6 Wheat Dreams

Scientific Interventions at Chinese Model Farms in Kham,
1937-1949

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Abstract

China's direct control over the Tibetan Plateau was long limited to relatively low-altitude sites where intensive agriculture was viable. The integration of Kham into Xikang Province in 1939 was accompanied by a programme of experimental agriculture under the Bureau of Agricultural Improvement (B.A.I.) that sought to extend the elevational limits of intensive agriculture and 'improve' agricultural production. Based on archival and print materials, this essay contextualizes the work of the B.A.I. within national agrarian developments and offers a portrait of everyday life at two of its experimental farm stations in Kham. I contend that these sites, though diminutive, inspired confidence in the ability of the Chinese state to implement larger social and environmental interventions on the plateau.

Keywords: agricultural history, environmental history, ecology, history of science and technology

In politics everything hangs together and all politics starts with a grain of wheat.

– *Victor de Riqueti, Marquis of Mirabeau (1775)*¹

Introduction

Historians are by now accustomed to thinking about 'the frontier as a discursive process' as Lawrence Epstein once urged (2002, 2), but recently China historians have paid closer attention to the frontier as an environmental

¹ Quoted from Fox-Genovese (1976, 47-48).

process.² In line with the broader field of environmental history, some recent scholarship emphasizes that while ideas about environmental difference have historically been central to distinguishing between China proper (*neidi*) and the lands 'beyond the pass' (*guanwai*), these environmental differences are not reducible to pure discourse (Bello 2016, 2, 7). In the twentieth century, scientific approaches to diagnosing and circumnavigating environmental obstacles were integral to the process of 'frontier reconstruction' that Stéphane Gros points to in his Introduction. This chapter examines how the Chinese nation-state addressed ecological challenges in its attempt to settle Kham during the early twentieth century.

Specifically, Chinese of the early twentieth century associated Kham's 'frontier' status with its relatively low production of recognizable food grains. That concern came to a head when Kham was incorporated into China's new Xikang Province in 1939. The subsequent decade saw a spirited discussion of the 'food grain problem' (*liangshi wenti*) in Kham, the so-called 'problem' being that local soils could not produce large volumes of the crops that Han settlers desired (see Duan 1944). A 1943 agricultural survey concluded that 'since there are many mountain slopes, the altitude is high, and the temperatures are low [...] food grain production amounts are insufficient to provide for a dense population' (Zhang Yuxin and Zhang Shuangzhi 2009, 412). The following year, Xikang agriculture chief Duan Tianjue concurred that 'food grain production in the Kham dependency is sufficient only for the consumption of a small portion of residents within the territory' (1944, 16). Even so, there was a growing confidence that climate would not forestall the march of Chinese progress – confidence that was inspired by a series of small-scale interventions in the landscape.

Consider the experience of Zhang Jinqun, an agronomist from faraway Zhejiang Province. The Japanese invasion of east China in 1937 drove him west, and in June 1942 he became the chief of an experimental farm station in Kham called Taining Pastures (*Taining mu chang*) where he endeavoured to grow wheat (S.A., Min 249-1-156). He sowed his first crop at Bamei in the spring of that year, much as he would have in lowland Zhejiang, but early frosts kept his stalks from producing ears in the fall. It must have been cold comfort when the Department of Agriculture and Forestry telegraphed from Chongqing to recommend that Zhang find more frost-resistant strains of wheat to plant next year. Faced with hunger, he consigned himself to growing highland barley like Khampa farmers and learned to forage for

2 Recent environmental histories of the Chinese frontier/borderlands include Bello 2016, Schlesinger 2017, Kinzley 2018.

wild ginseng roots in the high grasslands like Khampa nomads (Zhang Jinquan 1947, 27).

But Zhang was undeterred. 'Highland barley is no good for Han people', he complained. Wheat was the most common grain on earth; if Siberia could grow wheat, Zhang reasoned, so could Kham. As war with Japan raged in the interior provinces, Zhang waged his own war against hunger in the highlands. By 1944 he had assembled 25 varieties of wheat seed from different Chinese institutions for a variety comparison experiment, which he ran at two different sites near the town of Kangding. By 1946 he had identified and re-tested three high-yielding, cold-resistant varieties that the government could plant throughout the Kham region at elevations of up to 3500 metres (Zhang Jinquan 1947).

Zhang's experience is extraordinary, but not unique. He belonged to a new professional class of agriculturalists that were university-educated, mobile, and well connected. In the late 1920s Zhang matriculated at the agricultural college of National Central University, where he likely brushed shoulders with prominent American agronomists, including the missionary John Lossing Buck.³ He graduated from the Department of Agricultural Land Reclamation (*Nongyi kenzhi ke*) in 1931, and served as an agricultural technician in the eastern provinces of Anhui, Fujian, and Zhejiang before his thousand-mile exodus to Kham, where he joined the government of the newly-established Xikang Province. During Zhang's time at the Anhui Province Cotton Improvement Station he had served alongside brothers Duan Tianjue and Duan Tianzhen, both of whom would join him in the Xikang Provincial Bureau of Agricultural Improvement (*Xikang sheng nongye gaijin suo*, henceforth B.A.I.).⁴ There they shared quarters with migrants from several other provinces at experimental farm stations modelled on those of the interior provinces, where they managed small local labour forces. The work these agriculturalists did, and the topic of this essay, was 'improvement' (*gaijin*, or *gailiang*).

Improvement was in many ways a precursor to the notion of 'development' that found prominence in the latter half of the twentieth century (see Giersch and Tan, this volume). The origins of improvement are in early modern Europe where it clearly signified agricultural innovation, although by the twentieth century 'improvement' referred more broadly to a range of

3 The American agronomist and missionary John Lossing Buck moved from Anhui to Nanking University in 1920 (Stross 1986, 161). He remained until 1944, traveling intermittently to the United States and elsewhere.

4 These biographical details are gleaned from personnel files in S.A., Min 249-156.

technocratic interventions in society and the environment. Anthropologist Tania Murray Li cogently identifies two core features of global improvement schemes: the first is *problematization*, or 'identifying deficiencies that need to be rectified', and the second is *rendering technical*, or assigning resolution of the problem to experts in a neatly-defined field (2007, 7). This understanding of improvement fits the B.A.I., which conceived its mission in opposition to the supposed 'food grain problem'. It also fits the general approach to the 'frontier service' and forms of social work that, as Gros reminds us in the Introduction, formed a new ideology for borderlands integration.

In the long view, the B.A.I. was part of a process that began in the late Qing Dynasty. In 1904 Fengquan, an Assistant Amban commissioned by the Qing court, launched an unprecedented agricultural colonization effort that provoked local unrest and his subsequent murder by Khampa hands (Gao Lao 1913, 7; Relyea, this volume). Rather than dissuade the imperial state, Fengquan's death catalyzed Qing intervention in Kham, beginning with Frontier Commissioner Zhao Erfeng's campaign to consolidate power in the region (Wang 2011, 212). As part of this effort, Zhao conceived an elephantine scheme to settle Kham with farmers from Sichuan, commissioning 50,000 title deeds for migrant settlers. Most of these settlers either failed to materialize or deserted after realizing that Kham's growing potential did not meet expectations (Relyea, this volume). But in the late 1930s, the incorporation of the Kham region into a 'Xikang Province' of the Republic of China reinvigorated land reclamation efforts there under the governorship of warlord Liu Wenhui. As the *Christian Science Monitor* reported in 1939:

Government heads at Chungking have decided that with the New Year, Sikang – formerly known as 'Inner Tibet' – will be a new province and given full recognition for its role as site of vast land-reclamation projects which are to be pushed by both Government and semiofficial circles. [...] Sikang will become to China what the Japanese used to say Manchuria was to them – a 'life line'. ('China Builds Inner Empire' 1939)

Superficially, the Republic of China appeared to inherit its Kham doctrine from the Qing empire. Scott Relyea (this volume) notes several features of Zhao Erfeng's colonization push that resonate with subsequent efforts under Liu Wenhui: namely, reliance on civilian migrants, the establishment of experimental farms, the introduction of nonnative crops, and the conceptualization of land reclamation as a civilizing project. Yet Republican state-builders perceived that Zhao had failed. 'Zhao Erfeng once implemented migrant cultivation', wrote Kham scholar Ren Naiqiang,

'but unfortunately, he did not see results' (2009 [1931], 3). In reprising an ill-fated imperial project, were officials trying to do the same thing and get different results?

This chapter demonstrates that fundamental changes in Chinese agrarianism differentiated Republican-era agricultural colonization in Kham from that of the late Qing. A new agrarianism emerged that was distinctly nationalist in character, and that offered a holistic vision of China's place in the international community: China, some said, was 'a country founded on agriculture'. Politicians employed this vision to enhance the popular appeal of migrant land reclamation, construing it as an avenue for broad participation in what Benedict Anderson (2006, 7) calls the 'deep, horizontal comradeship' of the nation. This 'agrarian nationalism' was also characterized by a turn to the international paradigm of scientific, industrial agriculture. Experimental farms were not entirely new to China, but China's experimental farms of the 1930s and beyond were linked in unprecedented ways to networks of bio-matter, information, and agricultural professionals.

The Tibetan plateau proved to be a unique challenge for agrarian nationalism, which presumed isometry of national territory with fertile earth. The elevation and topography of Eastern Tibet militated against the cultivation of the food crops that Chinese settlers desired. Wheat cultivation was exceedingly difficult, rice impossible. I have previously contended that the elevational limits of grain agriculture were effectively the material limits of the Chinese state apparatus (Frank 2016, 115-123). This essay chronicles how the Xikang provincial government sought to extend its limits by technical means through the agronomists of the Bureau of Agricultural Improvement. Through their research on 'high-cold' (*gao han*) crops and livestock, technicians like Zhang Jinquan contributed to ameliorating national territory and local soils. Drawing deeply from the unpublished archives of the Xikang Province Bureau of Agricultural Improvement, I analyse everyday practice at two experimental sites, Simaqiao and Taining, that occupied different ecological niches within the Kham region. Both sites entailed creative adaptations of agrarian nationalism to challenging local conditions, with mixed results.

Reclaiming Kham

Chinese land reclamation policy of the twentieth century turned its attention from the imperial practice of establishing discrete military colonies (*tuntian*) to land reclamation as a continuous civilian and military enterprise, now

referred to as *tunken* or *kaiken* (Relyea 2010, 50).⁵ Kate Merkel-Hess describes *tunken*-style development as 'a distinct alternative to rural reconstruction's remaking of the countryside' that nevertheless co-opted rural reconstruction's village utopianism (2016, 82). Kham was among the earliest regions to institutionalize this approach with the 1926 establishment of the Xikang *Tunken* Commissioner (*Xikang tunken shi*). In 1928 the Nanjing government identified fourteen zones for institutionalized land reclamation, most of which were in the borderlands, including Xikang (Huang Fensheng 1946, 182).⁶

It was in this milieu that a certain Zhang Yunping published a manifesto in 1931 entitled '*Tunken* Recommendations Regarding the Moving of Soldiers to Xikang' (*Duiyu yi bing Xikang zhi tunken jianyi*). The thrust of Zhang's proposal was that Xikang administrators could settle all of its 34 counties with farmer-soldiers who would 'turn stony fields into fertile land', and who could revert to civilian status and receive titles to their land after three years of continuous cultivation (Zhang Yunping 1931, 47). The author hailed from Sichuan's Maogong, which had been a land reclamation station (*tunwu ting*) since the eighteenth century. At the heart of his manifesto was an agrarian philosophy of the Chinese nation, which he articulated as follows:

Our country is a country founded on agriculture; the refinement of poetry and the discipline of calligraphy take their restraint from agriculture and their diligence from agriculture. The governance of agriculture is done by expert officials, who in directing the hardships of sowing and reaping must lead by example and inspire their countrymen. (Zhang Yunping 1931, 43)

The phrase 'our country is a country founded on agriculture' (*wo guo yi nong li guo*) was a watchword of a conservative vein of nationalism that originated with the influential writer and statesman Zhang Shizhao.⁷ Zhang introduced the slogan that 'China is a country founded on agriculture' in the 1920s after his experiences as a student in Tokyo and then Edinburgh, which

5 These words were often used interchangeably in Republican-era discourse, but *tunken* implies land reclamation overseen by the army while *kaiken* has no military implication.

6 The other thirteen locations slated for *tunken* development were Xing'an, Songhua Jiang, Rehe, Chahar, Gansu, Xining, Qinghai, Xinjiang, Outer Mongolia, Tibet, Yunnan, Sichuan, and Guizhou.

7 The phrase *Zhongguo yi nong li guo* is difficult to translate. A more literal translation might be 'China erects the country with agriculture', but I have opted for the translation 'China is a country founded on agriculture', which I believe sounds more natural while maintaining functional equivalency with the Chinese phrase.

were instrumental in his embrace of what he perceived to be traditional Chinese values (Boorman 1967, 105-106). He outlined a fundamental, binary opposition between 'agrarian states' (*nong guo*) and 'industrial states' (*gong guo*), associating the agrarian state with the virtues of thrift, modesty and the ancient principle of *wu wei* (non-action) but the industrial state with greed that begat capitalism and imperialism (Zhang Shizhao 1926). His agrarianism inspired a number of disciples, corresponding to what historian Zhuang Junju describes as a loosely-aligned 'country founded on agriculture' clique (*yi nong li guo pai*) (Zhuang Junju 2007, 94).

Zhang Yunping's rhetoric in '*Tunken* Recommendations' echoed Zhang Shizhao's, including the latter's depiction of imperialist powers as posing an existential threat to a fundamentally agrarian China. But equally troubling to Zhang Yunping were the nomadic ways of the Khampas. He conjured the image of a Kham stuck in the 'nomadic age' (*youmu shidai*) and populated with 'restless people, wriggling around, accustomed to drink, given to drunken stupors, stark raving mad (*ru kuang ru chi*), with cattle shit all over their tents' (Zhang Yunping 1931, 44). His agrarianism thus figured as a sort of middle ground between two extremes: the nomadic and the industrial.

Agrarian thought in Republican China paralleled similar ideas in Japan, where discontent with rapid urbanization and industrialization fuelled an 'agrarian nationalism' among certain statesmen and intellectuals who 'shared a conviction that agriculture was crucial for creating a stable, harmonious Japan' (Havens 2015, 7). Japanese agrarian nationalists like Katō Kanji advocated mass agricultural emigration to Manchuria under the belief that it would simultaneously create utopian farming villages on the Manchurian frontier and revitalize struggling villages on the home islands (Young 1999, 309-310). In a similar vein, Chiang Kai-shek implored Chinese youths to ease population pressure in the industrialized treaty ports by migrating to the borderlands for *tunken* work, calling it 'a great task of the highest order in the building of our nation' (Jiang Jieshi 1943, 28). The ethnologist Huang Fensheng seized on Chiang's terse *tunken* remarks to write his own manifesto, which he published in 1946 as the *Borderlands Tunken-worker's Handbook* (*Bianjiang tunken yuan shouce*). Huang wrangled a multitude of facts and figures into a narrative on the historical trajectory of *tunken* practice covering two millennia of Chinese history, in which *tunken* figured as an enabling condition of the development of borderlands into Chinese provinces.⁸ His rhetoric reflects both Zhang Yunping's holistic

8 Scott Relyea notes that the conversion of borderlands into provinces, including Xikang Province, was a project that linked the late Qing dynasty with the Republican era (2010, 50-51).

interpretation of *tunken* and Chiang Kai-shek's concern with population redistribution:

The land (*tudi*) of a nation should be harmonized with the people of the nation. Only then can this land be possessed by the people, be exploited by the people, be enjoyed by the people. Otherwise, the relationship between humans and earth will be in discord. There are some areas where the human population is densely concentrated, and there are other areas where humans have not left their footprints and the land is gone to waste. This gives rise to lopsided development; not only does it influence citizens' livelihood, but it threatens the very existence of the nation (*minzu*). (Huang Fensheng 1946, 183-184)

Huang's *Handbook* inundated its readers with startling population statistics: for instance, it compared the population density of Henan at 211.16 people per square kilometre with that of Xikang, at 5.76. Of China's 11,562,888 square kilometres, only 9,300,000 (about twelve per cent) was under cultivation – far less than that in most industrialized states – and most of this uncultivated land was in the borderlands. Huang offered an ambitious solution: 'more than one hundred million people should be distributed from the population of the interior to various locations in the borderlands' (Huang Fensheng 1946, 194).

Tunken's ascendancy in national policy provided the provincial and central governments with a common idiom regarding land use policy. In 1940 Liu Wenhui petitioned the central Administrative Yuan to supplement his funding for military *tunken* in Xikang, with the reason that 'the population of this province is scant and the soldiers deployed are limited' (AS 20-00-63-017-13). In May of the same year, Xikang's provincial government promulgated a set of twelve stipulations for the reclamation of public land, which the central Administrative Yuan approved. Province-wide figures on the total number of migrants and the total area reclaimed are exceedingly hard to come by, because reclamation was a piecemeal activity rather than a centrally-coordinated strategy; various provincial organs ran their own reclamation programs on the land under their control.⁹

Hundreds of migrants from other provinces, including many war refugees, came to Xikang each year as participants in land reclamation, but few of

9 For example, in 1940 the Provincial Council office in Hanyuan welcomed 53 war refugees to settle as cultivators in Yichang and nearby counties, while the nationally-administered Xikang Student Headquarters settled 81 war refugees (including 60 students) in the Xikang counties of Ya'an, Hanyuan, and Xichang (J.S.G. 18-21-16-020-01).

these wound up in the Kham region. Hesitant to financially subsidize Liu Wenhui's province-building project, the nationalist government in Chongqing instead authorized the redrafting of Xikang's eastern border to incorporate fourteen fertile lowland counties and three proto-counties (*shezhi ju*) from west Sichuan as of September 1939 (JDKQ 59; see also Jagou, this volume).¹⁰ These counties, corresponding to the province's new Ya and Ning dependencies, would absorb most of Xikang's incoming *tunken* settlers, thanks in large part to the 1939 establishment of a Xikang Province Ning Dependency Tunken Council (*Xikang sheng Ning shu tunken weiyuan hui*). All of this production subsidized rapid institutional growth. Historian Joseph Lawson writes that the Ning dependency metropolis of Xichang 'flourished during the war' and that, according to one contemporary observer, it was 'a city of civil servants' (Lawson 2018, 163-164). The situation was different in the Kham region, where the state farms were barely solvent, there was little investment from the central government, and Han migrants remained distinctly in the minority. To colonize Kham, the state would need to confront that region's environmental peculiarity.

Kham as an Empirical Problem

Tunken discourse tended to elide regional differences. Historian Wang Xiuyu notes that 'the very compound term *tunken* evokes the agrarian ideals of the central plain: that of expanding productive farm land by opening up wastelands and the venerable tradition of farm colonization' (2013, 212). If advocates of migrant land reclamation offered a vision for harmonizing borderland soils to the needs of the nation, they did so based on dubious claims about soils. Zhang Yunping's '*Tunken* Recommendations' was unequivocally optimistic about Kham's cultivation potential. He described the fields of Kham as 'level and fertile, conducive to herding and conducive to planting' (1931, 40), and elsewhere referred to Kham's 'boundless fertile soil' (43). Huang Fengshen's *Handbook* spoke of 'limitless virgin land' and beckoned youths to 'create an ideal environment upon the white paper of this swathe of nature' (1946, 192). Ignoring local ecologies and indigenous peoples, these agrarian nationalists imagined the Inner Asian borderlands as an empty scroll upon which migrant farmers might inscribe the nation. Their optimism lacked any clear evidentiary basis.

10 'Proto-counties' here refers to *shezhi ju*. In the administrative system of the Republic of China, provinces instituting new counties first established a *shezhi ju* (literally 'establishment office') that eventually achieved full status as a county.

Field surveys produced more cautious forecasts, though some early reports were in fact quite optimistic. Feng Yunxian of the national Tibetan-Mongolian Affairs Council performed county surveys that seemed to support bold claims about the region's potential, prompting her to return optimistic reports to the Council and issue public calls for citizens to settle Kham as *tunken* workers. In a 1931 essay on 'Essentials of Reforming Contemporary Xikang' in the journal *New Asia* she claims the 'Lamaist religion' (Tibetan Buddhism) inducts so many young Khampa men into monasteries that there is plenty of abandoned land for the taking. Feng writes that in Kangding (Dartsedo), Jiulong (Gyezil), Luhuo (Drango), Danba (Rongdrak), Daofu (Tawu), and Ba'an (Bathang), only three tenths of the arable land was under cultivation, while in the more remote counties of Yajiang (Nyakchu), Lihua (Lithang), Ganzi (Kandzé), Zhanhua (Nyarong), Daocheng (Dabpa), Yanjing (Yerkalo), and Derong (Dérong), only half of the arable land was under cultivation. She proposed a dual programme of encouraging citizens to migrate to the Kham region and resettling soldiers there as *tunken* workers once the civil war has ended. 'We should absolutely implement cultivation (*kaiken*)', she urges, 'so as to open up the spring of benefits' (Feng Yunxian 1931, 62). The same year in a private memorandum to the Tibetan-Mongolian Affairs Council, Feng would write that 'this land is situated in the southwest epicentre of national defence', and that 'the fertility of the land and the bounty of its production are not less than those of the interior (*neidi*)' (Z.D.E. 374).

Scientific analyses of Kham's growing conditions began in earnest during the late 1930s. These were sobering. The National Agricultural Research Institute (*Zhongyang nongye shiyan suo*) carried out an extensive survey of soils in west China after the Japanese invasion of 1937 forced that institute to relocate from Nanjing to Chengdu.¹¹ Among the research team was the London-trained soil scientist H.L. Richardson, who summarized his findings in a report on 'Soil and Man in West China'. West China, he explained, suffered from a phenomenon called 'fertility migration' in which fast-flowing rivers (especially the Yangtze and its tributaries) washed nutrients to the south and east, such that 'the high productivity of east China has been obtained at the expense of the west'. Further, soils in upland and far northern settings were subject to 'podzolization', a process in which key nutrients are leached from higher to lower levels of soil because cool temperatures inhibit decomposition near the surface. And western Kham was exceptionally arid

11 The provinces surveyed included Gansu, Shanxi, Sichuan, Hubei, Hunan, Yunnan, Guizhou, and Guanxi as well as Tonkin in Indo-China.

because the 'Szechuan alps' (Zheduo mountains) intercepted precipitation (Richardson 1940). The implication, he contended, was that the political hype over agrarian migration was unmerited:

The existence of these immense areas of uncultivated land has suggested to many that there must be a fine field in the west for resettlement and the disposal of some of the surplus population of the east. Actually this is not so, at least with present methods of land utilization and the traditional Chinese pattern of cultivation. China has already reached the stage where almost all the land which should be cultivated is being cultivated, and much is already being cultivated which should not. (Richardson 1940, 124)

Chinese land use surveys roughly concurred. In 1943, Xikang officials participated in the first county-by-county 'National Survey of Land Use Status'.¹² Existing farmland in most Kham counties was estimated to comprise about five to ten per cent of total area, and arable waste (the site of agrarian potential) was generally estimated at well under ten per cent of total area. Ning counties, by contrast, were believed to feature more arable waste in spite of this region's far greater Han population – as much as 20 per cent of Xichang's area was unused and arable. There was great variation within Kham as well, consistent with Feng's observations; counties along the southern route such as Ganzi and Danba were associated with greater growing potential than those along the northern route, such as Dengke, where it was felt that there was *no* potential for farm expansion. The greatest obstacle was Kham's high-altitude climate. Land labelled 'severely cold and not conducive to forestry or pastoralism' (industries more cold-resistant than cereal farming) reached 20 per cent in Dengke and Lihua and an incredible 40 per cent of total area in mountainous Derong (S.A., Min 234-1-253).

In 1941 a 'University Summer Term Borderlands Service Group', comprised of students from various Chinese universities, embarked on a survey tour of Xikang, the outcome of which was their 'Western Sichuan Survey Report'. The team departed westward from Chengdu on 15 August and spent over a month conducting surveys of indigenous peoples, geography, economy, agriculture, and animals along the courses of the Zagunao and Min rivers. As educated youths, these students would appear to have been the target demographic for Chiang Kai-shek's call to *tunken* service, but even their brief visit was beset by environment-related difficulties. The two teams that conducted the agricultural surveys suffered attrition from the elements;

12 The results of this survey would not reach Chongqing until 1946 due to the war with Japan.

the report notes that several people (not numbered) had to retreat because of 'bodily weakness' and that 'limitations on the survey could thus not be avoided'. Even in summer the climate was severe; though afternoons felt pleasantly similar to 'mid-autumn in the lands along the Yangtze', mornings and evenings were bitterly cold. What arable fields the surveyors found among the mountains and valleys were plagued by a lack of rainfall and an excess of salt that ran down from the mountaintops when it did rain (Zhang Yuxin and Zhang Shuangzhi, 439-440).

In spite of all this, the agricultural survey report ends on a high note with recommendations on how to 'improve' (*gailiang*) agriculture in Kham. These focused heavily on variety selection. Different varieties of corn and wheat were optimal for various elevations, but the surveyors noted that local farmers did little to prevent these varieties from cross-pollinating. By sowing selectively, modern farmers could keep varieties with longer growing periods at low altitude and varieties with shorter periods at high altitude, maximizing production. By isolating crops with one annual harvest from those with two, farms could conserve manpower. The surveyors also recommend replacing much of Kham's corn with potatoes, which yield more food at high altitudes (Zhang Yuxin and Zhang Shuangzhi, 447-449). These student opinions of course contended with a multitude of professional opinions, but they did so using the shared vocabulary of 'improvement' agriculture, based on the notion that the agricultural productivity of a particular region was not a given, but could be altered through scientific methods.

The Mission to Improve Kham

The new paradigm of agricultural 'improvement' helps to explain renewed interest in cultivating Kham during the mid-twentieth century in spite of decades of seemingly fruitless labour. It was largely a matter of faith. The outcome of any given improvement effort was unpredictable, and 'improvement' in this context might best be understood not as a result, but as a protocol by which crops, livestock, implements, and methods were altered through experimentation to optimize performance in a given region. Institutionally, these efforts were spearheaded by a local improvement bureau that exchanged personnel, material, and information with national and international improvement networks, and it is this network aspect that differentiated Liu Wenhui's experimental programme from that of Zhao Erfeng during the late Qing. Insofar as the local agriculture organ had yet to

implement a modern improvement protocol, Kham stood to be improved. This is what the manuscript for the *Xikang Tongzhi* implied, for example, by a remark that 'everywhere there are fertile grasslands that remained uncultivated with grain, and enormous herds of livestock whose quality remains *unimproved*' (emphasis added, X.T.G. 346).

'Improvement' had its origins in England of the eighteenth and nineteenth centuries, where it fuelled a dramatic increase in agricultural production that we now call the 'British agricultural revolution'. The emergence of market capitalism in northern Europe, and England in particular, prompted the marketization of crops, which in turn drove the consolidation or 'enclosure' of land under wealthy landowners. The ensuing privatization of commons provided new incentive for increasing yields, and agriculture became an intellectual pursuit of the bourgeoisie, who took advantage of the new technologies of printing to share knowledge about it. Noel Kingsbury writes that 'by 1640 it was possible for an English landowner to have quite a serviceable library on farming matters' (2009, 57). The United States inherited and improvised on these developments; Randall Stross notes that there were over 400 farm periodicals in the United States before 1860 (1986, 4). The English and American improvement movements benefited from relatively low population density and the emergence of print capitalism.

The population explosion that China experienced during the Qing ensured that it did not share the conditions that facilitated the agricultural revolution in the western hemisphere even after the fall of the dynasty. The average size of a farm in north China of the 1930s was 5.1 acres, and the average size in the south was 2.8 acres. In the United States of the 1930s, 'the average farm family of 4.2 people lived on 157 acres; in China, the average farm family of 6.2 people drew its sustenance from about 4.2 acres' (Eastman 1988, 54). Developments in (mainland) Chinese agriculture fell far behind those in Korea, Japan, and Taiwan during the twentieth century because of population pressure; its agricultural history in the twentieth century more closely resembles that of India than those of its East Asian neighbours (P. Huang 2016, 340). With such diminutive farms, there was little room for most Chinese farmers to produce more food than they needed for sustenance and thus little incentive to invest in crop improvement. Mass marketization of food crops would not occur in China until the 1980s.

Accordingly, agricultural innovation was propelled mainly by the state. Late imperial officials provided seeds to peasants, allocated funds for experimental fields, and sometimes even invested in agricultural experiments (Perdue 1987, 22). Some late Qing statesmen were impressed by agricultural development in the west, including Kang Youwei, who in 1895 unsuccessfully

proposed to the Guangxu Emperor a programme of state-guided agricultural improvement modelled on the U.S. Department of Agriculture, which, we should note, had been established only three decades prior (Stross 1986, 11). Nevertheless, Japan's stunning victory in the Sino-Japanese war of 1894-1895 jolted the provinces into implementing their own experiment stations modelled on Japanese and American precedents. Some of these stations survived the Chinese revolution of 1911, but Peter Lavelle observes several marked shifts in agricultural programs during the 1920s. Japanese influence waned and the United States emerged as the dominant influence on Chinese agronomy. Universities, rather than provincial governments, were now the epicentre of agricultural improvement, and they narrowed their focus to a select few industrial and food crops, like wheat and cotton (Lavelle 2015, 340-341).

By the 1930s, however, circumstances had changed. China had developed its own network of agricultural improvement organs thanks in part to direct exchanges with the United States, as institutions (most famously the Rockefeller Foundation) and missionaries (most famously John Lossing Buck) made inroads at Chinese institutions (especially in Nanjing). Meanwhile, improvement agriculture in the U.S. was experiencing its own changes. Deborah Fitzgerald chronicles the rise of an 'industrial ideal in American agriculture', in which farming came to resemble factory manufacturing during the 1920s (2003, 22-23). Certain aspects of this transformation were impractical for China, such as mechanization, which was too costly to implement and uneconomical on small farms. However, the Guomindang's agrarian organs did implement other aspects of farm industrialization. These include the establishment of agricultural colleges, which led to the emergence of an agricultural professional class, and concomitantly what Fitzgerald describes (in the American context) as a 'reliance on managerial (rather than artisanal) expertise, and a continual evocation of "efficiency" as a production mandate' (2003, 23), at least at the state-run agricultural stations.

By the 1930s there was renewed interest in implementing a programme of experimental agriculture in Kham in line with those of more developed provinces. Multiple authors presaged the eventual founding of the Xikang Province Bureau of Agricultural Improvement; for example, Chen Chongwei's *The Xikang Problem* (Xikang wenti) envisioned agricultural experimentation stations and an Agricultural Research Council under a Ministry for the Management of Agricultural and Forestry Affairs (1930, 192), while Zhang Yunping's 'Tunken Recommendations' similarly proposed that the Xikang administration establish agricultural experiment bureaus in each county

(1931, 43). In the following decade Huang Fensheng invoked the goal of developing scientific and industrial agriculture on the frontier, pontificating that 'primitive modes of agriculture no longer meet our national defence needs in the borderlands' (1946, 185). Huang's statement in particular reflects the synthesis of industrialist and agrarian ideals in the larger discourse on the Chinese nation. When Xikang Province officially launched its Bureau of Agricultural Improvement in 1939, these aspirations provided it with a clear mandate: to grow where no Han had grown before.

The Xikang Provincial Bureau of Agricultural Improvement

The Xikang Provincial B.A.I. was chartered in April of 1938 but was officially launched on January first, 1939, the inaugural day of the province. Under the direct authority of the Xikang Province Establishment Office, the B.A.I. oversaw public forestry, husbandry, and agriculture in the province's three administrative zones of Kham, Ning, and Ya. Its programmes in the relatively low-altitude Ning and Ya zones were ecologically diverse and included paddy (rice) farming and silk production, but its Kham farms were designated as sites for research on 'high-cold' (*gao han*) crops and livestock. The bureau's two chief sites were located in Simaqiao, near Kangding, and Taining, to the northeast of Kangding bordering Daofu County.

An immediate benefit of Xikang's establishment as a province is that the provincial B.A.I., being under the tutelage of the national Department of Agriculture and Forestry (*Nonglin bu*), could tap into a national network of educated professionals, including agrarian specialists educated at China's premier schools of agriculture. The typical professional (*zhiyuan*) migrant to Xikang was a male between the ages of 20 and 40 with some higher education, but staff came from diverse geographical and professional backgrounds. Duan Tianjue typifies these professionals; a native of Anhui Province, he graduated from National Southeast University in 1925 and made a career of education and scientific cotton farming in his home province, then travelled to the United States on the provincial dime for an agricultural survey tour. Shortly thereafter he moved to Xikang to become a member of the Provincial Establishment Council (*Jian sheng hui*). Duan became vice-chairman of the B.A.I. and then chairman in 1945, frequently intermediating between its various sites and Governor Liu. Many other professionals moved to Xikang from sites along the war-torn and heavily-populated east coast, including Hubei, Anhui, Jiangsu, Zhejiang, and Shanghai (S.A., Min 249-156).

The B.A.I. was also linked to a national network of plant matter. Experimental sites like that at Simaqiao sent letters soliciting seed packets to research sites and schools of agriculture around the country, as well as other B.A.I. sites within Xikang, and catalogued their holdings on hundreds of index cards. The largest donor by far was the National Central University, conveniently based in Chongqing during the war. The Xikang B.A.I. received seed stock for nationally-designated 'good varieties' (*youliang pinzhong*) of major crops and tested them at experimental stations in Kham to see whether they could thrive in a 'high-cold' environment. In turn, Liu Wenhui authorized the extension of certain premium varieties in the Kham administrative zone as designated by the B.A.I., some of which came from other regions but some of which were apparently indigenous. If late Qing officials were dismissive of Khampa farmers because 'they did not cultivate "proper" crops', as Scott Relyea highlights (this volume), these culinary prejudices were institutionalized in Republican China through the designation of good varieties.

However diminutive they were in relation to Kham's vast land area, the sites run by the B.A.I. were models of agrarian nationalism that melded economic and social functions in keeping with the modern *tunken* vision. They were farms and laboratories, but they were also model communities that engaged neighbouring communities. I would argue that through the B.A.I., the modern Chinese state employed what James Scott calls 'miniaturization' as a response to adverse conditions in Kham, which he defines as 'the creation of a more easily controlled micro-order' in such things as model villages and model farms (1998, 4). Much as American agronomists in Republican China 'generally dwelt in protective bubbles' (Stross 1986, 13), the Han personnel at Xikang's Kham dependency stations were relatively isolated within their agricultural micro-orders. It was the manageability of these sites, rather than their size, that allowed Han agronomists to envision large-scale transformations in Kham.

Whereas Zhao Erfeng had focused his agrarian efforts on the Bathang valley, the administration of Liu Wenhui turned its attention south. In principle, each Xikang county was to have its own agricultural station, or *nongchang*, subordinated to the county government. But only two farm sites within the Kham administrative region were directly administered by the province: Simaqiao and Taining (see Map 6.1). These were the B.A.I.'s primary interface with the growing conditions of Kham, and experimental results at these sites were distilled into directives to extend (*tuiguang*) premium varieties and growing methods throughout the counties of Kham. Below I employ a rich body of bureau archives to reconstruct a virtual tour through each of these sites.

Map 6.1 Map of Xikang territory showing the locations of the Simaqqiao and Taining experimental stations

Sources: Based on Chen & Chen (2003, 22); SRTM (NASA) and modern administrative borders extracted from GADM database (www.gadm.org, v.2.5 July 2015)

Authors: Rémi Chaix and Mark Frank

Simaqqiao

Situated in a mountain valley at 2650 metres above sea level and fifteen *li* (7.5 km) south of the provincial capital of Kangding, the experimental site

at Simaqiao was founded in 1940 by the provincial B.A.I. and charged with overseeing research on 'high-cold' crop varieties. Kangding (Dartsedo) in southern Kham was set at the confluence of two rivers and host to a large Han population, so it seemed like a natural site for the province's first crop experimentation station. The site initially planted some 84 *mu* of farmland, expanding this on a yearly basis.

Interestingly, the B.A.I. leased most of this land from local landlords, including the French Catholic mission in Kangding and at least two prominent Tibetan *guozhuang* trading houses: the Wesekeyap (Ch. *Wasidiao*) trading house and the Zhabpetsang (*Wangjia*) trading house.¹³ The largest tract of land belonged to the See, which provided 40 *mu* (6.6 acres) of waste (S.A., Min 249-1-140). The mission had in turn purchased this land from the Chakla King (*Mingzheng tusi*), at a price of 3000 taels of silver, and hired labourers to open it for cultivation at a wage of eight yuan per *mu*, then rented it to tenants (Ren Naiqiang 2009 [1931], 3-4). The mission had also cultivated plots in Luding and Ba'an, and Kham scholar Ren Naiqiang felt that the French had succeeded where Zhao had failed. 'Such a vast stretch of fertile earth Han people have not been able to cultivate in over two hundred years of management, he remarked, but the French Catholic church has cultivated it in our place – how disgraceful ought this to be?' (Ren Naiqiang 2009 [1931], 4).

The B.A.I. began planting land in Kangding under informal lease agreements, but the concerned county magistrate implored the bureau to sign formal contracts 'to avoid conflict'. At 10 a.m. on 29 July 1940 the acting head of the B.A.I. met with representatives of its three Simaqiao landlords at the office of the magistrate to negotiate lease terms and sign contracts. These each stipulated a 20-year lease term at a price the equivalent of sixteen *jin* of highland barley per *mu* per year after the harvest at current prices, but they made an exception according to a local custom: newly opened wasteland (uncultivated earth) was rent-free for the first three years in compensation for the labour of clearing and tilling it (S.A., Min 249-1-81). The B.A.I. additionally negotiated a contract for use of the county's state farm, with the condition that land from the Catholic church and other landlords be used first. Absorption of the state farm would disrupt its current work, and farm labourers were to be compensated for labour and materials over the past season; the B.A.I. was also to offer current farmers position as farm labourers (*nong gong*), or assist in their relocation (S.A., Min 249-1-81, p. 98). Ten farmers received compensation for human labour, cattle labour, fertilizer

13 Many thanks to Yudru Tsomu for personally helping me to identify these trading houses by their Chinese names. More can be found on both trading houses in Tsomu (2016).

and seeds, totalling 2453.60 yuan, and they appear to have been retained as labourers (S.A., Min 249-1-81, p. 96). Under the administration of the B.A.I., the repurposed Simaqiao state farm had the ambitious goal of transforming agriculture in Kham by working on modest parcels of (mostly) rented land.

As with other sites run by the B.A.I., there was a division of labour between administrative staff (*zhiyuan*) and labourers (*gongyi*). Labourers were more likely to be local in origin, slept in cramped dorms, and were responsible for the back-breaking work of clearing waste, tilling fields, planting and harvesting, and so on. From approximately February through September of each year workers tended to their crops, while October through February were devoted to various other activities: threshing the harvest, clearing the fields, experimenting with winter planting, composting fertilizer, but also the critical (if tedious) task of *kaiken*, or opening up waste to cultivation. Quotas were set for how much waste a single labourer was to reclaim per day: if they shouldered their own yoke, 500 square *shichi* (167 square metres); with a single-ox plough, 2.5 *mu* (1536 square metres); with a double-ox plough, at least 3 *mu* (1843 square metres) (S.A., Min 249-1-11).

Improvement work at Simaqiao focused on staple crops. Highland barley (*qingke*) was the predominant crop in the environs of Kangding and a staple of Tibetan diets, but it was not particularly palatable to Han migrants and the Simaqiao station sought viable alternatives. It also sought options for increasing the number of growing seasons in the region from one to two by experimenting with different crops and methods. In some ways its mission was anticipated by the Catholic church, which had been introducing new bio-matter for years. Among the bureau's earliest experiments in Simaqiao was a planting period experiment on a variety of rye that was introduced to local communities by the French priest, to determine its viability as a winter crop. Other crops grown at Simaqiao initially included wheat, potatoes, barley, highland barley, oats, broad beans, French beans, peas, corn, and buckwheat. In 1940, potatoes provided the largest yield by far at 4072 *jin*, followed by highland barley at 1078 *jin*.

Shortly after its establishment, the Simaqiao Agricultural Experimental Site performed a survey of farming practices in the surrounding area and found that wheat, though morphologically similar to highland barley, was entirely absent from nearby farms. The surveyors learned that local farmers had little interest in wheat since it competed with barley for time and farm space, but did not perform as well. Because wheat was far more palatable than highland barley to Han migrants, introducing wheat to the region was an early priority. The challenge was finding a suitably cold-resistant variety: the maiden crop of wheat planted in the spring of 1940 put forth

ears but yielded a disappointingly low amount of grain, which researchers attributed to the region's short growing season (planting occurred later than in lowland regions) (S.A., Min 249-1-33).

Potatoes were already moderately popular in the region by 1939, and the site worked to further encourage their cultivation. This aligned with national policy, since experts promoted potatoes throughout China as a solution to the Chinese famine of 1942-1943. In a memo to B.A.I. chief Duan Tianjue, the Simaqiao site chief Liang Daxin noted that 'potatoes are a disaster relief crop and a wonderful vegetable, and the environment (*fengtu*) of Kangding is very amenable to the production of this crop. Our site has observed this and thus decided to implement large-scale planting, and to encourage planting among farmers in the vicinity' (S.A., Min 249-1-78, S.A., p. 10). Though promotion work was a large part of the Bureau's mission, usually through lectures and demonstrations, Simaqiao was exceptionally aggressive in promoting potatoes. Not only did it distribute 6050 *jin* of seed to fourteen nearby households, but it leased out 26 *mu* of land to four households with the stipulation that they pay yearly rent in potatoes. When loaning potato seed, the site forecasted 600 per cent returns and levied 50 per cent interest, such that a farmer receiving 1000 *jin* of seed should expect a yield of 6000 *jin* and return 1500 *jin* to the bureau. At the same time, the site planted 70 *mu* of its own land with potatoes and anticipated a harvest of 84,000 *jin* in the fall of 1943 (S.A., Min 249-1-78, S.A.).

Meanwhile, the B.A.I. persisted with its wheat experiments. After his disastrous attempt to grow wheat in Bamei at 3500 metres above sea level, Zhang Jinquan moved south to Kangding and repeated his attempt at lower altitude. There was no guarantee that this would succeed, and indeed, technicians at Simaqiao had thus far failed to grow edible wheat in their plots outside the southern gate. Over a span of three growing seasons from 1944-1946 Zhang experimented with altering two major variables in wheat production: the planting period and the varieties planted. In the first year Zhang solicited 25 wheat varieties from the Central Bureau for Agricultural Research (*Zhongyang nongye shiyan suo*), and by the second year he had narrowed the list to nine viable varieties, which he then tested the indigenous staple of highland barley. In the third year Zhang re-tested these, adding Simaqiao's original wheat variety (Zhang Jinquan 1947).

By 1946 he arrived at a breakthrough: Not only did wheat variety *Zhongda* III 23-2419 (known today simply as 'Nanjing Wheat') put forth full ears, it also out-produced the control variety of highland barley. Two other wheats, #100 and #690 matched this top yield within the margin of error. Moreover, Zhang simultaneously tested the same ten varieties in Bamei (3500 metres) and East

Eluo (3100 metres) in 1946 and found that the same varieties out-performed local highland barley there as well. Another variety, #487, displayed the shortest growing period, making it a candidate for higher elevations. Planting period trials further demonstrated that the best results were achieved by planting as soon as the earth thawed in the spring, given the early onset of frost at harvest time. In his report, Zhang concluded that ‘these four varieties can be extended throughout Kham, and that generally wherever highland barley can grow, these wheats can grow’ (Zhang Jinquan 1947, 32). Finally, the ambition of the B.A.I. to replace indigenous barley with wheat seemed empirically feasible.

Though Simaqiao would continue to operate until the Communist takeover and beyond, its prominence as a research site seems to have peaked with the culmination of this experiment. In 1946 it reported an ‘enormous funding shortage’, and its scope encompassed little more than wheat and grazing grass improvement (S.A., Min 249-147, S.A.). In its role as an experiment station, Simaqiao was eclipsed by the more ambitious target of Bamei, situated in the Taining Experimental Zone.

Taining

About a half-day’s ride to the northwest between Kangding and Daoфу counties was a stretch of hills and grasslands known as Taining, site of Xikang Province’s oldest experimental farms (see Figure 6.1).¹⁴ Taining was already a Qing military post by the early eighteenth century, but the rapid expansion of Chinese mining operations and seizure of Khampa farms in 1904 led to discontent among indigenous locals and, ultimately, an anti-settler uprising the following year (Relyea 2015, 190-192). This only resulted in consolidation of Qing power over the area, and it became an early target for state intervention in livestock and agriculture. In 1913 an agricultural society proposed Taining as the initial site for a large-scale colonization project in Kham (Relyea 2015, 199). Zhang Yunping’s 1931 *Tunken Recommendations* accurately predicted both Taining and the environs of Kangding as initial sites for a renewed attempt at migrant land reclamation. Presciently, Zhang (1931, 42) understood that the Chinese state must venture into yak husbandry if it wished to control Kham, and that Taining was well suited for such a venture.

14 Taining was the oldest extant experimental zone in Xikang Province after 1939; Qing experimental farms predate it but were closed by the time that Xikang Province was founded.

Figure 6.1 B.A.I. staff member (name unknown) standing in front of an entrance to the headquarters of the Xikang Provincial Taining Pastures in 1939

Source: Sun and Zhang (2003, 150)

The experimental station at Taining preceded the establishment of the provincial B.A.I., and indeed, the establishment of Xikang Province itself. It was founded in 1937 by the Provincial Preparatory Committee as the Taining Cultivation and Pastoralism Experimental Site (*Taining kenmu shiyan chang*), then placed under the B.A.I. in 1942 and renamed the Xikang Provincial Taining Pastures (*Xikang sheng Taining muchang*). By 1946 it managed a large swathe of land, including 23,000 *shimu* of pasture and 4200 *shimu* of farmland (S.A., Min 249-147). Though Taining was deceptively close to Simaqiao, its climate was considerably harsher. In 1939 a provincial weather observer stumbled into the meteorological bureau in Kangding after a disastrous attempt to reach Taining on horseback; his partner's horse had collapsed, and the pair had fallen ill after being 'caught in the wind and rain'. Days later, another meteorologist travelled from Kangding to Taining for survey work and developed a hacking cough that would plague him until his evacuation from Kham the following year (S.A., Min 249-1-170).

In contrast to Simaqiao, Taining seems like a counterintuitive site for heavy state investment. The *Xikang Tongzhi* raves about the region's

potential, calling it 'conducive to pastoralism and conducive to agriculture' (X.T.G., S.A., 111). But other, more detailed sources paint a less sunny picture: as of 1943, 70 per cent of Taining's area was deemed to be 'incapable of production' and 40 per cent suffered from a 'severely cold climate unsuitable for forestry or pastoralism' (S.A., Min 234-01-0253). The county experienced as little as 45 days of frost-free growing time annually. In 1943 frosts are recorded as continuing until June fifth; on July twentieth temperatures reached 23 degrees Celsius during the day but once again dropped to zero degrees overnight. Workers awoke to find that frost had obliterated the entire potato crop, half of the peas, a large portion of the wheat and some of the highland barley. In a petition to the central Ministry of Agriculture and Forestry, administrators predicted that 'if frost continues to descend, there will be nothing to harvest in the entire Taining belt this year'. Yet provincial funding for the Taining site nearly kept pace with Simaqiao, ballooning from about 64,000 yuan in 1939 to about 660,000 in 1946 (S.A., Min 249-147). Why?

The establishment of the Taining site was predicated on an understanding that the economy of Kham was dominated by mobile pastoralism, and that the state would need to engage this livelihood if it hoped to remain viable (Frank 2018, 32-33). The focus here was on high-altitude livestock of the sort conventionally held by indigenous Khampas – chiefly yaks (and hybrid *dzo*), sheep, and to a lesser extent, horses. Initially the Taining ranch supplied livestock for a state-run Animal Transport Company (*Mu yun gongsi*) that was founded in 1938, although that was a short-lived enterprise (Lawson 2013, 306). The B.A.I.'s long-term priorities were to improve wool quality and quantity of sheep wool, and to increase the stature and dairy production of yaks (X.T.G. 319-320). In a 1945 work report, the Taining site's activities were enumerated as follows: 1) choosing livestock varieties; 2) improving livestock technology; 3) improving and transporting livestock products; 4) grazing grass and fodder crops experiments; 5) promoting optimal livestock breeds; 6) managing livestock hygiene and preventing veterinary disease; 7) survey and statistics on livestock; 8) other matters pertaining to livestock improvement (S.A., Min 249-113).

Taining was a more ethnically mixed community than Simaqiao, although roles were allotted unevenly. Formally educated Han migrants occupied all administrative positions while Khampas as well as local Han were most likely to be herders or labourers. By 1946, the site employed sixteen staff, eight manual labourers, and an additional four farm and livestock hands (S.A., Min 249-1147). Considerably larger than Simaqiao, the Taining Pastures were actually three branch sites in a triangular arrangement linked by the

seasonal migration of livestock. Facilities at each site allowed for the migration of workers, somewhat resembling a bureaucratic version of indigenous *drokpa* (pastoralist) clans that also migrated their animals between three to four seasonal pastures. The primary branch was at Bamei, where, as of 1945, the headquarters enclosed three offices, a laboratory, an animal clinic, ten livestock pens, multiple store rooms and granaries, and facilities for the on-site workers (S.A., Min 249-1-13).

Even as livestock specialists mimicked indigenous pastoral practices, they sought to improve on them through agriculture. Globally, modern industrial livestock farming had turned to fodder as the primary avenue for ‘improving’ animals, which generally meant increasing their fat, wool, and dairy content (depending on the animal). Indigenous Khampas grazed their animals freely on the grasslands, a practice that the Chinese livestock scientists referred to as ‘natural grazing’ (*tianran fangmu*). An early and impactful experiment at Taining under Zhang Zhiyuan set out to determine the effects of fodder feeding versus natural grazing on yak-cattle hybrids (Tib. *dzo*; Ch. *pianniu*), effectively pitting indigenous practices against Chinese modernity. The results seemed to prove unequivocally that grain-fed *dzo* developed significantly higher fat and dairy content than naturally-grazed animals, but with the caveat that it was uneconomical to import grain from Xichang, which had provided the fodder used in the experiment (Zhang Zhiyuan 1939).¹⁵

From that point on, Taining fixed its sights on growing food for yaks and sheep, including fodder crops but also superior grazing grasses that scientists hoped would replace indigenous ones. Fodder crops included (in order of prevalence) highland barley, wheat, oats, hay, and peas, supplying livestock with a diet heavy in carbohydrates and protein (S.A., Min 249-1-13). As at Simaqiao, crop scientists at Taining conducted experiments to determine the most productive varieties and the optimal planting periods and methods. International grazing grasses also vied against one another in experiments. The American west served as a model for bovine and ovine production, and in 1946 Taining received an infusion of 56 American grasses to be tested against indigenous varieties, and found eleven of these to be viable; as of 1947 the site cultivated twelve grazing grasses from China and sixteen imported from other countries, primarily the United States (S.A., Min 249-1-136).

After establishing the value of fodder, two more major victories over indigenous methods – this time farming methods – seemed evident when

15 For more on this experiment and yak improvement at Taining, see Frank (2018).

scientists attempted to employ deep ploughing and to subvert the local practice of leaving fields to fallow every other year. The only reason a fallow year was necessary, they suspected, was that local farmers did not fertilize properly. Manure production was a major enterprise for the B.A.I., and in fact much of it was made of plants that were grown and composted specifically to produce what is known as 'green fertilizer'. 'After applying fertilizer and planting equally each year', wrote site chief Liang Daxin, 'the result is that crop viability is the same as planting every other year, effectively smashing the superstition among Khampas that crop viability will be poor if they plant every year' (S.A., Min 249-1-13, p. 46). Scientists also experimented with using deeper ploughs than were used by locals, and found that a single *shidou* of wheat seed now yielded six *shidou* of grain instead of the usual three – an astounding 100 per cent increase. Imagining the combined results of deep ploughing and fertilizing rather than fallowing, Liang wrote that 'if we are able to extend (*tuiguang*) these experimental results throughout the Kham region, Kham's grain could increase four-fold' (S.A., Min 249-1-13, p. 46).

By the late 1940s Taining expanded into human food. The site held vastly more land than it needed for experiments, and much of this – tens of thousands of *mu* – was put to use through the 1944 establishment of a Taining Tunken Zone, through which the state solicited cultivators to convert waste into farmland. In 1947 the experimental zone at Taining Pastures officially branched into growing and experimenting with its own food crops, chiefly wheat and highland barley. But it also began working with greenhouse vegetables, among them carrots, cabbages, peas, garlic, onions, and American cucumbers. Liang Daxin explained that 'the lands beyond the pass (*guanwai*) are lacking in vegetables and [Taining] has no vegetables to speak of; nutritional vitamins and nutrients cannot be obtained' (S.A., Min 239-1-136, p. 12).

Taining Pastures was broadly touted as a success in its time. One headline read 'Migration for Planting the Borderlands Sets Great Example, Xikang Experimental Planting Succeeds, Taining Experimental Zone Plants over 300 Mu', and intoned that 'one cannot but beam with happiness' (*Yi min zhi bian*', 15). In 1947 the region surrounding Taining Pastures was established as its own county, Qianning County, and the following year the site was renamed the Qianning Provincial Agricultural and Pastoral Site (*Shengli Qianning nong mu chang*). In 1950 the Communists would rename it the Bamei Agricultural Experimentation Site (*Bamei nongye shiyan chang*), and this would eventually develop into the Agricultural and Pastoral Scientific Research Institute (*Nongmuye kexue yanjiusuo*) in 1963 (Wang Chuan 2005, 69). Bamei is to this day a thriving (and largely Han)

township. While Simaqiao was a fairly conventional growing site, Taining showcased the adaptability of scientific agrarianism to unconventional and environmentally challenging settings.

Beyond the Experiment Stations

Administrators envisioned the B.A.I.'s experiment stations as incubators for a comprehensive programme of *tunken*-style development in Kham. In 1942 the provincial government, in consultation with the central Ministry of Agriculture and Forestry, set a land reclamation target of 45,000 *shimu* in Kham spanning ten counties.¹⁶ Development was to begin on the outskirts of the Simaqiao and Taining stations, which were declared 'model cultivation districts' (*kenzhi shifan qu*), and radiate gradually outward. The experiment stations would perform the dual role of modelling scientific land reclamation for neighbouring areas and providing seed for 'good varieties' to incoming migrants in their respective regions. The Simaqiao site was to oversee extension work, including seed distribution, in southeast Kham, while the Taining site would oversee extension west of the Zheduo mountains (A.S. 20-00-63-017-09).¹⁷

Reclamation efforts were further consolidated in 1944 when the Ministry of Agriculture and Forestry established a 'Taining Tunken Experimental Zone' (*Taining tunken shiyan qu*) that subsumed all wasteland in the five counties of Kangding, Taining, Daofu, Luding, and Ganzi (A.S. 20-26-039-15). The Ministry appointed a management staff of several dozen personnel, including administrators, technicians, a physician, and a full complement of policemen. Some of the administration held concurrent positions in the provincial B.A.I., including Duan Tianjue, who was appointed head of the experimental zone, and Zhang Jinqian, who was appointed to the role of technician (A.S. 20-87-270-04). In 1944 the Experimental Zone recruited eleven migrant households that opened some 1269 *shimu* to new cultivation. Meanwhile, recruiters journeyed to northern Sichuan as well as Xikang's own Hanyuan county in an effort to recruit a further 500 cultivators (*kenmin*) who might eventually colonize 200,000 *mu* of wasteland in the cultivation zone (A.S. 20-26-039-15).

16 The ten counties slated for land reclamation included Danba, Jiulong, Yajiang, Luhuo, Ganzi, Ba'an, Lihua, Taining, Luding, and Kangding (20-00-63-017-09, A.S.).

17 Specifically, the Simaqiao agricultural station was assigned to oversee extension in Kangding, Luding, Danba, and Jiulong counties.

These local schemes meshed neatly with the national *tunken* ideal of ethnic assimilation through agricultural migration. In the scenario that Duan Tianjue and Xikang superintendent of grain production Liu Yiyan jointly proposed to the central government in 1942, tens of thousands of Han migrants would transform the landscape over several years by planting empirically tested 'good varieties' of wheat, potatoes, highland barley, rye, and peas. The 1943 work plan for Taining alone would require 30,000 migrants to clear and till wasteland, and another 7000 to cultivate it. Duan and Liu specified *Han* labourers, claiming that Khampas were indisposed to arduous reclamation work by nature. Provincial estimates set the cost of land reclamation in the Kham dependency at twice that of simultaneous reclamation in the Ning and Ya dependencies per *shimu*, due mainly to the cost of labour (A.S. 20-00-63-017-09).¹⁸

In retrospect the goals of these extension schemes were unrealistic because they were prohibitively expensive. Theoretically, the province was to pay for tools, fertilizer, and migrant resettlement with loans from the Farmer's Bank of China (*Zhongguo nongmin yinhang*) and repay these loans with sales proceeds after the harvest. But runaway inflation during the war made long-term financial planning all but impossible. In fact, the Ministry of Agriculture and Forestry was unable to adequately fund even the management office of the Taining Tunken Experimental Zone, which complained in 1944 that its stipends covered less than half of personnel expenses after inflation, such that staff were 'all beset by hardship' (A.S. 20-26-039-15). By the time of the Communist takeover in 1949, labourers had reclaimed at least several thousand *shimu* within Kham's two model districts, but it is unclear how far the project progressed beyond these areas.¹⁹

Conclusion: The B.A.I. in Critical Perspective

Unlike Zhao Erfeng's agrarian exploits during the late Qing, those of the Xikang Provincial Bureau of Agricultural Improvement have been regarded kindly by Chinese historians. The historiography of the P.R.C., while devoting

18 Budgeted land reclamation expenses included seed stock, fertilizer, and farm implements, but worker wages comprised a majority of the budget for the 1943 work plan (20-0-63-017-09, A.S.).

19 There is undoubtedly more information on the outcome of Kham land reclamation efforts in the P.R.C.-era archives of Xikang and Sichuan provinces at the Sichuan Provincial Archives, but I was not granted access to P.R.C.-era documents during my research. See Tan (this volume) for contemporary parallels.

little attention to Xikang Province, appraises the B.A.I. as having made impressive contributions to both Kham's regional economy and the national war effort in spite of adverse conditions. Wang Chuan writes that the work of the B.A.I. 'may be considered the beginning of agricultural and husbandry modernization for the areas inhabited by Sichuan's Tibetan, Yi and other ethnic groups' (2009, 234), while Liu Jun notes that Xikang became a major domestic supplier of wool products to the war-torn interior, such that 'the people of the borderlands made their own appropriate contribution to the War of Resistance' (1988, 326). It is not difficult to imagine that the provincial government might have come closer to realizing its ambitious land reclamation goals had it not been impeded by the bleak wartime economy.

But in evaluating the success of Xikang's 'improvement' efforts, we ought to ask: for *whom* was agriculture improved? The history of U.S. agricultural interventions in the developing world during the mid-twentieth century, commonly known as the Green Revolution, offers an instructive analogy. The Green Revolution has been widely praised for roughly doubling agricultural production in much of the developing world, but it has also come under criticism. Some scholars argue that the United States initiated environmentally unsustainable patterns of growth by disregarding local ecologies and indigenous practice. Others observe that national security, not altruism, was the driving factor behind these interventions, and that they fostered economic dependence upon the United States.²⁰ The logic of 'improvement' foreshadows the developmentalist approach that informed subsequent policies in Kham and greatly impacted local economies, as Giersch aptly shows in his chapter.

Similar criticisms are applicable to the study of Chinese agricultural interventions in Kham. We should not ignore that where the B.A.I. achieved results that it considered successful, it did so according to criteria that it imputed on indigenous agriculture. This is most evident in two scientific endeavours of the B.A.I. that I chronicled in this essay: the effort to identify wheat varieties that could replace highland barley, and the effort to develop a sedentary mode of yak production that out-performed nomadic yak production. In both cases, technicians ultimately seemed to arrive at 'improved' methods that produced higher yields than indigenous methods. In pursuing those results, however, they were driven by ethnocentric concerns that were extraneous to production targets: namely, a cultural preference for wheat over barley, and a cultural preference for sedentism over nomadism. The latter preference is particularly problematic, since Chinese and international

20 For a critique of the environmental impact of the Green Revolution, see Shiva (1989); for a critique of Green Revolution politics, see Perkins (1997).

scientists now increasingly recognize that nomadic pastoralism has salubrious effects on the grasslands ecology of the Kham region, which faces serious degradation from other human causes.²¹ Nor is mobile pastoralism a more primitive mode of production than sedentary agriculture. *Drokpa* pastoralism relies on an elaborate system of indigenous knowledge that has been cultivated over many generations, even if this knowledge goes largely unappreciated by the Chinese state (Tan, this volume; Frank 2018, 23-28).

The politics of 'improvement' are especially legible in the context of national discourses on borderlands agriculture. This essay situated local improvement projects within the broader milieu of agrarian nationalism, which looked to agriculture as a source of national strength. The mission of the B.A.I. aligned especially well with national discourses on *tunken*, a practice that aimed to consolidate (Han) Chinese control in the borderlands through population redistribution. However, the careful reader may have observed a quirk in the timeline: state actors articulated clear visions of *tunken* development in Kham well before Chiang Kai-shek endorsed that strategy at the highest level. Further inquiry may illuminate the extent to which state-building in Kham informed national policy during the Republican era, and the extent to which *tunken*-style projects in various borderlands regions informed one another.

Glossary of Chinese Terms

Bamei	八美
Bamei nongye shiyan chang	八美農業試驗場
Dajinhuang	大金黃
Danba	丹巴
Dengke	鄧科
Derong	德榮
Duan Tianjue	段天爵
Duan Tianzhen	段天楨
<i>Duiyu yi bing Xikang zhi tunken jianyi fengtu</i>	對於移兵西康之屯墾建議風土
Fengquan	鳳全
Feng Yunxian	馮雲仙
<i>gaijin</i>	改近
<i>gailiang</i>	改良

21 For example, see Feng Hao (2017), Lei Dongjun (2013).

gongyi
 Ganzi
gao han
gexin zhidu pai
gong guo
gongren shouce
gongzuo fuze
gongzuo qinlao
 Guangxu
guanwai
guo tu
jiankang
 Jian sheng hui
Jun shi zazhi
 Kangding
 Kang Youwei
kaiken
kenzhi shifan qu
 Liang Daxin
 Litang
 Liu Wenhui
 Min jiang
 Mingzheng tusi
minzu
 Mu yun gongsi
neidi
 Ning
 Niujaoshi
nongchang
nong gong
nong guo
 Nonglin bu
 Nongmuye kexue yanjiusuo
 Nongyi kenzhi ke
pianniu
quannong
 Ren Naiqiang
 Shaoniaosi
 Shengli Qianning nong mu chang
shichi

工役
 甘孜
 高寒
 革新制度派
 工國
 工人手冊
 工作负责
 工作勤劳
 光绪
 關外
 國土
 健康
 建省會
 軍事雜誌
 康定
 康有為
 開墾
 墾殖示範區
 梁達新
 理塘
 劉文輝
 岷江
 明正土司
 民族
 牧運公司
 內地
 寧
 牛角石
 農場
 農工
 農國
 農林部
 農牧業科學研究所
 農藝墾殖科
 犏牛
 勸農
 任乃强
 少鳥寺
 省立乾寧農牧場
 市尺

<i>shidou</i>	市斗
<i>shimu</i>	市亩
Simaqiao	駟馬橋
Taining	泰寧
Taining kenmu shiyan chang	泰寧墾牧試驗場
Taining mu chang	泰寧牧場
<i>taowang hu</i>	逃亡戶
<i>tianran fangmu</i>	天然放牧
<i>tudi</i>	土地
<i>tunken</i>	屯墾
<i>tuiguang</i>	推廣
<i>tuntian</i>	屯田
<i>tunwu ting</i>	屯務廳
Wangjia	汪家
Wasidiao	瓦斯碛
<i>wo guo yi nong li guo</i>	我國以農立國
<i>wu wei</i>	無為
Xiaojinhuang	小金黃
Xikang	西康
Xikang sheng Ning shu tunken weiyuan hui	西康省寧屬屯墾委員會
Xikang tunken shi	西康屯墾使
<i>xi xiao</i>	嬉笑
<i>Xin nongbenzhuyi pipan</i>	新農本主義批判
Ya	雅
Yang Kaidao	楊開道
<i>yi nong li guo pai</i>	以農立國派
<i>youliang pinzhong</i>	優良品種
Zhang Shizhao	章士釗
Zhang Jinquan	張錦泉
Zhang Yunping	張允平
Zhang Zhiyuan	張志遠
Zhao Erfeng	趙爾豐
<i>zhiyuan</i>	職員
Zhongda	中大
Zhongguo ren	中国人
Zhou Xianwen	周憲文
Zhongyang nongye shiyan suo	中央農業實驗所
<i>zhong yuan</i>	中原
Zagunao	杂谷脑
zhongzu	種族

Glossary of Tibetan Terms

Bathang	'Ba' thang
Dabpa	'Dab pa
Dartsedo	Dar rtse mdo
Tawu	Rta 'u
Dérong	Sde rong
Drango	Brag 'go
<i>dra</i>	<i>sbra</i>
<i>drokpa</i>	<i>'brog pa</i>
<i>dzo</i>	<i>mdzo</i>
Kandzé	Dkar mdzes
Gyezil	Brgyad zil
Kham	Khams
Khampa	Khams pa
Lithang	Li thang
Nyakchu	Nyag chu
Nyarong	Nyag rong
Rongdrak	Rong brag
Wesekyap	Dbal gsas skyabs
Zhabpetsang	Zhabs pad tshang

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