

## Water Sector Analysis

### Sector Overview

**Romania's water resources are moderate, but sufficient with prudent resource management that would ensure conservation and sustainability; regional and inter-annual variation is, however, significant.**

Water availability in Romania is only 2,000 cubic meters per capita per year, just above the international threshold for water stress of 1,700 m<sup>3</sup> and more than twice below the Europe's average of 4,500 m<sup>3</sup>.

Water withdrawals currently stay substantially below the international benchmark for pressure on available water resources, but climate change is pushing demand for water up, thus altering this balance. Also, a significant inter-basin and inter-annual variation in water resources availability creates an additional challenge for water resource management.

**Romania's water sector is vulnerable to climate change, and adaptation efforts are essential for its continued ability to meet demand for water from the end-use sectors – households, industry, agriculture, environment and hydropower.**

The water sector in Romania is facing a dual challenge: water availability is dropping and demand for water increasing, both due to climate change. Irrigation water supply is constrained by the inadequate irrigation infrastructure, while irrigation availability is becoming critical for agriculture due to climate change.



Similarly, supply reliability for industrial and domestic use is most challenged for basins with lower water endowment, especially during summer months.

Hydropower generation will both constrain and be constrained by water demand in other sectors in Romania. It is also sensitive to water scarcity in basins during the dry seasons. In addition, the adverse environmental impacts of climate-induced water quantity and quality constraints will also need to be managed.

Adaptation efforts are therefore important in all water end-use sectors.



**The objective of the analysis was to assess the climate change impact on water availability and how the adaptation policies and investments can offset the impact of the changing water availability on sectoral outcomes in the water consuming sectors, with the emphasis on agriculture.**

Two sets of models were used in the analysis: climate models and adaptation models.

**Climate models** (General Circulation Models or GCMs) produced climate projections as a function of initial conditions and projected quantities of greenhouse gases emitted.

**Adaptation models** projected water availability, crop yields, and hydropower impact of climate and assessed the effectiveness of the proposed green policies and investments.

Adaptation modeling set included three models:

- a water run-off model (CLIRUN) to estimate streamflow runoff,
- the AquaCrop model to assess crop yield and irrigation demand,
- the Water Evaluation And Planning (WEAP) model to evaluate the water storage, hydropower potential, and water availability.

Adaptation modeling compared the modeling results in two green (adaptation) scenarios:

- Green (requiring a moderate adaptation effort),
- Super Green (entailing an ambitious adaptation plan) - to the outcomes in the Baseline scenario.



**The analysis addresses several policy issues including potential adaptive measures in agriculture, prioritization of water use in end-use sectors, and adaptation costs and benefits in the water sector.**

The analysis addressed four policy-relevant issues:

- 1 the possible adaptive responses by farmers to climate change and the resulting marginal impact on agricultural production and incomes;
- 2 projected impacts on energy (hydropower) production under the modelled development and climate scenarios;
- 3 trade-offs between alternative water uses (for irrigation, hydropower, and municipal and industrial use);
- 4 financial implications of climate change and green growth investments: crop yield and hydropower generation modeling outcomes were analyzed to produce projections of the cost and revenue flows and to calculate on that basis the net present value (NPV) of the proposed green investment in these sectors and the benefit-cost ratio.

### **Climate change will increase water demand-supply gap, affecting mostly irrigation and industrial sector, and less so municipal sector.**

Water demand-supply gap is estimated to increase as a result of climate change. Climate change will lead to a decreased river runoff, which in turn will negatively affect water demand-supply balance. In agriculture, water availability will be threatened during the primary growing months, while demand for irrigation will be higher due to rising temperature and decreasing and more variable precipitation.

Unmet municipal demands are modest but irrigation and industrial activities are estimated to suffer more from the growing demand-supply gap. Hydropower will also be affected by the decreased river runoff.

### **Climate change will negatively affect yields of rainfed crops and have a positive impact on irrigated crops, overall.**

The analysis considered impact of climate change on yields of irrigated and rainfed crops across administrative regions of the country and by type of crop and evaluated how to target adaptation efforts geographically and by crop.

There are substantial crop yield benefits from irrigation:

- if water stress is removed by irrigating, then the climate change (in particular, temperature increase) has a positive effect on future crop yields. By moving from rainfed to irrigated agricultural land, farming will become much more resilient to the effects of climate change.
- however, without irrigation, most of the crops will be harmed by climate change, especially in the south of the country, where some of the crops will experience up to 35 percent drop in yields.



### **Adaptation policies and investments will offset the significant risks that climate change presents to water supply, agricultural production, and hydropower generation in Romania.**

In the analysis, a number of green investments were evaluated for their potential yield impact, including adopting improved drought tolerant crop varieties, converting from rainfed to irrigated agriculture, improving soil drainage, improving soil aeration, optimizing fertilizer application and optimizing the timing of irrigation water application.

The most promising investments for yield improvement were:

- rehabilitating irrigation infrastructure to restore irrigated production to certain currently rainfed areas,
- optimizing agronomic inputs, including fertilizer inputs,
- adopting improved, drought tolerant, crop varieties.



While the first two measures have clearly positive outcomes across regions and crops, the third one (crop varieties) is estimated to provide benefits in particular regions and crops.

**In both Green and Super Green scenarios, revenues will exceed costs resulting in a significant positive NPV of the overall investment (Figure 1).**

The overall NPVs of the proposed adaptation measures for Romania under the Green and the Super Green investment options are projected to be positive at \$1.8 billion or 0.05 percent of GDP and \$11.0 billion or 0.32 percent of GDP, respectively<sup>1</sup>.

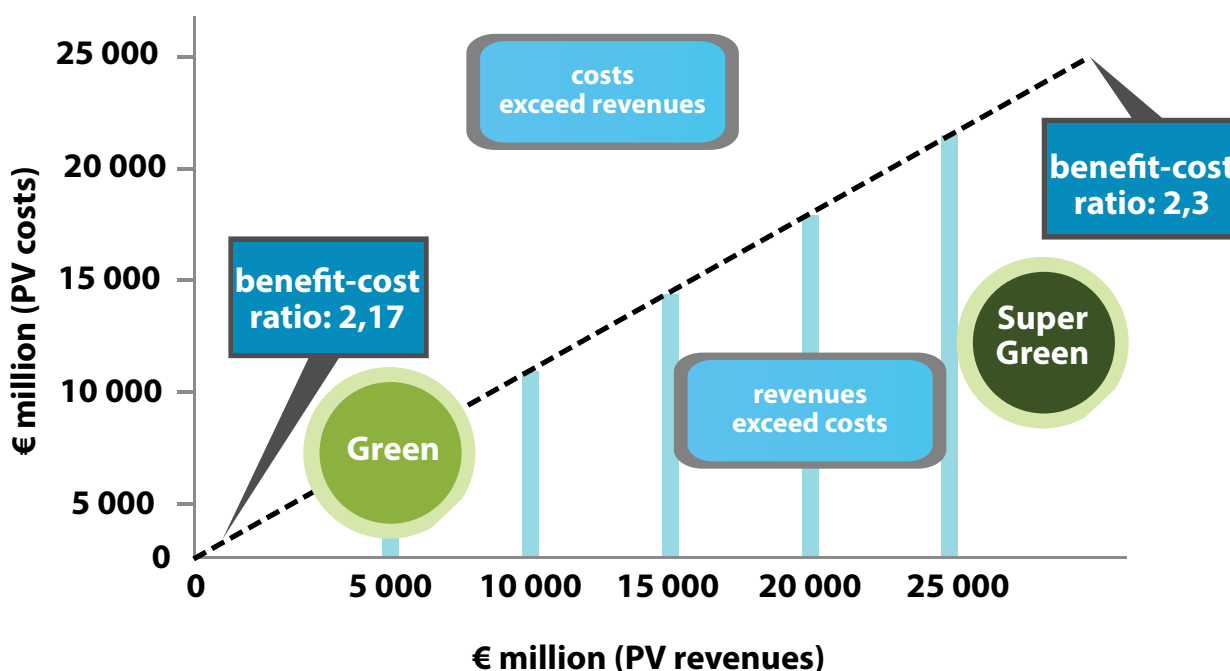


With Super Green investments, the NPV is dramatically higher due to the broader set of investment options that are considered. The schedule of investments puts a higher burden on the period 2015-2030 when approximately 65 percent of the total required investment is made.

The benefit-cost ratio of the investments is above 1 in both scenarios, demonstrating that benefits exceed costs: it equals 1.8 in the Green and increases to 1.9 in the Super Green scenario. While the financial outcomes are positive at the scenario level, they vary across the selected green measures.

Two of the measures - enhanced fertilizer application and rehabilitated irrigation - have positive NPVs and benefit-cost ratios exceeding 1 (benefits outweigh costs) in both scenarios and across regions, while with the third measure - improved crop varieties - costs outweigh benefits in most regions.

**Figure 1 Super Green costs are higher than in Green, but so is return on investment**  
Green and Super Green scenarios: cost, revenues and benefit-cost ratio



Source: Romania: A Climate Change and Low Carbon Green Growth Country Assessment, World Bank, 2015, in print.

<sup>1</sup>Present value is calculated at five percent discount rate.

## Conclusions and Recommendations

**Climate change presents a substantial risk to agricultural production, irrigation, municipal and industrial water uses, and hydropower generation in Romania. However, these risks can be addressed by green growth investments.**

The greatest investment potential exists for rehabilitating irrigation infrastructure to restore irrigation production to currently rainfed areas and for optimizing agronomic inputs, including fertilizer application.

While these two measures have clearly positive (both in terms of sector productivity and NPV) outcomes across regions and crops and should be implemented at the country level, the third one (crop varieties) is estimated to provide benefits in particular regions and crops, to which it should be targeted.



**As a result of this assessment, a set of tools for water sector investment analyses has been developed and transferred to local counterparts in the Ministry of Environment, as well as ANAR, INHGA, and other local stakeholders.**

These tools can be applied to further assess the irrigation and other water and agriculture investment options, both individually and in combination with water use efficiency options. They can also be used to assess multi-sectoral water use strategies.

The results developed in this assessment, as well as further assessments using the tools transferred to local counterparts, can have lasting benefits for evaluation and prioritization of a broad range of water and agriculture sector investment options.

**The required investment in the Green scenario amounts to €1.8 billion (NPV) or 0.05 percent of GDP, while a more aggressive Super Green scenario requires €11.0 billion in investment costs (NPV) or 0.32 percent of GDP<sup>2</sup>.**

The Green investments would be a manageable increase from 2013 levels of agricultural sector support of €1 billion direct payments, and €1.3 billion of rural development expenditures. By contrast, Super Green investments would represent a substantial increase from current spending and would quickly exhaust the National Rural Development Plan (NRDP) 2014-2020 financial allocation for irrigation infrastructure, which is over €400 million, or about €65 million annually.



<sup>2</sup>Present value is calculated at five percent discount rate.



UNIUNEA EUROPEANĂ



Instrumente Structurale  
2007-2013

Project co-financed by the European Regional Development Fund through OPTA 2007-2013

## Romania:

Climate Change and Low Carbon Green Growth Program OPERA-CLIMA



*For more information and the publications of the  
OPERA-CLIMA Program, please visit its webpage at:*

*<http://opera-clima.ro/en/>*



MINISTRY OF ENVIRONMENT,  
WATERS AND FORESTS



**THE WORLD BANK**  
IBRD • IDA | WORLD BANK GROUP