

Inner Mongolia Grasslands Management Project Policy Issue Discussion Papers

PIDP I: 2005 Overview of advanced desertification & salinity in Middle Banner sandy grasslands and the Chaohaoritu aili (village area) case study

Chinese Summary

内蒙古草场管理项目 政策问题研讨系列论文

第二篇

案例分析：2005年中旗沙地草原和朝好日图艾里严重沙漠化、盐碱化概述

总结

内蒙古草场管理项目第二期，致力于支持政府和牧区，在中旗南部沙地草原逐步实现可持续草场管理制度。项目的目标是改进目前政策法规的分析和实施，支持草场资源的可持续的、经济化利用。

项目共选取两个嘎查用作分析案例，本文就其中的一个，详细描述其严重退化的景观和草场环境的沙漠化。勘察观测工作于2005年春夏开展，在植被长势最好、覆盖率最高的时候，拍摄高像素的卫星图像用作勘测的辅助资料。该图像资料扩展到周边大约10×6公里，像素等于低空摄影的图像。图像鲜明的图释了当地的地貌特征，以及扩展到整个地区的沙漠化的实际情况。

朝好日图景观的主要特征包括分布广泛但流失严重的多年生植物。春季的大风吹过裸露的土壤表层、吹过水土流失严重的土丘，和无数遭受了水土流失后形成的结痂，破坏了整体的土壤，表层的自然水土流失很普遍。没有表层土，下层的沙很容易遭到破坏，变成频繁发生的沙尘暴。至少41个独立的移动沙丘带形成了一片沙地平原。这些沙丘都位于水土流失特别严重的沙源下风方向，并且距离相对很近。雨水形成了当地的涝灾和盐碱地。

低地平原以前是当地最好的耕地、后来又用作打草场，现在全年地下水位明显升高。涝灾和盐碱化“烫伤”了平原，这在卫星图像上看的十分清楚，能看到地表有盐的沉积。图像上能看到大概30个独立的小块盐碱地。在这些地区，“烫伤”的土地一直沿着艾里向北延伸超过10公里，超过了那些小块盐碱地的面积总和。盐碱地再也不能用来耕作了，只覆盖着一些零星的植物。

（牧民提供的）口头证据和实地证据（从同样面积、禁牧20年的另外一块沙地草原得出）都表明，朝好日图以前生长着茂密的、不同种类的榆树林，那些没有放牧压力的地区可以渐渐的恢复其生物多样性和环境功能，慢慢的重建其流失的表层土。最近，沙漠化进程的四个主要阶段已经可以识别。过牧和过耕造成脆弱的景观开始沙漠化，就是沙漠化的自然进程。

1998年夏季洪涝灾害的时候，如果有更多的原生多年生植物，洪灾不会那么严重，也将避免洪灾后造成的大面积土地盐碱化。没有足够的牧场在一个人口密集的小村子里重新安置那么多遭受洪灾的牧户，以后按照经营权分配到的小块土地超载更加严重，也面临着更严峻的沙漠化问题。

具有更广泛代表意义的内蒙古草场管理项目艾里被讨论，开展讨论的还有使用高像素卫星图像，监测整个内蒙古地区沙漠化的推进或是停止的潜在意义。

至今，社区和政府项目没有任何干预土地使用和放牧的政策或管理措施，这些政策或管理措施可能会有助于延缓目前沙漠化的进程。

Executive Summary

Phase II of IMGMP has been working to support government and herding communities to move towards sustainable grassland management systems in the degraded sandy grasslands of south Middle Banner. The Project's goal is to improve the ongoing analysis and implementation of policies and regulations to promote sustainable, economic utilisation of grassland resources.

This report describes the highly degraded landscape and the desertification of the grassland environment in one of two study gacha. Reconnaissance observations made in spring and summer 2005, supplemented by high resolution satellite imagery made over the area at the time of maximum vegetation growth and greenness, vividly illustrate the features and the extent of active desertification throughout this area. This data set imagery extends over an area about 10x6 km with resolution equivalent to low level aerial photography.

The Chaohaoritu landscape features widespread and general loss of perennial vegetation from the former grassy elm woodland. The entire top soil profile is being destroyed from unprotected soil surfaces, eroding soil cliffs and numerous erosion scars, and removed by frequent dust and sand storms exposing sandy and clayey subsoils. At least 41 separate areas of new mobile sand dunes have formed throughout the sandy plains. These dunes are short distances downwind from their source areas of deep erosion. The rainfall they collect contributes to local waterlogging and salinity.

Lowland plains which were once the best local agricultural and hay lands are now suffering from high water tables. Waterlogging and sodicity scald the plains with sodic deposits which can be seen on the surface in the August satellite imagery. Some 30 separate areas of saline-scalded land have been identified in the imagery. The area extending more than 10 km across the north of the aili is bigger than all the others together. This saline land no longer has cropping potential and supports only patchy vegetation. According to herders' oral descriptions, this part of Middle Banner was formerly vegetated by diverse elm woodland. Field evidence from an equivalent area of sandy grassland, which has been protected from grazing for about 20 years, shows that land rested from grazing pressure can slowly stabilize and recover its natural diversity in order to rebuild lost topsoil.

Four main stages of the current desertification process are identified including the impact of overgrazing and overcropping.

Heavy summer rain led to serious flooding in 1998. If more perennial vegetation had been growing at the time, the floods would have been less serious and the loss of so much land to salinity would have been avoided. The resettlement of flood-affected herder families into one village with an inadequate area for grazing meant that each family's allocation under User Rights was small and overstocking and desertification pressures were intensified.

The quality of representation of IMGMP's project aili in the wider area is discussed, as is the potential value of using high resolution satellite imagery for monitoring the increase or arrest of gross desertification across Inner Mongolia.

Despite the change from a GDP zone to conservation area under the 11th 5 Year Plan, to date, there is no adequate intervention in land use, grazing management or policy, by the community's actions or through government programs, that is likely to halt the current rapid rate of desertification.

Background

IMGMP's involvement in severely degraded Kerquin grassland

In 2004, at the request of Xing'an League government, the focus of IMGMP turned to new project gachas (administrative area for a group of neighbour villages) in Bayannaouer and Haoyao sumus in southern Middle Banner. Both are situated between 44°22' and 44°46' N and 141°47' and 142°00' E and are in the ecological zone of the north-eastern Kerquin sands, which extends from Xilinguole League to the south-east through adjacent parts of Jilin Province in the south and east. This grassland area type was studied and characterised in Phase I investigations prior to 2001 which looked at the basic biophysical parameters of grassland productivity and conditions under heavy grazing. The grassland gacha communities are of ethnic Mongolian descent and made up partly by families resettled during the 1970s from further east in Jilin prior to de-collectivisation.

Prior to the League government ordering the distribution of User Rights, location of approximate aili boundaries and main classes of land (by GPS) were found in autumn 2004. At the beginning of the community consultation process, herders pointed out the land degradation problem which included large areas of saline land and the growth of large mobile sand dunes.

Overview of the condition of the grassland ecosystem

Field conditions in spring

In March to May 2005, field reconnaissance confirmed the crisis. In March, animals had denuded the land of dry grass and flocks not accessing sufficient yard feed were clearly on the brink of starvation. Major soil erosion and daily dust and sand-storms from springtime Mongolian cyclonic winds were making life a misery in every village and sumu town.



Vegetation loss

Both Project gacha were suffering from gross loss of all types of perennial vegetation. There was not a minimum level of grass cover (e.g. 10 kg per mu), adequate to protect the soil surfaces from prevailing north-west winds. Frequent dust-storms and irregular, more serious, sand-storms dominated village and town life in southern Middle Banner.



Soil loss

Soil profiles to a depth between 0.5 and 2.5 metres were being cut out by wind erosion. This erosion works back through the deep scars in the soil profile, often with terraced lines of north-west facing soil micro-cliffs. Every site examined during reconnaissance was suffering from gross deflation of the soil or fresh deposits of sand or both. The sand sits as thin sand veils, but at Chaohaoritu also as prominent drift accumulations including extensive mobile sand dunes, of 10-15m high.



The reconnaissance failed to locate any area with any of the former topsoil profile. This landform is described by Zou *et al*¹ as having been stable for at least 250,000 years. Beernaert² describes it as

¹ Zou Shouyi, Xu Jiuru, Liu Zhongling and Li Hapling. Elm open woodland research in the Korquin sandy lands. Dust Storm Formation and Comprehensive Control Measures pp. 371-392. Inner Mongolia People's Publishing House 2004

² Beernaert et al. Consultancy on Land Classification of the Kerquin sandy lands (Inner Mongolia and NE China). FAO Consultant's Report GCP/CPR/009/BEL, 1997.

having had long-stabilised, relatively fertile topsoils (such as Haplic Phaeozems or black earths) “where these are not degraded...thousands of years of equilibrium are witnessed by thick, dark, humiferous topsoils in non-degraded parts of the sandsheet.”

Lowland plains

The landscape’s second major unit is the lowland plain. This is flat and 5 to 20 metres lower than the sandy plains. All of the lowland plains visited had clayey type soils, prone to waterlogging, with thawing water tables within a metre of the surface. The waterlogging was evident even some seven months after the last rains at the end of a very dry summer. Herder work groups were attempting to fill low spots in these plains, which had prominent whitish efflorescence on the soil surface.

These are still the main hay lands on which the villagers depend for winter and spring fodder. These lowland plains were once the main crop lands and are now severely scalded with sodic, slumped soils and waterlogging.



Crop fields

The inspection showed that the previous season’s crop fields were all deeply tilled and on sandy soils. None showed any useful cover of stubble. Other than the areas protected by household walls, fields were generally exposed to continuous grazing, trampling and the prevailing north-west winds. There was ongoing gross soil loss, wind-sculpted erosion faces, severely eroded tillage lines, patchy sheeting and sand drift accumulations.

Several of the fields seen higher in the landscape were said to have been ploughed for the first time in 2004 when they were cropped for mung beans after poor early rains.



Overall situation and quality of life

The spring 2005 reconnaissance survey of two project aili indicated that the Chaohaoritu area was rapidly desertifying under the normal pattern of spring diurnal winds. Only 6 months after UR had been distributed, the extent of gross erosion, dune-building and salinisation was greater than found on the PMO/PIO survey in autumn 2004 and prior to the User Rights allocation process.

The quality of life in the district was being impaired by frequent dust storms generated under the normal conditions of afternoon strong breezes. The local doctor remarked on high rates of pulmonary and eye infections.



The summer growth response and high resolution remote sensing

High resolution ‘Quickbird’ satellite imagery was taken on overpasses on August 3, 5 and 8 to obtain a more accurate and updated overview. These showed vegetation greenness and biomass were close to their peak for the growing season, which began and finished earlier than average this year.

For Chaohaoritu, coverage centred on a point just east of the main settlement and extended approximately 10km x 6 km.

To illustrate particular features of the landscape condition, the scene is presented in the Appendix as six sub-scenes:

north-west	north-centre	north-east
south-west	south-centre	south-east

The imagery is derived from 0.62m pixel panchromatic-sharpened 3-band data.

The actual geographical coverage to the east and west extends beyond the aili’s notional boundaries within Huadeng gacha.

Notes from the imagery and ground observations on field conditions in August

The resolution of the imagery is good enough to make out individual cattle in the main street in the village. Major features dominating the scene are:

- **mobile sand dunes with mostly unvegetated ridge-line crests**

There are 41 separate areas of sand deposits blown into mobile dunes (numbered in blue on the images - see *Appendix*). Most of these, including all the largest areas, source areas are clearly discernible 0.2 to 1.5 km up-wind (to the north-west) appearing bare but with darker-coloured areas of major soil deflation scars, soil cliffs and mesas.

These sand deposits appearing so close to the mobilised sand suggests that all the dunes are either relatively newly-formed or newly-grown. The largest dune areas (numbers 5, 21, 36 & 41) are each roughly a kilometre long. Area 21 is up-wind from Chaohaoritu main village. As can be seen in Appendix Sub-scene 5, its south-western part has joined up with the severely eroded main animal access track on the west side of the settlement.



Here, active gross deflation of up to 2.5 metres of soil profile was evident in May. Pools and shallow lakes have formed between and adjacent to many of the dunes, reflecting the new hydrological imbalance they create.

The grassland areas now lost to dunes were formerly broadleaved woodland (see below), but all that is left of the previous cover of moderately large elm trees is isolated living trees and occasional cut stumps still visible around the dunes.



- **other unvegetated erosion scars**



Many darker-toned spots and patches of sandy land dissected by erosion (source areas for the mobile dunes) are conspicuous alongside bright creamy-coloured deposits. Many of these are within the crop fields themselves and some have very sharp edge-lines along the boundaries of particular ploughed areas. There are also many sandy tracks which have eroded badly and been repeatedly moved and expanded further as a consequence.

- **bare, saline scalded areas**

The flat, sodic scalds with very shallow or surface water tables remained mostly unvegetated throughout the growing season. On the images, their central areas show up as having maximum reflectance for the scene in all 3 spectral bands. The distribution of scalding appears to be confined to the lowland plains with heavier soils and shallow seasonal wetlands, such as area S 28 in Sub-scene 6.

The huge saline area of scalding across the entire north (labelled in yellow as S 01) is more or less continuous throughout. South of that area, several of the other 29 worst scalded areas are evidently former cropping areas. There are 3 clearly visible abandoned villages centred on these scalded areas. The scalded area to the south-east of the main settlement shows conspicuous (raised) lines of slumped former earthworks and irrigation channels. These still grow patchy salt-tolerant and waterlogging-tolerant perennials among invasive and toxic annual vegetation such as lua topeng Pegarnum harmala. Most of the aili's former preferred crop and hay land is now affected in this way.



An insight into the landscape up to the 1970s: a remnant area of equivalent sandy plain vegetation recovered by grazing exclusion

Observations over summer largely confirm and expand on the initial attempt at a reconstruction of the pre-1970s landscape, from oral accounts given by older residents and before widespread damage to soils, vegetation and water balance (see Figure 1).



Valuable observations were also made in late June near Xinjiamu, in an area of equivalent sand plains, in Middle Banner’s Nature Reserve about 50 km to the north-east. This former communal grazing and cropping area is said to have been protected from pastoral use for about 20 years, although parts of it had obviously experienced fairly recent fires.

landscapes includes old erosion features that are now inactive, having been naturally re-stabilised through biotic processes and self-seeded regrowth.

The vegetation’s recovery is striking. The previous elm (Ulmus) woodland has returned, with its perennial understorey shrubs, diverse herbs and grasses. Here, the



With abundant litter, this crust is once again slowly rebuilding an organic topsoil. Soil surfaces have also recovered their biotic crusting, with a surface cover of cyanobacteria, liverworts, lichens and mosses. The presence of these tiny but critical plants and the essential soil ‘skin’ required for sustainability can be easily determined by examination of soil surfaces with a hand lens. No comparable development of similar cryptogamic plants was to be found on the soil surfaces at Chaohaoritu.



Many studies of the ecological functions of cryptogamic crusts in sandy grasslands worldwide have shown how their capacity to maintain soil surfaces is destroyed by exceeding relatively low threshold levels of physical disturbance by hard-hoofed animals. These crusts both result from and drive a functional relationship between the top few millimetres of the soil and an assortment of simple plants: lichens, mosses, liverworts, cyanobacteria, algae, fungi and bacteria.

In such areas, these 'microphytic' plant crusts are known to play five major roles:

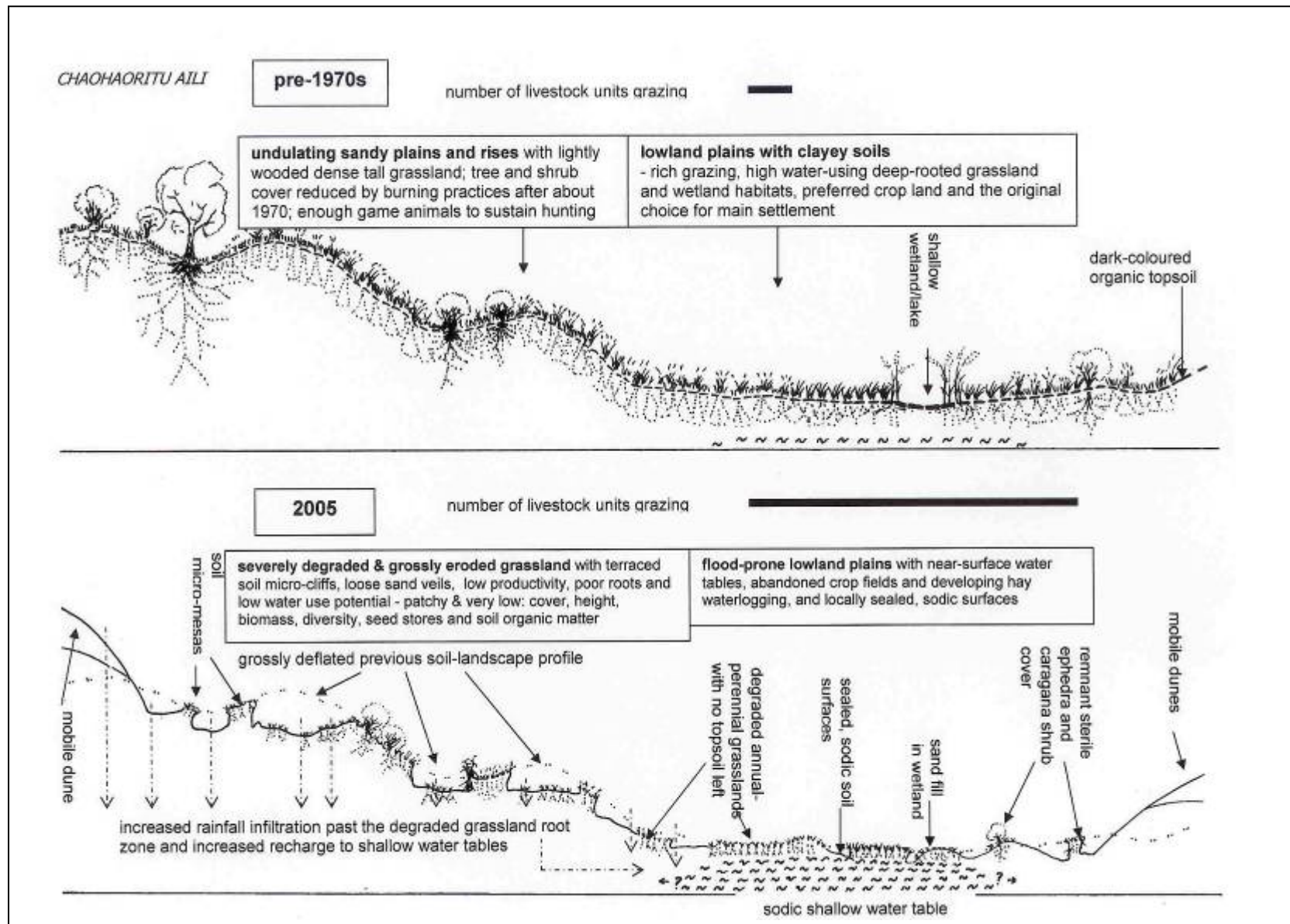
- (1) they stabilize the soil surface as a protective ecosystem 'skin', protecting against both water erosion and wind erosion;
- (2) they regulate the flow of water into soils;
- (3) organisms in the crusts produce nitrogen and distribute organic carbon which is needed by plants and plant seedlings;
- (4) crusts provide favourable sites for seed storage and the germination, establishment and survival of many higher (vascular) plant seedlings; and
- (5) crusts act as refuges for soil invertebrates which enable decomposition, soil carbon storage and soil mineralization processes³.



Landscape processes; Previous and Present

The diagrams in Figure 1, of a stylised section of the summer Chaohaoritu landscape, contrast the landscape features of 2005 advanced desertification with those of a 1970s functional, sustainable, biodiverse landscape as described by older members of the community in oral accounts given to IMGMP.

³ D.J. Eldridge & R. Rosentreter. Morphological Groups: a framework for monitoring microphytic crusts in arid landscapes. *Journal of Arid Environments* 41: 11-25, 1999.



A tentative landscape model of the ecosystem's collapse

Four main stages can be identified in the likely desertification process that has occurred since the recent land degradation cycle began in the 1980s:

FOUR-STAGE DESERTIFICATION MODEL: CHAOHAORITU ECOSYSTEM COLLAPSE***Stage 1: Fires and loss of larger native animals***

This stage is associated with the loss of a community economy based on hunting and gathering and the initial increase in livestock and grazing, together with vegetation burning and collecting of wood.

Stage 2: Shrubby woodland conversion to perennial grassland

The initial years of more intensive grazing use provided the incentive to maximize the yield from grassland productivity for maximum possible animal productivity. A major decline occurs in trees, shrubs and perennial herbs as open perennial grassland increases.

Stage 3: Degradation of perennial grassland and expanding erosion & salinity

Overgrazing-induced general loss of perennial vegetation hugely reduces the landscape's capacity to use deep soil moisture and transpire rainfall from summer storms. [Reports suggest that heavy rains in 1998 raised near-surface water tables to new levels and salinity then spread.]

Stage 4: Annual vegetation, gross erosion, dominance of salinity & mobile dunes

Only relic trees and shrubs remain in the landscape, otherwise there is general replacement of more valuable perennial grazing with annual grasses, increaser species and a proportionately high biomass of poisonous plants such as lua topeng *Pegarnum harmala* on the lowland plains. Mobile sand crests form on many higher points of the landscape, then expand and coalesce into dunefields. There is a significant proportion of bare, unvegetated areas of all sizes within both the sandy plains and the lowland plains. Sodic water tables remain close to the surface of most or all the lowland plain. Rapid desertification and salinisation under an unsustainable concentration of herder households following resettlement policy

Rapid desertification and salinisation under concentration of herder households following resettlement

Oral accounts of recent history suggest an escalation of land degradation began with an inappropriately concentrated village resettlement plan. The resettlement was evidently designed to put post-1998 housing area beyond the reach of flooding. Stock build-up and overgrazing due to the relatively small size and fragility of the land has continued to 2005. IMGMP has made a major effort to assist the community to find mechanisms to end the stock build-up so that User Rights could be distributed among families at a more sustainable level. Allocations of a notional number of grazing animals among the 123 households were suggested to utilise the approximately 50,000 mu of degraded grassland with shared access to additional hay and crop land.

This particular aili, in a 300/350mm rainfall zone, is only about 77,000 mu with two-thirds allocated to communal grazing land. However, it is being used to support some 120 families housed within blocks averaging about 0.1 ha within a 15 ha 'suburban subdivision' which was built on the most extensive elevated land near the original settlements following the 1998 floods. All of the households are dependent on this infrastructure to make a living by communal grazing and cropping. Environmental disaster was inevitable as a consequence. In August 2005, the aili was said to be carrying roughly 10,000 stock units, less than at any other time in the last three years, following some sales and the general loss of this year's spring lambs and some kids from malnutrition and exposure in early May.



The speed at which Chaohaoritu's gross desertification has become widespread and general is not exactly known but appears to be a very short timeframe; perhaps 15 years, and evidently mainly within the last 1 to 5 years of herd build-up. The 15 year figure corresponds with indications in Ho⁴ of an overgrazing-induced desertification case study in Ningxia and again in Williams⁵ at Nasihan (near Chifeng) from a study of overgrazing and policy failure in an equivalent Kerquin sandy grassland in the 1980s.

Fragmentation of the sandy plain landscape by gross erosion

Currently, there is an alarming rate of destruction to exposed soil profiles occurring, both by sheeting and along the lines of soil micro-cliffs. Some idea of this rate of destruction at the fragmented edge of a 2-metre soil profile during spring 2005 is provided by the photo-pair shown below, taken only 77 days apart between April and June 2005.

Once an ancient fertile soil such as this has been subject to wind erosion its fertility is effectively lost forever. A resultant growing mobile sand dune can be stabilized to some degree within a single growing season, through natural ecological recovery potential (as IMGMP proved) or by reseeding and using northern Chinese expertise in engineering dune stabilization. But the fertility, land use options and biodiversity potential are permanently reduced. Chaohaoritu has already lost the productive potential of most, or possibly all, its best soils due to gross desertification and salinity. Rapid desertification continues everywhere within a 3km radius of the main settlement. At the time of writing, unsustainable and destructive grazing and cropping practices seem set to continue at both of the IMGMP Middle Banner study gacha.

⁴Ho, Peter (1996) Ownership and control in Chinese rangeland management since Mao: the case of free-riding in Ningxia. ODI papers 39C.

⁵Williams, D.M. (1996). Grassland enclosures: catalyst of land degradation in Inner Mongolia. Journal of the Society for Applied Anthropology 55(3):307-313.



Whole landscape desertification here is partly a result small areas of community land being allocated to so many in the Mongolian re-settlement communities; and the limited land capability with its high susceptibility under the prevailing climatic forces. Higher classes of land capability (regardless of susceptibility to desertification and salinity), were always going to be required as the basis to sustain intensive grazing management and fodder cropping when it is the only source of economy around densely populated resettlement villages such as Chaohaoritui.

Monitoring the intensifying salinity and desertification

Although this belt of Inner Mongolia is well-known to have dryland salinity problems, the widespread extent of sodic-salinity and waterlogging throughout the lower parts of the landscape and the heavier soils was unexpected. Previous verbal accounts and reports, even from the early 1990s, suggest that it was not yet a serious problem then. The general loss of transpiration potential (as leaf area from the previous dense vegetation cover of trees, shrubs and other deep-rooted perennials) has had devastating consequences. The landscape's present capacity to intercept and use soil and subsoil water from heavy summer rainfall events has declined steeply since about 1980. Had the landscape still been well-vegetated at the time of the 1998 rainfall and flooding, it may have avoided both the severity of flooding experienced as well as the subsequent semi-permanent loss of all its best agricultural land to salinity and waterlogging.



Detecting and monitoring the extent of soil scalding and the location dynamics of mobile dunes proved to be very easy using summer high resolution imagery. Continued intensive monitoring of this area's desertification would be very valuable. This would inform any substantial management intervention to arrest desertification by changing present patterns of grazing and cropping. At a commercial cost of about Y10,000 a data set for such coverage, Quickbird satellite remote sensing is relatively expensive to acquire - when it is needed over areas for which there are no suitable data archived (i.e. most of Inner Mongolia). Its detailed resolution is comparable to

1:10,000 scale low level colour aerial photography and it vividly illustrates fine scale landscape features in a desertifying landscape such as this. The geodetic accuracy of its data also means that any point located on the ground with a hand-held GPS can be exactly located on the image display.

A detailed monitoring of a relatively small sample of sandy Kerquin grassland areas across the IMAR by Quickbird imagery would provide a powerful tool for following and understanding the local dynamics of gross desertification and salinity. Areas under continuing uncontrolled grazing could be compared with areas which have adopted changes of land use, or better community or household level management systems. [With this opportunity in mind, the 2005 Quickbird digital data sets have been provided to the IMAR Grassland Survey and Monitoring Institute and the Alxa League Environmental Rehabilitation Project, both of which have facilities to use such data.]

With deep-rooted vegetation almost entirely destroyed, ecosystem resilience is low. Very shallow surface water tables persist and exacerbate future risk of floods, waterlogging and salt damage to roads and buildings, pests, outbreaks and diseases. High densities of grasshoppers were evident in summer 2005. The Animal Husbandry Bureau conducts poisoning campaigns against grassland 'rats'. Village reports and so many burrows through the grasslands suggest appreciable populations of small to medium-sized mammals. But with only very occasional predators in evidence, such as saker falcons *Falco cherrug* and steppe buzzards *Buteo buteo*, the potential for biological control is lost. These species have been shown to be nest site deficient and rodenticide-susceptible from other studies in the region.

Representativeness of desertifying conditions

Is Chaohaoritu representative of the wider district situation? There is no definitive evidence, but local government staff indicate that the condition of the grassland in our study gacha is not exceptional.

District vegetation change imagery calculated from the Normalised Difference Vegetation Index is another measure. Comparison of satellite data between 1998 and 2004 indicates that our two study gacha there show different trends (Chaohaoritu slightly less vegetation, Baiyinhaga slightly more), and as such reflect the similarly patchy trends across southern Middle Banner.

Saline, waterlogged and eroded plains are certainly widespread to the north of Tongliao in Jilin. Dr Li Qingfeng, who has extensive experience of Xilinguole and Chifeng grasslands, commented that the Chaohaoritu situation observable in May 2006 was 'severe – most of the areas in Xilinguole are better'.

Conceptualising the rapid collapse of landscape functions

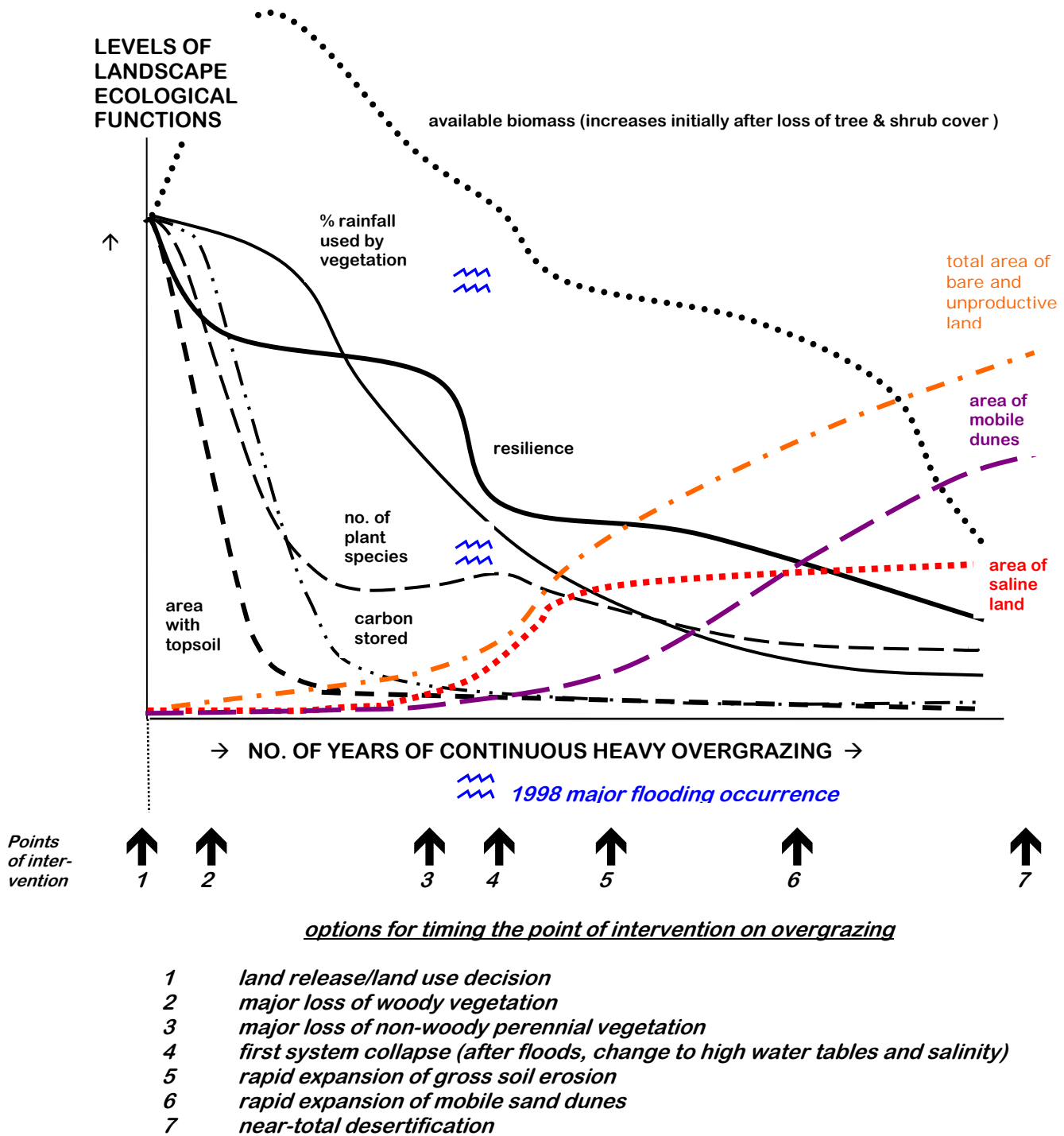
Through this review of IMGMP Middle Banner case studies, a rough model can be constructed. This shows the various rates of decline in the interconnected vegetation, land and water functions of Kerquin sandy grasslands under relentless overgrazing. (Figure 2).

Using this model, the ecological landscape functions at Chaohaoritu have already reached point 6 on a 7 point scale which takes only 15-20 years to arrive at desertified conditions. At Baiyinhaga, 40 km to the north, conditions are closer to point 5.

It is evident that intervening on overgrazing and on early stage desertification (at point 2 or 3) will be easier, faster, less expensive and result in better resilience and land use options than by intervention at points 4 or 5. With effective land capability assessment, decisions would ideally be made at point 1 about the land use for which the area should be developed.

Recent internationally recognised desertification containment interventions, in the Kerquin grassland of Chifeng Prefecture for example, did not occur until the lands were at the final stages of landscape function collapse.

Figure 2 Implied sequence and timing of changes to landscape functions after an initiation of continuous heavy overgrazing upon intact elm woodland/sandy Kerquin grassland. Arrows indicate the main notional points of possible policy and management intervention, which can be assessed for benefit-costs (based on Chaohaoritu & Baiyinhaga case studies from Middle Banner).



Conclusions

Only early action can sustain a future for Middle Banner's children

Many leading climatologists now accept that over the next 10 years, climate change impacts of a 'warming and storming' nature will take effect in different ways across the whole of northern China.

Areas which are expected to form the centres of rapidly expanding new deserts and dust-bowls if they are allowed to persist as desertified areas will have:

- unsustainable land usage beyond land capability;
- over-grazing and over-cropping practices;
- little or no perennial vegetation coverage on the soil surfaces in sandy lands;
- active and expanding landscape desertification and salinisation.

If conditions such as southern Middle Banner are not subject to drastic intervention and changes to grazing use, such Kerquin grasslands will rapidly become inhospitable areas. Communities will lose their livelihoods as the crop lands, grasslands and woodlands become a memory. The likely outcome is Xing'an's first desert, and 'ecological migration' through assisted voluntary resettlement of some of those best-placed to move. A further decline will occur among current disadvantaged Mongolian communities who lack adequate services and development supports to create a better future for themselves⁶.

The former Kerquin grasslands will continue to be areas in which China will need to spend enormous sums of money in attempting to contain its multiplying new deserts, saline wastes and most importantly, dust sources. Governments will need to protect human health, water supplies, transport systems, high-technology infrastructure, business investment, trade and tourism industries from the impacts of new deserts across the north. Such expenditure will have been preventable and will bring little or no compounding economic returns.

All the worst consequences inherent in this scenario are avoidable.

Why total bans are probably essential here for recovery from salinity across the cropping land and a growing sand desert on higher areas

The low-lying parts of the landscape with productive clayey soils are now semi-permanently waterlogged and badly affected by salts at the surface which should be stored harmlessly in subsoil layers below the plant root zone. This lost cropping potential of the best land appears to be caused by a change in the hydrological balance at the landscape scale. This is likely to be a direct result of the general loss of perennial vegetation by overgrazing. It would be locally worsened by poor irrigation practices followed by heavy rainfall and floods which raise the sub-surface water tables and carry salts to the shallow root zone of crops. This problem, which robs the villagers of productivity from their best land, can be reversed only by lowering subsurface local water tables. The best way to achieve this at the lowest cost may be by adopting a grassland management goal of general perennial revegetation across the landscape. In this way, more and more water is transpired from the soil as vegetation re-grows.

If such revegetation works the same way in Middle Banner as it does elsewhere, for example in salinity-affected areas of Australia and Pakistan, it will succeed provided the regenerating vegetation is protected from grazing. Bare, scalded plains can be allowed to grow back salt-tolerant plants. If these are not grazed, they can develop mats of plant material on the surface which acidify the surface as they break down and decay, remobilizing accumulated alkaline deposits. Generally speaking, the less grazing occurs, the more leaf area develops per tonne of biomass and the more soil and subsoil water gets used by deep-rooted plants.

When surface salinity abates and water tables begin to drop, it may also be possible to reclaim some former cropping land. Using locally-developed alley farming techniques (strips of tillage between rows

⁶ Lin Zhibin Voluntary resettlement in China: Policy and Outcomes of Government-organised Poverty Reduction Projects. ISBN 09-5808-765-4. 2003

of trees) combined techniques will work as a variation on plantation forestry areas newly established in Middle Banner and in Front Banner.



The workforce of these Mongolian communities is now needed for a much more important purpose than to continue to produce poor quality livestock and very low turnover rates from poor quality grassland. The prevention of gacha-scale local desertification and the protection and management of rehabilitated grasslands is the goal required. With adequate support, villagers could actively revegetate these lands, protect and facilitate recovery of an iconic ecosystem, part of China's heritage, and, secure a future for these grassland communities.

Young villagers have told IMGMP that they want to be able to be able to protect their heritage, but that they cannot

under the present system of land use and village governance.

Without the grasslands, most Mongolian songs lose their meaning.

Policies which would support revegetation management

In the policy sense, the 11th 5 Year Plan has signalled a change in the purpose of sandy Kerquin land use in this general area. It has, in theory, moved on from a goal of squeezing the last yuan of income from extensive grazing and fodder production, to a priority of environmental rehabilitation.

Local support for a new system of stall-fed animal production and diversified village economies would enable:

- Larger scale goals encompassing the aims of 'Grain for Green' and 'Fallow Grassland' projects, which continue to spend large sums but have had little real impact to date in the exclusion of grazing or the rehabilitation of selected areas of desertifying land in Middle Banner;
- Additional achievements for China as a ratified signatory under the United Nations Convention Combatting Desertification;
- Addressing National Government's new vision of sustainable development (and where necessary with community development for alternative land uses and income diversifications more in tune with land capability);
- Addressing the IMAR Government's policies for grassland protection;
- Developing China's economic and future trade options through recovering its Kerquin grasslands as globally viable zones of atmospheric carbon sequestration *for profit*;
- A basis by which China can address international criticisms and rebuild its reputation regarding the aspirations of rural Mongolians as ethnic minorities.

To implement existing policies, governments and communities must now begin negotiating an organised support program for phasing out the continued use of these grasslands for year-round grazing. An end to grazing in some areas is not a new idea for southern Middle Banner. The idea was actively discussed and reported during Phase I of IMGMP, pre-2000. There are many ways in which present household incomes from grazing animals could be replaced. More modern forms of intensive animal husbandry can be developed in most of the villages and at feedlots on suitable locations off the grasslands, as has been done in other banners and regions of northern China.

What is needed is visionary leadership and a new goal for regional and local governments in this region. This comes with a willingness to prioritize the significant investment needed in expenditure for the early years of land use change. These costs are incurred due to the need to subsidise the incomes of Mongolian families whose livelihoods have been maintained at the cost of destroying China's

grassland heritage, piece by piece, under resettlement and livestock development policies since the 1980s,. Such issues are discussed in more detail in [PIDP 2](#).

Huadeng gacha and the Chaohaoritu community are good examples of communities which need a long-term local government plan for alternative land usage. The plan should include investment in social and economic development mechanisms. It should also include the means to prevent permanent desertification by resting the land indefinitely from the unsustainable grazing and cropping system currently being used.

“...Human interferences may break the system’s stability and balance. Once interfering forces dissipate or disappear, the disturbed ecosystem can gradually return to its original state by means of its self-repair function. Relying on investment, man-made projects focus on local environmental improvement; while the system’s inherent self-repair mechanism can make improvement on a much larger scale. Unfortunately, in the past we have been deeply interested in man-made projects, neglecting the dramatic effects of natural forces as well as the potential commercial benefits they can bring in.

The reason for the above mistaken ideas lies in the concepts of extensive management and self-sufficient, small-scale farming plus the conviction of “man harnessing nature” promoted by the late Chairman Mao Zedong in the mid-1970s, disrespecting natural rules and lacking modern view of agricultural management. When in practice, local interests emphasizing the introduction of investment and launching of new projects lured the decision-makers to lend an ear to one side and make policies not in line with the local conditions. Based on a review of achievements and failure in previous desertification-control projects, three goals have to be attained in the future.

Over-cultivation, grazing and logging must be restrained in the source area of desertification. Stopping grazing aims to keep the carrying capacity of degraded grasslands below the limit allowed, while grazing will be forbidden in those seriously degenerated and desertified grasslands. By means of stopping cultivation, with the prerequisite of maintaining the main arable lands, those poor and remote lands with low yield and great ecological destruction will be protected from cultivation.

The purpose of stopping cultivation and grazing is to activate the ecosystem’s self-repair function, so that vegetation cover and soil conditions can be improved on a large scale. They are effective rather than passive anti-desertification measures... Agricultural zones can supply abundant feeding sources for raising sheep in folds, while in return the latter can create new opportunities for the readjustment of agricultural structure, industrial management and increase in farmers’ income.”

Reflections on Twenty Years' Desertification-control in China by Shi Yuanchun, ex-President of China Agricultural University, and academician of the Chinese Academy of Sciences) 科技日报 [Science and Technology Daily] February 25, 2002, translated by Shao Da for china.org.cn

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Please note: IMGMP Policy Issue Discussion Papers were originally drafted as informal documents for discussion purposes only. They do not represent official records or views of either of the bilateral partnering agencies involved in the Project.

Appendix

SIX QUICKBIRD SUB-SCENE IMAGES OF CHAOHAORITU, 8 AUGUST 2005

Key:

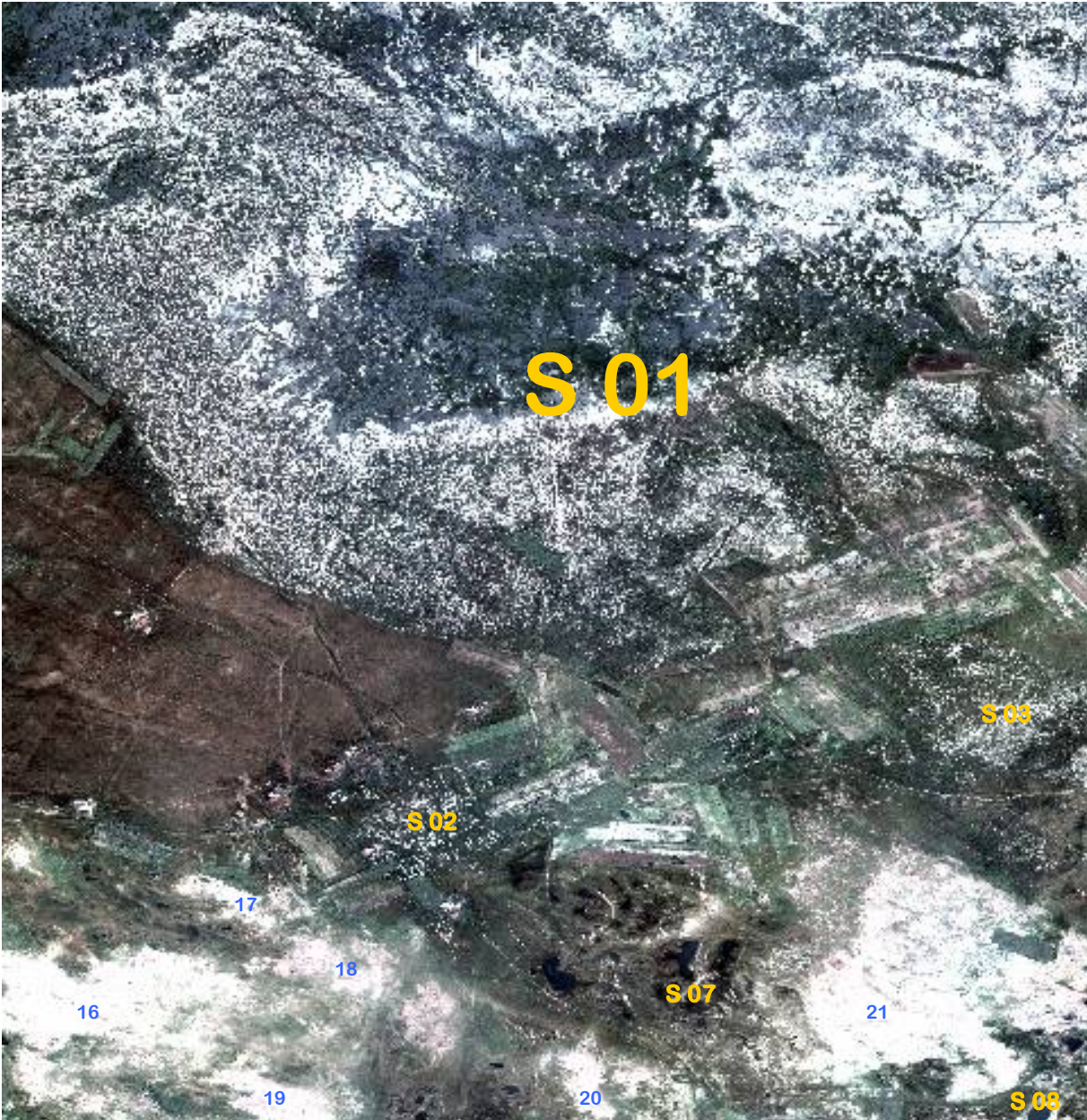
S 01, 02 etc.

sodic/saline areas

01, 02 etc.

mobile dune accumulations (of loose sand)

Sub-scene scale is approximately 3 x 3 km



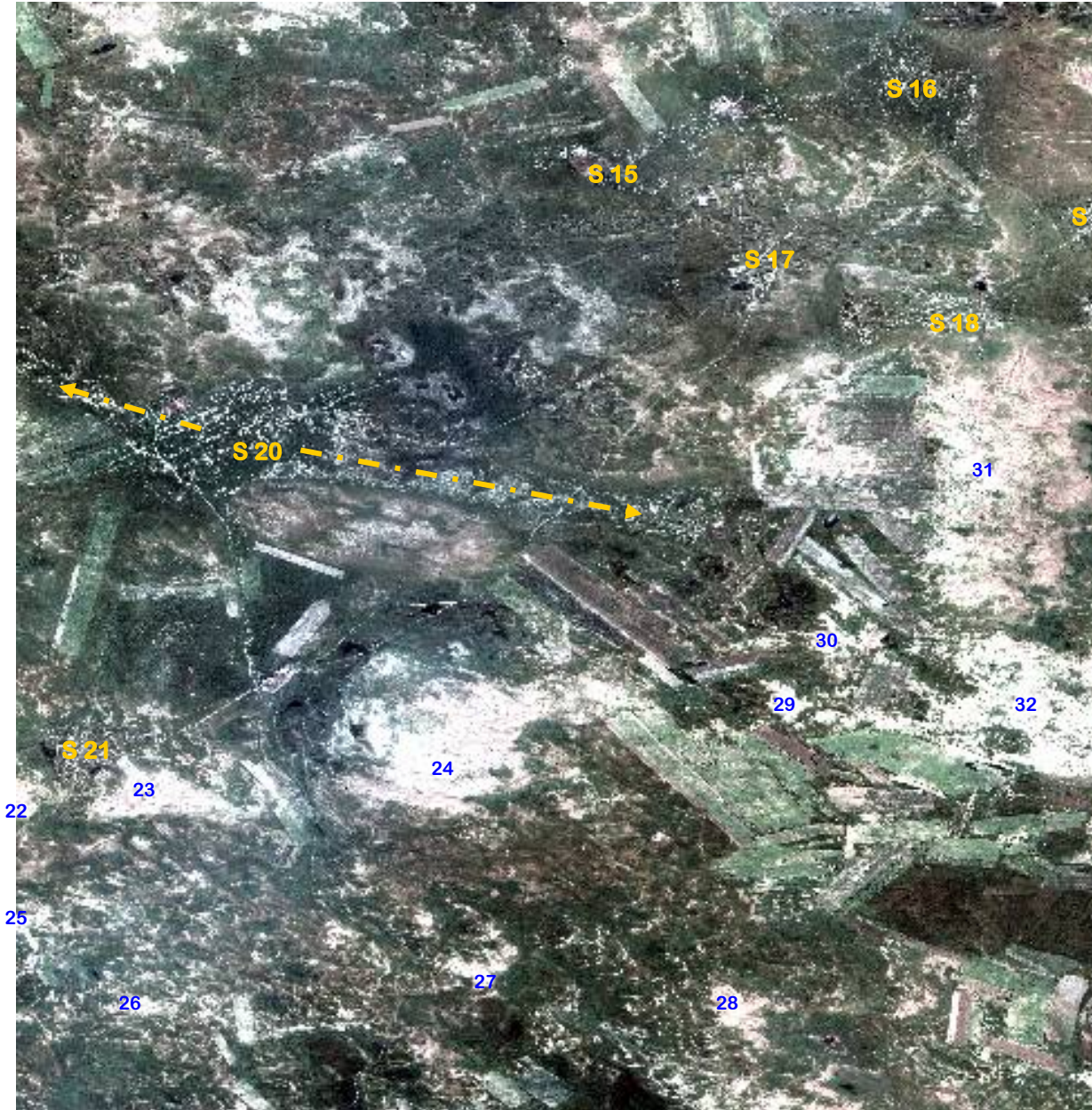
Sub-scene 1 Chaohaoritu north-west



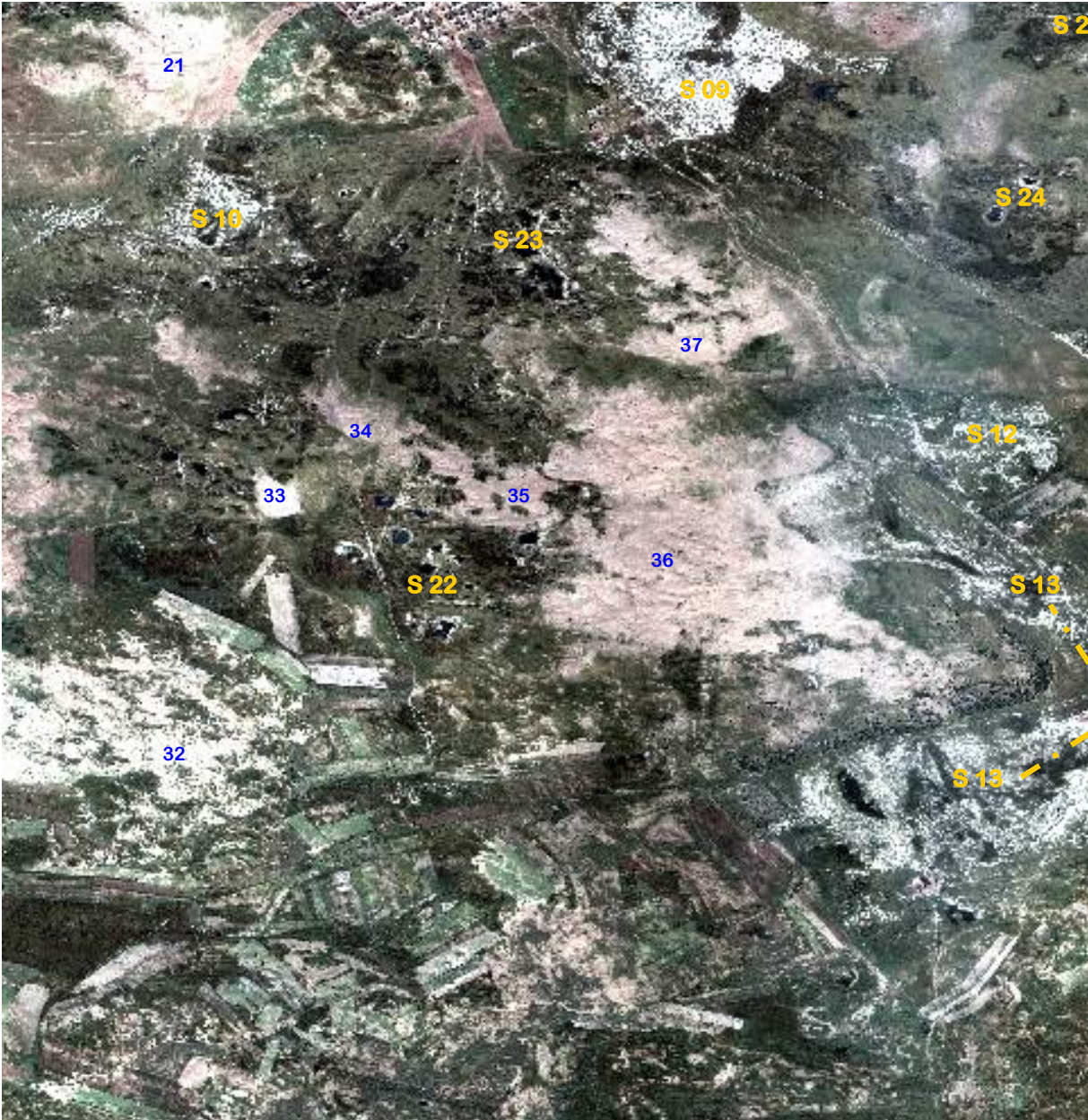
Sub-scene 2 Chaohaoritu north-central



Sub-scene 3 Chaohaoritu north-east



Sub-scene 4 Chaohaoritu south-west



Sub-scene 5 Chaohaoritu south-central



Sub-scene 6 Chaohaoritu north-east