and re-sorting prior to sale to mills or higher level traders.

Preferential and low cost access to finance for storage and price stabilisation allowed restructured provincial level SMCs to retain a strong presence in the wool market and they still account for a significant proportion of the trade in

domestic fine wool in China (up to 40 kt). Their links to a select hierarchical network of traders along with the state subsidies confers upon them a significant degree of market power allowing them to both utilise and compete against individual traders. Despite the opportunity to do so, these companies have not developed the genuine fine wool segment of the domestic market but nonetheless, have exerted a strong influence in the broader domestic wool market.

The concept of path dependence helps explain the evolution of industry policies and developments. Brown *et al.* (2013b) highlight that while the sequencing of reforms in the wool industry has led to what could be regarded as a logical and appropriate industry development path—they have also had negative consequences. In particular, household responsibility reforms, marketing reforms and State farm reforms all occurred before new agencies emerged to provide the industry services no longer supplied by centrally planned institutions. This almost led to the demise of genuine fine wool production in China. In recent times, there have been efforts in some localities to resurrect the production of genuine fine wool but these efforts have been severely hampered by the lack of the necessary facilitating marketing services. Beef differed from wool and many other industries in becoming a significant industry only in the post-reform era. Prior to early 1980s cattle were used primarily for draught purposes and the small amount of beef produced was distributed among the Muslim population only (Longworth *et al.* 2001). It might be expected, therefore, that path dependency would not have had a significant role in the case of the emergence of the beef industry because it was one industry that did not have a history in the centrally planned era. Nonetheless, in their diachronic analysis of the Chinese beef industry, Brown *et al.* (2013a) highlight how previous developments during the centrally planned era bequeathed a significant legacy in terms of both production and processing capacity to the new market-oriented beef industry that emerged after 1980. This is especially important because similar historical legacies are not always evident in other countries (such as Indonesia) that may be looking to China for a model of how to build a beef industry (Waldron and Brown, 2013).

### Implications and concluding remarks

Traditionally herders have exhibited a remarkable capacity to adapt to changing environments. A feature of the adaptation highlighted in this paper that is common to changes in either the institutional, market or bio-physical environments is that they have been embedded in social relations and networks. As the scope and pace of changes in these environments increase, so too does the pressure for more innovative responses to these changes. Micro level initiatives to improve feeding, grazing and production systems and to improve ruminant livestock product markets must be cognisant of these social relations and networks if they are to facilitate adaptation by herders and grassland communities. Furthermore, there needs to be both a coherence between macro-level central policies and local-level micro initiatives and an effective capacity of the state to implement these policies and initiatives if the adaptation is to be facilitated.

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