



A group of young Tibetan monks huddles on a degraded pasture on the Tibetan Plateau.

TROUBLE IN TIBET

Rapid changes in Tibetan grasslands are threatening Asia's main water supply and the livelihood of nomads.

BY JANE QIU

In the northern reaches of the Tibetan Plateau, dozens of yaks graze on grasslands that look like a threadbare carpet. The pasture has been munched down to bare soil in places, and deep cracks run across the snow-dusted landscape. The animals' owner, a herder named Dodra, emerges from his home wearing a black robe, a cowboy hat and a gentle smile tinged with worry.

"The pastures are in a bad state and lack the kind of plants that make livestock strong and grow fat," says Dodra. "The yaks are skinny and produce little milk."

His family of eight relies on the yaks for most of its livelihood

— milk, butter, meat and fuel. Dodra was forced to give up half of his animals a decade ago, when the Chinese government imposed strict limits on livestock numbers. Although his family receives financial compensation, nobody knows how long it will last.

"We barely survive these days," he says. "It's a hand-to-mouth existence." If the grasslands continue to deteriorate, he says, "we will lose our only lifeline."

The challenges that face Dodra and other Tibetan herders are at odds with glowing reports from Chinese state media about the health of Tibetan grasslands — an area of 1.5 million square kilometres — and the experiences of the millions of nomads there. Since the 1990s, the government has carried out a series of policies that moved once-mobile

herders into settlements and sharply limited livestock grazing. According to the official account, these policies have helped to restore the grasslands and to improve standards of living for the nomads.

But many researchers argue that available evidence shows the opposite: that the policies are harming the environment and the herders. “Tibetan grasslands are far from safe,” says Wang Shiping, an ecologist at the Chinese Academy of Sciences’ (CAS) Institute of Tibetan Plateau Research (ITPR) in Beijing. “A big part of the problem is that the policies are not guided by science, and fail to take account of climate change and regional variations.”

The implications of that argument stretch far beyond the Tibetan Plateau, which spans 2.5 million square kilometres — an area bigger than Greenland — and is mostly controlled by China. The grasslands, which make up nearly two-thirds of the plateau, store water that feeds into Asia’s largest rivers. Those same pastures also serve as a gigantic reservoir of carbon, some of which could escape into the atmosphere if current trends continue. Degradation of the grasslands “will exacerbate global warming, threaten water resources for over 1.4 billion people and affect Asian monsoons”, says David Molden, director general of the International Centre for Integrated Mountain Development (ICIMOD) in Kathmandu, Nepal.

Such concerns propelled me to make a 4,700-kilometre journey last year from Xining, on the northeastern fringe of the plateau, to Lhasa in the Tibetan heartland (see ‘Trek across Tibet’). Meeting with herders and scientists along the way, I traversed diverse landscapes and traced the Yellow and Yangtze Rivers to their sources. The trip revealed that Tibetan grasslands are far less healthy than official government reports suggest, and scientists are struggling to understand how and why the pastures are changing.

FENCED IN

It began to drizzle soon after we set off from the city of Xining on a stretch of newly built highway along the Yellow River. As our Land Cruiser climbed onto a 3,800-metre-high part of the plateau, the vista opened to reveal rolling hills blanketed by a thick layer of alpine meadow, resembling a gigantic golf course. We passed herds of sheep and yaks, white tents and nomads in colourful robes — along with barbed-wired fences that cut the rangeland into small blocks.

This part of the Tibetan Plateau, in a region known as Henan county, is blessed with abundant monsoonal rains every summer. The herders who live here are able to maintain healthy livestock and can make a decent living. “We have plenty to go around, and the livestock are well taken care of,” says herder Gongbu Dondrup.

But life has been different since the government began to fence up grasslands around a decade ago, says Dondrup. Before that, he took his herd to the best pastures at high elevations in the summer, and then came back down in the winter. Now, he must keep the yaks in an 80-hectare plot that the government assigned to his family. The pasture looks worn, and he is being pressed by the government to further downsize his herd. “I don’t know how long it can keep us going,” he says.

The fencing initiative is the latest of a string of Chinese grassland policies. After annexing Tibet in 1950, the young revolutionary Chinese republic turned all livestock and land into state properties. Large state farms competed with each other to maximize production, and livestock numbers on the plateau doubled over two decades, reaching nearly 100 million by the late 1970s. But in the 1980s, as China moved towards a market-based economy, Beijing swung to the other extreme: it privatized the pastures and gave yaks back to individual households, hoping that the move would push Tibetans to better manage their land and so boost its productivity.

Despite the privatization, nomads continued to use the rangeland communally — often in groups led by village elders. Then the government began to limit herds, and it built fences to separate households and villages. “This has totally changed the way livestock are traditionally raised on the plateau, turning a mobile lifestyle into a sedentary existence,” says Yang Xiaosheng, director of Henan county’s

rangeland-management office.

The fencing policy does have merits when applied in moderation, says Yönten Nyima, a Tibetan policy researcher at Sichuan University in Chengdu. Because an increasing number of nomads now lead a settled life — at least for parts of the year — it helps to control the level of grazing in heavily populated areas, he says. “Fencing is an effective way to keep animals out of a patch of meadow.” Many herders also say that it makes life much easier: they do not have to spend all day walking the hills to herd their yaks and sheep, and if they go away for a few days, they don’t worry about the animals running off.

But the convenience comes at a cost, says Cao Jianjun, an ecologist at Northwest Normal University in Lanzhou. Fenced pastures often show signs of wear after a few years. In a 2013 study, Cao and his colleagues measured growth of the sedge species preferred by livestock in two scenarios: enclosed pastures and much larger patches of land jointly managed by up to 30 households. Despite similar livestock densities in both cases, the sedge grew twice as fast in the larger pastures, where animals could roam and plants had more opportunity to recover¹. That matches the experience of Henan county herders, who say that their land sustains fewer animals than it has in the past.

WATER WORRIES

The future of the grasslands looked even bleaker as we left relatively well-to-do Henan county and ventured into the much higher, arid territory to the west. After 700 kilometres, we reached Madoi county, also known as *qianhu xian* (‘county of a thousand lakes’), where the Yellow River begins. Although this region gets only 328 millimetres of rain on average each year, about half of what Henan receives, Madoi was once one of the richest counties on the plateau — famous for its fish, high-quality livestock and gold mines.

Now, the wetlands are drying up and sand dunes are replacing the prairies, which means that less water flows into the Yellow River. Such changes on the plateau have contributed to recurring water shortages downstream: the Yellow River often dries up well before it reaches the sea, an event not recorded before 1970.

In 2000, China sought to protect this region, along with adjacent areas that give rise to the Yangtze and Mekong Rivers, by establishing the Sanjiangyuan (or Three-Rivers’ Headwaters) National Nature Reserve, an area nearly two-thirds the size of the United Kingdom.

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Nearly one-tenth of the reserve area falls into core zones in which all activities, including herding, are prohibited. The government spends hundreds of millions of US dollars each year on moving nomads out of those core areas, constructing steel meshes to stabilize the slopes and planting artificially bred grass species to restore the eroded land. Outside the core regions, officials have banned grazing on ‘severely degraded grasslands’, where vegetation typically covers less than 25% of the ground. Land that is ‘moderately degraded’, where vegetation coverage measures 25–50%, can be grazed for half of the year.

Such policies — and related initiatives to limit livestock numbers and fence off areas of pasture — have not been easy on the herders, says Guo Hongbao, director of the livestock-husbandry bureau in Nagchu county in the southern Tibetan Plateau. “The nomads have made sacrifices for protecting the grasslands,” he says. But he also says that the strategies have paid off. Guo and other officials point to satellite studies showing that the plateau has grown greener in the past three decades². This increase in vegetation growth, possibly the result

of a combination of grazing restrictions and climate change, “has had a surprisingly beneficial effect on climate by dampening surface warming”, says Piao Shilong, a climate modeller at Peking University.

But ecologists say that such measurements look only at surface biomass and thus are not a good indicator of grassland health. “Not all vegetation species are equal,” says Wang. “And satellites can’t see what’s going on underground.”

This is particularly important in the case of the sedge species that dominate much of the Tibetan Plateau, and that are the preferred food of livestock. These species, part of the *Kobresia* genus, grow only 2 centimetres above the surface and have a dense, extensive root mat that contains 80% of the total biomass.

Studies of pollen in lake sediments show that *Kobresia* and other dominant sedges emerged about 8,000 years ago, when early Tibetans began burning forests to convert them to grasslands for livestock³. The prehistoric grazing helped to create the thick root mat that blankets the vast plateau and that has stored 18.1 billion tonnes of organic carbon.

But *Kobresia* plants are being driven out by other types of vegetation, and there is a risk that the locked-up carbon could be released and contribute to global warming. Every now and then on the trip to Lhasa, we passed fields blooming with the beautiful red and white flowers of *Stellera chamaejasme*, also known as wolf poison. “It’s one of a dozen poisonous species that have increasingly plagued China’s grasslands,” says Zhao Baoyu, an ecologist at the Northwest Agriculture and Forestry University in Yangling. Zhao and his colleagues estimated that poisonous weeds have infested more than 160,000 square kilometres of the Tibetan grasslands, killing tens of thousands of animals a year⁴.

Herders also report seeing new grass species and weeds emerge in recent years. Although most are not toxic, they are much less nutritious than *Kobresia* pastures, says Karma Phuntsho, a specialist on natural-resource management at ICIMOD. “Some parts of the plateau may seem lush to an untrained eye,” he says. “But it’s a kind of ‘green desertification’ that has little value.”

In one unpublished study of the northeastern Tibetan Plateau, researchers found that *Kobresia* pastures that had gone ungrazed for more than a decade had been taken over by toxic weeds and much taller, non-palatable grasses: the abundance of the sedge species had dropped from 40% to as low as 1%. “*Kobresia* simply doesn’t stand a chance when ungrazed,” says Elke Seeber, a PhD student at the Senckenberg Natural History Museum in Görlitz, Germany, who conducted the field experiment for a project supported by the German Research Foundation (DFG).

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The changes in vegetation composition have important implications for long-term carbon storage, says project member Georg Guggenberger, a soil scientist at Leibniz University of Hanover in Germany. In moderately grazed *Kobresia* pastures, up to 60% of the carbon that is fixed by photosynthesis went into the roots and soil instead of the above-ground vegetation — three times the amount seen in ungrazed plots⁵. This underground organic carbon is much more stable than surface biomass, which normally decomposes within a couple of years and releases its stored carbon into the air. So a shift from *Kobresia* sedge to taller grasses on the plateau will ultimately release a carbon sink that has remained buried for thousands of years, says Guggenberger.

Critics of the grazing restrictions in Tibet say that the government has applied them in a blanket way, without proper study and without



taking on board scientific findings. In some cases, they make sense, says Tsechoe Dorji, an ecologist at the ITPR’s Lhasa branch, who grew up in a herder family in western Tibet. “A total grazing ban can be justified in regions that are severely degraded”, he says, but he objects to the simple system used by the government to classify the health of the grasslands. It only considers the percentage of land covered by vegetation and uses the same threshold for all areas, without adjusting for elevation or natural moisture levels.

“Pastures with 20% vegetation cover, for instance, could be severely degraded at one place but totally normal at another,” says Dorji. This means that some of the grasslands that are classified as severely degraded are actually doing fine — and the grazing ban is actually hurting the ecosystem. “Having a sweeping grazing policy regardless of geographical variations is a recipe for disasters,” he says.

FAST FORWARD

China’s grazing policy is only one of several factors responsible for such damaging changes, say the researchers. Pollution, global warming and a rash of road-building and other infrastructure-construction projects have all taken a toll on the grasslands.

Ten days after leaving Xining, we caught a glimpse of Tibet’s future when we arrived at Nam Tso, a massive glacial lake in the southern part of the plateau. Here Dorji and Kelly Hopping, a graduate student at Colorado State University in Fort Collins, have been turning the clock forward by surrounding small patches of grassland with open-topped plastic chambers that artificially raise the temperature. These experiments are important because Tibet is a hotspot in terms of climate change; the average temperature on the plateau has soared by 0.3–0.4°C per decade since 1960 — about twice the global average.

In trials over the past six years, they found that *Kobresia pygmaea*, the dominant sedge species, develops fewer flowers and blooms much later under warming conditions⁶. Such changes, says Dorji, “may compromise its reproductive success and long-term competitiveness”.

At the experimental site, the artificially warmed pastures have been taken over by shrubs, lichens, toxic weeds and non-palatable grass species, says Hopping. But when the researchers added snow



Near the headwaters of the Yellow River, lush grasslands have given way to sand dunes.



JONAS BENDIKSEN/MAGNUM

to some heated plots, *Kobresia* did not lose out to the other plants, which suggests that the loss of soil moisture might be driving the shift in species. Higher temperatures increase evaporation, which can be especially potent at high elevations. “This is not good news for species with shallow roots”, such as the *Kobresia* favoured by livestock, she says.

Piao says that “this interplay between temperature and precipitation illustrates the complexity of ecosystem responses to climate change”. But researchers have too little information at this point to build models that can reliably predict how global warming will affect the grasslands, he says. To fill that gap, Wang and his colleagues started a decade-long experiment in 2013 at Nagchu, where they are using heat lamps to warm patches of grassland by precise amounts, ranging from 0.5°C to 4°C. They are also varying the amount of rainfall on the plots, and they are measuring a host of factors, such as plant growth, vegetation composition, nutrient cycling and soil carbon content. They hope to improve projections for how the grasslands will change — and also to determine whether there is a tipping point that would lead to an irreversible collapse of the ecosystem, says Piao.

PLATEAU PROGNOSIS

A fortnight into the trip, we finally arrived at the outskirts of Lhasa. At the end of the day, herders were rounding up their sheep and yaks in the shadows cast by snow-capped peaks. They and the other pastoralists across the plateau will have a difficult time in coming decades, says Nyima. Climate change was not a consideration when grassland policies were conceived over a decade ago, and so “many pastoralists are ill prepared for a changing environment”, he says. “There is a pressing need to take this into account and identify sound adaptation strategies.”

As a start, researchers would like to conduct a comprehensive survey of plant cover and vegetation composition at key locations across different climate regimes. “The information would form the baseline against which future changes can be measured,” says Wang. Many scientists would also support changes to the grazing ban and fencing policies that have harmed the grasslands. Dorji says that the government should drop the simplistic practice of ‘one policy fits all’

across the plateau and re-evaluate whether individual regions are degraded enough to merit a ban on grazing. “Unless the pastures are severely degraded, moderate grazing will help to restore the ecosystems,” he says.

But scientists are not banking on such reforms happening soon. Policies in Tibet are driven less by scientific evidence than by bureaucrats’ quest for power and funds, says a Lhasa-based researcher who requests anonymity for fear of political repercussions. Local officials often lobby Beijing for big investments and expensive projects in the name of *weiwén* (meaning ‘maintaining stability’). Because resistance to Chinese control over Tibet continues to flare up, the government is mostly concerned with maintaining political stability, and it does not require local officials to back up plans with scientific support, says the researcher. “As long as it’s for *weiwén*, anything goes.”

But officials such as Guo say that their policies are intended to help Tibet. “Although there is certainly room for improvement in some of the policies, our primary goals are to promote economic development and protect the environment,” he says.

Far away from Lhasa, herders such as Dodra say that they are not seeing the benefits of government policies. After we finish our visit at his home, Dodra’s entire family walks us into the courtyard — his mother-in-law spinning a prayer wheel and his children trailing behind. It has stopped snowing, and the sky has turned a crystal-clear, cobalt blue. “The land has served us well for generations,” says Dodra as he looks uneasily over his pasture. “Now things are falling apart — but we don’t get a say about how best to safeguard our land and future.” ■

Jane Qiu is a freelance writer in Beijing. Her trip across the Tibetan Plateau was supported by the SciDev.Net Investigative Science Journalism Fellowship for the Global South.

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