Adaptation of Irrigation under climate change in Bulgaria

Vesselin Alexandrov, NIMH-Sofia

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Percentage of 5-min grid cell area that was classified as irrigated agriculture in the GLCC (in Robinson projection).
OUTLINE

• History (irrigation in BG)
• Recent years (irrigation in BG)
• Past and expected drought in the region
• Adaptation of agriculture under climate change
• Agriculture in BG
• Adaptation of BG irrigation under climate change
History

- Irrigation activities in Bulgaria have a long tradition dating back in the 15th century when first rice production along the Maritza River and, later, vegetable and fruit growing were supported by means of irrigation.
History

- Irrigation is very important for Bulgarian agriculture, but until the end of the **Second World War** only a small part of the land was irrigated.
- During the 1960s, the state initiated an extensive program to increase irrigated areas. Since co-operatives were then the dominant organisational form, irrigation systems were designed to supply water to large production units.
- The main sources of water supply were **large dams located in the mountains, and rivers**. Ground water was used as a complementary source.
- In **1990**, the total irrigated land was about 1,200,000 hectares (25 % of the arable land in Bulgaria.)
History

• The land restitution process was slow and contradictory.

• At the end of land reform in the year 2000, Bulgarian farm structure was dominated by three groups: small subsistent farms operated by people close to retirement, co-operatives, most of them in bad financial situation, and large commercial farms.

• The number of middle-size family farms remained small.
History

• During transition, the amount of water used for irrigation in Bulgaria has sharply declined.
• In addition, the share of actually irrigated areas to those that can be irrigated is low.
• Large sections of existing irrigation systems lie abandoned, and the ones still in use are barely maintained.
• Crops such as wheat and barley have replaced more water-intensive crops, including vegetables, rice and maize.
Current years

- **Irrigation**, until recently a major water user in Bulgaria, has been drastically affected.
- Uneven distribution of Bulgaria’s natural water resources over time and space makes **irrigation necessary** to reduce production risk and insures that the common-pool resource retains continuous high economic importance.
- Yet, the **irrigation systems** were built to serve large production units during socialism and do not meet the needs of the huge number of small-scale landowners that emerged following the land restitution process.
- Moreover, facilities have largely deteriorated, property rights on the infrastructure are ambiguous and **water loss in the system amount to 70%** owing to un-maintained facilities and water stealing.
Fig. 1. Organizational structure of Bulgaria’s irrigation sector.
No rain, no water for hundreds of thousands of Bulgarians

by Staff Writers
Sofia (AFP) Aug 31, 2008

Summer drought, lagging dam construction and persistent leaks and failures in old pipes have again made water rationing a part of life for hundreds of thousands of Bulgarians this summer.

On Monday, a state of emergency was declared in the central municipality of Panagyurishte, after already three weeks of shortages.

Major breaks in the main pipe channelling water uphill from the Maritza river, over 40 kilometres (25 miles) away, had sent thick rusty water, if any, running from the taps.

And local catchments -- the only other source of water in the region -- had already dried out from the summer heat, forcing people, under the scorching sun, into daily queues in front of the few water tanks brought to town.
Oxford Business Group Report 'Bulgaria 2008'

- The *drought* in summer 2007 was a tough time for Bulgaria, causing food prices to soar and driving year-on-year *inflation* up to 12.5% in December.
Past drying trends over Europe (1950-2000)
Model climate change scenarios (in %) for winter (left) and summer (right) precipitation in Europe, 21st century.
Figure 5.6: Water stress in Europe in the 2070s under the Baseline-A scenario (with climate data of HadCM3). Water stress is defined by the withdrawals-to-availability ratio.
Adaptation in agriculture

- **objectives** of adaptation measures in agriculture are to support and sustain the agricultural production and to bring to minimum the impact of climate change by reducing the vulnerability of the agricultural crops.

- The adaptation to climate change will be carried out in **various forms**, including technological innovations, changes in arable land, changes in irrigation, etc.

- **Technological innovations** include the creation of new cultivars and hybrids, which have higher productivity during changes in the climate. Farmers can start growing other cultures or cultures prone to drought and diseases.
Adaptation in agriculture

- The *changes in arable lands*, due not only to the needs of agricultural production following a population increase but also to climate change, are expected to be another form of adaptation. It is reasonable to expect that because of climate changes, there will be significant changes in arable lands.

- As the global climate has a tendency towards warming, a significant change in the *irrigation* of agricultural crops is expected.
Agriculture in BG

• The agriculture is one of the most important sectors of the Bulgarian economy. Much of the Bulgarian population is involved in it.

• The sector forms a relatively small share of the GDP.

• Cultivated agricultural land covers 48% of the total territory of the country.
Agriculture in BG

- Agriculture is still in a crisis at present.
- Most of the farms are small and do not have at their disposal significant financial means. Various European funds are not enough efficiently used.
- The government must invest to get out quickly of the crisis in this important structural sector of the Bulgarian economy.
ADAPTATION

- The adaptation measures presented below in relation to *irrigation* in the conditions of the present and future climate in Bulgaria are based on various:
  - expert assessments
  - documents
  - action plans
  - and programs
Second National Action Plan on Climate Change

• The Bulgarian Government has clearly demonstrated strong commitment and willingness to join the international efforts in mitigating climate change by ratifying the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol to the Convention (KP). The Second National Plan on Climate Change (Second NAPCC) is a governmental plan to streamline and guide the efforts of the Bulgarian government in mitigating climate change.
Second National Action Plan on Climate Change

Agriculture

● Manure management
Manure is one of the most considerable methane sources in agriculture. The modern manure management practices are not applied in Bulgaria. Transportation tanks, underground disposal at cattle-breeding farms and poultry-farming sites, separation of manure into liquid and solid fraction at pig-breeding farms, etc. are used in liquid manure management.

● Fertilization and irrigation
During the last years fertilization was conducted in an uncontrolled manner. The amounts of nitrous fertilizers applied to soils often exceeded the recommended ones. The requirements for quality of production and lower prime costs grew strict due to expanded import of agricultural goods from the neighbouring countries.
Measures for IMPROVING irrigation UNDER climate changes

• improvement of management, use and protection of water resources in irrigated agriculture;
• improving the efficiency of the management and use of the existing irrigation facilities and elaboration of the technological and technical facilities for irrigation;
• use of rational and economically sound irrigation regimes for the irrigated crops and
• elaboration of the technologies for cultivation of crops in the conditions of droughts and water deficit.
improve management, use and protection of water resources in Irrigated agriculture

• establishing the *impact* of climate changes and drought on the quantity and quality of water resources used in irrigated agriculture;

• assessing the *needs* of water for irrigation of agricultural crops under climate changes and preparing long term projections for the required water resources to be used in agriculture.
improve management, use and protection of water resources in Irrigated agriculture

Work is going on in various institutions like:
• Institute of melioration and mechanization,
• Institute of Water Problems,
• University of Architecture, Civil Engineering and Geodesy
• Institute of Soil Science and Agroecology "N. Pushkarov",
• Higher Institute of Agriculture,
• National Institute of Meteorology and Hydrology (NIMH),
• etc.
improve management, use and protection of water resources in Irrigated agriculture

• *Numerical experiments* to determine the *optimal dates and water quantity* for irrigation of the maize for various climate scenarios are carried out in NIMH, using computer system for agrotechnological decision taking *DSSAT*. The calculations are taken in regard to biophysical and economic analysis of the final yield and the received profit from the maize
improve management, use and protection of water resources in Irrigated agriculture

- During limited precipitation in summer, irrigation facilities must be used, oriented towards design and operation of irrigation facilities, which use water resources in an *economical* way and have very low water transportation losses during irrigation.

- **Gravitee feed irrigation and flooding** of beds and rice fields should be used as a last resort, only when proven to be *effective*.

- Main and distribution canals of old irrigation systems must be coated to bring to *minimum losses* from filtration. Permanent canals in irrigation systems must be afforested on sufferance strips to utilize filtered water and to cover them aiming at the *reduction of the physical evaporation* from water surface in the canals.
Adaptation measures to improve management efficiency and use of existing irrigation systems and elaboration of technological and technical means for irrigation

• To prepare up-to-date strategy and new program for the rehabilitation and restructuring of irrigation management and improving the efficiency of use of the existing irrigation infrastructure;

• To change legislation and regulation in the irrigation sector taking into consideration the altered agricultural conditions, the experience from the reforms carried out so far and to ask for free use of the technologically established hydromeliorative infrastructure and service facilities on the territory of the associations;
Adaptation measures to improve management efficiency and use of existing irrigation systems and elaboration of technological and technical means for irrigation

• To implement proper *educational and training programs* with emphasis on major issues on the involvement of users of water and the general public on drought problems;

• Preparation of *information materials* for water users on the benefits and good practices of agricultural crop irrigation.
Adaptation measures for use of rational and economically viable irrigation regimes

• Determining the *vulnerability* of agricultural crops under climate changes, long term droughts and water deficit in the major agroclimatic regions in the country, respectively their impact on the quantity and quality of the yield from them;

• *Reassessment* of the water and irrigation norms and legislative provisions of irrigation, new zoning for the irrigated crops in the country;

• Development and application of *optimized* irrigation regimes for the major agricultural crops for various agroclimatic regions in the country;
Adaptation measures for use of rational and economically viable irrigation regimes

• **Research** on the effect from irrigation and sustainability of yields under various water saving methods and irrigation technologies;

• Creation and application of mineral **fertilization** systems and integrated weed fight during cultivation of agricultural crops under irrigation conditions;

• Application of proper moisture preserving **technologies** and techniques for soil treatment in irrigated lands;
Adaptation measures for use of rational and economically viable irrigation regimes

• Adaptation and introduction in practice of information and advisory system for irrigation necessity forecast and defining the parameters of the irrigation regime for the irrigated crops;

• Technology changes for irrigated crop cultivation in various agroclimatic regions under water shortage conditions;

• Use of new cultivars and hybrids that adapt better to water deficit.