

Rangeland Privatization and Its Impacts on the Zoige Wetlands on the Eastern Tibetan Plateau

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Abstract: The high Zoige Basin (Ruoergai Plateau) on the eastern Tibetan Plateau is a fault depression formed during intensive uplifting of the Tibetan Plateau. The wetland is globally important in biodiversity and is composed of marshes, bogs, fens, wet meadows and shallow water interspersed with low hills and sub-alpine meadows. Most of the Zoige wetlands have long been one of the most important grazing lands in China. Recent rangeland policy has allowed grazing, and usable wetland areas have been being legally allocated to individuals or groups of households on a long-term lease basis. Privatization of the wetland has impacted the Zoige wetlands in aspects of hydrologic condition, landscape and biodiversity. The uneven spatial distribution of water resources on private lands has led to the practice of extracting ground water, which has decreased the perched water table in Zoige. Fencing off the rangelands and grazing on expanding sand dunes have affected landscapes. Variation in the water table has led to the changes in vegetation diversity, resulting in the changes in wildlife and aquatic

diversities and ecosystem processes. Making use all year round of the pasture that was previously grazed only in summer has shrunk the daily activity space of wildlife, and the newly erected fences blocked the movement of wild animals looking for food in the snow to lower and open areas. To maintain the favorable conditions of the Zoige wetland ecosystem, the author suggests that, in addition to biophysical research and implementation of conservation practices, there is an immediate need to initiate an integrated management program, increase public awareness of wetland functions and provide better training for the local conservation staff.

Keywords: Tibetan Plateau; rangeland; privatization; Zoige (Ruoergai); wetland; ecosystem integrity; landscape; biodiversity

Introduction

The Tibetan Plateau is one of the world's major rangeland ecosystems and one of the largest

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pastoral areas on earth (Miller 1998, WU and YAN 2002). With rangeland accounting for 70% of the region total land area or about half of China's total rangeland area, the Tibetan Plateau in China is home to 2 million Tibetan pastoralists plus some 3 million agro-pastoralists and supports a livestock population of some 10 million yaks and 30 million sheep and goats. Cold-tolerant livestock grazing by Tibetan herders on the plateau has been the dominant, and environmentally sustainable land use for thousands of years. In the last five decades the rangeland management regime on the Tibetan Plateau, as in other pastoral areas of China, has undergone some fundamental policy changes. It is now widely accepted that rangeland deterioration in China is more severe than ever before, even though the extent and scientific causes of that are contested (HO 2001).

The numerous lakes and mires on the Tibetan Plateau make up one of China's largest intact natural wetlands (LANG *et al.* 1983). This wetland, like others in China, and the biodiversity it supports, much of which is of global significance, is under constant threat of deterioration, mostly associated with human development pressures. There is an urgent need to identify current and future threats to the wetland's biodiversity and to identify management practices for the sustainable use of the wetland resources for socio-economic development of the communities living off the wetlands and being intimately linked to its conservation. This paper discusses the impacts of rangeland privatization on the integrity of the Zoige (Ruoergai) high basin wetland complex on the eastern Tibetan Plateau. The findings of this work will contribute to a better understanding of the threats current policies are presenting to the preservation of these natural wetlands, and help in the formulation of policies and mitigation measures.

1 Zoige Wetlands and Their Use as Rangelands

With an area of 19,600 km² and average elevation of 3400~3500 m, the Zoige High Basin in the upper Yellow River of the eastern Tibetan Plateau, straddling the boundary between the

provinces of Sichuan and Gansu, is a fault depression formed during the uplifting of the Tibetan Plateau in late Cenozoic period (Figure 1).



Figure 1 The location of the working site

Originally it was a lake till it was cut open by the Yellow River 22,000 to 40,000 years ago (WANG *et al.* 1994). The Basin, with its lacustrine sediments depth of over 300 m in the center, is surrounded by 4000 m high mountains. Annual precipitation in the Basin ranges from 560 to 860 mm and its annual average temperatures fall between 0.6~1.5 degree C. The Basin's high altitude and harsh environment have created and maintained one of China's largest wetlands, using the Keddy classification system (Keddy 2000). This Zoige wetland, which was traditionally called the Zoige Marshes is a complex of marshes, bogs, fens, wet meadows, and shallow water, interspersed with low hills and sub-alpine meadows (See photos 1~3). It is one of the largest such high wetlands in the world giving it global biodiversity significance for its diverse and endemic biota and landscape as well as a unique array of eastern Himalayas and Tibetan



Photo 1 The sight of the Zoige Wetland I



Photo 2 The sight of the Zoige Wetland II



Photo 3 The sight of the Zoige Wetland III

bio-geographic characteristics (Scott 1993, HE and ZHAO 1999, WU 1997, YANG 1999). The Biodiversity Review of China has rated the Zoige Basin as being of global significance for wetland biodiversity conservation, and the China Biodiversity Conservation Action Plan has rated the Songpan grasslands (Zoige belonged to Songpan before P.R.China and thus has also been called the Songpan grasslands) as being of national significance for biodiversity conservation (McNamee 2003).

Total of four nature reserves, two national, one provincial and one at the prefecture level, have been set up in the Zoige high basin to promote wetland biodiversity conservation and sustainable use. Some 178 plant and 218 animal species have been identified in the Ruoergai (Zoige)¹ National Wetland Nature Reserve, which is the largest one of the four Zoige wetland reserves, and of these about 1/3 of the birds and almost 40% of the mammal species are listed on the international or

national protected bird and animal lists. Four bird species and eleven mammal species found in the Nature Reserve are on the IUCN 2000 China Red List (McNamee 2003). The principal endangered species in Zoige, and the one of major international interest, is the black-necked crane, *Grus nigricollis*, which comes to the Zoige wetland area for summer subsistence. In addition, the Zoige wetlands also provide water retention functions that are important for flood control and are therefore of great value for economic development in the upper reaches of the Yellow River.

Topographically, the Zoige high basin is the drainage divide for the Yangtze and the Yellow River. It is located in the transition area among China's all three geographic territories, namely the first territory of eastern China monsoon plain, the second territory the high erosive Loess Plateau and Yunnan-Guizhou plateau and, the third territory the Tibetan Plateau. The ecotone location of the Zoige high basin on the one hand accounts for its

1) Zoige and Ruoergai stand for the same high basin or plateau with one county in the center having the same name. While Zoige was early translated directly from Tibetan into English and used in most English maps and documents, Ruoergai is Chinese *pinyin* translation spelling of the area and used in English more recently.

characteristics of rich biodiversity and ecosystem services of global importance, but on the other also leads to its special sensitivity to stressors and difficulties of restoring pristine condition after these have been changed. Therefore, special care and attention should be paid to protecting the Zoige wetlands and its ecosystem health so as to conserve its functions and services.

While the Zoige wetlands are of national and global importance for their biological diversity, the area is also very important to the livelihood of its local inhabitants. Conservation activities, can and must never neglect the socio-economic consequences for those affected by them, doing so would lead to failure in achieving any conservation objective. The rangelands in Zoige are ranked as one of China's most productive grazing areas for livestock production (Photo 4). Some 83% of local people in Zoige are Tibetan pastoralists who have depended on the grasslands to support their vast herds, and their families for thousands of years. The Zoige basin is one of the most productive areas on the Tibetan Plateau, but it is also one of the most sparsely populated, remote, marginalized,

and poorest areas in China. Annual average income per capita of local people was 1600 RMB (194 USD) in 2001.

Under China's Household Contract Responsibility System (HCRS) (introduced from successful rural China's arable land reformation in the late 1970s) these rangelands, except for the deepest wetlands, were allocated to individual or groups of nomadic households. This new policy was expected to lead to changes in the way that local people use the grasslands. Decision-makers predicted that nomadic people should, from experience, have awareness of their contracted rangeland carrying capacity and thus limit herd size and invest in rangeland improvement when given long-term use right of the rangeland. All of these are based on a theory that the individual livestock owner would view the pasture essentially as a free commodity, as predicted by Hardin (1968) in his paradigm of the "tragedy of the commons". In cases where there is neither a fee nor a grazing quota, this presumably leads to a situation in which each herder maximizes the number of animals grazed on the rangeland. Intense competition may



Photo 4 Yak grazing on the Zoige Wetland

thus ensue for the use of this scarce resource, which if left unchecked would result in overstocking and overgrazing thus impending ecological crisis on the range. Without control of pasture resources, the situation can lead to one of open access, which is the true embodiment of Hardin's hypothesis. However, the HCRS policy transformation from arable land to rangeland and the assumptions made have evidently raised problems about communal access, given the results of the previous collective period and consequent weakening of traditional institutional control on pasture access. Some ecologists and pastoral development researchers even queried the validity of Hardin's theory in traditional pastoral regions (HO 1996, Banks 2001, Sneath 1998, WU and Richard 1999, Richard 2000, YAN *et al.* 2002, 2003). This paper continues this questioning by focusing on the impact of privatization on one particular area, the Zoige High Basin wetland complex.

2 Settlement and Impacts on Water

Hydrology is probably the single most important determinant of the establishment and maintenance of specific types of wetlands and wetland process (Mitsch and Gosselink 2000). Changes to any of the hydrologic factors may lead to a change in the wetland's structure and functions. Precipitation is the main water source for the Zoige wetlands. Annual average precipitation of 560 to 860 mm is abundant compared to the estimated actual evaporation of 450 mm (CHAI *et al.* 1965 as quoted in Han). Surface from the Yellow River and its branches, which meander across the basin lands, is another water source for the Zoige wetlands. The Yellow River flows into the Zoige basin from the east where its first bend forms, and then flows down out of the basin in the northeast. Its two branch rivers, the Black and White River, flow from their source area in southwest montane area to the northeast plain within the basin to join the Yellow River. Gradient ratio in the lower Black river is only two to three of one hundred thousands. All these hydrologic conditions lead to water accumulation in the Zoige region with its restricted drainage, hence forming the wetlands. About 48% of Zoige

basin rangelands are marshlands, and Zoige County in the basin center is a more extreme case with 79% of its rangeland being marshland, 76% of which can be used for livestock grazing (Lehmkuhl and LIU 1997).

Surface water on the Zoige basin lands, is spatially unevenly distributed like on any other rangeland. When all wetlands, save for unusable deepest marshes and lakes, were privatized and much of it fenced for livestock grazing, it led to not only water scarcity on many parcels of private land but also to difficulties in being able to fetch water from other peoples' lands (Photo 5). Approximately 19,300 people and 1.12 million livestock in Zoige County, the center of the Zoige basin, faced water scarcity in 2000, and that was about three times greater than similar occurrences before rangeland privatization according to the county grassland supervision staff. Before rangelands (including wetlands) were allocated, all livestock were taken to a nearby river to drink; at the same time people from large numbers of households were also able to share one water source, e.g. stream, spring or well. With privatization and the fencing of rangelands, this was often no longer possible. Some rangelands finished up supplies (this especially on small parcels of land), and householders have to dig wells on their own lands. During the summer season households would generally move their family tents 3~6 times a year to browse their livestock on different parts of their lands even after the settlement practice (YAN *et al.* 2003), new wells would have to be dug every time when moving their tents or on return to winter settlements, for old well would have filled up with sediment and in many cases the water table had declined. Fetching water for people and livestock has therefore become much more difficult on private lands faced with low water tables and surface water sources being far away. In the Zoige basin center some people have to keep extracting water from their well every hour of the day to get water, but even then it is still not enough.

It is reasonable to question why water scarcity is a serious problem in a wetland area like Zoige. Research shows that there is no deep artesian water in Zoige but only phreatic water in the Quaternary loosening accumulative formation (CHAI *et al.* 1965, SWRICMS and SIF 1997). Field investigations have shown an area between the



Photo 5 Ditch made in 1970 to drain water from the Zoige wetlands for grazing

perched water table and the transmissive underlying aquifers in many areas of the Zoige wetlands occupied by a thick impermeable stratum. In the northern core zone of the Zoige National Wetland Nature Reserve, for example, an area of 32,177 ha composed of 5 lakes ranging from ten to hundreds of hectare large with connecting marshes and streams among them, and also some springs, but with the transmissive underlying aquifers around the marshes being at generally 40~70 m and even up to 90m below ground according to Zoige County Water Hydrology Bureau staffs who are responsible to help local people chiseling machinery pumped wells. Those hydro-bureau staff started chiseling pumped wells in the same area in the late 1960s, when one hundred of households used to share one such well until rangelands were privatized, and their experience is that the water table has decreased a lot in the last decades with a maximum drop in places of 10 meters. To illustrate the water table difference, two examples can be quoted: one is a machinery-pumped well dug only 20 meters away from the Black River bank but worked only when it was deeper than 70 meters;

another example is that Zoige National Wetland Nature Reserve Authority had to build its conservation station and tourists center inside the northern core zone close to a spring simply due to water problem, though China's National Regulations on Nature Reserve stipulate that no unit or individual is allowed to enter a core zone save for approved scientific research activities.

No statistics are available as yet to show how many new wells are dug each year to extract perched water above impermeable stratum or deep ones below it. The fact that this is happening however, may widen the difference between the perched water table and transmissive underlying aquifers in the Zoige wetlands. The Zoige wetlands are naturally drying up due to the general lithosphere rising while, the river cutting itself deeper in the Basin, leading to dropping water tables, shrinking of lakes and springs and climate change (CHAI *et al.* 1965). The southeastern Tibetan Plateau is thought currently to be the fastest uplifting zone on earth (ZHONG 1996), as well as an 'initiating zone of climate change' (TANG 1992, 1998). Mankind can do little about the

lithosphere or in the short term about climate change. Recent dry years have been shown to pose a moderate to significant threat to the Zoige wetlands (McNamee 2003). The increasing numbers of wells and the water extracting practices can only exacerbate the situation. Exhaustion of the perched water above the thick impermeable stratum can lead to the destruction of the wetlands.

Field investigations have shown that rangeland privatization in the eastern Tibetan Plateau did increase local herders' awareness of and responsibility for land improvement to some extent (YAN *et al.* 2003). Many nomadic people see little value in wetlands for livestock grazing, however, a few herders regard them as good for breeding and fattening of livestock. Many families with their pastures in wetlands are seeking ways to dry the marshes through clearing tussock mounds and draining efforts. Increasing use of chemicals on private lands to control weeds and small mammals, e.g. persistent herbicide 2-4-D, contaminates the Zoige wetland. Where use exceeds the capacity of the wetland to neutralize the chemicals, damage is done to the Yellow River system and downstream communities. Wetland eutrophication can also be linked to the settlement of nomadic people.

3 Fragmentation of Landscape

The Zoige wetlands are valuable owing to their high altitude and relatively untouchable landscape, and the unique biodiversity they support. Fencing of boundaries (occasionally also for rotation) and activities to have higher livestock off-take on private lands, has influenced the landscape of Zoige wetlands directly or indirectly in several ways.

Wire meshwork fences with steel or cement pillars every 2~4 meters at the boundaries of private lands are seen all over the Zoige wetlands. Up to 2002, a total length of 500,000 m wire meshwork fence was installed in the 166,570 hectare of Zoige National Wetland Nature Reserve — the largest reserve of the four. The fences, seen by rangeland management decision-makers as indicators of livestock production technology and probably socio-economic development, are seen somewhat redundant to the landscape of the intact Zoige wetlands. In addition, there are many tussock mounds in the Zoige wetlands, which are

very good at retaining water but not good for livestock grazing. Herders deliberately clear the tussock mounds by fire in the dry spring period, and local livestock production technicians are thinking of using disc harrows. Fencing and clearing of grassy mounds impede corridors between patches of wetland in Zoige, leading to fragmentation and dry up of isolating small wetlands.

Small cutoff lakes once spread all over Zoige wetlands, especially at the lower Black River, like stars in the sky and scattered like the pieces on a chessboard (CHAI *et al.* 1965, SWRICMS and SIF 1997), can hardly be seen now. Only three of over two hundred such lakes along the lower Black River had some water in them in August to October 2002, but the lakes used to be full at that time. The practice, in recent years of increasing ground water extraction on private lands is probably partially to blame.

When rangelands are contracted to individual or groups of households using long-term use rights certificate, there is little effective control of grazing pattern or stocking-rates on private lands. Grazing on the expanding sand dunes on many of the interspersing hills in the Zoige basin wetlands has accelerated desertification of the hills. The desertification represents a further threat to the wetlands. When lacustrine sediment sand is emergent and displaced by wind, because of strong solar radiation and high sand temperature in the daytime, this hot displaced sand burns pressed plants and destroys the top sod layer of the meadows. This further accelerates the desertification process. If this process is not prevented, sand may finally start to displace some of the wetlands.

4 Reduction of Biodiversity

Mitsch and Gosselink (2000) determined that despite hydrogeomorphic differences and vastly different climates, fresh water marshes around the world share some common species, many common genera, and are functionally much the same. In the 197 plant species of 109 genera identified in the Zoige National Wetland Nature Reserve, only two species of two genera (*Sinocarum coloratum* and *Scrofella chinensis*) are endemic species of the

eastern Tibetan Plateau and two species of two genera (*Scrofularia chinensis* and *Rheum palmatum*) are endangered species (SWRICMS and SIF 1997). Although the significance of vegetation diversity in the Zoige wetlands is not as important as that of animals, the composition and structure of plant community do change significantly with variations in the water table. When wetlands become dry, many hygrophyte and wet plants are replaced by meadow and some invasive plants in Zoige. Compared to earlier plant surveys (ZHAO *et al.* 1995, ZHAO 1996), field vegetation investigation has shown a significant vegetation composition, biomass, and height change in the last years in the same area as the early survey. This change has been accompanied by the disappearance of some hydrophytic species like *Menyanthes trifolia*, *Carex pamirensis*, and *Myriophyllum spicatum* and occurrence of species of *Potentilla*, *Pedicularis*, *Gentiana*, and *Sanguisorba* (detailed data will be published separately).

Fencing for livestock or wild animal grazing does not have a significant influence on the plateau biodiversity according to findings from an experiment by LIU and JIANG (2002). However, rangeland privatization has led to doubling in the area required for winter pastures in Zoige (YAN *et al.* 2003). Settlements and fencing erected by herders on previously seasonal wetland pastures constrain wildlife activity especially when it is cold. There is no absolute frost-free day and snow occurs in Zoige normally from September to next May. When wild animals are dispelled to more remote, higher and colder areas by humans, they desperately need to be able to go down to lower and open areas for food when accumulated snow is too deep on the ground of their shrinking habitat. Wild animals, including rare and endangered species like Tibetan gazelle (*Procapra picticaudata*), alpine mask deer (*Moschus sifanicas*) etc., are seen rustling in the central plain of Zoige basin whenever there is heavy snow. Doubling winter pastures to settle down pastoralists has led to people penetrating to previous summer pastures all the year round, which shrunk daily activity space of wildlife. Fencing off rangelands further blocks wild animals from looking for food in the snow to lower and open areas. Furthermore, little is known about the impact of livestock grazing on the habitats,

breeding and migrating patterns of wildlife.

Variations in vegetation and wildlife diversity influence invertebrates and aquatic diversity in the food web so that this will lead to further changes in ecosystem processes, e.g. energy flow and nutrient cycling. Even though it has not been researched as yet, the increased levels of energy and chemical inputs into the wetland system after the rangeland privatization to improve animal productivity should be expected to lead to the altered ecological process.

5 Recommendation for Actions to Preserve and Sustainably Use the Zoige Wetland.

5.1 Scientific research on the impact of rangeland privatization on Zoige wetland integrity

The Zoige wetlands are one of the few remaining intact high wetlands with global biodiversity significance facing various anthropogenic threats together with natural stressors. There are a number of threats to the Zoige wetlands (McNamee 2003), but the impacts to the wetland ecosystem's integrity of China's newly introduced rangeland privatization process are a relatively neglected field of research. Little research to date, save for some baseline or peat resource surveys, has been conducted. It is suggested that more research is conducted especially on the impact of grazing management practices and water extraction and its impact on the wetland's integrity.

5.2 Development and promotion of an integrated wetland management regime

While conservation of the Zoige wetlands is the mission of local forestry bureau, rangelands used for livestock grazing are managed by the animal husbandry bureau in Zoige high basin area, with one exception in Maqu County, Gansu Province where it is a pure pastoral area and has no forestry bureau in the county. Having separated management organizations subject to different decision-making department makes it more difficult to achieve optimal wetland management.

This shows in the fact that while most of the Zoige wetlands are ranked for conservation into four nature reserves, most of them (although not all) have also been allocated to individual or group of households for livestock production through long term (50 years) lease use rights certificates. It is stipulated in the China National Regulations on Nature Reserves (1994) that generally no human activities in the core zone and no economic generation activities in the whole nature reserve are permitted, but local herders use rights to their contracted rangelands are also protected under China's Grassland Law (1985) and Rural Land Contracting Law (2002). Communication and close cooperation between the different organizations is suggested to develop and promote an integrated Zoige wetlands management regime.

5.3 Facilitating an increase in public awareness of wetland functions and conservation

Nomadic people, who have lived on the Zoige wetlands for thousands of years, have successfully lived in harmony with its rich biodiversity. Living on the remote and marginalized Tibetan Plateau these people are far away from decision makers and language differences between them and those who make decision further widen the gap of their communication. They are in most cases excluded from the increasing process of globalization and new cognitions. They have been subjected, in the last five decades, to many policies driven rangeland management changes and now have both private livestock and rangeland use rights, although they have never before managed rangelands individually and often may not know how. While the importance of wetlands to society has become increasingly recognized since the 1970s, both in China and worldwide, most nomadic people in Zoige still treat wetland as wasteland for their

livestock production without awareness of its global significance and the threats it faces. Conservation of the Zoige wetlands will never be successful if local nomadic people are not positively involved in the process of decision-making.

Although the nomadic people are putting stress on the wetland through their attempts to increase productivity of their livestock and the extraction of groundwater, they do not kill wildlife on purpose. Many local officials and staff, who are powerful or have easy access to arms, impact negatively on the Zoige wetland ecosystem and its biodiversity through improper management decision, hunting, and so on. They also are in need of awareness raising of, education about the functions of the wetlands and the benefits to the world, nation and region of conserving this area. There are four nature reserves in Zoige, none of their conservation staff has an education background in wetland management or even ecology, most of them come out of the forestry and animal husbandry sector. Very few of them are full time conservation staff. Equipments for conservation of Zoige wetland reserves are also very much limited. It is hard to attract people with good wetland background to come and work in Zoige, and it is therefore of great importance to provide better training on wetland conservation and monitoring to local staff.

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