Anna Gamburd
Lycée Français de New York, New York, NY, USA
Russia, Sustainable Agriculture

The Kulunda Steppe: Reconciling Productivity with Sustainability

Widely acknowledged as an energy superpower, Russia is also gaining global recognition as a potential agricultural giant. With a population of over 140,000,000 and a land area of 17,098,242 square kilometers, Russia is the ninth most populous country and the largest country in the world (World Population Review). Though Russia has been a mainly urban country for more than half a century, over 5% of the workforce remains in the agricultural sector. Because of the great cultural and social diversity in the country, it is difficult to determine the composition of an average family. Russia's fertility rate dropped from 6.36 in 1930 to 2.02 in 1970, before reaching 1.82 in 2020. The female labor force participation rate reached 54.41% in 2020, exceeding the world average of 46.9% (Statista).

Russian agriculture has been one of the fastest growing segments of the economy in recent years. Russia is the world's largest producer of barley; the largest exporter of wheat; the second-largest producer of sunflower seeds; the third-largest producer of potatoes and milk, and the fifth-largest producer of eggs and chicken meat. After a decade of import dependence following the fall of the Soviet Union, Russia launched its agricultural support policies on a meaningful scale in 2005, as one of the National Priority Projects, which then converted into multi-year programs for agricultural development. From 2014, these were supplemented by protectionist counter sanctions and additional sanitary and phytosanitary restrictions. This combination of government support for agriculture and a strongly protectionist trade policy has enabled Russia to transform its agriculture sector from a modest level of production in the 2000s to a significant contributor to the economy and a growing global player (Agricultural Economy and Policy Report).

Although most of its territory is not arable due to extreme weather conditions, Russia has the fourth largest area of cropland in the world after the United States, India, and China. 28% of the land currently cultivated in Russia is located in its vast Asian region, Siberia. With 13.1 million square kilometers, Siberia is larger than Brazil and the European Union combined. It extends across 6,000 kilometers, stretching from the Urals to the Pacific Ocean. Siberia is one of the least populated regions on earth, with a population density of only 3 people per square kilometer. The region's agriculture is mainly confined to two areas: the Russian Far East and the Western Siberian grain belt. In the Russian Far East, warm and moist summers support Russia's soybean growing area. This region has profited significantly from the substantial increase in Chinese soybean demand: however, despite the recent boom of the Russian Far East, the principal area of Siberian agricultural activity is the Western Siberian grain belt, located in the Asian part of Russia, characterized by its fertile Chernozem soils and vast crop fields. The area is dominated by large-scale agriculture, with corporate farms managing between 3,000 to 10,000 hectares of farmland (Elferink et al.).

The logical destinations for the wheat grown in the Western Siberian grain belt are East Asian and Southeast Asian countries. Rising incomes in these countries have led to increased consumption of protein-rich diets and a preference for wheat products over traditional rice based products. Demand for meat has in turn led to increased demand for grain: in China, feed for the growing domestic pig and poultry sectors is the main driver of surging grain imports. Furthermore, Chinese imports of grain are likely to continue to increase in the coming years, as climate-induced harvest failures imperil domestic reserves. A surge in Chinese demand would take a significant amount of grain out of global supplies, negatively impacting prices and food security worldwide. China's infrastructural proximity to Russia makes it an even more desirable recipient of Siberian grain: the Trans-Siberian Railroad, which runs over 5,000 miles from Moscow to Vladivostok, connects the West Siberian grain belt with the Free Port of Vladivostok, from which grain can easily be shipped to China (Elferink et al.).

This paper examines two of the principal challenges which must be addressed in order for Russian agriculture to reach its full potential. The first is the development of an efficient land policy to facilitate land regulation and agricultural land transactions; the second is the implementation of sustainable farming practices to counter land degradation. This paper presents solutions which have been set forth in response to each of these challenges, and concludes with the elaboration of a project to help address the second issue.

The current policies on land regulation and agricultural land transactions are rooted in the complex history of land ownership in the Russian Federation. During more than seven decades, from 1917 to 1990, there was no private land ownership in Russia. Land nationalization after the 1917 Revolution was followed by forced collectivization in 1929. By the end of the 1930s a relatively small number of collective and state farms controlled 98% of agricultural land. However, individual agriculture persisted on millions of small subsistence-oriented household plots (Lerman et al. 15). In 1991, the agricultural land held by collective and state farms began to be privatized through the distribution of land shares to the workers of the former collective farms. Many liberals believed that if workers were given the right to purchase and administer their own land, a new class of entrepreneurs would come to dominate rural production, as large farms would recede in importance, and Russian agriculture would be transformed into large numbers of smaller farms with higher efficiency (Lindsay 263).

The current reality is very different. Today, about 53% of domestic agricultural products are produced by agricultural enterprises, large industrial farms with expansive land and livestock holdings (Agricultural Economy and Policy Report). The failure of small farms to develop can be explained in part by the rural population's general lack of enthusiasm for decollectivization. Under the Soviet system, collective and state owned farms had been responsible for providing a range of social services and utilities to the rural population, including education, medical assistance, and inputs for agricultural production. Because state and local governments typically did not have the resources to provide such services, many rural Russians saw the collective farms as their only realistic source of social support. They were therefore justifiably unenthusiastic about the prospect of decollectivizing farms (Lindsay 267).

Farmers who did seek to break away from the collectives were faced with a series of practical and bureaucratic impediments which made the purchase of land an extremely complicated procedure. One significant obstacle was the difficulty of obtaining land: farm managers and local officials sometimes refused to convert the farmers' land shares into plots or selected the worst land for the private plots. Land transactions were rendered extremely difficult by an exceedingly complex land registration procedure. When privatization took place, state offices registered land shares in the name of collective farm workers without the participation of the new owners. Since registration of land shares made their owners subject to the land tax, those inheriting land shares often failed to register them. This has led to a situation where farmers tend to register their land shares only if they become interested in selling their land, or if they want to convert their land share into a plot.

In 1998, a new Federal State Land Cadastre was created to reorganize the land registration procedure. In order to buy or sell land that was registered under the old system, landowners are required to re-register the land in the new Federal Land Cadastre. Since most privately held land has not been sold since 1998, the Cadastre chambres do not have accurate records of ownership for most agricultural land. The registration procedure itself is complicated by the fact that there are multiple government agencies that play an important role in the registration process, and the agencies have different and sometimes contradictory internal procedures and standards (Lindsay 277).

Ultimately, in order to convert a land share into a plot of land, or register a land share in order to conduct a transaction, a shareholder must gather the necessary documents from the various offices to establish the location, size, and ownership of a parcel, a process which can take as many as eight trips to six different offices and which may take up to six months. Furthermore, the Cadastre usually requires owners to survey their plot of land before allowing them to begin the registration process. A shareholder withdrawing their land share from the collective holdings of a farm may even be required to survey the entire area under collective ownership. In most cases, the cost of this process exceeds the worth of the land share the holder hopes to convert (Lindsay 278). Private farms are particularly hard hit by these bureaucratic complications: unlike large corporations, private farms cannot afford to hire advisors and have specialized staff responsible for transaction registration (Lerman et al. 22). Land transactions are further complicated by a general lack of market information: a survey conducted by Shagaida and Lerman found that 22%-33% of respondents indicated that lack of information on land prices, lease contracts, and transaction registration procedures was a problem for engaging in land transactions (Lerman et al. 4).

Bureaucratic obstacles to land registration have had the unintended consequence of engendering the growth of a strong land lease market. Leasing land does not require the land to be registered, and is consequently considered a much more effective way of expanding one’s holdings among farmers. The considerable size of land shares in Russia - 10 ha on average - make it easy for farmers to accumulate enough land by leasing just one or two land shares without the complication of added transaction costs (Lerman et al. 16). According to official all-Russia statistics, the share of owned land in farm enterprises was only 1.3% in 2007, and only 5% of agricultural land participated annually in market transactions (Lerman et al. 2). The rental market can be a functional replacement for the sales market because it allows landowners to transfer control of land into the hands of those likely to use it more productively (Lindsay 298).

Despite the growth of the rental market, the creation of a strong land market remains a crucial step in the development of Russian agriculture and Russia’s integration in the global economy. Several steps in the right direction have been made in recent years. The government has begun to provide small farming companies with compensation for part of the expenses associated with the registration of land ownership rights. The consolidation of the three offices involved in the registration procedure into a single ministry in 2009 was also a significant achievement. However, many legislative acts pertaining to land policy are temporary and do not contain mechanisms for their implementation. There is currently still no government structure in place for the effective implementation of land policy: land use and care management continues to be performed by various independent government bodies, and has no integral coordination center (Andreeva et al. 4). Furthermore, current Russian land legislation tends to prioritize issues of land registration over environmental concerns (Andreeva et al. 6). The resolution of the land registration question is thus central both to the development of a strong land market and to the adoption of a sound environmental policy.

Several ideas have been forth as to how the land transaction process can be facilitated. Ira Lindsay has proposed reducing transaction costs by subsidizing the conversion of land shares into plots and increasing funding for land surveying services (Lindsay 300). Another sound initiative would be to extend current state subsidies to private farms and households engaged in commercial production rather than limiting government support to large corporations (Lindsay 301). The creation of an accessible database to provide the public with market information would also be advisable. More broadly, improvements in the legal and administrative mechanism for the land policy implementation should be the top-priority government task (Andreeva et al. 6). These improvements can be achieved through the development of a state land use management system which focuses the country's land policy implementation within one government agency. Greater centralization at all levels of the land policy and registration network would dispel both the uncertainty and the costs associated with bureaucratic barriers to development borne of contradictory or inefficient policies.

The second challenge faced by Russian agriculture today is the land deterioration resulting from the recultivation of previously abandoned cropland. Appreciating this problem requires a closer examination of the Russian government's approach to the agricultural sector over the course of the past century.

Before the Revolution of 1917, Russia was a significant global grain exporter. The rise of the Soviet Union put an end to the lucrative Siberian export, as production was directed towards satisfying domestic demand (Elferink et al.). Under the Soviet Union, the great grain monoculture depended on the central government to finance equipment, fertilizers and other inputs. The distribution of the grain was in turn assured by a pan-Soviet distribution channel centered in Moscow. With the fall of the Soviet Union, government support for the agricultural sector dried up, and the distribution channel collapsed (Elie et al. 81). The challenges that Russian agriculture faces today can largely be traced back to these two developments.

Between 1954 and 1963, the Virgin Land Campaign greatly expanded the Soviet Union's agricultural land base. As low and volatile yields in European Russia increasingly threatened domestic food security, the government ordered a vast cropland expansion in the steppes of Siberia and northern Kazakhstan, resulting in the plowing of 45 million hectares of new land. Hundreds of thousands of farmers flocked to the new collective farms. After the fall of the Soviet Union in 1991, this trend reversed itself: deprived of agricultural subsidies and of a functional distribution channel for their products, farmers emigrated from the previously virgin lands en masse, and large areas of cropland were abandoned. From 1990 to 2007, Siberian croplands declined by 39% (Elferink et al.).

Russian agriculture emerged strengthened from the economic crash of 1998. Russia had been a net importer since the fall of the Soviet Union: however, the devaluation of the ruble suddenly made many imported products unaffordable for most Russians. As demand for domestic products increased, so too did the attractiveness of the agricultural sector. The crash also marked the beginning of the gradual return of the state to the agricultural arena. Under Putin's first term, the state took various measures to promote the growth of the agricultural sector. Among the most notable achievements were the implementation of protectionist custom and tariff policies to strengthen domestic food production; the regulation of the grain market by using customs and tariff regulation, commodity intervention, and purchase intervention; the creation of credit organizations to financially support large agricultural enterprises; the introduction of a consolidated agricultural tax to simplify taxes for both corporate and private farms; and the establishment of equipment leasing programs to improve the stock of agricultural machinery (Wegren 227). Key to the development of reliable sources of credit for large enterprises was the creation of an agricultural bank, Rosselkhozbank, also at the initiative of the government, as well as the development of credit cooperatives to broaden access to credit among smaller producers (Wegren 231).

The government's supportive measures initiated an era of renewed interest in the agricultural sector. In recent decades, climate change has also led to an increase in precipitation, higher temperatures, and longer vegetative seasons in Russia's steppe regions, resulting in higher yields (Elie et al. 95). The sharp rise in grain prices in 2007-2008 further contributed to renewed public interest in the sector. The combination of active government support, favorable conditions for growing crops, and rising grain prices have led to a massive movement to recultivate cropland abandoned in the 1990s. Since 2007, approximately 1.1 million hectares of previously abandoned cropland in Siberia have been replanted (Elferink et al.).

This second wave of cropland colonization has significant environmental costs. The unsustainable, intensive exploitation of previously virgin land during the Virgin Land Campaign caused wind erosion on a massive scale, resulting in a "soviet Dust Bowl" in the 1960s (Elie et al. 100). The recultivation of abandoned cropland today is often carried out with a comparable disregard for sustainability and is having similar environmental consequences. It is crucial that sustainable cultivation methods be implemented in Russia's steppe regions in order to avert further land degradation and fulfill these regions' immense agricultural potential.

One of the prime agricultural regions within the Western Siberian grain belt is the Kulunda Dry Steppe, one of the largest agrarian landscapes in temperate zones. This region has numerous assets which give it enormous potential for mitigating climate change: if properly farmed, the Kulunda Steppe can serve as a model for the type of sustainable and profitable agriculture which could provide for the needs of millions of people. The Kulunda Steppe rates among the regions with the highest soil-organic-carbon worldwide: it is therefore a significant global carbon sink, mitigating climate change. The naturally fertile soil rich in organic matter favors intensive agricultural production: agriculture in this region is therefore characterized by large-scale intensive farming based on monocultures. However, inappropriate land use and poor land management on the steppe have led to severe land degradation. Significant amounts of water are sacrificed as a result of unsustainable farming practices: a substantial amount of water is lost through evaporation during fallow periods, and water availability is further decreased by persistent drought periods. The most pressing issue posed by the current unsustainable farming practices in the Kulunda Dry

Steppe, however, is wind erosion. Wind erosion causes the loss of fertile topsoils, such as humus, accompanied by a decrease in soil organic matter and a loss of carbon. The potential long-term effects of wind erosion on topsoils are devastating: when topsoil is raised by heavy winds, dust particles can agglomerate in the air to form toxic clouds which sweep over thousands of kilometers, destroying land and adversely impacting human health. The most notable example of this is the Dust Bowl of 1930s America, which displaced more than 250,000 people in the Great Plains and took over 7,000 lives. The Dust Bowl of the 1930s also resulted from the Great Plains' farmers' unsustainable soil-tilling methods, which caused topsoil erosion eerily similar to that plaguing the Kulunda Steppe today ("Kulunda Project in West Siberia").

The effects of unsustainable farming practices have also been deeply felt by farmers, who are directly affected by unreliable crop yields and an overall decline in productivity. As a result of the uncertainties involved in farming the once-fertile soil, farming in the Kulunda region has become unattractive and is being abandoned: young people are migrating to cities in search of higher wages and economic opportunity. Meanwhile, modernizing agricultural enterprises have difficulty finding professionals in agronomy or veterinary skills, as the range of careers available to educated young people continues to expand outside of agriculture (Agricultural Economy and Policy Report).The region is thus losing its role as a carbon sink as its potential to mitigate climate change goes largely uncultivated.

In 2011, a research initiative - the Kulunda Project - was started with the goal of "generat[ing] innovative research results to ensure the sustainable economic, social and ecological development of agriculture in the Russian part of the Kulunda Steppe and in comparable regions as well" (Frühauf et al.). The project was conceived as part of the FONA strategy of the Federal Republic of Germany, an initiative of the Federal Research Ministry which aims to support sustainability research. It was conducted by 16 partners from German research facilities, universities, and enterprises in collaboration with the Altai State University of Barnaul and the Altai State Agricultural University (ASAU), the principal educational and research institutions of the Altai Krai. Researchers engaged in on-site measurements and set up trial fields to experiment with different types of land cultivation. Students from the German universities played a central role in the project, conducting most of the on-site testing and carrying out the experiments on the trial fields. The research results were shared with the local farming community at field days held every year in early August through the end of the program in 2016.

The principal sustainable intensification methods investigated by the Kulunda Project were No-till and Minimum-tillage techniques. No-till involves growing crops year upon year without disturbing the soil with the plow: this ensures that the field surface remains covered with residue and stubble from the previous season. Leaving stubble and mulch preserves soil moisture, as it ensures that water accumulated during the winter does not evaporate during the dry season: stubble traps the snow, while mulch provides moisture and oxygen. A factorial field trial conducted in 2015 near Ishim, Russia, seems to confirm this finding: soil moisture was on average 34.4% higher under No-till conditions compared to conventional tillage (Kühling et al. 15). Full implementation of No-till requires specialized No-till equipment that opens narrow slots in the unplowed soil just wide enough to insert seeds without upsetting the soil. The disadvantage of No-till is that leaving the soil unplowed leads the soil to harden ("Minimum Tillage and No-till in Western Siberia"). To counter this problem, researchers experimented with a second type of sustainable intensification, Minimum-tillage.

Minimum-tillage does not turn the soil over, but it does permit minimum disturbance to loosen up hard compacted topsoil before planting. Like No-till, Minimum-tillage increases infiltration, minimizing wind and water erosion and reducing loss of water by evaporation. Both methods result in improved soil structure and aggregate stability: better structure, more organic matter, and increased soil moisture lead to improved activity of soil microorganisms, which play a key role in soil fertility. No- and Minimum-tillage techniques were also shown to increase soil organic carbon by 30-50%: implementation of these techniques therefore has the potential to restore the Kulunda Steppe's role as a global carbon sink ("Minimum Tillage and No-Till in western Siberia").

One disadvantage of No- and Minimum-tillage is that both methods lead to the proliferation of weeds, which in turn results in increased use of pesticides. This problem can be countered by the use of infrared detection technology. As part of the Kulunda Project, the German agricultural engineering company Amazone-Werke GmbH developed a trailed sprayer equipped with a mechanism which only sprays pesticides when weeds are detected. The sprayer works precisely and saves a lot of chemicals: it therefore has substantial economic advantages over conventional fertilizing methods, which consume a greater amount of pesticides ("Amazone in Sibirien").

Another objective of the Kulunda project was the development of a strategic crop rotation system. During trials with sustainable intensification methods, researchers from the Kulunda Project grew rapeseed and nitrogen-fixing peas on soil which Kulunda farmers customarily leave fallow for a season. The regenerative effects of this crop rotation system on the soil were found to be greatly superior to those of the conventional black fallow method: the crops provided the soil with nutrients and leaf cover, leading to reduced water losses, improved soil structure and fertility, and better pest control ("Minimum Tillage and No-Till in western Siberia").

Aside from their clear environmental benefits, No-till and Minimum-tillage have substantial economic advantages. Both methods require less labor and machine hours for the preparation of fields before planting. The researchers' field trials also demonstrated that they can increase yields by up to 25% ("Minimum Tillage and No-Till in western Siberia"). Higher yields coupled with reduced costs result in increased farm income in the long-term. As it takes three to four years for the soil structure to change after these methods are implemented, the economic advantages do not manifest themselves immediately. The same can be said of the infrared detection technology: the advantages of investing in this expensive physical capital manifest themselves in the long-term savings resulting from decreased pesticide purchases. In order to justify the costs that come with investing in equipment involved in sustainable intensification methods, it is therefore essential that the long-term benefits of these methods be made clear to farmers.

Identifying these solutions was but the first part of the Kulunda Project. The second part of the project was geared towards the transfer of technology and acquired knowledge to the farmers. This objective was achieved through the organization of field days sponsored by the researchers' farm OOO KH Partner held once every year for the duration of the project. Up to 450-550 people participated in the field days each year, including heads of the Altai region, members of regional government bodies, heads of other farms, scientists, dealers of machinery manufacturers, and farmers from other Steppe regions, such as Northern

Kazakhstan (Frühauf et al. 494). The goal of the field days was two-fold: first, to share the results of the year's research with the farmers; second, to give them access to the equipment necessary for the practical implementation of the research findings. Part of the field days was therefore devoted to machinery exhibition and a visit to the base experimenting sites, where farmers were shown how to operate equipment involved in sustainable intensification methods and soil monitoring.

Along with providing farmers with the tools and knowledge needed to implement sustainable intensification methods, the researchers sought to impart the findings of the Kulunda Project to a new generation of students in agriculture-related disciplines. This goal was achieved through the creation of the postgraduate German-language study program at the Altai State University. The program is taught in German by lecturers from Altai State University, and is supported financially by the German Academic Exchange Service, with an eye towards keeping German alive as a scientific language in the countries of Eastern Europe, Russia and Central Asia. It combines language learning and in-depth training in Geo-Ecology, which lays the base for a special education as a specialist in various fields related to agriculture and regional development (Frühauf et al. 501). All students attend a one-year German language course, and the best receive an invitation to a two month study stay at the Martin-Luther-Universität Halle-Wittenberg in Germany, where they get further hands-on experience working in research projects (Frühauf et al. 501). Successful completion of the program gives students qualifications in environmental monitoring: over the course of the program students are also introduced to German tools, machinery and enterprises. The goal is that students will be able to use these contacts later when working as professionals.

The German-language study program serves as a model of successful intergenerational, international scientific and cultural exchanges geared towards advancing sustainability goals of interest to the global community. Academic institutions in other countries can draw inspiration from this program when planning their own educational initiatives. Given the similarities between the challenges which Russian agriculture faces today and those confronting U.S. farmers in the 1930s, U.S. universities seem particularly well positioned to conduct a similar program. Such a program would also enhance cultural ties between the U.S. and the Russian Federation by forging lasting partnerships between these two countries. These strategic advantages should suffice to justify the implementation of an exchange program organized in collaboration between the Altai State University and an American university in the U.S.

Like the German-language study program described above, this program would have both a scientific and a cultural component, with the significant difference that the proposed program would be an exchange: students from the participating American university would spend the duration of the program at the Altai State University, and participants from the Altai State University would complete the program on-site at the partner university in the U.S. Coursework would be given in the language of the students' host country: students would also engage in field work, learn to operate machinery used by farmers in the host country, and interact with local enterprises.

The program serves two purposes: on the one hand, it promotes the transfer of technical skills and knowledge between the U.S. and the Russian Federation; on the other, it seeks to forge stronger cultural ties between the two countries. The involvement of an American university enables the sharing of American expertise on subjects relevant to the development of sustainable agricultural methods in the

Kulunda Steppe with a new generation of students from the region. Likewise, the participation of the Altai State University forwards the transmission of the institution's extensive knowledge and findings to the U.S. scientific community. The program also enables American and Russian students in Geography, Geo-Ecology and related disciplines to gain hands-on experience by conducting research and fieldwork in a region different from their own.

This program also furthers the objectives of the Critical Language Scholarship (CLS) program. CLS is part of a U.S. government initiative to expand the number of Americans studying and mastering foreign languages that the U.S. government considers critical to U.S. national security and prosperity. Russian is high on this list of critical languages. Providing American students with in-depth training in Russian with a special focus on technical vocabulary related to their field of study prepares students to use their acquired language skills in a professional context, advancing the declared CLS goal of "preparing U.S. students for the 21st century's globalized workforce, increasing American competitiveness, and contributing to national security" (exchanges.state.gov). At the same time, the program would increase the availability of English as a scientific language in the Altai Krai.

The program would also benefit from the involvement of an American agricultural engineering company. One of the strengths of the Kulunda Project was the central role played by the German agricultural engineering company Amazone-Werke GmbH. Amazone employees worked in close contact with the Kulunda researchers on site throughout the project and turned the vast Kulunda steppe lands into testing fields for new machines. They then used the results produced by the researchers' field studies to assess the machines' relative effectiveness and determine where improvements were needed. The perfected machines were presented to local farmers at the field days. Aside from enabling the company to enhance its products, Amazone's involvement in the project expanded its customer base to include farmers from the Kulunda Steppe and other Eurasian regions.

Introducing Russian students to American agricultural engineering companies and their products as part of the exchange program would benefit both parties: the students would be able to use their contacts with American companies later in their professional careers, and the companies would see their customer base expand and global prestige increase. As a further possibility, an American company choosing to take part in the program could provide the exchange students with experience in the design of machinery. Such an opportunity would be offered in particular to participants studying agricultural engineering. This experience would give students the practical knowledge needed to design and implement machinery that furthers the sustainability goals of their home region more efficiently.

Following is a succinct conclusion surmising the key takeaways of this study. Sustainable intensification methods, including No-till and Minimum-tillage as well as strategic crop rotation, make it possible to effortlessly reduce water waste and soil erosion. These practices also ensure that the Kulunda Steppe's soil organic carbon is constantly replenished, advancing the vast region's potential to mitigate climate change on a large scale. In order for these sustainable intensification methods to be implemented in farms on the Kulunda Steppe, it is necessary that young people entering the agricultural workforce be educated in these methods and have access to the equipment needed to implement them. An exchange program between the Altai State University and one or more U.S. universities with a focus on the mutual transfer of technical knowledge and expertise addresses this requirement. By providing a new generation of farmers with the tools they need to bring about lasting change in their region, this program will ensure that the Kulunda Steppe retains its role as the breadbasket of the Russian Federation for years to come through sustainable agricultural practices which successfully and efficiently mitigate climate change.

Bibliography

Andreeva, Natalya, Lyudmila Dubrova, Elena Ivanova, Mikhail Kabanenko and Lyudmila Orekhova. "The Contemporary State of Russian Land Policy." *e3s-conferences.org,* 29 June 2020,www.e3s-conferences.org/articles/e3sconf/abs/2020/35/e3sconf_interagromash2020_06005/e3sconf_interagromash2020_06005.html. Accessed 5 August 2021.

"Critical Language Scholarship Program." *exchange.state.gov*, exchanges.state.gov/cls. Accessed 5 Aug. 2021.

De Schutter, Olivier. "The Green Rush: The Global Race for Farmland and the Rights of Land Users." *Harvard International Law Journal*, vol.52, no.2, Summer 2011, pp.503-560. *Heinonline,* heinonline.org/HOL/LandingPage?handle=hein.journals/hilj52&div=15&id=&page=. Accessed 21 February 2021.

Elferink, Maarten and Florian Schierhorn. "The Dormant Breadbasket of the Asia-Pacific." *The Diplomat.* 12 February 2019. *The Diplomat,* thediplomat.com/2019/02/the-dormant-breadbasket-of-the-asia-pacific/. Accessed 17 February 2021.

Elie, Marc and Carla Ferret ed. *Verte, la Steppe*. EHESS, 2018, pp.81-101.

Frühauf, Manfred, Georg Guggenberger, Tobias Meinel, Insa Theesfeld and Sebastian Lentz eds. *Kulunda: Climate Smart Agriculture.* Springer, 2020.

Gennadyevna, Tatyana Plutalova. *Геоэкологическая Оценка Состояния и Развития Системы Землепользования в Условиях Трансграничности [Geoèkologičeskaja Ocenka Sostojanija i Razvitija Sistemy Zemlepol'zovanija v Uslovijah Transgraničnosti]*. 2018. Российская Академия Наук [Rossijskaja Akademija Nauk].

Ioffe, Grigory. "The Downsizing of Russian Agriculture." *Europe-Asia Studies,* vol.57, no.2, March 2005, pp.179-208. *JSTOR,* www.jstor.org/stable/30043869. Accessed 18 February 2021.

Kühling, Insa and Dieter Trautz. "Climate Smart Agriculture in Western Siberia - Potential of No-Till in Spring Wheat Production." 2016.

Kühling, Insa. *Strategies for sustainable agricultural land use in Western Siberia (Russian Federation)*. 2017. Osnabrück University, PhD dissertation.

"Largest Countries in Europe 2021." *World Population Review,* worldpopulationreview.com/country-rankings/largest-countries-in-europe. Accessed 5 August 2021.

Lerman, Zvi and Natalya Shagaida. "The Land Market: Living with Constraints." *Comparative Economic Studies,* vol.47, no.1, 2005, pp.127-140. *ResearchGate*, www.researchgate.net/publication/5218909_Agricultural_Land_Market_in_Russia_Living_with_Constraints. Accessed 19 February 2021.

Lerman, Zvi and Natalya Shagaida. “Land policies and agricultural land markets in Russia.” *Land Use Policy,* vol.24, no.1, 2007, pp.14-23. *ScienceDirect*, www.sciencedirect.com/science/article/abs/pii/S0264837706000044. Accessed 20 February 2021.

Lindsay, Ira. “A Troubled Path to Private Property: Agricultural Land Law in Russia.” *Columbia Journal of European Law*, vol.16, no.2, Spring 2010, pp.261-302. *Heinonline,* heinonline.org/HOL/LandingPage?handle=hein.journals/coljeul16&div=18&id=&page=. Accessed 21 February 2021.

Marchand, Pascal. “L’Océan de l’espace rural, bloqué depuis Stolypine.” *Géopolitique de la Russie*. Ellipses, 2007, pp.387-444.

Marchand, Pascal. “La puissance agricole retrouvée.” *Atlas géopolitique de la Russie.* Autrement, 2019, pp.34-35.

Marson, James. “Struggling U.S. Farmers Worry About a Resurgent Russia.” *Wall Street Journal*. 23 September 2018. *Wall Street Journal,* www.wsj.com/articles/grain-is-our-oil-russia-is-besting-the-u-s-as-a-wheat-powerhouse-1537719747. Accessed 18 February 2021.

MawiMedia. “Amazone in Sibirien.” *Youtube,* 7 Dec. 2015, https://www.youtube.com/watch?v=vN7f2FJWFww. Accessed 1 August 2021.

MawiMedia. “Kulunda Project in West Siberia.” *Youtube*, 14 Jun. 2016, https://www.youtube.com/watch?v=iNXqg8CjCew. Accessed 1 August 2021.

MawiMedia. “Das Kulunda-Projekt: Einführung.” *Youtube,* 6 Jan. 2017, https://www.youtube.com/watch?v=mUrWdVaHExE. Accessed 1 August 2021.

MawiMedia. “Das Kulunda-Projekt: Agronomie.” *Youtube,* 6 Jan. 2017, https://www.youtube.com/watch?v=pHTnpQvvVCs. Accessed 1 August 2021.

MawiMedia. “Das Kulunda-Projekt: Abwanderung.” *Youtube,* 6 Jan. 2017, https://www.youtube.com/watch?v=9bbDUscmgjI. Accessed 1 August 2021.

MawiMedia. “Das Kulunda-Projekt: Boden unter Nutzungsdruck.” *Youtube,* 6 Jan. 2017, https://www.youtube.com/watch?v=1NRb1SVN9Rs. Accessed 1 August 2021.

Medushevsky, Andrei. “Power and Property in Russia: The Adoption of the Land Code.” *East European Constitutional Review*, vol.11, no.3, Summer 2002, pp.105-118. *Heinonline*,

heinonline.org/HOL/LandingPage?handle=hein.journals/eeurcr11&div=28&id=&page=. Accessed 20 February 2021.

O'Neill, Aaron. "Russia: Distribution of the workforce across economic sectors from 2009 to 2019." *Statista*, www.statista.com/statistics/271373/distribution-of-the-workforce-across-economic-sectors-in-russia/. Accessed 5 August 2021.

United States Department of Agriculture, Foreign Agricultural Service. "Russia: Agricultural Economy and Policy Report." (GAIN Report Number: RS1819) 19 July 2018, www.fas.usda.gov/data/russia-agricultural-economy-and-policy-report. Accessed 20 February 2021.

Wegren, Stephen. "Russian Agriculture During Putin's First Term and Beyond." *Eurasian Geography and Economics*, vol.46, no.3, 2005, pp.224-244. *Researchgate,* www.researchgate.net/publication/250170299_Russian_Agriculture_During_Putin's_First_Term_and_Beyond. Accessed 26 July 2021.

Wocateer1. "Minimum Tillage and No-Till in western Siberia." *Youtube,* 6 Feb. 2018, https://www.youtube.com/watch?v=LJSqKGh7oKY. Accessed 1 August 2021.