UNIVERSITY OF TWENTE.

Linking the green-blue soil water distinction to AquaCrop

Package 7 (M1-M48) Assessment (UT)

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FIGARO PRECISION IRRIGATION TECHNOLOGIES

Content

- Structure of data supply to AquaCrop
- Approach to link green/blue water separation to AquaCrop
- Follow-up

Location

Scale -Spatial (Field, basin)

- Time

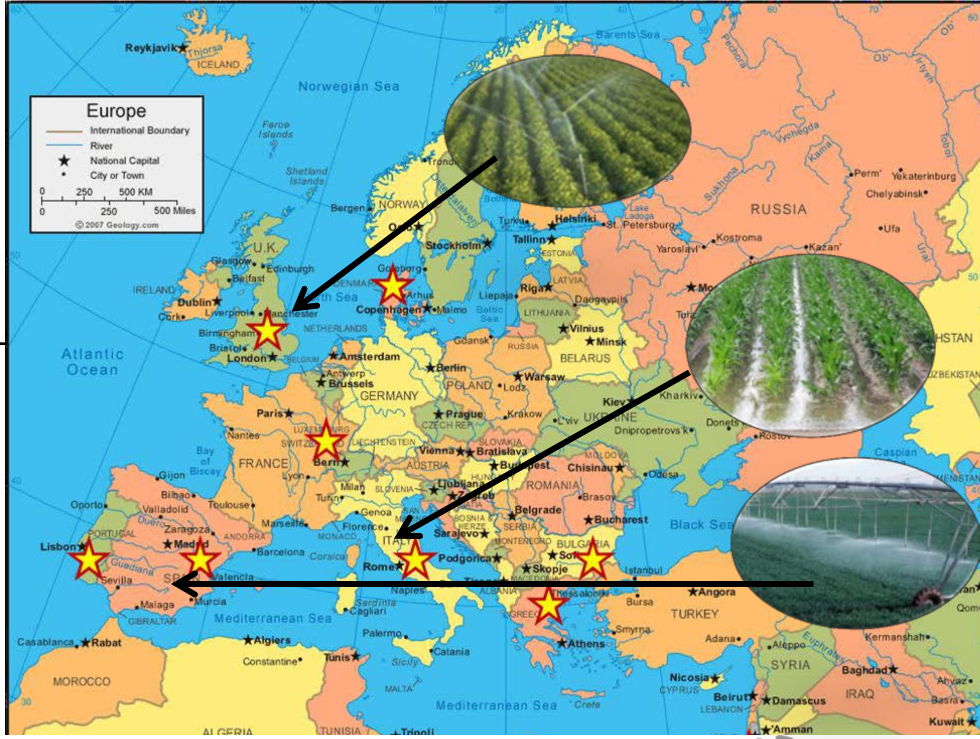
- Treatment (Existing + FiGARO test + other possibilities)

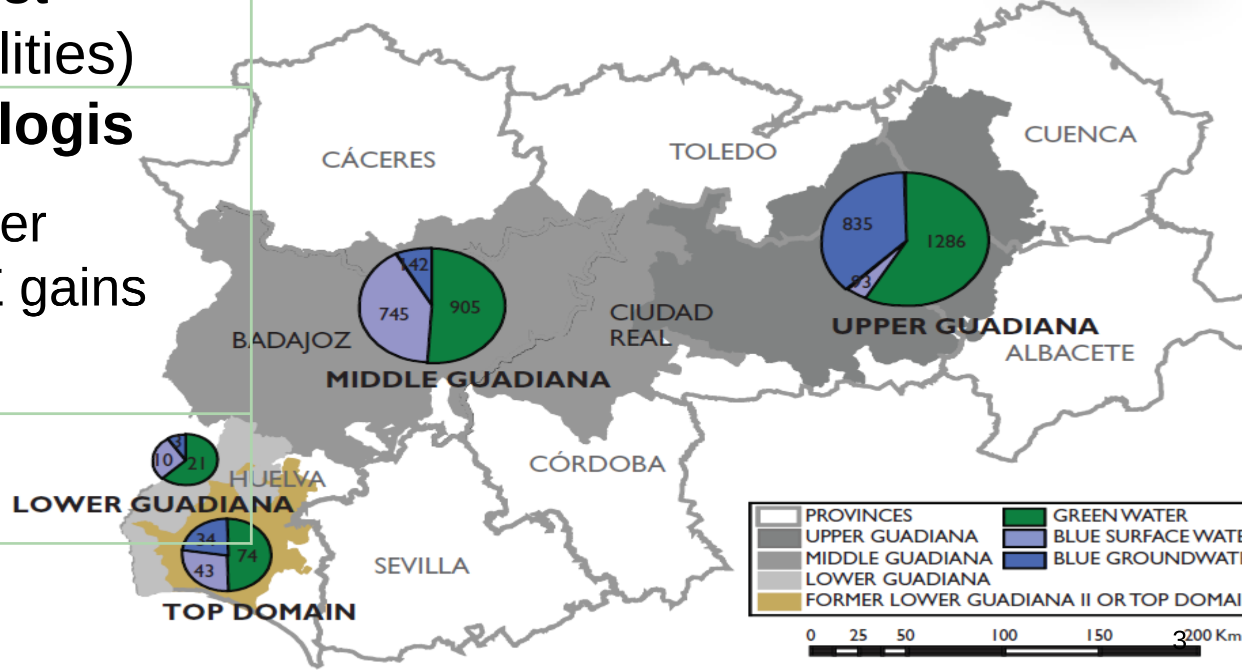
Models and methodologis

- Assessing potential water footprint reduction / WUE gains

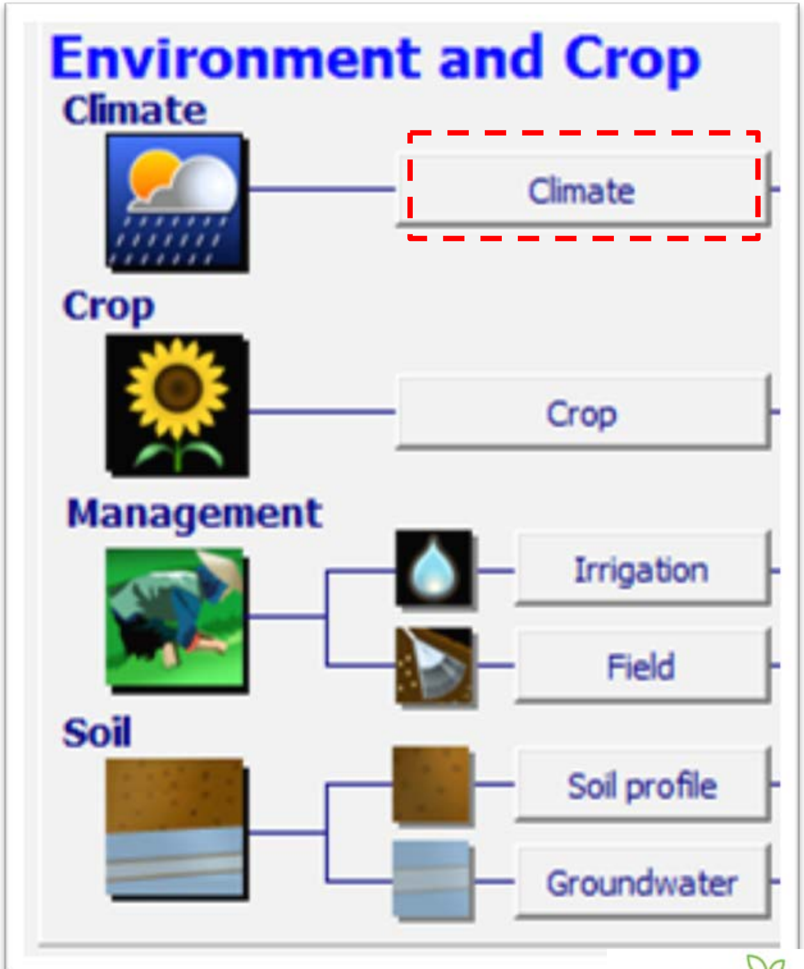
- Water saving

Data: Global/Local





Structure of data supply to AquaCrop

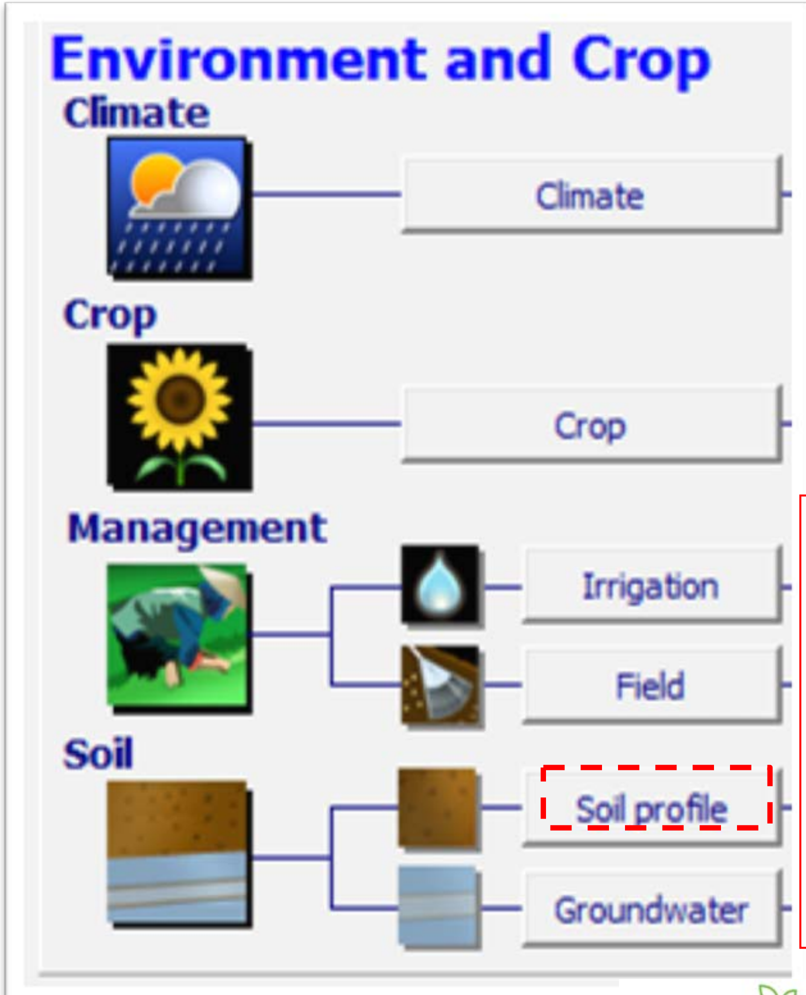


Grid and Observed dataset

The Royal Netherlands Meteorological Institute (KNMI), the European Climate Assessment & Dataset. (0.25 by 0.25 deg)

http://www.ecad.eu/dailydata/index.php
http://climexp.knmi.nl/selectdailyseries.cgi

Structure of data supply to AquaCrop



Crop: FAO database and local condition

Irrigation and field: Existing irrigation practices and

European Soil Database Raster Library 1kmx1km
http://eusoils.jrc.ec.europa.eu/ESDB_Archive/ESDB_Data_Distribution/ESDB_data.html
the 5 by 5 arc-minutes global grid

Approach to link green/blue separation to AquaCrop

Assumptions: the green and blue water fluxes in the root zone

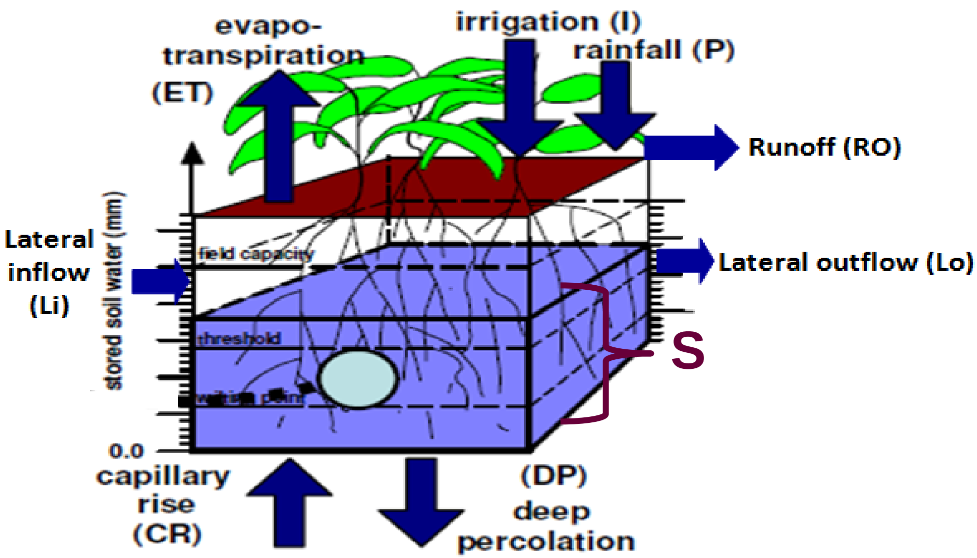
- The green and blue part of drain and ET are estimated based on the relative amount of the green and blue soil water storage to the total soil water storage

- The initial or carry over soil moisture is considered to be green water and the blue water at this stage is zero. $(S_T)_0 = (S_g)_0 = \theta_i$; $(S_b)_0 = 0$

- The origin of the RO as green (rain) and/or blue (surface water/groundwater) is estimated by dividing the amount **of rain** and **irrigation** to their sum respectively.
- CR, lateral flows are considered to contribute to the blue part of soil water storage.

Approach to link green/blue soil water separation to AquaCrop

The green and blue water fluxes in the root zone



$$(ET_g)_i = \left(\frac{S_g}{S}\right)_{i-1} * ET_i \text{ and } (ET_b)_i = \left(\frac{S_b}{S}\right)_{i-1} * ET_i$$

The green and blue consumptive water use (ET)

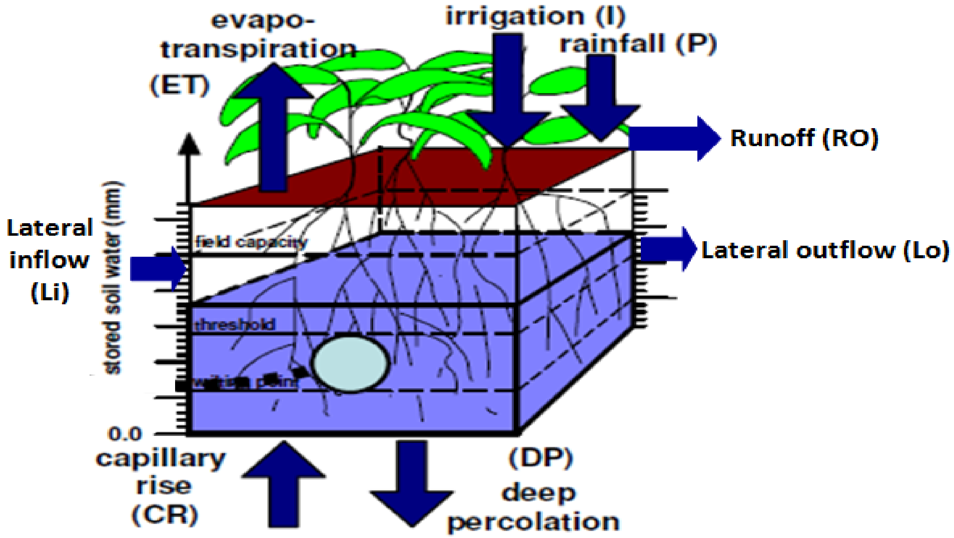
CR, capillary rise, contributes to the blue water

$$(Dr_g)_i = \left(\frac{S_g}{S}\right)_0 * Dr_i \text{ and } (Dr_b)_i = \left(\frac{S_b}{S}\right)_0 * Dr_i$$

The green and blue drain water respectively

Approach to link green/blue separation to AquaCrop

The green and blue water fluxes in the root zone

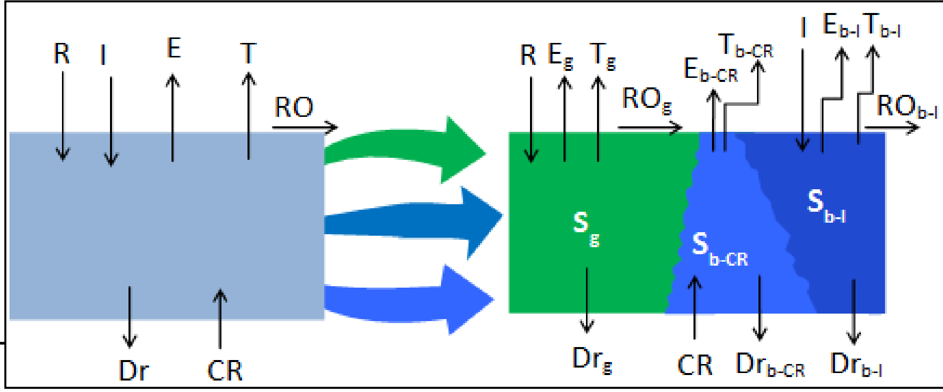


$$(RO_g)_i = \left(\frac{R}{I+R}\right)_i * RO_i \text{ and } (RO_b)_i = \left(\frac{I}{I+R}\right)_i * RO_i.$$

The runoff of green and blue water origin respectively, column 3 and 4

This is used to compute the change in the green and blue soil water respectively

Approach to link green/blue separation to AquaCrop



$$(\Delta_g S)_i = R_i - (Dr_g)_i - (RO_g)_i - (ET_g)_i$$

Change in the green soil water storage

$$(\Delta\Delta_b)_i = I_i + CR_i - (Dr_b)_i - (ET_b)_i - (RO_b)_i + (Li)_i - (Lo)_i$$

Change in the blue soil water storage

$$(S_g)_i = (S_g)_{i-1} + (\Delta S_g)_i$$

The green soil water storage at $i+1$ time step is the previous (at i time step) plus the change

$$(S_b)_i = (S_b)_{i-1} + (\Delta\Delta_b)_i$$

The blue soil water storage at $i+1$ time step is the previous (at I time step) plus the change

$$S_i = (S_g)_i + (S_b)_i$$

The total soil water storage at $i+1$ time step is the sum of the green and blue soil water at $i+1$ time step

Approach to link green-blue separation to AquaCrop

The green and blue water footprint described as a function of the green and blue water fluxes of the root zoon

$$WF_g = \sum_{i=1}^{n} \frac{(ET_g)_i}{Y}; \quad n = \text{number of days from sawing to harvesting}$$

$$WF_g = \sum_{i=1}^{n} \frac{(\frac{S_g}{S})_{i-1} * ET_i}{Y};$$

$$WF_g = \frac{(\frac{S_g}{S})_0 * ET_1}{Y} + \sum_{i=2}^{n} \frac{(\frac{S_g}{S})_{i-1} * ET_i}{Y}; \ (Sg)_0 = (S)_0 = \theta_i$$

$$WF_g = \frac{ET_1}{Y} + \sum_{i=2}^{n} \frac{\left[\frac{(S_g)_{i-2} + R_{i-1} - (Dr_g)_{i-1} - (RO_g)_{i-1} - \left(\frac{S_g}{S}\right)_{i-2} * ET_{i-1}}{S_{i-1}}\right] * ET_i}{Y}$$

$$WF_b = \sum_{i=1}^{n} \frac{(ET_b)_i}{Y}; \quad n = number\, of\, days\, from\, sawing\, to\, harvesting$$

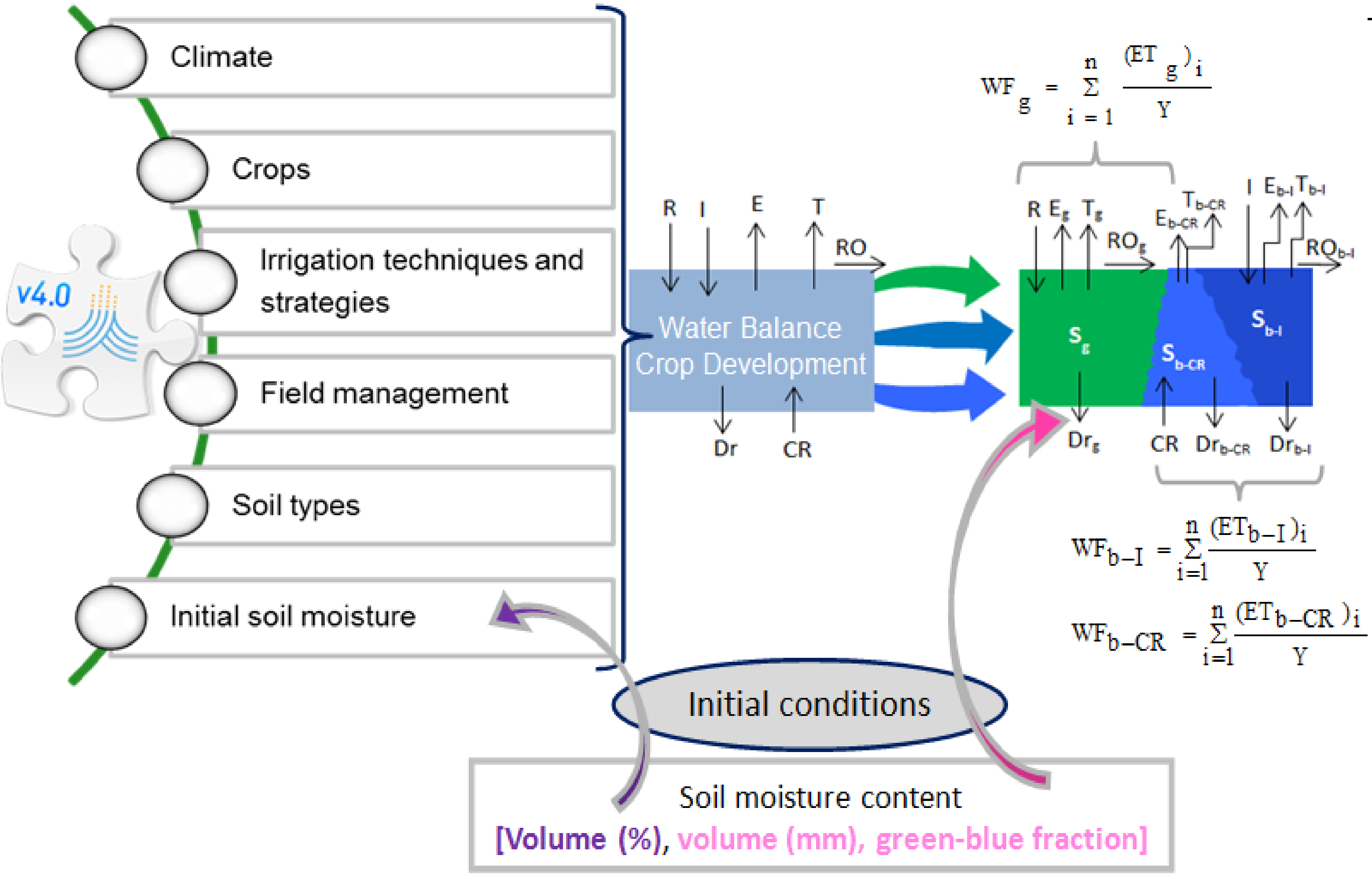
$$WF_b = \sum_{i=1}^{n} \frac{(\frac{S_b}{S})_{i-1} * ET_i}{Y}; \qquad WF_b = \sum_{i=1}^{1} \frac{(\frac{S_b}{S})_{i-1} * ET_i}{Y} + \sum_{i=2}^{n} \frac{(\frac{S_b}{S})_{i-1} * ET_i}{Y}$$

$$WF_b = \frac{(\frac{S_b}{S})_0 * ET_1}{Y} + \sum_{i=2}^{n} \frac{[\frac{(S_b)_{i-2} + (\Delta S_b)_{i-1}}{S_{i-1}}] * ET_i}{Y}; (\mathrm{S_b})_0 = \mathrm{S} = 0$$

$$WF_b = \sum_{i=2}^{n} \{[\frac{(S_b)_{i-2} + I_{i-1} + CR_{i-1} - (Dr_b)_{i-1} - \left(\frac{S_b}{S}\right)_{i-2} * ET_{i-1} - (RO_b)_{i-1} + (Li)_{i-1} - (Lo)_{i-1}}{S_{i-1}}] * ET_i\} * \frac{1}{Y}$$

Follow-up

Model run and implement methodologies for the assessment : potential water footprint reduction



Thank You