European Scholar Journal (ESJ)
Available Online at: https://www.scholarzest.com
Vol. 3 No.10, October 2022
ISSN: 2660-5562

EFFICIENT USE OF WATER RESOURCES IN SMALL RIVER BASINS

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Article history:

Received: 20th August 2022
Accepted: 20th September 2022
Published: 30th October 2022

Abstract:
The article provides a recommendation for the rational use of water resources in the basins of small foothill rivers. The research was carried out on the example of the Govasay River basin located in the northern part of the Fergana Valley. The efficiency factor of the canal has been determined and a technical assessment has been given for the management of water resources in the river basin; the efficiency of the canal is 65-75%. A program for the operational management of water resources in The Govasay river basin and a GIS map of water consumers in the Govasay river basin have been created.

Keywords: River basin, water resources, flood management, structures, irrigational canal, water distribution, operational management, water consumers.

1 INTRODUCTION

The vast majority of rivers on Earth are small rivers, which serve as source for large rivers, and big rivers are an integral part of entire water system. Researchers conducted research in the rivers of Central Asia V. Shults, I. Ilin, F.Khikmatov, V.E.Chub and many other scientists in their works focused on the geographical location of rivers, their water flow regimes and the features of the flow of streams [1,13,14], which correspond to small rivers. The possible definition is given by researchers A.Chernyaev and E.Sibukaev, in which small rivers - with a length of 26 km to 100 km, with an average annual water consumption of 2-18 m^3/s, as well as a basin with an area of 100-1000 km^2 noted that their facilities could be called small rivers [12].

A. Orlova and O. Dunin-Barkovskaya in their research, analyzed the sources that affect the quality of water resources of small rivers on each small river and put forward their proposals for the organization of water protection zones of these rivers [9], R. Razakov and L. Yaroshenkos conducted their research in the development of engineering and biotechnical measures to improve the quality of water resources of small rivers [10], A. Krutov's research, attempts to develop imitation models of small river water resources and their quality management [7], Sh. Rakhimov and S. Mamatov's research has developed proposals to improve the efficiency of small river water resources based on the rational management of water resourses of small rivers [11,8].

In modern practice, the idea of pumping water from large canals below to these areas as a solution of water shortages in small mountain basins is constantly being promoted, and this idea is being implemented as a key task of a number of investment projects. However, such method does not ensure the stability of small river basins, but rather makes the area completely dependent and the situation in the lower river basin even worst. There are other opportunities for rational management and efficient use of water resources in the foothills of small rivers, which not only saves finance on raising water resources to a height of hundreds of meters, but also creates new opportunities for sustainable water supply and sustainable development of agriculture.

The main body of the research presented in this article is to radically improves the management and use of water resources in small river basins, taking into account local conditions, optimizing the operation of water bodies, using modern approaches to system analysis, new mathematical methods of water distribution to increase water efficiency. In addition, it requires the development of models.

2. MATERIALS AND METHODS

The research was conducted on the example of the Govasay River for the management and use of water resources. The main source of water supply in the Gavasay River Basin is the Govasay River itself, which supplies water to consumers through a number of irrigation canals.

Irrigation systems for the supply of water from the Govasay River to consumers includes inter-farm canals with a total length of 615 km (of which 105 km are paved with concrete) and internal canals with a total length of 327.0 km (of which 177 km are concrete), 117 hydraulic structures (hydro stations, drainage facilities, aqueducts, bridges, hydro posts).

Govasay hydrojunction station: The hydrojunction station is a "Fergana" type hydrosystem station. The structure of the Govasay hydro-station consists of a water intake bank, a dam with gate, a dam, a water intake dam, a water intake bank, a single-chamber reservoir, New Karkidon, Left Bank and Right Bank canals with water regulators (Fig. 1)

Figure 1. Condition of Govasay hydrosystem station and Left bank canal

The main functions of the hydrosystem plant are guaranteed supply of water to the New Karkidon, Left Bank and Right Bank irrigation canals, preventing large streams from entering the main canals and diverting floodwater to the lower basin.

Dam: There is a dam on the Galaba canal located in the downstream of 500 m from the Govasay hydroelectric power station. The main function of the dam is to supply water to the Galaba Canal and through it to the Vorzik Reservoir (Figure 2). The water capacity of the canal is 15 m^3/s.

Figure 2. Water giving and barrier structure and condition of Galaba Canal

Kotarma, Shurkent, and Kayrogach canals also supply water to irrigated areas by local residents and farms, but there are no dams or water metering hydrologic stations at the catchments. As part of the research, we assessed the current technical condition of all existing facilities in the Govasay River basin based on field study. The results of the research showed that the technical condition of most irrigation canals in the Govasay river basin is not satisfactory and, accordingly, the efficiency of irrigation canals is not high. We used the hydrometric method to determine the efficiency of the channels (EC) and for it selected a specific part of the channel. In the selected section, the locations of the upper and lower storks were determined, hydrologic stations were installed, and water consumption was measured. The loss of water between the upper and lower storks was determined by the following formula.

$$S = Q_{.up} - \sum Q_{ch} + \sum Q_{dis} - Q_{down} \quad (1)$$

where; $Q_{.\,up}$ and Q_{up} - water consumption measured in the upper and lower points, m^3/s;
$\sum Q_{ch}$ - sum of water consumption of all water intake ditches between the plots, m^3/s;
$\sum Q_{dis}$ - sum of water consumption thrown between the plots, m^3/s.

The efficiency of the channels was determined by the following formula:

$$EFF = \frac{Q_{up} - S}{Q_{up}} \quad (2)$$

The efficiency of irrigation canals, determined based on the results of nature observations and measurement data conducted by the Department of exploitation, it equal to 65-75% (Table 1).

Table 1. Efficiency coefficients of the main irrigation canals receiving water from the Govasay River

№	Irrigation canals	Efficiency, %
1	Kutarma	65
2	Shurkent	70
3	Varzigon	70
4	Galaba	75
5	Naw Karkidon	65
6	Left Bank	75
7	Machit	75
8	Kayragoch	70
9	Right bank	65
10	Tegirmon	70
11	Sofibobo	65

At present, priority is given to the use of modern geographic information systems (GIS) technologies in the efficient use of water resources in river basins, analysis of such problems in irrigation systems, prevention of acceleration of processes, improvement of existing methods [2,3]. Based on the purpose of the study, the scheme of the Govasay river basin was drawn using GIS (Figures 3,4). For this purpose, Arc GIS 10 geoformation system technology and Cartosat-1 data were used to draw the scheme of irrigation networks of the Govasay river basin. The water consumption of the irrigation canals receiving water from the Govasay and the other areas connected to them are given in Table 2.

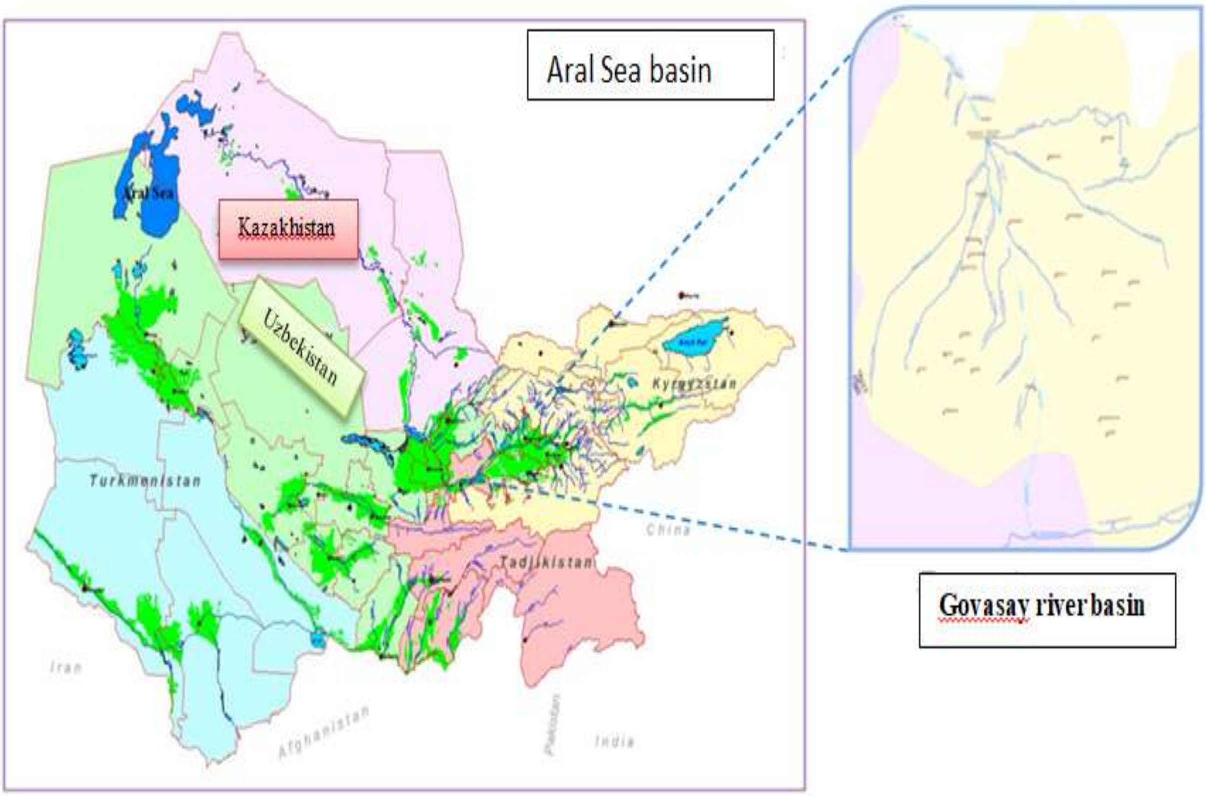

Figure 3. The location of the Govasay river basin

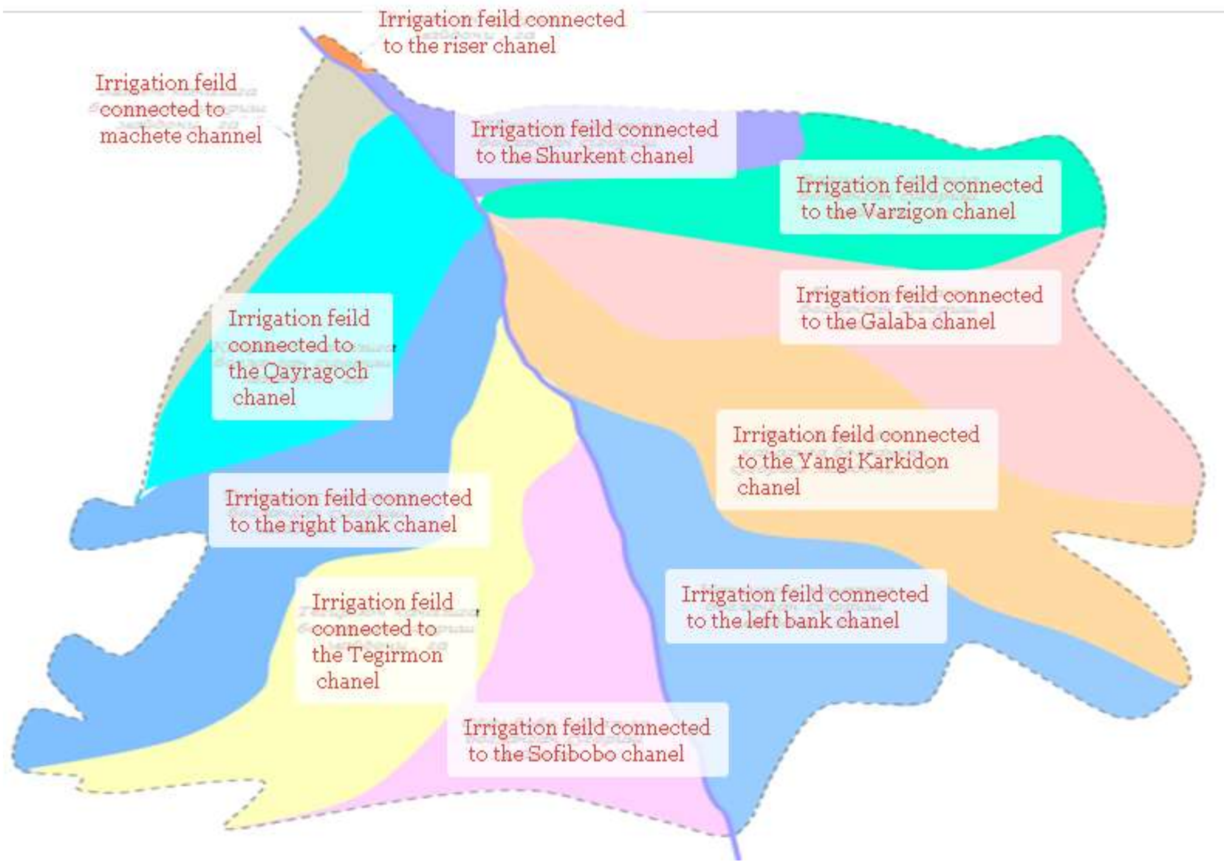

Figure 4. Administrative division of water comsumers associations

This is characterized by the absence of other water sources in small river basins, the speed of water flow in irrigation canals, the high slope of irrigated areas and the strength of water filtration in streams and irrigated areas

Table 2. Irrigation canals receiving water from the Govasay River and the areas of consideration

№	Channel name	Water intake capacity, m^3/s	Connected area, ha
1	Kutarma	0,8	92
2	Shurkent	1,0	109
3	Varzigon	0,3	10
4	Galaba	15	900
5	New Karkidon	7,0	1510
6	Left bank	5,6	2152
7	Machit	0,3	22
8	Kayragoch	0,3	35
9	Right bank	4,0	1750
10	Tegirmon	0,5	265
11	Sufibobo	3,0	426

Visual Basic software was used to calculate the water balance [19]. With this program, it is possible perform calculations at given, while previous calculations are stored in the program, we can easily find them at any time and, most importantly, it is possible to analyze and compare the distribution of water over several years. Display the results of the calculations using tables and graphs for efficient analysis, which in turn allows for quick and efficient control operations in water distribution also attainable. Based on field research in the Govasay river basin, the current linear and water balance scheme of the river basin was developed (Figure 5). As a result, based on the data of the research, a program was developed to ensure the rapid management of water resources in the Govasay river basin (Figure 6) [4].

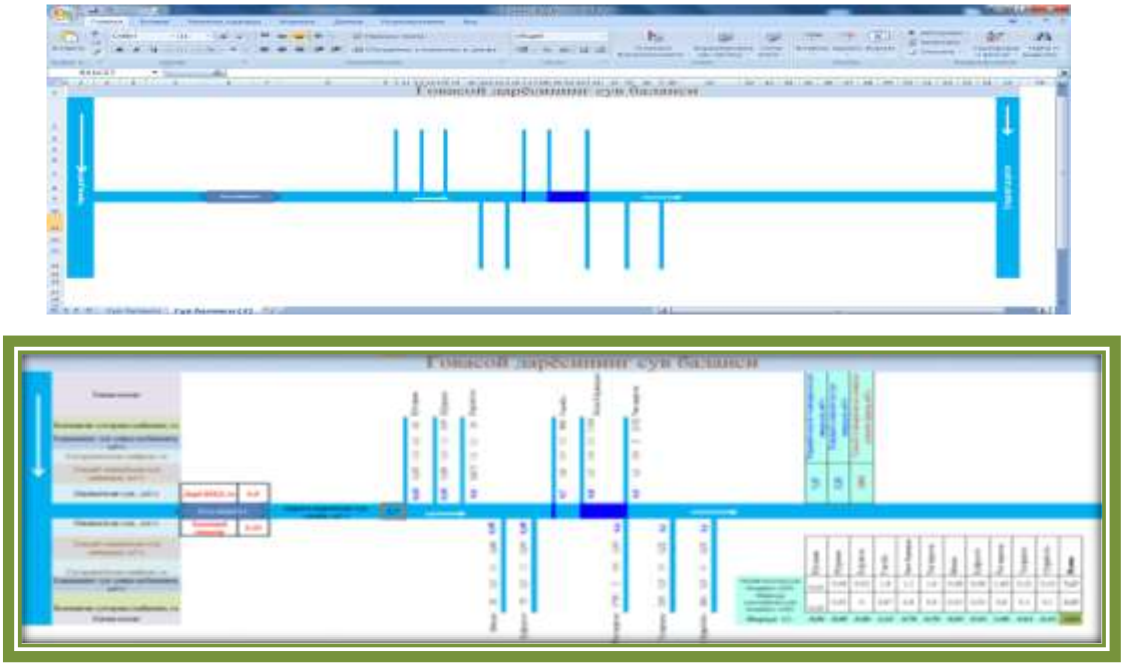

Figure 5. Linear and water balance scheme of the Govasay river basin

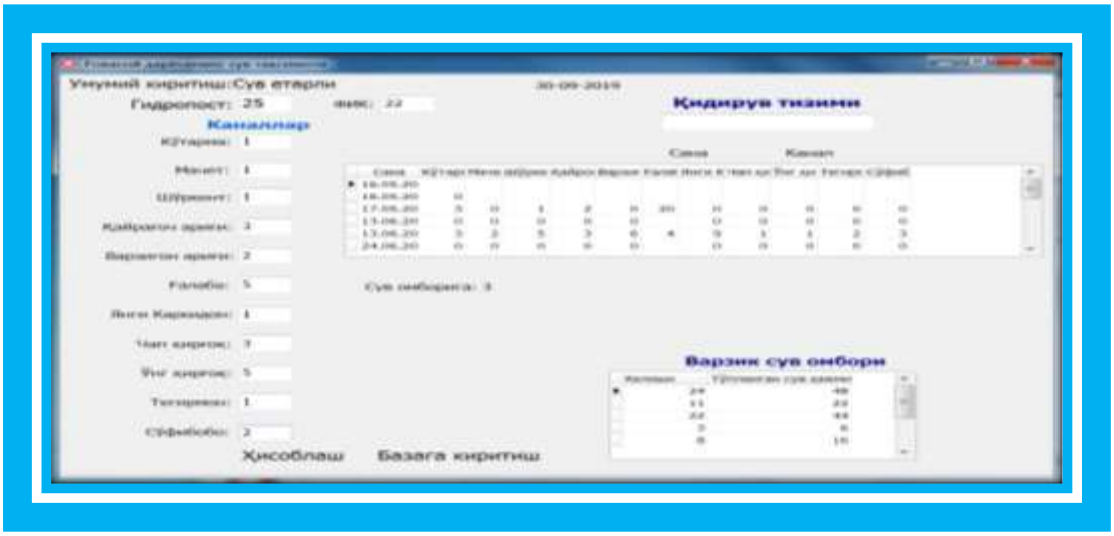

Figure 6. Program scheme for rapid management of water resources in the Gavasay river basin

The scientific and practical results of the research were accepted for use in the Department of Irrigation of Chust district of Namangan region. The developed software automatically calculates the water distribution. If there is an excess of water in the distribution, it should be directed to the Vorzik reservoir, and vice versa.

CONCLUSIONS

The results of the research and analysis of collected data show that changes in the average perennial flow of river water are insignificant, the fluctuations are increasing during the year, and the river flow is more active during floods. As a result, it was found that the volume and timing of the formation of the surface runoff of Govasay River are also changing under the influence of climate change in the region.

The current technical condition of irrigation systems in the Govasay River basin was determined through measurements and field observations. It was recommended to strengthen the canal bed with concrete coverings to ensure the efficiency of irrigation networks and uninterrupted water supply. Suggestions were also made for each water consumer to be fully equipped with water intake meters and water flow control facilities.

The technical condition of water supply canals in the Govasay river basin was assessed, a scheme of river basin irrigation networks was formed using GIS technologies, and the areas connected to them were identified. The components of the river basin water balance have been identified, and models that can ensure the efficient use of water resources have been improved, and their importance in irrigation systems has been demonstrated using GAT technologies.

The developed program will serve as a practical development in the implementation of operational management of water resources of the river basin, the organization of reliable monitoring of river flow and improving the accuracy of the calculation of water balance indicators.

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