IRRIGATION – aspiration or necessity

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Abstract

Until 2003 there were 9 275 ha under irrigation, which represents 0.86% of arable lands in Croatia. Irrigation systems were unorganized and conducted without plans with undefined rights and obligations of the participants. Surfaces under irrigation were small and the consequences of drought were measured in millions. Croatian government in 2005 has accepted the National Project of Irrigation and Land and Water Management in the Republic of Croatia. Main goal of the project is to increase surfaces under irrigation to 65 000 ha until 2020, which represents 6% of arable lands in Croatia. It would take planed approach to achieve this plan, and is possible thru building of infrastructure and with enlargement of production surfaces of the farmers. Until 2012 irrigated surfaces were increased up to 12 000 which is less then planed.

Keywords: irrigation, NAPNAV, drought

1. Introduction

Number of people included in agricultural production as main economic activity is much larger than other productions. In total world water consumption agricultural production participates with the highest 70% compare to industry (25%) and households (8%).

Main task of agricultural production is to secure enough food and raw materials for humanity which indicates to importance of correct use and application of all factors in agricultural production. Main factors in plant production are water, light, temperature and soil, and in this paper water or water deficit will be presented.

Main source of available water in soil are precipitations – rain. Annual distribution of precipitation mostly does not correspond to the needs of the plants. For the analysis of weather conditions it is better to analyze amount of precipitation and temperatures in vegetation season which is used in this paper. Insufficient amount of precipitation and increase of air temperatures leads to higher water demand in plant.

Irrigation is agricultural measure which in artificial way gives water to the plant. From totally 1.5 million ha of planted surfaces in world, 250 million are irrigated which represents 18% of arable lands in world. Almost 40% of food has been produced on irrigated surfaces.

2. Irrigation in Republic of Croatia

In Europe 13% of arable lands are irrigated. In our surroundings – Italy, Greek, Bulgaria, Romania are irrigating 20% to 30% and Hungary 5% of arable lands. Unfortunately, Croatia is at the bottom of the list regarding the surfaces under irrigation. Until 2003 [1] there were 9 275 ha under irrigation (1 077 403 ha), which represents 0.86% of arable lands in Croatia and 0.30% of agricultural lands.

General condition regarding the irrigation in Croatia could be evaluated as poor. There are few reason for this condition; irrigation system are unorganized, rights and obligations of participants in system were undefined, plans for progress were undefined, problems with the land owners, destruction of large agricultural producers, importance of irrigation; the end user or farmer was not included in management of irrigation and small production surfaces (Table 1).

Table 1. Average number and size of production surfaces in Croatia

|  |  |  |  |
| --- | --- | --- | --- |
|  | ha/household | Number osurfaces/household | Averagesurfaces(ha) |
| Croatia | 1.9 | 4.3 | 0.45 |

Small production surfaces are large financial and organization problem for economically organization of irrigation system.

In Republic of Croatia there are 3 187 494 ha of agricultural land with structure as follows: 2 043 767 ha in private properties which represents 46%, and 1 143 727 ha of state properties which represents 36% [2]. Large portion of private owners indicates to better need for financial support and organization of system for end users. Are conditions in Croatia much more favorable for irrigation than the one who are used?

Natural resources that are suitable for irrigation in Croatia are fertile soils and quality available water for irrigation. Amount of natural water resources (rivers, accumulations, wells, lakes) and the quality of water potential in Croatia could satisfy bigger consumption for irrigation than the one who exist. According to water potential, Croatia occupies 42nd place in World.

It is necessarily to construct artificially resource like canals and accumulations for irrigation water were there are no natural resources and the soil are suitable.

3. Necessity for irrigation

In average climate conditions in Croatia, yield reduction dry farming area is 10% to 60%, and up to 90% in dry vegetation seasons, depending on soil, culture and region [1].

Table 1. Analysis of dry, average, extreme wet years by Hydrothermal coefficient by Seljaninov

|  |
| --- |
| Hydrothermal coefficientby Seljaninov |
| Years | Osijek | Sl. Brod |
| 1973 |  |  |
| 1974 |  |  |
| 1975 |  |  |
| 1976 |  |  |
| 1977 |  |  |
| 1978 |  |  |
| 1979 |  |  |
| 1980 |  |  |
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| 1982 |  |  |
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| 1984 |  |  |
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| 2006 |  |  |
| 2007 |  |  |
| 2008 |  |  |
| 2009 |  |  |
| 2010 |  |  |
| 2011 |  |  |

|  |  |
| --- | --- |
|  |  Extreme wet years |
|  | Average years |
|  | Dry years |
|  | Extreme dry years |

There are many advantages in irrigation use: high and stable yields in years with average weather conditions but plant production in dry years as well.

Negative outcome of water deficit is reduced and man can achieve higher yield per area unit. In favorable conditions in soil the effectives of mineral fertilizers is better.

If we take in account all of the advantages of irrigation it could be said that every farmer and producer wish to irrigate. But, beside the desire it is necessarily to take in account all of the scientific criteria in order to apply irrigation in plant production.

A main criterion who determines is it necessarily to irrigate or not, is plants demand for water and amount of available water.

Analysis of weather and climate conditions in vegetation season is taken by Hydrothermal Coefficient by Seljaninov (HTC). Air temperatures and rainfall have been analyzed for vegetation season in Osijek and Slavonski Brod area. Period of research is 39 years, from 1973 to 2011, (Table 2). Result of analysis had shown 14 dry years in Osijek area and 6 dry years in Slavonski Brod area. From 1994 to 2011 (last 18 years) every 6thyear was dry in Osijek area and every 3th year in Slavonski Brod area. In same period every 8th year was extremely wet in Osijek and Slavonski Brod area. Dry and wet years and vegetation seasons are implying to weather oscillation.

Advice from professional’s agronomist is to make an analysis of weather conditions for period from 20 to 30 years.

According to Šoštarić [2] in decade from 1882 to 1993 every 6th to 10 year was dry.

*Figure 1.* Rainfall (mm) and trend in temperature decreasing in Osijek area 1993-2011

Amount of rainfall and trend in rainfall reduction in Osijek area for period from 1993 to 2011 is presented in Figure 1.

Average air temperatures (oC) in period from 1993 to 2011 for Osijek area and trend in air temperatures increasing is presented in Figure 2.

Figure 2. Average air temperatures (oC) and trend in temperature inceasing in Osijek 1993-2011

Amount of rainfall and trend in rainfall reduction in Slavonski Brod area for period from 1993 to 2011 is presented in Figure 3.

Figure 3. Rainfall (mm) and trend in rainfall decreasing in Slavonski Brod area 1993-2011

Average air temperatures (oC) in period from 1993 to 2011 for Slavonski Brod area and trend in air temperatures increasing is presented in Figure 4.

This transition of dry and wet years and vegetation seasons indicates to importance of management agricultural lands from excessive water (drainage) and dealing with water deficit (irrigation).

Figure 4. Average air temperatures (oC) and trend in temperature increasing in Slavonski Brod 1993-2011

4. National Project of Irrigation and Land and Water Management in the Republic of Croatia (NAPNAV)

Only two dry years (2000 and 2003) have resulted with damage from drought up to 3.4 billion of Croatian Kuna. That was the reason for the experts who are dealing with irrigation and agricultural amelioration to draw attention to this problem and offer their help to the government in form of long-term plan for irrigation in Republic of Croatia.

Government of Croatian Republic has accepted National Project of Irrigation and Land and Water Management in the Republic of Croatia (NAPNAV) in year 2005. Plan came as result of work 42 experts and 2 international consultants.

Main goal of National Project of Irrigation and Land and Water Management in the Republic of Croatia (NAPNAV) was to make conditions for better usage and exploitation of agricultural lands and to increase surfaces under irrigation.

Main task of the National Project of Irrigation and Land and Water Management in the Republic of Croatia (NAPNAV) to increase surfaces under irrigation from 9 264 ha from 2003 (0.86% of arable lands) to 65 000 ha (6% of arable lands) until the end of year 2020.

Main goal of National Project of Irrigation and Land and Water Management in the Republic of Croatia (NAPNAV) is:

- to analyze and define the potentials for irrigation;

- to define rights and obligations of all participants in system;

- to be able to see expected results from irrigation from economic and social view;

- to ensure infrastructure for irrigation;

- to make adjustment in law applying (water rights, land rights).

In realization of National Project of Irrigation and Land and Water Management in the Republic of Croatia (NAPNAV) very important role have Counties. Plans for irrigation as main document are made at County level. Main criteria’s for project are:

- soils suitable for irrigation;

- amount of water;

- prepared project documentation;

- system effectiveness.

To be able to approach to irrigation some of the factors like drainage of excessive water from the surface must be done. Excessive amount of water refers to the water from wet time of year – late spring and early autumn, whit the open canals.

The plan is to clean and maintain 22 000 km of canals.

Most of the drainage system has been constructed 30 years ago with financial support of Yugoslavian government. Canals were mainly located at surfaces of former corporations.

Financing and maintaining of canals and drainage infrastructure was poor so most of the canals are damaged.

It is necessarily to make infrastructure to brought water to end users. Implementation of large project such as this demands large quantities of financial and expert support. Realization of project (NAPNAV) takes 3 billion of Croatian Kuna from state budget and 1.4 billion from end users.

Financial support for project comes from:

- state budget Republic of Croatia;

- international institutions;

- regional and local authorities;

- end users (farmers and producers).

When Croatia becomes one of the members of European Union it would be possible to take a financial support from EU funds.

At the beginning there are some problems of financial and bureaucratic nature. Lott of time could be spend to gain all necessarily documents and license. Unresolved owner issues could be great problem for end users. Also, the economical crisis had negative influence to project financing.

There is some indirect benefit of the NAPNAV:

- development of rural area;

- increasing of farmers and producers income;

- more workplaces.

**5. Conclusions**

Although there are several naturals factors (fertile soils, clean and fresh water for irrigation) suitable for irrigation, only 0.86% of arable lands have been irrigated in Croatia. It is planned to increase surfaces under irrigation by implement National Project of Irrigation and Land and Water Management in the Republic of Croatia (NAPNAV). Analysis of weather condition in Osijek and Slavonski Brod area (1973 to 2011) shown increase in appearing of dry and extremely dry year. During dry and extremely dry vegetation season plant has higher demands for water and irrigation becomes justify agricultural measure. It was plan to irrigate 45 000 ha up to 2012 but there is only 12 000 ha which is significantly lower. Irrigation with all of his benefits is often forgotten with first drops of rain.

6. References

[1] Josipović M., Plavšić H., Šoštarić J., Madjar S., Marković M. (2009): Učinkovitost i iskustva navodnjavanja na poljoprivrednim površinama, Zadar 2009.

 [2] Vujčić D., Fred Van Antwerpen, Ramić Senk (2006):Analiza upravljanja poljoprivrednim zemljištem u Republici Hrvatskoj te preporuku za daljnju decentralizaciju. USAID/CROATIA. The Urban institute, Zagreb 2006.ISBN 978-953-7322-13-7).

 [3] Romić D., Marušić J. (2006): Nacionalni projekt navodnjavanja, gospodarenja poljoprivrednim zemljištem i vodama u RH. Zbornik radova, 41 Hrvatski i 1. Međunarodni simpozij agronoma. Opatija 2006.

[4] Šoštarić Jasna: Suša u poljoprivredi i potrebe za navodnjavanjem u istočnoj Hrvatskoj. Disertacija, Poljoprivredni fakultet Osijek, Sveučilište J. J. Strossmayera u Osijeku 1996.