



FELLOWSHIP SUMMARY REPORTS

- **Name:** Alfonso Domínguez Padilla
- **Subject title:** Assessing the use of regulated deficit irrigation techniques in water scarce areas (Theme 1. Managing Natural Capital for the Future)
- **Host institution:** USDA-ARS Conservation and Production Research Laboratory (Bushland, Texas)
- **Host collaborator:** Dr. Robert Schwartz
- **Dates:** Fellowship funded by OECD from April 16th to May 28th 2018
- **Consent:** I consent to my report being posted on the Co-operative Research Programme's website





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

The main objective of this project was to investigate the use of MOPECO model in the US southern Great Plains. For reaching this objective, the following sub-objectives were proposed: (i) to adapt and assess MOPECO for reaching a more profitable, efficient and sustainable use of irrigation water in the region; (ii) to calibrate MOPECO for a single crop and determine the potential for calibrations with other regional crops based on available experimental data; (iii) to develop the typical meteorological year for the study area that will allow simulation of crop yield using the ORDI (optimized regulated deficit irrigation) methodology; (iv) to assess the economic viability of using regulated deficit irrigation in the area through the simulation of several scenarios.

Castilla-La Mancha and the US southern Great Plains have similar problems in terms of low water availability and high irrigation requirements that have a considerable impact on the productivity of the agricultural sector and the regional economies. Moreover, these problems are expected to increase due to declining availability of fresh water for irrigation, global warming, and greater food demand in the future. The research project developed during the fellowship has allowed the research team to:

1. Adapt the MOPECO model for simulating the irrigation strategies used by the farmers in the US southern Great Plains when using a center pivot irrigation system for supplying water to a maize crop.
2. Carry out an economic analysis of the impact of decreasing the area irrigated by the center pivot or varying the irrigation dose supplied by the system depending on the available flow of irrigation water.
3. Demonstrate the applicability of MOPECO in US southern Great Plains.
4. Promote the use of MOPECO model developed by CREA.
5. Share solutions and methodologies for confronting low water availability and high irrigation requirements in semiarid agricultural areas.

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?)

Objective i: Yes.

Objective ii: We are finishing the calibration and validation of a maize crop.

Objective iii: Yes.

Objective iv: The preliminary simulations show that it is possible to increase the profitability of the farms by modifying the management of the center pivot irrigation systems, depending on the availability of irrigation water. It is necessary to finish the objective (ii) for obtaining the definitive results.

The short duration of the fellowship and the amount of activities carried out during my stay did not allowed us to finish these objectives, although we hope to finish them in the next months.

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

- Development of a new module compatible with the MOPECO model for simulating the effect of supplying irrigation water by using a center pivot irrigation system (objective i). The use of this module with the typical meteorological year of the area (objective iii), the calibrated parameters of a maize crop in the area (objective ii), and the economic data provided by the research team of the West Texas A&M University (Dr. Guerrero), will allow to determine the management of the standard center pivot in the area that maximizes the profitability of the farms depending on the availability of irrigation water.
- The great number of meetings (10) and the seminar allowed me to get in touch with many researchers of my field of expertise. During the meetings many of the researchers showed interest in promoting future collaborations. Moreover the collaboration between USDA-ARS (Bushland) and CREA, I would like to highlight the high probability of starting collaborations with the Colorado State University (Dr. Chávez).





- The meetings were also used for visiting different experimental farms and laboratories in Bushland, Tribune, Colby, Fort Collins, and Lubbock (see next point). This activity allowed me to familiarize myself with the equipment used by the different research teams as well as the management of the facilities during the studies. In addition, during my stay in the center of Bushland I participated in the seeding of a cotton experiment (May 21th) and in the installation of soil moisture sensors in a continuous weighing lysimeter (May 14th). The experience gained will be applied in our field trials.

4. Will there be any follow-up work?

- o *Is a publication envisaged? Will this be in a journal or a publication? When will it appear?*
Our aim is to publish a JCR paper with the adaptation of the MOPECO model for simulating the effect of irrigating a maize crop using a center pivot irrigation system under the conditions of the US Great Plains, which is an innovation that may help to increase the profitability of the farms in the study area. We hope to submit the paper at the end of 2018 or beginning of 2019.
- o *Is your fellowship likely to be the start of collaboration between your home institution and your host?*
We started our collaboration in 2017 during the fellowship of Dr. Schwartz at CREA. Moreover, thanks to the great amount of contacts carried out during my fellowship, I hope to collaborate with other institutions.

Meetings:

- April 20th Dr. R. Louis Baumhardt from USDA-ARS Conservation and Production Research Laboratory (Bushland, Texas).
- April 20th Dr. Jourdan Bell from USDA-ARS & TAMU AgriLife (Amarillo, Texas).
- April 23rd Dr. Alan Schlegel from Kansas State University, Southwest Research Station – Tribune (Tribune, Kansas).
- April 24th Dr. Freddie R. Lamm from Kansas State University, Northwest Research-Extension Center (Colby, Kansas).
- April 26th Dr. Kendall DeJonge from USDA Agricultural Research Service, Water Management and Systems Research Unit (Fort Collins, Colorado).
- April 26th Dr. José Chávez from Colorado State University, Civil and Environmental Engineering (Fort Collins, Colorado).
- April 30th Dr. Bridget Guerrero from West Texas A&M University, Department of Agricultural Sciences (Canyon, Texas).
- May 10th Dr. Steve R. Evett from USDA-ARS Conservation and Production Research Laboratory (Bushland, Texas).
- May 15th Dr. Robert J. Lascano from USDA Agricultural Research Service, Wind Erosion and Water Conservation Unit (Lubbock, Texas).
- May 15th Dr. Mauricio Ulloa from USDA Agricultural Research Service, Plant Stress and Germplasm Development Research (Lubbock, Texas).

Seminars:

- “May 15th Water management in Spain, and limited irrigation in Castilla-La Mancha” (oral communication) (USDA Agricultural Research Service, Lubbock, Texas).
- o *Is your research likely to result in protected intellectual property, novel products or processes?*
The MOPECO model is a software developed by CREA with a protected intellectual property, which will be improved with the development of the module for simulating a center pivot irrigation system.

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?

MOPECO model was conceived for maximizing the gross margin of irrigated farms, especially in arid or semiarid areas with water scarcity and/or high crop production costs that may affect the profitability of agricultural activities. To reach this objective, the model optimizes the use of available irrigable area and volume of irrigation water. The adaptation of this model to the farming conditions of the US Great Plains may be translated into a greater profitability and efficiency in the use of irrigation water, which may increase the profitability of the irrigated farms in the area and decrease the pressure on the natural water resources through a lower water footprint.





Moreover, the validation of the model in an area with climatic and management differences with regards the one where MOPECO was developed, increases its ability for being used in a wider range of agricultural systems. This result enforces the objective of developing a simplified online version of MOPECO to be used by the productive sector as a decision support system.

6. How was this research relevant to:

o The objectives of the CRP?

The results of the project improve the three main objectives of the CRP:

Sustainability: by improving the efficiency in the use of cultivable area and irrigation water.

Food security: by increasing the yield of the farms by using the same amount of natural resources (land and water).

Nutrition: according to the results of other experiments, the quality of the harvests is not affected by the methodologies proposed by the MOPECO model.

o The CRP research theme?

The results of this project have impact on two of the main natural resources considered in “Theme I. Managing Natural Capital for the Future”:

Water.

Improvement of water use efficiency entails attaining the same yield with less irrigation or alternatively increasing yield with the equivalent irrigation water. The former case results in a decrease in demand for natural water resources. ,

Integrated Agricultural Production Systems.

The adaptation of the MOPECO model to the conditions in the US Great Plains will improve the efficiency in the use of agricultural land and fresh water for irrigation.

Consequently, depending on the situation, the water authorities may propose policies focused on: a) decreasing the pressure on land and water resources keeping the profitability of the farms; b) increasing the profitability of the farms for promoting the establishment of the rural population in the area by using the same amount of natural resources; or c) a combination of both options.

7. Satisfaction

o Did your fellowship conform to your expectations?

The experience was better than expected, mainly thanks to my host Dr. Schwartz. He prepared for me a nice office at the research centre, he organized a lot of meetings with other researchers and visits to different research centres, the people at USDA involved me in their current tasks, we hope to publish a paper that will promote the model we are developing at CREA, and I am sure this fellowship has helped strengthen the collaborations among UCLM, USDA and other US Universities.

o Will the OECD Co-operative Research Programme fellowship increase directly or indirectly your career opportunities?

ANECA (Spanish accreditation and quality evaluation agency) considers as a merit for future promotions the fellowship of professors in recognized foreign research institutions, the publication of high JCR quality papers with foreign researchers, and the invitation to impart a conference.

o Did you encounter any practical problems?

No.

o Please suggest any improvements in the Fellowship Programme.

In my opinion, the minimum fellowship should be 1 month instead of 6 weeks. For senior researchers and university professors may be difficult to coordinate their normal activities with a longer fellowship (coordination of research teams, teaching, serving students...).





8. Advertising the Co-operative Research Programme

- *How did you learn about the Co-operative Research Programme?*
Through the fellowship of Dr. Robert Schwartz.

- *What would you suggest to make it more “visible”?*
It is difficult for researchers and professors to know all the institutions offering this type of programmes. However, universities usually have sections dedicated to these tasks and they are in charge of informing the faculty about the calls, as well as supporting them in preparing the documents. I suggest to contact these sections in order to increase the dissemination of this interesting program.

- *Are there any issues you would like to record?*
During the meetings with other US researchers, one of the problems we detected is the lack of programs offering funding to carry out joint research projects between USA and European research teams. Therefore, I encourage OECD to develop a programme focused on promoting the development of research projects among research teams of countries belonging to the OECD.

Finally, I wish to thank OECD and particularly to Mrs. Nathalie Elisseou, their help and support for this great professional and personal experience.

