

available at [www.sciencedirect.com](http://www.sciencedirect.com)[www.elsevier.com/locate/ecolecon](http://www.elsevier.com/locate/ecolecon)

## METHODS

# Mongolian nomadic culture and ecological culture: On the ecological reconstruction in the agro-pastoral mosaic zone in Northern China<sup>☆</sup>

MunkhDalai A. Zhang<sup>a,b,\*</sup>, Elles Borjigin<sup>c</sup>, Huiping Zhang<sup>d</sup>

<sup>a</sup>Research Center for Eco-Environmental Sciences, the Chinese Academy of Sciences, Beijing, China

<sup>b</sup>Bureau of Land and Mineral Resources of Hulunbuir City, Hulunbuir, Inner Mongolia, China

<sup>c</sup>Bureau of Culture of Hulunbuir City, Hulunbuir, Inner Mongolia, China

<sup>d</sup>Department of forestry management, Beijing Forestry University, Beijing, China

## ARTICLE INFO

## Article history:

Received 28 July 2006

Received in revised form

6 November 2006

Accepted 6 November 2006

Available online 14 December 2006

## Keywords:

The agro-pastoral mosaic zone in northern China

Mongolian nomadic culture

Ecological culture

Ecological protection

Ecological safety and social

economic safety

Sustainability

## ABSTRACT

After analyzing the grassland environmental characteristics and nomads vs. agrarian land use styles and their ecological and environmental influences in the arid and semiarid agro-pastoral mosaic zone in northern China, it was concluded that Mongolian nomadic culture is more close to the basic principles of the ecological culture in the modern sense. Mongolian nomadic culture has advantages over agrarian culture in ecology and environmental care, sustainable utilization of grasslands, and in sustainable human social economic development in the region. Generally speaking nomadic culture prevents desertification; whereas, agrarian culture facilitates desertification. Confliction between nomadic protection and agrarian destruction of grassland ecosystem is essentially focused on the problem of regional and even global ecological safety. Obviously, protection of ecological safety should be given priority because human social and economic existence, as well as development depend on and are decided by the vulnerable ecological safety in the arid and semiarid areas. Therefore expansion of cropping into the fragile ecosystem of arid lands was unfortunate. The long term sustainable management of these grassland ecosystems could benefit from reversal of policies that are exacerbating the problems of land degradation, and from the adoption of land use practices that have been successfully applied for centuries by Mongolian herders. Protection of grasslands and nomadic culture is far more important or even vital to the subsistence and sustainability of human and all other beings, compared to the protection of agrarian lifestyle and land cultivation. Protection of ecologic safety is protecting the premise and fundamental bases of economic and social development in the area. It is important to derive the rational elements of nomadic culture in construction of ecological culture, and in the ecological reconstruction in northern China. Based on analyzing and reasoning in line with the quintessence of nomadic culture summarized, some proposals on ecological reconstruction in the area are presented.

© 2006 Elsevier B.V. All rights reserved.

<sup>☆</sup> Foundation item: This research has been partly supported by National Natural Sciences Foundation of China (No.40071036), Natural Sciences Foundation of Inner Mongolia (No. 200308020512), and the Key Research Project of Ecological Evolution of Hulunbuir Grasslands of Hulunbuir City, Inner Mongolia Autonomous Region, P. R. China (No. 2002–01–15).

\* Corresponding author. 19th Arunlu, Hailar 021008, Hulunbuir, Inner Mongolia, P. R. China. Fax: +86 470 8226898.

E-mail address: [chaganchulu@126.com](mailto:chaganchulu@126.com) (M.A. Zhang).

## 1. Introduction

In this article we deal with the environmental problem of sandy desertification in a region in northern China from a cultural approach and its ecological reconstruction by a set of policy recommendations. The region has been given several names by Chinese scholars: the agro-pastoral transitional zone (Songqiao, 1991), the agro-pastoral zigzag zone (Dianfa and Fengquan, 2000; Halin et al, 2002), etc. As the region is a zonal area interlaced by nomadic and agrarian cultures with patches of plantations and settlements on the background of arid grasslands.

Historically, the region was the homeland of the nomadic ethnic groups. Nomadic culture was the dominant culture of the zone. Due to the large scale immigration of agrarian population from the Central Plain of China mainly from 1740s (Baozhong, 2003), the grassland ecology became gradually fragmented and turned into the agro-pastoral interlocked mosaic pattern at the interface area between nomadic and agrarian cultures. That is why sometimes it is also called agro-pastoral transitional zone.

From the very beginning of the immigration of agrarians into grasslands, conflict arose between agrarians and nomads. This shift in land use marked the beginning of serious problems of soil erosion by wind and sandy desertification related to human land use activities. Now the deteriorating ecological environment along the agro-pastoral mosaic zone in northern China is so serious that it has been hindering local economic development, as well as posing an ever-growing threat to ecological, environmental, and social economic safety of local and neighboring areas. At the same time, the problem has political, ethical, social, and moral dimensions requiring multidisciplinary and a more global approach to its solution. Therefore a deeper understanding of the root causes of such severe land degradation, as well as mechanisms for resolving this crisis need to be explored.

## 2. Environmental characteristics along the agro-pastoral mosaic zone in northern China and the adaptability of nomadic and agrarian cultures

The steppe exists as a result of an arid and semiarid climate, with perennial xerophilous gramineous grasses as its dominant species, and perennial weeds and half shrubs also play a significant role (Bo, 2000). From the viewpoint of regional ecosystem, the northern grasslands of East Asia are distributed over the vast region between the forest and desert ecosystems. It is a fragile ecosystem evolved by adaptation of herbs to the arid climate from Oligocene to present and can easily become unbalanced. Negligent human activities can easily trigger significant ecological responses in this ecosystem, and many human activities cause serious environmental consequences for human society itself.

Generally speaking, the agro-pastoral mosaic zone in northern China is located in the interface between the southeastern forests and grasslands of the Northern Asia. In the northeast it starts from Hulunbuir of Inner Mongolia, and stretches to the southwest, crossing southeastern Inner Mongolia, northern Hebei and Shanxi Provinces, and terminates in northern Shaanxi province, near the Ordos plateau. It encompasses a wide area of semiarid and arid regions. The rainfall is 300–450 mm. The aridity

is 1–2 degrees and the total area covers 654,564 km. Land use is characterized by interlocking cropping and animal husbandry. Over time, cultivation and herding raise and fall in response to seasons and government policies (Halin et al., 2002). The environment is brittle and sensitive, risky for agriculture (Songqiao, 1991). The combined effects of the Eastern Asian monsoon and irrational human land use activities make the region's environment vulnerable (Dianfa and Fengquan, 2000). Agricultural output is not only low and variable, but farming methods in current use accelerate wind erosion and desertification of the land, leading to widespread deterioration in the ecological environment in this region.

Fundamentally it is humans who choose their way of life, aesthetic standards and spiritual world. Facing the specific eco-environments, they make their own cultural choices which suit them best to survive and develop. Historically, herders chose the nomadic culture in the Mongolia Plateau and the farmers chose the agrarian culture in the central Plain of China. The intrinsic law that human civilizations blend with each other has led the nomads and farmers to the mutual relationships that were sometimes strained and sometimes harmonious. However, there is a significant ecological and environmental contrast between northern grasslands on Mongolian Plateau and the Central Plain of China, and migration of farmers onto these northern grasslands led to misunderstandings and some violence. Although anthropological research shows that northern Chinese people are so closely related in consanguinity that they have little hereditary difference compared with southerners (Ruofu et al., 1998), but there are major contrasts between culture and way of life.

The typical plain area of Central China, from which many migrants came, is characterized by plentiful rainfall where the soil can be tilled without danger of wind erosion. Deep plowing and active suppression of wild plants are routine farming operations. Conditions are completely different in the Mongolia Plateau.

The grassland region is less susceptible to water erosion due to the arid or semi-arid climate, but strong winds and an arid climate can cause severe wind erosion if the land surface is disturbed. There is a thin layer of sandy soil on top of the thick loose sand on the sandy grassland, and winds are strong in spring and autumn (Munkhdalai, 1998; Qingbiao et al, 2004). The prairie environment is vital to all living creatures, including humans.

Nomadic animal husbandry evolved in response to the environment and is a long term cultural choice for many. Thus it is not difficult to understand that the agrarian and nomadic cultures arise from completely different environmental conditions. Each developed as an adaptation to their respective environment. These two cultures embody adaptability and advantages specific to the regions in which they developed. If one culture is transplanted artificially to another region it seems inevitable that conflicts and misunderstanding will arise. This could be one of the reasons for conflicts between nomads and farmers in the agro-pastoral mosaic zone.

Hulunbuir sandy grasslands were opened up for cultivation on a large scale in the late 1960s, and then cropping was abandoned due to the severe dust storm and strong opposition by herders at the beginning of 1970s (Yongzong, 1981; Zhenda et al., 1989; Wengui, 2003). The grassland vegetation recovered quite well some decades after cultivation ceased. Nevertheless the recovery of the damaged surface soil layer and its structure is very slow

and soil organic materials are extremely low. Damage to the top soil layer occurs frequently from uncontrolled traffic and by sand drift from mobile dunes formed in recent decades.

Uncultivated grasslands are able to recover quickly once the damaging elements are eliminated. By contrast, it is the formerly cultivated soil layer that is especially vulnerable to wind erosion. This is because once the surface soil layer of sandy grassland was totally broken by deep plowing the loose sand underneath, with an average thickness of 38 m, was exposed to wind erosion. Once this starts and underlying sand comes to surface, it can develop rather quickly into a blowout that can measure up to 190 m long, 90 m wide and 12 m deep. Blowout dunes on the leeward side develop simultaneously. These can measure up to 700 m long, 300 m wide, and 5 m thick in the central part (MunkhDalai et al., 2006b).

The bare soil layer will be quickly eroded by wind until the cultivation layer disappears completely. We discovered a deflation of a horizon with an average thickness of 0.13 m, accounting for nearly half of the total thickness of top soil layer in the 1960s to 1970s abandoned plowed lands on Hulunbuir sandy grassland (MunkhDalai et al., 2006a). When the soil-grass root layer is lost the calcic horizon underneath, which plays also an important role in preventing the underlying sand from being exposed to wind, will be disrupted by sand flow ablation along the fissures and joints formed due to drying and sand wedge action. The result is the formation of holes in the top soil layer and the underlying sand exposed directly to the erosion of strong wind. When the exposed sand was blown out, the hole would develop into a large area of bare land and above mentioned huge blowouts and mobile dunes. The dunes can cover up to eight times the area of the grasslands destroyed by blowouts. Cultivation of these grasslands was risky and leads to degradation or even disappearance of original grassland vegetation on a large scale, and to the total destruction of soil and grass roots layer ecosystem.

Protection of the soil-grass roots layer is crucial in protecting the grassland ecology, and in desertification control in the agro-pastoral mosaic zone in northern China. And this could be the basic reason why the nomadic Mongolians stress most strongly the soil-grass roots layer protection in their unwritten law, statute law, custom, literature, ethics and so forth, which we will expand on below.

It must be accepted that expansion of cropping into this fragile ecosystem was an unfortunate mistake and that the long term sustainable management of these grassland ecosystems could benefit from reversal of policies that are exacerbating the problems of land degradation and the adoption of land use practices that have been successfully applied for centuries by Mongolian herders.

### 3. The practice, essence of ecology protection of Mongolian nomadic culture, and inspiration from it's ideology

The concept of respecting natural ecology embodied in nomadic cultures has the characteristics of being systematic, held by the nation as a whole, and putting superiority on protection rather than construction (Qingwu, 2001). Reverence for nature and protection of environment by nomadic culture are also fulfilled by the whole nation and is expressed in

multiple ways. In the dimension of ecological ethics, the core idea of nomadic culture is centered on an awe of life, respect to nature and harmonious co-existence of humans with nature (Gegenguva and Oyunbatu, 2002). These could easily be seen in the Jarlig (Holy Instructions) and Jasag (Laws and decrees) of the Great Mongol State, the Four Khanates, Yuan Empire, and

#### Box 1

Some typical folk tales or contemporary actions by Mongolians in defense of the grassland

It is told that Chinggis Khaan (Genghis Khan) said: the beloved and propitious ger (Mongolian yurts) are disaster-resistant and easy to move. Therefore we need not to build huge palaces and grand gardens. So long as we do not tear the holy skin of the golden land, and do not change the natural appearance of the vast grasslands. Then the grassland is the best natural garden without any human imprint (Guanbuzhab and Asgan, 2006).

Monke Khan (1209–1259) announced in his enthronement rescript that every grassland creature, including the plummy or the four-legged, under-water or on-land, must be kept away from the threat of hunter's arrow or noose. They should be let fly in air or swim in water freely. The earth should not to be disturbed by the knocks of horses' hoofs. Running water should never be contaminated by dirty things (Rashid al-Din Fadl Allāh, 1985). It has been alleged as the world's first ecology protection manifesto.

The construction and use of the ger by the nomads, especially by the Mongolians consume limited timber and can last for decades. It is forbidden to wash clothes too frequently in order to save water, washing dirty things in rivers is also forbidden to prevent water pollution and curb the spread of epidemic diseases. Mongolian nomads sacrifice nature at Oboo (heap of stones) constructed on grassland. They dispose of the dead by cremation of the corpse, for the natural death they choose celestial burial or deep burial without grave mound to let the grassland recover as soon and as thorough as possible. All these practices express the life concept held by the nomads. That is: moderate in self-satisfaction, harmonious coexistence with nature, environment protection, subsistence in accordance with the capability of natural ecosystem, and keep in pace with the changes of ecology and environment.

Modern herdsman, especially those represented by Gada Merin sacrificed themselves fighting against selling grassland to warlords for cultivating in the 1930s.

Herdsman wave their horsewhips in anger to drive the men who dig medicinal materials from the steppe, and collect Hair Weeds (a kind of algae which is a popular dish in South China for its Chinese spelling Facai sounds like to get rich). Collection techniques cause fundamental damage to the grassland vegetation and the precious top soil layer.

In an earlier time Munulun (Targun) and her eight children were killed for resisting vagrant tribes digging grass roots in the early stage of development of the Mongolian people (Rashid al-Din Fadl Allāh, 1983).

North Yuan Empire (Enkhee and Tumentsetseg, 2001; Ge et al., 2001), or in the local tales (Mandufu, 2000) and practices (Box 1).

Until recently the doors of the ger on grassland could not be locked, even at night, so that the passersby could come in anytime and they were allowed to have meals freely, have a rest, or take anything in urgent need even if the host was not present. These practices were consistent with the basic points of nomadic culture's reverence for life, moderate in self-satisfaction, and its humanistic characteristics of freedom, open, democracy, honesty and faith keeping (Chibei, 1999; Jergle, 2002). We can see that the nomads take the ecology and environment protection of the grasslands as a priority when dealing with the relationship between man and nature. But they take the human right of surviving and development as a priority when dealing with social relationship among people.

The environment and their way of life made Mongolian nomadic culture closer to nature, and to interact more directly and harmoniously with nature. Mongolian nomadic culture originated in the region of grassland and desert where the natural environments are among the most inclement and unpredictable in the world. They experience and comprehend the power of nature frequently and profoundly, feeling directly the sensitivity and fragility of the natural ecology in the region. Based on the perception of and practice with nature through thousands of years, the nomadic culture of the Mongols has taken shape, of which the essence is exactly to respect nature, including natural laws.

When natural environments change, nomadic society would react to it and adjust itself promptly in the direction favorable to the protection and development of the society itself, and also favorable to the rehabilitation and optimization of natural ecosystems. Therefore it can be said, according to the definition that "the ecological culture is a culture that human and nature co-develop harmoniously" (Encyclopedia of China, 2002). Mongolian nomadic culture is virtually closer to the basic meaning of ecological culture because it obeys the principles of revering nature, cherishing nature, and promoting the harmonious coexistence between humans and all other creatures of the world.

Throughout history many nomadic peoples chose the European-Asian grassland and the grassland chose the nomadic culture too. Through the mutual selection nomadic culture has taken a highly effective protection of the grassland and forest ecosystem and the same effective protection of the common homestead for humankind. Nomadic culture, characterized with its unique combination of man with nature, is a highly integrated compound ecosystem with grasslands, human society, ecology, culture and nature. Up to now the nomadic culture's rich experiences and efficient methods in management and utilization of the grassland have proven to be basically one of the sustainable ways of making use of the natural resources in the context of keeping integrity and health of grassland and forest eco-systems. These characteristics of nomadic culture prove its advantage or superiority over agrarian culture in the northern grassland regions.

In conclusion, Mongolian nomadic culture is distilled from the nomads' experience in arid and semiarid grassland based on knowledge gained from struggles against natural disasters. It is an important form of culture established due to the mutual affection and selection of the nomads and their

environment. It is also a unique cultural existence suitable, compatible, and a sustainable way of development in accordance with the natural ecology and environment in the arid and semiarid northern China.

We may also conclude the following: it is nature that created man and his position in the world, instead of the opposite. There shall never be an end for man to study and discover nature. Man needs to develop himself on the premise of obeying the law of nature, on the premise of preserving the integrity and healthiness of natural ecology. It is merely a dream or myth by man to conquer nature. Nature may reconstruct the ecological balance by punishing man finally if he destroys his natural environment and ecological balance arbitrarily instead of protecting it. Nature might even annihilate mankind as an ultimate punishment and replace man with some other creature if human kind's deeds overstep certain limits. It happened several times in geological history that certain creatures completely disappeared on earth after their booming days (Jinghua, 1997). It is time now for man to rediscover his proper role in the world, reflect on his deeds and then adjust himself in accordance with the change of nature. What man is supposed to do is to find a suitable way of development in order to preserve the global ecological balance according to natural regulations, instead of expanding his population without limit and demand from nature greedily to ruin the foundation on which humans and all other creatures depend.

Obviously the ecological issues of grassland degradation and sandy desertification in the agro-pastoral mosaic zone in northern China are beyond the scope of any single discipline. The reason and the consequence of the problem, for example the problem of dust storms, also go beyond the agro-pastoral mosaic area. Solutions need to be found from deep-seated level and with a broader field of vision. There is a need to absorb the rational essence and strength from the nomadic culture. Political and technical mistakes in grassland care and management in northern China over the last 50 years (Jimin and Tungsheng, 2001; Enkhee, 2003), together with environmental changes, have resulted in the severe ecological deterioration in the region and posed ecological threats to neighboring countries and regions. In order to mitigate the ecological pressure and promote resumption or re-construction of the ecology in the agro-pastoral mosaic area in northern China, there is a case for a return to the principles embodied in nomadic culture.

#### 4. Absorbing the essence of the nomadic culture in development of ecological culture

Scholars have brought forward many kinds of solutions for the ecological improvement of the agro-pastoral mosaic zone in northern China, and even for improvement of the global ecosystem. All of these solutions could be put under the general category of ecological culture.

Some suggested developing several green corridors along great rivers, so as to facilitate air current from the eastern and southern hydrosphere to transport water or moisture into the northwestern part of China to improve the ecological environment (Hongchang, 2001). It is proposed that new style of

eco-industrial regions should be constructed in accordance with the different ecosystems and environment, and industrial types (Zhongling and Dunyuan, 2001). Others proposed adjustment of the existing industrial distribution, rearrangement of the plantation and pasture, return the cropland to pasture, avoid over-grazing of grassland, development of mining and industrial trades, enhance development of science and education, and development of integrated land using systems for agriculture and forestry to facilitate the development of oasis and processes of sandy de-desertification (Songqiao, 1991). Specifically, it is proposed that poplar trees, which consume a great amount of water and nutrition, should be replaced gradually with local species such as elm, willow, pine, and apricot. The reconstructed vegetation for an ecological shelter should be arranged in belts using mainly shrubs, combined with trees and grasses imitating aboriginal vegetation of open forest grassland. The direction of agricultural reformation is to expand irrigated and ecological protective farming, to change the way of management to increase the per unit productivity on a small portion of land, and to transform the management style to reduce large scale sandy desertification (Halim et al., 2002). Yet some scholars also suggest that in the distant future the leading culture in the grassland district should be one that is based on the essence of nomadic culture. The ecological culture should be an open system that has sufficiently assimilated the advantages of agriculture, industry and information civilizations (Enkhee, 2003). In his approach to ecological culture, man should succeed the comprehensive tradition of harmony of man and nature of the eastern natural humanism. Abandon the human-centered concept of industry culture, to let his intelligence free and to shoulder his obligations as the manager of the biosphere (Qingwu, 2001). Some thinking on modern nomadic labor style from the dimension of ecological economic philosophy has also been advanced (Mandufu, 2001).

Agro-pastoral mosaic zone in northern China and the correlative ecological problems are complicated and have a long history. It is necessary to move beyond the vicious circle or dead lock of conventional thinking and mutual accusing, to break the antagonistic attitudes or relations between farming and nomadic cultures, and to correct irrational land use that resulted from cultural conflict. In other words, in the process of ecological reconstruction in the agro-pastoral mosaic zone in northern China, some conceptual or philosophical reasoning is necessary:

- Reestablishing the concept that man is part of nature, and nature should be given priority when man deals with the problem of ecology and environment protection. The development of humankind should not be at the expense of diversity, health, and integrality of the natural ecosystem. This should be one of the basic meanings of sustainability of the human-nature system.
- It is hard to imagine that the earth could sustain ever-growing human population, or ever-growing human demands for natural resources. Man needs to research into the sustainability of his population growth and his demands from nature; whereupon, to set limits, if limits could be set (See also Nentwig, 1999).

- Man needs to establish an environmental and ecological value system. Man may label all kinds of ecosystems with his monetary prices by evaluating the capacity of serving his needs of consumption, or by evaluating the monetary expense of destroying the ecosystems. Man might even sum up the value of the entire ecosystem to get the monetary value of the global ecosystem. But the problem is: whether the monetary value of the global ecosystem equates to its real value to man and all other species on the earth? Of course it does not, because the monetary value of the global eco-system does not equate its life sustaining function for the subsistence of man and all other lives. In other words, man is unable to compensate, and unable to bear the burden of destroying the global eco-system. We can see that the concept of ecological value of ecosystem implies giving priority of live supporting functions, but satisfying the demand for improving man's living status is secondary. The variety, health and integrity of the ecosystem is not only fundamental for preserving the global biosphere, but also important in maintaining subsistence and development of human society. Economic benefits from ecosystem must not be at the expense of its life maintaining function.
- It is important to establish the concept of maintaining the diversity, well functioning, and integrity of the ecosystems, and ecological elements involved. This requires to find the proper role that man is assumed to play in such a system, to determine the scale and limit of human social and economic development, and limit of natural resource and space utilization. Disintegration of natural ecosystem should be avoided, which may be accomplished by gradual rehabilitation of relationship between the ecological elements, or integration of fragmented ecosystem through restricting human activities, and by encouraging development of environment-friendly industries.
- Ecological ethics should be taken into consideration that human development and satisfaction of his demands should not be at the expense of endangering the fundamental rights, or safety and subsistence, of other species or other elements of the natural ecosystems in the biosphere. From the view point of ecological value, every species has the same status in the global ecosystem as man. Integrity of global natural ecosystem is fundamental for the subsistence and healthy development of human society.
- The mechanisms for stimulation, such as the market system and the evaluation system of growth expectation for economic development, need to be reassessed, redesigned, and reselected carefully to avoid foolhardy, prodigal activities in human mass behavior.

Land provides man with basic living space and material for farming industry. Grassland or grassland ecosystem is the most efficient in environmental protection in arid and semiarid area. This is because grassland ecosystem can protect the earth inch by inch, and to nourish the poor and limited thin top soil layer, prevent underlying sand from gaining energy and activation by strong wind to get onto the surface to spread and harm the ecosystem in large scale. Grassland ecosystem constitutes an ecological barrier against wind erosion and desertification. At the same time, grassland ecosystem can also support nomadic economy, which may

not give the highest annual economic production, but can make active and appropriate use of grassland resources while retaining ecosystem's integrity and healthiness.

Conversion of grassland to cropland totally destroys the grassland ecosystem's function. Cropping on dry and semidry lands may bring in relatively high production in a short period. But this can only be achieved at the expense of the rapid soil fertility depletion, soil erosion, and lasting and difficult-to-control sandy desertification. In other words, cropping in arid and semiarid areas is a form of mining of nutrients and organic matter and the economic gains are short lived and are at the expenses of sustainable development in the long term. The goal of maximizing economic income over a short period between plowing of grassland and its abandonment due to sandy desertification and large scale dust storm prove that it is unsustainable in arid and semiarid areas.

Therefore, agrarian land using style in arid and semiarid area along the agro-pastoral mosaic zone in northern China is destructive to natural ecology, also destructive to precious top soil resources, and is uneconomical in the long run compared with nomadic style.

We can see that protection of grasslands and nomadic culture is far more important or even vital to the subsistence and sustainability of human and all other beings than protection of agrarian style and cultivated land in the agro-pastoral mosaic zone in northern China. Protection of the remaining grassland ecosystems and natural ecological reconstruction in the area are to protect the basis or the fundamental premise, and the safety for the development of human society and economy in the region, also to protect the social and economic environments of its neighboring areas. This is a trans-boundary problem which needs global cooperation.

In order to facilitate ecological reconstruction in the agro-pastoral mosaic zone in northern China, nomadic culture should be given its deserved position and leading role because nomadic culture has the tradition to learn from history and from other cultures and to adapt actively to the harsh environment. These experiences and philosophy can be used in the fundamental reform of overall land use policies, and derivation of multidisciplinary solutions.

## 5. Some suggestion on ecological reconstruction in the agro-pastoral mosaic zone in northern China

Aiming at the material process of construction of ecological culture in the agro-pastoral mosaic zone in northern China, it is necessary to take into consideration any possible extreme environmental condition or event beside the above mentioned concepts and principles. That is to prearrange the space for the rehabilitation or self-maintenance by natural ecosystems in case such disastrous environmental event occurs. Thereby we propose the following measures:

- Ban cultivation in the sandy grasslands and environmentally endangered regions in the agro-pastoral mosaic area. Protect the remaining remnant forestry and grassland, with the aim to prevent soil wind erosion and desertification, to maintain ecological diversity and ecological function. Existing cultivated land should gradually be converted

to forestry and grassland. No-till crop systems should be implemented without delay as these are less harmful to the grassland vegetation and top soil layer. Growing perennial and low-water-consuming plants on temporary preserved cultivated land is also to be encouraged. The surplus human population should be transferred out of the region to Southeastern China, or gradually moved to cities and towns along with urbanization process, and development of service industry and other trades may be encouraged to offer working opportunities for the ecological migrants.

- Grassland (original or reclaimed from cultivation) should be used in line with environmental changes that have occurred over the past few decades. Stocking rates and grassland carrying capacity should be established, in consultation with local herders, according to the need of ecological protection and recovery of grasslands. Quotas for each household may be set to regulate total number of livestock on the grassland. Stock numbers could be calculated and adjusted periodically, as well as the type of animal to be raised, scale of nomadic rotation, herding duration and frequency. Temporary grazing bans could be decided in consultation with herders and in accordance to the changes of environmental and ecological conditions.
- Reconstructing the natural ecosystem in the agro-pastoral mosaic zone. The area of cropland in the entire interface area should be reduced. Traditional agricultural cultivation methods need to be changed to develop ecological protective farming methods and technologies. Afforestation should be a priority in the southern part of the area where water and heat conditions are favorable, to enhance transportation of moisture from southeast to north to facilitate improvement of climate and ecosystems. In the plain area south to the mosaic zone, it is also recommended to intensify and to develop modern high-tech agricultural production methods and focus on development of combined agriculture and forestry. This could not only reduce the effect from dust storm attack on the plain area, but also enhance transportation of moisture to the west and north to support and promote ecological rehabilitation.
- Sufficient amount of land for ecological purpose should be reserved. Land for ecological purpose should be established as a new item in national land classification with its deserved legal status. Land for ecological purpose should include water source protection land, forestry land and grassland vulnerable to human disturbances, natural ecosystem protection land, nature reserves. This would help maintain global and regional security, diversity and integrity of the natural ecosystem. No business-oriented wood-cutting, fuel collecting or cultivation should be allowed on the lands for ecological purpose, but strictly controlled light grazing, hunting, and ecological and/or cultural tourism may be allowed.
- Developing regional cooperative modern livestock industry. Transformation of the existing southern agricultural field should be directed to satisfy the development of large scale regional cooperative modern livestock industry in the entire agro-pastoral mosaic zone. Development of small-peasant style animal husbandry in the southern part should be restricted. It is proposed to

develop high-tech forage plantation in the south to meet the forage shortage in the northern nomadic breeding base, hence to develop professionalized, regional cooperative modern livestock husbandry.

The grassland household contracting system introduced from south China's agrarian countryside from 1980s has broken the traditional mega nomadic circle (transhumance) (Jiange, 2000). This confines herding pressure to the entire grassland on one hand and exerts concentrated and continuous herding pressure on every small patch of grassland held by households. It disregards changes in seasons and weather conditions, and takes no account of conditions of grassland vegetation and geological or soil properties. It has contributed a great deal to the acceleration of grassland degradation and desertification in recent decades (Williams, 2002), and demonstrates agrarian cultures' failure in the aspect of social, economic, and environmental sustainability in the arid area. The pressure of over-herding on grassland might be mitigated through associating contracted segments of grassland by certain number of households and to resume nomad herding in the enlarged grassland segments.

- Formulating local regulations on desertification control related to grassland management. The aim should be to reduce ecological pressure, to protect and improve ecological environment, and to encourage productive activities suitable to the local natural environment. Land use taxes, according to different ecological and geological situations of grasslands, may be employed. Ecological protective economic mechanisms should also be applied to the evaluating, examining and supervising systems.
- Reforming the traditional way of obtaining energy from plants to promote ecological protection and rehabilitation. The biomass productivity of grassland vegetation is very low. Mongolian herders commonly use Argal (dry dung of cattle collected from pasture during the autumn, dried and prepared in the next spring) and Huurdgeng (brick-shaped compact dung removed from sheepfold by cutting with a special spade, dried and prepared at the camps, usually used in the wintertime) for fuel. In contrast, farmers in the agrarian countryside in the region depend on plants, trees or grasses for fuel which is less effective and ecologically destructive. Regrettably, a great deal of solar energy is unable to be transformed into biological energy; instead it manifests itself as devastating strong wind energy that contributes to soil erosion and dust storms.

There is potential to use wind power in electricity generation (Zuoxiu and Yanan, 2004). Additional research is needed to develop more efficient transformation technology to enlarge the proportion of solar and wind energy utilization, to make use directly the solar energy and the destructive wind energy derived, to protect the vegetation to the greatest extent for its ecological value, and to reduce fossil energy consumption and carbon dioxide and pollution discharge.

- Setting up ecological compensation mechanism for ecological protection and reconstruction. Development of ecological protective animal husbandry in the area comes from the need of maintaining health and security of regional and global ecosystems, and it needs continuous long term investment and construction, which is not affordable by the area itself. Assistance from the central government and international

society is necessary, especially at its initial stage. A macroscopic mechanism of compensation for ecological protection and construction could be set up to offset the regional economic difficulty, which would result from the reduction of production and industrial transformation.

- Formulating new economic and social development index system to safe guard sustainable social economic development and ecological protection. Green GDP is an index system aimed at ecologically and environmentally favorable economic development. Practical ecology and environment expenses in production need to be taken into account in this index system (Zongwei and Xiaoke, 2002). When applied to arid and semiarid areas, this system should be formulated in accordance with the need of ecological protection and construction along with economic developments. Thus governments and enterprises at all levels should be encouraged to work voluntarily for the environmental improvement in the region.
- Encourage herders and farmers at the Sum or township, Gacha or village levels to found ecological protection organizations. Large scale development or construction, as well as important policy making and application which is of major ecological impacts in the area should be determined in the name of these organizations, so that the mass could have the fundamental power to protect local ecology.

Special attention needs to be focused to introduce and propagate modern science and technology, to facilitate combination of modern knowledge and skills with traditional nomadic heritage and customs, thus to improve practically and steadily the herder's and farmer's qualification and ability in ecological protection and economic development. This should be the fundamental way of investment and a solution for initiating development of ecological protective or environmental harmonious economies, to construct ecological culture, and to ensure sustainable development in the agro-pastoral mosaic zone in northern China.

---

## Acknowledgements

We would like to thank Dr Dezhu Zhang who enlightened us on this study. We are grateful to Professor Zongwei Feng, and the Research Center for Eco-Environmental Sciences for the opportunity to present a report at the center's 2003 Annual Academic Conference so as we can obtain many reactions contributed to sharpen our views. Also we are indebted to Professor Enkhee Jargalyn from Center for Mongolian Studies, Inner Mongolia University, and dry land management consultant Dr Victor R. Squires for their constructive suggestions and documents. Thank Dr Dean Struble and Professor Sigurdur Gudjonsson for their help in English. We owe special thanks to the anonymous reviewers for their valuable comments in revising this paper.

---

## REFERENCES

- Baozhong, Y., 2003. Reclamation of northeast grasslands and its environmental expenses from Qing Dynasty. *Agricultural History of China* 4, 112–119 (in Chinese).

- Bo, L., 2000. Ecology. High Education Publishing House, Beijing, p. 271 (in Chinese).
- Chibei, M., 1999. Grassland Culture and Human History. International Cultural Publishing Company, Beijing, 996 pp. (in Chinese).
- Dianfa, Z., Fengquan, L., 2000. Mechanism of formation of fragile eco-geo-environment of agro-pastoral zigzag zone in northern China. *Rural Eco-Environment* 16 (4), 58–60 62 (in Chinese, with English abstract).
- Encyclopedia of China, 2002. Volume of Environmental Science. Encyclopedia of China Publishing House, Beijing, p. 334 (in Chinese).
- Enkhee, J., 2003. A historical retrospect on grassland desertification: cultural dimension of development. *Journal of Inner Mongolia University (Humanities and Social Sciences)* 35 (2), 3–9 (in Chinese, with English abstract).
- Enkhee, J., Tumentsseteg, 2001. On the Mongolian culture of nature preservation and its inheritance. In: Zhongling, L., Erdenebukh (Eds.), *Nomadic Civilization and Ecological Civilization*. Inner Mongolia University Publishing House, Hohhot, pp. 59–71 (in Chinese, with English abstract).
- Ge, Q., Mingguang, Sh., Alta, 2001. The Mongolian ecological protective law of ancient times, 2001. In: Zhongling, L., Erdenebukh (Eds.), *Nomadic Civilization and Ecological Civilization*. Inner Mongolia University Publishing House, Hohhot, pp. 137–148 (in Chinese, with English abstract).
- Gegenguva, Oyunbatu, 2002. Mongolian ecological culture in the context of ecological ethics. *Journal of Inner Mongolia University (Humanities and Social Sciences)* 34 (4), 3–9 (in Chinese, with English abstract).
- Guanbuzhab, T., Asgan, 2006. The Secret History of Mongols (Modern Chinese edition). Xinhua Publishing House, Beijing, p. 232.
- Halin, Z., Xueyong, Z., Tonghui, Z., Ruilian, Z., 2002. Boundary line on agro-pasture zigzag zone in North China and its problems on eco-environment. *Advance in Earth Science* 17, 739–747 (in Chinese, with English abstract).
- Hongchang, W., 2001. Climate-Ecology Evolution in the West of China: History and Prospect. Economy and Management Publishing House, Beijing, 223 pp. (in Chinese).
- Jergle, B., 2002. Comments on the History of Nomadic Civilization. Inner Mongolia People's Publishing House, Hohhot, pp. 1–300 (in Chinese).
- Jiange, W., 2000. Nomadic circles and nomadic society: a research based mainly on the investigation materials by Japanese South Manchuria Railway Co., LTD. *Researches in Chinese Economic History* 3, 14–26 (in Chinese).
- Jimin, S., Tungsheng, L., 2001. Desertification in the Northeastern China. *Quaternary Sciences* 21 (1), 72–78 (in Chinese, with English abstract).
- Jinghua, X., 1997. Deracinate—Find Vanished Years, second edition. SDX Joint Publishing Company, Beijing, 218 pp. (in Chinese) (translated by Ke, Ren).
- Mandufu, 2000. Mongolian Aesthetics History. Liaoning National Publishing House, Shenyang, 718 pp. (in Chinese).
- Mandufu, 2001. Mongolian nomadic civilization and philosophical thought of ecological economy. In: Zhongling, L., Erdenebukh (Eds.), *Nomadic Civilization and Ecological Civilization*. Inner Mongolia University Publishing House, Hohhot, pp. 72–94 (in Chinese, with English abstract).
- MunkhDalai, A.Z., 1998. Guide to Geology and Mineral Resources in Hulunbuir League. Geology Publishing House, Beijing, pp. 3–21 (in Chinese).
- MunkhDalai, A.Z., Zongwei, F., Xiaoke, W., Hurlee, U., 2006a. Review on research of desertification mechanism in Hulunbuir Grassland, China. *Journal of Desert Research* 26 (2), 300–306 (in Chinese).
- MunkhDalai, A.Z., Xiaoke, W., Hasieerdun, S., Hongwei, Jiaming, Z., Xiu, L., Zongwei, F., 2006b. Hulunbuir sandy grassland blow-outs: geomorphology, classification, and significances. *Journal of Desert Research* 26 (6), 894–902 (in Chinese).
- Nentwig, W., 1999. The importance of human ecology at the threshold of the next millennium: how can population growth be stopped? *Naturwissenschaften* 86, 411–421.
- Qingbiao, W., Xiaoke, W., MunkhDalai, A.Z., Ran, G., 2004. Effects of clay-silt fractions of soil on SOC and TN in Hulunbuir grassland. *Ecology and Environment* 13 (4), 630–632 (in Chinese).
- Qingwu, B., 2001. Ecological sight of nomadic Mongolian. In: Zhongling, L., Erdenebukh (Eds.), *Nomadic Civilization and Ecological Civilization*. Inner Mongolia University Publishing House, Hohhot, pp. 33–58 (in Chinese, with English abstract).
- Rashid al-Din Fadl Allah, 1983. *Jami' al-Tawarikh* (Chinese Edition), vol. 1. Commercial Publishing House, Beijing, p. 19. fascicule 2.
- Rashid al-Din Fadl Allah, 1985. *Jami' al-Tawarikh* (Chinese Edition), vol. 2. Commercial Publishing House, Beijing, p. 243.
- Ruofu, D., Chunjie, X., Cavalli-Sforza, L.L., 1998. Calculation of hereditary distances among Chinese peoples with genetic frequency of 38 gene seat. *Science In China (Series C, Chinese Edition)* 28 (1), 83–89.
- Songqiao, Z., 1991. The environment transition of a critical zone in east and middle of Inner Mongolia semi-arid area. *Journal of Arid Land Resource and Environment* 5 (2), 1–9 (in Chinese, translated from English by Yunhong, Cai from Chinese Journal of Arid Land Research, 3(3)).
- Wengui, Z., 2003. Wulanfu and grassland construction. *Archives and Society* 5, 56 (in Chinese).
- Williams, Dee Mack, 2002. *Beyond Great Walls: Environment, Identity, and Development on the Chinese Grasslands of Inner Mongolia*. Stanford University Press, Stanford, xii, 251 pp.
- Yongzong, C., 1981. A preliminary research of Aeolian geomorphology in Hulunbuir Plateau. *Collected Papers on Geography*, No.13. Science Press, Beijing, pp. 73–84 (in Chinese).
- Zhenda, Z., Shu, L., Xingmin, D., 1989. Desertification and Harness in China. Beijing, Science Press, pp. 9–17, 43–48 (in Chinese).
- Zhongling, L., Dunyuan, H., 2001. The ecosystem conservation and sustainable development in agriculture and husbandry ecotone of Inner Mongolia steppe. In: Zhongling, L., Erdenebukh (Eds.), *Nomadic Civilization and Ecological Civilization*. Inner Mongolia University Publishing House, Hohhot, pp. 15–32 (in Chinese, with English abstract).
- Zongwei, F., Xiaoke, W., 2002. Economy development vs. ecology and environment protection. Keynote Report at the Annual Conference of the Chinese Association of Environmental Sciences, Beijing.
- Zuoxiu, H., Yinan, W., 2004. Wind power to relieve the shortage of electricity: the most practical choice in the sustainable development stratagem of energy and electricity in China. *Western Resources* 2, 4–12 (in Chinese).