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GLOBAL DISRUPTIVE TECH CHALLENGE 2021

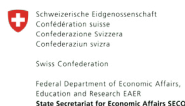
RESTORING LANDSCAPES IN THE ARAL SEA REGION



SYNOPSIS OF THE REPORT ON MARKET ANALYSIS OF EXISTING INNOVATIONS AND STARTUPS IN THE FIELD OF LAND RECLAMATION APPLICABLE IN THE ARAL SEA BASIN



Photo Credit: Алимжан Жоробаев



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Introduction

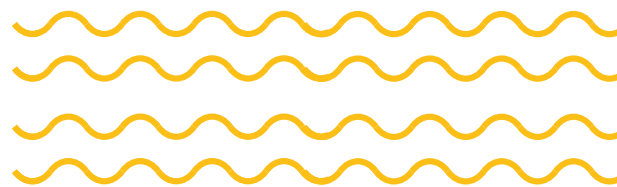
Aral Sea desiccation is one of the worst environmental disasters caused by humankind. Its ecological, climatic, socio-economic, and humanitarian consequences pose a direct threat to the sustainable development of the region, health, gene pool, and the future of the people living in the area [1]. Innovation technologies and approaches are a driver and a key to the restoration of the Aral region. *The main purpose of this report was to study the market for innovations applicable to the restoration of land resources, gene pool, the economic activity of the Aral region in four fields: agriculture and land management, sustainable forestry, socio-economic development, and sharing knowledge/information.* The report is done with the support of the project “Disruptive technology and innovation challenge for landscape restoration in the Aral sea watershed (Kazakhstan & Uzbekistan” implemented by Kazakh-German University (DKU) and the Global Landscapes Forum (GLF) within Central Asia Water and Energy Program (CAWEP), administered by the World Bank and financed by the European Union, Switzerland, and the United Kingdom, and is part of the World Bank Resilient Landscape in Central Asia RESILAND CA + Program.

This study assesses Kazakhstan’s innovative activity in the context of land restoration, which reflects the level of the State institutions’ interest in solving the problem. Innovative startups are inherently high-risk with many uncertainties during their development, and, thus, require financial and non-financial support. Therefore, the integration of innovations applicable to the restoration of natural resources is possible with close interaction of state institutions, businesses, non-profit organizations, and other interested parties. This report also reviews organizations funding startups and projects with innovative, technological approaches and advanced inventions applicable in land resources management (LRM) and the agro-industrial complex (AIC). Report also puts forward the recommendations to advance the innovative potential of Kazakhstan.



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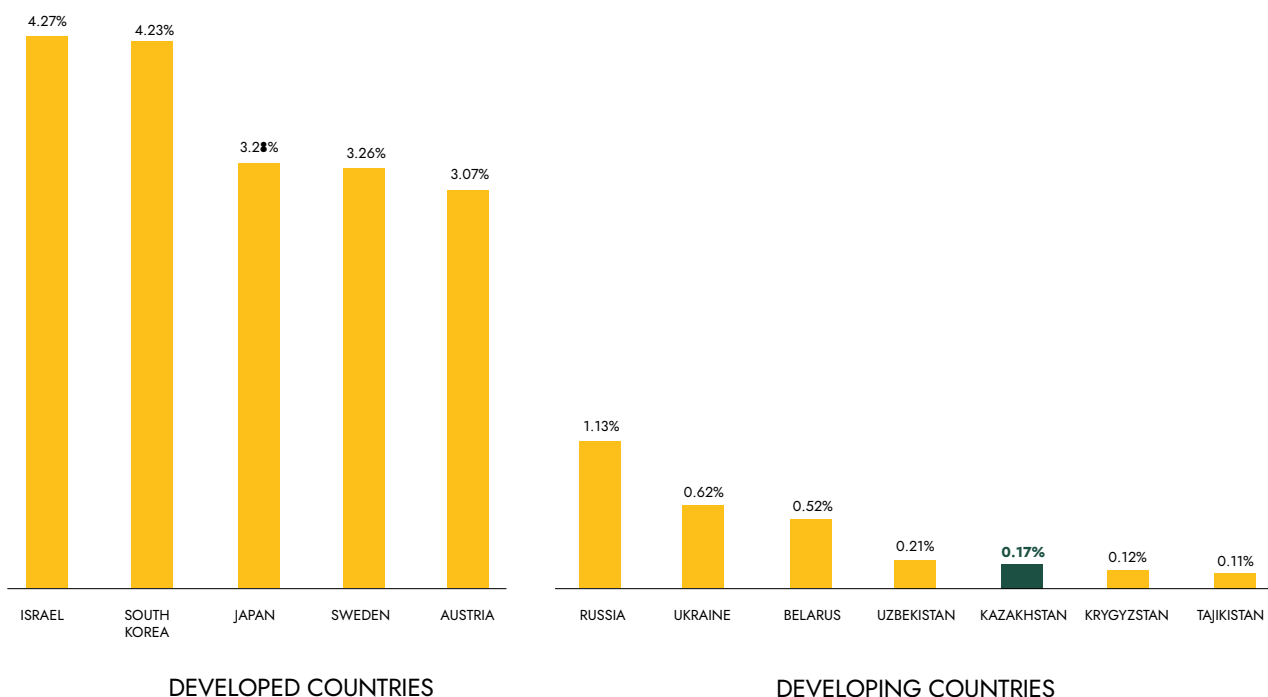
Current economic situation and general R&D trends in Kazakhstan



Economy

In the recent decade, Kazakhstan's average annual growth of the country's GDP was 10–12 % [2], for the exception of years when oil prices dropped down, reflecting the country dependence on the volume of production and the cost of minerals, including uranium, oil, and gas. The recent COVID-19 pandemic that halted the global economy in 2020, also lowered global demand and price of oil, leading to Kazakhstan's GDP decrease by 2.6% with inflation growth by 7.5% [3]. Pandemic also significantly depressed Kazakhstan's domestic economic activities resulting in sky-rocketing the unemployment rate by 46% [4]. The economy of the Republic of Kazakhstan is resource-based and depends on external influencing factors due to the weak diversification and the predominance of imports over exports. Insufficient funding for research and development (R&D) and the innovation ecosystem also negatively affects Kazakhstan's economy. The uneven distribution of economic activities poses a higher burden to rural and less developed areas of the country, like the Aral Sea basin area. The Aral Sea disaster has long-lasting negative economic, environmental, and social consequences, especially at the local level. A new economic crisis can further exacerbate the issue. Such a situation calls for the country's transition to an economy focused on solving socio-economic problems by introducing innovative solutions and following global land restoration trends.

SHARE OF GDP SPENT ON R&D





Level of innovation activity

Integrated innovations can provide a competitive edge to a country's economy. For example, countries that create new scientific achievements and technologies receive a special profit from intellectual property rights (20–95 % of the product price) [5]. However, at present, the level of innovation activity of enterprises in Kazakhstan on average is very small and amounts to 4.3%, while in Germany it is 80%, in the USA, Sweden, France – about 50%, in Russia – 9.1% [6]. The share of the GDP spend on R&D is also quite low: Kazakhstan ranked 63rd out of 74 countries in 2015 UNESCO rating (see figure above) [7]. According to the 2019 Global Innovation Index by World Intellectual Property Organization (WIPO), the Republic of Kazakhstan ranks at 79th place with 31.03 points out of 100 possible [8].



Research and development trends

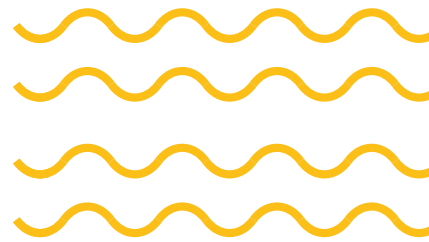
The volume of domestic spending on R&D in Kazakhstan ranged from 61.7 billion tenge to 69.3 billion tenge per year in the last decade, with an average share of 59.4% on applied research, 24.9% on experimental design, and 15.7% on fundamental research. The biggest source of its financing comes from the republican budget (51.3%), and out of enterprises' own funds (40.9%), other sources contribute 7.8% [9]. The priority direction of R&D was the field of engineering developments and technologies (45.6%), while expenditures on research in the natural sciences amounted to 32.6%, in the field of agricultural sciences – 9.5%, humanities – 5.1%, medical – 4.8%, social – 2.4% [9]. Since independence, the number of scientific workers in Kazakhstan is decreasing from over 50 thousand in the 90s [10] to about 22 thousand in 2018 [11]. In addition to the brain drain in science, the funding of scientific grants has been almost halved from 2015 to 2018, as well as the number of issued patents [7]. The R&D in Kazakhstan is mostly carried out by the business sector (39%), followed by the public sector (27%), higher professional education (25%), and non-profit organizations (9%) [12].



R&D perspectives in agriculture

A growing population in a context of limited natural resources, land degradation, and water scarcity requires new innovative approaches to produce sufficient food. According to McKinsey innovations that improve efficiency especially relevant for capital- and labor-intensive industries like agriculture, where investments in infrastructure, production, and equipment allow to decrease expenses while saving or improving the quality of a product [13]. Kazakhstan plans to implement 94 investment projects in the agro-industrial complex for 559 billion tenge (\$ 1.49 billion) [14]. The country is also in a process of digitizing areas and maps and has plans to use satellite monitoring of fields and equipment, as well as spot application of mineral fertilizers and pesticides.

Programs and organizations supporting entrepreneurs, startups, and innovation projects



Government policy and achievements

The Republic of Kazakhstan government pays attention to the development of the potential of young entrepreneurs, startups, scientific and innovative projects, business incubators by implementing the State Program of Industrial and Innovative Development of the Republic of Kazakhstan (SPIID) in 2010–2014, 2015–2019, and on-going period of 2020–2024. By 2015, a national system of scientific and technological forecasting was created, an intersectoral scientific and technological plan, regional and sectoral programs for the development of innovations were written; at least 2 national innovation clusters were made, including at least 10 large research institutes and centers, 30 innovation companies, 4 business incubators; the legislation was amended to create incentives for investment in R&D; the principles of systematic work with domestic innovators and consumers of innovations were introduced.



Business incubator and accelerator programs

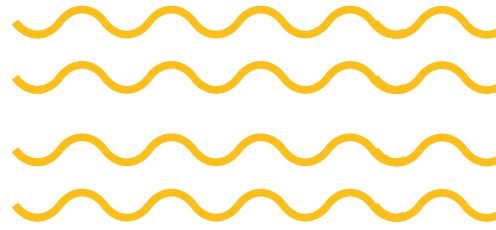
Within SPIID, JSC QazTech Ventures was declared the national operator in the field of innovation development. It conducts the Kazakhstan Digital Accelerator program, the purpose of which is to create a portfolio of startups that will receive investments from venture capital funds. A three-year (2018–2021) program to support business incubators by co-financing half of the operating costs was launched with the support of three key Kazakhstan business incubators (MOST Business Incubator, BI Innovations, Smart Point). Also, within SPIID, an intellectual and innovative cluster at the Nazarbayev University was created in Nur-Sultan, which consists of the NURIS business incubator and the Astana Business Campus.



Organizations' analysis

Analysis has revealed 66 organizations supporting start-ups and innovative projects, which shows the demand for innovative and technological solutions. *[The list can be found in full report annexes 2 and 3].* Most of them, i.e., 48, work with full- or partial government funding, indicating deep involvement of government development institutions. 11 international organizations provide support to young innovative entrepreneurs and startups, including three that do so in conjunction with state development institutions. Out of 15 support institutions at Kazakhstan universities, three work with private business organizations and 12 with government support. There are 14 technological parks in Kazakhstan where startups can get test sites and technology laboratories for testing products before entering the market. Eight of them have direct government funding, while others in addition to the government budget involve the private sector or universities. There is a need to increase private sector involvement in innovation development and integration because they can work faster as they are not restricted by the official program framework and budget. Currently, there are only 5 startup ecosystem development institutions that are not affiliated with state institutions, and 3 non-profit organizations that regularly support startups and innovative projects.

Business startups and innovative projects applicable for land restoration



Innovations can help to solve the problem of land degradation and subsequently help with improving the living standards of the local population. The global trends in land restoration innovations are reflected in the figure below.

Global trends in land restoration innovations

Innovative Technology

Internet of Things

Information exchange system between key devices, infrastructure, and production personnel, that makes it possible to analyze management processes, monitor and control production activity using “cloud” technologies.

BigData Processing

The process of deriving value out of massive data volume. In LRM BigData analyzes information from all kinds of field sensors and devices, that allows making quick and correct decisions regarding soil, water, and crop management, as well as land resources restoration.

Artificial Intelligence

A simulation of human intelligence in machines that helps to minimize the workload for humans. In agriculture it can help to analyze and organize data required for decision making, improve crop yields, reduce food production costs, etc.

Innovative Approaches

Attracting Venture Capital

Startups and innovative projects aiming to solve problems in agriculture and LRM get priority and receive more funding.

Outsourcing

Drives the development of relationships between partner enterprises based on competitive differentiation of services and works. In AIC outsourcing can be an effective business transformation tool exchanging roles of provider and customer for certain works and services

Technology Transfer and Commercialization

Allows to obtain and use rights to patents, inventions licenses, R&D results, know-how, advanced technology equipment, and hiring highly qualified specialists.

In Kazakhstan, during 2019–2020 there were more than 600 startups, half of which are actively developing [15]. In the agrotech field, there are 13 independent startups on the market, covering the issues of cattle breeding, agriculture, automation of management in agriculture, as well as issues of irrigation and soil cultivation [15]. Some of the startups are suitable for land restoration and can be implemented in the Aral Sea region.

The analysis of open sources identified 20 startups and innovative projects that are potentially applicable in the Aral Sea basin. [The complete list of startups is available in full report Appendix 4]. The figure below reflects the general directions of identified startups. These companies do not have the goal of restoring land resources, but their innovative approach and technological solutions can be refined in favor of land restoration with an appropriate motivation system.

20 startups and innovative projects that are potentially applicable in the Aral Sea basin

Artificial intelligence technologies

Most of the technological solutions are related to information exchange and land management technologies through artificial intelligence technologies.

Monitoring technologies (10)

Companies aiming at monitoring the geological and landscape conditions of land resources (**Gis Sat, Gis Analytics, Engeo.kz, GTS4B, Egistic, TOP, LASA, OAR, Koktem2, Terra Point**) that can aid agriculture land management through information and data exchange.

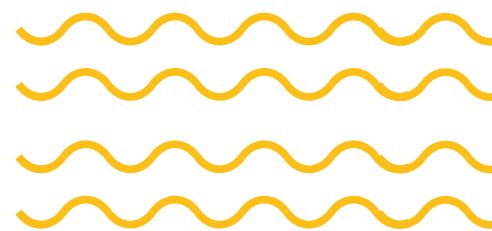
Socio-economic approach (6)

Energy and Food, AQUAL, All agro, "Aral Sea" project, Solar power plant, and Bakhcha Gastromarket focus on socio-economic development, that can directly or indirectly affect the economic situation.

Innovative business approach (4)

Posadiderevo.kz and **Biocarbon** innovative businesses applicable for afforestation of degraded land and prevention of forest degradation. **SmartEcoBoxes** and **Biogas Complex** help farms to deal with organic waste transforming it into fertilizer and energy.

Financial sources for innovative projects and startups in the field of sustainable land use



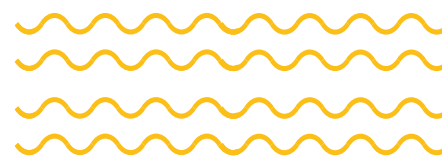
In Kazakhstan, there are 5 major financial sources available for innovative projects and startups in the field of sustainable land use: (1) loan, (2) subsidy, (3) venture capital funding, (4) grant, (5) crowdfunding.

Financial sources available for SLM innovative projects and startups in Kazakhstan	
Loans and subsidies	<p>A loan provides funds with the expectance of payback with interest, subsidy provides financial aid or support (usually by government) generally intending to promote economic and social policy</p> <p>An active role in the sustainable development of micro, small and medium-sized enterprises (MSMEs) in Kazakhstan plays Damu Entrepreneurship Development Fund. In cooperation with the State strategies and programs, international organizations like UNDP, ADB, EBRD, it provides loans and subsidies to local entrepreneurs with lower interest rate compared to a standard bank loan. For example, 6% subsidy under the State program “Business Road Map 2025”, 2-6% loan within the State program “Economy of Simple Things”, 14% loan via EBRD for up to 900 million tenge [16]. The Fund for Financial Support of Agriculture JSC (a subsidiary of the KazAgro Holding) guarantees up to 95% of the loan amount free of charge under the State Program for the Development of Productive Employment and Mass Entrepreneurship for 2017–2021 “Enbek”. One condition of the “Enbek” program is that 20% of funded projects should be startups, another 20% non-agricultural projects in rural areas. The loan interest rate within that program is ranged 6 to 18.4% per annum [17].</p>
Venture capital funding (VCF)	<p>VCF is a high-risk investment in innovative startups, where the likelihood of losing investments due to project failure is very high but an investor can get profit from the high return on the most successful investments</p> <p>Venture funding in Kazakhstan is done by state funds, international organizations, private businesses, including individual businessmen (business angels). Government-affiliated venture capital fund QazTech Ventures is a part of Baiterek National Managing Holding JSC. The Fund has available resources for 500 startup venture investments (\$250,000 per project), \$50 million for quest ventures (\$150,000 per project), and up to \$50,000 per project within Kazakhstan digital accelerator program [18]. The Development Bank of Kazakhstan apart from the financing of investment projects, provides project support, financing the development of project documentation and/or project monitoring [19]. Examples of international organizations providing venture funds in Kazakhstan include Seedstars, KPMG Digital Village [20,21]. From local organization is KASE Startup, which provides an internet platform to build communications between startup companies and investors and can fund startups with the assistance of Kazakhstan Stock Exchange JSC [22]. Business angels are successful entrepreneurs who have accumulated sufficient capital to invest funds, knowledge, time, and experience in early-stage startups. Among business angels in Kazakhstan are Kenes Rakishev, Nurzhas Makishev, and Adil Nurgozhin [23].</p>

Grants	<p>Grants on a comitative basis are essential for innovation development and integration in developing countries.</p> <p>Variety of state budget funding sources for science exist in Kazakhstan: (1) grant programs of the Science Fund JSC; (2) special state resources to support national scientific and engineering laboratories; (3) government funds allocated to support and modernize research infrastructure; (4) the funds of the Ministry of Education and Science of the Republic of Kazakhstan allocated for the implementation of grant programs in the field of fundamental research; (5) the funds of the development institutions of Kazyna Sustainable Development Fund JSC. The Ministry of Education and Science of the Republic of Kazakhstan is actively working on the technology commercialization program. It runs a grant program for young scientists and annually awards research scholarships. One of the grant area priorities is the sustainable development of the agro-industrial complex and the safety of agricultural products [24]. The Ministry of Energy of the Republic of Kazakhstan also organizes a research work competition 2021–2023 in the priority area “Energy and Mechanical Engineering” [25].</p> <p>The project “Stimulating Productive Innovation” (2016-2020), implemented under the agreement between the World Bank and the Republic of Kazakhstan, provides grants for research that help to increase the country’s innovative potential [26]. National Geographic Society provides grants for projects in conservation, education, research, storytelling, or technology [27]. There is an opportunity for Kazakhstani entrepreneurs to win grants within the international startup project competition DAR Lab. Also, the Saby Charitable Foundation, and Fund of the first President of the Republic of Kazakhstan – Elbasy, provides grants on a competitive basis for young entrepreneurs and scientists [28,29].</p>
Crowdfunding	<p>Crowdfunding is an alternative source of financing for small business projects. A method of raising funds for a project where investors are Internet users, potential clients interested in the product or service.</p> <p>The most popular crowdfunding platforms are Kickstarter and IndieGoGo. Kazakhstan’s analog of a crowdfunding platform is Start-Time, where 69 projects have already collected more than 31 million tenge for their ideas [23].</p>

[For the list with a more detailed description of the programs and sources of financial support, see full report Annex 5]

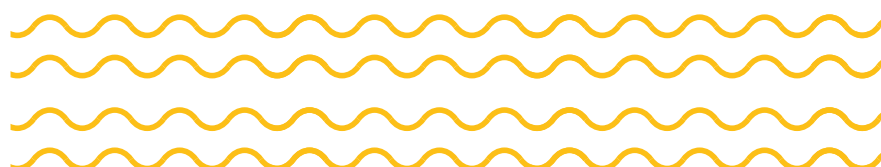
Results of the survey interview of key stakeholder respondents



The survey of key stakeholders was conducted to analyze the current economic situation in the field of innovation to identify existing barriers and develop recommendations. The number of respondents was 17, including 3 representatives of organizations supporting innovative projects, 2 of a quasi-state organization supporting technological solutions, 5 of incubators/commercialization centers at a higher educational institution, 2 of organizations supporting cooperation between startups and corporations, 5 managers of innovative, technological projects, business entities. Data was collected through surveys and interviews. The recommendations from the survey are incorporated in the following section, whereas the main difficulties mentioned by the respondents were:

- The rigidity, unwillingness to accept innovations in production among the management team. The mentality of senior managers, not understanding the need and significance of innovative solutions, the value of modern solutions.
- Fear of losing a job due to process automation.
- Poor quality of Internet coverage at land use facilities, which makes it impossible to fully implement innovations.
- A shortage of personnel, specialists capable of creating innovative solutions.
- Non-academic nature of the entrepreneurial sphere for conducting “entrepreneurship” classes. Absence or weakness of the methodological base for teaching entrepreneurship in universities, and the problem of the methodologies’ adaptability. Lack of payroll budget in university incubators.
- Low awareness of the value of entrepreneurial education in the regions.
- Government programs and support measures are not popular. Organizations more often receive support from international programs and international organizations.
- Technological innovators have limited access to research problems in narrow areas on the spot with potential customers.

Conclusions and recommendations



The review and analysis of trends showed a wide world interest in introducing innovations in the AIC. Moreover, the world’s leading agricultural companies are introducing innovations since those transforming activities the first will become the market leaders in the next decade. Kazakhstan understands the need to follow these global trends, but to do so government and society have to overcome some challenges and implement certain activities.

The number of startups engaged in the AIC in Kazakhstan is small compared with other sectors of the economy, which may indicate the unpopularity of the agriculture sector among young entrepreneurs, the lack of sufficient conditions, and support from society and the state. There is a need to make this sector attractive for high-tech IT companies and startups by providing tax incentives, co-financing operating activities, creating institutional support mechanisms, etc.

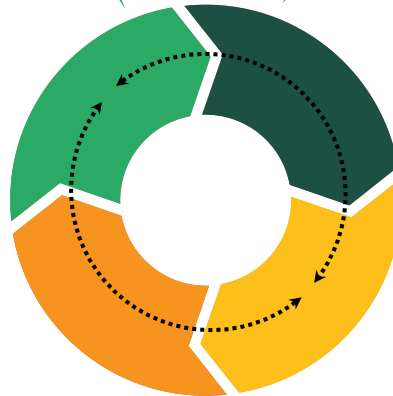
To accelerate the development of the innovative potential of Kazakhstan, a number of actions in different areas should be undertaken (see figure below).

Economy

- Ensure the relevance and demand for innovation in the economy of Kazakhstan.
- Invite private business structures with successful experience in introducing innovations on the country level for consulting or turnkey management.
- Create market conditions favorable for the demand of startup/technological solution.
- Create investment attractiveness of the country through creating a special condition for the investors similar to offshore zones.
- Increase the share of R&D expenditures from less than 1 percent to 1 percent of GDP or more.

Technology

- Improve internet quality and width of coverage at land use facilities throughout the Kazakhstan to enable innovation integration and replication capacity.
- Improve accessibility to water and electricity in remote areas as a baseline for innovations introduction potential in the AIC.



Human capital

- Scout talents and innovative technologies in the AIC and land reclamation sector around the world, and create conditions in the form of tax preferences, facilitated visa regimes.
- Increase the salaries for scientists and researchers and create attractive conditions for the return of talented youth from foreign countries.
- Introduce innovative knowledge and innovative literacy in schools, where students could become familiar with the key processes of innovation, investments, etc.
- Train innovators and entrepreneurs in presentation skills, packaging their solutions, to convey the value and importance of innovation to potential customers.
- Increase the bias towards the development of entrepreneurial thinking and to ensure the availability of this type of education in the regions.

Policy

- Facilitate the intellectual property registration processes.
- Promote and popularize technology transfer, innovations, and new approaches among business leaders and owners.
- Organize the selection of technological solutions for financing from the republican budget according to foreign analogs
- Create conditions for active cooperation of business incubators, technology parks with business representatives, where potential customer and innovator can interact, exchange data on problems and required solutions, study the sector specifics, create, test, update, and improve prototypes on-site for maximum effect.

Proposed measures entail a multiplier effect that can affect the macroeconomic situation in Kazakhstan, as well as the restoration of land resources in the Aral Sea basin. Innovations to some extent automate processes by introducing artificial intelligence and robotization. That can lead to a decrease in the demand for workers in sowing fields, land restoration, and animal breeding. Sametime, the demand for technical personnel to service technologies and startups will increase, as well as the production of related products and services, which can replenish the labor supply of the region's population and its purchasing power. For about a decade an imbalance in the distribution of labor is possible due to the transition period to a new industrial environment. The ecological situation can be improved with the emergence of demand for products/services sold in the Aral Sea basin, where demand can be spurred by innovative technologies and startups.

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