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Land improvement under conditions of permafrost: *melioratsiia* and intended forms of environmental change in Soviet Yakutia

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Abstract

Against the background of current debates on environmental change and permafrost degradation in the (Sub-) Arctic, this article looks into the agricultural history of the Republic of Sakha (Yakutia), one of the federal subjects in the Far East of Russia. In particular, the authors examine the development of land improvement (or land amelioration, *melioratsiia*) in the republic's central part during the Soviet period. The region is often described as unique, owing to its cattle and horse pastoralism along with crop cultivation under conditions of an extremely cold and generally dry climate. Relying mainly on documents retrieved from regional archives, the paper starts with an explication of the categories used by *melioratsiia* experts themselves, which permits an understanding of the management, success stories, and failures of land-improvement techniques. Notwithstanding scientific recommendations on land engineering in permafrost regions, documents from the 1980s reported increasing problems with maintenance of irrigation systems along with permafrost degradation and soil subsidence. The conclusion of the article offers a potential explanation for the neglect of research on agricultural land improvement in social sciences' and environmental sciences' research on northern, subarctic regions of Russia.

Keywords : drainage; irrigation; deforestation; permafrost; Sakha; Yakutia

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1. Introduction

The idea of *land improvement* (English language also has the term *land amelioration*) is closely connected with the practice of agriculture.⁽¹⁾ It denotes techniques to increase the productivity of land, to make limited areas of the natural environment more amenable and accessible for agricultural work. In Russian, the term *melioratsiia* has come into use as generic term for different kinds of land improvement. In this article we pursue a close reading of archival documents stored in Yakutsk to sketch out how different forms of technically engaging with the land have accompanied and intendedly triggered modifications of land use and landscapes in this part of Siberia.

Studying changes in land use and landscapes is of particular importance in this region, since it is often described as highly vulnerable in view of permafrost degradation under conditions of global warming (e.g., Crate et al. 2017). The Republic of Sakha (Yakutia) draws much of its reputation from a harsh continental climate with dry summers and extremely cold winters; simultaneously, it is renowned for horse and cattle husbandry, which are often associated with so-called traditional forms of land use and supposedly authentic Sakha culture (e.g., Maj 2009). In this light, the idea of landscape engineering (along with bulldozers, water pipelines, dams and pertinent infrastructure) may at first glance seem unexpected or even awkward. Towards the end of the article we venture into an explanation of this discursive dissonance.

What makes the Republic of Sakha (Yakutia) a highly relevant and, in global comparison, a rather specific case is the fact that land improvement (drainage, irrigation, clearing of forest) has been carried out to a significant extent in areas of continuous permafrost. Other regions feature similar but not identical processes. Problems of agriculture in permafrost areas have also been described for Central Alaska (Péwé 1954), though the scale of agricultural operations is much less than in Central Yakutia and differs in the way agricultural development is conditioned by state policies. Cases of large-scale opening up of erstwhile pasture lands or "wilderness" have been reported from Northeastern China (Sung-chiao 1981), but this literature makes no mentioning of permafrost-related aspects, be they in areas of continuous (in the Greater Khingan mountain range) or discontinuous permafrost (other parts of Heilongjiang). In this context, the case of agricultural development in northern Mongolia is also of interest and will be examined by the authors of this article in the near future.

Our line of argumentation proceeds as follows. Like other professions, land improvement has its own terms and its own rationale, which will be briefly introduced in Section 2. The article's main part, Section 3, delves into the institutional history of land improvement, explaining shifts in the utilisation of different techniques, changes in the scale of operation, and achievements along with failures. Towards the end of the main part we portray the most pervasive problems of *melioratsiia* during the late Soviet period, one of them being permafrost degradation induced by drainage, irrigation, or deforestation (the latter probably being the strongest in impact). Section 4 concludes with brief remarks on Post-Soviet trends and a potential

explanation for the neglect of research on agricultural land improvement in social sciences' and environmental sciences' research on northern, subarctic regions of Russia.

2. Land improvement: tasks and techniques

Generally speaking, the different activities can be summarised under (i) water regulation, or more exactly, the regulation of soil moisture; (ii) the removal (clearing) of unwanted trees and bushes – or the planting of trees and bushes as protection against winds; and (iii) levelling and/or primary tillage, to help prepare the soil for subsequent activities (such as secondary tillage and seeding). In what follows, we will briefly portray the main tasks in accordance with the classification used in Soviet Russia, notably in archival materials⁽²⁾ from Yakutia⁽³⁾ and thus obtain an initial understanding of the logic of amelioration, as seen by the experts themselves. It should be noted that all agricultural work in this region has to take into account permanently frozen ground (permafrost) in the subsoil, solidly frozen land and water surface for six or more months per year, and a correspondingly short vegetation period. The particularities of permafrost conditions will be discussed later in this paper.

Drainage (*osushenie*) serves the purpose of reducing soil moisture. As a rule, drainage is applied in level-surface areas with a higher content of water in the ground, such as plains geologically constituted by sediments, swamps and marshes, wetlands along rivers, and all other areas of land that feature high water in-take and comparatively little run-off into the deeper horizons. The easiest and most common practice of drainage is the digging of trenches, ditches, and canals, with the aim to permit the water to run off so to keep the upper layer of the ground comparatively dry. Drainage is arguably the primary task of land improvement, for other tasks cannot be pursued if the soil is not sufficiently dry. Even though it may seem counter-intuitive, drained land can be subsequently irrigated (*osushenie s posleduiushchim orosheniem*) according to the general principle of controlled soil moisture.

Irrigation (*oroshenie*) comprises different forms of watering, with the simple aim to foster the growth of plants. In the context of Yakutia, comparatively inexpensive measures of this type are small dam-like constructions to slow down the run-off of melting water in connection with the spring thaw, to raise the water level of natural water bodies, and generally to control the release of water. A frequently used term in the archival documents is *limannoe oroshenie*, which means flood irrigation, or controlled flooding of a plot for some period of time usually with the onset of the warm season. More expensive, but also more sophisticated, is the use of sprinklers, which in view of the rain-like character of irrigation is called *dozhdevanie* in Russian. As a precondition, a network of water pipes or canals and pumps need to be constructed to supply water at points nearby the field or plot to be irrigated. Apart from electricity, the maintenance of pipes and pumps requires substantial resources. The official reports and accounts of the Soviet period sometimes differentiate between *oroshenie* and *limnannoe oroshenie*, at other times they do

not.

Obvodnenie denotes a practice of controlled flooding, usually on the basis of spring meltwater, and is thus similar to the above-mentioned *limannoe oroshenie*. The archival documents from Yakutsk archives do not provide sufficient clues to cut a clear distinction. It appears that both terms were used synonymously in several Soviet decades. Both practices refer to the flooding of grasslands rather than arable lands. We may assume, however, that in comparison to *limannoe oroshenie*, *obvodnenie* is carried out with less intensive use of technology and human resources.

One of the characteristics of agriculture in the central part of Yakutia is the predominant role of lands for grazing (pasture, in Russian: *pastbishche*) and hay-making (meadow, in Russian: *lug, senokos*). For the purpose of this article, it is important to differentiate between (i) forest, (ii) grassland – i.e. pastures and meadows – and (iii) arable land – i.e. fields and plots. Central Yakutia is dominated by forest, with comparatively small sections of grasslands and arable land. Grasslands, however, exceed arable land in terms of size by far. Grass while is an important resource in the snow-free period, hay is needed as fodder for cattle and horses throughout the winter. Hence why amelioration in this region often entails the so-called fundamental improvement of meadows (*korennoe uluchshenie lugov*). This involves more than just control of soil moisture: grasslands often feature a rough surface with tussocks and hillocks (developing as a result of periglacial geomorphological processes). In order to alleviate the task of mowing grass and collecting hay, this form of land improvement aims at levelling the surface of the land.

Under the natural conditions of Central Yakutia, many meadows and pastures have developed in basin-like areas interspersed in the forest. These open-land areas, locally known as *alas* (in Russian, from *alaas* in Sakha language), have come into existence because of local processes of permafrost degradation and soil subsidence in earlier periods of comparatively warm climate. Subsequently, this natural landscape feature enabled Sakha (Yakut) people to pursue horse and cattle husbandry under generally harsh environmental conditions; consequently, *alas* areas play an important economic and cultural role in Sakha land use and livelihoods (Crate et al., 2017). While *alas* areas, along with river valleys, naturally comprise grasslands, they may be subject to the gradual natural growth of bushes and trees. On these grounds, it is necessary to clear the area from bushes (*raschistka kustarnikov*) and young trees, which is comparatively easy work.

More demanding is the felling of trees and removal of roots with the purpose of clearing land and opening up land for tillage and crop production, in other words: creating fields. With regard to Central Yakutia, deforestation for arable land (*raskorchevka lesa pod pashniu*) had already occurred in pre-revolution times, but it came to be applied comparatively widely from the 1940s to the 1970s, as the Soviet government generally pursued the policy of farmland extension and campaigned for higher amounts of crop production. More than other practices of land improvement, deforestation with this purpose occurred in areas with a high volume of ice in the ground, which entails a higher risk of permafrost degradation, as will be discussed below. To summarise the difference between arable land and grass lands, we quote the

statement of one author to whom we will return later: "Naturally, in the forest zone irrigated fields are obtained through [literally: at the expense of] deforestation. Traditionally, alas, lowland and wetland areas are mostly used as meadows and pastures" (Gavril'ev 1991: 10).

The latter three tasks – improvement of meadows; the cutting of bushes and smaller trees; and deforestation for arable land – are sometimes summarised as cultivation-technical jobs (*kul'turtekhnicheskie raboty*). The same term also comprises different techniques of tillage (i.e., stirring the soil) by means of a plough (*plug*; the process of plowing is called *pakhota* or *vspashka*), a drag harrow (*boronovanie*) or a disk harrow (*diskovanie*). Finally, the subsequent levelling of the stirred soil with the help of a roller (*prikatyvanie*) is also listed in this category. Obviously, some of the mentioned land-improvement techniques resemble and coincide with more conventional agricultural tasks. All the named techniques are usually carried out when temperatures are above zero, with one notable exception: the planning [levelling] of meadows can be proficiently done in the late autumn/early winter because the frost makes it easier to cut the tussocks and hillocks (*zimniaia srezka kochek*).⁽⁴⁾

The above classification of general tasks of land amelioration, as evident from Yakutian archival sources, provides for an initial understanding of its internal logic. This is the basis for the next step: an assessment of its institutional development in the light of the region's agricultural history.

3. Institutional history of land improvement in Yakutia

To understand the achievements, challenges and difficulties of land improvement in Yakutia in the Soviet period, it is necessary to contextualise its institutional make-up within the larger domain of agriculture in the Soviet Union. It is well known that the structure of land ownership was completely changed through collectivisation and centralisation from the 1920s onwards; however, one should also take into account the extent to which these policies have gradually led to large-scale changes not only in property but also in land use, and hence landscape development.

3.1. Main institutional changes in agriculture in Soviet Yakutia

The process of collectivisation (*kollektivizatsiia*) entailed the formation of small agricultural collective enterprises, known as *kollektivnye khoziaistva*, hence the acronym *kolkhoz*. Formally a "voluntary" process, collectivisation became mandatory in the early 1930s and was executed in all parts of the Soviet Union, though with different speed. In the Far North of Soviet Russia, the process was completed in the 1940s and went hand in hand with the sedentarisation of nomadic hunting and reindeer-herding groups, which in turn took several decades (Habeck 2013). The same applies to large parts of Yakutia, but the region described in this article – Central Yakutia – markedly differs, in that horse and cattle breeders traditionally lived in small hamlets within spatially circumscribed grasslands (such as *alas* and small valleys) and showed

a considerably lesser range of seasonal mobility than their reindeer-herding neighbours. The comparatively sedentary livelihood of Sakha pastoralists over the last two centuries has been documented in other publications (e.g. Crate 2006; Mészáros 2012, 2016; Takakura 2010, 2015; Vinokurova et al. 2015). Nonetheless, collectivisation involved the establishment of central settlements, with Sakha families being induced to move from their small hamlets into the new villages (*poselkovanie*, or literally translated, the settlement-ing).

Moreover, such process of gradual centralisation continued over the next decades, with smaller collective farms being merged into larger ones, and large collective farms being merged into state farms (*sovkhoz*) from 1961 onwards. This policy of enlargement (*ukrupnenie*) of agricultural enterprises meant larger production units (suitable for the use of heavy machinery), larger settlements with pertinent infrastructure and social services, more intensive animal husbandry and simultaneously the expansion of farm land (see below). At the same time, it also entailed centralisation of control over the production process, withdrawal from small and peripheral pastures and meadows, and generally a transition from kin-based farming to wage labour on pre-defined shifts and with work plans designed "from above".

Centralisation and mechanisation of agriculture brought about considerable changes in land use. Particularly in the 1940s to 1960s, the government pursued the expansion of arable land (fields for grain production). Collectives were encouraged to reduce gradually the number of horses, for the introduction of tractors and other vehicles made transportation by horse seem superfluous. The demand in hay and other fodder nonetheless increased, owing to higher numbers of cattle for meat and milk production. Throughout the period 1945 to 1991, regional party leaders, experts in agriculture, and *sovkhoz* directors were all in agreement about the necessity to increase productivity in all spheres of agriculture, and *melioratsiia* was one of the preconditions for productivity increase. In the remainder of this section, we are going to portray the gradual professionalisation of land improvement.

3.2. Early days of land improvement in Yakutia

As such, land improvement did not commence with Soviet power. From at least the 19th century onwards, Sakha pastoralists employed techniques of water regulation, notably by building temporary dams and digging trenches, the latter known as *khорuu* in Sakha language. These practices were conducive to higher yields in hay-making areas. Since neighbouring *alas* basins may differ in altitudinal level, it is sometimes possible to connect them through systems of artificial channels, so that annual flooding in spring can be regulated through lock systems.⁽⁵⁾ There are occasional reports of attempts to change the natural environment on a larger scale: for example, in 1820-1824 local inhabitants dug a canal to release the water of erstwhile Lake Niurba, the remainders of which are located within a few kilometers northeast of the town of Niurba (Maak 1886: 31-32 and Tabl. IV). In near-by Meiik, one of the farmers reported in 2014: "Firewood and timber are taken from one side of the *alas*, so that in the future on the cleared place one can

cut hay" (Aytal Yakovlev, field research material 2014). Such practice occurs also today.

With the gradual influx of Russian peasants in the 19th and early 20th century, the overall size of arable land increased (Basharin 1989). By 1938, scientific studies on agricultural development and farmland extension were underway, first in central Yakutia and later also in northern parts of the republic (Vinokurova et al. 2015: 580). One of the archival documents – a report written by agronomist S. Nekhaev and presented at a party meeting in Yakutsk in early 1949 – makes mention of this:

"It is not accidental that we now see [...] a number of small plots cleared in the forest in earlier times by previously private farms (*byvshykh edinolichnykh khoziaistv*), but regrettably, these are now largely abandoned. It is not accidental that the first initiators of market-oriented cultivation in our region [...] went into the dense forest. [...] They never pursued cultivation in *alas* [basins], in the valleys of the forest rivers or on *charan* (forest steppe) areas."⁽⁶⁾

Nekhaev used this observation to underline his general argument that the forested terrain is more suitable for new fields than the *alas* areas and river valleys – with the provision that the fields should not exceed 20 hectares, so that the surrounding forest provides protection against severe winds. The timing of this report coincides with the heyday of the Soviet government's attempt to expand crop production far into the circumpolar North (cf. Diuzhilov & Bogdan 2017). Therefore, clearing forest and sowing grain was of prime importance. One should remember that this period is marked by post-war optimism and economic growth along with a highly rigid system of leadership under Stalin.

3.3. The 1950s: machinery support stations to take the lead

Throughout the late 1940s and 1950s (and apparently, well into the 1960s), the diverse tasks of land improvement were carried out by *mashinno-tekhnicheskie stantsii* (MTS, machinery and technical support bases). MTS existed throughout the Soviet Union and were to offer their services to the numerous small collective farms that did not yet possess machinery of their own. MTS managers were also held responsible for propagating innovative methods of agriculture by demonstrating the advantages of contemporary technology. In the central administrative districts of the Yakut ASSR, each MTS was to serve some five to twelve collective farms.⁽⁷⁾

The focus region of our archival research is the Megino-Kangalasskii District, with an overall area of agricultural lands in the order of 115,000 hectares in the early 1950s and 125,000 hectares in 2007.⁽⁸⁾ It will serve as exemplary case of land amelioration in different decades. As of 1954, the district's collectives were affiliated with two MTS: one in the smalltown of Maiia for the southern part of the district and the other in Tiungiuliu, for the northern part. Tiungiuliu is known throughout the republic for its abundance of large and small *alas* areas, and also as a main site of animal husbandry.

The annual statistics and occasional evaluation reports of those years testify to the involvement of MTS in land improvement: here we look at the figures for 1954 from MTS Tiungiuliu in more detail, to give a

first-hand illustration of tasks. The MTS initially provided services for roughly a dozen small collective farms, which by the time of the report had been merged into five. Overall, these were to manage 40,146 ha of land: 21,879 ha meadows, 12,122 ha pastures, and 6,145 ha of arable land. Of the latter, 1687 ha had been opened up by clearing forest over the entire period the MTS's existence (we may presume, since 1938), with 628 ha having been appropriated within the last three years (1952-1954).⁽⁹⁾ Remarkable are these figures because they show the generally small but quite rapidly increasing amount of arable land.

In its zootechnical report of 1954, the managers of MTS Tiungiuliu conveyed generally positive outcomes of animal husbandry, though the insufficient amount of fodder per animal appeared to be a recurring problem. Apart from descriptions of hay production etc., the report provides details on the size of tasks carried out under land amelioration (Table 1).

Furthermore, the report highlights the considerable amount of time and workforce in the mowing, raking and bundling of hay (all of which, without the help of the MTS, would have been carried out manually). The report exemplifies that this as well as other MTS had been assigned various tasks of land improvement, but managed to fulfil them only partially. Seasonal work on the existing lands, notably hay-making, required most of the resources of the MTS. Regarding irrigation (*osushenie*) of grasslands, the workers managed to fulfil the plan to a quite large extent. What this zootechnical report does not specify (and was not meant to specify) is the amount of arable lands under irrigation.

However, about half a year after the report had been submitted, another, much more sceptical report was sent to the Communist Party headquarters in Yakutsk. It complains about different types of mismanagement, among these a weak performance in land irrigation:

Table 1. Land improvement activities carried out in 1954 by the Machinery and Technical Support Base (MTS) Tiungiuliu, Yakutia. Source: "Zootekhnicheskii otchet za 1954 god Tiungiuliunskoi MTS" (early 1955, no author given). Natsional'nyi arkhiv Respubliki Sakha (Yakutiia), fond 40, opis' 16, ed. khr. 87, list 2.

(Note: a dash presumably stands for zero, i.e. no work carried out in the named category and no percentage to be reported).

Task	Envisaged by plan (ha)	Actually carried out (ha)	Per cent of plan
Irrigation of meadows and pastures	1,968	1,710	86.89
Clearing of trunks and bushes	250	–	–
Draining of grasslands for meadows	120	–	–
Clearing of meadows for machine use	–	3,388	–
Enlarging meadows for machine use	200	–	–

"One of the reasons of the low level of cultivated plants and meadows is the weak organisation of irrigation of fields and meadows. In the collective farms 'Geroi Popov', 'Molotov' and 'Kirov' 12 dams exist, by which approximately 1,700 ha of land could be irrigated, however, in 1955 only about half of this area was irrigated. In the summer of 1955, on [the territory of] kolkhoz 'Molotov' the MTS used a specially modified iron wedge for laying out a canal to release water from the site Orto Ebe. By the canal mentioned, 250-300 ha meadows and pastures will be irrigated. The construction works have, however, not been finished because of the absence of mechanised [gear]. Repeated requests of the kolkhoz and the MTS [addressed to] the Water Management Department under the Council of Ministers of the Yakutian ASSR remained without attention."⁽¹⁰⁾

Generally speaking, the MTS experienced difficulties in managing all the tasks they were given. The degree of mechanisation in agriculture was still comparatively low. In Megino-Kangalasskii and other central districts, it was higher than in more remote areas of Yakutia; nonetheless, much of the daily work on the grasslands and fields, in the farms and sheds had to be done manually. During the subsequent years, mechanisation of agriculture gradually increased. MTS had to hand over equipment to "their" collective farms in 1958-1959 and were liquidated (though under the label *sel'khoztekhnika*, the bases continued to provide specialised technical support for agricultural enterprises). Land amelioration became the domain of experts in engineering and water management, as the following sections will show. What occasionally re-emerged in later years, however, was the problem of insufficient appropriate machinery or workforce.

3.4. The 1960s: professionalisation of land improvement

One may rightfully say that professional land amelioration seriously took off in the late 1950s and markedly in the 1960s. In 1965, irrigation activities had already increased in size as compared to the mid-1950s, but still took place at a comparatively modest level (Table 2). Flooding (*limannoe oroshenie*) played a substantial role vis-à-vis irrigation by pumps and pipes.⁽¹¹⁾

By 1966, the entire institutional system had profoundly changed, the MTS were no longer mentioned in the documents. Central actors were the Department of Amelioration and Water Management (*Otdel melioratsii i vodnogo khoziaistva*), the staff of which displayed ambitions and practical suggestions on how to upgrade the department into a ministry.⁽¹²⁾ The Department cooperated with a projecting institute and several construction units, the so-called MMS (*mashinno-meliorativnye stantsii*). Concerning the latter, these were organised in accordance with the territorial-administrative system; four of them already existed in different districts.⁽¹³⁾ Moreover, a specialised construction unit with the name Yakutvodstroï operated in the city of Yakutsk and the nearby districts, including Megino-Kangalasskii. The overall annual budget for construction work alone in 1966 was approx. 1.7 million rubles (facilitating a much larger volume of activities than in previous decades). New MMS were to be established within a couple of years in six districts⁽¹⁴⁾ with the aim to extend the regional network. In the Far Northern districts, however, MMS were

Table 2. "Extent of irrigated and drained lands in the Yakut ASSR in 1965 (ha)". Selected data from the source: "Predlozheniia po voprosam melioratsii zemel'", Appendix Table 4 (spring 1966, compiled by Bol'shev, Head of Department). *Natsional'nyi arkhiv Respubliki Sakha (Yakutiia), fond 1409, opis' 1, ed. khr. 28, list 7.*

(Note: a dash presumably stands for zero, i.e. no work carried out in the named category).

Districts, kolkhozy, sovkhozy	Flooding (<i>limannoe oroshenie</i>)	Irrigation of vegetables and potatoes	Draining of hay-making meadows
Amginskii: total	1,400	16	–
– collective farms	400	6	–
– state farms	1,000	10	–
Verkhneviliuiskii – collective farms	550	20	781
Megino-Kangalasskii – collective farms	4,841	81	–
Ordzohikidzevskii*: total	2,800	166	–
– collective farms	300	76	–
– state farms	2,500	90	–
Olekminskii – collective farms	80	1,690	873
Namskii: total	–	28	–
– collective farms	–	13	–
– state farms	–	15	–
Churapchinskii – collective farms	3,270	44	–
Ust'-Aldanskii – collective farms	290	57	–
Alekseevskii** – collective farms	920	14	–
Suntarskii – state farms	–	98	–
Leninskii*** – state farms	3,200	240	1,270
State farm "Yakutskii"	–	223	–
State farm "Khatasskii"	–	146	–
Yanskii – state farms	16,015	–	–
State farm "Momskii"	1,000	–	–
State farm "Tomponskii"	–	13	–

* Today's Khangalasskii District (NB: *not* Megino-Kangalasskii District)

** Today's Tattinskii District

*** Today's Niurbinskii District

not be founded; rather the state farms should carry out amelioration work where necessary. The former MTS, now labelled *sel'khoztekhnika*, were to hand over gear to the growing number of MMS.⁽¹⁵⁾

The projecting institute had its main seat in Moscow and maintained a branch in Yakutsk – Yakutskaia ekspeditsiia Rosgiprovodkhoz. The management of the Yakutsk branch was criticised for slow and unprofessional work of their unit, but simultaneously ballooned with dozens of new staff and one million rubles for the period 1967-1970.⁽¹⁶⁾ Monies were also offered for constructing apartment buildings for *melioratsiia* employees in Markha, a northern suburb of Yakutsk. It is hard to over-estimate the

enthusiasm of 1966 in the sphere of land improvement. Likewise, in the domain of scientific research, the period from 1958 onwards is remembered in a very positive light, for example by P. P. Gavril'ev (1991: 24-27) to whose research on land improvement under permafrost conditions we shall return in the penultimate section.

The activism of 1966 and subsequent years was spurred by a direct intervention from Moscow, or more exactly speaking, a memorandum of the Council of Ministers of the Russian SFSR, which explicitly endorsed the development of agriculture in Yakutia and put particular emphasis on increasing fodder production.⁽¹⁷⁾ As the previous section explained, shortage of fodder was indeed a perennial problem in many agricultural enterprises. Interestingly, the memorandum contains many justifications for improving meadows and pastures, but comparatively little information about fields. Rather than calling for an expansion of arable land (which had been common just before 1966), the memorandum states that natural conditions limit the possibilities for crop cultivation, and that sustainable production of potatoes and other vegetables can only be achieved by irrigation.⁽¹⁸⁾

The institutional development of land improvement must also be interpreted in the light of the more general policy of those days, to turn collective farms into state farms, push forward the centralisation of agriculture, enlarge production units, and implement industrial methods in animal husbandry and plant production. One of the trends in these years was a more wide-reaching implementation of canals or pipes and sprinklers (*dozhedeval'nye ustanovki*) as means of irrigation, whereas flood irrigation (*limannoe oroshenie*) continued to play an important role in the watering of meadows and pastures. As to *osushenie* or drainage, the districts along River Viliui were particularly targeted areas of action throughout this period.

3.5. *Taking stock: the state of land improvement in the late 1980s*

By the mid-1980s, land improvement had developed into a thoroughly professional business with its own specialised language, forms and documents, concerning all stages of planning, constructing, handing over to agricultural enterprises, testing the equipment's functionality, and accounting for financial means, work investments and efficiency. Despite further institutional changes in the 1970s and 1980s (and despite occasional animosities between individual actors in the participating organisations) the whole apparatus appears to have worked rather smoothly.⁽¹⁹⁾

At this point, let us take a glance at the general spatial extent of land amelioration in Yakutia in the last years of the Soviet Union. With regard to the late 1980s, Gavril'ev states: "In Yakutia, in the last years the ameliorated lands, taking up only 8.7 per cent of the overall area of agricultural lands, provide for 80 per cent of all potato produce, 90 to 100 per cent of marketable vegetables [*(valovogo sbora ovoshchei)*], and 15 to 18 per cent of fodder plants" (1991: 111). Data provided for 1991 by the Ministry of Agriculture read thus: "As of early 1991, in the republic there were 108.2 thousand ha ameliorated lands, of which 19.9

thousand ha were irrigated lands, 33.7 thousand ha lands with flood irrigation (*limannogo orosheniia*)⁽²⁰⁾ and 54.6 thousand ha drained areas. Of all agricultural lands, the share of ameliorated lands amounted to 8.2 per cent" (Nikolaev 2013).

Both Tables 3 and 4, on irrigated and drained lands, provide a number of clues on land use and environmental conditions in the different districts of Yakutia, and also on the development of land amelioration in the 1980s. First, it is possible to calculate the overall agricultural area per district.⁽²¹⁾ In many cases, these were small fractions of the overall territory of the district, especially so in the northern regions of Yakutia. In some of these, neither irrigation nor draining was conducted. Second, the focus area of this article, Megino-Kangalasskii District, features among the five most important regions in terms of irrigation, the other four entities⁽²²⁾ likewise being located in the central part of Yakutia with comparatively intensive agriculture under dry climatic conditions. Third, no artificial draining took place in Megino-Kangalasskii District. As explained earlier, characteristic for this region is natural draining as a result of geomorphological particularities. Ust'-Aldanskii District, adjacent to the north, also repeatedly suffered from severe droughts and has thus also benefited from irrigation projects; but it is nonetheless an area where artificial draining is conducted, notably on the wetlands along river Aldan. Fourth, draining was occasionally conducted to a considerable extent also in the northern, subpolar regions of the republic, such as Abyiskii or Srednekolymskii District, and there presumably in the wetlands along the Indigirka and Kolyma. However – and this is the fifth point – the most remarkable achievements in terms of draining are reported for the region along river Viliui, and here specifically for the Viliuiskii District, whose area of drained lands amounts to almost half of the overall figure for the entire republic. This indicates that the state and its land-improvement executives invested large resources in the Viliui region throughout most of the 1980s. Sixth, in many regions we can see a shrinking of numbers from 1986 to 1987: with regard to draining, less markedly, but in terms of irrigation, quite substantially so. These losses were then partially recovered in the following year, 1988. What do these losses indicate? The next section will elaborate some of the reasons.

3.6. *Negative impacts: lacking maintenance and risk of permafrost degradation*

Problems typical for the early decades of land amelioration have already been identified in previous sections: lack of gear and of workforce were the main reasons for failures in completing amelioration tasks within the planned timespan. However, in the mid-1980s a new problem emerged: maintenance. Technically, a maintenance crisis may already have been existing, but it now found its way into the engineers' statistics and statements (and from there, into public discourse). In addition, concerns about environmental degradation, and a concomitant environmentalist discourse, emerged in the Soviet Union under Gorbachev (1983-1991). In the days of *glasnost'*, the idea of a more "rational land use" (*ratsional'noe zemelepol'zovanie*) also became popular and induced experts to take a sober look at the state of irrigation

Table 3. "Extent of **irrigated** lands in state farms and other state enterprises of the Yakutian ASSR (ha)". Source: "Zapiska: nalichie i ispol'zovanie meliorirovannykh zemel' v sovkhovakh YaASSR za 1988 god" [Memo: extent and utilisation of ameliorated lands in the state farms of the Yakutian ASSR] (25 May 1989, V. P. Pavlov). Natsional'nyi arkhiv Respubliki Sakha (Yakutiya), fond 3, opis' 298, ed. khr. 428, list 13.

[District]	1980	1985	1986	1987	1988	1988 in % as to 1987	% of entire agric. area*
Yakutian ASSR total	22,497	26,284	27,535	19,527	20,979	107	1.3
Abyiskii							
Aldanskii	34	34	34	34	34	100	0.9
Alekseevskii**	1,063	1,252	1,252	896	896	100	0.8
Allaikhovskii							
Amginskii	1,374	1,682	1,789	2,128	2,386	112	2.6
Anabarskii							
Bulunskii							
Verkhneveliinskii	969	1,055	1,165	532	653	122	0.9
Verkhnekolymskii							
Verkhhoianskii					87		0.1
Viliuskii	876	909	909	558	638	114	0.7
Gornyi	351	351	351	139	139	100	0.2
Zhiganskii							
Kobiaisikii	48	48	48				
Leninskii***	1,098	1,196	1,196	722	783	108	0.7
Lenskii	701	1,050	1,028	990	990	100	7.9
Megino-Kangal.	2,043	2,533	2,533	2,131	2,278	107	1.8
Momskii							
Namskii	2,033	2,601	2,952	2,247	2,279	101	2.4
Nizhnekolymskii							
Oimiakonskii							
Olekminskii	2,213	2,536	2,536	1,542	1,592	103	2.9
Olenekskii							
Ordzhonikidze****	1,412	2,011	3,514	2,052	2,052	100	2.4
Srednekolymskii							
Suntarskii	1,720	2,030	2,070	1,166	1,420	122	1.2
Tomponskii	108	108	108	8	8	100	0.03
Ust'-Aldanskii	948	1,156	1,209	825	975	118	0.8
Ust'-Maiskii	99	59	59	59	59	100	0.2
Ust'-Yanskii							
Churapchinskii	985	1,252	1,252	1,075	1,139	106	0.8
City of Yakutsk	2,853	3,461	3,525	2,418	2,566	106	0.8
City of Mirnyi	5	5	5	5	5	100	0.1
City of Neriungri							

* Literally: Proportion of irrigated lands to the entire area of agricultural lands in 1988

** Today's Tattinskii District

*** Today's Niurbinskii District

**** Ordzhonikidzevskii District: today's Khangalasskii District (NB: not Megino-Kangalasskii District)

Table 4. "Extent of **drained** lands in state farms and other state enterprises of the Ya[kutian] ASSR (ha)". Source: "Zapiska: nalichie i ispol'zovanie meliorirovannykh zemel' v sovkhozakh YaASSR za 1988 god" [Memo: extent and utilisation of ameliorated lands in the state farms of the Yakutian ASSR] (25 May 1989, V. P. Pavlov). Natsional'nyi arkhiv Respubliki Sakha (Yakutiia), fond 3, opis' 298, ed. khr. 428, list 14.

[District]	1980	1985	1986	1987	1988	1988 in % as to 1987	% of entire agric. area*
Yakutian ASSR total	36,784	46,748	51,577	55,605	57,225	103	3.6
Abyiskii	9,235	9,784	9,784	3,454	3,454	100	29.[0]
Aldanskii							
Alekseevskii**	3,430	3,433	3,433	2,396	2,396	100	2.2
Allaikhovskii							
Amginskii	490	490	490	490	490	100	0.5
Anabarskii							
Bulunskii	88	88	88				
Verkhneviliuiskii	2,405	3,448	3,661	3,390	3,520	104	5.0
Verkhnekolymskii	1,324	1,324	1,324	3,168	3,380	107	43.3
Verkhoianskii							
Viliuiskii	4,380	8,708	12,717	22,403	23,077	103	27.4
Gornyi			244	244	244	100	0.4
Zhiganskii							
Kobiaisikii							
Leninskii***	4,590	1,154	1,154	1,154	1,374	119	1.3
Lenskii	75	75	228	329	329	100	2.7
Megino-Kangal.							
Momskii		550	550	550	550	100	3.0
Namskii	118	118	118	118	118	100	0.1
Nizhnekolymskii							
Oimiakonskii							
Olekminskii	672	1,322	1,322	1,022	1,034	101	1.9
Olenekskii	420	420	420	420	420	100	29.4
Ordzhonikidze****							
Srednekolymskii	6,544	6,544	6,544	5,417	5,417	100	19.7
Suntarskii		5,898	5,898	5,898	6,270	106	5.5
Tomponskii		190	190	190	190	100	0.7
Ust'-Aldanskii	3,313	3,002	3,002	4,552	4,552	100	3.7
Ust'-Maiskii							
Ust'-Yanskii							
Churapchinskii		200	410	410	410	100	0.3
City of Yakutsk							
City of Mirnyi							
City of Neriungri							

* Literally: Proportion of drained lands to the entire area of agricultural lands in 1988

** Today's Tattinskii District

*** Today's Niurbinskii District

**** Ordzhonikidzevskii District: today's Khangalasskii District (NB: *not* Megino-Kangalasskii District)

and drainage systems. Not all of these worked properly: some 10 to 20 per cent were defunct.⁽²³⁾ The report that contains the quoted tables goes into the reasons behind these deficiencies (as of May 1989):

"In 1987, 10.4 thousand ha of *irrigated* lands had to be excluded from the inventory. First and foremost, these are objects that were constructed without project [documentation], not listed in the balance [sheets] of the state farms, [objects] equipped with mobile irrigation lines, these are objects not connected to any source, or the water of the source contains carbonate compounds, these are also sections that underwent karst phenomena and slacks as a result of the thawing of underground ice, inundated by meltwater, where the irrigation network is completely destroyed and repair is impossible, finally there are sections salinified as a result of irrigation. – The main reasons for taking [areas] out of the inventory of *drained* lands are secondary ponding, inundation by floodings, the absence of [electric] lines and thermokarst phenomena." [Emphasis added]⁽²⁴⁾

Furthermore, even those irrigation systems that actually did work were not used in a rational way, the report stated. It also aired the (already ubiquitous) complaint that the agricultural enterprises did not possess certain equipment for land improvement. To summarise, then, this report of May 1989 testifies to a crisis in maintaining a technical and infrastructural system the construction of which had rapidly progressed in the previous two decades. To be sure, repair was underway. In another document of early 1989, we find evidence for the reconstruction of irrigation systems in the Megino-Kangalasskii District, as displayed in Table 5.

Thermokarst processes, i.e. soil surface subsidence due to thawing of ice-rich frozen ground – occurred not only along ditches, canals or irrigation pipes but also on newly acquired farmland (i.e. cleared areas). Gavril'ev – the scientific expert mentioned in previous sections – observed that "in some of the central districts of Yakutia about 25 per cent of arable land on forest clearings are abandoned because of soil surface subsidence (*iz-za obrazovaniia prosadok*) and devastation (*razrushenii*) of the soil surface" (1991: 89) as a consequence of ice-wedge thawing. Among the sites that he investigated is Kerdiugen, some 30 kilometers south of Yakutsk; here he could observe the progression of thermokarst on three formerly

Table 5. "Fulfilment of amelioration plan during three years of the XVth five-year plan" in four different districts. Only figures for the Megino-Kangalasskii District are given here. Source: "Vypolnenie plana meliorativnykh rabot za 3 goda XV piatiletki" (early 1989, GosAgroProm Deputee Chair N. A. Lipunov). Natsional'nyi arkhiv Respubliki Sakha (Yakutiia), fond 3, opis' 298, ed. khr. 428, list 5.

[Megino-Kangalasskii District]	1986-88 plan [ha]	1986-88 de facto [ha]	% of fulfilment
1. Irrigation	730	882	120.8
2. Reconstruction [of irrigation systems]	480	175	36.4
3. Drainage			
4. Deforestation for arable land	1,320	500	37.8
5. Profound improvement of meadows	8,780	7,044	80.2

forested plots cleared for agriculture in 1966, 1978 and 1984 respectively, with soil surface subsidence of up to 100 cm within 20 years (Gavril'ev 1991: 86-89). One of the most extreme cases of thermokarst that he mentioned is at Yukechi (Megino-Kangalasskii District), where the clearing of forest on ice-rich ground led to considerable soil subsidence, with lakes of 3 to 6 m depth having developed over a few decades (Gavril'ev 1991: 89 with reference to Bosikov 1988).⁽²⁵⁾ "It is necessary to note that farmlands on ice-rich permafrost deposits (*na ledovom komplekse*) such as at Yukechi, with [similarly] progressing and catastrophic character of thermokarst development are not numerous in Yakutia, constituting approximately 0.5 to 1 per cent of the overall number of cleared plots" (Gavril'ev 1991: 89). However, it should be added that during a scientific workshop co-organised by one of the authors (Ulrich & Habeck 2015) several participants reported that the number of such areas is increasing.

One of the main problems of agriculture in Yakutia – the recurring droughts in the central districts – was tackled by the Soviet government in the late 1980s: the Federal Ministry of Water Management and the State Committee for Agriculture were ready to support the construction of water pipelines, supplying irrigation and also drinking water for the villages of Megino-Kangalasskii, Churapchinskii and Alekseevskii (Tattinskii) districts⁽²⁶⁾ and also for neighbouring Ust'-Aldanskii District.⁽²⁷⁾ Similar ideas had already been discussed in the 1960s, and different proposals had been developed. By late 1988, a project was underway to construct a pipeline from River Lena to Ust'-Aldanskii District. In addition, engineers and regional politicians promoted the project of a pipeline to transfer water from River Amga to the smaller rivers Tatta and Suola, but this plan was not realised, probably due to divergent positions among the experts⁽²⁸⁾ and also because of protests among the inhabitants of the Amga valley (Yegorov et al. 2014: 43). When the economic difficulties of the 1990s began, the project was just about to take off. Water pipelines from River Lena to Miuriu (Ust'-Aldanskii District) and to Maiia (Megino-Kangalasskii District) were completed in 1996 and 2001 respectively; the latter was gradually extended to Tuora-Kiuel' (Tattinskii District), with a total length of almost 150 kilometres by 2012. Details on these water pipelines can be found in a publication by Yegorov et al. (2014), who speak of a megaproject in view of the financial investments and the economic significance for the region which now receives reliable water supplies for many thousands of hectares of fields, meadows and pastures.

4. Conclusion

The above observations pertained mostly to the final years of the Soviet Union. The profound political, social and economic changes that took place since then are beyond the scope of this article. To sketch out just two phenomena of the period after 1991, firstly there has been considerable out-migration from the rural areas towards Yakutsk and other cities, along with a process of spatial contraction of agriculture. Some of the remote *alas* basins, which had been deemed too costly and hence were abandoned in the days

of Soviet centralisation, are now being utilised again, but generally, the overall area of meadows, pastures and arable land has slightly shrunk. Secondly, considering the country-wide deplorable state of agricultural enterprises in the mid-1990s, the difficulties of properly maintaining existing irrigation systems occurred on even larger scales than those experienced in the late 1980s. For both reasons, many of the areas ameliorated in Soviet times were neglected during the hardest years of economic transformation, to become partly re-established in recent years.

The Republic's Ministry of Agriculture stated in 2013: "For several reasons, over the last 20 years approximately 40 per cent of ameliorated areas in the republic were withdrawn from agricultural use. Most seriously suffered the irrigation system – by 82 per cent; the artificial flooding system, by 42 per cent; and drainage systems, by 44 per cent" (Nikolaev 2013). This indicates the level of post-Soviet losses, which by the time of writing this article are likely to have been recovered to some extent.

One may contend that Soviet bureaucrats were sufficiently skilled in making statistics look better than what was really going on; or more drastically, that under the conditions of a one-party state with a centralised and planned economy, official documents do little more than tell white lies. Furthermore, the argument could be made that to get a real grasp of engineers' and farm hands' life experience, it is necessary to be with them on the land, literally to get down to earth and participate in their work. While such an approach, known as participant observation in ethnographic research, is certainly productive and needed, it does have to start from some shared understanding and some shared vocabulary. Any one profession has a certain work ethos and logic, which can be accessed by learning the language of the trade. This article has portrayed the main classificatory systems of land improvement in Russia and sketched out its institutional history in Yakutia along with success stories and difficulties, to alleviate further inquiries and excursions into this professional domain, which has thus far received astoundingly little scientific interest.

The fact that land improvement in this and other parts of Siberia has escaped the attention of both environmental and social scientists itself deserves an explanation. From a social-sciences vantage point, the study of land use in Siberia has often set the focus on so-called traditional forms of land use, and the self-depictions of Sakha (Yakut) or other Siberian ethnic groups rather confirm such a view.⁽²⁹⁾ What has been somewhat neglected is the extent to which Soviet methods (centralisation, mechanisation, specialisation) have not simply eradicated or transformed traditional forms of land use, but rather been adapted by local land users. Sakha ways of living on the land and their engagements with the land bear highly important symbolic and ritualised meanings, but it would be misleading to ignore the changes in grazing, hay-making, plant cultivation, and other agricultural activities that came with new technologies and management systems. As to environmental sciences, the central part of the Republic of Sakha (Yakutia) is a hotspot of research on permafrost, periglacial geomorphology, and also the likely impact of climate change; but it is seldom perceived as a cultural landscape. To be sure, the percentage of agricultural lands in this region is comparatively small; but when analysing the causes and likely consequences of permafrost degradation in

this ice-rich, sensitive environment, it is necessary to include the diverse small and large-scale methods of changing the landscape through drainage, irrigation, forest clearing, and other forms of intentional, collectively organised "land improvement".

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Notes

- (1) Occasional translations of *melioratsiia* as "land reclamation" are not suitable, for the latter term rather denotes the transformation of land into its erstwhile state after a period of industrial use.
- (2) The following overview of land-improvement tasks and techniques in Soviet times diverts slightly from the more recent description given by Nikolaev (2013); it is based mainly on two archival documents: "Predlozheniia po voprosam melioratsii zemel'" (1966) with attached tables (Natsional'nyi Arkhiv Respubliki Sakha (Yakutiia), fond 1409, opis' 1, ed. khr. 28, list 3-12) and "Plan fizicheskikh ob'emov rabot na 1978 god po Megino-Kangalasskoi PMK Tresta YaMVS" (Natsional'nyi Arkhiv Respubliki Sakha (Yakutiia), fond 1445, opis' 1, ed. khr. 51, list 121). A list of all archival files used for this article is given in the references section.
- (3) Yakutia is here used as a short-hand for the Republic of Sakha (Yakutia), which is one of the federal subjects of the Russian Federation. During the Soviet period, until 1990/91, its official name was Yakut Autonomous Soviet Socialist Republic (*Yakutskaiia Avtonomnaia Sovetskaia Sotsialisticheskaia Respublika; Sakha avtonomnai sebieskei sotsialisticheskei respublika-ta*), abbreviated as YaASSR. Since we refer mainly to archival material from the Soviet period, we will use "Yakutia" or "Yakutian ASSR" throughout the article, unless in those cases where we speak about processes in the Post-Soviet period.
- (4) Peat production is also occasionally mentioned as part of *kul'turtekhnicheskie raboty*, but it played much less of a role in the Yakut ASSR than elsewhere in Soviet Russia.
- (5) Mathias Ulrich, who read an earlier draft of this paper, reported that such a system is practiced at Khara Bulgunnyakh (near the village of Khorobut, Megino-Kangalasskii District).
- (6) Po voprosu "O vvedenii travopol'nykh sevooborotov v kolkhozakh Yakutskoi ASSR" (Report by S. Nekhaev, 1949). Natsional'nyi arkhiv Respubliki Sakha (Yakutiia), fond 3, opis' 107, ed. khr. 189, list 37.
- (7) Later, with the amalgamation of collective farms into state farms, the MTS sometimes came to be the core of the amalgamated enterprise.
- (8) The Megino-Kangalasskii District (raion, ulus) is located not far from the republic's capital Yakutsk, on the opposite (eastern) bank of river Lena. As of the late 1980s, its general surface area comprised 11,700 square kilometres, or 1,170,000 hectares. Of these, more than a tenth, namely 126,800 hectares, were officially identified as agricultural lands, with 45.7 per cent pastures, 40.9 meadows and 11.8 fields. These data can be found on several local webpages (among these, <http://сахалар.рф/ulusy/megino-kangalasskiy/> seems most trustworthy), but the initial source is given nowhere. Probably, the data are taken from statistical sources published in or briefly after 1989. The figure of 126,800 ha matches with the data in Tables 2 and 3 below. The overall agricultural area decreased after 1989, owing to economic changes mentioned in the conclusion, and amounted to 122,500 hectares in 2011 (Yegorov et al. 2014: 42).

- (9) "Spravka o finansovo-khoziaistvennoi deiatel'nosti Tiunguliunskoi MTS" (28.10.1955). Natsional'nyi arkhiv Respubliki Sakha (Yakutiia), fond 40, opis' 15, ed. khr. 52, list 1.
- (10) *ibid.*, list 8.
- (11) Table 2 shows an exceptional one-year peak of artificially flooded area in the subpolar Yanskii District and a remarkably large extent of irrigated lands in the southwestern Olekminskii District, even though further details show that only a quarter of this area was in fact watered in 1965.
- (12) Documents to this effect were submitted on 29 June 1966 by the head of department, Bol'shev (Natsional'nyi arkhiv Respubliki Sakha (Yakutiia), fond 1409, opis' 1, ed. khr. 28, list 14-16). Moreover, there is a letter by S. Sosin, Sekretar' Prezidiuma Verkhovnogo Soveta Yakutskoi ASSR, addressed to: "Ministru melioratsii i vodnogo khoziaistva Yakutskoi ASSR, tov[arishchu] E. A. Davydovu", 12.11.1966 (Natsional'nyi arkhiv Respubliki Sakha (Yakutiia), fond 1409, opis' 1, ed. khr. 28, list 40). However, this is one of the very scant occurrences of a Ministry with this name in this region. Another hint is the cover page of archival fond 1409 opis' 1: "Ministerstvo melioratsii i vodnogo khoziaistva YaASSR 1951-1968".
- (13) Gornaia, Tattinskaia, Niurbinskaia, and Viliuiskaia MMS (Natsional'nyi arkhiv Respubliki Sakha (Yakutiia), fond 1409, opis' 1, ed. khr. 28, list 3).
- (14) Suntarskaia, Ust'-Aldanskaia, Verkhneviliuiskaia, Amginskaia, Olekminskaia, and Churpachinskaia MMS (*ibid.*, list 3).
- (15) *ibid.*, list 3-4.
- (16) "Postanovlenie: O merakh rasshireniia vodokhoziaistvennogo proektirovaniia v respublike v svete reshenii maiskogo plenuma TsK KPSS" (16 September 1966). Natsional'nyi arkhiv Respubliki Sakha (Yakutiia), fond 1409, opis' 1, ed. khr. 23, list 1-5.
- (17) "O merakh pomoshchi po melioratsii i obvodneniiu zemel' v Yakutskoi ASSR" (22 October 1966). Natsional'nyi arkhiv Respubliki Sakha (Yakutiia), fond 1409, opis' 1, ed. khr. 28, list 51-53.
- (18) *ibid.*, list 52.
- (19) The procedures of planning, constructing, handing over and checking can best be recollected on the basis of these two files: Natsional'nyi arkhiv Respubliki Sakha (Yakutiia), fond 1445, opis' 1-2, "Yakutmeliovodstroii" [part 1 for 1968-1981 and part 2 for 1982-1988].
- (20) The areas with flood irrigation seem to constitute a category in their own right, for they do not show up in the column "extent of irrigated lands" in Table 3. One may therefore presume that Table 3 only refers to lands irrigated by canals or pipes (so-called *orositel'nye sistemy* or irrigation systems).
- (21) Dividing the amount of hectares (as of 1988) by the percentage value in the last column and then multiplying by one hundred, one approximately obtains the overall area of agricultural lands in hectares.
- (22) The City of Yakutsk, Amginskii, Namskii, and Ordzhonikidzevskii (Khangalasskii) District.
- (23) "Zapiska: nalichie i ispol'zovanie meliorirovannykh zemel' v sovkhodzakh YaASSR za 1988 god" [Memo: extent and utilization of ameliorated lands in the state farms of the Yakutian ASSR] (25 May 1989). Natsional'nyi arkhiv Respubliki Sakha (Yakutiia), fond 3, opis' 298, ed. khr. 428, list 1.
- (24) *ibid.*, list 10-11. The mentioning of 10.4 thousand hectares does not match with the decrease of the republic's total irrigated area from 1986 to 1987 (Table 3), which is only 8 thousand hectares. Possibly, the difference is compensated for by areas newly irrigated in 1987.
- (25) See Fedorov et al. (2014); Ulrich et al. (2017). The clearing took place shortly before 1940. The small *kolkhoz* was later amalgamated with other enterprises around Boko and Khorobut; the field was abandoned in the 1960s. Yukechi is often visited by permafrost researchers, constituting one of the sites in Yakutia with most detailed and long-standing scientific records of permafrost degradation (Ulrich et al. 2017).
- (26) "Svodnoe zakliuchenie ekspertnoi komissii gosudarstvennoi ekologicheskoi ekspertizy Goskomprirody YaASSR po 'tekhniko-ekonomicheskomu obosnovaniuu orosheniia, obvodneniia zemel' i vodosnabzheniia naseleennykh punktov Megino-Kangalasskogo, Churapchinskogo, Alekseevskogo raionov' [iz reki Amga], razrabotannoe institutami 'Rosgiprovodkhoz', 'Yakutgiprovodkhoz'". Natsional'nyi arkhiv Respubliki Sakha (Yakutiia), fond 3, opis' 298, ed. khr. 454, list 20-28.
- (27) "Protokol' soveshchaniia [...] o proektirovanii i stroitel'stva orosheniia i obvodneniia zemel' v Ust'-Aldanskom raione iz r. Lena" (29.09.1989). Natsional'nyi arkhiv Respubliki Sakha (Yakutiia), fond 3, opis' 298, ed. khr. 404, list 10.
- (28) "Svodnoe zakliuchenie ekspertnoi komissii..." (see above). Additional statement by commission member N. A. Ilarov (late 1989). Natsional'nyi arkhiv Respubliki Sakha (Yakutiia), fond 3, opis' 298, ed. khr. 454, list 28.
- (29) For a recent treatment of how particular animals (and particular forms of animal husbandry) serve as political symbols in

identity discourses in the Republic of Sakha (Yakutia), see Stammeler-Gossmann (2010).

References

Archival sources

Archival research took place in the National Archive of the Republic of Sakha (Yakutia) in July 2015. Documents in Russian archives are numbered by *fond* (first level), *opis'* (plural: *opisi*, second level), *edimitsa khraneniia* or colloquially *delo* (third level) and *list* ("sheet", fourth and last level).

Completely checked were four *opisi*:

- Fond 682 opis' 7: "Godovye otchety MTS" [of the 1950s];
- Fond 1409 opis' 1: "Ministerstvo melioratsii i vodnogo khoziaistva" [1951-1968];
- Fond 1445 opis' 1: "Yakutmeliovodstroï" [1968-1981];
- Fond 1445 opis' 2: "Yakutmeliovodstroï" [1982-1988].

Partially checked were another four *opisi*:

- Fond 3 opis' 107: "Sel'skhoe khoziaistvo" [crop cultivation, 1940s and 1950s];
- Fond 3 opis' 176: "Sel'skhoe khoziaistvo" [animal husbandry, 1940s and 1950s];
- Fond 3 opis' 298: "Sel'skhoe khoziaistvo" [1980s];
- Fond 40 opis' 15: "Megino-Kangalasskii raion" [letters, memos, reports etc., 1950s];
- Fond 40 opis' 16: "Megino-Kangalasskii raion" [agricultural reports and statistics, 1950s].

From the overall amount of approximately 2500 sheets perused in the reading rooms of the archive, 245 were selected for photocopying, scanning, and closer analysis.

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