EUROPEAN EVALUATION HELPDESK FOR RURAL DEVELOPMENT

ASSESSING RDP EFFECTS ON WATER ABSTRACTION: A MIXED METHODS APPROACH FROM THE GREEK REGION OF THESSALY

FACTSHEET OF THE EUROPEAN EVALUATION HELPDESK FOR RURAL DEVELOPMENT - MARCH 2020

MANAGING THE EARTH'S MOST VITAL RESOURCE

Water is one of the most vital resources on the planet and an essential and necessary input in crop production, however, under increasing pressure from climate change and other effects related to human activity, water and other natural resources have become increasingly scarce. Therefore, the sustainable management of natural resources is an essential step in preserving not only crop and food production, but the vast majority of activities that sustain today's societies.

The overall CAP objective of 'ensuring the sustainable management of natural resources and climate action', highlights the need for the integrated and sustainable management of water resources. Impact Indicator I.10 (water abstraction) is one of the primary indicators used to measure water management in agriculture. Targeting water abstraction with RDP measures helps to manage water as a constrained natural resource, which is important for people, nature and agricultural production. Water abstraction is addressed through rural development Priority 4 (ecosystems related to agriculture and forestry), notably through Focus Area 4B (improving water management) and Priority 5 (resource efficiency) and Focus Area 5A (increasing efficiency in water use by agriculture).

The main measures that contribute directly to these focus areas in Greece in relation to water abstraction are (in order of financial weight):

1. M04 (investment in physical assets),
2. M11 (organic agriculture),
3. M10.1 (agri-environment and climate commitments),
4. M12 (Natura 2000 and Water Framework Directive).

Secondary contributions are also provided through M01 and M02 (knowledge transfer and advisory services) and M16 (cooperation).

In rural development programmes issues related to water abstraction are assessed through answering the common evaluation questions (CEQs):

- CEQ 26: 'To what extent has the RDP contributed to improving the environment and to achieving the EU biodiversity strategy target of halting the loss of biodiversity and the degradation of ecosystem services, and to restore them?'

FURTHER INFORMATION

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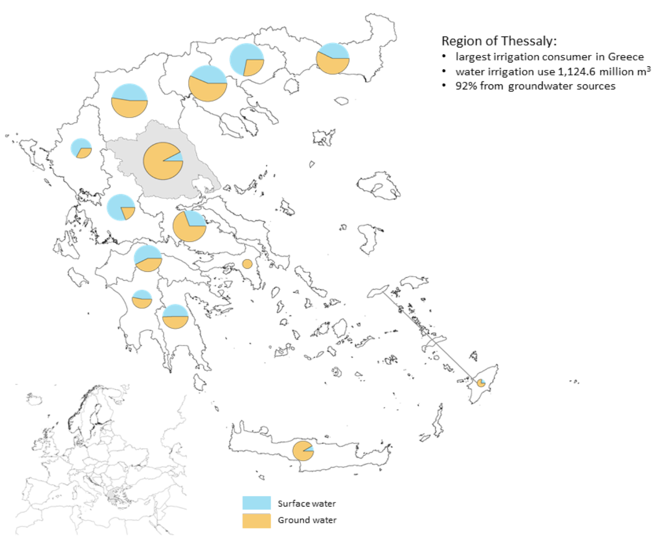
www.fao.org/aquacrop

Map 1: Water Distribution Map Greece



- CEQ 28: 'To what extent has the RDP contributed to the CAP objective of ensuring sustainable management of natural resources and climate action?'

USING A MIXED APPROACH TO ASSESS THE RDP'S EFFECTS ON WATER ABSTRACTION WHEN DATA IS SCARCE

This factsheet focuses on the evaluation of water abstraction conducted in the region of Thessaly. This assessment was completed in roughly one month and the results were used to report on this indicator in the AIR 2019 together with the results from a larger macro level assessment.

The evaluation approach combined quantitative and qualitative methods. The quantitative method Propensity Score Matching (PSM) was used to compare irrigation water needs between RDP beneficiaries and non-beneficiaries and qualitative methods included the use of elite in-depth interviews with managers of irrigation water user associations, agronomists working in the region of Thessaly and extensive research of the agronomic scientific literature considering the net irrigation needs of various cultivations in Greece.

The major challenge of this evaluation was related to the absence of data on irrigation water use at farm level. To overcome the lack of data on the use of irrigation water at the farm level, the evaluator assumed that farmers used optimum irrigation. This assumption can be made since irrigation takes up a substantial part of the total cost of production and thus, optimisation is critical for financially constrained farmers. Therefore, evaluators could use an estimate of a farm's Net Irrigation Requirements as the closest proxy to missing irrigation water use.

Working Steps:

Step 1 - Preparing the data: A random sample of 76 RDP beneficiaries from the region of Thessaly was provided by the Managing Authority. Data on 156 farm holdings of non-beneficiaries from the 2012-13 FADN records were used for the construction of a control group. Data preparation and cleaning ensured that for each record there was a detailed account of the type and size of each cultivation. Following that, the samples of beneficiaries and non-beneficiaries were pooled together to form one sample.

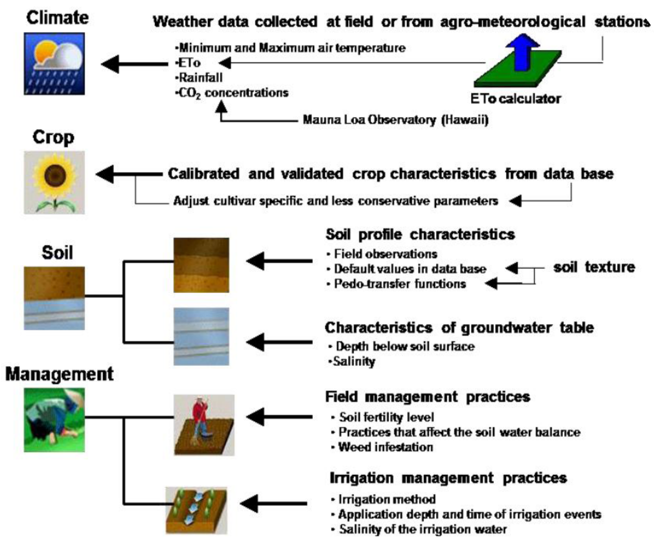
Step 2 - Checking sample representativeness: Sample representativeness was examined by comparing the sample as concerns the distribution of farms in land size categories and the distribution of cultivations against data from the 2016 Farm Structure Survey (FSS) for the region of Thessaly. Likelihood Ratio Chi-Square test statistics did not reveal any significant discrepancies between the sample and the population (i.e. the FSS).

Step 3 - Calculating the Indicator: The evaluators, instead of calculating the quantity of water applied through irrigation, for which there is insufficient available data in Greece, calculated the irrigation requirements as the closest proxy for the indicator I.10. The Net Irrigation Requirements for each cultivation and for each farm were computed using the AquaCrop growth model. AquaCrop is a software developed by FAO that simulates the yield response of herbaceous crops to water. The essential inputs required by AquaCrop are agronomic[1] (Figure 1). The evaluators applied extensive sensitivity analyses to examine whether derived irrigation requirements are sensitive to any of the parameters used by AquaCrop (e.g. the soil type or the period of planting). Irrigation requirements at the farm level were calculated by adding up the computed irrigation requirements of each individual cultivation on the farm.

Step 4 - Building comparison groups: The evaluators used PSM to construct comparison groups between beneficiaries and non-beneficiaries and estimate the net effects of the RDP on water abstraction. The total farm size, the existence and extent of water demanding cultivations such as cotton, maize or sugar beets and other variables guided the matching process. This procedure resulted in 76 matched pairs of beneficiaries and non-beneficiaries. The variables used for matching (farm size, etc.) were not statistically different between beneficiaries and non-beneficiaries after matching. The size of irrigated cultivations was the same for beneficiaries and non-beneficiaries with an average of 3.85 ha.

Step 5 - Analysing the differences: The difference in mean (average) irrigation requirements between beneficiaries and non-beneficiaries was performed and is called the Average Treatment Effect (ATE). The difference in irrigation requirements (i.e. the ATE) was then used to measure the causal effect of the RDP on water abstraction as this was proxied by irrigation requirements. Causal effects were then analysed through the difference between the average irrigation requirements of the beneficiary farms and the average irrigation requirements of the same farms not subjected to the RDP support (Average Treatment Effect on the Treated (ATET)).

Figure 1: Required input data for AquaCrop



Source: FAO, 2017

Step 6 - Checking the validity of the findings: Both causal effects, the ATE and the ATET are differences between averages. Standard statistical tests were then used to examine whether these differences were statistically significant. In this evaluation, a z-test was used and provided strong evidence that the size of ATE and ATET were statistically significant at the 5% level.

Major Findings

The average beneficiary farm enterprise uses 166,216 m^3 of irrigation water per year while the corresponding figure for the average non-beneficiary farm enterprise is 192,732 m^3. Reporting irrigation water needs at the level of the farm is the same as reporting irrigation needs per hectare since beneficiaries and non-beneficiaries have the same average size of 3.85 ha of irrigated cultivations. The ATE was estimated at 21,779 m^3 of irrigation water per year. This means that non-beneficiary farm enterprises use, on average, 21,779 m^3 of irrigation water more than the corresponding beneficiary enterprises. The ATET was estimated at 25,895 m^3 of irrigation water per year, indicating if beneficiary farm enterprises had not been supported by the RDP to control irrigation water use, they would have used, on average 25,895 m^3 more of irrigation water per year.

The positive net effects of RDP support were profound. Considering the number of beneficiaries, the ATE and the total demand for irrigation water in the region of Thessaly, the evaluators estimated an overall reduction of almost 2.2%.

Triangulation aimed at scrutinising the following research assumptions and results:

The assumption that farmers irrigate at the optimal or marginally sub-optimal level due to the high costs of irrigation was validated through in-depth interviews with managers of irrigation water users associations and extension agronomists. Therefore, the use of calculated net irrigation requirements instead of the non-available actual irrigation water application was valid.

The computed net irrigation requirements obtained by the AquaCrop growth model for each cultivation were validated through interviews with agronomists at the regional research station and through an extensive search of the scientific literature that identified relevant published research.

The estimation of the ATE from the evaluation was widely discussed with managers of irrigation water users' associations. Managers agreed that the estimated ATE had the correct sign (i.e. that beneficiaries use less water than non-beneficiaries due to the obligation to set a proportion of their land aside). However, they underlined that their own subjective estimate of the magnitude is uncertain since in their associations there are very few cases of non-beneficiaries, making it difficult to generalise.

Methodological Challenges for the Assessment of Water Abstraction

Data constraints for estimating the ATE may not only refer to the absence of irrigation water data at the farm level, but also, to the difficulty of constructing appropriate samples of beneficiaries and non-beneficiaries, as well as for the potential size of these samples and irregularities in the measured data due to changing climatic conditions. Most methodological challenges can be addressed by careful design and a good knowledge of the available databases from which data or alternative data can be drawn. For example, data for beneficiaries and non-beneficiaries may come from different sources (e.g. the monitoring framework for beneficiaries and the FADN or other databases for non-beneficiaries). The evaluators should take care of the definitions and the processes used to collect data in the different data sources. The same applies for data on irrigation water use if such data exists. If the AquaCrop software is used to provide estimates of net irrigation requirements, it is suggested to use the average from a time-series of meteorological data instead of single-year data to avoid data volatility due to weather extremes.

LESSONS LEARNT AND RECOMMENDATIONS

In many cases, data recording irrigation water use does not exist or is not readily available. The evaluators can use estimates of net irrigation requirements as the best proxy. Net irrigation requirements can be estimated by many computer programmes, and AquaCrop is just one of them. The main advantage of AquaCrop is its widespread use, which means that there are already many calibrated versions for most cultivations in most European regions.

When irrigation water use is simulated through a growth model like AquaCrop, the evaluators should always try and verify the main assumptions underlying the evaluations as well as the results of the simulations. The primary premise is that net irrigation requirements are a sufficient approximation of irrigation water use. This should be verified with experts who have a good knowledge not only of the agronomic conditions of the area, but also, of the behaviour of the farmers as entrepreneurs. Verification procedures or triangulation also should be extended to the results of the growth model (i.e. the calculation of the net irrigation requirements and the results of the statistical method chosen to estimate the net causal effects). Finally, at all stages of the quantitative evaluation procedure it is recommended that the evaluators employ sensitivity analysis to highlight the factors that are most influential in their results.

Send your questions to:
info@ruralevaluation.eu

[1] E.g. the type of cultivation, the time of planting and the root depth; meteorological, and especially temperature and rainfall; soil type and the method of irrigation. Most agronomic data is readily available by the software, meteorological data is available for most areas in Europe or accessible through climatic databases such as the CLIMWAT developed and maintained by FAO. Typical soil types are also available for most regions of Europe through national soil maps or the European Soil Data Centre (ESDAC).

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