

PROSPECTS OF TREATED WASTEWATER USAGE

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To implement comprehensive observation of drainage, wastewater treatment, and irrigation at using wastewater, it is necessary to form new managerial and organizational-structural approaches. In this regard, the proposed planning mechanism for irrigating the agricultural lands by using treated wastewater will allow to implement reliable and safe irrigation, use the limited resources of fresh water purposefully at the same time providing the farmers with the necessary supply of water rich in nutrients. The opportunities of maintaining the water treating stations will allow to maximally favor the solution of problems put forward.

Keywords: wastewater, agriculture, irrigation, planning process, development program.

Introduction. The main sources of surface water pollution are raw or not sufficiently treated domestic and industrial wastewater, atmospheric water of polluted air basins, flood water submerging agricultural land, communal wastewater of suburban villages, etc. These sources carry various pollutants causing surface water contamination, and thus giving rise to ecological disbalance. In most cases they include even such toxic substances which are difficult to reveal and their dangerous influence has not yet been studied.

The pollution of water basins in the first place negatively influences on their self-cleaning and biological balance and also on the useful microflora of the basins' biocenosis. As a result, the quantity of useful microorganisms is rapidly reduced in 1ml water. In addition, their species' composition is also changed and reduced. At that, potentially hazardous microorganisms are simultaneously developing very actively in the polluted water.

The uncontrollable use of water bodies continues to cause an irreversible change in their natural alternant order changed by different pollutants. Conservation of surface water ecological balance is an urgent problem waiting for its immediate solution. The use of treated or not sufficiently treated wastewater for irrigation purposes is a partial solution to that problem, which gives an opportunity to economically use the limited resources of fresh water, at the same time providing the supply of water with nutrients for irrigated lands. Such exchange has its positive environmental impact as it reduces the flow of grey water to natural fresh water rivers and basins and accumulation of nutritive elements contained in wastewater in the soil.

The typical content of microelements in communal wastewater is given in Table 1 [1].

Table 1

The typical content of microelements in communal wastewater

Microelement	Designation	Concentration	Type of wastewater flow		
			average density	scarce	very scarce
Nitrogen, N, g/m^3 , general	$C_{N_{gen}}$	80	50	30	20
Ammonium *	S_{NH_4}	50	30	18	12
Nitrite	S_{NO_2}	0,1	0,1	0,1	0,1
Nitrite	S_{NO_3}	0,5	0,5	0,5	0,5
organic	$S_{N_{org}}$	30	20	12	8
Phosphor, P, g/m^3 , general	$C_{P_{gen}}$	14	10	6	4
Orto- phosphor	S_{po_4}	10	7	4	3
Polyphosphor	S_{pph}	0	0	0	0
Organic	$C_{p_{org}}$	4	3	2	1

* $NH_3 + NH_4^+$

It is seen from the table that wastewater contains a certain quantity of nutritive elements necessary for the normal growth of plants.

Table 2 presents concentrations of microorganisms in communal wastewater before and after biological treatment [2].

It is obvious that after biotreatment wastewater is sufficiently clean from undesirable microelements, suspensions, etc and can be used for irrigation purposes.

Taking into account the growing scarcity of fresh water resources the use of urban wastewater for agricultural purposes can cover essential needs especially in arid and semidry climate. Despite the fact that in majority of developing countries, legal norms limiting or inhibiting the usage of raw wastewater have been adopted or are underway, the use of raw wastewater remains everyday practice.

Table 2

The change in the concentrations of microorganisms in the wastewater

Microorganisms	Concentration 100 ml in wastewater	
	Initial	After biological treatment
E. coli	10^7	10^4
C. perfringens	10^4	$3 \cdot 10^2$
Faecal streptococcus	10^7	10^4
Microorganisms	Concentration 100 ml in wastewater	
	Initial	After biological treatment
Salmonella	200	1
Campulobacter	$5 \cdot 10^4$	$5 \cdot 10^2$
Listeria	$5 \cdot 10^3$	50
Staphylococcus aureus	$5 \cdot 10^4$	$5 \cdot 10^2$
Coliphages	10^5	10^3
Giardia	10^3	20
Roundworms	10	0.1
Enterovirus	5000	500
Rotavirus	50	5
Suspended matter (mg/100 ml)	30	2

Presently, the use of wastewater enables nearing water demand in various water using spheres to the present-day supply. Certainly, the motives of wastewater use are different in developed and developing countries, but the increase of population on Earth, lack of food, global warming, and scarcity of water resources and troubling high level of environmental pollution are problems common for all countries and make the treated wastewater a valuable resource. Hence, the usage of treated wastewater solves not only environmental, but also problems of household and economic significance.

It enables to save water resources, mineral and organic fertilizers as well as to raise the land productivity.

The usage of treated wastewater for irrigation is the state policy in a number of countries (Israel, Jordan, Peru, Mexico etc.). These countries have hundreds of water

basins designed for collecting and reusing wastewater of which nearly 70% is urban wastewater [3].

If poorly purified, household and communal water doesn't meet agricultural standards and therefore doesn't provide enough safety, it would be preferable to use it for irrigation of cereals, forage and technical cultivated plants, as well as for green tree planting and lawns [4,5].

There are some regions in Republic of Armenia where water resources are scarce, therefore wastewater treatment has become imperative. It helps not only to solve some irrigation problems, but also problems of surface water purity preservation.

For instance, in several villages of Republic of Armenia – Geghanist, Khachpar, Lake Yerevan water mixture with the nearby villages domestic and communal wastewater is used for irrigation.

This water contains not only nutrients, but also large amounts of pathogens. Thus, it is forbidden to use this water to cultivate lands where potatoes, berries and pot-herb are growing. Instead of this, a large number of people have built green-houses in the yards where they use this water to cultivate roses. For citrus plants, particularly for lemon and grapefruit grafted onto lemon tree, they use comparatively pure water.

To provide a reliable water supply system and to develop agriculture in the country, the wastewater usage should be based on the determination of some main principles for the development of the drainage sphere, including irrigation of agricultural land by using wastewater. To this end, an appropriate program should be created and implemented.

Therefore, the aim of the drainage sphere development program should be designed to clarify the development directions and the main approaches for the following years (decades).

To define the main approaches, we should take into consideration:

- development and improvement of drainage services including technical equipment and staff training;
- development and improvement of secure water supply and drainage services in rural regions;
- registration of wastewater accumulation sources, introduction and development of wastewater leakage accounting system;
- development of drainage infrastructures;
- reconstruction and establishment of new structures of wastewater treatment plants;
- creation of efficient mechanisms for wastewater initial treatment;
- introduction of modern technologies in procedures of wastewater treatment;
- improvement of the drainage system management mechanisms;

- involvement of the required amount of investment to organize the proper operation of infrastructures, and future development of the sphere;
- implementation and determination of an economic mechanism to promote the investment of wastewater generation systems and procedures.

In setting up key approaches for agricultural land irrigation using wastewater, the following priorities should be taken into consideration:

- providing irrigation water of required quality and the needed quantity (including raw and treated water);
- providing reliable and stable water supply for irrigation;
- reducing the water loss in irrigation water supply systems essentially;
- applying incentive mechanisms in employing irrigation water saving state-of-art technologies.

Developing a comprehensive planning system is the most appropriate approach for establishing the base for wastewater use. The definition of realistic approaches for such a planning will make it possible to decide and clearly present the basic standards of the management system, discover problems and clarify the ways of their solution, establish the functions of bodies involved in the process. Fig.1 shows general stages of the planning process.

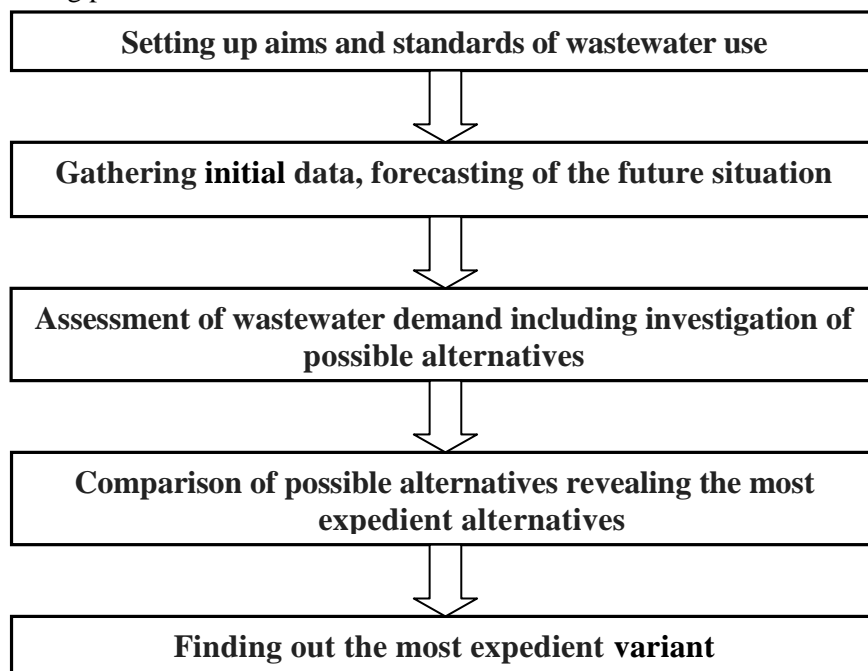


Fig. 1. The general stages of the planning process

In the first stage of planning, the initial data are gathered, the registration of potential water users is implemented, the determination of their water demand, as well as the water users' willingness to use treated wastewater and pay against the used water in accordance with statutory tariff is carried out. With regard to this, it is necessary to gather information about both the existing water use volumes and water springs, and water users who are ready to irrigate using treated wastewater and about their water needs.

Based on the above information, the following data are gathered and entered the database at each water user's level:

- the water spring which is used for irrigation at a given moment, the kinds of irrigable crops,
- the surface of the irrigable land,
- the position of the land on the map,
- the need of water in recent years (at least in the last 3 years),
- the schedule of the maximum need for irrigation water,
- the reliability of irrigation water supply,
- the willingness of irrigation using wastewater,
- the need of a local equipment installation necessary for wastewater use and the required expenses,
- the future trends of land-use, the possibility of irrigable land expansion,
- the future trends of crops change.



Fig. 2. The main directions of the analysis

The data gathered are analyzed, and the respective document processing is performed according to the presented in Fig. 2 standards of directions.

Now, on the basis of the gathered and analyzed data we can start implementation of planning by comparing possible versions and choose the most feasible one. Then the implementation stage begins which is one of the key and most responsible stages. The main elements of the planning in implementation stage are:

- development of the project;
- implementation of construction;
- treatment of wastewater,
- supply of the irrigable land by treated wastewater;
- collecting pays, securing financial stability;
- rendering the farmers' technical assistance;
- analyzing, monitoring, and evaluation;

In general, wastewater, removed through a sewage system, contains household grey water, industrial wastewater, and flood water. The wastewater from its source point to an irrigable land passes through a number of structures, in particular a sewage system, wastewater treatment plant, treated or partially treated wastewater supplying system, and then is used for irrigation of the agricultural land.

One of the most important problems of the planning process is the analysis of wastewater supply and demand and the balance analysis. At that, the instability of the wastewater flow should be taken into account, and particularly:

- the municipal wastewater quantity fluctuation during a day reaching its maximum value in the daytime and the minimum - at night,
- rain water also flows through a sewerage network and in rainy seasons the quantity of the wastewater flow is increased,
- a possible increase of the wastewater flow in the periods of active tourism,
- seasonal industrial branches also may discharge their waste to the sewerage.

The last stage of the planning process deals with establishing well-defined legal relationships and forming the necessary papers for clarifying the involved parts' functions and establishing relations among different parts.

The aim of the country drainage system development program is to make clear the direction, and key approaches for the coming years. The strategic aim of the program is to implement reliable and safe drainage, improve environmental characteristics, reduce the environment and, in particular, water resources pollution rate through organizations producing drainage, and wastewater treatment services.

Conclusions. The usage of proposed conceptual provisions and systematic approaches to wastewater for irrigation purposes will allow to increase the efficiency of functioning process of drainage systems.

The use of treated wastewater can solve a number of household, economic and environmental problems. It will enable to keep scarce water resources as clean and save as possible.

To implement comprehensive observation of drainage, wastewater treatment, and irrigation when wastewater is used, it is necessary to create new managerial and organizational-structural approaches. In this regard, the proposed planning mechanism for the agricultural land irrigation using treated wastewater will enable to implement reliable and safe irrigation, to use the limited resources of fresh water purposefully at the same time providing the farmers with the necessary water resources rich in nutrients.

Exploitation of water treating stations will create great opportunities for solving the arisen problems.

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Received on 19.11.2014.

Accepted for publication on 23.12.2014.

ՄԱՔՐՎԱԾ ԿԵՂՏԱԶՐԵՐԻ ՕԳՏԱԳՈՐԾՄԱՆ ՀԵՌԱՆԿԱՐՆԵՐԸ

Գ.Շ. Հովսեփյան

Ջրահեռացման, կեղտաջրերի մաքրման և ոռոգման նպատակով կեղտաջրերի օգտագործման ոլորտներում առկա խնդիրների համապարփակ դիտարկման նպատակով անհրաժեշտ է ձևավորել կառավարման և կազմակերպչական-կառուցվածքային նոր մոտեցումներ: Այս առումով գյուղատնտեսական հողատարածքների՝ մաքրված կեղտաջրերով ոռոգման գործընթացի պլանավորման առաջարկված մեխանիզմը թույլ կտա իրականացնել հուսալի և անվտանգ ոռոգում, նպատակային օգտագործել քաղցրահամ ջրի սահմանափակ պաշարը՝ միաժամանակ ապահովելով հողագործներին անհրաժեշտ սննդարար նյութերով հարուստ ջրի մատակարարումը: Մաքրման կայանների գործարկման հնարավորությունները թույլ կտան առավելագույնս նպաստել առաջադրված խնդիրների լուծմանը:

Առանցքային բաներ. կեղտաջրեր, գյուղատնտեսություն, ոռոգում, պլանավորման գործընթաց, զարգացման ծրագիր:

ПЕРСПЕКТИВЫ ИСПОЛЬЗОВАНИЯ ОЧИЩЕННЫХ СТОЧНЫХ ВОД

Г.Ш. Овсепян

С целью полноценного обзора существующих проблем в сферах водоотведения, очистки сточных вод и их использования для орошения необходимо формирование новых управленческих и организационно-структурных подходов. В этом аспекте предлагаемый механизм для процесса орошения сельскохозяйственных земель сточными водами позволит реализовать надежное и безопасное орошение, целевое использование ограниченных ресурсов пресной воды, обеспечивая при этом фермеров водоснабжением с богатыми питательными веществами. Возможности эксплуатации станций очистки позволят максимально способствовать решению выдвинутых проблем.

Ключевые слова: сточные воды, сельское хозяйство, ирригация, процесс планирования, программа развития.