

## **Agricultural Water Management Models for Optimum Use of Water Resources in Georgia**

**Solomon Pavliashvili\* and David Gubeladze\*\***

*\* Academy Member, Georgian National Academy of Sciences, Tbilisi, Georgia*

*\*\* Faculty of Agrarian Sciences and Biosystems Engineering, Georgian Technical University, Tbilisi, Georgia*

**In agriculture, the key to managing natural resource efficiency is the integrated use and protection of water resources. We must change the priorities; the focus should be shifted from labor economics to efficient use of natural resources. One important consideration in this regard is the use of complex agricultural water management models, taking into account the complexity of the system and the interests of the user. © 2021 Bull. Georg. Natl. Acad. Sci.**

Water resources, optimization, irrigation, irrigation water, water supply

The level of production efficiency in agriculture and its individual sectors in Georgia lags far behind the existing level of developed countries. Of course, the main reasons for this are the market economy, lack of competition, inefficient use of natural resources, low level of mechanization and automation of production, high resource capacity in the previous period of development of the industry, and in the next period - a transformational crisis, which decreased even more significantly, practically reduced the level of efficiency. But at the same time, nowadays, it is necessary to highlight the issues of the integrated use of water resources and other macroeconomic and microeconomic factors.

It is impossible to quantify each of these tasks, but, in our opinion, one of the main reasons for this is the ineffective use of natural resources and the lack of integrated management of agricultural efficiency.

### **Strategic Vision**

Agricultural production in Georgia is only at the initial stage of a competitive advantage. Its competitive advantages, as already mentioned, mainly depend on natural, climatic and environmental factors. Therefore, it is necessary to create a competitive environment, the introduction of modern agricultural technologies, the integrated efficient use of natural resources, the use of qualified human resources, the economically efficient use of natural resources and compliance with standards in accordance with modern requirements.

The variety of climatic, soil and relief conditions in Georgia also contributes to the heterogeneity of water use for the development of agriculture. In particular, the arid continental climate of eastern Georgia requires extensive use of irrigation, while in western Georgia it is necessary

to remove excess water and carry out activities relating to drainage.

Nowadays, the first task is to fully finance the land reclamation sector and effectively use the funds. Gradual cessation of the downward trend, implementation of development-oriented measures require coordination of the functions and responsibility of irrigation management and drainage systems.

### Development of agricultural irrigation infrastructure

The need for hydro-reclamation infrastructure in the field of agriculture is defined as the need to take measures to increase yields and improve agro-ecological environmental conditions. The most favorable natural conditions for agricultural activities are: environment, light, heat, water, air, nutrients in the soil, and others.

The viability and yield of the plant depends on the correct use of these factors. Most of the listed activities: relative improvement of soil and air moisture by irrigation or drainage, flushing of saline soils, control of mechanical impact on water-soil, leveling the soil surface (shrinkage), uprooting, etc. are related to the issues of water resources regulation, and their implementation necessarily requires maintenance of rather complex technical systems (irrigation and drainage network with its structures, etc.) and knowledge of management systems for their operation.

### Irrigation Water Supply Schemes and Types of Service

As international experience shows, the management of irrigation systems should be carried out in such types and methods that are economically acceptable for water users.

When choosing a management model, the engineering and technical complexity of the irrigation system management, its operating costs, income and optimal consumption of water

resources are of great importance. Consider a four-element analytical management model, as can be seen from the analysis of the existing model, basically the form of irrigation water management is distributed between the state and private companies, there are also mixed and single forms of management associated with the complexity of system services (Fig. 1).

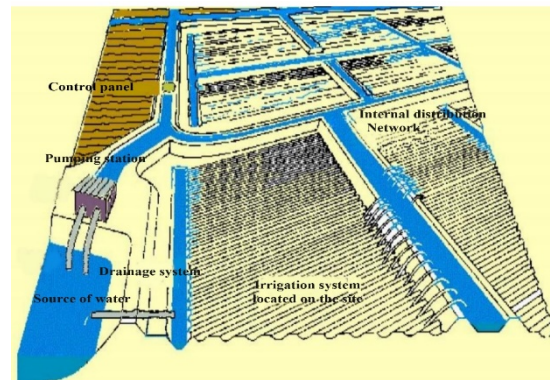


Fig. 1. Optimal water supply scheme for agricultural land.

The management of irrigation systems should be monitored and require subsidies from the state if complex irrigation systems are rehabilitated, in order to avoid technically unforeseen accidents, annual erosion processes caused by improper operation, natural disasters and disruption of agricultural activities (Fig. 2).

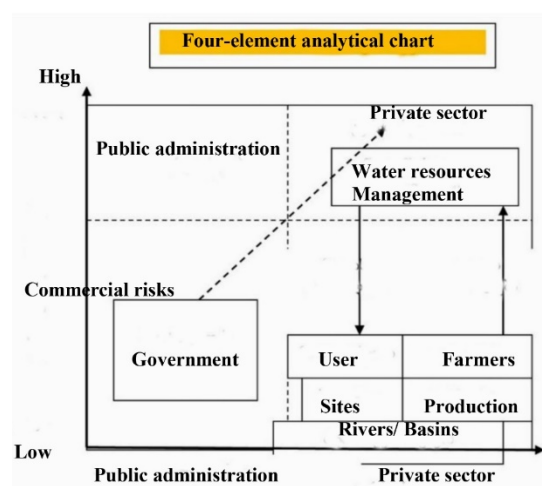


Fig. 2. Models of management of irrigation systems.

## Basic Service Elements

According to the rule of water supply, irrigation systems can be divided into self-flow (gravity) and confined flow system. Currently, the land in Georgia is irrigated by gravity systems. This is how 90% of the total irrigated area is irrigated, although pumping stations remain in some regions. As part of the rehabilitation of the irrigation system, several new pumping stations have been built in recent years.

There are different attitudes towards the organization of irrigation services. The preferred option is a demand-based system that allows the farmer to request and receive water based on plant needs and climatic conditions. In this case, the customer submits an application to the water supply organization before the agreed term, receives the service within the agreed deadline and, accordingly, he/she determines the terms and conditions of the service. In terms of supply-based service, which is used in the presence of insufficient water resources or a low-tech system, the starting point is the existence of a water resource, according to which the water distribution rule is developed (rotation, pre-agreed supply, central planning, etc.).

Irrigation water service is determined by good management and proper operation of the irrigation infrastructure. Reliable, timely and necessary supply of irrigation water with products necessary for agricultural production, in particular seeds, fertilizers, etc. of agricultural crops, contributes to high yields and increases the income of farmers. The products grown as a result of the consumption of irrigation water and the income generated from it allow the farmer to pay the service fee. A high level of service increases the ability of the water user and his willingness to pay for it.

On the other hand, the solvency of the water user and the desire to introduce efficient water consumption determine the proper performance of service and the timely water supply.

The service provider's organization must have effective controls, especially in the areas of finance,

operations and maintenance. The effectiveness of such management systems improves the quality of service [1,2].

Irrigation systems should be managed in forms and methods that are economically acceptable for the water user. Water supply services should be provided on the basis that the water user has an interest in agricultural activities, the sale of which will allow him to obtain economic profit. Due to the complexity of the systems, water charges vary by region. Leaving a fixed tax, as it is now, requires government subsidies, so it is necessary to expand the business, to find and offer alternative options.

**Forms of management of irrigation systems.** The classification is based on who determines the state; who supplies – service organization; who pays – user.

Services are an integral part of the structural management of irrigation production, and the service of supplying irrigation water during maintenance is determined by good management and proper operation of the irrigation infrastructure. Reliable, timely and necessary supply of irrigation water with products necessary for agricultural production, in particular seeds, fertilizers, etc. of agricultural crops, contributes to high yields and increases the income of farmers. The products grown as a result of the consumption of irrigation water and the income generated from it allow the farmer to pay the service fee. A high level of service increases the ability of the water user and his willingness to pay for it.

The service provider's organization must have effective controls, especially in the areas of finance, operations and maintenance. The effectiveness of such management systems improves the quality of service.

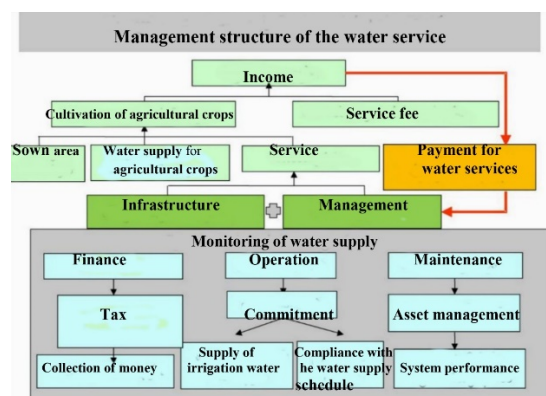
## An Efficient Water Management Services and Cost of Water

Service fees for supplying or removing excess water depend on the quality of the service. This

method of payment for services is widely accepted in countries with market economy experience. In Georgia, this method is still not widely used – as in the irrigation and drainage sector, similar problems with the collection of funds are found in other areas of service.

It is important to share the experience of other countries in order to determine the sources and area of financing for the sector in the future. Especially in countries that are somewhat similar to Georgia in terms of natural conditions: climate, relief, soil cover, water resources, crops, etc. and are at the same level.

Studies have shown that when choosing a management model, one should take into account all the circumstances that may accompany water supply activities. You should also take into account the culture of the local population and its main source of income. It is also necessary to take into account natural resources: soil, agro-climatic factors of water, ecological balance of the environment, etc., which affect water services, the cost of irrigation water (Fig. 3).



**Fig. 3.** Structure of water services management and monitoring.

Along with general economic development, the irrigation water service in Georgia is gradually strengthening, it is expected that collection of

payments by water users will be improved, and state funding will be reduced. However, this depends on whether the involved structure receives the assistance needed to provide adequate services in the future. The current legal framework for maintaining the sustainability of the sector should regulate the legal relationship: between individuals – water users and government bodies in the field of natural resources. You should also pay attention to surface and ground waters, as well as protection zones when using them [3,4].

## Conclusion

According to the individual model, the issues of regulation of the infrastructure of irrigation systems in the water supply service area, management, operation, maintenance and maintenance of the irrigation infrastructure (canals of the second / third tier and local irrigation systems) should be distributed. Services to other water users, in accordance with the charter and on the basis of an agreement, accounting and rational distribution of water at points of delivery, collection of payment for water use and payment with first user are necessary. Consideration should be given to the structure of water services management and monitoring, which determines the optimal use of water resources and effective economic management.

From a perspective, in order to effectively manage agriculture economically, in terms of optimal use of natural resources, it is recommended to move from linear economic models to circular economy, which leads to the optimization of the use of water resources in agriculture and the introduction of waste-free technological production.

## ჰიდროლოგია

# სოფლის მეურნეობაში წყლის მართვის მოდელები წყლის რესურსების ოპტიმალურად გამოყენებისათვის საქართველოში

ს. პავლიაშვილი\* და დ. გუბელაძე\*\*

\* აკადემიის წევრი, საქართველოს მეცნიერებათა ეროვნული აკადემია, თბილისი, საქართველო

\*\* საქართველოს ტექნიკური უნივერსიტეტი, აგრარული მეცნიერებების და ბიოსისტემების ინჟინერინგის ფაკულტეტი, თბილისი, საქართველო

სოფლის მეურნეობაში ბუნებრივი რესურსების გამოყენების ეფექტიანობის მართვაში მთავარია წყლის რესურსების კომპლექსური გამოყენება და დაცვა. საჭიროა განხორციელდეს პრიორიტეტების შეცვლა, როდესაც აქცენტი ცოცხალი შრომის ეკონომიიდან გადატანილი იქნება ბუნებრივი რესურსების გამოყენების ეფექტიანობაზე. ამ მხრივ ერთ-ერთ მნიშვნელოვან ყურადღებას იმსახურებს სოფლის მეურნეობაში წყლის რესურსების კომპლექსური მართვის მოდელების გამოყენება სისტემის სირთულისა და მომხმარებლის ინტერესების გათვალისწინებით.

## REFERENCES

1. Pavliashvili S., Gubeladze D. (2020) The economic challenges in times of Covid-19, circular labor migration, the necessity to switch from a linear to a circular economy and business opportunities; Social and economic aspects of education in modern society (Scientific and Practical Conference) ISBN 978-83-958980-6-8, 1:3, RS Global Sp. z O.O., Warsaw, Poland.
2. Pavliashvili S., Gubeladze D. (2020) Linear economy and circular economy – current state assessment and future vision, *International Journal of Technologies in Economy*, Scientific edition, ISSN 2412-8368, 5(32):79. RS Global Sp. z O.O., Warsaw, Poland.
3. Pavliashvili S., Gubeladze D. (2020) Agriculture, economic efficiency management and circular economics, Manual. Tbilisi.
4. Pavliashvili S., Dr Dariusz Edward Prasek (2020) Accelerating transition to the circular economy in Georgia, *Bull. Georg. Natl. Acad. Sci.* **14**, 3:7-12. Tbilisi.

Received August, 2021