



## **FELLOWSHIP SUMMARY REPORT**

- ❖ Name: Pilar Gracia de Rentería
- ❖ Subject Title: Capturing the drivers of crop water footprints in Africa and its regional patterns. Looking backward to move forward
- ❖ Theme Number: Managing Natural Capital (Theme 1)
- ❖ Host Institution: Joint Research Centre (Seville)
- ❖ Host Collaborator: Emanuele Ferrari
- ❖ Fellowship Dates: 5th September – 4th December 2022

I consent this report to be posted in the Co-operative Research Programme website.





## **1. What were the objectives of the research project? Why is the research project important?**

The project assesses the sign and magnitude of a series of macroeconomic, climatic and structural input drivers on the agricultural crop water footprint (WF) in the African continent. Using econometric panel data techniques and accounting for spatial dependence across countries, the objective was to obtain elasticities that allow estimating future WF. These WF estimations provide a valuable output to be matched with ex ante simulation model drivers to improve existing assessments of irrigated water usage (virtual water flows) under significant economic and population growth, by introducing some degree of temporal variation to the WF metric.

The project steps included: i) a literature review; ii) the construction of a database on crop WF in the African continent; iii) an econometric analysis to assess the drivers of crop WF using panel data models and accounting for spatial dependence; iv) the parametrisation of obtained elasticities into ex-ante forward looking simulation models.

The importance of the project relies on the increasing pressure on water resources due to the growth of population, urbanization, and productive activity, together with the effects of climate change. In this context, the WF is a relevant metric to measure efficiency in the use of water, which is key to ensure sustainable withdrawals and supply of freshwater in a context of increasing water scarcity and human water demands. Despite this fact, a common denominator of the previous literature is the assumption that the WF remains constant over time (or varies at an assumed rate), whilst relatively scant attention has been paid to the drivers of the WF. In addition, the consideration of spatial dependence on this research field was not previously considered.

Therefore, this project contributed to the literature by making progress in these aforementioned issues and focusing in the African continent as a relevant case study with a two-fold interest. First, the performance of the agricultural sector plays a crucial role for eradicating hunger and improving food security in Africa, and heavily influence economic growth and employment. Second, water resources availability strongly conditions agricultural production and crop productivity, especially in the African continent with a higher drought occurrence and a larger dependence on rain-fed agriculture than other regions in the world.

Therefore, the assessment of the drivers of crop WF in the African continent provides valuable information about how a series of macro-level variables affect African crop WF and how the African crop WF may change in the next future under different socioeconomic pathways. This information may be very useful for the design of adequate agricultural and water resource management policies to achieve sustainable and resilient food systems capable of adapting to population growth, climate change (and specially, to its consequences in water resources) and other potential risks and future threats to human health, prosperity and environmental sustainability.

Moreover, the consideration of geographical patterns in this project informed about the spatial relationships and dependences between African countries, that is, how the WF of one country may also affect the WF of other countries. On this point, one should note that interactions between countries are especially relevant when analysing the WF, since international trade implies also a virtual water trade that conditions the water usage of countries. Moreover, this global component of the WF also implies that the study of the African continent can also help to guide the agricultural policy of other regions of the world.

## **2. Were the objectives of the fellowship achieved? Or are they on the way to being achieved?**

**If not, for what reasons? (The data or research is still ongoing or being analysed; technical reasons (e.g. equipment not working, adverse weather conditions, unexpected results, etc.); other reasons?)**

Research objectives were almost totally achieved. The first three steps of the project (literature review, database construction, and econometric analysis) were completed. Now, in cooperation with JRC staff, I am working on introducing these elasticities in ex-ante simulation models to obtain projections of the water footprint under diverse socioeconomic pathways.





**3. What were the major achievements of the fellowship? (up to three)**

- Assessing the drivers of crop water footprint accounting for potential spatial dependence. The existence of spatial patterns when analysing the water footprint was not been previously considered in the literature.
- Obtaining elasticities to measure the impact of relevant drivers on the crop water footprint with the aim of introducing them in ex-ante simulation models.
- The collaboration between the two organizations. The fellowship was the starting point of a future collaboration between the two institutions.

**4. Will there be any follow-up work?**

○ **Is a publication envisaged? Will this be in a journal or a publication? When will it appear?**

Yes. Two publications are envisaged in peer-review journals. One publication will address the econometric part of the project and the existence of spatial patterns, while the other publication will focus on obtaining water footprint projections under diverse socioeconomic scenarios with the view eyes set to the achievement of Sustainable development Goals. The two publications are expected to appear in 2023.

Moreover, the results of the project were presented in an internal seminar at the Joint Research Centre and, in 2023, are also expected to be presented in two international conferences.

○ **Is your fellowship likely to be the start of collaboration between your home institution and your host?**

Yes. Future work is planned in collaboration with the host institution to analysis the water footprint for different crop products, and also to consider the different impact of drivers along diverse African regions.

○ **Is your research likely to result in protected intellectual property, novel products or processes?**

No.

**5. How might the results of your research project be important for helping develop regional, national or international agro-food, fisheries or forestry policies and, or practices, or be beneficial for society? Please express this in terms of environmental/food security/food safety/economic/health (human and livestock and plant) benefits, etc.**

The project has strong implications for the achievement of sustainable, resilient and safe food systems. The results of the project can be extremely useful for the design of adequate water management policies, agricultural policies, and development policies. Moreover, it provides valuable information for the achievement of relevant international sustainable strategies, such as the European Green Deal or the Sustainable Development Goals.

**6. How was this research relevant to:**

○ **The objectives of the CRP?**

The project perfectly aligns with the general aim of the CRP programme, since it is focus on the assessment of the drivers of crop WF with a triple dimension prism (social, economic and environmental). A better knowledge of the rationale that guides WF could be very useful for the design of adequate agricultural and water resource management policies with the aim of achieving sustainable and resilient food systems capable of adapting to population growth, climate change, and other potential risks and future threats to human health, prosperity and environmental sustainability. Moreover, the focus on the African continent has a special interest in terms of food security and nutrition, and in terms of economic development and prosperity.

○ **The CRP research theme?**

The project is aligned with the theme “managing natural capital”, in which a better evaluation of WF is highlighted as a key objective. The project contributes to this theme by assessing the sign and magnitude of crop WF drivers in the African continent. The results of this project provide valuable information for the design of water management policies aimed at improving water-use efficiency and thus ensure sustainable withdrawals and supply of freshwater in a context of increasing water scarcity and human water demands. The





usefulness of these results is not restricted to the African continent, but it has also relevant implications for other regions of the world in which the use of water is also conditioned by the virtual water flows between regions.

## 7. Satisfaction

- **Did your fellowship conform to your expectations?**  
Yes.
- **Will the OECD Co-operative Research Programme fellowship increase directly or indirectly your career opportunities? Please specify.**  
Yes. I hope the grant of this fellowship and the opportunity to do a research stay at the host institution will help me to obtain a permanent position in my research centre in the next future.
- **Did you encounter any practical problems?**  
No.
- **Please suggest any improvements in the Fellowship Programme.**  
Additional support for researchers traveling with their families (especially with children) would be useful.

## 8. Advertising the Co-operative Research Programme

- **How did you learn about the Co-operative Research Programme?**  
Through my research institution.
- **What would you suggest to make it more “visible”?**  
Promotion via social media.
- **Are there any issues you would like to record?**  
I would like to thank the OECD for this grant and the host institution for this great opportunity.

