THE COMPUTER AND THE FARMER: THE ROLE OF INFORMATION TECHNOLOGY IN BOOSTING AGRICULTURAL PRODUCTIVITY IN KAZAKHSTAN

SPECIAL POLICY BRIEF BY CASPIAN POLICY CENTER

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ABOUT THE AUTHORS

Ambassador (Ret.) Robert Cekuta
Caspian Energy and Economy Program Chair,
Caspian Policy Center

Ambassador to the Republic of Azerbaijan (2015 – 2018), Robert Cekuta has long and extensive experience as a top level U.S. diplomat. Deeply engaged in advancing high-profile international energy projects, trade policy initiatives and agreements, commercial sales, and other complex international security matters, Amb. Cekuta's positions in the State Department included Principal Deputy Assistant Secretary for Energy Resources as well as Deputy Assistant Secretary for Energy, Sanctions, and Commodities.

In addition, he was Deputy Chief of Mission in Albania and held positions in Vienna, Baghdad, Kabul, Johannesburg, and Sana'a, Yemen.

He set up the Economic Policy Analysis and Public Diplomacy Office in the State Department's Bureau for Economic and Business Affairs, and served on the boards of the Extractive Industries Transparency Initiative (EITI) and the International Energy Agency (IEA), where he also chaired the IEA Board's Standing Group on Long-term Cooperation charged with anticipating global energy developments.

Kristen Cheriegate
Program Manager, Caspian Policy Center

Kristen Cheriegate is currently the Program Manager for the Caspian Policy Center. She holds a Master's degree in Security Policy and National Security Law from the George Washington University. Formerly, she was a Guest Lecturer at College of the Canyons in Southern California and was on the Board of Directors for the United Nations Association of the National Capital Area. She has also conducted research and analysis for both the Center for Cyber and Homeland Security and the Center for European Policy Analysis.

Blake Wilcox
Research Intern, Caspian Policy Center

Blake Wilcox is an MA candidate in the Eurasian, Russian and East European Studies program at Georgetown's Walsh School of Foreign Service. He graduated magna cum laude with a BA from Brown University, where he concentrated in Slavic studies and German Studies. Blake has served as a research assistant at Brown, worked as a business consultant in Washington, DC and participated in the American Councils' Business Russian Language and Internship Program. His research interests include the energy industry in the CIS, sanctions' impact on the Russian economy, and the role of the international financial system in Russia's economy.

Chapter 1
Executive Summary

Boosting agricultural production is a stated policy goal for many of the countries in the Greater Caspian Region. The majority of these countries have a third or more of their populations living in rural areas, often listing them in official statistics as "engaged in agriculture." However, output statistics show meager levels of per-farmer-productivity. Boosting this productivity is, therefore, essential for raising the prosperity and level of living for significant portions of these countries' populations.

The governments of the Greater Caspian Region also frequently announce modernizing or raising their country's agricultural sector as a national goal. The reasons often include boosting export levels or reducing import levels as well as expanding economic prosperity or diversifying the economic base. Programs to increase grain, particularly wheat, production fall into this category as do the initiatives in a number of the countries to increase cotton production. Separate but related to this goal is the push to strengthen food security, i.e., the assured and affordable availability of food supplies to the country's population.

A long-standing aspect of United States engagement with the region's governments is the effort to improve the agricultural base and rural standards of living. USAID has active programs in Afghanistan, Armenia, Georgia, and Kyrgyzstan, for example, to boost animal husbandry, help farmers increase the production of fruits, nuts, and vegetables and to market them more profitably, promote water management, or to help increase farmers' access to credit. It also continues to support the agriculture and food security sector in Azerbaijan, Kazakhstan, Tajikistan, Turkmenistan, and Uzbekistan.

There is engagement by various U.S. states as well. Governments from the Greater Caspian Region have also begun reaching out directly to American states, for example Illinois and Mississippi, to look at how those states support farmers and how farming practices there can be adopted in the Caucasus or Central Asia. Maine is one of many states interested in farmer-to-farmer contacts, noting the experiences U.S. smallholder farmers can share, and how it can benefit both sides.

There is another vector for sharing experiences and expertise which might seem surprising: private sector companies. Farm equipment manufacturers, for example, will offer training to the farmers in countries importing their equipment.

Increased engagement between Americans and the farmers of the Caucasus and Central Asia would be mutually beneficial. The productivity of American farms is among the highest in the world, but there is tremendous diversity in terms of farm size, crops, growing conditions, and marketing goals that can be tapped as countries in the Greater Caspian Region pursue programs to reform and increase the profitability and output of their agricultural sectors.

Against this background, this new Caspian Policy Center report looks at developments in Kazakhstan's agricultural sector. The sector there is already large and profitable. Almost three-quarters of the country's territory is suitable for some sort of agricultural activity and 25-32 percent of the country's soil is arable. Kazakhstan is one of the top ten grain exporters in the world. However, it also classifies 32.2 percent of its estimated 8.2 million strong workforce as engaging in agriculture; meanwhile they account for just 5.8 percent of Kazakhstan's GDP.[i] Eighty percent of the machinery in use is at the end of its lifecycle and needs to be replaced, and 94 percent of the tractors in Kazakhstan are over ten years old. Agricultural machinery

imports were about $300 million in 2017.[ii]

Kazakhstan also offers important insights into the growing intersection between information technology (IT) and agriculture. It is not just that new combines can be run from an iPad, but IT is critical for farmers' marketing decisions as well as for obtaining information to grow better crops.

Moreover, Kazakhstan is putting emphasis on agriculture as part of its overarching drive to be one of the world's top 30 economies by 2050. Even with the shakeup in the Cabinet and President Nazerbayev's resignation, we expect the focus on upgrading agriculture and food production in country to continue. The promotion of Vice Minister of Agriculture Saparkhan Kesikbaevich Omarov to Minister supports this idea. Furthermore, Azerbaijan and other countries in the region are proceeding with agricultural sector reforms as well, including buying modern, western equipment to boost production—bringing new or marginal lands into cultivation, and seeking foreign know-how to improve yields and farmers' incomes.

Chapter 2
A History of Agricultural Reform in Kazakhstan

Agricultural reform in the first two decades after Kazakhstan's independence focused largely on land use rights and ownership structure, basically reversing systems the Soviets had put in place. This period also witnessed the divergence of the agricultural sectors in the country's North and South. In the North, large, vertically-integrated corporate landholders, primarily focused on cul-tivating and processing wheat and oilseed, tended to predominate. In contrast, the South came to have a higher share of family or "peasant" farms: small landholdings dedicated to mixed agricul-ture, producing vegetables, cotton, sugar beets and sunflower, among other crops.[iii] The central part of Kazakhstan has relatively little arable land, but is well-suited for pasture. Thus, it is used largely for meat production.[iv] In addition to the agricultural enterprises and individual farms, there are 2 million rural households that cultivate minute household plots averaging just 0.13 hectares in size.[v]

During the Soviet period, agriculture in Kazakhstan centered on large collective farms, which ac-counted for 99.8 percent of agricultural land.[vi] In 1993, Kazakhstan adopted legislation abolish-ing collective ownership of property—reasserting state ownership of land but establishing a pro-cedure for the redemption of an individual's stake in the property of a collective farm. In 1995, a new law mandated that stakeholders in the erstwhile collective farms receive conditional land shares, which could be used to acquire a land plot or else transferred to another party.

Eighteen percent of shares were transferred to new corporate entities that would become the large agro-holding companies predominant in the wheat-producing North. Twenty-nine percent of the shares were used to procure land plots that formed the basis for family farms that are now a common feature in the South. Twenty-eight percent were subleased to other parties. The re-maining shares were gifted, sold to another party, or went unclaimed.[vii]

The area of land cultivated by agricultural companies declined dramatically in the first years of Kazakhstan's independence. From 1990-2005, the land in use by large holdings dropped from 197 million hectares to 41 million hectares, a 79 percent decline. While part of this decrease stems from the transfer of 37 million hectares of land from collectives to family farms and household plots, 119 million hectares of land ceased being used during this period.[viii] Zheksen-bay Kaskirbayev, Director of Al Barayev Research and Production Center for Grain Farming, notes what outside experts have said as well: Soviet planners cultivated large swathes of highly unproductive land. Thus, a decrease in utilized acreage after the Soviet collapse was to be ex-pected.[ix] Nonetheless, total land under cultivation then increased by 19 percent between the low-point in 2004 and the peak in 2010, suggesting some of this suboptimal land came back into use in the mid-2000s.[x]

The period 2003-2014 saw the agricultural sector stabilized and some additional reforms insti-tuted; but with the oil boom then underway, agriculture was not an area of focus for the govern-ment. In 2003, the government amended the land code to prohibit subleasing condi-tional land shares granted by the 1995 land reform legislation, and mandating that all such shares be trans-ferred to agro holdings, be converted to family farms, or be surrendered to the government.[xi] Nonetheless, subleasing agricultural land remains a fairly common practice, even though legisla-tive changes have driven it underground, with agreements made without any formal contracts and payments made in cash.[xii] The 2003 legislation also for the first time allowed private owner-ship of agricultural land for the first time, although long-term leases remain far more common than private ownership.[xiii]

Agricultural exports, especially of wheat, increased dramatically in this period, but agricultural imports grew even more—resulting in a large trade deficit in agricultural products for most of this period.xiv Rising income levels connected with the oil boom spurred demand, especially for higher-cost products such as meat and milk. However, commercial livestock production col-lapsed in the 1990s, with most meat- and milk-producing activities from 2003-2014 concen-trated in household plots and intended for personal consumption.xv Thus, Kazakhstan needed to import food products to meet domestic demand, with Russia and Belarus being particularly important suppliers.[xvi]

There were also concerns that Kazakhstan's agricultural support mechanisms were biased to-ward the agro-holdings. In a World Bank working paper, Dudwick et al suggest "the enabling envi-ronment for agriculture in Kazakhstan seems to be supportive of large farms though quite a bit less so for small farms."[xvii] This situation is at least partially, perhaps entirely, attributable to the challenges of supporting small family farmers ("small farmers"). Small farmers tend to absorb new information more slowly than large firms, since the latter can hire employees to monitor de-velopments in agricultural science and government policy toward agriculture. Fur-thermore, small farmers are often poor candidates for investment in large capital expenditures often neces-sary for advanced farm equipment, since the financial benefits of such investment tend to in-crease with the size of one's landholding. Finally, transaction costs are high for both parties when family farms apply for insurance, credit, or even subsidies since farmers must dedicate time to learning about opportunities and then filling out forms, which must then be processed by counter-parties.

Nonetheless, the rising tide provided by the oil boom did lift the fortunes of rural citizens. De-spite chronically low levels of labor productivity on small farms, the percentage of the rural pop-ulation with income below subsistence level dropped from a high of 59.4 percent in 2001 to 8.8 percent in 2011.

The drop in world oil prices starting in 2014 seems to have led Kazakhstan's leaders to express sustained interest in growing the agricultural sector as a means of diversifying the economy. Previous president Nazarbayev underscored this point in his 2014 Address to the Nation, stating "it is important to safeguard the transition of the agro-industrial complex to a path of inno-va-tion."[xviii] The former president reiterated this sentiment during his 2017 Address to the Na-tion, saying "the agricultural sector should become a new driver of the economy."[xix] Repeated themes in Kazakhstan's current agricultural programs include boosting labor productivity in agriculture, investing in agricultural research, increasing exports, and developing local meat and dairy pro-duction capacity. Kazakhstan's government, while continuing to support large agro-holdings, has increased its efforts to support small farmers. Moreover, and as this report

details, Kazakh-stan has utilized the Internet to create a platform for helping its farmers, e.g., by hosting a variety of educational materials as well as electronic access to insurance, cred-it, and government subsi-dies, particularly to reduce obstacles small farmers face to increase their productivity.

Fig 1: The agro-food trade deficit has narrowed somewhat in recent years

Chapter 3
Digital Kazakhsta

On December 12, 2017, the government of Kazakhstan adopted legislation launching "Digital Kazakhstan."[xx] The ambitious program calls for transforming Kazakhstan's economy by applying innovations in information technology to a vast range of economic sectors, including agriculture.

As the legislation notes, agriculture, forestry, and aquaculture represent just 4.6 percent of Kazakhstan's GDP, while employing 18 percent of the country's workforce. Although the value of agricultural goods and services rose 5.4 percent year-on-year in 2016, the law's authors note agricultural production "lags behind the tempo of growth in the population's consumption and income." In addition, as levels of labor productivity and competitiveness remain low, Kazakhstan continues to rely on imported food, despite the country's enormous agricultural potential. The 2017 law also expresses the desire to learn from other countries with highly competitive agricultural sectors, noting, "As demonstrated by the experience of developed countries like the United States, Canada, and Australia, digital technology is fundamentally changing this traditional sector."

Kazakhstan has already made a number of policy changes in recent years, including in its use of IT. The OECD, for example, noted that applications to KazAgro for credit and leasing instruments have been able to be made electronically since 2017.[xxi] The OECD also pointed to the implementation of computerized customs procedures as part of the new Customs Code of the Eurasian Economic Union that came into force in January 2018. The government looks to build several Internet-based platforms to boost efficiency across various aspects of Kazakhstan's agricultural sector. A broad array of projects is included, but two overarching goals are apparent. One is a push to reduce bureaucratic burdens on farmers by computerizing and automatizing government processes. Another is to provide additional information/data to farmers in order to help them boost their productivity.

The government expects significant agricultural sector growth as a result of the modernization envisioned by Digital Kazakhstan. It foresees 6.4 percent annual increases in agriculture-sector labor productivity, and yearly rises in the level of food exports of 11.1 percent through 2022. Overall, Kazakhstan's authorities expect agriculture-sector labor productivity to be 45.1 percent higher in 2022 than in 2016, and food exports in this period to be up 69 percent.

Implementing the Digital Kazakhstan program requires a number of organizations with different core competencies to cooperate, including the Agriculture Ministry, IT holding company Zerde, the agricultural research organization NASEC, and AgriTechHub Kazakhstan.

Kazakhstan's Ministry of Agriculture plays a key role in coordinating and managing the various initiatives. Former vice minister of agriculture, Arman Yevniyev, lead the program. The First Vice Minister oversees the Department of Development of Government Services and Digitalization of the Agro-Industrial Complex, which is directed by Bauyrzhan Aimbetov. This department is subdivided into three offices, with managers for the various projects. These managers are to coordinate the activity of the Agricultural Ministry utilizing with input from outside stakeholders.[xxii]

Zerde, an IT holding company operating under the auspices of Kazakhstan's Ministry of Information and Communication, is to assist in building out the back-end digital architecture necessary for Internet-based platforms.[xxiii] NASEC has been involved through its Kaskelen Agropark, which has been engaged in field-testing newly imported techniques and equipment.[xxiv] Finally, AgriTechHub Kazakhstan serves as a start-up accelerator for agriculture, connecting foreign and domestic academics to research funding and start-up capital.[xxv]

Chapter 4
Digitizing State Agricultural Services

The advancement of the agritech industry remains imperative to Kazakhstan's continued economic success. As noted in the previous chapters, the Central Asian country has taken steps to improve the role of technology in its agricultural sector in recent years, most certainly to ease restrictions previously burdening its farmers.

Previous Kazakh President Nursultan Nazarbayev took note of these needed changes last year and provided the nation with a new direction. In his January 10, 2018 speech, the former President acknowledged digitalization and the application of new technologies as the primary vectors to further the country's overall development. These programs present opportunities to take advantage of the extensive amount of farmland available, and the country's diverse climatic conditions.[xxvi] Moreover, steps such as digitalizing state regulations and services, and a renewed focus on technologies, keep with the government's overall goal of making Kazakhstan one of the world's top thirty economies by 2050.

Electronic agro-industrial complex (E-AIC) is one of the seven focus areas in Kazakhstan's Ministry of Agriculture's program for developing the country's AIC. Exports of processed agricultural products can remain at a steady level without the introduction of digital technologies, and Kazakhstan has noted this. However, in order to increase the number of exports, in line with the digitalization of the AIC, at least 20 digital farms and 4,000 advanced farms throughout Kazakhstan are to be created, with 100 percent automation of processes and digitalization of public services.[xxvii]

This economic effort is expected to extend until 2025 and to cost just over $106 million.[xxviii] Digitalization of state agricultural services will help increase competitiveness and labor productivity, ensure food safety, and attract investment in the industry. Farmers in Kazakhstan should soon reap the benefits of this digitalization, most certainly those in rural areas, as its main elements of precision farming and "smart farms" are slowly introduced and implemented.

The Kazakh government has put farmers' ability to have access to efficient and productive technologies in the forefront of its policy. In January 2019, Yevniyev had reported that the Ministry had set up an office specifically for digitizing Kazakhstan's agricultural complex. The office reportedly has already begun to increase Kazakhstan's labor productivity and efficiency through technology, while assisting businesses in developing IT in the field.[xxxii] Umirzak Shukeyev, Deputy Prime Minister in Kazakhstan's Ministry of Agriculture, was of the lead spokespeople to

Brief Explanation of Precision Farming

The first stage of this process involves the creation of electronic maps of fields with geopositional, vegetative, agrochemical, hydrogeological, ameliorative, and meteorological layers.[xxix] Precision farming consists of a range of processes that facilitate accuracy and control when it comes to growing crops and raising livestock. A key component of this farm management approach is the use of information technology and equipment for GPS guidance, control systems, sensors, robotics, drones, autonomous vehicles, variable rate technology, GPS-based soil sampling, automated hardware, telematics, and software.[xxx] Digitization also facilitates precision farming. Precision farming utilizes satellite and computer technologies—providing farmers with the ability to erect a detailed portrait of their fields. More than 70 percent of today's agriculture equipment possess at least one aspect applicable to precision farming, and the relevant measures are expected to decrease losses in the field by 25 percent.[xxxi]

propose equipping all agricultural equipment with GPS tracking systems and connecting them to a centralized system within the Ministry. According to Shukeyev, there is an opportunity to create more than 2,000 digital farms by 2021.[xxxiii] Many rural farmers, however, question whether it will indeed be possible to purchase the machinery needed to implement such advances. At the same time, there are indications that investments in these new technologies may be feasible for farmers, with some reportedly priced at around $100 per unit of such equipment.

A great case study would be the Kostanay region — which started the digitalization process some time ago. Project "Smart Dairy Farm" was implemented in early 2018, which introduced new technologies. The head of the Kostanay Region's Agricultural Department, Darkhan Abdikarimov, stated in 2018 that the region had already digitized crop rotations. The receipt and consumption of grain, as well as fuel use, are monitored online; based on the electronic data on the production of aggregates, wages are charged to machine operators, where a statistical analysis of production records is conducted.[xxxv] For example, the project "Smart Dairy Farm" provides for the introduction of technology implantation bolus. Executed by Sadchikovskoe LLP, a company that produces natural dairy products in the Kostanay region, there has been an increase in the amount of milk produced due to the precise determination of the insemination period.

Looking for Inspiration

In its drive to modernize agriculture and boost productivity, Kazakhstan has looked at technologies and processes that have worked in other countries. One example is the first joint German-Kazakhstan agricultural forum "Digitization in Agriculture," which was held at the Kazakh Agrotechnical University in May 2018. There, scientists reported that if modern technologies were introduced into production, Kazakhstan could increase the yield of grain crops by at least two times, labor productivity by 2.5 times, and the number of livestock by 1.5 to 2 times.[xxxiv]

Digitalization will be a key tool for the development of the following four directions of state regulation of the agro-industrial complex: availability of funding for AIC subjects, availability of commodity markets and export development, effectiveness of state control and supervision, and effective management of water and biodiversity.[xxxvi] In general, the push is expected to last until 2025 and is estimated to cost just over $106 million.[xxxvii] The bottom line is that digitalization of state agricultural services will help increase competitiveness and labor productivity, ensure food security, and attract investment in the industry

Chapter 5
Qoldau – Kazakhstan's Unified Agriculture Portal

Kazakhstan's Agricultural Ministry plans to create a single web-based hub that can provide a wide range of services for farmers. Government plans call for the site to provide access to government services as well as services from third parties curated by the government site, qoldau.kz, which is already up and running; although, its functionality is limited since many planned features of the platform have yet to be implemented.

The Qoldau platform is largely built around Kazakhstan's digital registry of agricultural land. By creating a digital map of all extant plots of land, the authorities can eliminate overlapping claims, improve the accuracy of the land register, and streamline the process of gathering information about landholders for third parties. The project is largely complete, with 23.7 million hectares, or 98.8 percent of agricultural land, included in the system as of September 2018.[xxxviii] Within the system, every plot of land receives a unique identification number, which is then associated with a single individual or corporate entities with rights to farm it. Qoldau currently has 141,982 registered users according to the site's statistics page,[xxxix] each of whom has a profile page linked to their land holdings under the digital registry.

Qoldau provides an interface for users to access government services. Applications for agricultural producers to receive government subsidies are made on the site and if an application is successful, the disbursement of funds is also managed via the platform.

The site is a clear example of Kazakhstan's e-governance policy, which seeks to leverage computer technology to reduce bureaucratic headaches for its citizenry while also reducing the opportunities for graft by maximizing transparency.[xl] Because users submit applications for payments and other services that are digitally linked to plots of land with known acreage, the system can easily calculate appropriate subsidies for each user based on digital records. This linkage effectively prevents individuals from claiming subsidies in excess of their legally mandated allocation, reduces the chances for officials to seek bribes, and decreases the administrative burden of checking physical documents to verify applications.

The site also holds information about a number of other government programs related to the agricultural sector, including state purchases of grain to enforce a price floor on wheat and the distribution of subsidized fuel for agricultural use.

The platform also offers a suite of third-party services for agriculturalists that includes insurance, credit, weather reporting, consulting, and data analytics, with additional offerings planned for the future.

Drought insurance, for example, is available through Qoldau. The system leverages data to lower costs by reducing administrative burdens and more accurately assessing risk. The service, called "Agroinsurance," provides indexed insurance with payouts tied to the level of moisture in the soil in a particular plot of land. Soil moisture across Kazakhstan is determined by VanderSat, a Dutch firm which utilizes satellite data to infer the presence of water in the soil. Thus, if a farmer purchases insurance, the platform simply queries the database of soil moisture data from VanderSat and triggers an insurance payout in the event that the moisture index drops below the established limit. Again, this system drastically reduces opportunities for fraud since the validity of any claim is determined by an objective third party whose methodology is based on Big Data analytics. The system also requires substantially lower administrative expenditures by the insurer, since 1) there is no need to dispatch an insurance adjuster to assess a claim's

validity, and 2) the Qoldau portal handles claims disbursement. Furthermore, the wealth of data contained in Qoldau can be used to assess more accurately the risk of the insurance pool, thereby enabling the insurance provider to lower reinsurance fees by reducing uncertainty.[xli]

Qoldau's online credit service will expand farmers' access to credit. Farmers need access to significant funds to invest in newer agricultural techniques and equipment in order to improve labor productivity and outputs. Historically, Kazakhstan's farmers have underinvested in factors that could improve the quality and increase the quantities their farms produce. Much of this underinvestment can be attributed to the high up-front costs equipment purchases often require and to the lack personal assets that farmers can utilize. Thus, increased access to credit allows agriculturalists to invest in business improvements and increase output.

Qoldau will also help promote optimal investment by pairing access to financing with resources that will increase the intellectual capital of farmers. Examples include consulting services that can advise farmers on suitable investments in precision agriculture, as well as forthcoming training courses that will teach farmers how to utilize new equipment with maximal efficiency.

Extension services, prized and even expected by farmers in the United States and the west, are often weak or lacking in Central Asia and the Caucasus. Qoldau also offers an "AgroConsultant" service in partnership with AgriLab, a Ukrainian consulting firm dedicated to enabling productivity gains in agriculture through the use of technology.

The AgroConsultant service offers farmers the ability to conduct agrochemical soil analysis, providing various types of support to facilitate the procedure. One example is a tool on the Qoldau user portal which helps agriculturalists independently extract soil cores for analysis. Users construct a grid system superimposed on the digital map of their plot, and the system then outputs the precise location coordinates for soil core extraction. This tool allows farmers to save money that would otherwise be spent on hiring a third party to gather soil samples. The chemical analysis records the prevalence of more than a dozen compounds in the soil, which is then used to make recommendations about methods for rectifying soil deficiencies. Soil analysis is flexible insofar as it can be adopted for different purposes. A relatively small number of cores can be analyzed to make more general recommendations on micronutrients to add to a field. More detailed analyses with a greater density of samples per hectare can generate high-resolution nutrient maps that serve as the basis for variable rate application of seeds and fertilizers. Use of this "Variable Rate Technology" is a feature of digital farms identified in documents released by the Kazakh Ministry of Agriculture, and promoted as part of the Digital Kazakhstan initiative. Thus, Qoldau is being leveraged to promote other goals in an example of positive synergy.[xlii]

Plans call for additional functions to be added to Qoldau. AgroTracker will provide satellite monitoring for agricultural products after they leave the farm, enabling tracking of food supplies to increase domestic food safety. AgroUber has been mentioned as a future project, and although few details have been released, expectations are that the service will serve as a market for vehicle rental, allowing owners to derive earnings from unused capital and permitting other farmers to access technologically advanced equipment without upfront expenditure. AgroTrader will function like eBay for agricultural products, allowing agricultural producers to market their products directly to anyone interested in using the platform, thereby increasing farmers' incomes by reducing the need for intermediary buyers.[xliii] The Ministry of Agriculture has also announced plans to release an online training program for farmers, allowing them to bring their skillsets in line with the requirements of modern, high-tech agriculture. It is unclear

whether this education platform will operate independently or as part of Qoldau, although the latter seems likely, given the emphasis on consolidating resources into a single website.[xliv]

While the services available on Qoldau are valuable in and of themselves, perhaps the greatest value of the site lies in its ability to serve as a platform that can support the connection of different applications and facilitate the sharing of data across different programs. In a white paper on IT in agriculture, Dean Hamilton of Accelerite argues that the creation of a unified data ecosystem is a necessary next step in precision agriculture.[xlv]

"The problem with many of today's smart farm IT technologies is that these applications exist in silos. Even if fully-automated, they do not work efficiently together. The algorithms for scheduling irrigation don't take into account when fertilizer was last applied. [...] Valuable data from the many silos throughout the farming operation must easily and automatically integrate."

Hamilton's white paper was reposted on the website for the Digital Kazakhstan project run by Zerde, which is also a partner on Qoldau.[xlvi] The post suggests that responsible parties are already thinking about the importance of developing an integrated digital hub for precision farming. Qoldau has the potential to be turned into just such a hub, since it already hosts multiple relevant data sources, including digital maps of farm plots, weather data and soil moisture data from VanderSat. Even if Qoldau is not turned into a digital hub for precision agriculture, it could still serve as a valuable source of input data sent from a Qoldau app to a third party's integration platform. Thus, many opportunities exist for fruitful collaboration between independent software developers, smart equipment producers and Qoldau developers. Qoldau's developers could serve, therefore, not just as passive participants, but actually as active drivers in the development of smart farming technology in Kazakhstan.

Chapter 6
Case Study Comparison: Georgia and Kazakhstan

Georgia has witnessed the development of a number of Internet-based platforms similar to Kazakhstan's Qoldau. However, the structures of the economy in Kazakhstan and Georgia have determined the development paths of the web platforms.

Kazakhstan employs a model of state capitalism, with the government in control of a large percentage of economic activity in the country. Reflective of this situation, Qoldau is being developed as a government initiative and combines government services with commercial services of independent firms. The combination effectively drives traffic to the non-governmental offerings. Farmers who may not have thought of conducting soil analysis will, at the very least, scroll past the service as they go to claim their agricultural subsidies.

In contrast, Georgia is oriented towards free-market capitalism. The three Georgian agricultural platforms detailed below were developed by non-governmental entities, with funding from development organizations.[xlvii] Consequently, they cannot offer government services to drive traffic to their platform and must compete with one another for market share. As a result of these structural factors, Georgian Internet-based platforms for farmers have a relatively small number of users. Faced with structural challenges to growing their platforms, the developers will need to utilize innovative techniques to increase their user base.

Traktor

Traktor was launched as an Internet site and mobile app dedicated to providing education materials to Georgian farmers. A Georgian-Dutch team of serial web entrepreneurs developed the platform with funding from the EU, USAID and the Dutch government.[xlviii] Traktor offered Georgian farmers instructional videos on best practices in agricultural science and a crop calendar with advice on optimal planting times. To reach farmers with limited Internet access, Traktor partnered with a Georgian telecom company to offer its member a smartphone with a data bundle for just $3 per month. The platform also offered an online marketplace with seeds and equipment, allowing farmers to access high-quality inputs referenced in instructional materials while giving the platform's developers a means to monetize their platform by receiving a percentage of marketplace sales. In 2018, Traktor was absorbed by Kalo; Traktor services are now offered on the Kalo platform, and the Traktor app and website were discontinued.[xlix]

Kalo

Credo Bank, a micro-finance organization active in Georgia, developed the Kalo platform as a source of educational materials for farmers. The project was conceived as a means to reduce credit risk for Credo by raising farmers' productivity and income. The results benefit both parties. Initially, the platform was funded by Credo's loan portfolio, with a fee for Kalo site maintenance included in each farmer's loan package.[l] The merger with Traktor has enabled an increase in Kalo's service offering and an expansion of the platform's user base. Kalo has also been working toward integration of Credo's lending arm and the Traktor shop so as to allow farmers to make purchases from the platform's store on credit.[li]

Agronavti

Agronavti is a mobile app developed by the Georgian Farmers' Association (GFA) as a marketplace for agricultural products. The app supports the Georgian Farmers' Distribution Company's activities by connecting supplies from registered farmers and demand from consumers in the hospitality industry. In contrast to Traktor and Kalo, which utilize an open-access model for

their platforms, Agronavti is intended to boost membership in the GFA by providing only registered affiliates access to services. Agronavti provides other useful information to farmers, such as weekly price indices for agricultural products, reports on new developments in agricultural science, and weather data. The app is developing the capability to provide farm-to-table traceability of food products on its site, just like Kazakhstan's Qoldau.[lii]

Chapter 7
Agritech Investment Opportunities

Investments in agriculture technology have sharply increased in the past few years. The amount of money invested worldwide in the sector jumped by more than 40 percent in 2018, amounting to $17 billion according to new industry figures.[liii] Kazakhstan's proximity to its neighbors' large markets is a factor in developing business and investment strategies. There are also a great number of areas within Kazakhstan's agriculture sector where the U.S. private sector may be able to realize opportunities.

Agriculture Equipment and Machinery

Nearly 80 percent of machinery currently in use in Kazakhstan is at the end of its lifecycle and needs to be replaced. For example, tractors that have been in use for over 10 years account for 94 percent of Kazakhstan's fleet, while harvesting combines in similar condition make up 77 percent of the country's total.[liv] Most agricultural equipment and machinery is imported, with few produced locally. In 2017, Kazakhstan's agricultural machinery sector was roughly estimated at approximately $500 million, of which $300 million was imported; Russia is a market leader in this sector, with a 40 percent market share.[lv]

The costs of new machinery will likely be surprising and may be a hurdle for many farmers, even though the Kazakh government seems determined to prove the worth of such purchases. The Ministry of Agriculture allocated approximately $1.1 million to import three new combines to assist in the modernization of Kazakhstan's agricultural equipment last year. One of which was tested in a wheat field in Almaty Province in July 2018 and controlled via satellite.[lvi] Praising this particular combine, then vice minister of agriculture Arman Yevniyev remarked, "Any farmer can come to the agricultural park, sit down, steer, and become convinced how convenient this is."

The Kaskelen Agropark began to lead the way for many last year, showing the new harvesters are worth the cost. Executive Director of the Kaskelen Agropark Andrei Ageyenko said the following in an interview with Caravanserai:

"The agricultural park intends to prove the advantages of the American combine under real world conditions by using it to harvest grain in test fields. […] Each harvester costs about $340,905, but it will save up to $56,249 in operating costs per 100 hectares of land. For the average farmer, this machine will be expensive, but if several farms join together, they will be able to purchase a combine and it will pay for itself in a year."

Satellite Technology

Satellites have proven to not only be useful in controlling machinery, but particularly in locating unused plots of land. Two and a half million hectares of unused land lie throughout Kazakhstan. Its Ministry of Agriculture recently reported that 388,000 hectares are currently being used, 804,000 have been returned to the state, and the remaining 1.4 million hectares are to be returned through legal proceedings.[lvii]

Previous vice minister of defense and aerospace activities of the Republic of Kazakhstan Marat Nurguzhin has emphasized the benefits satellite technology can bring. During a February 2019 roundtable in Mazhilis on the rational use of land resources, he noted that over 15,000 plots of unused land on 4.7 million hectares were found through the technology, making it possible to reduce the number of illegally seized plots of land from 2,500 to 400.[lviii]

Digitalized maps of this land can assist farmers in making better use of it as well. They have the ability to help farmers anticipate the likelihood of a food shortage or oversupply—all while predicting and observing natural disasters. Although illegally seized lands are a problem in Kazakhstan, their return will provide for opportunities for investment to support farmers through advancements in technology.

Smart Bridge Project and Quality Internet

The Smart Bridge project is a system that accounts for agricultural machinery through a single electronic database, with its registration falling under the Digital Kazakhstan program. This project is used to promote the country's standing in the United Nation's ranking of countries who have high levels of e-government development. Kazakhstan's National Information Technologies (NIT) JSC operates the government's Intranet and provides system and technical support to fifty-four information systems used by government agencies. The NIT JSC Board Chairman, Aset Turysov, spoke at a February 2019 press conference about the purpose of the Smart Bridge project. The project, he said, will cut integration time within the framework of business management softwares from three months to one, decreasing the amount of technical and working documentation, and reducing the time for official approvals accordingly.[lix] Moreover, one of the main elements of this project is the introduction of artificial intelligence.

The lack of quality Internet, especially in rural areas, is also a critical factor affecting the ability of Kazakh farmers to use these improved technologies. The good news is that 2.4 million Kazakhs living in these regions expect to receive high-speed Internet by 2020. Then Minister of Information and Communications, Dauren Abayev, released a yearly report for 2019, flagging the start of construction on a 20,000-kilometer (about 12,427 miles) optical fiber network. The 1,200 affected villages (and 3,500 schools) will be connected in stages and the government expects over 1.29 million people to receive high-speed Internet near the end of 2019 and ahead of the deadline.[lx]

For the private sector, this development means connectivity will be a focal point for the foreseeable future. For many regions the changes will be monumental, even if the technology might seem small to outsiders—such as the use of smartphones. Smart phones and the ability they provide to individuals to find and act on information will likely be much more readily available to the public; currently only 64 percent of Kazakhs use such phones to access the Internet. Also, many forms that were previously required to be filled out and submitted in-person can now be handled online. For rural farmers, access to electronic databases may be key to improving output, as well as providing them with a level of connectivity that was once otherwise not readily available.

Drip Irrigation

The desiccation of the Aral Sea is one of the world's great environmental disasters. What used to be the fourth largest saline lake in the world is now just a tenth of its original size. This situation came about via the Soviet Union's misuse of water. Drip agriculture is an important step forward, as one of the most efficient methods of irrigation. Kazakhstan, not wanting to perpetuate past mistakes, is looking for investments in the sector.

Kazakhstan does not currently have any environment-related criteria for allocation of subsidies, although drip irrigation is included in the list of eligible investment projects.[lxi] As Kazakhstan also reduces CO2 emissions from its agricultural sector, it has utilized drip irrigation systems to reduce its energy intensity, thus making it a prime option for investments for organizations keen to reduce their carbon footprint.

It previously acquired these technologies from Israel as part of its efforts to export new agricultural products to world markets. Drip irrigation systems have proven to be about 90 percent efficient in comparison to sprinkler systems at 75 percent, with water savings reaching up to 50 percent, as well.

The improvement in irrigation and drainage systems is already visible in regions where they have had the finances to implement this new technology. For example, one hectare on a farm in south Kazakhstan previously produced 4,409 pounds of tomatoes, but that same hectare now produces over 22,000 pounds using five times less water.[lxii] Moreover, farmers of the Panfilov region, who use drip irrigation to grow corn, receive up to 13,200 pounds from one hectare, which is twice more than the average yield in the oblast.[lxiii] While these successes are to be applauded, there are many regions in the country that still do not have access to such technologies.

There are other technologies that can also boost production and use water more efficiently. One advanced technology, which can be used in tandem with drip and subsurface drip irrigation, is variable rate irrigation (VRI). VRI provides farmers with the ability to customize water application between fields, and is customizable down to the square foot. In center pivot technology, VRI works by combining hardware and software, along with tailor-made preferences for each grower, to apply only as much water as is needed to the precise location that needs it.[lxiv] This type of technology can preemptively stop a recurrence of past ecological problems.

Farmers are heeding the call to increase their production by utilizing such technology, but costs and access to financing may be a problem. Investors who can provide, or have access to, low-cost drip systems are needed. Small-scale farmers in Kazakhstan may hit a bump in the road when looking to purchase drip irrigation systems, since the conventional systems cost approximately $1,200-$3,000 per hectare. Low-cost systems can fall in the range of $500 per hectare and would offer rural farmers more opportunity to purchase these technologies, as well as variety of sizes to choose from. By providing systems that are designed with affordability in mind, the market for investment will be much broader.

Green Technology

Kazakhstan is pushing a "go green" movement, which then President Nazarbayev had helped support with a commitment to renewable energy. Various agencies have used this movement to catapult their own projects, with the Energy Ministry boasting a goal of increasing its non-fossil-fueled energy to 50 percent by 2050. Kazakhstan's government also notes that the sun shines down on the nation for 70 percent of the year, thus providing opportunities for solar power. Many financing organizations are taking advantage of this and showing interest in supporting solar panel projects, with the European Bank for Reconstruction and Development (EBRD) providing $73.4 million for such a project in late 2018. The EBRD was joined by the Green Climate Fund in the $130 million effort that successfully built the Saran power plant, which houses 307,664 solar panels across 405 acres—now considered to be the largest solar plant in Central Asia to date.[lxv]

Additionally, a Best Available Technologies Inventory is being established in Kazakhstan. Upon completion, farmers will have the means to choose optimal alternatives, easing the decision-making process for those involved in green projects. Head of the International Center for Green Technologies and Investment Projects Rapil Zhoshybayev has stated that the purpose of the center is to create conditions to attract investors, to assure payback and security of green investments, to build green culture, and to tackle ecological problems through the development

of green technologies in Kazakhstan and subsequently in Central Asia.[lxvi]

Investment in Technology and Research
Attracting investment funds is essential for the application of the modern technologies key to Kazakhstan's economic sector ambitions. In October 2018, the Kostanay region's Investment Forum boasted 19 agreements that totaled $680 million worth of investments—almost double the number signed the previous year. While some of these investment agreements apply to the production of televisions and computers, as well as other manufacturing projects, millions pertain to the production of tractors and agricultural equipment (with one of these projects estimated at $43 million).

The "Kazakhstan 2050" strategy provides the framework for this economic modernization. "We expect to ensure the investments in technology up to $742 million by 2021 with a gradual increase of support measures. The renewal of agricultural machinery will reach approximately 6 percent in three years; now, it stands at 2 percent," according to then Prime Minister Shukeyev. [lxvii]

That said, public spending on research and development in agriculture (relative to the value of production), termed "agricultural research intensity," has dropped to very low levels. Shukeyev noted agricultural research intensity in the United States is more than 25 times that of Kazakhstan. Yermek Beisembayev, chair of the company San Mir Astana, is a strong advocate of raising public spending in this area.[lxviii] Just transferring tools, machines, and engines is not enough, Beisembayev noted, adding that when looking to transfer technology, transferring knowledge, experience, and skills along with the tools is far more important. Investments in technology that are paired with providing expertise in the usage of such equipment may prove to be the top choice for Kazakh regions.

This point is key. Continuing agricultural research, including on how best to apply new technologies to the various conditions farmers face, is critical for maintaining and boosting agricultural production. Moreover, the risks inherent in farming are such that farmers are often nervous about new crops, equipment, and techniques. Farmers need to learn about, and become comfortable with, new technologies to boost labor productivity in the agricultural sector—as well as on how to boost output and agricultural exports. This offers an open door for private companies that have the ability to not only provide the technology and equipment, but also offer an investment in education and expertise.

Chapter 8
Recommendations

Recommendations to the Kazakh government:

- **Kazakhstan's new government should continue to focus on strengthening the country's agricultural sector.** A new administration is an opportunity to reassess and recalibrate. However, the size of the country's rural population, the current level of their standard of living, and Kazakhstan's agricultural potential all argue for ongoing focus on the sector and the needs of individual farmers.

- **Keep improving transport systems to facilitate the movement of agricultural goods to market**. There are a number of projects underway to address weaknesses in the country's transportation network. Doing so will facilitate farmers' access to both domestic and international markets.

- **Increase the ways for rural populations to utilize the Internet.** Smart Bridge can be an important step to help Kazakhstan's farmers and to boost agricultural productivity. Expanding it or establishing another unified platform for farmers and government workers to exchange information would simplify organizational procedures for integration and interaction. At the same time, it is necessary to act to increase rural populations' ability to have access to quality internet in order to use electronic databases, obtain timely information about markets and prices, and get needed services.

- **Increase and broaden levels of research**. In addition to looking at ways to improve farming techniques or the production of specific crops, it is important to have mechanisms to ensure that agricultural technologies are relevant to user needs or adoption contexts, or that broader agricultural expenditures are effective. The social science and economic capacity of the research system should thus be enhanced and should look also to help ensure agricultural policies re evidenced-based.

- **Accelerate research network linkages and technology transfers**. There is currently a gap between domestic and international research institutes. By expanding their current partnerships through the transfer/borrowing of unique technologies, research networks will provide for a stronger economy of transferrable knowledge.

- **Revisit existing agriculture taxes**. While a number of factors need to be taken into account, attention should also be paid to seeing that tax policies help ensure a farmer's land is used efficiently, instead of leaving it idle.

- **Boost connections between Kazakhstan's farmers and agricultural policy makers and counterparts at the Federal and state levels in the United States.** State and local agencies are important repositories of agricultural know-how in the United States. On-going connections between them and Kazakhstan's authorities and using them as a means to foster or increase farmer-to-farmer connections would yield economic as well as foreign policy benefits.

- **The U.S. Administration should continue working to build bridges between America's agribusiness and technical/research communities and Kazakhstan**. United States exports to Kazakhstan consist mostly of grain harvesting combines, reapers, sprayers, tractors, seeders, cultivators, grain drying, and cleaning equipment. The U.S. Commerce Department has noted prospects, which include 100-150 horse power (hp) tractors and combines for the southern regions, tractors of greater than 250 hp and combines for the northern regions, pneumatic seeders, reapers, sprayers, grain drying and cleaning technologies, grain storage equipment and storage quality control systems, water-saving technologies, engineering, design, and veterinary services for cattle feed complexes, and on-farm processing facilities.

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1725 I ST NW, SUITE 300, WASHINGTON, DC 20006
202.349.3762
INFO@CASPIANPOLICY.ORG
CASPIANPOLICY.ORG

CPC  CASPIAN POLICY CENTER