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Rehabilitation of Saline Soils in Tajikistan: The Example of Saline Soils in Vakhsh Valley

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Executive Summary

Over the past 25 years, since Tajikistan's independence, economic crisis and various social and natural disasters (the result of failure to carry out the bulk of reclamation activities) have led to secondary soil salinization in some areas. Secondary salinization results from anthropogenic impact on natural factors affecting the development of soils and landscape in general. It is caused by the intake of soluble salts that result from irrigation-related agrogenic contamination or from changes in the direction of natural processes. The immediate causes of salinization are improper irrigation, untimely clean-up of irrigation systems, irrigation erosion, and other factors. As a result, the groundwater level rises; its vaporization increases; and, consequently, an additional amount of salt is released into soil. Furthermore, an increasing land area affected by secondary soil salinization is being observed in the soils of Vakhsh Valley, which have been irrigated for a long time.

Currently Tajikistan is an agrarian country with about 60 percent of its population residing in rural areas. Agriculture is an important sector of the economy. As a result of economic reforms, about 20 percent of irrigated land has been transferred to private farmers' ownership (*dehkan* farms).

When saline soils are being developed, two periods are distinguished: the reclamation (transient) period and the operational (constant) period, which lasts as long as an irrigation system exists.

This study focuses on the development of recommendations and actions (using the example of the saline soils in the Vakhsh area) aimed at the restoration and the involvement of saline soils in agricultural land use and the dissemination of lessons learned from this experience to other territories.

The analysis of the modern condition of irrigated lands and the remediation of salted soils with the aim of increasing their productivity revealed the following issues that require decisions at different administrative levels: the reconstruction of infrastructure and economic and institutional reforms in irrigation; the increase in the operating cost of the cleaning, repair, and rehabilitation of existing irrigation and drainage-collector systems; the further deepening of land reform designed to transfer the selected *dehkan* land into private property or rent it on a long-term basis; the necessity of adopting measures for the mandatory transfer of responsibility for repair and maintenance of drainage and irrigation

channels located on both state and farmers' land; the implementation of advanced agricultural techniques and salt-tolerant varieties of crops on saline lands and the observance of irrigation regimes; the resolution of questions of pricing policy for electricity (including the timing of its supply to consumers) and irrigation water, and so on.

To resolve these issues, the Government of Tajikistan and Parliament (*Majlisi Namoyandagon*) are expected to adopt legislative acts mandating state and local (*hukumats*) authorities to carry out reclamation works on both state and farmers' irrigated lands. Funding of soil desalinization reclamation is possible with the financial support of the National Bank of Tajikistan, nongovernmental organizations, local *hukumats*, *dehkan* farms, and private investors.

Your task is to present policy options that address the problem of the salinization of irrigated soils in the environment of changing market relations and to focus the solution to this problem on poverty reduction and the increased food security of the country.

Background

Irrigated agriculture is one of the most intensive types of farming established in desert, semi-desert, and arid zones as well as in areas lacking moisture during certain periods of the growing season. Irrigated lands deliver high and guaranteed yields from agricultural crops (wheat, rice, cotton, etc.) that are three to five times higher than yields from rainfed agriculture. Throughout the world, irrigated agriculture occupies about 18 percent of cultivated land, but its production is the same as that of rainfed agriculture [1]. According to various estimates, the irrigated land in the world totals about 250 million hectares.

As a result of the long-term use of the same land subject to excess watering, groundwater levels rise and the water-salt balance is disrupted. When passing through the soil, the water-salt content increases to 10.3 grams per liter, and once moisture evaporates, the salt stays. The irrigated lands of Central Asia evaporate up to 10,000 cubic meters of water per year per hectare; the process is accompanied by the accumulation of up to 20 tonnes of salts in the upper soil layer. For example, within 10 years of operation following the launch of a main irrigation channel, the area of highly saline and saline lands increases by 1 percent.

Historical Facts

As a mountainous and agricultural country, Tajikistan has limited land resources, although it is simultaneously rich in water and hydropower reserves (Figure 1).

Tajikistan's economy has evolved and developed mainly as a result of its agricultural sector, which is a key sector of the country's economy, representing 23.5 percent of GDP and employing 66.2 percent of the working population [2].

Crop production in inter-mountain valleys rich with water resources was launched in the Soviet era by expanding irrigation networks. As a result, irrigated land increased from 450,000 hectares in 1960 to 700,000 hectares in 1990; since 2010 it has remained at 745,000 hectares. The total land area in the country suitable for irrigation is 1.6 million hectares, of which currently (in 2015) 753,000 hectares have been developed. From 1930 to 2015, irrigated land in Tajikistan increased 5.2 times, while the population grew more than 8 times. Thus the specific area of irrigated land per capita has been gradually dropping, and now stands at 0.09 hectares per person.

Irrigation and Drainage Systems

The basis of the irrigation and drainage infrastructure is represented by large-scale systems built in the Soviet period, 1930–80. It is a complex infrastructure in terms of technical equipment and technology of

service, and includes different types of water intake facilities as well as pumping stations of various types and capacity.

About 60 percent (452,000 hectares) of irrigated land in Tajikistan is irrigated by gravity-flow irrigation systems with waterworks built in the middle of the last century that are physically worn out by more than 50 percent. Many of these water intake facilities are built on non-regulated rivers, creating problems with the water intake each year. Part of the water intake is located in the territory of neighboring countries¹.

About 40 percent (301,000 hectares) of irrigated lands are located in areas with pumping stations and wells. However, because of the deterioration from long use of about a third of pumping equipment and pressure pipelines, and the high cost of electricity and its shortages in spring², actually about 262,000 hectares are irrigated by pumps³. Moreover, 5.2 percent of these lands are not irrigated.

The technical condition of the pressure pipelines of pumping stations along the total length of 298 kilometers is of serious concern. These pipelines

¹ For example, the Amu Darya river basin is shared by five countries: Tajikistan, Uzbekistan, Turkmenistan, Kazakhstan, and Afghanistan.

² In the Sughd Region, in March and April there is still a limited power supply regime in effect in accordance with an intergovernmental agreement with Uzbekistan, which is executed annually.

³ The main areas of pumping irrigation are located in the Sughd Region, where in March through May there are electricity shortages. The power supply to pumping stations starts after mid-April or in May.



Figure 1: Map of Tajikistan

Source: State Committee on Investments and State Property Management of the Republic of Tajikistan [3].

have been in operation for over 40 years (some more than 50 years) and more than half of them need to be replaced. Socioeconomic consequences of a pumping irrigation area failure could be disastrous for residents, who will be threatened with becoming environmental refugees as a result of desertification. Addressing this problem will be more expensive than maintaining and operating existing pumping stations.

The irrigation water supplied by pumping stations is further hampered by regularly increased electricity prices and unstable supply. Because of the late delivery of electricity in spring or its early shut-off in autumn, in a crop rotation area of about 110,000 hectares⁴, farmers are losing up to 30 percent of potential income from the cultivation of early vegetables and grains. For this reason, farmers are losing income on 38,000 hectares of land irrigated by electrified vertical wells.

Of the existing 1,823 drainage wells, about 74 percent are not working [5]. Unsatisfactory maintenance roads and communications systems make managing irrigation systems difficult.

Investment projects for the rehabilitation of water infrastructure totaling US\$80.83 million, implemented since 2000, to some extent improved the technical condition of the irrigation systems in the areas where these projects were executed. With an average funding of US\$250–450 per hectare, these projects, however, do not resolve all technical problems at the ground level. Upon their completion, only part of the problem has been fixed in the area of 108,000 hectares, which represents 14 percent of the country's total irrigated land [6].

Full elimination of saline soils and improvement of soil quality can add up to 20 percent of the gross harvest of cotton in the same area.

In some old irrigated areas, crop productivity increase is constrained by secondary salinization of soils associated with high saline groundwater, while newly developed areas are characterized by natural salinity and alkalinity of soils, resulting in an estimated loss (shortfall) of raw cotton production in the country of 100,000 tonnes each year. Therefore an improvement of irrigated lands represents the main growth potential for crops' productivity.

Prior to the start of the 1990s, the drainage system as a whole was supporting the normal operation of irrigated lands. The sharp decline in financing for the system's maintenance, along with the lack of

⁴ The data are from the Ministry of Agriculture of the Republic of Tajikistan, 2009 [4].

an appropriate agro-technical approach to the use of saline land and violation of watering regimes led, by January 1, 2013, to the unsatisfactory ameliorative status of 56,076 hectares of the total irrigated area of 749,665 hectares in the country.

Vakhsh Valley: Lessons from the Saline Soils Study

With the establishment of the Vakhsh Soil-Reclamation Station (VSRS) in the mid-1930s, the study of salinity problems in Tajikistan gathered momentum. The research, guided by academician I. N. Antipov-Karataev, was conducted by VSRS staff, the Vakhsh hydrogeological party, and an expedition of the V. R. Williams Institute of Water Resource Engineers.

Actual water use on irrigated lands was studied in a detailed fashion for many years. A number of these studies were published in 1947 in the digest *The Soils of Vakhsh Valley and their Reclamation*⁵.

The VSRS staff made recommendations regarding the drainage network in the valley (drains and collectors' depth, their location, length, etc.) that formed the basis of irrigation and land reclamation projects implemented in Vakhsh Valley [7]. These recommendations were subsequently used to carry out reclamation works in other areas of the Republic.

Implementing the VSRS recommendations, respective producers, within a very short time frame, successfully carried out the reclamation of a large part of the saline land in the valley. From 1945 to 1962, the area of saline soils in Vakhsh Valley decreased from 50 percent to 10 percent.

Along with development and research work, other aspects of salinity prevention and control were addressed, including soil and hydro operational, hydrogeological, agronomical, and other measures. Over the years, the research became complex and integrated, while evidence-based recommendations led to a negative water-salt balance in a number of irrigated areas (where the total water consumption exceeded water supply). Alongside the obvious positive results associated with the widespread use of reclamation in irrigated agriculture in the 1970s to 1980s, certain negative trends manifested themselves. An objective analysis of their causes is needed to understand the place and role of land reclamation in the national economy of the republic. One of the causes, of course, was a

⁵ This was the joint work of the Vakhsh Soil-Reclamation Station (VSRS), the Vakhsh soil-meliorative station, the Vakhsh hydrogeological party, and the V.R. Williams Institution of Water Resource Engineers.

large water intake, both general and specific, for irrigation systems that for many years exceeded the country's water intake limit of 11.3 billion cubic meters per year reaching 15,000–20,000 cubic meters per hectare and above. This situation had a number of causes.

Soil-reclamation science in the country has developed a large arsenal of tools and preventive measures in the fight against soil salinity and waterlogging. However, a number of these tools and measures were not properly tested, while others, as demonstrated later, were based on a faulty underlying concept. For example, in the development of new large plots of land, drainage was laid out at great depths and calculated assuming the full removal of salts from these plots of land and others.

Policy Issues

When developing an adequate policy aimed at solving the problems of irrigated agriculture, the rehabilitation of saline soils and ensuring the food security of the country must take into account the regional, soil, technical, financial, and political realities that emerged after independence.

Following the independence proclaimed in September 1991, the Government of Tajikistan continued to use some elements of the socialist system of centralized planning and management of the national economy. However, the transition to a market economy required a variety of reforms to be implemented in all areas of public management. In the process of this transition, all political and economic changes as a whole have an impact on agricultural production, including irrigated agriculture.

Irrigation and drainage were subject to significant investments in the Soviet era, but water management was not appropriate. Extremely extensive water use resulted in increased groundwater levels and therefore increased salinity, which in turn led to the deterioration of land quality. Often construction and maintenance were not thorough, resulting in the irrigation and drainage systems being in a poor state even before independence in 1991. After independence, the situation continued to decline. Maintenance had been repeatedly postponed, and many irrigation and drainage systems had further deteriorated.

In 2006, the Government of Tajikistan carried out the first agricultural reform that dissolved state and collective farms and divided them into dehkan (private) farms. At that time, all debts of agricultural enterprises to suppliers of electricity and water

were written off. By then, the market prices for the agricultural produce started to stabilize. It was expected that smaller dehkan farms that replaced collective and state farms would be motivated to develop agriculture more rapidly. However, after nearly a decade, the reform failed to produce the desired results. For various reasons (mostly administrative) most of the private farmers have not become land owners. Only a small portion of dehkan farms became profitable. Meanwhile, the experience of individual farmers who were more successful prompted the authorities to expand land reform.

Unfortunately, land privatization was not accompanied by reforms that transferred responsibility for drainage and irrigation canals, which had previously been the responsibility of collective and state farms. Following the privatization of agriculture and the subsequent reform of collective farms, little has been done to create a new physical and institutional infrastructure suitable for small private farms. As a result, dehkan farms almost entirely lack capacity and financial incentives to use water resources sustainably and reduce the unit cost of irrigation.

The agricultural irrigation subsector plays an important role in providing the population with food and creating jobs in rural areas. This subsector has faced a number of challenges, including the deterioration of existing irrigation and drainage infrastructure, expanded land areas that are unsatisfactory in terms of amelioration, the withdrawal of irrigated arable land from agricultural use, the erosion of irrigated land, the breakdown of pumping stations, insufficient machinery, and a lack of normal water metering among other problems.

As of January 1, 2015, about 33,500 hectares in the country were withdrawn from agricultural use, including 16,800 hectares of irrigated arable land, as well as 31,000 hectares of wastelands similarly withdrawn. Furthermore, 49,000 hectares of irrigated lands are in a poor ameliorative condition. The efficiency of the country's irrigation systems is often only 40 to 50 percent [8].

These problems that limit farmers' access to the required water supply have a negative impact on agricultural production yields. One solution to these problems is the reconstruction of infrastructure and implementation of economic and institutional reforms in land reclamation.

Since 2000, production mechanisms, land ownership and economic relations between producers, suppliers, and direct consumers have radically changed. Following land reform, agricultural

products are produced by private companies; these products are sold based on free market principles. Yet irrigation and drainage services are far from based on market principles. In order to establish such a system, it is necessary to improve the existing legislation.

Cotton is the main crop in Tajikistan. However, low prices combined with low profit have made this industry unprofitable, resulting in lower production and a debt crisis in the cotton sector.

Salinization of 16 percent of irrigated land has contributed to this problem. For example, according to Ministry of Melioration and Water Resources estimates, salinization and inefficient drainage infrastructure reduce cotton production by 100,000 tonnes per year [9].

Tajikistan is challenged by a complex, capital-intensive long-term goal of developing all lands suitable for irrigation, restoring saline soils, and rehabilitating and improving the technical level of irrigation and drainage systems. It would make sense to implement these tasks in the following order:

1. carry out short-, medium-, and long-term programs with measures aimed at raising the efficiency of inter-farm and on-farm irrigation systems;
2. improve techniques and modernize irrigation technology;
3. carry out substantial land leveling and complex reconstruction of irrigated lands;
4. execute desalinization of saline soils by washing them out with irrigation water;
5. implement biomeliorative saline lands with the use of phytomeliorants (alfalfa, sweet clover, licorice root, sugar beet, corn, sweet sorghum);
6. recover and reconstruct drainage-collection networks; and
7. gradually reclaim land for irrigation.

In order to make these improvements, it will be necessary to:

- seek opportunities to expand the area of gravity irrigation;
- ensure normative operation and maintenance of irrigation and drainage systems subject to state

support (government funding), charges for water supply, and other sources;

- ensure the reasonable, sustainable use of water through improved soil agro-landscaping, reclamation and hydro-zoning, research-based irrigation scheduling, advanced water-saving technologies, and improved land reclamation, which is of great economic, environmental, and ecological significance and is addressing issues of food security; and
- resolve the debt problem and establish a system of state support for farmers in order to increase their farms' profitability and increase their contribution to irrigation, collector-drainage systems, and water saving.

The introduction of universal water metering, staff training, the preparation and implementation of water management plans—the transition to hydrographic management and shaping public opinion and interest—these are the main organizational objectives in the area of irrigated agriculture.

There are the following limitations to achieving these objectives:

- the lack of current inventory: since 1990, no inventory of the irrigation and drainage systems has been made;
- the high degree of depreciation of fixed assets of irrigation and collector-drainage network;
- the lack of financial resources;
- low water tariffs for consumers;
- inflation, increased tariffs for electricity, energy, and other resources;
- the lack of government regulatory documents regarding the reform process and the lack of state support, although allowed by the Water Code;
- complexities in providing water organizations with land for conducting land reclamation;
- low investment attractiveness of irrigation and drainage; and
- the lack of incentive mechanism for water conservation, among others.

Stakeholder Groups

In addressing issues of food security of Tajikistan, in particular those of agriculture and irrigated agriculture, the key role belongs to the government, which is the main shareholder approving decisions and laws at the state level.

The government approves regulations for ministries and state committees, determines the structure of their central bodies, and is responsible for their coordination and inter-agency cooperation.

A very important role in the enforcement of land legislation is played by regional and district committees, which report directly to the umbrella organization and, jointly with local governments (*hukumats*) are actively involved in the implementation of land policies on the ground.

There are three groups of stakeholders in land management. The **first group** performs controlling functions, the **second** one includes land users, and the **third** one consists of intermediaries.

Controlling Government Organizations

The first group includes state committees, ministries, research and design institutions—that is, state supervision and implementation organizations.

State control over the use and protection of lands is carried out by the authorized state agency of regulation of land relations and its local agencies and by the authorized state agency of Tajikistan. Land protection involves a system of legal, economic, and other measures aimed at protection for the use of lands, soil conservation, and the prevention of their degradation, and to prevent unreasonable seizure of the most valuable lands from agricultural turnover, as well as to restore and improve soil fertility.

The State Committee on Land Management and Geodesy of Tajikistan is the central body of the executive authority responsible for the development and implementation of a unified state policy in the area of state land survey work; land cadaster; topographic, geodesic, aerospace, and cartographic works; and state registration of immovable property and titles.

The Agency for Amelioration and Irrigation is responsible for the development and operation of irrigation canals, water reservoirs and associated equipment, land reclamation and irrigation of new areas, distribution of water among agricultural customers and collection of payments therefrom,

and promotion of coherent technology policy. It also sets the rules and limits on water intake by users, monitors the effectiveness of water use, and provides water consumption data.

The Ministry of Agriculture is responsible for the development and implementation of a unified state agricultural policy. Its most important tasks are its obligations to monitor the import, export, production, processing, or storage of agricultural produce, waste, and equipment in order to ensure the quality of final products and environmental safety in general. It cannot impose administrative sanctions on violators of environmental legislation. The Ministry of Agriculture operates in close collaboration with other ministries and departments, local executive authorities (*hukumats*), the Academy of Sciences of the Republic of Tajikistan, the Tajik Academy of Agricultural Sciences, and other organizations, institutions, and enterprises.

The interaction between the government's Agency for Melioration and Irrigation and the Ministry of Agriculture is very poor, despite the fact that 85 percent of the water is used for irrigation.

Local administrations or local *Majlis* (councils of people's deputies), according to the Law on *Local Self-Government and Local Economy*, are elected by direct vote in towns and villages. Local councils are authorized to coordinate the protection of environment and the use of resources by enterprises within their jurisdiction. They may suspend the activities of an enterprise that fails to have its plans approved in the prescribed manner.

Hukumats (local executive authorities) implement environmental laws and other regulations. Their chairmen are appointed by the president of Tajikistan and approved by the *Majlis*.

Local councils may grant or withdraw land plots and monitor their reasonable and sustainable use, register titles or land use rights, and establish water use rules, including water consumption by households, farms, and others.

Land Users

The second group is composed of *dehkan* and seed farms, owners of presidential land⁶, tenants, and owners of private plots.

⁶ *Presidential land* is made up of fertile sites from former collective and state farms that have been distributed by the presidential decree in 1995 and 1997 to the citizens for the organization of private farms. Presidential land is reserved for rural *jamaat* (local government bodies), and are exempt from all taxes except land tax. These areas are intended for agricultural production but not for the construction and cultivation of gardens.

Land users in Tajikistan are juridical and physical persons. Juridical and physical persons can be primary or secondary land users. Primary land users are juridical and physical persons using the land in perpetuity, for fixed-term or lifetime inheritable use. Secondary land users are juridical and physical persons using land plots according to the terms of a lease.

Land users are obliged to:

- ensure the land is used in accordance with the purpose and conditions of its provision;
- effectively use all the available land, and use environmental production technology, to prevent the deterioration of the environmental situation in the territory as a result of economic activities;
- pay land taxes or rent in a timely manner;
- not violate the rights of other land users; and
- provide to the relevant authorities established by the country's laws timely data on the status and use of lands.

Nongovernmental Organizations and Communities

The third group consists of local nongovernmental organizations and communities.

Analysis of the different population groups that (i) increase land salinity and those that (ii) are directly impacted by its effects shows that these two groups are closely related to each other; a population group can both cause salinity and simultaneously be impacted by it. Schematically, this relationship is represented in Figure 2.

The entire range of groups that generate the processes of salinization and are affected by those

Figure 2: Relationship between Population Groups Involved in the Salinization Process



Source: Akhmadov and Khodjaev 2013 [10].

processes can be divided into four levels: regional, district, local, and individual. Each of them includes areas defined by land users.

Depending on causal factors and the impact of soil salinity, these groups can be divided into two categories: a group of people causing the salinity of soils and groups of people directly affected by soil salinity. Depending on the effect of salinity on the population, all irrigated areas are divided into land that has been irrigated for a long time, old irrigated, irrigated land, and newly irrigated land.

The following groups of people who are not part of those listed above should also be highlighted:

Members of dehkan farms. Most of these people are directly dependent on the degree of soil salinity, soil natural fertility, watering method and techniques, and other agro-technical measures aimed at increasing land productivity. Of all categories of farmers most affected by soil salinity are the farmers of the irrigated land of the Vakhsh Valley.

Members of households. This group, in the same manner as members of dehkan farms, depends on soil's physical and chemical properties. Depending on where the land is located, these households should be divided into two groups: those in irrigated areas and those in rainfed areas, because the number of potential factors affecting erosion processes in rainfed areas is greater than it is in irrigated areas.

Individual land users. This group is closely related to land salinization. Sometimes several categories of soil salinity can be detected within the same area. The main development factor is anthropogenic and natural.

Among all the stakeholders listed above, the most interested are farmers and rural population, who account for 72 percent of the total population and for whom agriculture is the key source of livelihood.

Policy Options

The key strategic objective in the area of agriculture is enhancing the self-sufficiency of the country in food and gradually increasing its export potential by cultivating profitable and exportable processed crops. At the same time, necessary measures should be taken to ensure that, by 2025, the country's population will be provided with food and agricultural raw materials in quantities no less than those required by food security standards in Tajikistan [11]. An important factor contributing to the success of this policy is the ability to obtain sustainable yields

of crops on irrigated lands after the restoration of saline soils. There are several potential options for the development of irrigation.

Statistical analysis showed that the security of grain, meat, milk, and fruit available to the population of Tajikistan was behind consumer standards by 25 to 73 percent. The availability of other foodstuff (potatoes, vegetables, and melons) already exceeds the established international standards. A 10-fold increase in fodder crop production is required to develop the animal husbandry industry and to ensure an adequate level of meat consumption, which is currently low. To fully meet the food needs of the population, by 2025 the irrigated area should reach 922,000 hectares, or about 0.10 hectares per person. At the same time, the level of crop yield should approximate maximum levels (3 tonnes per hectare for grain, 10 tonnes per hectare for fodder, 30 tonnes per hectare for potatoes, 50 tonnes per hectare for vegetables and melons, and 20 tonnes per hectare for fruits and berries).

There are several options for the development of irrigation.

1. Maintain the Existing Pace of Land Development

Given the current pace, by 2025 the irrigated land in the country will total 780,110 hectares with an average 11,500–12,000 hectares added each five-year period. At this rate of land development, per capita area will decrease by 23.29 percent, from 0.105 to 0.081 hectares.

The current pace of land development for irrigation is possible only through the involvement of new land in mountainous areas or through newly desalinated saline soils and soil that is improved through secondary salinization in lowland areas.

2. Keep the per Capita Irrigated Area (Approximately 0.1 Hectares per Person) at the Current Level

By 2025, to maintain the per capita irrigated area at 0.1 hectares per person will require bringing the total irrigated land area to 965,000 hectares by developing an additional 65,000 to 85,000 hectares every five years.

The implementation of this option is possible by carrying out major works to improve secondary salinization of soil and to regulate the operation of collector-drainage networks.

3. Guarantee Food Security in Tajikistan

This requires the sensible use of land resources, especially arable land (including land usable as a result of soil desalinization), including saline soils, so as to produce two or three harvests in one field; norms of fertilizer quantity, technology, and irrigation; and so on. On desalinated soils, after the first harvest, it is necessary to plant a second crop (rice).

After political stability was achieved in 1996–97, a large number of reforms were launched in Tajikistan. Macroeconomic stabilization was, perhaps, the most successful and was an essential precondition for other reforms and investments. Such stabilization laid the foundation for land management as well, though not sufficiently—especially in a small landlocked country such as Tajikistan, where new regional barriers and foreign trade in agricultural produce have significant implications for land use. One of the export crops is cotton grown in Tajikistan, with its controversial impact on the distribution of saline land.

Land reform was the main objective of government efforts aimed at enhancing land productivity. Its goal was to transform the old collectivized agriculture consisting of about 500 large collective farms into a more responsive and efficient sector by creating new forms of farming supported through the right to lease land. By 2016, the number of such farms totaled about 160,000, of which 140,000 were individual *dehkan* farms, while another 20,000 were collective farms (different from old collective farms). Formally, to a large extent reform has been carried out. However, a deeper analysis reveals a number of unresolved issues, superficial changes, and weaknesses or the absence of several features that incentivize caring about the land (lease terms, adequate legal protections, transferability, etc.).

It should be noted that Tajikistan excludes individual ownership of land, which is an accepted fact and not questioned by land users. This practice weakens the impact of reform. In general, land management policy has been correct although incomplete and shallow, with weak links to implementation. Incompleteness also refers to the management of saline and unproductive lands. In the future, these two neglected aspects (individual ownership of land and management of saline lands) may play an important role in the development of agriculture in the valley. The transition from a planned to market-based agriculture has been relatively difficult for Tajikistan. The government's intervention in the cultivation of cotton is visible.

A complex set of issues is related to irrigation and the policy of maintaining low fees for irrigation. This indirectly promotes the expansion of irrigated agriculture in high-value or environmentally sensitive areas, potentially negating other forms of land use that are more socially beneficial⁷.

Technical support to the organizations managing land resources continues to be distorted. Methods of farming reminiscent of Soviet collective farms continue to dominate. Research institutions and technology are slow to reorient to new methods of production and management approaches that take into account altered expenditure related to resources and supply, and modified decision-making. For a long time, since independence, the majority of research institutions have failed to adjust. This situation is slowly beginning to change because the newest initiatives are donor-funded. Although much of the funding is regional, there has been some progress even in this area.

Responding to the Challenges Faced by Irrigated Agriculture

Approximately one-third of the existing irrigation systems (a total of 240,000 hectares) rely on pumping water into gravity distribution systems. About 75,000 hectares of land lift water up to 150 meters with pumps. These highly energy consuming systems are in poor condition. Abandoning these systems would endanger the livelihood of a large share of the rural population. It would also threaten irrigation reform. Approximately 60,000 hectares are irrigated with wells. By most standards, the fact that only 17 percent have full irrigation efficiency (transportation losses combined with losses by farms) is very low. The drainage network covers about 350,000 hectares, or half of the total irrigated area. At the beginning of the decade, about 50 to 80 percent of the drainage network was in poor condition and in need of repair. The main causes of waterlogging and secondary salinity are the lack of a drainage system or poor farm management. Even traditional opponents of “water consumption” are beginning to understand the difference between the abundant water coming from the mountains and a sustainable supply of water to the fields, which entails a significant loss of water and higher costs.

The land reform process being undertaken in Tajikistan is complex and faced with implementation problems. Nevertheless, this reform represents the biggest and only hope for sustainable land management. Legislative reforms should be mainly aimed at improving land use rights and, ideally, full

⁷ For example, the gradual transition from pump irrigation to improved global irrigation or the improvement of saline land.

land ownership (with safeguards against abuse, ownership concentration, and exceptions). The guaranteed right to lease includes a plurality of elements (legal, supporting the right kind of property, effective land management, etc.), all of which should be present in order to really guarantee the lease.

Lack of land ownership and existing restrictions on land transfer remain a major obstacle to investment in land productivity improvement. The rapid adoption of new land-related laws is not conducive to clarifying this situation. The intended beneficiaries—members of former collective and state farms—remain poorly informed about important aspects of land reform and their rights and responsibilities in the new environment. Hukumats continue to be interested in influencing the production-related decisions of “their” farmers, thus undermining their managerial autonomy. There are cases of unfair initial distribution of previously jointly managed land. Continued lack of farm credit for any subsector except cotton (which itself is in deep crisis) and a general lack of credit management experience reinforce the reluctance of many new land users to make investments. If a weakened farm support system and various product transportation problems are combined with investment constraints, the costs of improved land productivity become enormous.

Planning and management of land use continue to be addressed at the national level; this is an important plus. The peculiarities of the land reform are reflected in the National Poverty Reduction Strategy (NPRS) and the Poverty Reduction Strategy Paper (PRSP). Land salinization is the main challenge in the Government Program of Economic Development to 2015 [6].

Obviously, the best known form of land degradation associated with irrigation is secondary salinization caused by poorly managed irrigation that leads to overwatering, gradual elevation of groundwater levels, and increased salinity. Soil erosion caused by irrigation represents another problem. Uncalculated irrigation leads to soil being washed out. Among the main technical causes of irrigation erosion are poor initial layout and poor technical land preparation, siltation of irrigation canals and drainage collectors, inadequate quantity of water, and applied methods of field irrigation. The extent of salinization associated with irrigation has increased with the use of the irrigation system.

Unreliable irrigation water supply in a country where more than 40 percent of all irrigation supply is ensured by pumps is the main immediate problem, with its underlying complex issue of how to restore,

maintain, and manage the pumping system that was developed in a different time and for a different production system. Indirectly there are also problems associated with the assessment of the electricity supply for pumping stations.

Integrated resource management is currently applied only to selected communities and areas where the physical configuration (i.e., a valley) and social organization facilitate an integrated vision of resource use, and where active supporters of this vision (international nongovernmental organizations or a number of bilateral donors) provide financial and technical support.

Therefore, the role of the Ministry of Agriculture should evolve from managing to providing assistance to producers in the private and household sectors. Its regulatory functions should be limited to the key aspects of the public interest. In working with farming communities, the Ministry of Agriculture should focus more on consultative approaches.

In irrigated land management, the Ministry of Agriculture and the Agency for Melioration and Irrigation should abandon the policy of “irrigation at any cost” while focusing on the social profitability of irrigation, and should assess various methods of irrigation. It is necessary to amend the legislation to permit collateralization of the right to land use. The Agency for Melioration and Irrigation’s potential should be strengthened in financial management, legal issues, water management, investment planning, and cost recovery procedures. It is necessary, in every way possible, to promote mechanisms of voluntary transfer of land ownership to areas that are subjected to salinization and swamping.

In agricultural finance it is necessary to promote savings, loans, and credit systems, thus allowing a transition from the traditional model of cotton credit intermediaries to direct lending. It is necessary to amend legislation to stimulate the establishment of credit unions and microfinance organizations.

Sustainable land management policy—particularly regarding the sustainable use of saline soils—should be more closely linked to government funding. Appropriate measures should be taken to facilitate budget formulation and preparation and the implementation of measures to control land-based territories on the basis of projects and programs that require close interagency coordination. This integration should take place at both central and local levels, and it should be preceded by the strengthening of local capacities and the establishment of

consultative mechanisms. The present stage of agricultural reform in Tajikistan should promote the transition from large to small units.

The problem facing mountainous areas that require pumping water to a higher level and a related subsidy policy are worth thinking of as an opportunity to partially reorient the land use from pump-irrigated areas in higher elevations to crops that need far less water and thus reduce waterlogging and salinity. It is necessary to seek alternative agricultural and non-agricultural land use in those areas where irrigation is not economically viable.

Land management research in Tajikistan should be applied rather than theoretical in nature and serve new *dehkan* clientele. Research should focus on areas such as soil fertility, land development, and reclamation methods, with an emphasis on economic sustainability and the efficiency of investments as well as on land and water protection methods through decentralization. It is necessary to provide maximum opportunities to introduce the results of the best applied research in arid zones, relying on the recommendations of the International Center for Agricultural Research in Dry Areas and the International Crops Research Institute for the Semi-Arid Tropics.

All investments in sustainable land management in Tajikistan should be supported through mutual departmental consent and be integrated in this sense. Currently the process of policy formulation within each ministry is rather weak. As a result, public spending is disproportionate and managed mainly through inertia and the old habits of regulatory budgeting. The departments that are administratively most involved with sustainable land management are hampered by their perceived status as “ordinary” administrators rather than masters of the situation (for example, the Ministry of Agriculture and the Agency for Melioration and Irrigation); their work style and priorities have been inherited from the priority-setting in the central planned economy. Another deficiency separating policy and funding is the narrow definition of land improvement that has long been regarded in Tajikistan as synonymous with the Ministry of Melioration and Water Resources activities and with irrigated land, as if land can be improved only through irrigation.

The place of sustainable land management in cross-sectoral documents is evolving. Sustainable land management is reflected respectively in the PRSP (although it is not highlighted there as a separate budget category); however, it is not presented as a separate issue in the Plan and the Program of Socio-Economic Development (SEDP). The PRSP and

SEDP remain largely on the sidelines. The existence of two guiding documents parallel to the budget makes combining politics with the budget process more difficult. Currently the budget includes the Centralized Public Investment Program (CPIP) and is complemented by the Public Investment Program (PIP). Between them (each accounts for about 3 to 4 percent of GDP), CPIP and PIP finance virtually all new public investment; previously disbursed funds were mainly provided by donors. Currently PIP is not directly included in the budget. CPIP is part of the current budget process, but its funding priorities are in conflict with those of the PRSP.

The solution to the existing problems of irrigated areas should fully tap the potential of land reform in order to increase land productivity and reduce the overwhelming dependence on one or a limited number of crops (for example, cotton).

Water Price

The transition to more sustainable agriculture in valleys requires a recognition of the real cost of water and energy and of the idea that the water supplied to a field is a precious resource that should be used accordingly. Between half and two-thirds of the irrigated land in Tajikistan (depending on the forecast of future crop prices) would not be sustainable if the water were priced at its potential cost.

In 1996, after the Tajikistan Presidential Decree “On the Introduction of Fees for Services of Water Delivery from State Irrigation and Watering Systems” and the reform of agriculture, the share of public financing available for the maintenance of irrigation systems was gradually reduced because of the state’s financial difficulties after independence. Currently the share of state finance is less than 20 percent, and the rest of the financing expense (80 percent) comes out of the water supply fees. Every year, in November and February, the water consumer must provide advance payment of 40 percent of the fee to the water supplier for the preparation of irrigation systems for the irrigation season. Then, in the second half of the irrigation season, the balance (60 percent) is paid out gradually, as water is provided. However, this requirement is not met by the consumers, who do not pay the balance; this lack of funding leads to further deterioration of the technical condition of the irrigation systems and structures. In fact, the overall level of payment received from the water consumers ranges from 32 to 66 percent.

The problem of unsustainable water use is primarily caused by the fact that the existing irrigation

systems were designed and built for the water supply and drainage of large collective farms. Many of these systems cover several villages. Following the privatization of agriculture and the subsequent collapse of these farms, little has been done to create new a physical and institutional infrastructure suitable for small private farms. Many new households do not own hydraulic valves and water meters, and they are not able to adjust the time and amount of water used. Payment is at a fixed rate for the use of water without regard to the volume consumed. As a result, farms do not have enough opportunities or incentives to promote the sensible use of water resources or to decrease the unit costs of irrigation⁸.

In order to reduce poverty in Tajikistan, a transition from agriculture with a high cost of irrigation to another type of agriculture and land and water use is necessary. The introduction of new technologies of irrigation (drip, subsurface, sprinkler irrigation) saves water by two- to threefold. Such reform should lead to decreased use of water-intensive crops and improved water use efficiency with environmental benefits (less waterlogging, salinization, and soil erosion) as an important economic advantage. However, limited resources and the lack of a production base do not yet allow development in this direction. Perhaps deliberate steps that would accelerate this change are needed, rather than expecting these adjustments to occur through market mechanisms. Creating self-supporting advisory services in the area of advanced irrigation methods and lease-related issues could be an important factor facilitating this transition.

The organization and management systems for primary and secondary irrigation networks should be further decentralized. It is necessary to promote and establish water user associations. Technical assistance should be provided to water management agencies to improve water use and groundwater monitoring, as well as to improve soil fertility and land reclamation techniques.

The most difficult aspect that needs to be addressed is faced by a few regions that are currently engaged in irrigation pumping, where continued farming is minimally effective and economically unprofitable. These areas are subsidized by the cost savings that is a consequence of using the improved water supply to other areas that are mostly enjoying gravity irrigation.

⁸ For example, water consumption per 1 hectare is, on average, 10,000 cubic meters. The cost of 1 cubic meter of irrigated water is 0.047 Tajik somoni. Therefore, 10,000 cubic meters of water = 472.44 somoni or US\$60.1 (at the July 2016 exchange rate of US\$1 = 7.86 somoni).

Land resources–related research is only now beginning to show signs of modest recovery after a decade of decline. In general, land management in Tajikistan still suffers from the continued mechanisms of interaction between technical, scientific, and administrative bodies that were established to serve collectivized land use. The aim, therefore, is not to restore the previous scope and breadth of research, but rather to redirect it to the current and emerging priorities. The research should take into account different levels and structure of land- and water-use units and be more focused on management.

In order to resolve this issue, the Government of Tajikistan and Parliament (*Majlisi Namoyandagon*) are expected to adopt legislative acts mandating state and local authorities (*hukumats*) to carry out reclamation work on both state and farmers' irrigated lands. Funding soil desalinization reclamation is possible with the financial support of the National Bank of Tajikistan, nongovernmental organizations, local *hukumats*, *dehkan* farms, and private investors.

Assignment

Your task is to present policy options to address the problem of salinization of irrigated soils in the environment of changing market relations and focus the solution to this problem on poverty reduction and increased food security of the country. Evaluate the presented policy options from the perspective of each stakeholder group.

Policy Recommendations

Problems of irrigated agriculture and food security can be solved by carrying out the following priority activities:

1. Establish the sensible, sustainable use of land resources, especially irrigated lands, including saline soils, with two or three yields from each field, including those with saline soil, and using norms of fertilizers, machinery and irrigation norms, and so on.
2. Keep up the current pace of land development for irrigation, which is possible only through the involvement of new lands in mountainous areas or the new desalinization of saline soils, and improve the condition of soils that have undergone secondary salinization in lowland areas.
3. Carry out large-scale works to improve and regulate the operation of collector and drainage networks.

4. Convert part of the irrigated land in rainfed agriculture to crops that are less demanding for irrigation and/or introduce new irrigation technologies (drip, subsurface, sprinkler irrigation).
5. Introduce differentiated tariffs for water depending on natural and climatic zones, gravity water supply, water lifting machine, and so on.
6. Form a clear payment mechanism between water suppliers and water consumers that takes into account the seasonal nature of the work, as well as individual parts of irrigation systems.
7. Address 100 percent of the level of payment for water services and electricity; this is possible with a realistic assessment of the paying capacity of users and the corresponding economic justification of tariffs.

Improvement of water resources management system could have several levels:

- *The first level is national*, and includes the parliament, government, ministries, and departments empowered to manage and regulate the use of water resources. The Ministry of Melioration and Water Resources of Tajikistan plays a key role, since it is a specially authorized state agency concerned with the regulation of use and protection of water resources for irrigation and with issuing permits for special water use in this sphere of activity.
- *The second level is the level of the water basin*, and should include the basin water organizations (management) created by the main river basins.
- *The third level is the management of large channels*, which needs to take place through a centralized administration system because they are the primary channels from which water is supplied to the irrigation fields.
- *The fourth is the grassroots level*, where water management is carried out directly within the enterprises of various patterns of ownership and water users' associations.

Financing for irrigated agriculture can come from:

- funds collected from water consumers,
- means derived from the budget of the Republic;
- means derived from local budgets;
- foreign investment; and
- other sources not prohibited by legislation.

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Abbreviations

CPIP	Centralized Public Investment Program
GDP	gross domestic product
NPRS	National Poverty Reduction Strategy
PIP	Public Investment Program
PRSP	Poverty Reduction Strategy Paper
SEDP	Program of Socio-Economic Development
TAAS	Tajik Academy of Agricultural Sciences
VSRS	Vakhsh Soil-Reclamation Station