AGRIBALYSE WATER scarcity assessment project: integrating water consumption LCI data to support ecodesign of farming systems in France

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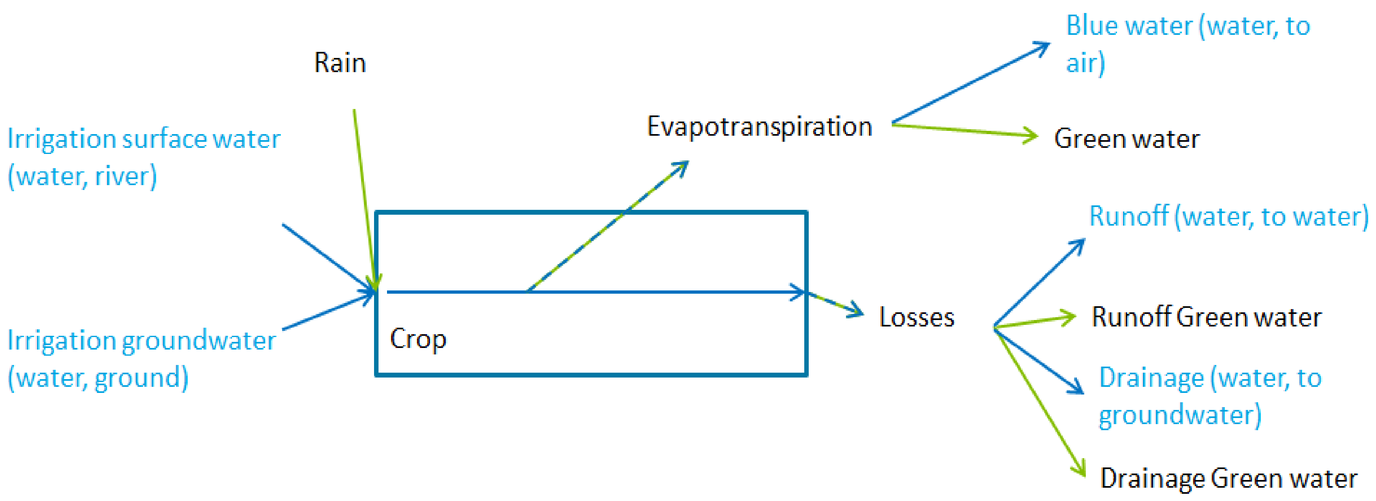
The AGRIBALYSE LCI database aims to contribute to the development of LCAs for the eco-design of agricultural products on the French scale. In order to integrate the water resource into the database in a way that meets the expectations of the ISO 14046 standard, the AGRIBALYSE WATER project has selected and parametrized CROPWAT model to calculate the water consumption of the 8 crops and 2 animal studied productions.
Results show improved water LCI for the crops due to the better consideration of irrigation need that were calculated precisely for different French regions and crop practice management.

Defining and setting up the parameters for an LCI calculation tool

We defined a list of elementary flows according to the AWARE characterization method (WULCA 2015) and ecoinvent database structure. We then chose Cropwat as the emission calculation model, namely the agricultural system water consumption model, that was implemented in MEANS InOut, an INRA LCI calculation tool.

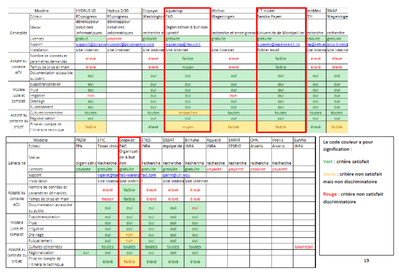
1 Specification of the elementary water flows



Blue arrows represent blue water flows, i.e water withdrawn from rivers and undergrounds. Green arrows represent green water, i.e rainwater that is stored in the upper layers of soil and vegetation.
Only blue water flows are taken into account for impact calculation.

2 Selection of Cropwat

Using a **grid of criterias**, the FAO irrigation tool was identified as the most suitable model for the calculation of the elementary flows.



CROPWAT version 8.0

3 Adaptations to French and LCA context

Parameters adapted to the **French territory** and to the **different scenarios** were chosen

- Kc Crop coefficient
- Cultivation period
- Irrigation methods and practices
- Soil characteristics (depth, water storage capacity…)

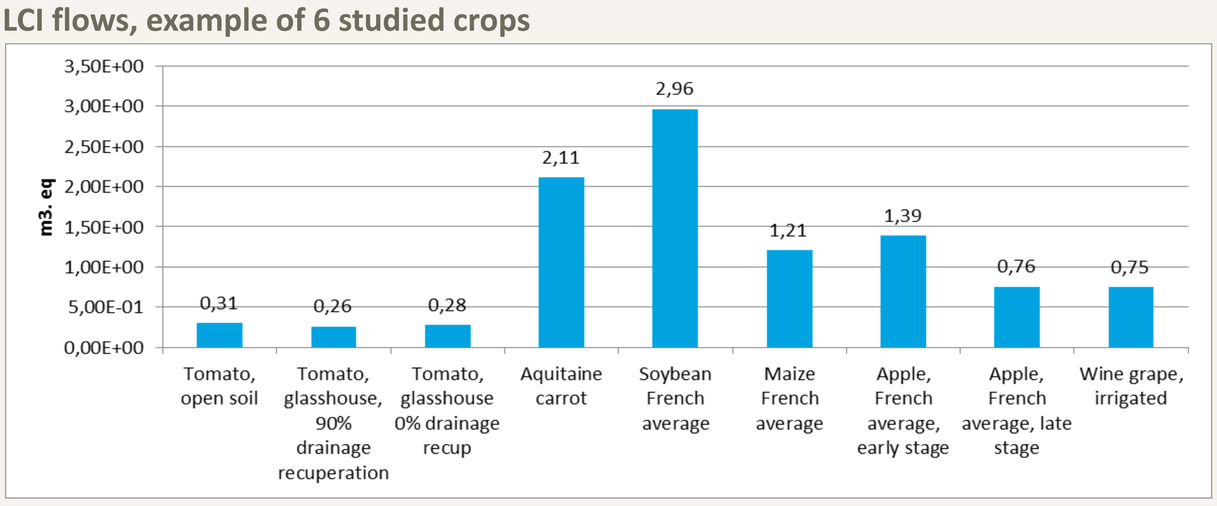
4 Integration in MEANS and calculations

MEANS

Finally, the adapted model was integrated into **MEANS In-Out.** Using climatic data (rain, Et0) from local meteorological stations, the model calculated the crop water needs, evapotranspiration, run off and drainage. These flows were then used to generate the LCIs and the impacts.

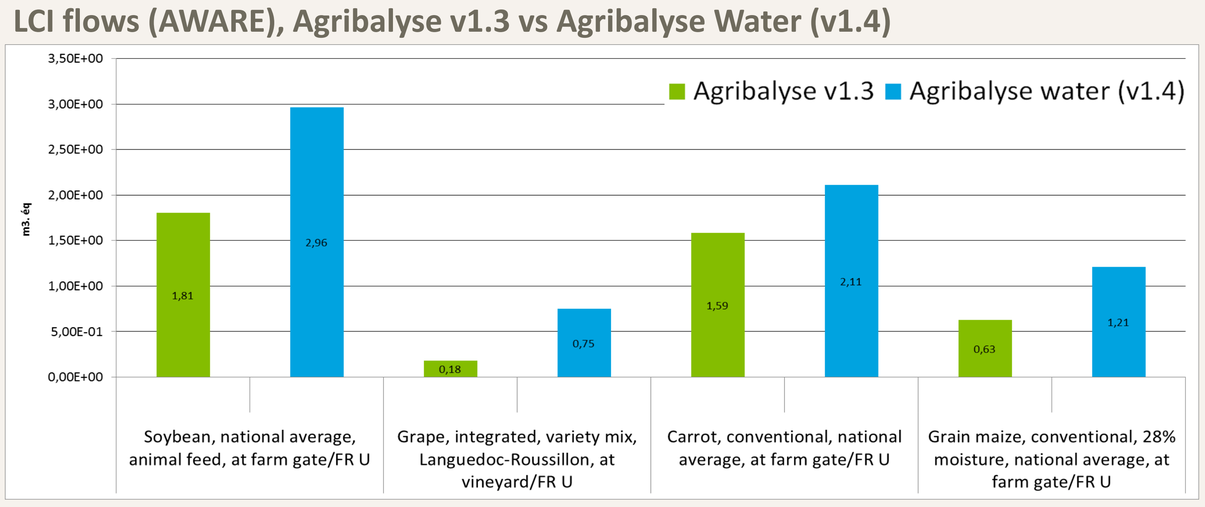
Results of LCI calculations for six different crops

LCI flows, example of 6 studied crops



Using the AWaRe method, the technical institutes calculated 70 different LCIs some of which were gathered to calculate a French average LCI for the crops and animal productions.
They show substantial differences between the crops with soybean, apple, carrot and corn that appear as the most important water users whereas tomato and wine seem to be the least consuming ones.

LCI flows (AWARE), Agribalyse v1.3 vs Agribalyse Water (v1.4)



The newly generated LCIs show a significant increase of the result when compared to the previously used LCIs in Agribalyse which is explained by the fact that the quality of the irrigation elementary flow was greatly improved and that evapotranspiration; drainage and run-off flows have been added.

Discussion

Improvement possibilities still remain such as the consideration of crop management practices that could have consequences on the use of water (tillage, vegetation cover ...), these practices are not taken into account as they necessitate more complex models and data. Better calculations of the drainage and run-off flows may also be considered as presently, a ratio based on the Quantis WFLDB is used (80% run-off, 20% drainage). As currently used impact calculation methods do not take into account the destination of the water losses, this improvement can be postponed until further development of the calculation methods.
Origin of water (underground, river etc.) may also be taken into account with more accuracy on the basis of the ELSA Water Supply Mix work (Leão et al. 2017).

Conclusion

The project resulted in choosing Cropwat model, as a calculation tool to be integrated into MEANS InOut platform, the INRA LCI agricultural calculation tool. Cropwat was improved for LCI implementation and tested on several crops from AGRIBALYSE database: corn, soybean, carrots, apples, tomatoes, wine grapes and cattle productions. The results highlight the need for accurate parametrization of water models, as it has a strong influence on the impact indicators.
Thus, this project contributes to better data for French agricultural productions. MEANS-InOut is now available for agricultural stakeholders to perform robust water footprint assessments allowing sound interpretation of the results. It is now "relatively" easy to adapt MEANS-InOut to other crop or conditions. Coverage of the entire AGRIBALYSE product for water data remain to be done in coming years.