

SITUATION AND DEVELOPMENT OF IRRIGATION IN REPUBLIC MACEDONIA

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INTRODUCTION

Current situation, development and prosperity of whole economy in underdeveloped country, is connected with development of water management. There is almost none branch of economy which is not connected with water management. According to this, water is basic factor of whole living world and represent connection between all economy branches. Because of this, we can see that total development of water management is compatible with the whole development of the country.

The science and the field profession established the generally known rule, that underdeveloped water management means backward development of all other economy branches and standard living of all citizens. World literature from the field of water and many specialized organization, warning that we will have long lasting crises for drinking water and irrigation water as a result of all civilization activities and global climatic changes.

According to previous, Government of R. Macedonia brought decree, to obtain National strategy for economy development made by different institutions and organization, which also will include water management, which we will represent in the following text.

THE SITUATION AND PERSPECTIVE ON IRRIGATION IN REPUBLIC OF MACEDONIA

Geographic location and climatic conditions in RM, enable higher and more quality agricultural production. Water is usually limiting factor. Appearance of dry period with a different intensity is common, even in years with floods. In average of 20 years, 10 years are

with more expressed dry period, 9 years are average, and 1 year is with appearance of floods. With global warming, risk for appearance of dry period is increasing, but water for any purpose became even more important (significant). Increased warming and climate changes are not taken very seriously. After 60 years registration of meteorological elements, for the first time whole different hydrological cycles appeared. In year 2002, we have appearance of floods, at the end of summer and beginning of autumn, and then arise dry winter and spring (in all regions, except in Pelagonia).

For climatic conditions in RM, irrigation always had great importance. Some crops regard as identical with irrigation period (vegetable crops, rise), but another group of crops (cereals, orchard, vineyard) can survive more or less without irrigation depending on climatic conditions, but yields decreased proportionally with deficit of water or draught intensity. Especially negative effects appeared at perennial plants.

Importance of irrigation for crops which can survive without irrigation (depending only on precipitation and agro technical measurement), can be underlined in several examples: autumn cereals, untypical for irrigation, only with intervention watering in April and May, have doubled their yield. Corn as typical crop for irrigation without this measurement is unprofitable and gave under 2 t/ha, but with irrigation yields increases for about 400-500%, sugar beat 200-300%, Alfa Alfa 300-400% and orchard 200-300% etc.

Natural income of moisture for many years average precipitation (40 years), depending of region, move from 366 to 1044 mm, in producing region from 366-600 mm. During vegetation period income of precipitation is 200-250 mm with using coefficient $k=0,3-0,7$, average

Rad saopšten na skupu "Navodnjavanje - izazov za investitore".

$k=0,5$. From here we can see that income is 50-150 mm. ET for typical crops for irrigation, calculated with widely excepted methods and with direct methods, is 600-800mm, from here we can see that average deficit is around 650mm. This is reason for large restrictions of yields in conditions without irrigation.

Because that kind of climate conditions, R.Macedonia before 50 years started with constructions of hydro ameliorative systems (HMS), mostly for irrigation but also for water supply and electricity production.

Constructions of HMS were carrying out in 3 periods: until 1958 year, until 1958 to 1985 year and after 1975 year. First period is characteristically with building of HMS on small areas and only with application of surface irrigation, in second period were constructed the large number of HMS represented with 60% sprinklers irrigation technique and in the third period carry on tendency like in second period, but with more sophisticated technique.

During this period were constructed 19 high dams (large accumulations) and over 100 micro accumulations. From total cultivated area (around 670.000 ha) HMS are build upon 25%, or in other words on 163.693 ha on which with sprinklers are irrigated around 100.000 ha or 61%, and other with furrows, from which around 5000 ha with flooding

(Rise) and 1000 ha irrigated with drip irrigation (vegetable, orchard, and vineyard). The systems which are building with detailed network occupy 124.000-126.000 ha.

EXPLOITATION OF HMS

Exploitation on HMS in the past period vary from system to system and from year to year, depending on climatic conditions, hydrological situation, accessible irrigation equipment, crop structure, market conditions and etc.

In accordance with HMS organizations total exploitation is:

Year	Possible area for irrigation (ha)	Plan (ha)	Irrigated area (ha)	3:2 (%)	4:2 (%)	4:3 (%)
1	2	3	4	5	6	7
1987	122 259	110 109	82 582	90.0	67.5	75.0
1988	122 259	99 807	76 937	81.6	62.9	77.0
1989	123 159	96 605	66 860	78.4	54.3	69.2

1990	123 159	93 320	77 790	75.8	63.2	83.4
1991	123 159	85 599	63 716	69.5	51.7	74.4
1992	124 310	81 275	70 050	65.4	56.3	86.2
1993	124 310	69 088	45 231	55.6	36.4	65.5
1994	125 980	73 610	53 939	58.4	42.8	73.3
1995	126 617	70 406	39 163	55.6	30.9	55.6
1996	124 250	73 069	45 465	58.8	36.6	62.2
1997	124 250	69 946	50 692	56.3	40.8	72.4
1998	124 250	87 812	44 520	46.5	35.8	77.0
1999	124 250	56 674	34 696	45.6	27.4	61.2
2000	124 250	57 823	42 248	46.5	34.0	73.0

From presented data we can see that:

- The planning area for irrigation in relation with area which can be irrigated vary from 90% in 1987 year to 46,5% in year 2000;
- The irrigated area in relation with area which can be irrigated vary from 67,5% to 34,0%;
- The irrigated area in relation with planning area varies from 77,0% to 55,6%.

THE PROBLEMS IN EXPLOITATION OF HMS

The problems with exploitation of HMS can be analyzed from three aspects: hydro technical, agro technical, economic and law aspect.

From hydro technical aspect can be presented the following basic problems:

- Providing water by project and crops structure;
- Technical potential of basic objects and detailed network to accumulate and distribute the necessary amount of water;
- Possibility of irrigation equipment to take water from the system, scheduling by surface and to transform it in soil moisture.

As special problem in exploitation or in other words degree of exploitation underline the loss of water from opened channel network, except in HMS "Strezevo" where the main and detailed network are closed.

Agro technical problems are also numerous, but we will present only leading one:

- The areas in HMS are split to large number of small parcels, as a result of this the irrigation is ineffective, the irrigation equipment is with low degree of exploitation, huge areas are surround with borders, the exploitation of mechanization equipment is ineffective, distribution of water

between parcels is limited and it is very hard to irrigate numerous parcels with different crop structure. This problem without redistribution of land or without grouping of areas will have negative consequences in exploitation of HMS.

Economical and law problems:

- The legal status on HMS in spite of brought Law for water, it is not yet define, from which originate many problems in technical maintained of hydro technical objects and equipment, and also functioning of HMS. In this case is also included financial situation of public organizations and water users. With suggestions for changes of Law for water this problem should be solved.

PERSPECTIVE ON IRRIGATION IN REPUBLIC OF MACEDONIA

According to experts of FAO, from long ago was pointed to fact, that the problem with food for all people in the world, beside another measurements (genetic, selection, mechanization and plant protection) irrigation became more and more important. Long ago was established, that only on 17% of cultivated area is used for crop production of food. Possibilities are significantly bigger. The same sources (FAO) claimed that, with optimal total conditions, present total production can be produced only on 10% of cultivated area. Water pollution, human needs for drinking water for survival, global warming, or in other words higher consumption of water for all living creatures and for all other purposes, because of all this, water is more and more significant.

The climatic conditions in RM forced Government to search for opinions from scientific organizations and experts to prepare national strategy for economical development, where among other, development of water management and water resources are also included.

PLANNING AREA FOR IRRIGATION AND AMOUNT OF WATER REQUIREMENT

Planning area for irrigation is based on suitable areas for this purpose, climatic conditions, soil and water resources.

According to national strategy for development of water management and water resources, development of irrigation by periods is following:

Period	Area (ha)	Amount of water $m^3 \times 10^6$
Present	126 617 (19%)	900x10 ⁶
2020 god.	266 327 (39%)	1990x10 ⁶
After 2025 god.	369 910 (55%)	2610x10 ⁶
Total	400 000 (59%)	2810x10 ⁶

Based on 40 years average flow on main river basin (99%), available water is:

River basin	Average $m^3 \times 10^6$	Middle dry period $m^3 \times 10^6$
Vardar	4771	3340
Crn Drim	1681	1344
Strumica	177	106
	6629	4790

How many of this water flow satisfied needs for all purposes we can see from the following data:

Total needs of water (2025 year)

Population	590x10 ⁶
Industry	843x10 ⁶
Agriculture	2610x10 ⁶
Biological minimum	653x10 ⁶
Total	4696

Global overview, needs of water in average dry years will be satisfied, but on the border of total exploitation.

First, that means, that RM is not rich with water resources. Second also very important, the water resources are unequally distributed by river basin and by area in the same river basin. In Strumica river basin even now we have deficit. In Vardar river basin the needs will be satisfied, but it is necessary to invest in constructions of systems and equally distribution by area. In Crn Drim river basin the balance is positive.

One of the ways for general solution for deficit in river basin or area with deficit of water is to transfer water from one to another river basin. Those investments are expensive, but in the future they will be necessary. That kind of transfer from Crn Drim to Vardar river basin we have even now.

WATER AND ENVIRONMENTAL PROTECTION

Measurements which are taken in order to protect the environment will become more and more important. We will mention here only erosion and water quality.

In R. of Macedonia, over 90% of area is overcome with erosion of some category (I and II category over 16%). This has great significance for protection of environment, creation of whole organic matter, organic matter circulation and food production.

As time pass protection of water quality will become even more important. In the future this parameter probably will be basic condition for survival and better quality of life.

From this aspect, in RM water quality could be observed on two different levels. The water in main water current is exposed to attack of industrial and communal water, and commonly has quality of II and III class (mainly for recreation and irrigation).

It is convenient that most of the large accumulations are located above level of polluters. In this way water can be used for irrigation, but also with some preparations can be brought to I class and can be used for drinking and in industry of food production.

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