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ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ

Satbayev University

# ХАБАРЛАРЫ

# ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ
НАУК РЕСПУБЛИКИ
КАЗАХСТАН
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# CURRENT ISSUES OF WATER MANAGEMENT IN KAZAKHSTAN

**Abstract.** Water management is one of the fundamental sectors of Kazakhstan's economy, the successful operation of which is critical to the country's economic stability, population livelihood, environmental sustainability, and national security. In the near future, Kazakhstan will face a severe water resource deficit in all economic sectors, especially in the agro-industrial complex. At present, the agricultural sector is considered the main water consumer and, according to the experts' forecasts, the consumption of water in Kazakhstan can increase and the deficit of the water resources can reach a large scale. The principal reasons for the current issues in water management in Kazakhstan are that during the transition to the market economy, almost no investment was made in water management; the level of public and private investment in the development of the country's water sector is insufficient; lack of incentive for agricultural producers to water conservation due to low tariffs; inefficient water management; and lack of a system of control over the state of irrigated lands by the government. The governmental program documents of the country in the coming decades provide for an increase in the total area of irrigated land, including with the use of water-saving irrigation technologies. The problems outlined above, as well as potentially irrigated agriculture, require the application of active measures to the restoration of irrigated lands. In Kazakhstan, there are opportunities to significantly increase productivity through the implementation of water-saving technologies, the comprehensive reconstruction of irrigation and drainage systems, and other modern agricultural activities. It is necessary to create a

system for the efficient use of water for agricultural purposes that will allow maximum production at the lowest possible cost.

**Key words:** Water management, water resources, water saving technologies, irrigated lands.

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## ҚАЗАҚСТАННЫҢ СУ ШАРУАШЫЛЫҒЫНЫҢ ӨЗЕКТІ МӘСЕЛЕЛЕРІ

**Аннотация.** Су шаруашылығы - еліміздің негізгі салаларының бірі, оның табысты жұмыс істеуіне бүкіл экономиканың тұрақтылығы, халық тіршілігін қамтамасыз ету, қоршаған табиғи ортаның тұрақтылығы және Қазақстанның Ұлттық қауіпсіздігі ықпал етеді. Таяу болашақта Қазақстан экономикасының барлық салаларында, әсіресе еліміздің агроөнеркәсіптік кешенінде су ресурстарының қатаң тапшылығы орын алады. Қазіргі уақытта негізгі су тұтынушы - ауыл шаруашылығы болып табылады және сарапшылардың болжамдары бойынша болашақта Қазақстанда судың тұтынылуы өседі, ал су ресурстарының тапшылығы үлкен көлемдерге жетуі мүмкін. Қазақстанның су шаруашылығының өзекті мәселелерінің негізгі себептеріне нарықтық экономикаға көшу кезеңінде су шаруашылығына инвестициялар іс жүзінде жүргізілмегендігі; еліміздің су шаруашылығын дамытуға жұмсалатын мемлекеттік және жеке инвестициялар деңгейінің жеткіліксіз болуы; су тарифтері деңгейінің төмен болуына байланысты ауыл шаруашылығы тауар өндірушілерінің суды үнемдеуге ынтасының болмауы; су шаруашылығының тиімсіз басқарылуы; мемлекет тарапынан суармалы жерлердің жағдайын бақылау жүйесінің болмауы жатады. Мемлекетіміздің Үкіметінің бағдарламалық құжаттарында таяудағы онжылдықта суармалы жерлердің жалпы алқабын, яғни соның ішінде суарудың суды үнемдеу технологияларын қолдана отырып ұлғайту көзделуде. Жоғарыда аталған мәселелер, сондай-ақ суармалы егіншіліктің әлеуеті суармалы жерлерді қалпына келтіру бойынша белсенді шаралар қабылдау қажеттілігін растайды. Қазақстанда суды үнемдеу технологияларын ендіру, гидромелиоративтік

жүйелерді және басқа да қазіргі заманғы аграрлық шараларды кешенді қайта құруды жүргізу есебінен өнімділікті едәуір арттыруға мүмкіндік бар. Ауыл шаруашылығы мақсаттары үшін суды тиімді пайдалану жүйесін құру қажет, бұл жүйе барынша аз шығынмен өнім шығаруға мүмкіндік береді.

**Түйін сөздер:** су шаруашылығы, су ресурстары, суды үнемдеу технологиялары, суармалы жерлер.

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## АКТУАЛЬНЫЕ ВОПРОСЫ ВОДНОГО ХОЗЯЙСТВА КАЗАХСТАНА

**Аннотация.** Водное хозяйство - одна из базовых отраслей страны, от успешного функционирования которой зависят стабильность всей экономики. жизнеобеспечение населения, устойчивость окружающей природной среды и национальная безопасность Казахстана. В ближайшей перспективе Казахстан столкнется с жестким дефицитом водных ресурсов во всех отраслях экономики и особенно в агропромышленном комплексе страны. В настоящее время основным водопотребителем является сельское хозяйство и по прогнозам экспертов, водопотребление Казахстана в перспективе вырастет, а дефицит водных ресурсов может достигнуть больших объемов. Основные причины актуальных вопросов водного хозяйства Казахстан: в период перехода к рыночной экономике инвестиции в водное хозяйство практически не производились; уровень государственных и частных инвестиций в развитие водного хозяйства страны является недостаточным; отсутствие стимула у сельхозтоваропроизводителей к экономии воды в связи с низким уровнем тарифов; малоэффективное управление водным хозяйством; отсутствие системы контроля за состоянием орошаемых земель со стороны государства. Программными документами правительства страны в ближайшие десятилетия предполагается увеличение общей площади орошаемых земель, в том числе и с применением водосберегающих технологий

орошения. Обозначенные выше проблемы, а также потенциал орошаемого земледелия подтверждают необходимость принятия активных мер по восстановлению орошаемых земель. В Казахстане имеется возможности значительно повысить урожайность за счет внедрения водосберегающих технологий, проведения комплексной реконструкции гидромелиоративных систем и других современных агромероприятий. Необходимо создать систему эффективного использования воды для сельскохозяйственных целей, которая позволит производить максимум продукции при возможно минимальных затратах.

**Ключевые слова:** водное хозяйство, водные ресурсы, водосберегающие технологии, орошаемые земли.

**Introduction.** Water management is one of the fundamental sectors of Kazakhstan's economy, the successful operation of which is critical to the country's economic stability, population livelihood, environmental sustainability, and national security.

The average long-term volume of Kazakhstan's water resources in 1960 comprised 115 km3, in 2021 it had decreased to 93 km^3. According to experts' evaluation, by 2030 this indicator could decrease to 78.4 km3. This can lead to the fact that, in the near future, Kazakhstan will face a severe water resource deficit in all economic sectors, especially in the agro-industrial complex (Ibrayev, T., 2022).

The distribution of water resources across the country is extremely uneven. The largest volumes of surface runoff in Kazakhstan are formed in the Ertis River basin (up to 33% of total resources and 45% of local resources). In Nura-Sarysu, Ishim, and Tobol-Torgai, less than 6% of the river flow is formed, and in dry years it is about 10 times less than the average (The construction of the Trans-Kazakhstan canal will solve the problem of water shortage in Kazakhstan, 2022).

The main water consumer is the agricultural sector, which requires 12.1 km3 of water annually for irrigation of agricultural crops. Of these, 11.8 km3 is used in four regions in the south of the country, where irrigated crops are grown on an area of 1.25 million hectares (97% of the water intake) (Central Asian Regional Network for capacity building in the field of water resources, 2022).

At the same time, according to experts' forecasts, by 2040 Kazakhstan's water consumption will increase by 56%, and the shortage of water resources can reach 12 km³ per year. In addition, there is a continuing cycle of oligohydramnios in the river basins of Kazakhstan. All this increases the risk of water shortages in the southern regions of the country (It is necessary to increase the rational use of water, 2022).

**Materials and methods.** For the analysis of the current state of the water sector in Kazakhstan, information materials and data from water management, research and design organizations, state and public bodies, and sources in the open literature were used. The information obtained and the analytical methods of research contributed to considering, optimizing, summarizing, and understanding the problems of the current state of the water economy in Kazakhstan, as well as suggesting ways to improve it.

The investigations used in the article were aimed at understanding the current issues of water management in Kazakhstan. Investigations included studying, analyzing patterns, and systematization based on the existing information. Scientific research was determined by the following criteria:

- a specific purpose of the research;
- an aspiration to discover unclear aspects;
- grouping and classification of the procedure and indicators of studies;
- clarification and confirmation of the final provisions

The particular methods, which represent common ways to achieve the goal of the study for scientific research, were applied. The specific methods that contribute to a clear and prompt finding of results that correspond to the purpose of the research were selected.

The method of comparing the indicators and results of the assessment of the current state and ways of further development of the water industry in Kazakhstan was used. It was concluded that it is necessary to create a system for the efficient use of water for agricultural purposes that will allow maximum production at the lowest possible cost.

Elements of the logical method of scientific research were applied based on the collection, generalization, analysis, and summary of the materials and data gathered during the research on the problems of the development of the water industry in Kazakhstan. Predictive calculations of the dynamics of changes in the use of water resources in the country's agriculture using the methods of probability theory were presented.

**Result and discussion.** According to the forecast calculations of the Committee for Water Resources of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan (CWR MEGNR), the dynamics of changes in the use of water resources in agriculture is as follows (National Water Resources Management Project for 2021-2025, 2021):

For the period 2021–2025, it is planned to increase the total area of irrigated land to 2,200 thousand hectares, with an increase in the area of irrigation using water-saving irrigation technologies to 450 thousand hectares, i.e., 20% of the total area of irrigated land (Figure 1).

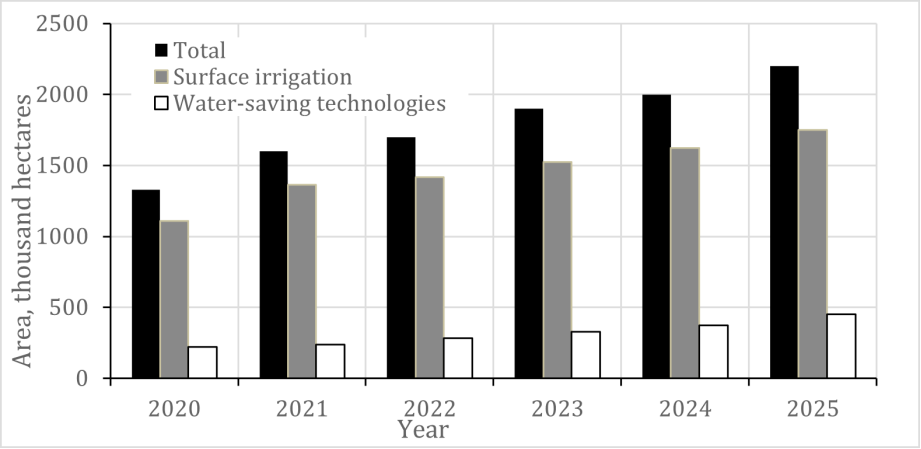


Figure 1 – The irrigation areas of Kazakhstan

For the period 2021-2025, it is expected to increase the efficiency of irrigation systems to 0.6, with the use of surface irrigation - 0.75, and with the use of water-saving irrigation technologies - 0.95 (Figure 2).

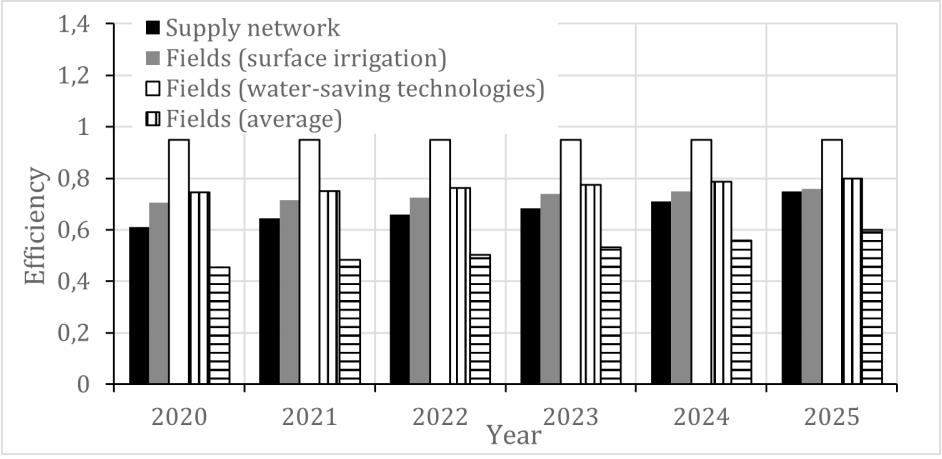


Figure 2 – The efficiency of irrigated lands of Kazakhstan

For the period 2021-2025, it is expected to increase the volume of water intake with regular irrigation to 14.67 km3 and reduce water losses with regular irrigation to 5.88 km3 (Figure 3).

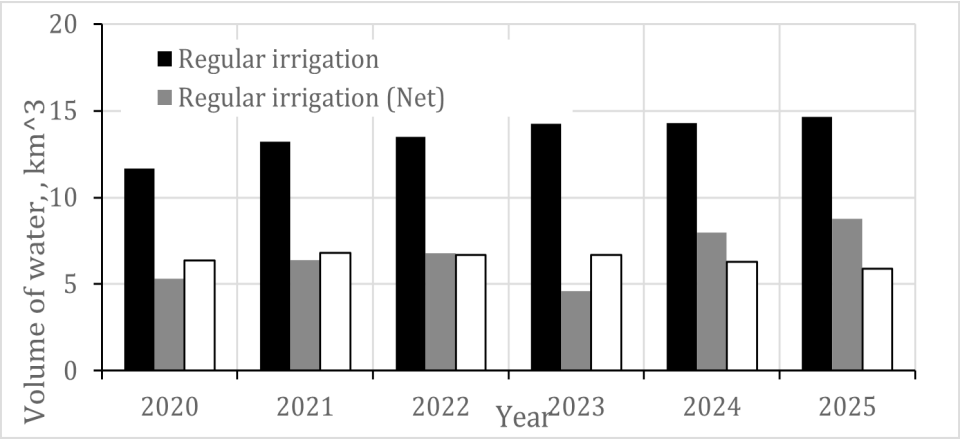


Figure 3 – The volume of water intake with regular irrigation

In the context of the growing level of water resources deficit during the growing season, the issues of rational and efficient use of irrigated lands should become a priority of Kazakhstan's water policy.

Currently, according to statistics, the area of irrigated land in the republic is about 1.7 million hectares, of which 268.6 thousand hectares use water-saving irrigation technologies (May 2022), which provides only 5.8% of gross crop production, i.e., the area of irrigated lands and their productivity has decreased (National Water Resources Management Project for 2021-2025, 2021).

In 2019, irrigated land accounted for only 6.7% of the total agricultural land. However, it simultaneously contributed to receiving 45% of the country's gross agricultural production. The forecast for the development of irrigated agriculture until 2030 has demonstrated that with an area of irrigated land of 3 million hectares, they will amount to 13.5% and can contribute to receiving up to 80% of the total gross revenue of the agricultural sector of Kazakhstan (Kalybekova, 2022).

The most acute deficit is observed in the southern regions—these are the Almaty, Zhambyl, Turkestan, and Kyzylorda regions. At the moment, 95% of the irrigated area is accounted for by those four regions of southern Kazakhstan (11.8 km3 out of 12.1 km3). Local farmers report problems such as local water deficits, incomplete construction of water facilities, and difficulties in obtaining subsidies for the installment of water-saving irrigation technologies. So far, they are applied only to 5.4% of the irrigated area in the southern regions. As of January 1, 2022, the area covered by water-saving technologies in the republic amounted to 258 thousand hectares. Of these, in the southern region, out of 1.25 million hectares, only 5.4% of the total irrigation area, or 67.7 thousand hectares,

has been installed (Creation of water allocation management in irrigation systems based on hydrological information, using water resources formation in river basins: Research report (interim), 2021; Ibrayev, 2022; Balgabaev, 2020; Mukhamedzhanov, 2020).

The quality of use of available areas under irrigation is also insufficient. An important indicator of their use is the productivity of irrigation water, i.e., the crop yield from each cubic meter of water supply. So, if in foreign countries the productivity of 1 m3 of water is 2.5–6.0 kg, in Kazakhstan it does not exceed 0.8 kg.

That is, the deterioration of the technical condition of irrigation and drainage systems and degradation processes, as well as the low level of implementation of advanced irrigation technologies, affected the productivity of the remaining irrigated lands.

In this regard, in terms of crop yields on irrigated lands, Kazakh farmers are 2-4 times inferior to foreign ones.

In Australia, 79 thousand hectares are sown with rice, and 520 million m3 of water are used for their irrigation. In the Kyzylorda region, 4.5 billion m3 of water is not sufficient for 80 thousand hectares of rice (Water Crisis: Tariff for irrigation of fields will be increased for Kazakh farmers, 2022).

According to the Ministry of Agriculture of the Republic of Kazakhstan, in order to diversify water-intensive crops, the area under rice will be reduced by 8.7 thousand hectares compared to 2021. Including the Kyzylorda region (by 5.3 thousand hectares), Turkestan (2.9 thousand hectares) and Almaty (0.6 thousand hectares) (Water deficit will cover Kazakhstan in June: is the government ready? 2022).

Nevertheless, in Kazakhstan, there are opportunities to significantly increase productivity through the implementation of water-saving technologies, a comprehensive reconstruction of irrigation and drainage systems, and other contemporary agricultural activities (Zharkov, 2020; Kalashnikov, 2020).

Comprehensive reconstruction and restoration of irrigation systems will increase their efficiency to 0.75-0.8. This will contribute to the rational and efficient use of about 30% of water lost during the intake and delivery, implement digital solutions in the system of accounting and management of water resources, increase the level of knowledge about water-saving technologies' exploitation and achieve savings in irrigation water of 20-30% (Ibrayev, 2014; Ibrayev, 2014; Li, 2018). The use of water-saving irrigation technologies, such as drip, sprinkler, and subsoil, can increase the productivity of water use by 2–2.5 times (Zhang, 2019; Kulkarni, 2011).

In general, in the country in 2022, three emergency reservoirs will be restored, construction of a new reservoir in the Kyzylorda region will begin, and project

documentation for the construction of five more water objects will be prepared. It is planned to reconstruct 1,720 km of main and inter-farm canals, which will allow the restoration of 80,000 hectares of irrigated land and improve water supply on another 24,000 hectares. 2022). The restoration of 14,000 hydraulic structures on canals and the reconstruction of 676 km of collectors can reduce annual water losses by almost 500 million m3 (Water insufficiency: How is Kazakhstan trying to solve the problem of water scarcity, 2022).

Governmental support measures involve partial compensation of investments in a drip irrigation installation or sprinkling machines (50%), as well as the creation of water supply infrastructure - wells, pumps, main pipelines, distribution networks (50% at a maximum cost of 800 thousand tenge per 1 ha). Part of the cost of irrigation water itself is also reimbursed - from 65 to 80%.

The main causes of the above problems are as follows:

1. During the transition to the market economy, almost no investment was made in water management, which led to the intensive wear of irrigation and drainage systems and the deterioration of the ecological states of lands.

At the same time, about 700,000 hectares of irrigated land have been removed from agricultural use. The wear of most irrigation and drainage systems exceeds 50%, and in some areas, this figure reaches 100%. As a result, the efficiency of irrigation systems does not exceed 0.50-0.55, i.e., 45-50% of the water from the canals does not reach the fields.

Thus, only 60% of the volume of water for agriculture reaches the fields. The rest of the water is lost due to the poor condition of the infrastructure. It is necessary to repair canals, reservoirs, and introduce automated water management (It is necessary to increase the rational use of water, 2022).

According to the plans of the MEGPR RK, in 2022 it is planned to reconstruct 259 hydraulic structures in the basins of transboundary rivers, mechanically clean 535 km of main and inter-farm canals, and purchase and install 67 pumping units (Water Crisis: Tariff for irrigation of fields will be increased for Kazakh farmers, 2022).

2. The level of public and private investment in the development of the country's water sector is insufficient.

Financing from the state budget for the current repair and restoration of water management systems allows them to be kept only at the level of minimum operational requirements and does not solve the current problems with irrigation and drainage systems completely. Funding is mainly provided from the republican budget. Local budgets, due to limited opportunities, do not provide funding for these purposes. There is almost no investment from the private sector.

According to the plan of the national project «Zhasyl Kazakhstan», in 2022, in order to increase productivity through the economical use of water, 13.3

billion tenge will be allocated from the republican budget. This money will be used to reconstruct sixteen hydraulic structures (8 billion tenge), modernize 7.5 thousand kilometers of irrigation canals in some regions of the country (5.2 billion tenge), build nine reservoirs (44.9 million tenge), preserve ecosystems of water objects (1 billion tenge).

3. Lack of incentives for agricultural producers to practice water conservation due to low tariffs.

For instance, in the southern regions, the cost of 1 m3 of water for agricultural producers is 0.2-0.5 tenge/cube, i.e., the share of the cost of water in the cost of production is in the range of 1.3-4.4%. In addition, the state also subsidizes part of the cost of supplied water.

The low cost of water does not encourage agricultural producers to implement water-saving technologies as well as to reconstruct irrigation systems to prevent water losses. Irrigation technologies on more than 90% of the area lead to the development of irrigation erosion, soil salinization, and other negative processes. New investments are not possible because of the low tariffs.

Thus, one of the most effective mechanisms for ensuring both frugality in water consumption and the attraction of investments in inter-farm irrigation systems can be the establishment of adequate market water tariffs.

In Kazakhstan, it is planned to introduce payment for the volume rather than use of irrigation water per hectare of irrigated land. This can contribute to an increase in the rational use of water.

4. Inefficient water management.

Currently, the government, local executive bodies (akims of regions, districts, cities, auls), the state water resources management body CWR MEGNR, as well as other specially authorized bodies within their competence, are responsible for water management in Kazakhstan.

In recent years, numerous organizational changes have been made and the status of the CWR has undergone major changes, which have not led to anything positive. The creation of the Republican State Enterprise «Kazvodkhoz» as part of the CWR MEGNR, with regional branches and district sections, further complicated the situation. The minimum state financing, in an even more reduced form, begins to reach the water management facilities.

The transfer of part of the water management structures and facilities to communal ownership, as well as repeated attempts to privatize and restructure state property in the water management industry, did not have a positive effect.

It would be necessary to stop experimenting in the field of water management and to study and comprehensively implement the most successful foreign experience of the developed agrarian powers of the world, without considering and implementing only the most convenient provisions of different water management systems.

5. Lack of a system of control over the state of irrigated lands by the government leads to the failure of agricultural producers to conduct preventive maintenance activities on the irrigation and drainage systems on irrigated lands (current and capital field planning, land leaching, and deep loosening of the soil).

This problem should be solved in conjunction with measures to ensure the rational use of land and with the necessary legislative support.

The problems outlined above, as well as the potential of irrigated agriculture, clearly demonstrate the need for active measures to restore irrigated lands.

In order to determine the conceptual approaches to the restoration and involvement of these lands in circulation, it is necessary to understand that the reconstruction and repair of water management systems is a rather capital-intensive undertaking.

According to preliminary consolidated calculations, about 1.5–2.0 trillion tenge is needed for the restoration of 0.7 million hectares of land that were removed from the agricultural circulation, as well as reconstruction and repair of irrigation and drainage systems on 1.4 million hectares of irrigated land.

While maintaining funds for repairs from the state budget in current volumes, the repair of water facilities and irrigation systems will last for 50–70 years. Taking into account the technical wear of these structures, with this approach in the medium term, there is a risk of not maintaining the existing volumes of irrigated agriculture.

At the same time, due to the budget's limited resources, financing all of these projects solely with state funds is not feasible. Thus, it is necessary to involve others, including loan sources of financing for measures to restore irrigation systems.

Attracting such investments is impossible if there is no prospect of a guaranteed return on funds. Thus, it is possible to stimulate the attraction of investments in the development of irrigation systems only by ensuring an adequate tariff policy (Mukhamedzhanov, 2020).

In general, reducing water consumption will have a beneficial effect on the environment and will also provide an opportunity to involve additional areas of agricultural land in irrigation.

**Conclusions.** The principal reasons for the current issues in water management in Kazakhstan are that during the transition to the market economy, almost no investment was made in water management; the level of public and private investment in the development of the country's water sector is insufficient; lack of incentive for agricultural producers to water conservation due to low tariffs; inefficient water management; and lack of a system of control over the state of irrigated lands by the government.

In Kazakhstan, there are opportunities to significantly increase productivity

through the implementation of water-saving technologies, the comprehensive reconstruction of irrigation and drainage systems, and other modern agricultural activities. It is necessary to create a system for the efficient use of water for agricultural purposes that will allow maximum production at the lowest possible cost.

The governmental program documents of the country in the coming decades provide for an increase in the total area of irrigated land, including with the use of water-saving irrigation technologies. Involvement of the removed from the agricultural circulation irrigated lands as well as the implementation of modern technologies for the use of water resources will have the following positive results:

- improve the condition of water management systems;
- restore lands removed from the agricultural circulation;
- provide irrigation water to 2.2 million hectares of irrigated land;
- increase the yield of agricultural crops by 2-4 times;
- reduce water consumption during irrigation by 3-4 times;
- to practically double the volume of crop production;
- to bring the share of irrigated agriculture in the gross crop production to 50%.

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