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Irrigation Equipment Production in Central Asia:

Industrializing the Water Sector

Almaty — 2025

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Abstract

The management of water resources in Central Asia is a critical and pressing issue for the region. The sustainable development of agriculture depends heavily on the adoption of advanced irrigation systems and innovative technologies that maximize water efficiency. To address these challenges, Central Asian governments have already implemented significant initiatives aimed at improving water management. The current irrigation equipment market is valued at approximately $130–200 million, with a substantial portion of demand met through imports. Projections indicate that by 2040, the area of irrigated land in the region will increase to 10.6 million hectares, with a notable shift toward sprinkler and drip irrigation systems. This growth in irrigated land, along with the adoption of advanced technologies, is expected to drive demand for approximately 2 million units of irrigation equipment. As a result, the local production of irrigation equipment in Central Asia could generate up to $426 million annually, offering a promising opportunity to address the region's needs while tapping into the market potential.

Keywords: Central Asia, irrigation equipment, localization, manufacturing, industrial policy, water efficiency

JEL: D20, E61, L52, O14, O25.

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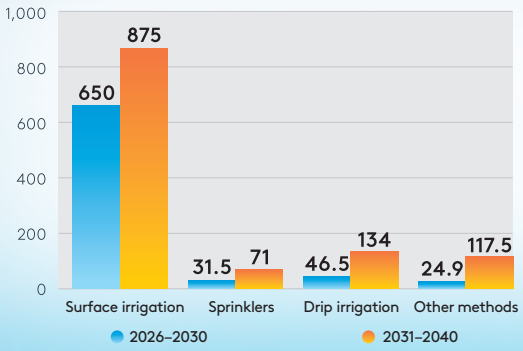
IRRIGATION EQUIPMENT PRODUCTION IN CENTRAL ASIA: INDUSTRIALIZING THE WATER SECTOR

KEY FINDINGS

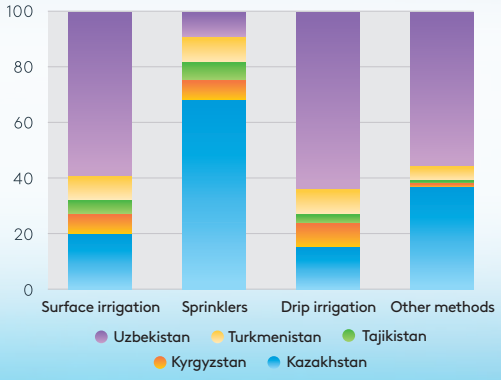
Analytical report '25

MARKET FOR IRRIGATION EQUIPMENT IN CENTRAL ASIA WILL GROW AS MORE EFFICIENT WAYS OF MANAGING WATER ARE NEEDED

Demand for technical means and equipment for irrigation up to 2040, in thousand units



Irrigation equipment demand up to 2040 across countries of the region, %



Annual investments for new irrigation equipment needed by 2030

$426 million

For sprinklers only

$114 million

For drip irrigation only

$220 million

KEY FACTORS NEEDED FOR SUCCESSFUL LAUNCH OF IRRIGATION EQUIPMENT PRODUCTION IN CENTRAL ASIA

- ACTIVE INDUSTRIAL POLICY
- DEVELOPED HARD INFRASTRUCTURE
- PREVIOUS POLICY WORK ON CLUSTERS
- SPECIAL ECONOMIC ZONES
- FAVORABLE REGULATORY BASE
- INCREASING ADOPTION OF DIGITAL AGENDA

THREE STAGES OF DEVELOPING AN IRRIGATION EQUIPMENT PRODUCTION CLUSTER IN CENTRAL ASIA

STAGE I

BUILDING CRITICAL MASS

Of irrigation equipment manufacturing enterprises through enhanced project financing

STAGE II

STRENGTHENING CLUSTER POLICY

At the national level in line with other state development programs and policies

STAGE III

ENHANCING CLUSTER FORMATIONS

To increase their synergies within the clusters and with external bodies

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ABBREVIATIONS

ADT	Advanced development territory
AI	Artificial Intelligence
CA	Central Asia
CDA	Cluster Development Agent
CIS	The Commonwealth of Independent States
EBRD	The European Bank for Reconstruction and Development
EDB	Eurasian Development Bank
EPZ	Export processing zone
EU	The European Union
FAO	Food and Agriculture Organization of the United Nations
FTZ	Free trade zone
GDP	Gross domestic product
Ha	Hectare
IFI	International Financial Institution
IoT	Internet of Things
IT	Information technologies
IZ	Industrial zone
JSC	Joint-stock company
Km³	Cubic kilometer
LLC	Limited liability company
LTD	Limited liability company
Mm	Millimeter
Mpa	Mega Pascal
R&D	Research and development
SEZ	Special Economic Zone
SME	Small and medium enterprises
SoC	System-on-Chip
S&T	Science and technology
US/USA	The United States of America
USD	United States dollar
WEF	The World Economic Forum
WIPO	World Intellectual Property Organization
WSN	Wireless Sensor Networks

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INTRODUCTORY NOTE BY THE EURASIAN DEVELOPMENT BANK'S CHAIRMAN OF THE MANAGEMENT BOARD

Nikolai Podguzov,
Chairman of the Management Board, The Eurasian Development Bank

Central Asia requires not only sustainable growth but also rapid progress, as it is essential for the well-being of its population. A key factor in achieving this goal is the advancement of industrialization, particularly through the production of higher value-added goods. To this end, it is critical to identify and target stable niches where the region can gain a competitive edge. One promising area of opportunity is the irrigation equipment market.

In Central Asia, irrigation is a vital component of agricultural production and food security. The annual market for irrigation equipment is currently valued at approximately $200 million, mostly met through imports. By 2030, it is expected to more than double, reaching over $400 million annually. Developing local industrial production in this sector is crucial for ensuring a sustainable future for the region. Modern technologies can enhance water use efficiency by 50–80%, reducing losses and increasing crop yields by 30-50%. Localizing production will allow for technologies to be tailored to the specific needs of the region and local farmers, potentially reducing equipment costs by up to 30%.

The introduction of advanced irrigation systems requires investment, sound policy, and effective cooperation among key stakeholders. One potential solution is the formation of a regional cluster for irrigation equipment production, which could leverage the region's economic potential.

The release of this new joint Working Document with UNIDO on the development of the irrigation equipment cluster in Central Asia is a significant milestone. Our institutions' collaboration aligns with industry standards for knowledge creation and sharing. This paper serves as a foundation for further research and solutions to the region's economic challenges, contributing to its sustainable development. It opens the door for long-term and productive cooperation between our organizations.

We hope this proposal will play a key role in fostering economic prosperity throughout Central Asia. UNIDO's industrial development initiatives remain crucial to driving inclusive and sustainable economic growth. We are confident that our continued partnership will deliver valuable outcomes for both our institutions and the region as a whole.

FOREWORD FROM THE DIRECTOR GENERAL OF THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Gerd Müller,
Director General, UNIDO

In Central Asia in particular, the sustainable management of water resources is key to agricultural productivity, food security, and economic development. The sustainable development of agriculture in the region depends on the introduction of novel technological and irrigation solutions designed to optimize the use of each drop of water. Establishing an irrigation equipment manufacturing and service cluster is an innovative path forward in response to the region's growing demand for modern water-saving techniques.

At United Nations Industrial Development Organization (UNIDO) we are committed to reducing poverty and hunger by facilitating such innovative technologies and solutions in order to stop environmental degradation and alleviate climate change impacts. Addressing challenges such as water scarcity, outdated irrigation infrastructure, and the effects of climate change requires targeted action and new levels of cooperation. Moreover, expanding collaboration in the water sector across Central Asia and strengthening ties within the countries of the Aral Sea Basin through cluster initiatives will drive innovation, increase the flow of foreign direct investment, and promote job creation.

Many significant measures have already been implemented by the Governments of Central Asian countries in order to address the region's water-related challenges. The market for irrigation equipment is currently valued between $130–200 million, yet most equipment is currently still imported. Moreover, the demand for sprinkler and drip irrigation systems is projected to further rise. Increasing the amount of properly irrigated land and the corresponding increase in the implementation of technological solutions will result in a demand for approximately 2 million pieces of irrigation equipment. This is a huge opportunity: Central Asia could generate over $400 million annually from the production of irrigation equipment.

An efficient irrigation cluster addresses these evolving challenges and chances. It would improve the management and regulation of limited water resources in the region, improve the living standards of local communities, and improve the market competitiveness of regionally manufactured products. By integrating modern irrigation systems and precision technologies, the cluster initiative will not only enhance water-use efficiency but also contribute to achieving the wider Sustainable Development Goals.

UNIDO is very glad to work together with the Eurasian Development Bank, sharing our expertise in cluster development to better advance sustainable industrial development. This joint publication paves the way towards the establishment of a game-changing irrigation equipment manufacturing and service cluster in Central Asia.

I hope this publication will inspire more decisive action and new partnerships and help create a more resilient, prosperous, and sustainable future for Central Asia and beyond.

SUMMARY

The formation of an irrigation equipment production and supporting irrigation services sector would enable the aggregation of capacities to provide irrigation equipment and efficient technologies tailored to the irrigation needs of Central Asian countries. Efficient irrigation technologies are a critical component of water resource management in Central Asia, which is a pressing issue in the region today. The development of agriculture in Central Asia depends on the implementation of modern irrigation and innovative technological solutions to optimize the efficiency of water use.

The United Nations Industrial Development Organization (UNIDO) and the Eurasian Development Bank (EDB) have both expressed their intention to support the production of irrigation equipment and supporting irrigation services in Central Asia. The development of irrigation equipment production can address challenges in the water sector (Vinokurov et al., 2023) and enhance industrial potential. The irrigation equipment sector would produce high quality irrigation equipment and focus on the development of high performance, multifunctional irrigation tools. In addition to industrial goods production, the sector would develop precision irrigation technologies, digital tools for water management, and centers of excellence for water resources and irrigation. It would also improve the scientific and workforce competencies and competitiveness of the agro-industrial complex of the region.

The effective management of water resources is a critical and time-sensitive issue in Central Asia. Central Asian states are already implementing tangible measures to address emerging water challenges. Governments in the region are directing particular attention to modern irrigation and water management. Currently, up to $200 million worth of irrigation equipment is imported into the region each year to meet farmers' current needs. Of these imports, approximately 80% in 2023 were destined for Kazakhstan. Kazakhstan is currently implementing extensive initiatives to address emerging water challenges, with the introduction of water-saving technologies being a key component of these plans. Over the

Annual imports of irrigation equipment in Central Asia amount to

$200 million

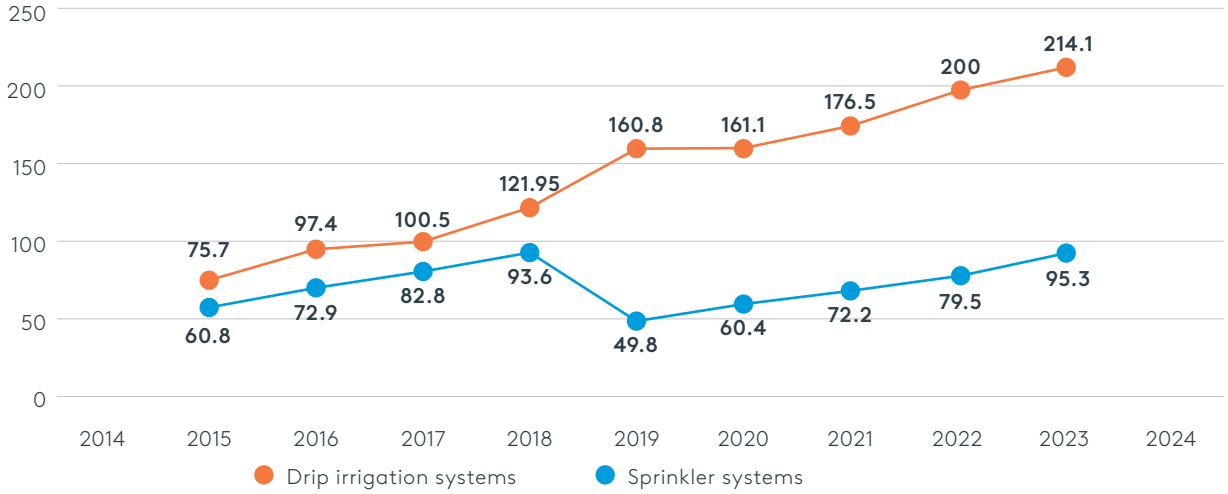
About

80%

in 2023 are destined for Kazakhstan

past ten years, the country has achieved remarkable success in introducing new water-saving technologies on irrigated land (Figure A).

↓ Figure A: Introduction of water-saving irrigation technologies in the Republic of Kazakhstan, annual deployment area in 1,000 ha



Source: Concept of Water Resources Management System Development in the Republic of Kazakhstan for 2024-2030.

Additionally, specific government programs and agencies are being established. It is worth noting that the Republic of Kazakhstan has recently adopted new Water Code, which aims to address a number of critical challenges in the country's water sector, taking into account the regional aspect.

However, the demand for irrigation equipment and methods will experience a significant long-term increase. The modernization of existing agricultural fields and the introduction of new irrigated areas in the near future will put considerable pressure on the development of new irrigation equipment.

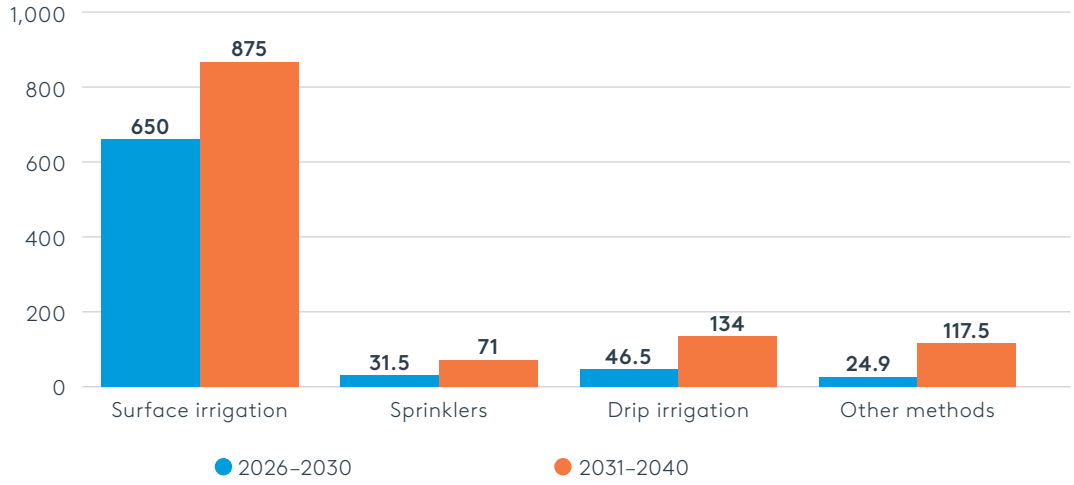
According to government plans and program documents, Central Asian countries are expected to significantly increase the area under irrigated agriculture using various irrigation technologies (Dankova et al., 2022). By 2040, the total area covered by these technologies is expected to reach 10.6 million hectares. Uzbekistan will account for the largest share with 4.3 million hectares (40.5%), followed by Kazakhstan with 2.7 million hectares (25.5%).

By 2040, the total area covered by water-saving technologies will be

10.6 million ha

Based on these projections, we have forecast the approximate demand for irrigation technologies and equipment that will be needed to meet the growing agricultural needs of the Central Asian countries (Figure B). The largest demand for irrigation equipment between 2026 and 2040 will be for surface irrigation, with an estimated 1,525,000 units required.

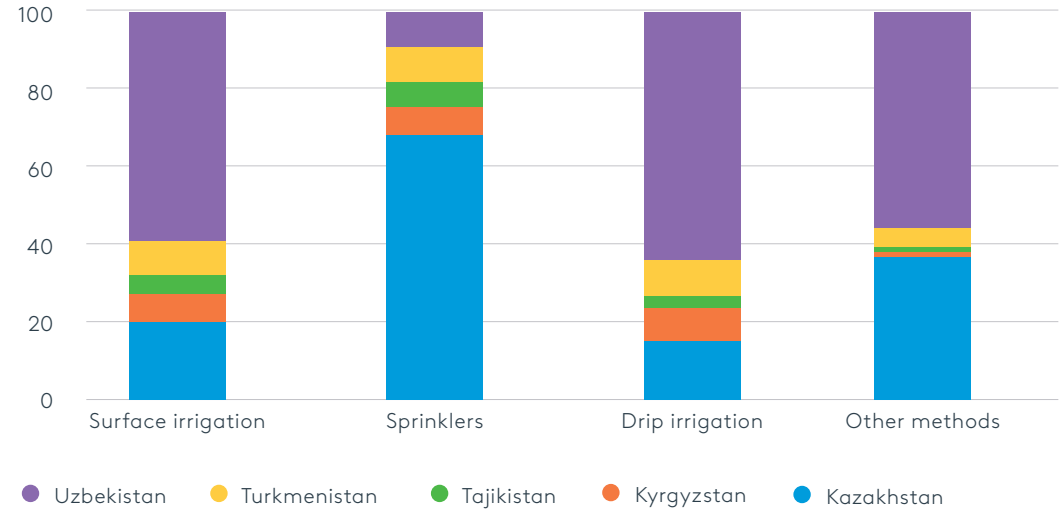
↓ Figure B. Forecast of demand for technical means and equipment for irrigation up to 2040, thousand units



Source: EDB calculations.

The surface irrigation method will remain dominant in the region, particularly in Uzbekistan, which would require approximately 900,000 units, or 59% of the total demand (Figure C). In addition, approximately 102,500 units of sprinklers would be required, with Kazakhstan being the primary market and requiring approximately 70,000 units (representing 68.3% of regional demand).

↓ Figure C. Irrigation equipment demand up to 2040 across countries of the region, %



Source: EDB calculations.

Drip irrigation systems are expected to account for a significant portion of the total demand for irrigation equipment in the region. In total, the region would require 180,500 units of new drip irrigation systems. Given the region's agricultural conditions, the majority of these systems will be required, with Uzbekistan accounting for the largest demand (115,000 units or 63.7% of the region's total drip irrigation systems).

The total investment that is necessary to introduce new irrigation equipment in Central Asia would be around $426 million annually until 2030. The introduction of sprinklers would cost $114 million a year, while drip irrigation would cost $220 million for the same period. The localization of essential irrigation equipment in Central Asia has the potential to facilitate the retention of these investments within the local economy.

The total amount of investments in the introduction of new irrigation equipment is projected to reach

$426 million

annually until 2030, including

$114 million

for sprinklers and

$220 million

for drip irrigation.

We propose the establishment of a local irrigation equipment production through clusterisation, which could prove an effective means of leveraging the region's growing potential. Based on the required irrigation infrastructure, it is possible to produce a range of irrigation equipment in the domestic market, including sprinklers, regulators, pipelines, drip pipes, connecting fittings, nozzles, valves, and mobile means of water redistribution.

To begin with, among all Central Asian countries the Republic of Kazakhstan offers an optimal environment for the development of irrigation equipment production. This is due to the country's advanced infrastructure and favorable regulatory environment. The country has an active industrial development policy that provides support for new manufacturing industries through a range of financial and non-financial instruments.

Furthermore, the Government of Kazakhstan has implemented a comprehensive cluster policy that includes approved programs and measures to support cluster initiatives. Furthermore, Kazakhstan's advanced digital agenda and affiliation with the Global Network of Fourth Industrial Revolution Centers, along with the associated center at the Astana International Financial Center, provide a platform for the professional development of digital water metering and infrastructure monitoring technologies. This will attract skilled labor and scientific expertise to develop new equipment using digital tools, including digital twins of irrigation fields, advanced analytics, sensors, and digital water meters and etc.

To reduce costs and facilitate accelerated development of a sector, we recommend that the initial production make use of existing infrastructure, including both hard and soft facilities. Special Economic Zones (SEZs) have the potential to serve as a catalyst for the growth of industrial enterprises. In the early stages of emerging industries, SEZs provide incentives to attract manufacturers, thereby facilitating the establishment of critical mass. There are currently 14 SEZs in Kazakhstan.

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We believe that the SEZ "Jibek Joly" in the Zhambyl region of southern Kazakhstan is a promising location for the formation of an irrigation equipment production sector due to its strategic location near the Aral Sea basin and irrigated lands in Central Asia, coupled with its focus on priority industrial activities. This experience can later be shared with other Central Asian countries.

This experience can later be shared with other Central Asian countries.

Furthermore, the Republic of Kazakhstan and the Republic of Uzbekistan have the potential to establish a regional joint production cluster through industrial collaboration. Currently, an interstate joint project, the 'International Center for Industrial Cooperation 'Central Asia', is being implemented by both countries. Construction and installation are scheduled to commence in March 2025. However, the latest data indicates that the Republic of Uzbekistan has already granted the Center the status of a special economic zone. The status and benefits of the SEZ, as previously recommended, will be a key initial condition for the production of irrigation equipment and its subsequent transformation into a fully-fledged cluster formation.

The establishment of a cluster partnership for irrigation equipment production at this location would provide a significant boost to regional industrial collaboration and represent a crucial milestone in addressing the growing water challenges in Central Asia. Furthermore, this initiative will facilitate participation by both countries in the global

value chain and import substitution in irrigation equipment in Central Asia. Moreover, our projections indicate that Kazakhstan and Uzbekistan will be the primary consumers of irrigation technologies and equipment in the coming years. Given these circumstances, the project can be successfully implemented at the site of 'International Center for Industrial Cooperation 'Central Asia''.

The development of the irrigation equipment manufacturing as a comprehensive program for the development of the industry and the economy as a whole can be carried out in three stages. The initial stage involves the establishment and development of production, while the subsequent stages involve the cultivation of cluster competencies and the implementation of necessary policies within the country (Figure D).

↓ **Figure D. The stages of irrigation equipment manufacturing sector development**

Source: EDB and UNIDO estimates.

Prior to the installation of cluster initiatives, it is essential to establish a greater number of companies engaged in the production of irrigation equipment in the region. The EDB has agreed to assist in the development of irrigation equipment manufacturing projects. Significant progress has already been made in this regard. In addition to investment projects, we have been working with the Ministry of Water Resources and Irrigation of the Republic of Kazakhstan and the United Nations Development Program on a joint initiative in the water sector. The goal of this initiative is to promote best practices in water management and irrigation in five regions of Kazakhstan. It is expected that the joint efforts of the aforementioned parties, in conjunction with UNIDO, will bring significant benefits to the water sector and the economies of the entire Central Asian region.

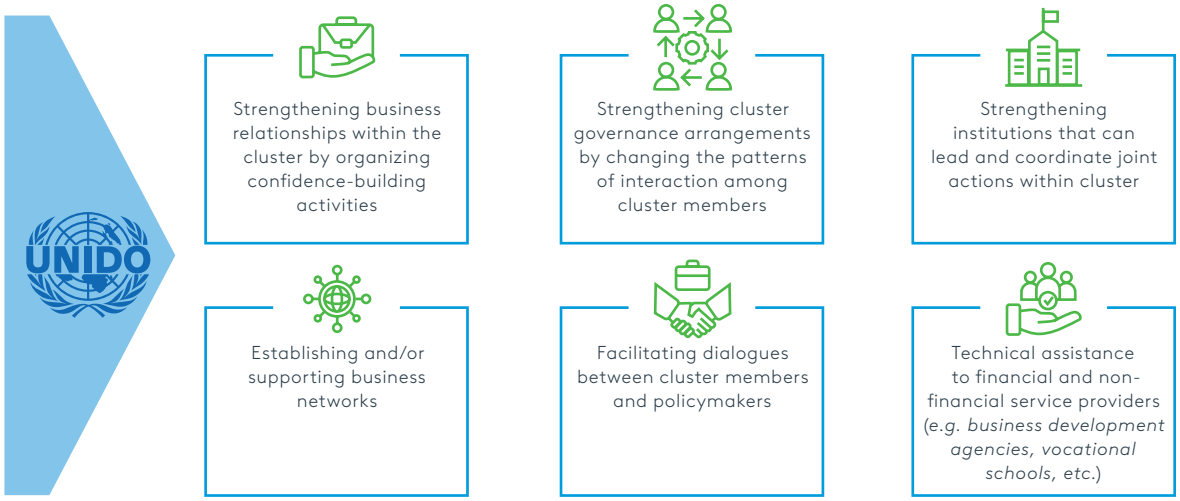
Given UNIDO's extensive experience in industrial development and the establishment of cluster initiatives, its remit could be extended to the

formulation of cluster initiatives, the enhancement of special economic zones. UNIDO is well positioned to conduct feasibility studies aimed at identifying optimal cluster structures, formulating policy recommendations, ensuring implementation, monitoring development activities and evaluating results.

UNIDO's expertise would facilitate the modernization of the industrial and cluster policy and the involvement of producers in the project. The aim of work will be to strengthen the cluster approach and equip local experts with the necessary skills for effective engagement. The initiative should be launched in parallel with the development of irrigation equipment manufacturing projects and continue as industrial facilities are established.

At last, once clusters are ready, collaboration with manufacturers to form a unified cluster is essential. UNIDO would assist by conducting feasibility studies, defining optimal structures and strengthening business relationships within the cluster (figure E). Effective cluster governance involves the establishment of business networks, public-private partnerships and dialogues between service providers and policy makers. Technical assistance is also needed to align the services of financial and non-financial service providers with the needs of the cluster.

↓ Figure E: UNIDO's role in facilitating the formation of irrigation equipment manufacturing sector



Source: UNIDO.

01 IMPORTANCE OF EFFICIENT IRRIGATION EQUIPMENT FOR CENTRAL ASIA

Efficient irrigation technologies are crucial for water management in Central Asia. Agriculture is the main water consumer in Central Asian (hereafter CA) countries: 100.4 out of 127.3 km^3/year, or 79%, of water used in the region is for irrigation (2020).

Irrigated agriculture plays a major role in ensuring food security in CA countries. Occupying about 24% of all cultivated areas, irrigated land provides 66% of the gross agricultural output of the region in value terms: about 100% in Turkmenistan, 87% in Uzbekistan, 85% in Kyrgyzstan, 82% in Tajikistan, and 40% in Kazakhstan. In crop production, the figure reaches 80% on average for CA countries. This is due to the fact that a significant part of the territory of the region is located in a zone of insufficient and unstable humidification and the development of agriculture is possible only using irrigation. Irrigated lands allow maintaining the sustainability of agricultural production, especially in dry years.

The socio-economic development of CA countries takes place under conditions of water deficit, which creates risks for food and water security. The region is exposed to climatic changes and weather cataclysms. Some territories of the countries of the region, due to their geographical location, are increasingly suffering from severe droughts and extremely high pressure on water resources. The increasing number of droughts and dry spells, changes in the hydrological

regime of rivers and groundwater recharge conditions pose threats and high risks to food security. By 2028, the combination of climate change, the onset of low-water periods, and the commissioning of the Kosh-Tepa Canal in Afghanistan will lead the Central Asian region to an acute chronic water deficit estimated by EDB analysts at 5–12 km^3 (Vinokurov et al., 2023).

The irrigation infrastructure of CA countries is characterized by high (70–80%) wear and tear on water sector fixed assets. The average age of irrigation inter-farm and on-farm infrastructure reaches 50 years, and large main canals are even older. Unsatisfactory technical condition of irrigation infrastructure reduces the quality of services on maintenance and upkeep of irrigation systems — both by state water management organizations (main and inter-farm irrigation structures, canals) and irrigated land owners (on-farm structures and irrigation networks), which together leads to large economic losses.

70–80%
of the irrigation infrastructure in CA countries exhibits high levels of wear and tear on water sector fixed assets

50 years
is the average age of irrigation inter-farm and on-farm infrastructure

A distinctive characteristic of CA countries is also extremely low economic efficiency of water use (Vinokurov et al., 2022). One of the reasons is significant water losses. Studies (Royal Haskoning, 2003) have revealed large water losses at all stages of water transport from the water intake to the field and on the field itself during irrigation.

About 40% of water withdrawn from rivers is subject to filtration losses in the canal system. On farms, water losses in most cases occur due to poor on-farm water management caused by the extremely unsatisfactory ameliorative condition of irrigated lands, irrigation, and the collector-drainage network.

Under conditions of limited water resources and reaching the limit of extensive irrigated farming in Central Asia, the role of industrial agricultural technologies based on water and energy saving is increasing. Irrigation infrastructure on irrigated lands has an insufficient technical level, poorly equipped with modern means of distribution of irrigation systems and control of irrigation water in the field. Central Asian countries should strive for widespread adoption of water-saving technologies and improvement of technical and engineering level of irrigation systems, as well as cultivation of high-yield crops.

Efficient use of limited water resources in agriculture requires modern irrigation technologies and advanced water management practices. Some progress has been made in this area, such as the transition from surface irrigation to more efficient sprinkler and drip irrigation technologies. However, surface irrigation of agricultural crops will remain the dominant irrigation technology in the near future, and further improvements are needed.

Today's irrigation systems around the world are more than just field irrigation and drainage systems. Irrigation involves complex machinery and equipment, including pumping equipment, water delivery pipelines, sprinklers such as Big Gun sprinklers (Nelson Irrigation Corporation), wheeled wide-beam frontal and rotary sprinklers, drip tape and tubing, micro-sprinklers, and so on. Increasingly, precision technologies (drones, sensing devices, sensors, mobile applications, etc.) are becoming an integral part of irrigation systems because of their potential to improve efficiency and reduce costs in the production of high-value crops.

Irrigation continues to use more traditional irrigation technologies that have proven to be effective. Microsprinkler irrigation is one of the most expensive but water-efficient irrigation technologies. This technology uses small nozzles (sprinklers) to spray water over gardens, greenhouses, and fields. There is also drip irrigation, which uses drip emitters to deliver small amounts of water directly to the root zone of plants. This type of irrigation is traditional, and there are two types — subsurface and above-ground. They differ in the location of the drip network to deliver water to the plants.

There are several types of sprinkler irrigation that differ in the way the main irrigation machine is operated. A centralized circular sprinkler irrigation system consists of long steel beams, sprinkler nozzles and pivots (usually electric) around a central base that spray water in a circular system across the field. Linear sprinkler irrigation uses sprinklers mounted on wheels that move across the irrigated area of the field. Roller sprinkler irrigation distributes water through a pipe with a sprinkler on rollers that move across areas between rows (Table 1).

↓ **Table 1. Application of different irrigation methods according to natural-climatic and meliorative conditions**

Irigation technology	Ameliorative condition of soil			Complex topography	Large slopes	Close proximity to the GWT	Mineralised waters	Water shortage
	Salted	light mechanical compound	heavy mechanical compound					
Microsprinkler micro-irrigation	-	+	+	+	+	+	-	+
Sprinkling	-	+	+	+	+	-	-	+
Surface	+	-	+	-	-	-	+	-
Underground	-	-	+	+	+	-	-	+
Drip	-	+	+	+	+	+	-	+

Note: GWT — groundwater table.
Source: Olgarenko and Turapin, 2020.

Automated irrigation systems are needed to conserve water, and this improvement can play a paramount role in minimizing water use. Agriculture and farming practices are already linked to the Internet of Things and automation, which can make processes much more efficient and effective (FAO, 2022; Bauyin et al., 2020). Sensor systems help farmers better understand the needs of crops, reduce environmental impact, and conserve resources (Rezac, 2022; Xiuling et al., 2023).

Sensors and monitoring equipment as components of an irrigation system are critical to the development of an effective irrigation management system. Their use can increase food production with minimal water loss. Accurate monitoring facilitates data collection to adequately reflect real-time crop, soil, and weather conditions in irrigated areas using the Internet of Things (IoT) and Wireless Sensor Networks (WSN). Through these advanced systems, effective soil and weather monitoring and efficient water management are realized (Obaideen et al., 2022).

In the future, AI-based applications are expected to play an increasing role in irrigation (Qazi et al., 2022), with peripheral devices such as wireless sensors becoming "smart" enough to make autonomous decisions without relying on powerful central servers running AI algorithms. With recent advances in electronics, embedded systems with increased processing power and memory (system-on-chip, SoC) can provide a complex solution without relying on other external entities. In addition, we can note the development and use of 5G technologies and the emergence of self-managed irrigation and watering techniques and devices, the rise of blockchain technologies to fend off cyberattacks on sophisticated water supply and distribution information systems, and smart irrigation based on big data.

Innovations in the irrigation sector are emerging and being implemented in response to changing environmental demands and the threat of escalating water risks. The development of related technologies and their reduction in cost is also a strong reason to support the establishment of new water and irrigation systems. However, any single irrigation technology, when applied to a specific region, requires time to be fully implemented and to increase long-term efficiency (US Government Accountability Office, 2019).

The global pattern of investment in irrigated land is gradually changing, with priorities shifting from the development of large-scale irrigation infrastructure (dams, reservoirs and large main canals, large areas of irrigated land) to more efficient technological methods of water use and water demand management.

In this context, with regional population growth, rapid climate change, increasing pressure on water resources, and limited capacity to bring new agricultural land under cultivation, there will be an increasing need to further expand the area of irrigation rehabilitation and adopt modern and integrated agro-meliorative solutions.

02 THE IRRIGATION EQUIPMENT MARKET IN CENTRAL ASIA

Current Market Volume

The share of irrigated land in Central Asia is 26.2% of the total arable land. According to EDB estimates, based on data from national statistical offices and relevant government agencies, the irrigated area in the region will be 10.1 million ha (by 2022). This is about 2.9% of the world's irrigated area. Central Asia ranks fifth in the world in terms of irrigated area, after major players such as China, the USA, India and Pakistan. Uzbekistan has 42.3% of the region's irrigated area, followed by Kazakhstan (22.2%), Turkmenistan (17.8%), Kyrgyzstan (10.1%), and Tajikistan (7.5%). Most of the irrigated land (75% of the total area) is located in the Aral Sea basin.

Most of the irrigated area in Central Asia (8.6 million ha or 85%) is equipped with technical irrigation infrastructure. Surface irrigation technology is the dominant method (88%), with the largest area in Uzbekistan (3.6 million ha). Mechanized irrigation technologies, including sprinkler irrigation, are used on only 4.7% of the total area, with the dominant use in Kazakhstan (186,000 ha).

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Rational and economical use of water in agricultural fields is the main factor of water saving and reduction of salinization of irrigated land in Central Asian countries. In the context of modern irrigation water supply, the proportion of water withdrawn from sources and delivered to the field is estimated to be between 40 and 50 percent, while the proportion used by crops is estimated to be between 35 and 42 percent.

It is therefore imperative to further optimize water use in agriculture to reduce the water deficit in the region. To achieve this, it is necessary to improve the techniques and methods used to irrigate crops and to modernize the irrigation infrastructure. One method of reducing water consumption in irrigated agriculture is the use of sprinklers of various types and modifications, as well as the development of drip irrigation technologies for the cultivation of high-yield crops in horticulture, vegetable farming, and other agricultural practices.

Today, the total demand for irrigation equipment in the Central Asian countries is estimated to be between $140 and $320 million per year. This represents about 4–8% of the world market, according to the most conservative estimates. Uzbekistan is the main source of demand with an estimated value of $200 million per year. This includes drip irrigation equipment, various pumps and metering equipment.

$140–320 million

the total demand for irrigation equipment in Central Asian countries. This is approximately

4–8%

of the global market.

↓ Table 2. Regional demand for irrigation equipment by countries

Country	Demand for irrigation equipment	Top demand, USD mln.
Uzbekistan	• pumping units of various types and capacities • drip irrigation equipment • surface irrigation and drainage equipment • water metering equipment	200
Tajikistan		60
Kazakhstan	• sprinkler technology • surface irrigation equipment • drip irrigation equipment • water metering equipment	30
Turkmenistan	• surface irrigation and drainage equipment • water distribution equipment	20
Kyrgyzstan	• water metering equipment • water distribution automation equipment • drip irrigation systems • surface irrigation equipment	9

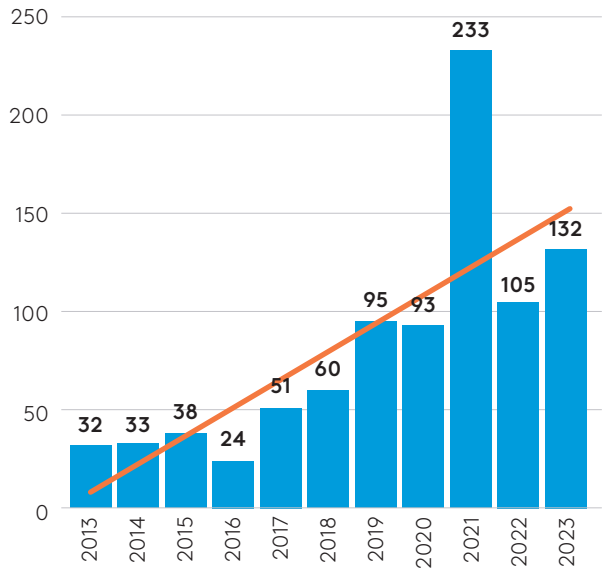
Source: EDB calculations, state support programs, trademap

In 2023, the value of imports of irrigation equipment in CA amounted to **$132 million.**

A total of **81.5%** of these imports were destined for Kazakhstan.

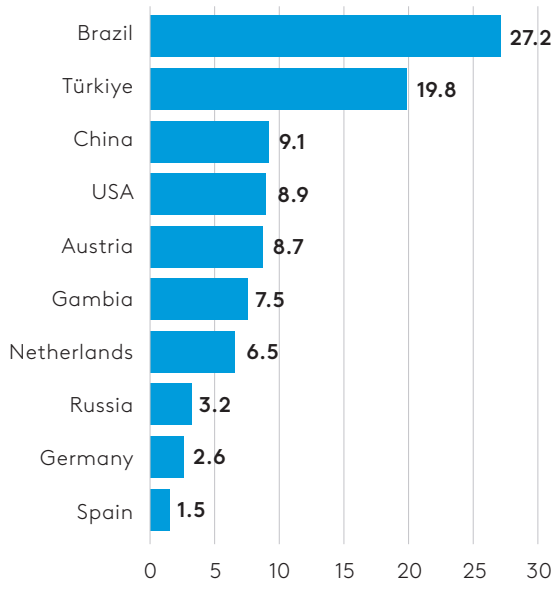
Currently, a significant portion of this demand is met by imports of irrigation equipment. Over the past decade, the volume of imports has increased fourfold, reaching a value of $132 million by the end of 2023 (Figure 1). Of the total imports, 81.5% were destined for Kazakhstan.

↓ Figure 1: Imports of irrigation equipment in Central Asia 2013-2023, USD mln.



Source: EDB calculations, trademap.

↓ Figure 2: Top 10 major suppliers of irrigation equipment to the region by 2023, %



Source: EDB calculations, trademap.

The Central Asian market is supplied by a number of companies from different countries, including Brazil, Turkey, China, the US and Austria (Figure 2). Companies include Lindsay, Piltar, Acarmaksan, Alchemist Technologies, Ezport, Serdrip (Turkey); Golden Dragon, Ybiyuan, Yulin (China); Valley, Zimmatik, Reinke, TL (USA). The following companies are also represented: Poliv, Raduga, Aquafield (Russia); Bauer (Austria); Beinlich, Karcher (Germany); Ocmis, RM, Nettuno, Idrofoglia, Irtec, Irrimec (Italy); RKD (Spain). All equipment is designed to operate in a closed irrigation network, with automated operation, multi-purpose use, computer control and management systems, a wide range of modifications and options, and maximum consideration of specific application conditions.

Government support

Global market trends show the importance of government support for the irrigation equipment market. Central Asian countries have active policies to support the introduction of irrigation technologies and the purchase of irrigation equipment. Mechanisms of state support for the agro-industrial complex and, consequently, for irrigation equipment in the CA countries include subsidies for part of the cost of purchased equipment, leasing, preferential loans, subsidized interest rates for the purchase of agricultural machinery and equipment for own needs, and special privileges under investment agreements.

In the Republic of Kazakhstan, President Kasym-Jomart Tokayev, in his address to the people of Kazakhstan on September 1, 2023, noted the importance of introducing water-saving technologies and ordered the establishment of a Ministry of Water Resources and Irrigation. In 2024, as part of the new ministry's comprehensive work on all aspects of water resources management, subsidies were revised. In particular, subsidies for farmers to adopt water-saving technologies were increased by 30%, from 50% to 80%. This will help cover the cost of purchasing modern irrigation systems and connecting all the necessary infrastructure. Other measures have been developed to encourage farmers to conserve water and use it efficiently. In particular, the new Water Code provides for government support in the form of subsidies and reduced water tariffs

According to the New Water Code of the Republic of Kazakhstan, farmers may receive subsidies amounting to up to

80%

of the costs associated with the adoption of water-saving technologies.

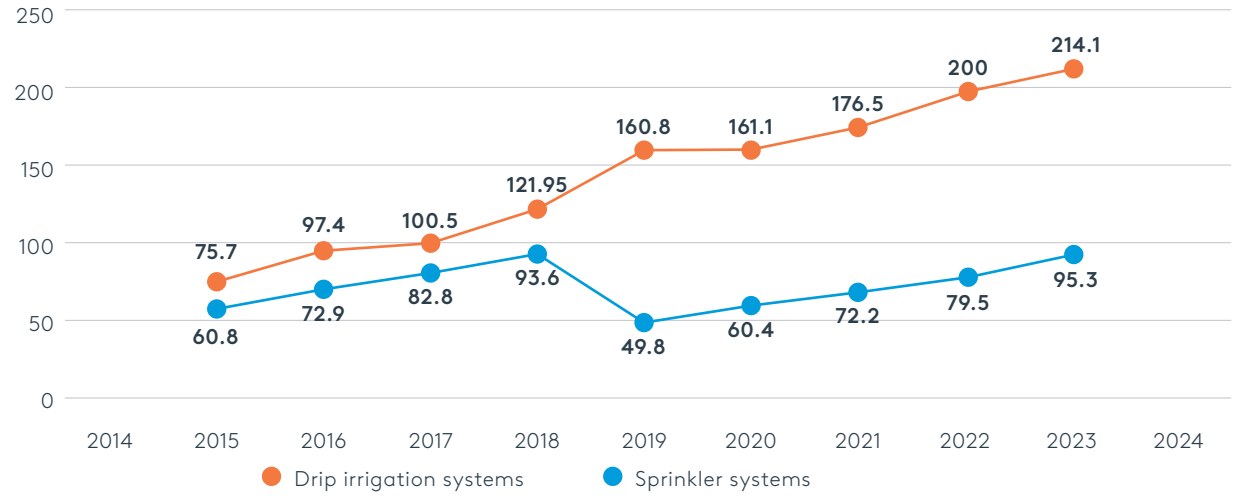
depending on the adoption of water-saving technologies. It also proposes that tariffs be calculated according to the types of crops grown and the amount of water they consume. In addition, subsidies for drilling wells have been increased to 80%.

The Ministry plans to introduce water-saving technologies throughout the country. To implement the President's directive, a step-by-step plan has been developed until the end of 2030, and each region has been given specific target indicators to increase the area of crops where water-saving systems are installed.

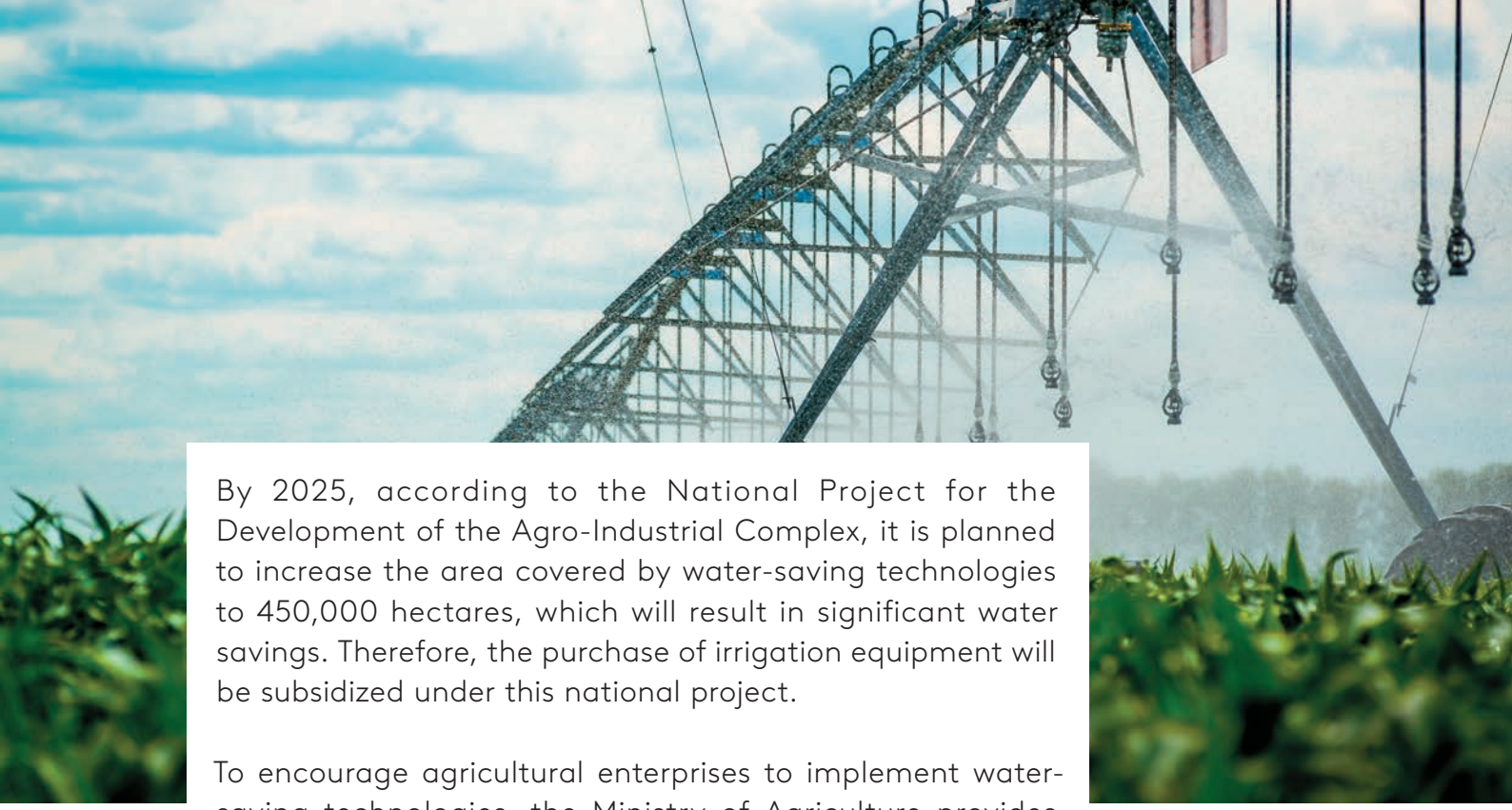
By the end of 2030, the plan is to save up to 2.1 billion cubic meters of water per year by covering more than 50% of the country's total irrigated area with water-saving technologies

Today, certain achievements have been made in the development of the implementation of water-saving technologies in the Republic of Kazakhstan. Over the past 8 years, the annual area of land where drip irrigation systems have been introduced has grown 2.8 times (from 75.7 thousand ha to 214.1 thousand ha), and 1.6 times where sprinkler systems have been introduced (from 60.8 thousand ha to 95.3 thousand ha).

↓ Figure 3: Dynamics of introduction of water-saving irrigation technologies in the Republic of Kazakhstan, annual deployment area in 1,000 ha



Source: Concept of Water Resources Management System Development in the Republic of Kazakhstan for 2024-2030.



By 2025, according to the National Project for the Development of the Agro-Industrial Complex, it is planned to increase the area covered by water-saving technologies to 450,000 hectares, which will result in significant water savings. Therefore, the purchase of irrigation equipment will be subsidized under this national project.

To encourage agricultural enterprises to implement water-saving technologies, the Ministry of Agriculture provides government support in the form of investment subsidies and subsidizes the cost of water supply services to farmers. From May 2024, the standard of cost subsidization is 80% for investment in the purchase and installation of water-saving technologies, of which 30% is subsidized from the local budget.

In addition, in July 2023, in order to encourage farmers to use modern water-saving technologies, the Regulations on Subsidizing the Cost of Water Supply Services to Farmers were amended to differentiate the amount of subsidy according to the type of irrigation.

According to the amendments, the percentage of compensation for irrigation without the use of water-saving technologies, regardless of the method of water supply, will be gradually reduced over three years and will range from 30% to 55%, depending on the cost of the tariff. In the case of irrigation using water-saving technologies, the compensation will range from 60% to 85%, depending on the cost of the tariff. In 2024, 44 irrigation projects were planned to be implemented in Kazakhstan as a result of government initiatives.

The development of domestic irrigation equipment production can be based on the already applied mechanisms of subsidizing the purchase of irrigation machinery and equipment. At present, these subsidies are used for imports, thus supporting foreign producers. The amount of subsidies is quite sufficient to meet the domestic demand

for irrigation equipment in Kazakhstan and, accordingly, to develop its own industrial production. Such manufacturers of equipment for irrigation systems — sprinklers and drip irrigation systems — as Metzer Kazakhstan, BNK irrigation, Samal commodities, JSC "KELET", etc. could form the basis of a new machine-building industry.

The concept of development of the water sector for 2020–2030 is being implemented in Uzbekistan. The strategy includes a number of infrastructure, policy, institutional and capacity-building measures for sustainable water resources management and modernization of the country's irrigation sector, as well as programs and measures aimed at water resources management and development of the irrigation sector. Key activities include:

- Repair and rehabilitation of irrigation canals on the balance sheet of water management organizations;
- Construction and reconstruction of irrigation facilities;
- Equipping hydrological stations on rivers with automated equipment based on digital technologies;
- Replacement of obsolete pumping units of pumping stations of the system;
- Introduction of digital technologies to ensure on-line control;
- Introduction of water-saving technologies for crop irrigation.

Specifically, the program has set goals of increasing water use efficiency by 25% and increasing the total area covered by water-efficient irrigation technologies to 2 million acres, including drip irrigation technologies to 600,000 acres.

A number of manufacturers of irrigation equipment — drip irrigation systems, fittings, fertilizer dispensers, taps and valves for irrigation control, external drippers and other irrigation accessories, as well as pumping stations and water meters — are produced in Uzbekistan. The main consumers of Uzbek products are industrial cotton and textile clusters, such as Mergantex and Agrocluster in Bukhara. In addition to production, Uzbek companies are also involved in the

installation and operation of irrigation systems. The localization of water-saving technologies has reached 80%. In Uzbekistan, there are more than 50 enterprises producing technologies that can cover up to 300,000 ha per year.

Irrigation is a priority sector in the Kyrgyz Republic. The State Irrigation Development Program for 2017–2026 is being implemented, which provides for the construction of irrigation infrastructure to create new irrigated land for rural residents. Under the program, 2,100 km of canals and 10,000 hydraulic structures have been rehabilitated and 119 pumping units have been replaced. In addition, 67 canals with a length of 1,068 kilometers were rehabilitated.

From 2024 to 2030, 39,600 ha of new irrigated land will be developed through the construction of 86 ten-day regulation reservoirs, and water supply to 223,700 ha of irrigated land will be increased

These measures will reduce irrigation water losses by 30–50%. Under the Agricultural Mechanization Program, farmers will have access to preferential leasing of all types of agricultural machinery and equipment, as well as sprinkler and drip irrigation equipment for crop irrigation, for up to 10 years at an interest rate of 6% per annum.

Irrigation Equipment Production Initiatives in Central Asia

Against the background of increasing water scarcity and the corresponding expansion of measures to support the introduction of efficient irrigation technologies in 2023–2024, Central Asia has intensified activities to organize its own production of irrigation equipment.

In Kazakhstan, the American company Valmont Industries has announced plans to build a large-scale production facility for modern irrigation systems. The projected cost of the project is $53 million, and the projected production capacity is up to 1,000 units of irrigation equipment per year. It is estimated that the project will create 200 jobs. The facility is expected to be operational in the fourth quarter of 2025. While the company has selected the Kairat Industrial Zone in the Almaty region, there is potential for further discussions to establish an irrigation cluster in Kazakhstan.

In the rural district of Shaga in the Sauran district of the Turkestan region, the Kazakh company BNK Group in cooperation with the American company Nelson Irrigation has started the production of circular and frontal sprinklers in 2023. The total cost of the sprinkler irrigation machinery plant is 4.05 billion tenge. The production facility will occupy an area of about 3,000 square meters. The project will establish the production of a full cycle of irrigation machines for the widespread application of water-saving technologies in Kazakhstan. In 2024, a new automated workshop was built, where each joint of the sprinkler is welded by robots. The plant has already reached its maximum production capacity of 1,000 irrigation machines per year. In 2024, the construction of a galvanizing line have begun another workshop. By the end of 2024, the production of irrigation systems have started. In addition, BNK GROUP LTD is in the process of preparing the third phase of the project, which will include the production of agricultural machinery and tractors, as well as water catchment pumps. The total cost of the project is estimated at 7 billion tenge.

In December 2023, the launch of another irrigation equipment production project was announced under the name of "Irrigator Kazakhstan" LLP. "Irrigator Kazakhstan" LLP has localized the production of drip pipes of the Israeli brand METZER, with which the local company has been cooperating for over a decade as a distributor of products in Kazakhstan. "Irrigator Kazakhstan LLP aims to export its products to the markets of the Russian Federation, Central Asia and Transcaucasia. At present "Irrigator Kazakhstan" LLP has about 400 regular customers among agricultural producers, mainly consisting of farms and large agricultural

enterprises in Kazakhstan. The project is located within the Almaty City Industrial Zone, in close proximity to the regions with the highest demand for drip irrigation, namely the Zhambyl and Turkestan regions of southern Kazakhstan. The Almaty City Industrial Zone provided a site for the project that included the necessary infrastructure, such as a stable power supply, a reliable water supply, and access to railroad tracks. In addition, the plant is strategically located within the boundaries of a major industrial city, providing convenient access to key resources and support systems.

SPACETIME sprinklers will be manufactured in Kazakhstan through SPK JSC. The SPACETIME factory is located in Astana, where the company's products are manufactured. The same irrigation equipment production is expected to be established in East Kazakhstan. The first production samples of "Su Bereke" irrigation machines have already been installed on farms in East Kazakhstan. The primary structure is manufactured in Kazakhstan, but the intention is to replace imported components with domestic ones in the future.

Other initiatives in Kazakhstan include the following:

- Kazakhstan and Turkey signed an agreement on the construction of two plants for the assembly of irrigation equipment in the Zhambyl region. Relevant cooperation agreements on investment projects were signed with Ardent Plastik A.S. and Atlantis A.S. The latter is one of the leading companies in Turkey that produces high-quality irrigation products, including sprinkler systems, drip irrigation pipes and various types of plastic pipes. The company was established in 1979 and exports its products to more than 35 international markets. Atlantis was established in 1998 in Istanbul. It specializes in the production and installation of agricultural irrigation systems, drip irrigation systems, landscape (recreational) irrigation systems and compact construction equipment. It also manufactures greenhouses and agricultural products.

- The project for the production of components for drip irrigation systems in the city of Konaev. The plant is a joint project of Kazakh and Chinese companies. It is expected that the plant will be able to supply up to 500 hectares of fields per week with drip irrigation technologies. It is planned to open a similar plant in Taraz.

- The project of KAZ Caspian HYDRO Auyl Sharuashylylylygi Technologiyasy to manufacture drip irrigation systems in the Zhambyl region in the amount of $6 million. Work has begun on the installation of production equipment. The launch of the enterprise will create 30 new jobs.

In the Kyrgyz Republic in the summer of 2024 it was planned to start construction of a plant for production of equipment for drip and sprinkler irrigation. The corresponding memorandum was signed with the Turkish company "Akplas Plastik San. Ve Tic. A.S." The company will invest $10 million in the first stage according to the investment agreement. It is expected that the construction and commissioning of the plant will be completed within eight months. The plant will require 10 hectares of land for construction.

The Republic of Tajikistan in 2024 noted cooperation with Iran in introducing water-saving technologies and modernizing irrigation and drainage systems. Eight Iranian companies specializing in the production of advanced water-saving technologies and modernization of irrigation and drainage systems are considering the possibility of selling their products and services.

In Turkmenistan, the economic company "Turkmen Senagat" has established the production of high-tech drip irrigation systems, which are manufactured according to customer specifications. "Turkmen Senagat" is a prominent pipe manufacturing company in Turkmenistan. Established in 2018, the company initially focused on the production of small-diameter polyethylene pipes. Over time, it has diversified its product range to include pipes with diameters ranging from 16 to 1,200 mm.

In terms of irrigated area, Uzbekistan is the largest in Central Asia, the second largest among CIS countries, the fourth largest among Asian countries, and the 13th largest in the world. The localization of the production of water-saving technologies has reached 80%, with more than 50 production enterprises capable of manufacturing technologies that can cover up to 300,000 ha per year. The Republic continues to make efforts to localize production. For example, the possibility of establishing an Uzbek-Israeli-Swiss joint venture "Irrigation Advance" with the Israeli company "Agrotal Group" in Tashkent is currently being discussed. The primary goal of the new joint venture is to introduce modern irrigation technologies to Uzbekistan. Initially, the venture plans to import advanced Israeli drip irrigation equipment, facilitated by credit lines in two Uzbek banks, Pakhtabank and Asaka. In the long term, the venture aims to establish a joint production facility for advanced irrigation equipment in Uzbekistan.

Future Market Assessment

According to government plans and program documents, the countries of the Central Asian region are expected to increase the area under irrigated agriculture using various irrigation technologies (Dankova et al., 2022). By 2040, the largest number of hectares of land covered by irrigation technologies is expected to be reached. The total area covered by irrigation technologies is estimated to be 10.6 million hectares, with Uzbekistan accounting for 4.3 million hectares (40.5%) and Kazakhstan for 2.7 million hectares (25.5%) (Table 3). Drip irrigation is expected to maintain its dominant position in Uzbekistan, while sprinkling is expected to become the dominant technology in Kazakhstan. Surface irrigation is expected to remain the main method, with Uzbekistan and Turkmenistan using it most extensively.

10.6 million ha

total area covered by irrigation technologies by 2040, with dominance of drip irrigation in Uzbekistan and sprinkling technologies in Kazakhstan

↓ Table 3. Status and forecast of irrigated areas with irrigation infrastructure

	Irrigated lands, as of 2024		by irrigation methods and techniques											
			Surface irrigation			Sprinklers			Drip irrigation			Other methods		
	Total, 1,000 ha	utilized	2024	2030	2040	2024	2030	2040	2024	2030	2040	2024	2030	2040
Kazakhstan	2,243.4	1,557.6	1,298.4	1,300.0	1,400*	185.8	300.0	950*	73.0	100.0	300*	2.0	10.0	50*
Kyrgyzstan	1,025.0	925.0	811.3	753.5	572	100.0	150.0	200	13.2	70.0	250	0.5	1.5	3
Tajikistan	763.0	680.0	639.3	626.6	677	40.0	50.0	80	0.5	25.0	50	0.2	0.4	1
Turkmenistan	1,800.0	1,400.0	1,333.8	1,318.0	1,605	50.0	60.0	90	15.2	20.0	100	1.0	2.0	5
Uzbekistan	4,280.5	4,010.0	3565	3,244.5	3,530	31.0	48.2	100	398.0	471.8	600	16	24.6	50
Central Asia	10,111.9	8,572.6	7,647.8	7,242.6	7,784	406.8	608.2	1420	499.9	686.8	1300	19.7	38.5	109

Note: * In Kazakhstan it is planned to increase the area of irrigated lands up to 2,700,000 ha by 2050.
Source: EDB calculations

The projected number of technical means and equipment for irrigation up to 2040 was revealed through an analysis of the relevant calculations. The greatest demand for irrigation equipment for surface irrigation between 2026 and 2040 will be for 1,525,000 units of equipment. It is noteworthy that this method of irrigation will remain the dominant method in this region, and it will be necessary to maintain the level of technical equipment and introduce modern types of equipment. Most of the demand for this type of irrigation equipment for surface irrigation will be in Uzbekistan, with an estimated 900,000 units, accounting for 59% of the total demand.

During the same forecast period, approximately 102,500 units of sprinkler equipment and machines of various capacities will be required. The primary market for sprinkler machines will be in Kazakhstan, with an estimated demand of 70,000 units, representing 68.3% of the total regional demand for sprinkler machines.

Drip irrigation systems will account for a significant portion of the total demand for irrigation equipment. In total, the region will require 180,500 units of new drip irrigation systems. The region's agricultural conditions will require the majority of the region's drip irrigation equipment, with the greatest demand in Uzbekistan (115,000 units, or 63.7% of the region's total drip irrigation systems) (Table 4).

↓ Table 4. Forecast of demand for technical means and equipment for irrigation up to 2040

	Irrigated lands, as of 2040	Technical irrigation equipment, thousand units							
		Surface irrigation**		Sprinklers***		Drip irrigation		Other methods	
	Total, 1,000 ha	2026–2030	2031–2040*	2026–2030	2031–2040*	2026–2030	2031–2040*	2026–2030	2026–2040*
Kazakhstan	2,700.0*	100.0	200.0	20.0	50.0	7.5	20.0	2.5	50.0
Kyrgyzstan	1,025.0	50.0	60.0	2.5	5.0	1.5	14.0	0.5	1.5
Tajikistan	763.0	40.0	45.0	2.0	4.0	0.5	5.0	0.4	1.0
Turkmenistan	1,800.0	60.0	70.0	3.0	7.0	2.0	15.0	2.0	5.0
Uzbekistan	4,280.5	400.0	500.0	4.0	5.0	35.0	80.0	19.5	60.0
Central Asia	10,568.5	650.0	875.0	31.5	71.0	46.5	134.0	24.9	117.5

Note: * In Kazakhstan it is planned to increase the area of irrigated lands up to 2,700,000 ha by 2050.
** different technical means used in surface irrigation
*** different types of sprinkling machines and equipment.
Source: EDB calculations.

Taking into account the current level of scientific and technical progress and the planned implementation of water-saving technologies on irrigated lands, the main technical means and equipment for irrigation necessary for their use in agricultural production of Central Asian countries can be classified as follows.

For surface irrigation systems, the production of modern mechanization and automation solutions is an important area of focus. This includes the development of advanced irrigation fittings, portable mobile systems for water redistribution within irrigated areas, and other innovative solutions. Similarly, the production of various trenchers and ditch diggers, machines for preparing horizontal closed drainage and equipment for laying open drainage is an important aspect of this area. The production of earthen canals and their distribution is also a key area of expertise. The production of various mechanization means for levelling the surface of irrigated plots should also be considered. This could include the production of various laser-controlled earthmoving and planning machines, automated short-base planners, and machines and equipment for maintenance and repair work against sediments, shrub vegetation, as well as ameliorative dredgers and canal cleaners with equipment for cleaning concrete canals.

Furthermore, in order to meet the future needs of the downstream countries located along the main rivers of the Aral Sea basin (namely, Uzbekistan and Turkmenistan), it is imperative to start the production of drip irrigation systems, including drip pipes and drip tapes in both compensated and non-pressure compensated designs. In addition, the production of drippers, sets of connecting fittings, flexible pipes, layflat (LFT) 50, 75, 100 and 150 mm in diameter with a working pressure of 4–9 atm, and systems of control and automation of the irrigation process is required.

Kazakhstan needs to establish production of various microsprinkler systems, including a full range of microsprinklers that operate at pressures ranging from 0.15 to 0.35 MPa. Additionally, low-pressure sprinkler nozzles are required. At a pressure of 0.1–0.2 MPa, the necessary equipment includes stands and holders for nozzles, shut-off and control valves, head regulators, booster pumps, special equipment for fertilizing with irrigation water, and computerized irrigation control systems. Wide-catch sprinklers with electric drive on pneumatic stroke, operating automatically from a closed network, are needed for irrigating areas ranging from 10–50 hectares up to 200 hectares per season. Hose reel sprinklers with medium jet devices or cantilever carts with low-pressure devices are needed for areas ranging from 3 to 30 hectares per season. Portable sprinklers that can be easily assembled are also required. The sprinkler pipelines, made of aluminum or plastic, should be capable of serving

up to 50 hectares per season, operating at pressures from 0.3 to 0.5 MPa. It is important to have hydraulic shutoff and control valves, head and flow controllers, booster pumps, and power pumping equipment.

The cost of equipment of foreign manufacturers, based on expert assessments of information resources and proposals of foreign manufacturers and data of dealer centers, is Large-area sprinklers of circular action — $75,000–100,000 (basic machine with an operating area per season up to 70 ha); large-area sprinklers of frontal action — $90,000–120,000 (basic machine with an operating area per season up to 70 ha); Hose reel sprinklers with hydraulic drive — $35,000–42,000 (basic machine with a service area per season up to 30 ha), drip irrigation systems — $20,000–25,000 (basic module with a service area up to 10 ha); stationary sprinkler systems — $25,000–30,000 (basic module for a service area up to 10 ha); microsprinkler systems — $30,000–40,000 (module — 10 ha).

Accordingly, an approximation of the investment costs required to introduce irrigation technologies in CA countries to expand irrigated land coverage can be calculated. This estimate is based on the projected need for equipment to improve irrigation methods and technologies up to 2040.

Total investments needed to introduce water-saving technologies in CA

$6.5 billion

for drip irrigation systems

$2.2 billion

for sprinkler technologies

$3.2 billion

for surface irrigation systems

The largest investment will be required for drip irrigation systems, with an estimated $6.5 billion needed across Central Asia. Significant investment will also be required for sprinkler technologies, with an estimated $2.2 billion needed across Central Asia between 2026 and 2040. However, the development and maintenance of surface irrigation systems will continue to represent the largest investment, with an estimated $3.2 billion over the same period.

This signifies that, on average, **the irrigation equipment market has the potential to generate up to $426 million annually for domestic producers** in the region by 2030 (Table 5). It is reasonable to expect that with full localization of irrigation equipment would allow to keep all these investments within the market of the Eurasian region. In the period up to 2030, the majority of irrigation equipment production will be concentrated in drip irrigation and sprinkling systems.

$426 million

annually domestic producers could generate from the irrigation equipment market by 2030

↓ Table 5. Assessment of investments in improvement of crop irrigation techniques and methods in Central Asia up to 2040

	Irrigated lands, as of 2040	Investments in the development of irrigation methods and techniques, USD mln.							
		Surface irrigation		Sprinklers		Drip irrigation		Other methods	
	Total, 1,000 ha	2026–2030	2031–2040*	2026–2030	2031–2040*	2026–2030	2031–2040*	2026–2030	2026–2040*
Kazakhstan	2,700.0*	75.0	200.0	370.0	1,300.0	54.0	400.0	16.0	80.0
Kyrgyzstan	1,025.0	25.0	100.0	100.0	100.0	114.0	360.0	2.0	3.0
Tajikistan	763.0	20.0	100.0	20.0	60.0	20.0	300.0	0.4	1.2
Turkmenistan	1,800.0	50.0	400.0	20.0	60.0	15.0	350.0	2.0	6.0
Uzbekistan	4,280.5	250.0	2,000.0	60.0	120.0	900.0	4,000.0	20.0	50.8
Central Asia	10,568.5	420.0	2,800.0	570.0	1,640.0	1,103.0	5,410.0	40.4	141.0

Note: * In Kazakhstan it is planned to increase the area of irrigated lands up to 2,700,000 ha by 2050.
Source: EDB calculations.

03 CLUSTER FORMATION IN THE WATER SECTOR OF CENTRAL ASIA

The production of irrigation equipment and related parts and machinery in Central Asian countries is **currently in its infancy**. Despite ongoing initiatives to develop domestic production of irrigation equipment and systems, imports still dominate in Central Asia.

The cluster approach (Delgado et al., 2016), which aims not only to develop the production of agricultural and irrigation machinery and equipment, but also to improve the competitiveness of agricultural production in rural regions of CA countries, can be a solution to the shortage or lack of domestic production of irrigation equipment. The geographical proximity of irrigated areas in the Central Asian region — the Amu Darya and Syr Darya river basins, the Chu and Talas river basins — is also an advantage for the formation of agro-industrial clusters. The development of local production of equipment and machinery for irrigation and watering will increase the efficiency of water resources management in the region, taking into account the organization of such production for local conditions, and will also realize the industrial potential of regions that are exclusively agricultural (Gálvez-Nogales, 2010).

The joint efforts within the industrial cluster should be aimed at the creation of high-performance and multifunctional sprinklers and other equipment that implement "precision irrigation" techniques, provide increased reliability, improved working conditions and safety, application of new technologies and materials, reduction of material and energy intensity, unification of modules and assembly units.

The new generation of irrigation systems and machines should be low pressure and provide high quality irrigation performance. They should be able to optimize the water delivery algorithm and combine irrigation with the simultaneous delivery of water, nutrients, disease, pest and weed control products, soil amendment chemicals, plant growth regulators and photosynthesis activation. Resource conservation is ensured by saving water, fertilizers, electricity, fuel during construction, reconstruction and operation

of irrigation systems using new generation irrigation technologies and by reducing material intensity through new design solutions. Automation of the technological process of irrigation and application of nutrients and other substances allows achieving high technical, economic and qualitative indicators. Control systems should monitor and regulate the water regime to ensure optimal moisture reserves in the soil (Olgarenko and Turapin, 2020).

International experience in the development of clusters in the agricultural and water sectors indicates that irrigation clusters should preferably be developed in places where water resources are scarce, in arid regions, in places where arable land is concentrated. In general, such clusters are developed in regions with water problems similar to those in Central Asia, where water stress in the Aral Sea basin has increased in recent years (Vinokurov et al., 2023).

In the agricultural complex, the cluster approach is comprehensively linked to water resources management. It includes agricultural activities related to irrigation, animal husbandry and agro-industrial processes (Aysarova, 2023). Clustering in agriculture helps not only to increase the yield of cultivated crops, but also to bring a coordinated approach to the management of limited water resources for the sustainable development of the agricultural sector and the region as a whole.

There are many successful water and irrigation clusters around the world that contribute to the efficient use of water resources and increase agricultural yields. The structure of such cluster formations includes elements of water management, irrigation services, and irrigation equipment manufacturing, as well as producers in related industries, institutes for scientific development to improve equipment efficiency, water conservation, and crop yields, IT technologies, and other activities.

Some successful irrigation equipment or technology clusters have demonstrated effective internal collaboration, high levels of innovation, and significant increases in economic growth within the water and irrigation industry.

The California Water Agriculture Cluster. While California is perhaps best known for its Silicon Valley and the development of a primarily technology industry, the state's Central Valley is a significant agricultural region. An irrigation equipment cluster has developed there, with water technology companies also located in the area. The combined efforts of universities, manufacturers, and farmers have led to the development of advanced irrigation technologies, including automatic sprinkler systems, soil moisture sensors, and smart water management platforms. The success of the cluster can be attributed to the coordinated efforts of its members, the sharing of knowledge, and the political support it has received. The cluster benefits greatly from its proximity to world-class research institutions (such as Stanford University) and venture capital funding. Notable companies in the cluster include Xylem, which specializes in water infrastructure solutions, and Ayyeka, a leader in remote monitoring and control systems (including air quality, solar energy, ground and surface water, etc.).

The Water Technology Cluster in the Netherlands. The Netherlands has a long tradition in water management, shaped by its unique geography (the country is low-lying). The Water Technology Cluster brings together a wide range of entities, including companies, research institutes and government agencies. Its members specialize in areas such as water treatment, desalination, flood control and wastewater treatment. Companies such as Royal Haskoning DHV and PWN Technologies play a key role in advancing sustainable water solutions.

The Singapore Water Hub. Despite its limited freshwater resources, Singapore has become a global hub for water technology. The Singapore Water Exchange (SgWX) facilitates collaboration between water companies, investors and research institutions. The cluster focuses on water reuse, desalination and smart water technologies.

Israel Water Technology Cluster. Israel's arid Negev Desert has become one of the world's centers for irrigation technology. The Negev Desert Cluster has brought together research institutes, start-ups and established companies to develop advanced irrigation solutions. The collaboration between academia, industry and government has led to innovations such as drip irrigation systems, precision farming, water-saving sensors and smart water management systems. The cluster includes companies such as IDEXX, which specializes in water quality testing, and Tal-Ya Agriculture Solutions, known for its efficient irrigation systems.

India's water equipment manufacturing cluster is located in Coimbatore, Tamil Nadu, home to a vibrant cluster of irrigation and water supply equipment manufacturers.

These include EKKI Pumps and Sharp Pumps, which manufacture water pumps, filtration systems and irrigation equipment. Advantages of the cluster include a skilled workforce, research institutes, and a favorable ecosystem. In addition, the city and region specialize in the moisture-intensive cotton and textile industries, with Coimbatore being referred to as the "Cotton City" or "India's Manchester.

In general, successful global clusters in the water and irrigation sector share similar characteristics. These include joint efforts of different stakeholders (science, production, consumers, government) that ultimately lead to improved water management and increased crop yields in different regions of the world.

Based on the successful international experience, the characteristics of a successful irrigation equipment cluster in CA should be continuous innovation and internationalization of business. Continuous technological improvement of manufactured equipment and entry of products into export markets will allow the realization of such cooperative projects in CA. In addition, supporting a cluster initiative in agricultural machinery (irrigation equipment) can also be an effective tool for developing the value chain of regional agricultural products (Sonobe and Otsuka, 2006). In addition, the irrigation equipment cluster initiative in CA will facilitate the access of local farmers, including smallholders, to credit, quality inputs and technological equipment (Otsuka, Zhang, 2021; Bizikova et al., 2020).

04 INDUSTRIAL CLUSTERS AND CRITERIA FOR THEIR ESTABLISHMENT AND FUNCTIONING IN CENTRAL ASIA

General principles of cluster development

The classic definition of an economic "cluster" as outlined by Michael Porter (1998) is a group of interrelated firms, specialized suppliers, service organizations, firms in related industries, and related institutions and organizations (e.g., universities, standards agencies, and trade associations) that both compete and cooperate with each other.

Box 1. The concept of "cluster"

One of the first definitions of an economic cluster was provided by Alfred Marshall in the late 19th century. At that time, closely located enterprises were called "industrial districts" (Mikhaltsov, 2014). In such formations, the intensity of communication and interaction among workers increased, which led to the flow and rapid diffusion of new ideas, improved production processes, and strengthened close ties between firms. In the future, the growth of globalization, increased competition, and intensified scientific and innovative development contributed to the emergence of new regional formations. One of the most notable examples of such regional formations with a strong concentration of scientific and production actors is Silicon Valley in the USA. The widespread development of such regional formations in various global economic hotspots has provided a new perspective on the issue of scientific-innovative and economic development of individual regions.

To date, researchers have distinguished numerous types of clusters. Among them, industrial clusters, which also have their own classification by structure and forms of development, are of particular interest for the development of irrigation equipment production in the Central Asian region (Yachmeneva and Yachmenev, 2017).

Industrial clusters are regional clusters consisting of a group of geographically concentrated enterprises of one or several related industries and supporting institutions, located in a certain region. The main component of such clusters is a concentration of industrial enterprises.

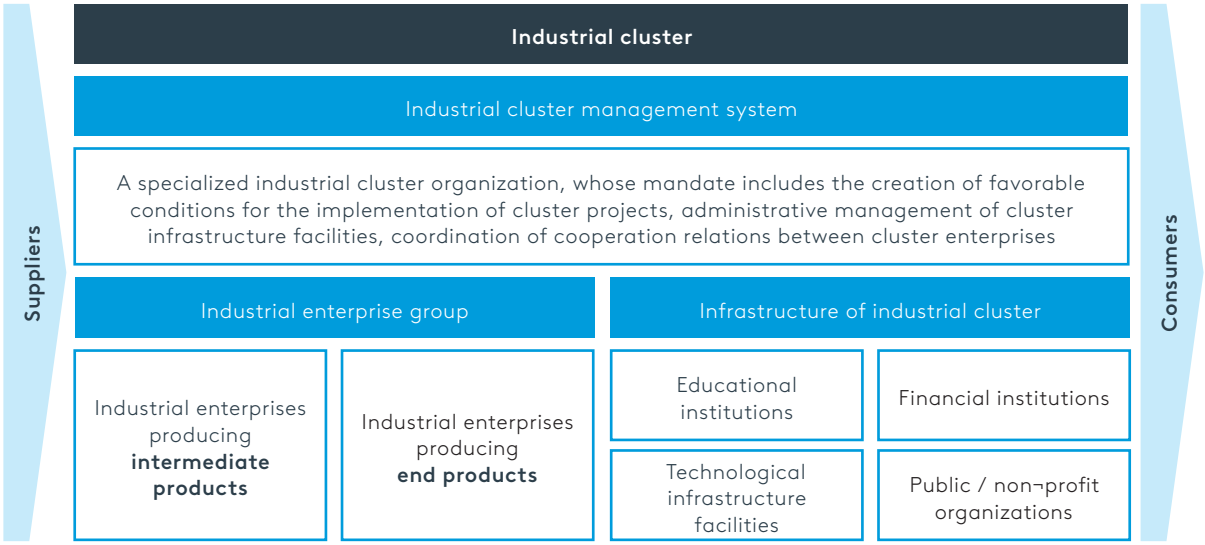
The infrastructure of a standard industrial cluster typically includes at least one educational institution, two technological infrastructure facilities, one non-profit or public organization, and one financial organization.

These clusters also include at least ten industrial enterprises that work in close cooperation. Of these, one company serves as the "final production" stage of the production cycle.

In addition, additional criteria have been set for the level of mandatory industrial cooperation. These stipulate that at least 20% of the industrial products produced by each participant should be consumed or processed

within the cluster. The majority of researchers state that the entity responsible for initiating an industrial cluster and overseeing cluster projects should be a specialized organization comprising a group of industrial enterprises with cooperative ties within the cluster. This business approach will facilitate the nascent cluster's transition to a subsequent growth phase.

↓ **Figure 4. Industrial cluster structure**



Sources: EDB and UNIDO estimates.

The analysis of examples of cluster formation in world practice generally suggests that each country and region creates clusters that take into account sectoral and local specificities. Studies on clusters do not provide a clear picture of the key factors of sectoral clustering in specific territorial formations. What distinguishes successful clusters is their successful symbiosis of different factors. The most important of them is the high interest of the state in small and medium-sized enterprises as the drivers of the country's economic development.

The international experience of cluster development in developed countries shows that most of them are formed at the regional level.

One of the defining characteristics of clusters organized on the regional principle is the uniqueness of the internal environment, infrastructure and ecosystem of a given region. Competitive advantages of territories through integration can result from clustering.

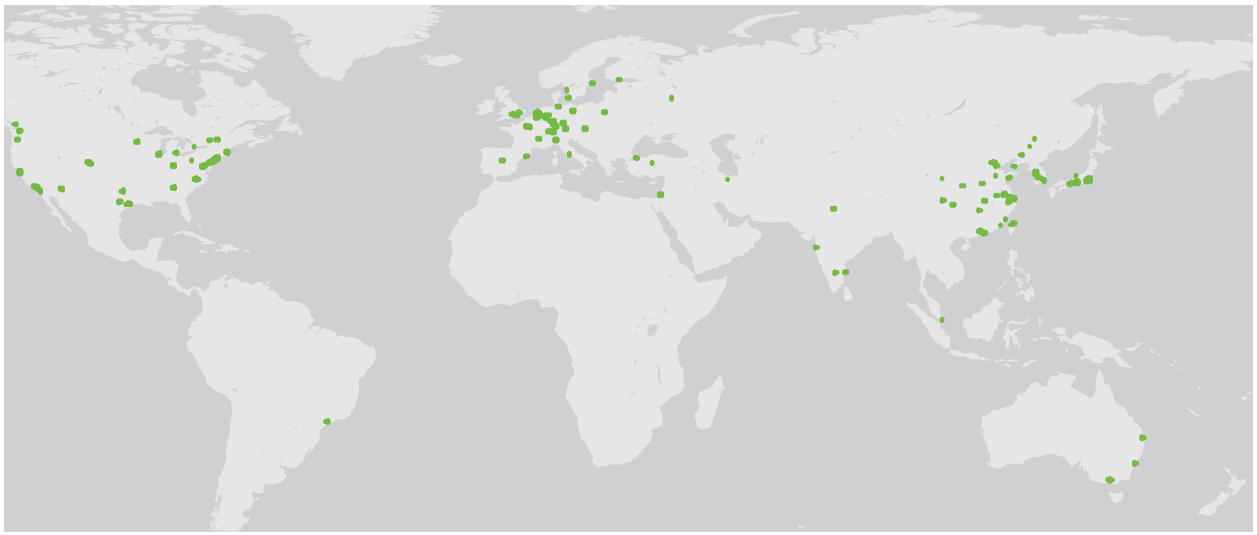
Clustering is an effective tool of sectoral competition at the international level. In the context of globalization and increasing regionalization of the world economy, it could be argued that clusters are the engines of regional competitiveness on a global scale.

Clustering is an effective tool of sectoral competition at the international level. In the context of globalization and increasing regionalization of the world economy (Kostyunina, 2020), it could be argued that clusters are the engines of regional competitiveness on a global scale. In such a transformation of markets, the importance of the cluster concept of development of national economies among developing countries will undoubtedly increase.

The cluster approach is a distinctive feature of developing countries as it facilitates intensive economic growth through innovative development and diversification of economic activities in the region. This approach can serve as a basis for economic growth and provide a significant economic boost.

The experience of cluster development in developed countries in modern conditions indicates that the increase in competitiveness of regions is due to the development of innovation clusters. Innovation clusters are understood as a mechanism of economic interaction between enterprises, providing them with effective business models of a certain specialization, based on the systemic interaction of all participants in the process of value creation, starting from research and development to the formation of an innovative product (Ibragimova and Golovkin, 2019).

↓ **Figure 5. Global distribution of science and technology clusters**



Source: WIPO Statistics Database.

It can be observed that effective clusters, in the role of instruments concentrating high indicators of labor productivity and S&T potential in one place, are more common in the most developed countries. The Global Innovation Index (WIPO, 2023) shows that the most prominent S&T clusters in the world are located in Japan, particularly in the Tokyo-Yokohama region. This is followed by clusters in China and Hong Kong, including Shenzhen-Hong Kong-Guangzhou, Seoul in the Republic of Korea, and other Chinese clusters, including Beijing and Shanghai-Suzhou. In terms of the number of clusters represented in the top 100, China (24 clusters), the United States of America (21), Germany (9) and Japan (4) lead the way. It should be noted that the Central Asian countries are not among them.

Global experience shows that industrial clusters can be established on the basis of existing and efficient enterprises and objects of innovation and industrial infrastructure, including special economic zones (SEZs), industrial parks, advanced development territories (ADTs), technology parks, business incubators and accelerators, and others

The establishment of SEZs creates special legal regimes that attract new businesses and create specialized jobs. In the absence of a critical mass of enterprises and already established manufacturers of irrigation equipment, the organization of a cluster on the basis of such SEZs can act as a kind of initial incentive to nurture a critical mass of industrial enterprises. At the initial stage of formation of the first production enterprises in a new industry, it is possible to stimulate their emergence by offering them special privileges and preferences.

There is no single, universal formula for success in cluster development, but it is possible to identify several general characteristics of the global clustering experience:

- The creation of clusters is a tool for the development of countries and regions and an indicator of the transition of the economy to a qualitatively new level of development.

- The peculiarity of a cluster is the synergetic effect of its member organizations, which is expressed in the increased competitiveness of the whole system in comparison with individual economic entities.

- The system is different from individual economic entities. The specific feature of the cluster is its innovative orientation.

- The cluster policy is based on the organization of interaction between authorities, enterprises, scientific and educational institutions in order to create drivers of innovative development of the regions and to achieve synergy effect with the possible support of international financial institutions.

Cluster initiatives in Central Asia

In developing countries, cluster development occurs at the national level, in contrast to more developed economies where such initiatives are more regional in nature.

In the latter economies, this is due to the greater autonomy of regions and their economic potential. As a result, clusters in developing countries are classified as national clusters, with a significant amount of support coming from central government agencies.

This is also evident in Central Asian countries, where the majority of cluster development plans are set out in regulatory legal documents at the national level. However, the approach to cluster development varies across the region, with different countries adopting different strategies.

In Kyrgyzstan, for example, cluster initiatives are reflected in the "Concept of Regional Policy of the Kyrgyz Republic for 2023–2027". In Kyrgyzstan, the development of clusters and their definition are considered more important in the classical sense as defined by M. Porter — as an effective tool for the development of the country's territories based on the principles of economic specialization. The concept of cluster development in Kyrgyzstan has been in force since March 24, 2022, after the approval of the project "Lending to the agro-industrial complex". The program of cluster development of agriculture is considered necessary to ensure food security with the aim of increasing the production of agricultural crops. The project is expected to provide soft loans to farmers with a total budget of 17 billion soms ($190 million).

Tajikistan has established cluster development goals within the framework of the "National Development Strategy of the Republic of Tajikistan for the period up to 2030" (adopted in 2016). According to the strategy, the second stage begins with the accelerated development of the economy based on investment (between 2021–2025). The aim is to achieve the goals set in Tajikistan, which includes increasing the competitiveness of the national economy, its integration into global and regional value chains, and the development of the country's regions. The underlying philosophy of cluster development is to significantly increase investments in the real sector and infrastructure with the participation of foreign and domestic investors. The priority sectors of the economy within the framework of clustering include the agro-industrial complex, industry, education, transport and logistics, and the creative economy. The development of cluster initiatives in these sectors is seen as an opportunity to create competitive production chains with the aim of import substitution and increased exports.

Cluster initiatives are not yet operational in the territories of these CA countries. The strategic approach to cluster development is based on the symbiosis of existing enterprises and the aspirations of the state, as well as various memoranda of cooperation.

Kazakhstan's clustering and experience in the development of territorial clusters stands out among the countries of the region. Since the early 2000s, Kazakhstan has been implementing market reforms to liberalize economic activity, diversify production, and increase the innovation component of the economy. Various reforms have been introduced, particularly in the industrial sector, and a solid infrastructure has been created. In turn, the authorities recognized the need for progressive forms of production organization for the innovative development of the national economic system. Since then, there has been an active process of cluster formation and development, which can be divided into three stages.

In the first stage (2003–2005) M. Porter was the scientific consultant of cluster development in Kazakhstan. During this period, the strategy of industrial and innovative development of the Republic of Kazakhstan for 2003–2015 defined the cluster as a form of production organization in the country. A list of seven promising clusters was identified — metallurgy, transport logistics, textile industry, tourism, oil and gas, engineering, construction materials and food industry.

During the second stage (2005–2012) of cluster formation and development, a document was adopted — Resolution of the Government of the Republic of Kazakhstan No. 633 dated June 25, 2005 "On Approval of Plans for Creation and Development of Pilot Clusters in Priority Sectors of the Economy". According to this decree, organizational and economic bases for the functioning of clusters were developed. As a result, in 2006 the government approved plans for the creation and development of a pilot pharmaceutical cluster in Karaganda and a medical services cluster based on new centers in Astana. In general, this period saw the formation of cluster models based on centers of economic attraction.

The third stage (since 2013) was marked by the adoption of a separate concept for the formation of promising clusters of the Republic of Kazakhstan until 2020. At the same time, already in 2014, within the framework of the Decree of the President of the Republic of Kazakhstan #874 "On Approval of the State Program of Industrial and Innovative Development of the Republic of Kazakhstan for 2015–2019" (hereinafter SPIID) dated August 1, 2014, the national approach to the formation and development of clusters was developed. The purpose of the development of cluster initiatives is

to promote the growth of competitiveness of the domestic manufacturing industry through the creation and localization of technological chains, cooperation, development of integration and acceleration of innovative development.

At present there is an active development of cluster initiatives in the country; the introduction of the state policy on the development of cluster initiatives is carried out everywhere. Cluster initiatives are being developed, which are divided into two groups — the national cluster in West Kazakhstan (petrochemicals) and sectoral territorial clusters. As part of the development of territorial clusters, six pilot clusters were selected on a competitive basis:

- the flour-milling cluster in the Kostanay oblast,
- the tourism cluster in the Almaty area (Almaty city and Almaty oblast),
- the construction cluster in the Karaganda oblast,
- the furniture cluster in the Almaty city,
- the milk-processing cluster in the Akmola oblast,
- the pharmaceutical cluster in the Turkestan oblast.

All six pilot territorial clusters are holders of the bronze label according to the results of the expert evaluation of the European Secretariat for Cluster Analysis (ESCA)[1] operating under the European Union (EU), which allows them to register on the EU cluster platform and participate in competitions for grants from the EU.

To date, cluster development after the completion of the SPIID 2015–2019 has been reflected in the Law of the Republic of Kazakhstan "On Industrial Policy" dated 27 December 2021. It is expected that the country will add another group of innovation clusters by the 2050s.

For the successful implementation of cluster initiatives in Kazakhstan, the operator of territorial clusters at the national level was identified — JSC "Kazakhstan Industry and Export Centre "QazIndustry" (formerly JSC "Kazakhstan Institute of Industrial Development"), a subordinate organization of the Ministry of Industry and Construction of the Republic of Kazakhstan. In addition, an agreement was signed in 2016 between the Ministry of the National Economy and the Spanish consulting company INFYDE LTD to provide services for the implementation of cluster policy in Kazakhstan. The European Foundation for Cluster Excellence and The Cluster Competitiveness Group Inc. were engaged to provide consulting services for capacity building of cluster policy operators in Kazakhstan (QazIndustry, 2017).

Work on the active development of cluster initiatives in Kazakhstan continues to this day.

For example, the national operator regularly organizes seminars in the country's regions to implement cluster policy. The regions are provided with materials and analyses of the status and prospects for the development of cluster initiatives in their locations. In other CA countries, such events are not yet organized and there are no officially recognized cluster initiatives.

[1] ESCA (European Secretariat for Cluster Analysis) brings together leading cluster analysis experts from around the world. ESCA uses a portfolio of more than 800 clusters from 40 European countries for comparative analyses.

The digitalization program can be an advantage for the development of innovative projects in the irrigation cluster. Globally, the digitalization of industrial production and agriculture is underway, with significant changes in the way products are manufactured, consumed, and food grown. Digitalization in industry leads to increased innovation activity in the country and the emergence of new innovative products, while in agriculture it leads to a reduction in costs and an increase in the productivity of cultivated land.

Reflecting these and other changes, the global network of Fourth Industrial Revolution Centers continued to expand during 2022–2023 to 19 such centers, each with its own areas of activity (WEF, 2023). In Kazakhstan, a similar affiliated Fourth Industrial Revolution Center was opened in July 2021 at the Astana International Financial Center in cooperation with the Ministry of Digital Development and Aerospace Industry of the Republic of Kazakhstan. It started functioning in September 2021 and held online sessions (round tables) with WEF experts.

Box 2. Industry 4.0 and Kazakhstan's participation in the global network of the Fourth Industrial Revolution Centers

Kazakhstan is a member of the Global Network of Centers of the Fourth Industrial Revolution under the signed agreement between the Government of the Republic of Kazakhstan and the World Economic Forum (WEF), approved by Resolution of the Government of the Republic of Kazakhstan No. 894 of 25 December 2020.

The WEF is one of the world's leading organizations promoting and supporting the development of the Fourth Industrial Revolution. It was the WEF that established the global network of Fourth Industrial Revolution Centers, which brings together global companies, governments, start-ups, SMEs, academia, and international organizations from around the world to collaborate in nine innovation areas: artificial intelligence and machine learning, the Internet of Things, robotics and smart cities, block chain and distributed ledger technology, autonomous and urban mobility, drones, and the airspace of tomorrow. Launched in 2017, the global network of centers has affiliate centers in the United States, China, Israel, India, Japan, and the United Arab Emirates.

The Center for the Fourth Industrial Revolution can be designed to help the Irrigation Cluster on the path of innovative development by creating a strategic platform for the adaptation and implementation of advanced technologies and the formation of new types of production that are

competitive in global markets. The work of such a center for the irrigation cluster can also be useful for generating practical knowledge about new and emerging technologies, improving governance to ensure the safety, ethics, and reliability of technologies, and developing mechanisms to prevent collateral damage.

In almost all CA countries, the experience of clustering shows the involvement of SEZs. In one form or another, cluster development is promoted through the development of such forms of infrastructure formation with access to "hard" infrastructure and a package of benefits and preferences in the form of tax deductions, customs exemptions, and other incentives.

Limited financing for SMEs and underdeveloped venture capital markets in Central Asia constrain the growth of innovative firms. In addition, the high barriers to business creation observed in most CA countries also have a negative impact on the level of competition in national markets, which in turn affects the productivity and innovation potential of the country's industries and, ultimately, the formation of full-fledged clusters.

Since the production of irrigation equipment is currently limited to Kazakhstan, an additional approach could be to implement projects in an Industrial Zone (IZ) or Special

Economic Zone (SEZ), where infrastructure, services, and a favorable policy environment will facilitate the development of irrigation production. The main objective of an IZ/SEZ is to attract industries by providing ready-to-use land, utilities, transport connectivity, and other amenities conducive to industrial activity, as well as a favorable policy environment (duty free import of components, tax incentives, etc.). Such a cluster does not necessarily have to be a "greenfield"; it can be part of an existing IZ/SEZ in order to reduce any infrastructure and other such initial costs.

In this regard, it is worth considering the feasibility of developing an irrigation cluster based on one of the SEZs closer to the Aral Sea Basin region.

As a suggestion: SEZ "Jibek Joly" (formerly SEZ "Chempark Taraz" until 2024), located in the valley of the Chu River in the Zhambyl oblast (a predominantly agricultural region). The development of the irrigation cluster in the region will increase the investment attractiveness (Shpilenko, 2019) of a predominantly agricultural area with a shift to an industrial component.

Moreover, the location of the irrigation cluster in the Zhambyl oblast will not only allow use of the advantages of the close geographical location to irrigated areas, the advantages and preferences of SEZ "Jibek Joly", but also to reduce the level of tension in the region after the water crisis that occurred in the summer of 2023, when almost all crops in the oblast were threatened and regional tensions over transboundary water resources arose.

Box 3. SEZ "Jibek Joly"

SEZ "Jibek Joly" (formerly SEZ "Chempark Taraz" until 2024) was established in 2012 and is located in Shu district, Zhambyl oblast. The area of the SEZ is 505 ha and the infrastructure completion is estimated at 99%. Currently, according to QazIndustry, 16 legal entities are registered in the SEZ. The SEZ is valid until 1 January 2037 (with the possibility of extension).

This SEZ was created for the purpose of development of the Zhambyl region by attracting investments and creating highly efficient, including high-tech and competitive industries, capable of manufacturing new types of products.

A participant of SEZ can be a legal entity that carries out priority types of activities on the territory of SEZ and is registered in the Unified Register of Participants of SEZ. In accordance with the Order of the Minister of Industry and Construction of the Republic of Kazakhstan №72 dated 22 February 2024, the priority types of SEZ activities are as follows:

1. production of chemical products
2. manufacture of rubber and plastic products;
3. manufacture of other non-metallic mineral products;
4. production of machinery and equipment for the chemical industry;
5. construction and commissioning of facilities directly intended for the implementation of the priority activities, within the limits of the design and cost documentation;
6. construction of a sugar factory and production of sugar, including raw sugar or refined cane or beet sugar; molasses; beet pulp, bagasse (sugar cane pulp), sugar cane pulp, other waste from sugar production; services in the field of sugar production;
7. construction of a plant for potato processing and production of chips (processing and canning);
8. construction and commissioning of a multi-profile hospital.

However, these priority activities can be changed in order to expand the range of industries that can be admitted.

The customs procedure of a free customs zone is applied on the territory of the SEZ. As of 1 January 2024, a differentiated approach to the granting of tax concessions in SEZs will be introduced, based on the principle «the greater the investment, the greater the concession», i.e. the duration of tax concessions will be determined directly on the basis of the investment volume.

At all stages of cluster initiative formation, from an industrial policy perspective, any financial and non-financial incentives not provided in existing SEZs can then be put in place to assist promising domestic SMEs in the irrigation sector to enter the planned cluster, as well as to assist large international firms to localize production in Kazakhstan. SEZs/IZs may also include support services such as logistics, warehousing, business support services, training, research centers including digitalization, and innovative financial instruments.

The formation of an industrial-service cluster for irrigation equipment manufacturing should take into account regional peculiarities and the lack of naturally developed enterprises. Cluster development can be "piloted" in one country in order to then qualitatively transform the successful experience to other Central Asian countries.

At the moment, there is no critical mass of enterprises in the region to justify fully calling such a formation a cluster initiative. However, in 2023–2024, positive shifts in the development of irrigation equipment production projects in all CA countries have been recorded.

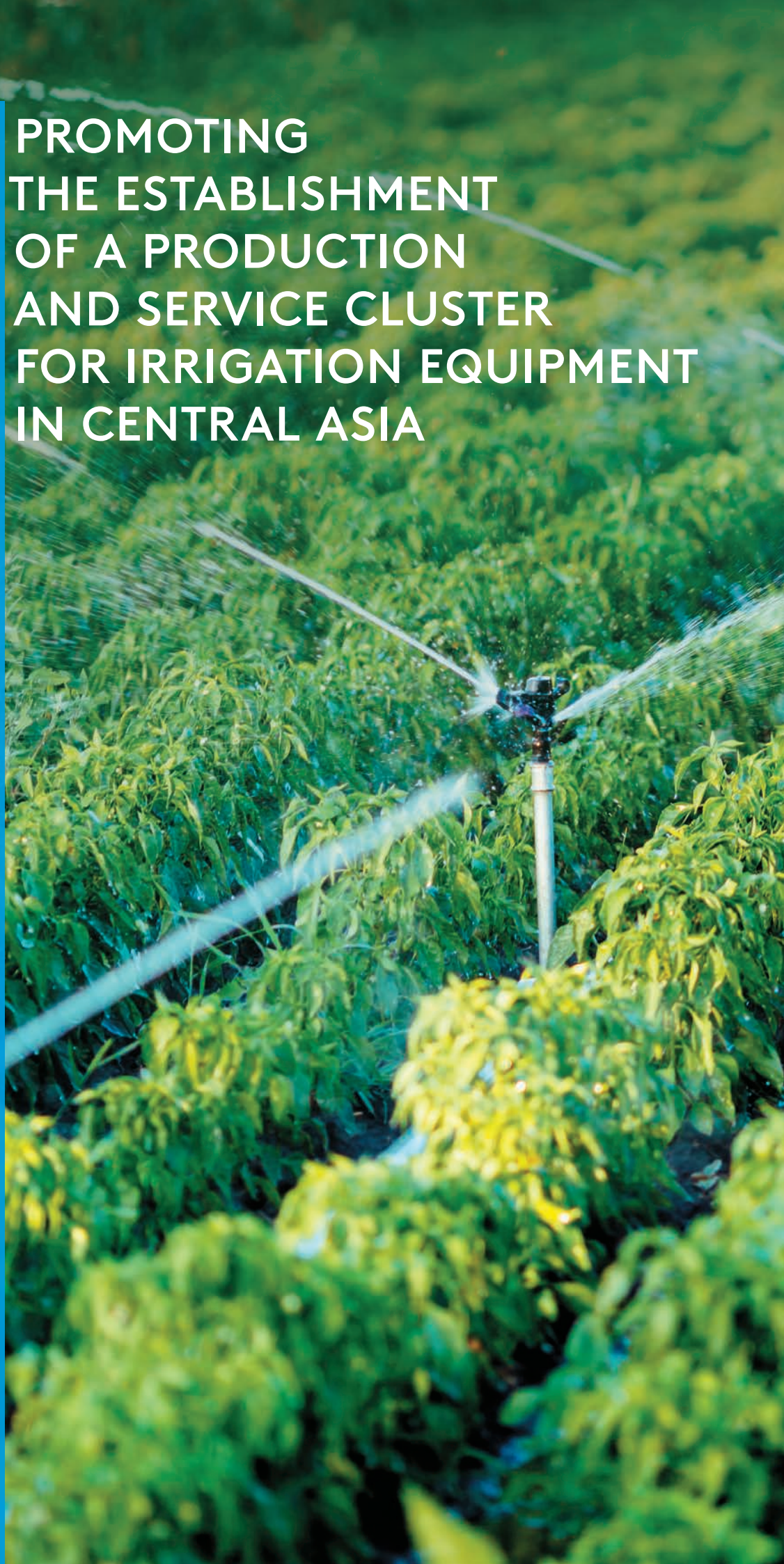
In 2023-2024, positive shifts in the development of irrigation equipment production projects in all CA countries have been recorded. In the initial stage of a cluster initiative.

In the initial stage of a cluster initiative, it is essential for the state and IFIs to provide support and financing for the development of investment projects in the region, specifically for the production of irrigation equipment. It is the responsibility of the manufacturing companies to oversee the production process. The private sector should determine the type of equipment to be produced, with the government providing the necessary support to create an enabling environment. It is evident that the "cluster approach" represents the optimal end result. Based on international experience, it would be prudent to prioritize supporting the government's efforts to increase production of irrigation equipment and related parts and machinery.

In the second stage, the irrigation cluster concept should be developed in conjunction with the national cluster strategy, which includes a specific set of measures to improve competitiveness and access for enterprises to the cluster structure at the national level, as well as to promote the inter-regional cluster network in the future. It is also essential to consider the role of supporting institutions, in addition to manufacturing enterprises. These include business organizations, financial service providers, such as banks, public authorities at the local, regional, and national levels, as well as regulatory bodies. Educational institutions, such as vocational schools and universities, also have an important part to play.

In the third stage, once a critical mass of enterprises has been reached and a national agenda for cluster initiatives has been established, it will be possible and appropriate to organize support activities at the cluster level. IFIs can play a useful role in this process by helping to build the capacity of cluster associations, strengthen the chains of interaction between firms, facilitate knowledge exchange and training, support technology transfers and technical assistance, and potentially provide financing for the development of necessary infrastructure, in line with the cluster experience in developed countries.

05 PROMOTING THE ESTABLISHMENT OF A PRODUCTION AND SERVICE CLUSTER FOR IRRIGATION EQUIPMENT IN CENTRAL ASIA



Industrial clusters evolve over time, developing in specific geographical areas due to the presence of competitive advantages. Alternatively, they can be supported by external factors. At any stage of cluster development, the government provides substantial financial assistance through a range of cluster programs. Concurrently, state support is primarily focused on infrastructure development, R&D, and encompasses grant funding for firms, loan financing, and tax incentives. Consequently, numerous thriving clusters in China, South Korea, and other top Asian nations have emerged in SEZs (Tomashevskaya, 2023).

Cluster projects receive financial support at two levels: state and regional. State support is provided in the form of co-financing based on implemented activities, preferential or grant funding, and the formulation of general cluster policies. Regional support is more targeted and aims to enhance the competitiveness of local players and cluster formations. In developing countries, state support is the primary form of support due to the low concentration of critical mass cluster enterprises and other limiting factors.

There are a number of common characteristics that are found in successful clusters. The key to successful cluster initiatives is developing robust business processes within the cluster itself. The formation of an intra-cluster system of relationship management and the creation of a platform for fruitful cooperation among irrigation cluster participants will foster an atmosphere of trust (Takun and Takun, 2023), which is crucial in a cluster where enterprises not only compete with each other but also collaborate actively, continuously enhancing joint competitiveness in foreign markets. Consequently, expert platforms for the exchange of information and experience may emerge, and an environment for inter-cluster communication may be established.

As previously stated, the advancement of cluster initiatives is contingent upon the availability of service organizations that provide support to small and medium-sized enterprises, such as business incubators. Business incubators facilitate the attraction of funding and the strengthening of links between organizations within the cluster. Such organizations can be financed jointly, with contributions from the state, businesses in the cluster, and international financial institutions.

Furthermore, the varying forms of support that facilitate regional development and are integral to the cluster infrastructure may necessitate distinct forms of enterprise organization. Business incubators are better suited to assist microbusinesses, while technoparks are more effective in supporting small businesses. Industrial parks are more aligned with the needs of medium-sized serial manufacturers, and large businesses tend to benefit more from the advantages of SEZs. However, despite the gradation in enterprise size and the conditions required for their development within the cluster, there is the option of using a tool such as an extraterritorial location for service enterprises, which can be located outside the SEZ boundaries.

It is worth noting the role of International Financial Institutions (IFIs) in the development of national cluster policies and cluster initiatives in CA countries. This involvement can take various forms, including financing, technical assistance, grants, programs, and development strategies. The majority of the largest IFIs' activities are concentrated in Kazakhstan.

In Kazakhstan, the International Bank for Reconstruction and Development provided a loan to launch the "Enhancing the Competitiveness of Small and Medium Enterprises" project. The project's primary objective is to enhance the capacity of Kazakhstani small and medium enterprises (SMEs) and strengthen their linkages in competitive sectors of the economy. The World Bank is providing technical assistance for the Competitive Industries and Innovation Development Program as part of this investment project. This assistance includes the development and application of cluster development approaches and methodologies.

One of the primary performance indicators for this project is the number of initiatives implemented to enhance cluster competitiveness. The Project Appraisal Document (PAD956) for this project indicates that a significant focus was placed on developing the capabilities of the Kazakhstan Industry and Export Centre "QazIndustry" JSC, the organization responsible for cluster development. The World Bank project in Kazakhstan is notable for its comprehensive scope.

Other CA countries have a variety of support programs that are not necessarily focused on cluster initiatives. These programs are designed to enhance the overall competitiveness of enterprises in the region. A recent example is the Asian Development Bank's allocation of $50 million for economic diversification and job creation in Kyrgyzstan in 2022. Moreover, the European Union Investment Facility provides assistance to bolster SME competitiveness through investment grants, technical assistance, venture capital, and other risk-sharing mechanisms. It should be noted that the European Bank for Reconstruction and Development has developed a range of instruments to stimulate innovation, promote regional development, and improve access to finance for enterprises that lack or have limited channels for obtaining affordable long-term financing. The EBRD's activities in this sector include support for both heavy and light industry, as well as processing and manufacturing of goods. Moreover, a number of agencies within the European Union and other global entities are active in Central Asia, offering a range of support in discussions on the competitiveness of enterprises in the region.

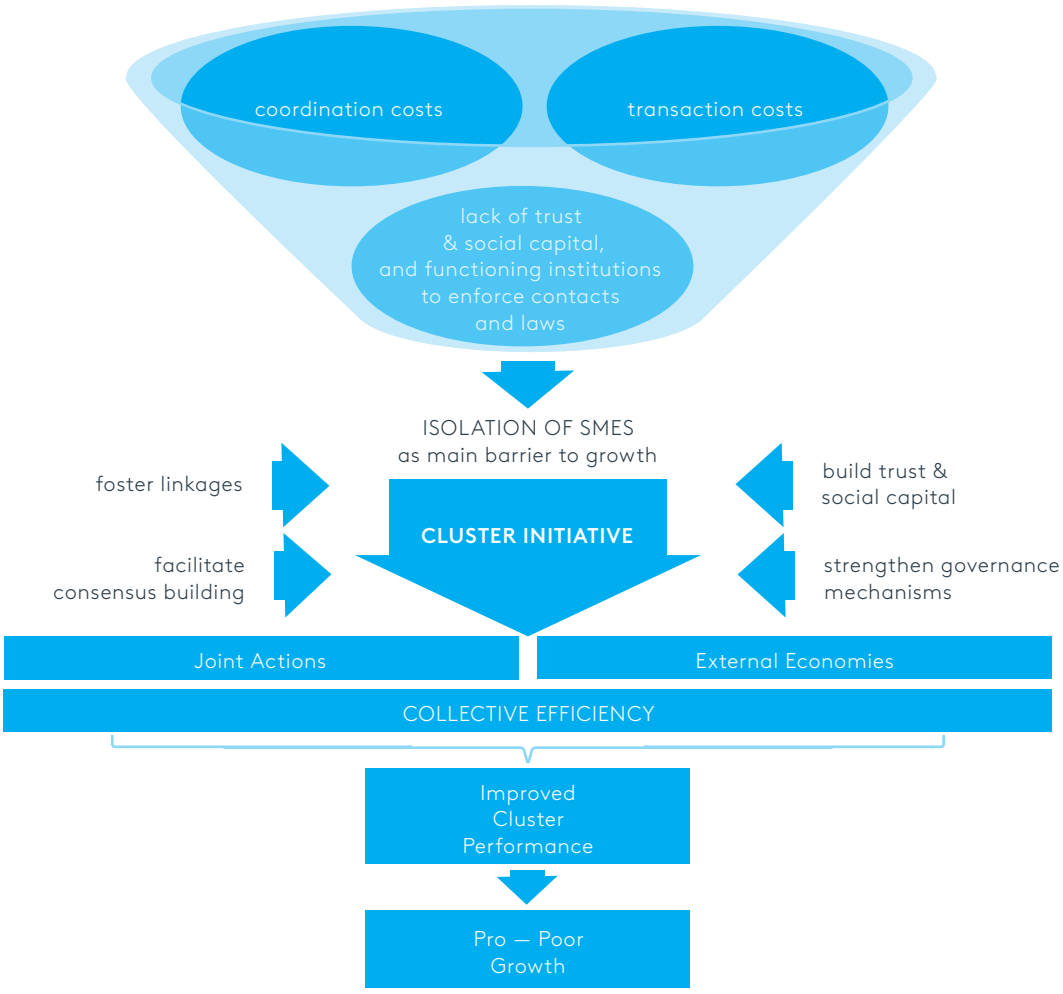
International experience with cluster development in other countries indicates that infrastructure is a promising area for IFI lending. Successful experience in this area demonstrates the interdependence and integration of production. Without appropriate infrastructure, clusters will not have a full-fledged positive socio-economic effect for the region or country. Given the specifics of infrastructure development and the accumulated experience and best practices available to IFIs, investment projects to develop infrastructure networks of clusters are a strategic and promising area.

06 UNIDO'S ROLE IN THE DEVELOPMENT OF EFFICIENT CLUSTERS

Development of the cluster initiative

Examples of world-famous clusters such as Silicon Valley in California, the information technology cluster in Bangalore (India), or the Australian and Chilean wine clusters demonstrate that clusters are environments in which businesses can develop competitiveness and global advantages, creating wealth and boosting local economic development. However, the mere fact that enterprises are geographically agglomerated is no guarantee of strong economic performance. Relatively few clusters in developing countries have been able to achieve high and sustained growth rates. In many cases, they are trapped in a vicious cycle of intense competition and stagnation, and cannot spontaneously move towards innovation and growth.

↓ **Figure 6: General scheme of cluster development support**



Source: UNIDO.

This often requires appropriate support and assistance. UNIDO has developed an approach to cluster development that addresses the causes of cluster stagnation and helps to capitalize on opportunities for growth and overcome obstacles to development. This experience should be used in organizing a manufacturing and service cluster in CA. With the participation of UNIDO, such cluster projects were realized as:

- Cluster of clothing and footwear production in Ecuador
- Textile manufacturing cluster in Turkey
- Cluster of automotive spare parts production in Samara region of Russia
- Oilseeds processing cluster in Ethiopia
- Development of agro-industrial clusters in South Africa
- Creation of cluster development strategy in Montenegro
- Agricultural production cluster in Nicaragua and others.

From practical experience, based on more than 23 real cases, the most effective way to develop cluster initiatives is through technical assistance aimed at fostering joint action between companies and support institutions. Such joint actions help cluster members to overcome constraints and seize opportunities that are not available to them individually. This eliminates bottlenecks that constrain the growth of small businesses, resulting in improved performance in the economic, social, and environmental spheres of the local economy.

The international approach to cluster development is based on the following principles:

Focus on existing clusters

An important factor is to focus on working with existing clusters. While existing clusters often show significant unrealized potential, creating clusters from scratch is likely to result in a significant reduction in efficiency and proactivity. In doing so, there will be little incentive for the private sector to take the lead.

Relying on the private sector

The private sector plays a leading role in delivering broad-based, sustainable economic growth that involves all stakeholders. Increasing productivity, innovation, and economic participation also requires addressing non-economic challenges, such as limited human and social capital, by empowering all social groups and improving the health, and education of workers.

Promoting collective efficiencies through joint action

The focus is on initiatives that encourage businesses and institutions to take joint action that can ultimately benefit both the cluster as a whole and the communities in which they operate.

Measures to help cluster stakeholders reduce barriers to cooperation include:

- Strengthening linkages between stakeholders
- Facilitating consensus building
- Building relationships
- Fostering trust
- Strengthening governance mechanisms
- Supporting the institutional network of the cluster.

Strengthening cluster governance mechanisms

As already mentioned, cooperation can be strengthened by investing in trust-building activities. In the context of cluster development, it is not only the propensity of individual actors to act together that matters, but also how these interactions are organized and embedded in the local economic system. Any formal or informal organization or mechanism that takes the lead in managing collaborative action to improve the competitiveness of a cluster can be defined as a governance mechanism.

In cluster development, great importance is attached to strengthening cluster governance mechanisms by changing patterns of interaction among cluster members and creating or strengthening institutions that can lead and coordinate joint actions. Effective governance in a cluster allows for coordinated and effective planning. Through coordinated joint action, the cluster can achieve a higher level of efficiency.

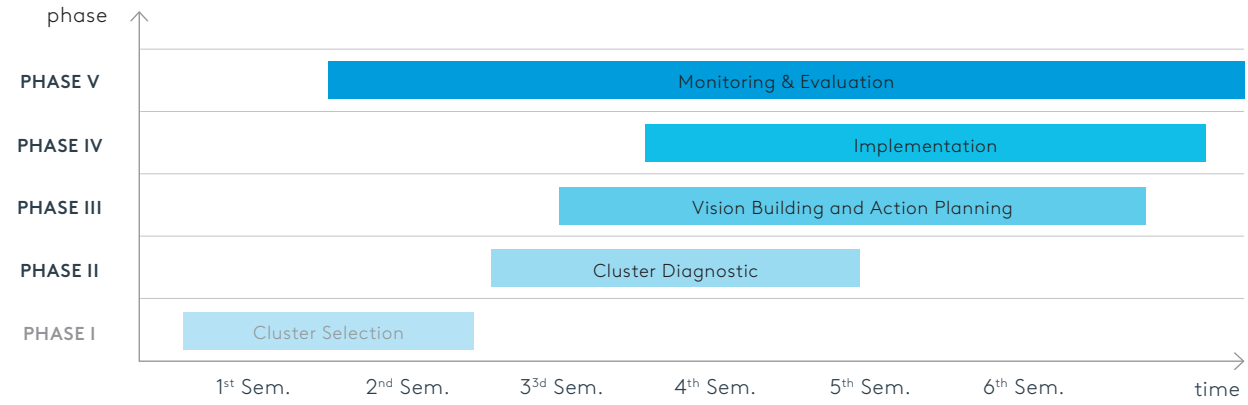
Cluster development also involves creating incentives for public authorities and private sector actors to better promote cluster development. Local, regional, and national institutions, including chambers of commerce, local governments, NGOs, producer associations, universities, educational institutions, and regional as well as local economic development agencies, are assisted to gradually assume an active supportive role in cluster development.

Activities include establishing and/or supporting business networks, building public-private partnerships, and facilitating dialogue among service providers and/or policymakers. Technical assistance to financial and non-financial service providers (e.g., business development service

providers, vocational schools) is also needed to make their services more responsive to the requirements of the cluster.

The standard UNIDO Cluster Development Plan is as follows and its implementation takes on average about three years:

↓ **Figure 7. UNIDO Cluster Development Plan**



Source: UNIDO.

Step 1: Cluster selection

A well-designed and participatory selection process, based on clearly defined criteria, identifies those clusters where the impact of planned interventions can be maximized given the time and resources available. Facilitation of the selection process recommends the criteria and variables most suitable for achieving the agreed development objective. Technical inputs and facilitator services can also be provided upon request, encouraging the participation of national and regional actors.

Step 2: Selection of the cluster development agent

Once a cluster has been selected for support, a Cluster Development Agent (CDA) is appointed. After conducting a diagnostic study of the cluster (see Step 3), the CDA works with the cluster to deepen the engagement of all stakeholders to improve the cluster's functioning mechanisms, and ultimately establish the cluster's governance structure.

Step 3: Cluster diagnostics

Once a cluster is selected, a diagnostic study of the cluster is conducted to help:

- develop an understanding of the cluster's socio-economic and institutional environment;
- identify potential points of intervention;
- provide baseline data for monitoring and evaluation;
- establish initial engagement between the CDA and stakeholders.

Diagnostics is a participatory exercise, led and facilitated by the CDA, in which cluster stakeholders are key informants. It is often the first opportunity for the CDA to establish relationships with stakeholders and to present a vision for cluster development.

Step 4: Vision building and action planning

Vision building and action planning are not one-off processes; they evolve in a feedback loop throughout the life of the cluster initiative. Starting with a discussion of the results of the diagnostic study, stakeholders formulate a shared vision of the cluster's future activities or overall development path, which is periodically reviewed and, if necessary, refined over time to reflect changes in the cluster or relevant framework conditions. Action planning is concerned with translating the vision statement into a realistic and achievable development strategy over time. Action plans are also periodically reviewed by all cluster stakeholders based on a robust monitoring and evaluation system.

Step 5: Implementation

Implementation refers to the execution and management of the activities described in the action plan. The CDA facilitates this process but does not directly deliver services or allocate resources to cluster stakeholders. The CDA does not replace functions that existing private or public sector organizations can perform, but rather strengthens their capacity to implement and enhances their ability to respond to the needs of the cluster.

Step 6: Monitoring and evaluation

Monitoring and evaluation of cluster initiatives is an ongoing process that begins with a clear list of expected results. These describe how the specific resources and project activities used

relate to the expected outputs and outcomes and how they contribute to the impact or overall development objective of the cluster. According to the information needs of the various stakeholders, key performance indicators, data collection methods, reporting responsibilities, and frequency are defined and incorporated into the overall monitoring system.

Institutional capacity-building and confidence-building activities underpin the entire cluster development process. These start with a diagnostic study, continue during the development of the action plan, and are reinforced during implementation, as well as monitoring and evaluation.

Industrial park development

The recommendation to facilitate the emergence of a robust irrigation equipment manufacturing hub in Kazakhstan, and eventually the wider region, can also benefit from UNIDO's experience in industrial park development.

The basic idea of an "industrial park" is that it is an industrial policy instrument designed by the government to attract investment in order to achieve growth and development. This is consistent with the objective of facilitating the emergence of a strong irrigation equipment manufacturing sector. Various terminologies are used to refer to such an area, including free trade zones (FTZs), export processing zones (EPZs), special economic zones (SEZs), high technology zones, free ports, enterprise zones, etc. This variation in terminology is the result, among other things, of differences in the objectives, functions or forms of these parks, as well as the desire of certain industrial parks or programs to differentiate themselves.

UNIDO uses the term "industrial park" to refer to site-specific industrial policy instruments, often with the prefix eco-, sustainable, agro- and techno- (e.g. eco-industrial parks, sustainable industrial parks, agro-food parks).

The main rationale for establishing industrial parks/zones is to allow companies to locate and develop in a specific, planned and dedicated location: in this case, irrigation equipment manufacturing companies. Industrial parks are designed to attract investment, create jobs and boost exports by overcoming constraints to industrialization, such as limited access to infrastructure, technology and finance, and high production and transaction costs due to lack of infrastructure and weak institutions outside the parks. As noted above, clustering will benefit the entry of new firms into the markets facilitated by the industrial park.

CONCLUSION

The establishment of a comprehensive irrigation equipment production in Central Asia is both viable and sustainable. The irrigation equipment manufacturing sector would include not only industrial enterprises but also service and maintenance organizations, financial enterprises, and other enterprises from related sectors of the economy. The later development of such a cluster would not only improve the management and regulation of limited water resources in the region, but also ensure the socio-economic well-being of the territory by increasing the competitiveness of manufactured products. It has the potential to enhance investment appeal and the caliber of human capital, facilitate sustainable GDP growth, and contribute to other key performance indicators.

All stakeholders involved in the creation of the irrigation equipment production could expect to see positive results. The cluster approach would have a significant impact, primarily reflected in the growth of the cluster's economic contribution, an increase in the innovative development index for the region, and the share of irrigation equipment products in the gross output. Additionally, this would contribute to the reduction of water stress throughout Central Asia.

In light of the mounting challenges to water resource provision in CA countries, a unified regional reference point is a crucial element in the development of irrigation equipment production.

A sizeable domestic market for irrigation equipment in Central Asia greatly enhances the appeal of irrigation cluster development, while also laying the groundwork for the subsequent export orientation. This approach would ensure a qualitative industrial transformation of the predominantly agrarian region, which would in turn enable the region, together with the irrigation equipment manufacturing sector, to gain a fair share of the world market for irrigation equipment.

Furthermore, to ensure the long-term success of the irrigation equipment manufacturing sector, it is essential to reformat state incentives for procurement, subsidies for the purchase of agricultural equipment and machinery, and other support measures in agriculture to align with the sectoral objectives.

The irrigation equipment production has the potential to facilitate deeper collaboration in the water sector across Central Asia and bolster ties within the Aral Sea Basin. The implementation of joint projects, an increase in foreign direct investment flows, and a concentration of scientific and innovative developments in the field of water regulation and management will serve as effective levers for enhancing regional cooperation, fostering a platform for knowledge exchange and the sharing of best practices.

Given the current stage of industrial transformation in the region and the availability of supporting factors for the qualitative development of cluster initiatives, the immediate development of irrigation clusters in the classical sense is not a viable option. This initiative is part of a long-term plan for comprehensive cluster development in the region, regardless of sectoral affiliation.

The region lacks a critical mass of irrigation equipment manufacturers, and its industrial policy is region-specific, which presents a challenge. It is recommended developing the cluster at the national level first.

Kazakhstan is the most promising place for developing an industrial cluster for the production of irrigation equipment for several reasons, including its developed infrastructure, favorable regulations, and active industrial policy. This experience can later be shared with other Central Asian countries.

Therefore, the current priority would be to build a critical mass of industrial enterprises for the production of irrigation and related equipment, based on the existing special economic zones. These would provide favorable conditions and incentives for the formation of the initial cluster in the region. Kazakhstan is the most promising place for developing an industrial cluster for the production of irrigation equipment for several reasons, including its developed infrastructure, favorable regulations, and active industrial policy. This experience can later be shared with other Central Asian countries.

The SEZ "Jibek Joly" in the Kazakhstani Zhambyl oblast is a promising location for the future cluster.

The SEZ “Jibek Joly” in the Kazakhstani Zhambyl oblast is a promising location for the future cluster. The SEZ policy itself provides for the granting of privileges and preferences (customs, tariffs, taxes, etc.) to manufacturers, which would serve as a stimulating criterion at the initial stage of forming a full-fledged cluster.

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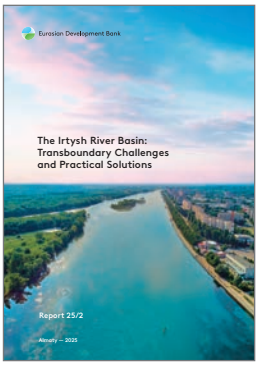
THE LIST OF EDB PUBLICATIONS

Macroeconomic Outlook
(RU/EN)

Macroeconomic Outlook 2025–2027

The Eurasian Development Bank (EDB) has published its Macroeconomic Outlook, summarising a preliminary overview of economic developments in the Bank's member states in 2024, along with key macroeconomic projections for countries in the region for 2025, as well as for 2026 and 2027.



Report 25/2
(RU/EN)

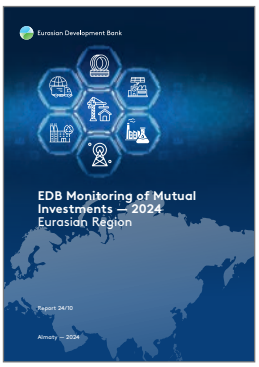
The Irtysh River Basin: Transboundary Challenges and Practical Solutions

A recent study by the Eurasian Development Bank, titled "The Irtysh River Basin: Transboundary Challenges and Practical Solutions," presents the findings of a diagnostic analysis and a forecasting model of the basin's water resources. The study identifies the positions of the three countries involved and puts forward a series of practical solutions, including investment recommendations.

Report 25/1
(RU/EN)

Mutual Investments on the Eurasian Continent: New and Traditional Partners

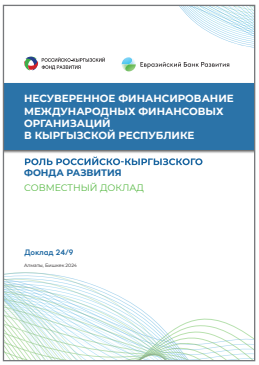
The report contains detailed information on the scale, dynamics, geographical and sectoral structure of mutual direct investment stock between the countries of the Eurasian region, on the one hand, and China, Türkiye, Iran, and the Gulf states, on the other hand, for the period from 2016 to the first half of 2024.



Report 24/10
(RU/EN)

EDB Monitoring of Mutual Investments — 2024. Eurasian Region

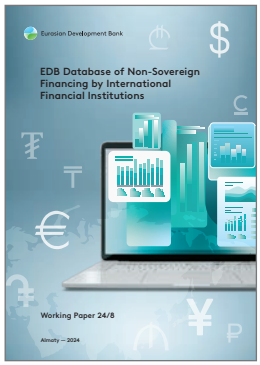
The report contains detailed information on the scale, dynamics, geographical and sectoral structure of mutual direct investments of the Eurasian region from 2016 to 1H of 2024.



Report 24/9
(RU)

Non-sovereign financing of international financial organizations in the Kyrgyz Republic

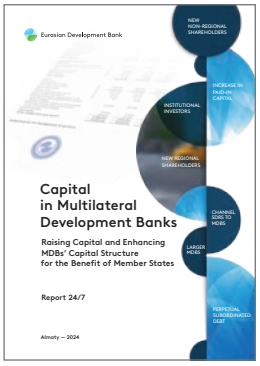
The report contains a comprehensive analysis of non-sovereign financing operations by international financial institutions in the Kyrgyz Republic over the last decade.



Report 24/8
(RU/EN)

EDB Database of Non-Sovereign Financing by International Financial Institutions

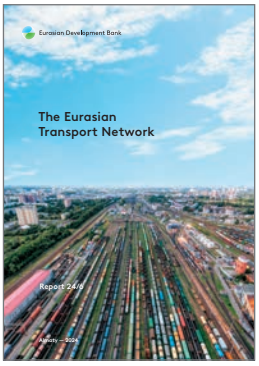
Non-Sovereign Financing (NSF) Database is EDB's new analytical project. The EDB Database is a dynamic tool for timely monitoring and analysis of non-sovereign operations of IFIs in the Eurasian region.



Report 24/7
(RU/EN)

Capital in Multilateral Development Banks

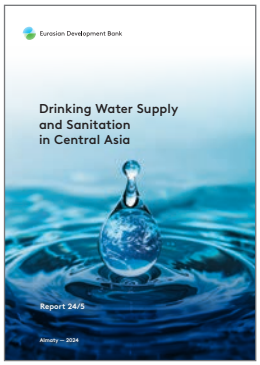
This paper covers the whole 'MDB family' of institutions but highlights regional and sub-regional MDBs because of their specifics of raising shareholders' capital. The study discusses seven standard and novel options for increasing capital



Report 24/6
(RU/EN)

The Eurasian Transport Network

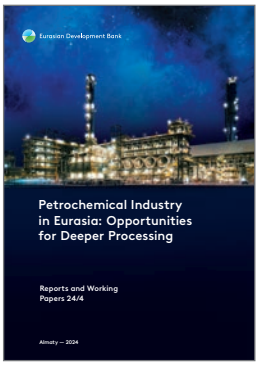
The report examines ten system elements of the Eurasian transport framework concept. Among them are the formation of a transport crossroads in Central Asia, priorities for intraregional transport connectivity, an impetus for realizing the agro-industrial potential of the countries of the region, and improvement of soft infrastructure.



Report 24/5
(RU/EN)

Drinking Wateer Supply and Sanitation in Central Asia

In Central Asia, 10 million people do not have access to safe drinking water. Given the priority importance of drinking water for public health and the scale of the challenges, a comprehensive approach is required in the region. A new EDB report presents a set of practical steps that shape such an approach.



Report 24/4
(RU/EN)

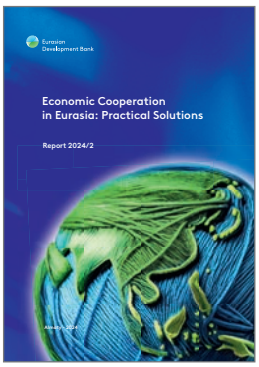
Petrochemical industry in Eurasia: Opportunities for Deeper Processing

The analytical report uses a balance approach to assess the production and export potential of the petrochemical complex of the Eurasian region (Armenia, Belarus, Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan) in the perspective up to 2035.

Report 24/3
(RU/EN)

Infrastructure in Eurasia: short-term and medium-term trends

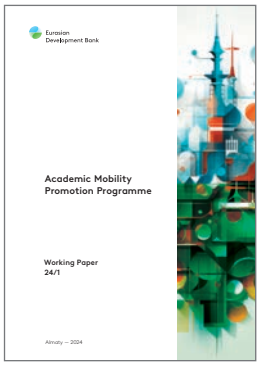
The EDB's report highlights ten important short- and medium-term investment and institutional trends in the region's energy, transportation, logistics, water supply and telecommunications sectors.



Report 24/2
(RU/EN)

Economic Cooperation in Eurasia: Practical Solutions

The EDB's report "Economic Cooperation in Eurasia: Practical Solutions" contains a "menu" of pragmatic applied solutions that can be enabled relatively fast and with flexible configurations among participating countries aimed at fostering mutually beneficial economic cooperation among Eurasian countries.



Report 24/1
(RU/EN)

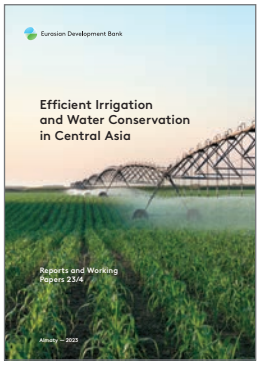
EDB Monitoring of Mutual Investments — 2023

Eurasian countries' FDI stock reached $48.8 billion by mid-2023, following a 5.4% increase in 2022 and with continued growth in 2023.

Report 23/5
(RU/EN)

EDB Monitoring of Mutual Investments — 2023

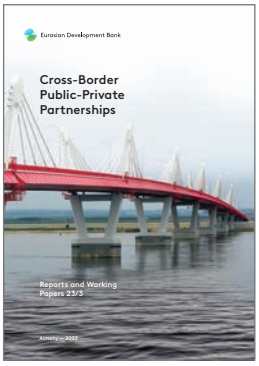
Eurasian countries' FDI stock reached $48.8 billion by mid-2023, following a 5.4% increase in 2022 and with continued growth in 2023.



Report 23/4
(RU/EN)

Efficient Irrigation and Water Conservation in Central Asia

A new EDB study outlines ten practical steps for preserving irrigated land potential and promoting water conservation. The list includes four recommendations for adoption at the regional level and six at the national level.



Report 23/3
(RU/EN)

Cross-Border Public-Private Partnerships

The report outlines the criteria and scope of cross-border PPP projects, evaluates their potential for fostering cross-border infrastructure development in the EAEU, Central Asia, and the South Caucasus, and suggests guidelines for the successful implementation of cross-border PPPs in the region.

THE LIST OF UNIDO PUBLICATIONS

Fostering Sustainability and Responsible Social and Economic Action: Building legal frameworks for a future-proof Quality Infrastructure

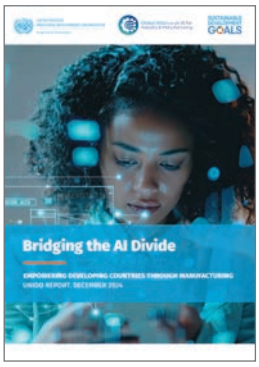
This publication delves into the development of the QI legal framework and the relationship of the QI system with sectoral policies and technical regulations. It also highlights the critical role of QI in upholding the quality of products and services, facilitating international trade, and contributing to sustainable development.

Rethinking Quality Infrastructure Quality Policies for a Sustainable Future: EGM Summary Report (13–15 November 2024)

This publication discusses key outcomes of an Expert Group Meeting (EGM) on Quality Policy (QP) and Quality Infrastructure for Sustainable Development (QI4SD), convened by the United Nations Industrial Development Organization (UNIDO) in close coordination with the International Network on Quality Infrastructure (INetQI)

Advancing Gender Equality to Foster the Transition to Eco¾ Industrial Parks: Best Practice Series

The publication discusses the gender-sensitive infrastructure planning including enhanced street lighting and safer public spaces as being essential to ensuring that all workers can benefit equitably.



Bridging the AI Divide Empowering Developing Countries Through Manufacturing

This report provides its member states and partners with recommendations towards a strategic framework for adopting AI in industry in ways that align with local development needs and contribute to a balanced global AI ecosystem.

Lean Local API Manufacturing: Introducing UNIDO's Approach

The publication makes reference to the importance of local production of APIs based on international GMP standards in developing countries and how it can provide better access to medicines.

Blueprint for Sustainable Development: UNIDO's Blue Industry Contribution to the Blue Economy Agenda

This report examines four key Blue Industry sectors (energy, blue food, tourism and recreation, and transport and trade) and four cross-cutting sectors (marine biotechnology, BlueTech, blue finance, and marine conservation).

Summary of QI4SD Index 2024 Outcomes: Key Trends

The 2024 edition of the Quality Infrastructure for Sustainable Development (QI4SD) Index provides a comprehensive assessment of how countries' QI systems contribute to achieving the Sustainable Development Goals (SDGs). Covering 155 countries, this updated index evaluates national QI readiness through five core dimensions: metrology, standards, accreditation, conformity assessment, and quality policy, mapped across the SDG-linked dimensions of People, Planet, and Prosperity.

Inclusive and Sustainable Cluster Development UNIDO'S Approach: Key Principles and Project Success Stories

This publication discusses the cluster development for broad-based economic growth, key principles of UNIDO approach towards cluster development and presents projects success stories from Georgia, Ghana, Liberia, and Tunisia.

Tackling Climate Change: Fostering trust in climate action through quality and standards

This document describes how QI can be used to support and promote climate action initiatives, including describing the reasons why climate change and associated adaptation and mitigation initiatives have become a strategic imperative in recent years to support inclusive and sustainable industrial development as well as describing how individual enterprises can make use of the QIS to support their climate adaptation and mitigation initiatives.

Guidelines for the establishment of a Smart Factory Lab: Building on the Lessons Learned from the Automotive Sector

The purpose of the guidelines is to provide a generic comprehensive and practical roadmap for firms and other organizations looking to establish a Smart Factory Lab, with the goal to improve productivity, quality, and competitiveness through the integration of digital technologies, business models and effective use of resources and energy in the automotive sector.

Creating Value with Standards: Industry engagement for a sustainable future

This publication sets out some of the key economic benefits of standards for SMEs and how standards also provide numerous social and environmental advantages, such as promoting good governance.

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