Co-funded by the
Erasmus+ Programme
of the European Union

# Investments in Irrigation Infrastructure

## Water Saving Requirements.

## Determining Potential Water Savings due to investments

Assoc. Prof. Petar Filkov
University of Architecture, Civil Engineering and Geodesy - Sofia

Sofia winter School 29 November – 10 December 2021
Date: 30 November – Lecture 5.

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

# 1. Investments in Irrigation Infrastructure

- Investments in irrigation infrastructure have multiple goals, depending on the level of the investments:
  - Farm Level
    - ✓ To decrease the labour use
    - ✓ To increase the water use efficiency (to decrease losses)
    - ✓ To increase and/or to make the yields sustainable
    - ✓ To improve the energy efficiency
  - Water User Association Level (Irrigation Field Level)
    - ✓ To increase the water use efficiency (to decrease losses)
    - ✓ To improve the energy efficiency
    - ✓ To decrease the water price

# 1. Investments in Irrigation Infrastructure

- Investments in irrigation infrastructure - goals:
  - ➢ Irrigation System Level
    - ✓ To increase the water use efficiency (to decrease losses)
    - ✓ To improve the energy efficiency
    - ✓ To facilitate the IS management
    - ✓ To improve the service quality (delivery of irrigation water)
    - ✓ To decrease the water price
- The investments in irrigation infrastructure in Bulgaria are supported mainly by *European Agricultural Fund for Rural Development*
  - ➢ There are also several other EU funds
    - ✓ e.g. Programme for Vines and Grapes

# 1. Investments in Irrigation Infrastructure

- The *Rural Development Programme* of EU developed requirements for support of the investments in irrigation
  - ➢ The requirements for the period 2014-2021 are described in the document

*Regulation (EU) No 1305/2013 of the European Parliament and of the Council of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005*

  - ➢ The Article 46 is dedicated to requirements in irrigation infrastructure

Co-funded by the
Erasmus+ Programme
of the European Union

# 2. Requirements of EU

- According to Article 46 – Investments in irrigation
  - ➢ The investments are eligible for funding, if the following requirements are fulfilled
    1. **A River Basin Management Plan** for the entire area in which the investment is to take place **is approved**
       a. The River Basin Management Plan is required by the Water Framework Directive of EU
       b. The measures under the River Basin Management Plan related to the agricultural sector have to be already specified.
    2. **Water metering** enabling measurement of water use at the level of the supported investment **has be in place** or **has to be put in place as part of the investment**

# 2. Requirements of EU

- According to Article 46 – Investments in irrigation

3. The investment for improvement of an existing IS, part of IS or irrigation installation (i.e. the investment, which *does not lead to net increase of irrigated area*) is eligible only if it offers **potential water savings (PWS)** of a minimum of between 5% and 25%, according to the technical parameters of the existing infrastructure.
4. If the investment affects bodies of ground- or surface water whose status has been identified as less than good for reasons related to water quantity:
   a. the investment has to ensure an **effective reduction in water use** of at least **50%** of the **PWS**, estimated at the level of the investment;
   b. in the case of an investment in a single farm, it has to result in a reduction to the farm's total water use amounting to at least **50%** of the **PWS**

# 2. Requirements of EU

- According to Article 46 – Investments in irrigation

5. None of the conditions in paragraph 4 shall apply to an investment in an existing installation which:
   a. affects only energy efficiency or
   b. is for creation of a reservoir or
   c. is for use of recycled water, which does not affect a body of ground or surface water.
6. An investment resulting in a *net increase of the irrigated area* affecting a given body of ground or surface water *is eligible only if*:
   a. the status of the water body is not *less than good* for *reasons related to water quantity*; and
   b. an environmental analysis shows that there will be no significant negative environmental impact from the investment

# 2. Requirements of EU

- According to Article 46 – Investments in irrigation

7. Areas which are not irrigated but in which an irrigation has been done in the recent past, may be considered as irrigated areas for the purpose of determining the net increase of the irrigated area.
8. The investments resulting in a *net increase of the irrigated area*, according to paragraph 6, may still be eligible if:
   a. they are combined with an investment in an existing irrigation installation or element of irrigation infrastructure, which offers **PWS** of a minimum **5% to 25%,** according to the technical parameters of the existing infrastructure and
   b. the investment ensures an ***effective reduction in water*** use, at the level of the investment, amounting to at least **50%** of the **PWS** made possible by the investment in the existing irrigation infrastructure.

Co-funded by the
Erasmus+ Programme
of the European Union

# 2. Requirements of EU

- According to Article 46 – Investments in irrigation

  9. As an exception in case of a *net increase of irrigated area*, the investments are eligible if a new irrigation installation is provided and it is *supplied* with water *from an existing reservoir*, and if the following conditions are met:

     a. the reservoir is identified in the River Basin Management Plan and is subject to the control requirements set out in the Water Framework Directive;

     b. there is in force either a maximum limit on total abstractions from the reservoir or a minimum required water discharge downstream of the reservoir;

     c. the investment in question does not result in abstractions beyond the maximum limit or result in a reduction of the water discharge downstream of the reservoir

Co-funded by the
Erasmus+ Programme
of the European Union

# 3. Potential Water Savings

- Potential Water Savings (*PWS*), according to Article 46:

$$PWS = U_{old} - U_{new}$$

  - The difference between the water use before the investment is made – $U_{old}$ and the water use after the investment – $U_{new}$.
  - $U_{old}$ is the average current water use, in case of bad or not satisfactory technical status of the IS or the irrigation equipment
  - $U_{new}$ is the anticipated (or expected) average water use in the future, decreased, due to investments and improved technical status of the IS or the irrigation equipment

- Relative Potential Water Savings (*RPWS*) can be defined as:

$$RPWS = \frac{U_{old} - U_{new}}{U_{old}}$$

# 3. Potential Water Savings

- PWS have to be estimated on the same basis, i.e. at *the same net water use* before and after the investments are made.
  - ➢ The net water use is: $U_{net} = F.M_{net}$, m$^3$,

  where $F$ is the irrigation system area, ha

  $M_{net}$ is the net irrigation requirement, estimated on the basis of the entire IS area, m$^3$/ha.
- The gross water use before the investment is made is:

$$U_{gross}^{old} = \frac{FM_{net}}{\eta_{IS}^{old}}$$

  - ➢ where $\eta_{IS}^{old}$ is the overall IS efficiency before the investment.
- The gross water use after the investment will be:

$$U_{gross}^{new} = \frac{FM_{net}}{\eta_{IS}^{new}}$$

# 3. Potential Water Savings

- If it is assumed:
  - The net irrigation requirement $M_{net}$ will be the same before and after the investment, and
  - The IS area $F$ will be the same,
- The following short formula for estimation of $PWS$ is present:

$$PWS = U_{gross}^{old} - U_{gross}^{new} = \frac{FM_{net}}{\eta_{IS}^{old}} - \frac{FM_{net}}{\eta_{IS}^{new}} = FM_{net}\left(\frac{\eta_{IS}^{new} - \eta_{IS}^{old}}{\eta_{IS}^{old}\eta_{IS}^{new}}\right)$$

- The formula for direct estimation of the $RPWS$ is:

$$RPWS = \frac{U_{gross}^{old} - U_{gross}^{new}}{U_{gross}^{old}} = \frac{FM_{net}\left(\frac{\eta_{IS}^{new} - \eta_{IS}^{old}}{\eta_{IS}^{old}\eta_{IS}^{new}}\right)}{\frac{FM_{net}}{\eta_{IS}^{old}}} = \frac{\eta_{IS}^{new} - \eta_{IS}^{old}}{\eta_{IS}^{new}}$$

Co-funded by the Erasmus+ Programme of the European Union

# 3. Potential Water Savings

- Considering the short formula for *RPWS*, if the old and new efficiencies of the IS are known, on can quickly estimate expected *RPWS* and can see if the eligibility requirement is met.
- To estimate *RPWS*:
  - ➢ The current efficiency of the IS $\eta_{IS}^{old}$ has to be determined
  - ➢ The new efficiency of the IS $\eta_{IS}^{new}$ has to be obtained
    - ✓ The value of the new efficiency $\eta_{IS}^{new}$ depends on the measures taken during the process of improvement of the IS infrastructure
  - ➢ The investments may be used for improvement of:
    - ✓ the **technical status** of the IS (i.e. to decrease the technical losses)
    - ✓ the **operational capabilities** of the IS (i.e. to decrease the operational losses)
    - ✓ both **technical status** and **operational capabilities**

Co-funded by the
Erasmus+ Programme
of the European Union

# 3. Potential Water Savings

- The *PWS* are estimated *before the investments* are made
  - ➢ Thus, *PWS* show *anticipated*, or *planned*, or *theoretical* water savings due to investments
- The actual water savings (*AWS*) are determined *after the investments* are made
  - ➢ *AWS* have to be determined on the *basis of actual measurements* done by means of the water measurement structures and devices – existing or installed as part of the investment
    - ✓Obviously, the *AWS* have to be determined as average value for several years of operation of IS after the investments
      - – This is due to the fact that years differ – some are wet, with small irrigation requirements, some are dry, with high irrigation requirements
    - ✓The comparison between *PWS* and *AWS* has to be on the same basis, i.e. it has to be *based on the same average net irrigation requirement*

# 3. Potential Water Savings

- The ***effective reduction of water use***, mentioned in Article 46, is the same as the actual water savings ($AWS$) :

$$AWS = U_{gross}^{old} - U_{gross}^{new,actual}$$

where $U_{gross}^{new,actual}$ is the actual gross water use after the investments.

- It is possible and it is natural to have $AWS$ less than $PWS$.
  - Possible reasons:
    - ✓ Overestimation of the effect of the rehabilitation works
    - ✓ Overestimation of the effect of the implemented new automation or new method for water distribution
- That is why the requirement is to have at least $AWS = 50\% PWS$
  - In case of water body with status less than good, related to quantity
  - In case of increase of the irrigated area.

# 3. Potential Water Savings

- The ***level of the investment***
  - When PWS or efficiencies are estimated it is essential to specify *at which point* of the IS this is done
  - The main idea behind the requirements of Article 46 is to assure that EU funded investments lead to water savings, i.e. lead to decrease of the abstraction from water bodies.
- The ***level of the investment*** should mean that part of the IS which benefits from the investments
  - ***Benefit*** means that the water losses are decreased in that part of the IS (thus, the water use is decreased in that part of IS)

*Example:* One cannot expect that the decrease of the water use in a single farm will have an effect of reduction between 5% and 25% of the water use in entire IS.

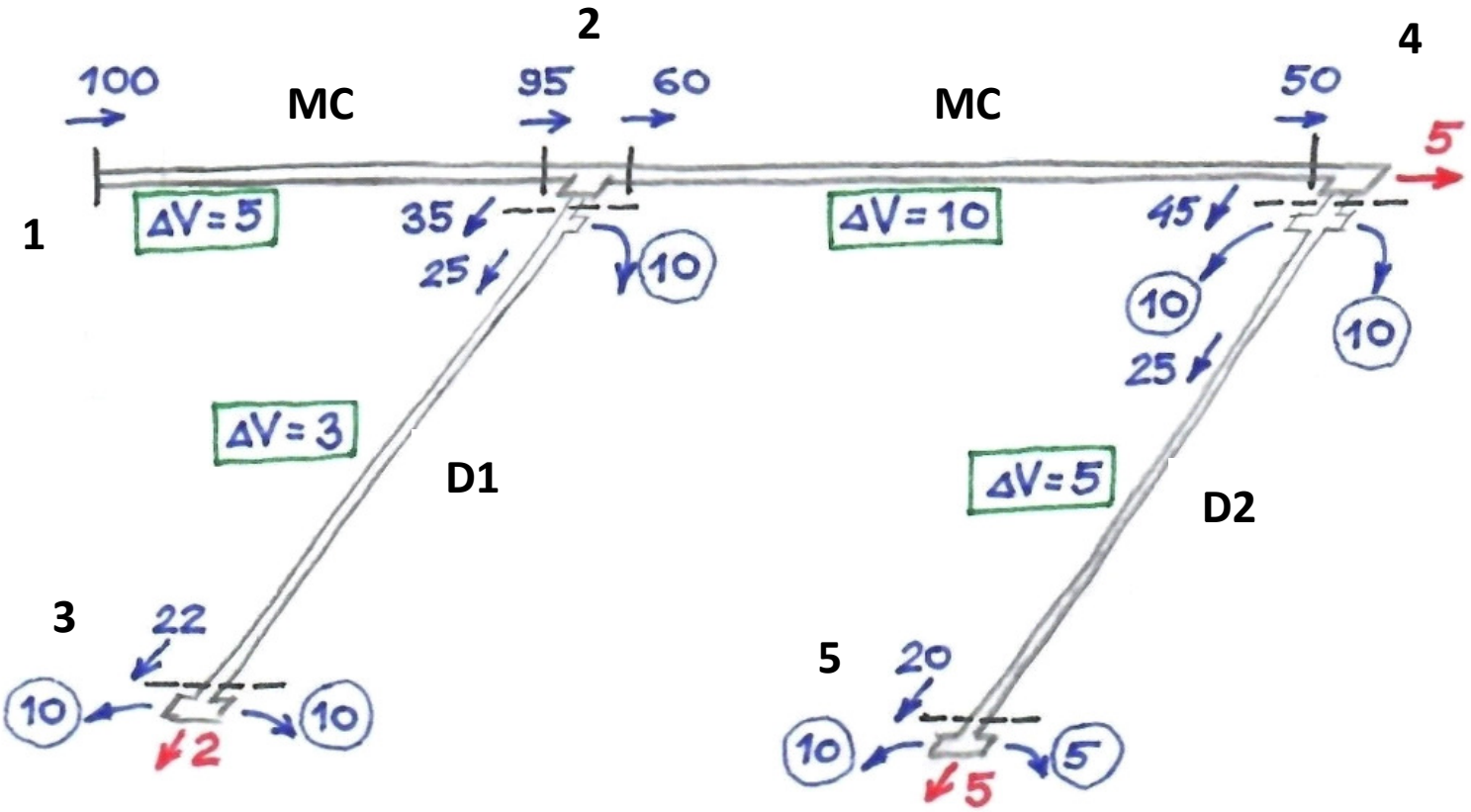
Co-funded by the
Erasmus+ Programme
of the European Union

# 3. Potential Water Savings

- The ***level of the investment*** may be:
  - **a farm** – when investment is for new, water saving irrigation equipment
    - ✓ *example*: switching from surface or sprinkler irrigation to drip
  - **a Water User Association** or **Irrigation Field** – when the investment is for improvement of:
    - ✓ (part of) distribution network and/or
    - ✓ water distribution method and/or
    - ✓ automation of water delivery.
  - **part of IS** – when investments are used for improvement of technical or operational status of part of the delivery network
  - **IS as a whole** – when head reach of the main canal is included in rehabilitation (improvement) together with other parts of the delivery network

# 3. Potential Water Savings

- Example:
  - For the IS shown below, only one section of Main canal is rehabilitated – between nodes 2 and 4.

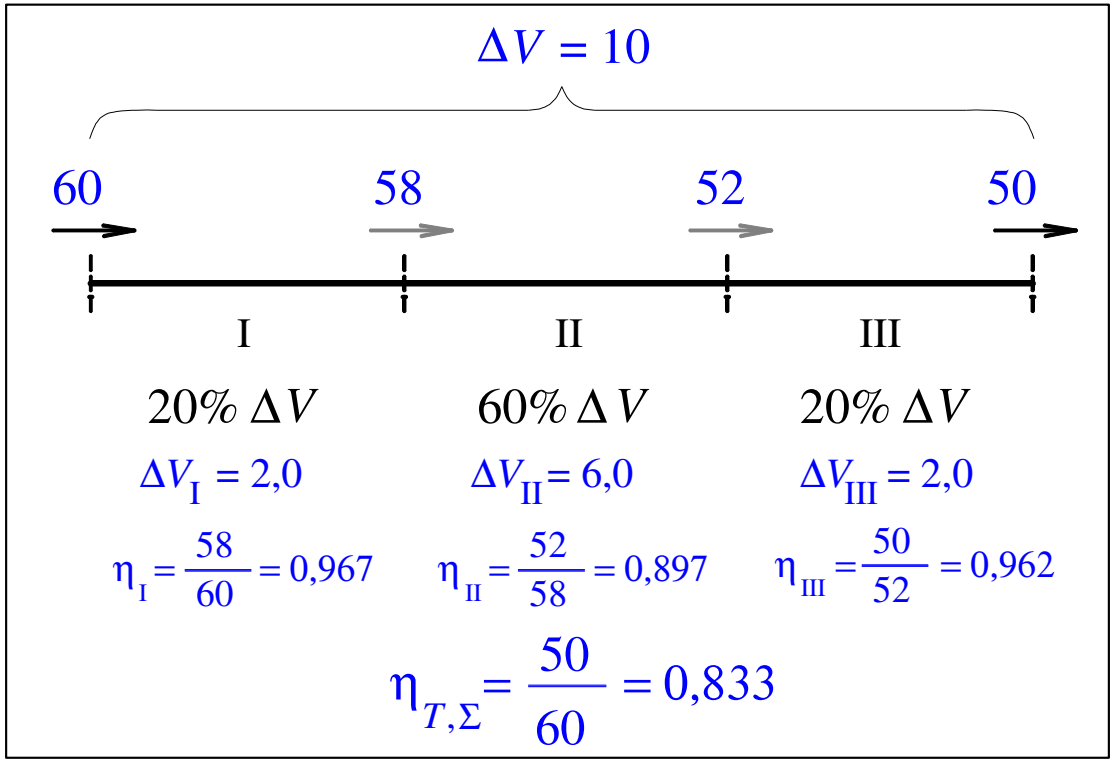


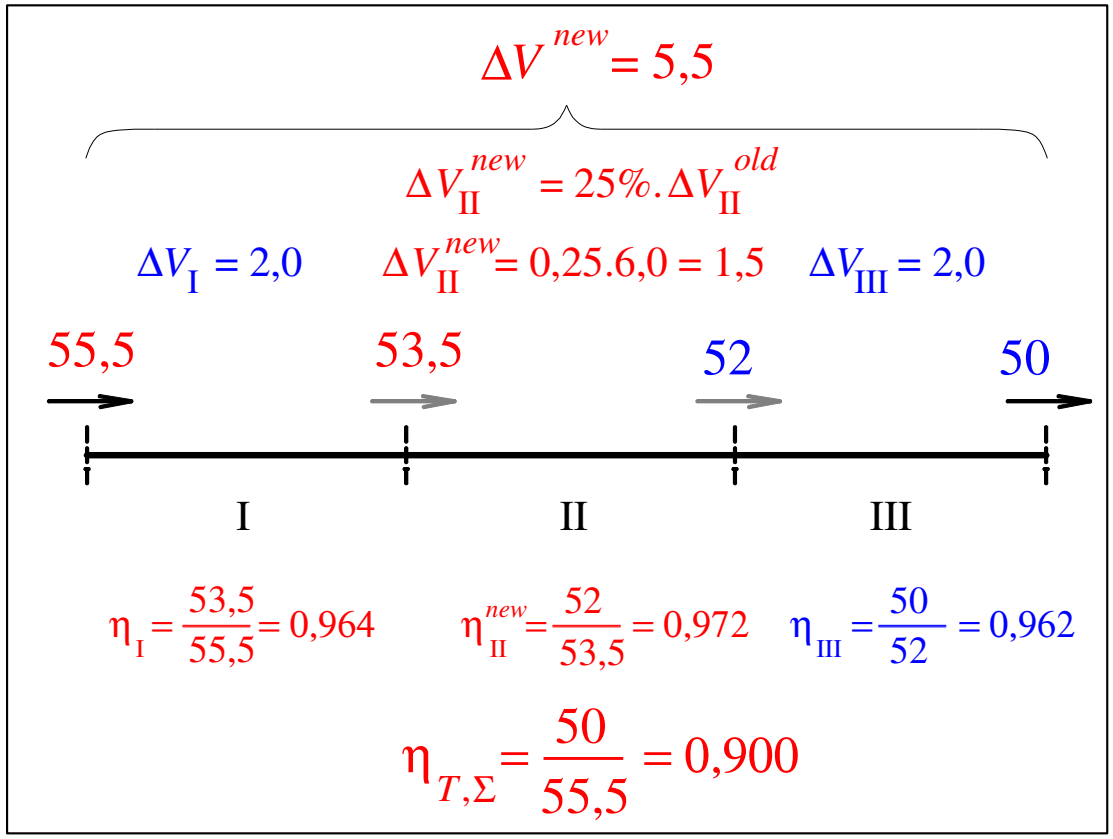
Co-funded by the Erasmus+ Programme of the European Union

# 3. Potential Water Savings

- Example:
  - ➢ For that canal section the losses are decreased from 10 to 5,5 units.

The **left picture** shows the water losses and delivered volumes before the investments




The **right picture** shows the water losses and delivered volumes after the investments

Co-funded by the
Erasmus+ Programme
of the European Union

# 3. Potential Water Savings

- Example:
  a) If **the level of investment is the canal subsection II**, i.e. the delivery network downstream of the section I, then the *RPWS* will be:

$$RPWS = \frac{58 - 53,5}{58} = 7,76\%$$

  b) If **the level of investment is the canal section** (between nodes 2 and 4), i.e. the delivery network downstream of the node 2, then the *RPWS* will be

$$RPWS = \frac{60 - 55,5}{60} = 7,5\%$$

  c) If **the level of investment is the entire IS**, then the *RPWS* will be:

$$RPWS = \frac{100 - 95,5}{60} = 4,5\%$$