CONFERENCE

# IRRIGATION

## QUELLES STRATÉGIES POUR ÉCONOMISER L'EAU ?

## WHAT STRATEGIES FOR WATER SAVINGS ?

*REGARDS CROISÉS EUROPÉENS*

*SHARING EUROPEAN VIEWS*



**13 - 14**

nov. 2019

MONTPELLIER

FRANCE

irstea LA SCIENCE AU CŒUR DE L'ENVIRONNEMENT

l'Europe s'engage en Occitanie

UNION EUROPÉENNE

La Région Occitanie Pyrénées · Méditerranée

PROJET COFINANCÉ PAR LE FONDS EUROPÉEN AGRICOLE POUR LE DÉVELOPPEMENT RURAL
L'EUROPE INVESTIT DANS LES ZONES RURALES

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

RéseauRural Français 2014 - 2020

MUSE MONTPELLIER UNIVERSITY OF EXCELLENCE

KEY INITIATIVE WATERS

INVESTISSEMENTS D'AVENIR

G-eau Gestion de l'Eau, Acteurs, Usages

Montpellier SupAgro

AFEID Association Française pour l'Eau, l'Irrigation et le Drainage

AIRMF Association des Irrigants des Régions Méditerranéennes Françaises

AGRICULTURES & TERRITOIRES CHAMBRE D'AGRICULTURE OCCITANIE

AGRICULTURES & TERRITOIRES CHAMBRE D'AGRICULTURE PROVENCE-ALPES-CÔTE D'AZUR

AQUA VALLEY

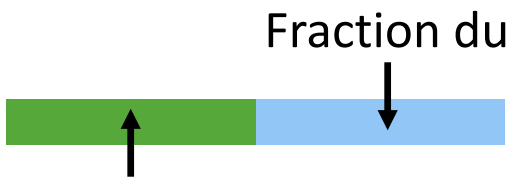
# Irrigation efficiency and optimization
# The Optirrig model

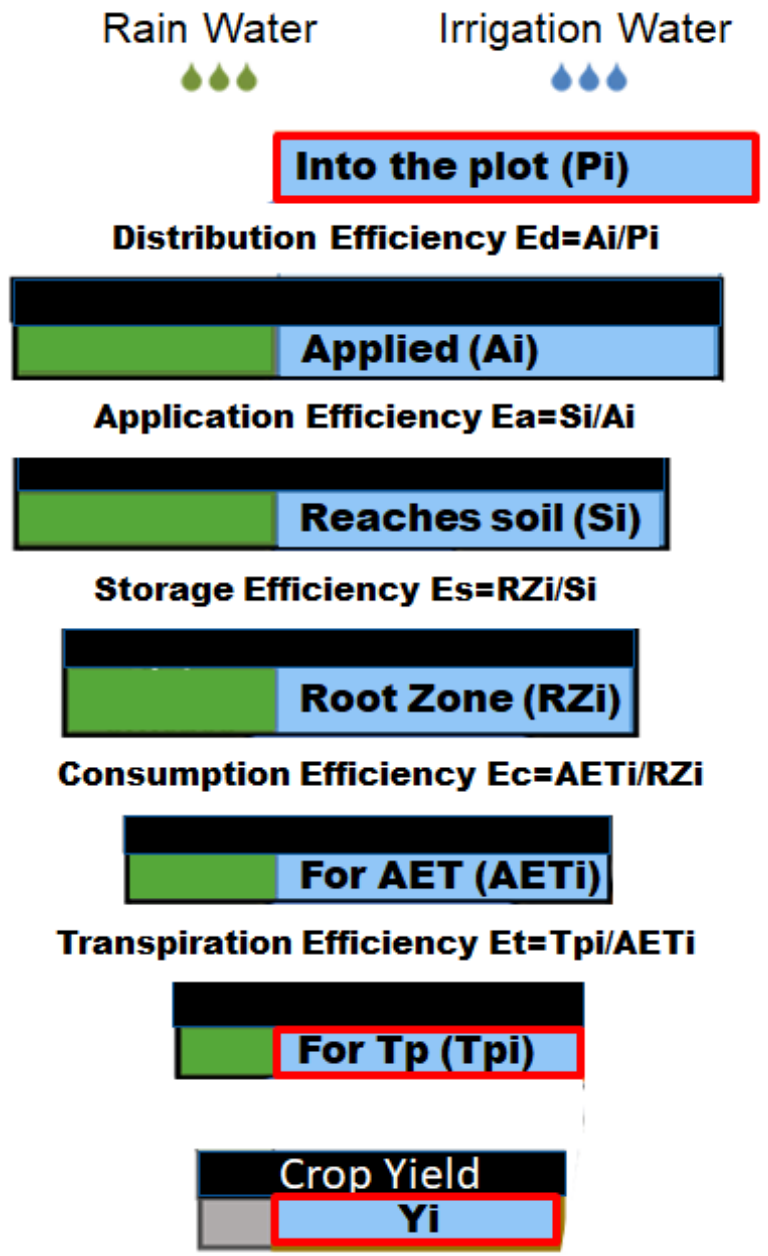
Bruno Cheviron, Claire Serra-Wittling, Juan-David Dominguez-Bohorquez,
Magalie Delmas, Bruno Molle

# Water savings from improvements of…
# Irrigation efficiency

As defined in the "cascade scheme" of Serra-Wittling & Molle 2017
[Invited report for the French Ministry of Agriculture]

Color code



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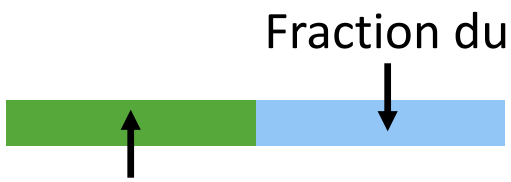
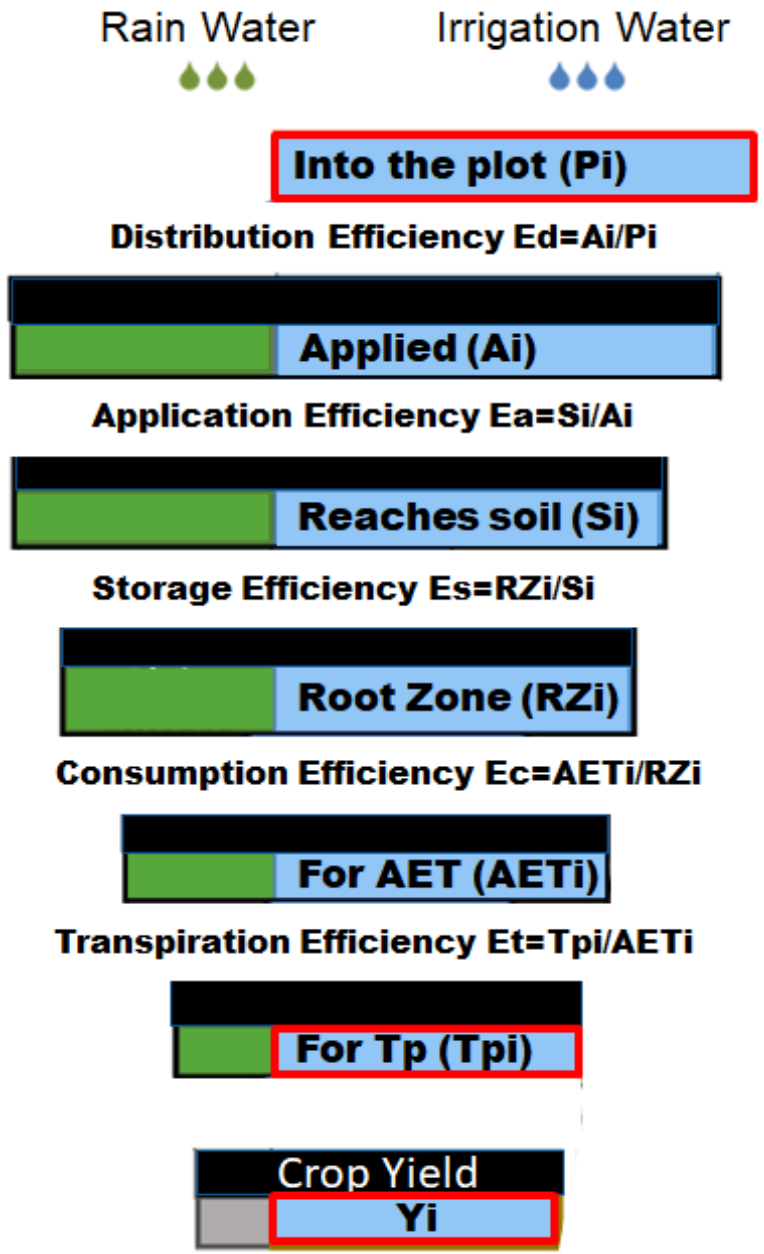
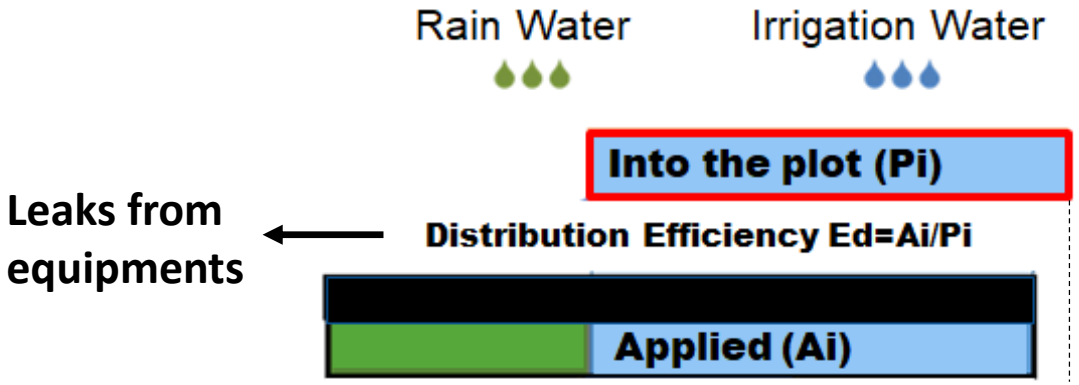



Rationale

- ✓ Calculation of efficiencies and losses in 5 successive stages from irrigation water distribution to crop transpiration
- ✓ Complete mixing of rain water (RW) and irrigation water (IW) in soil with time-variable volume fractions carried on through the "cascade scheme"
- ✓ Challenge for metrology and modelling: quite tricky to code but physically sound and yields promising results



# Water savings from improvements of…
# Irrigation efficiency




*Stage 1*

E=Ed=Ai/Pi

*Applied* *Brought in*

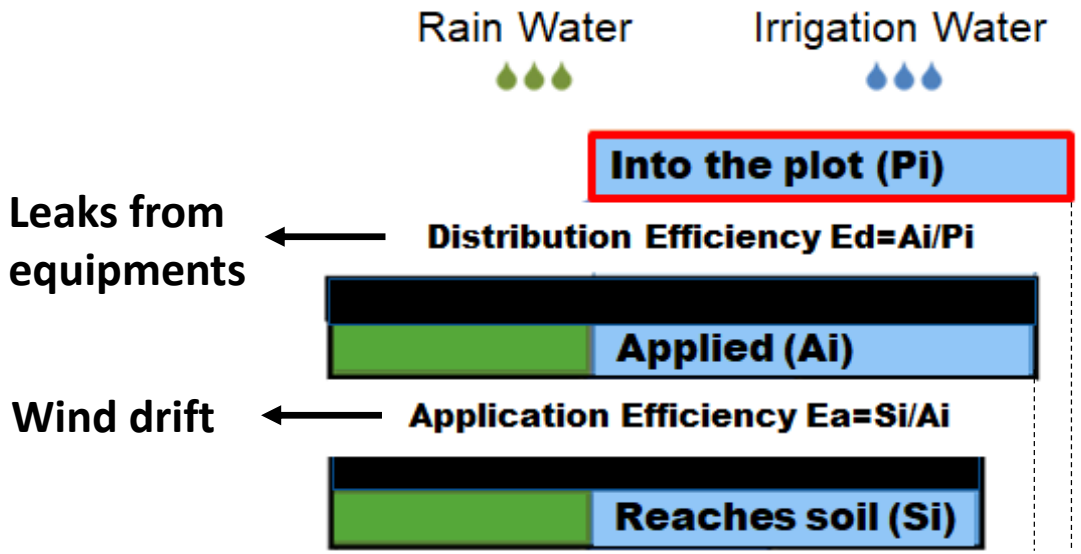
# Water savings from improvements of…

# Irrigation efficiency

*Stage 2*

$$E = Ed.Ea = Si/Pi$$

*Reaches soil* *Brought in*

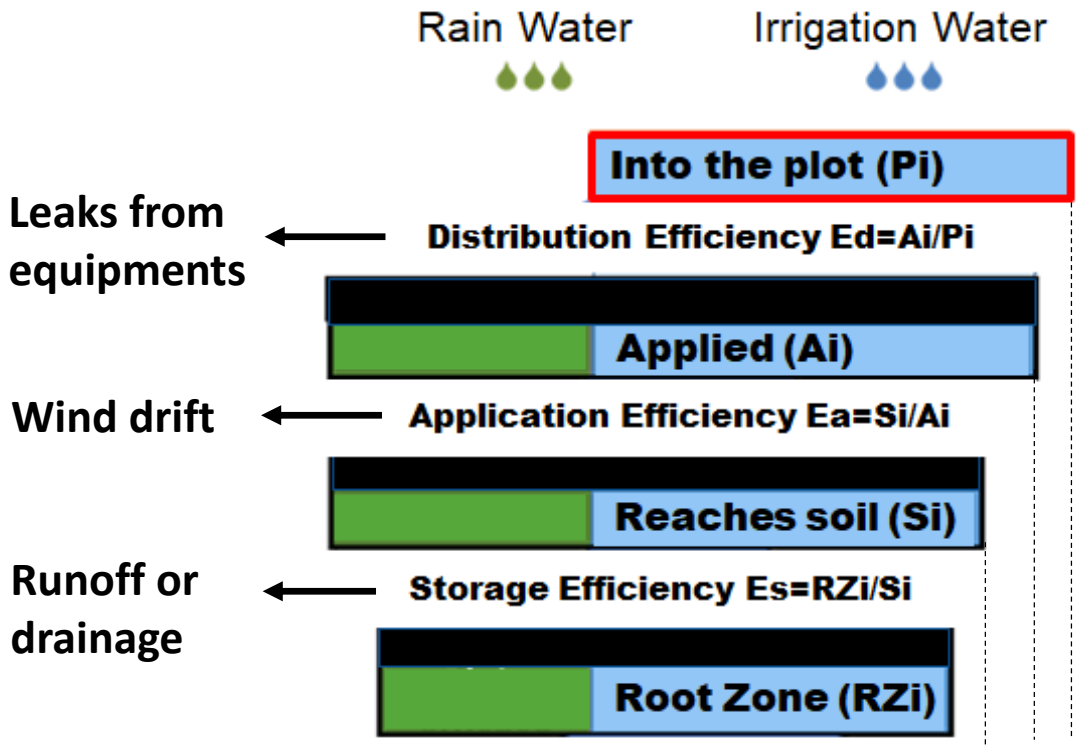


# Water savings from improvements of…
# Irrigation efficiency

*Stage 3*

E=Ed.Ea.Es=Rzi/Pi

*Stored in root zone* *Brought in*



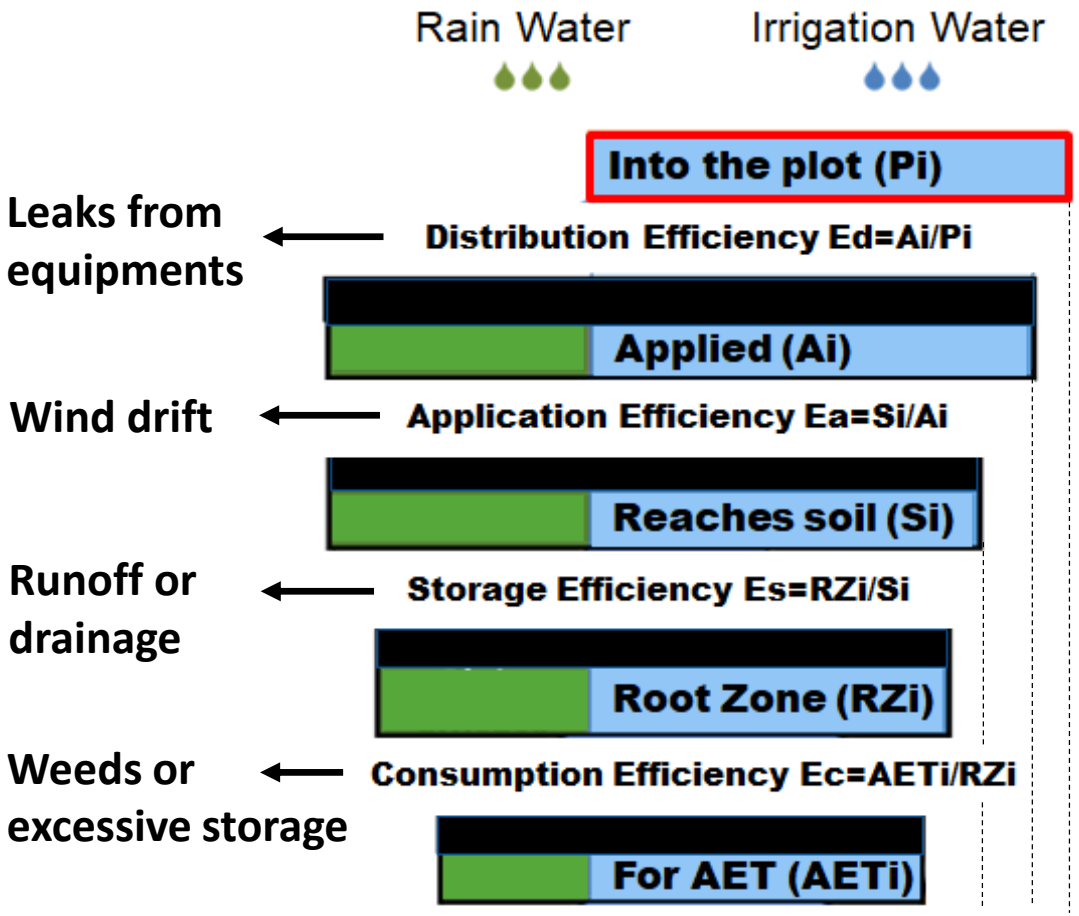
# Water savings from improvements of…

# Irrigation efficiency

*Stage 4*

$$E = Ed.Ea.Es.Ec = AETi/Pi$$

*Evapotranspirated* *Brought in*

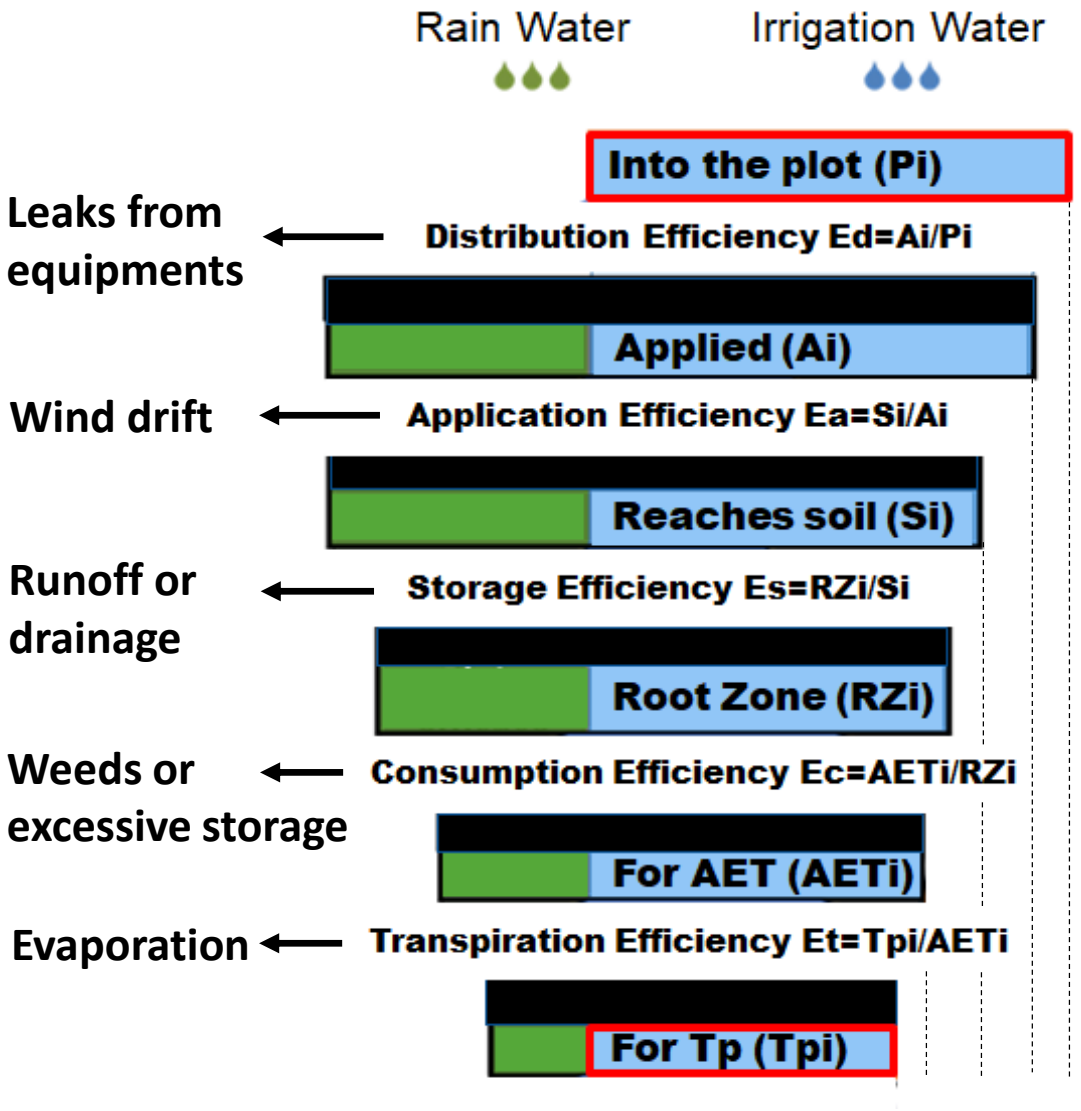


# Water savings from improvements of…
# Irrigation efficiency

*Stage 5*

E=Ed.Ea.Es.Ec.Et=Tpi/Pi

*Finally transpirated* — *Brought in*



# Water savings from improvements of…
# Irrigation efficiency

*Stage 5*

$$E=Ed.Ea.Es.Ec.Et=Tpi/Pi$$

$$E=[0,1] \times \ldots \times [0,1] \in [0,1]$$

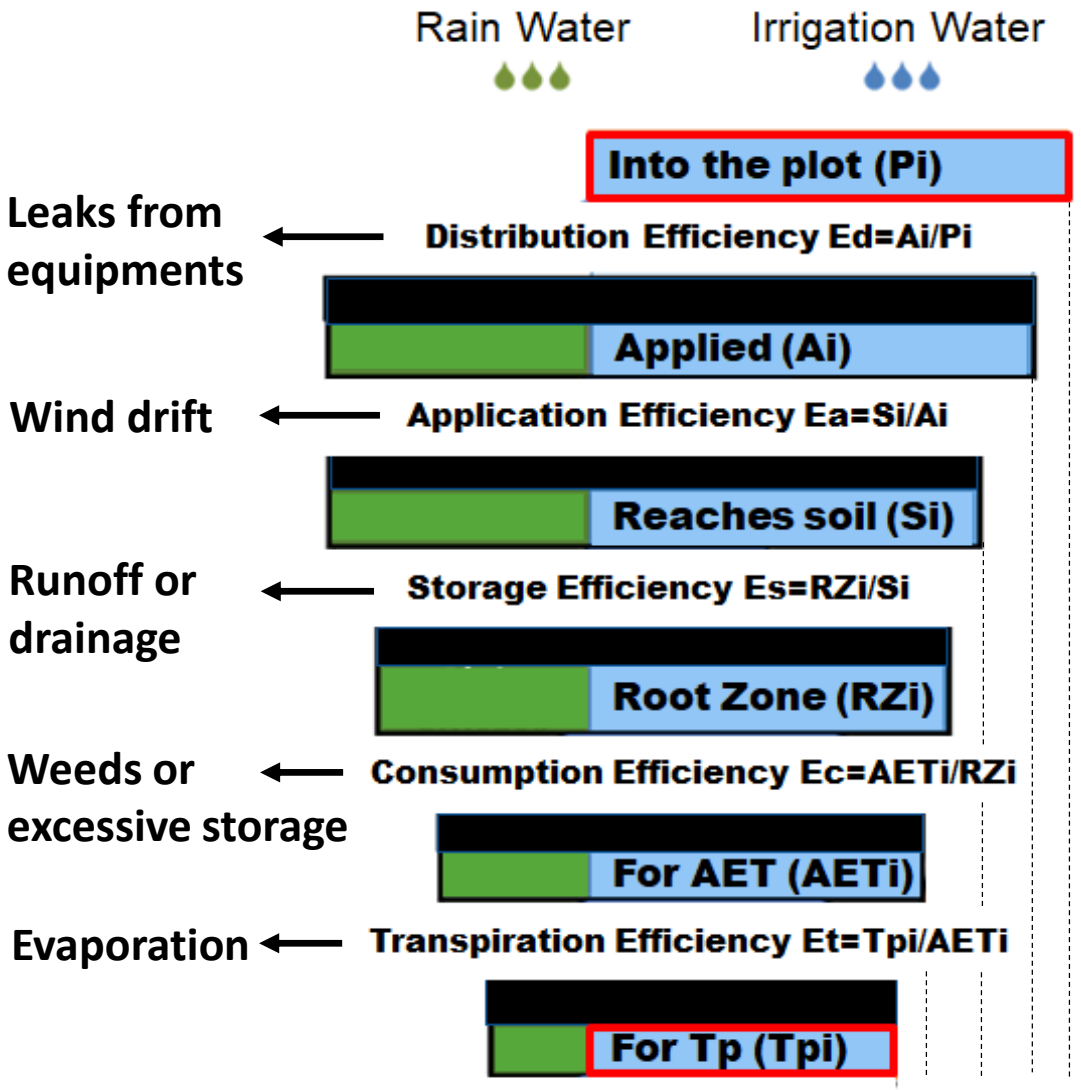
Examples

$E=0.90^5 = 0.69$

$E=0.75^5 = 0.24$

Real-life realistic range

Quite drastic effect, nope?



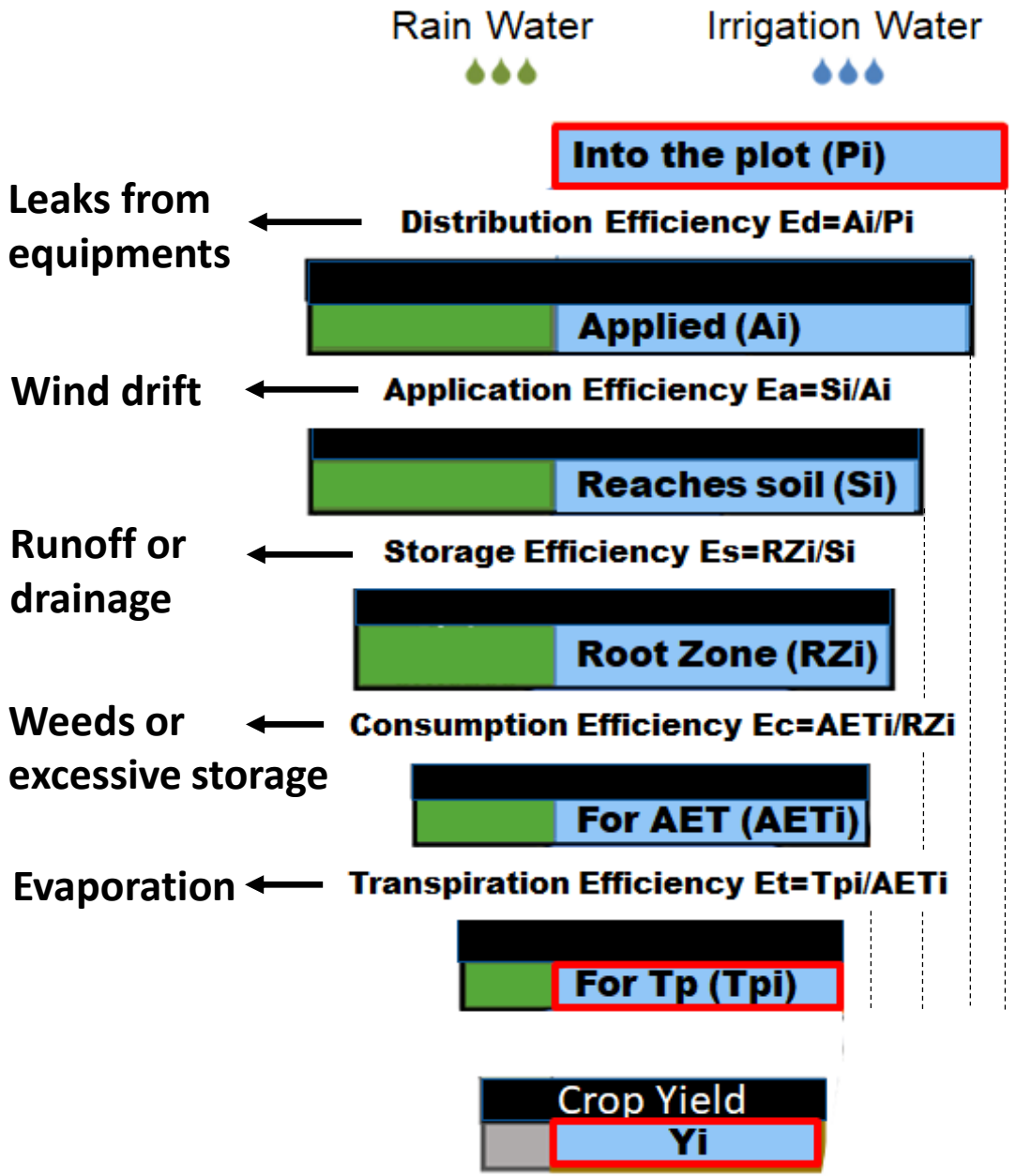
# Water savings from improvements of...
# Irrigation efficiency

*Stage 5*

E=Ed.Ea.Es.Ec.Et=Tpi/Pi

| | |
|---|---|
| Efficiency E=Tpi/Pi | mm/mm or [-] |
| Productivity P=Yi/Pi | (ton/ha)/mm |
| Profitability F=Fi(Yi)/Pi | (€/ha)/mm |

"Then I should definitely increase my irrigation water efficiency"



# Water savings from improvements of...
# Irrigation efficiency

*Stage 5*

E=Ed.Ea.Es.Ec.Et=Tpi/Pi

| | |
|---|---|
| Efficiency E=Tpi/Pi | mm/mm or [-] |
| Productivity P=Yi/Pi | (ton/ha)/mm |
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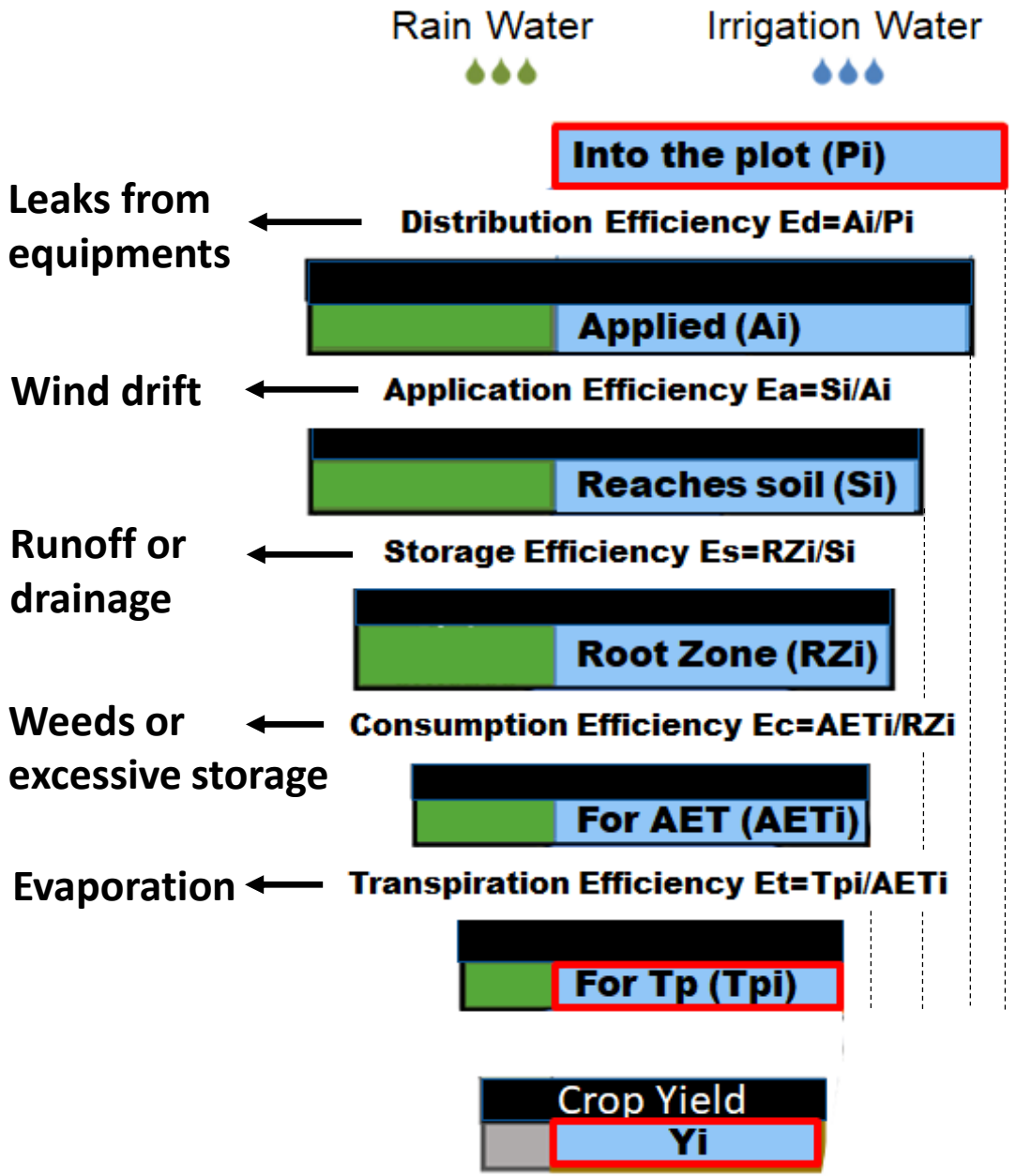
"Then I should definitely increase my irrigation water efficiency"

"Yes buddy and you should really start by reducing the losses"



# Water savings from improvements of…
# Irrigation efficiency

***Technical losses***

*Various upstream losses*

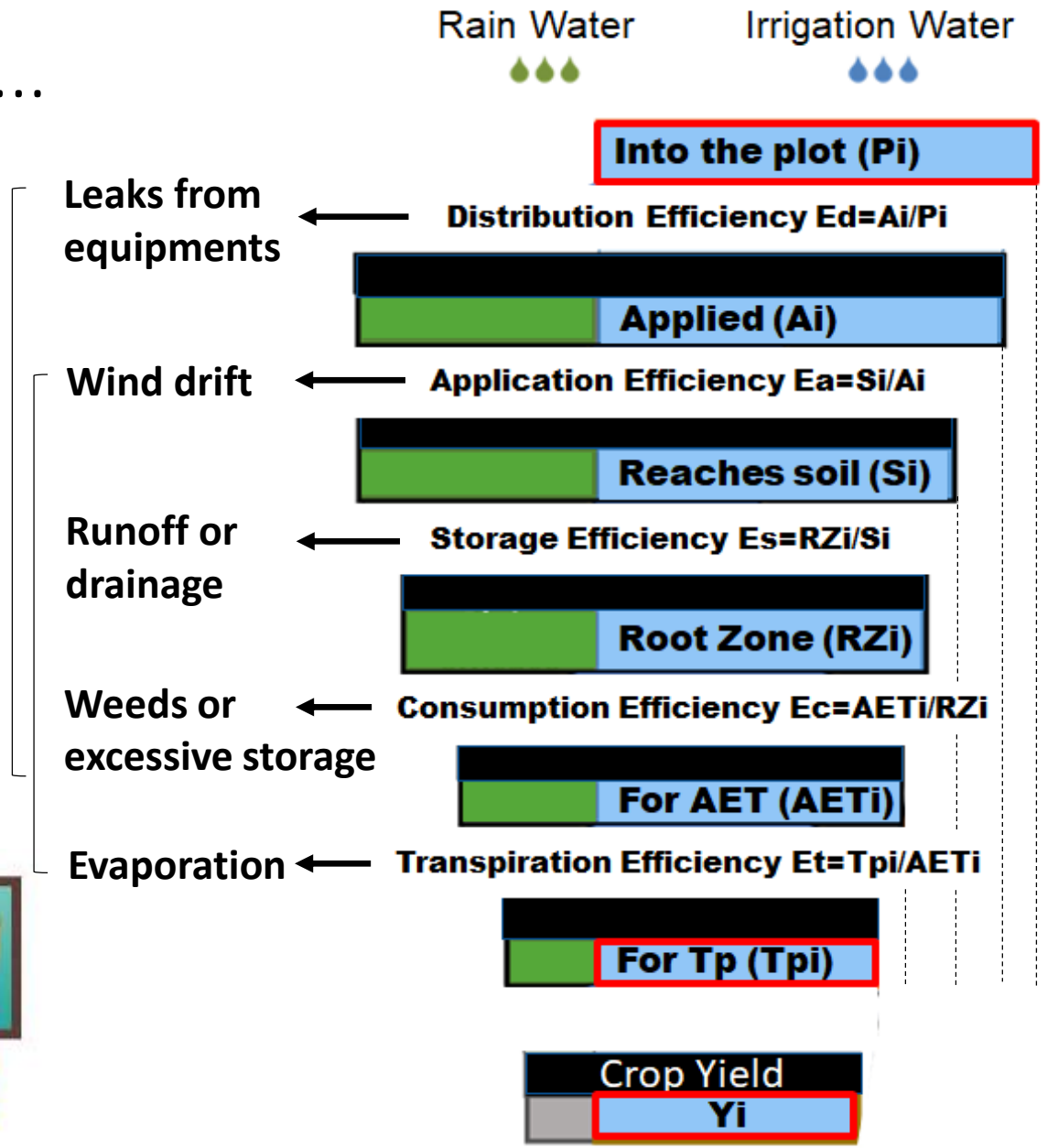
*Improper, defective or miscontrolled plot equipment*

***Tactical losses***

*Dummy, default or too constrained irrigation strategy*

"Then I should definitely increase my irrigation water efficiency"

"Yes buddy and you should really start by reducing the losses"



# Water savings from improvements of…
# Irrigation efficiency


***Generation, analysis & optimization of crop irrigation scenarios***

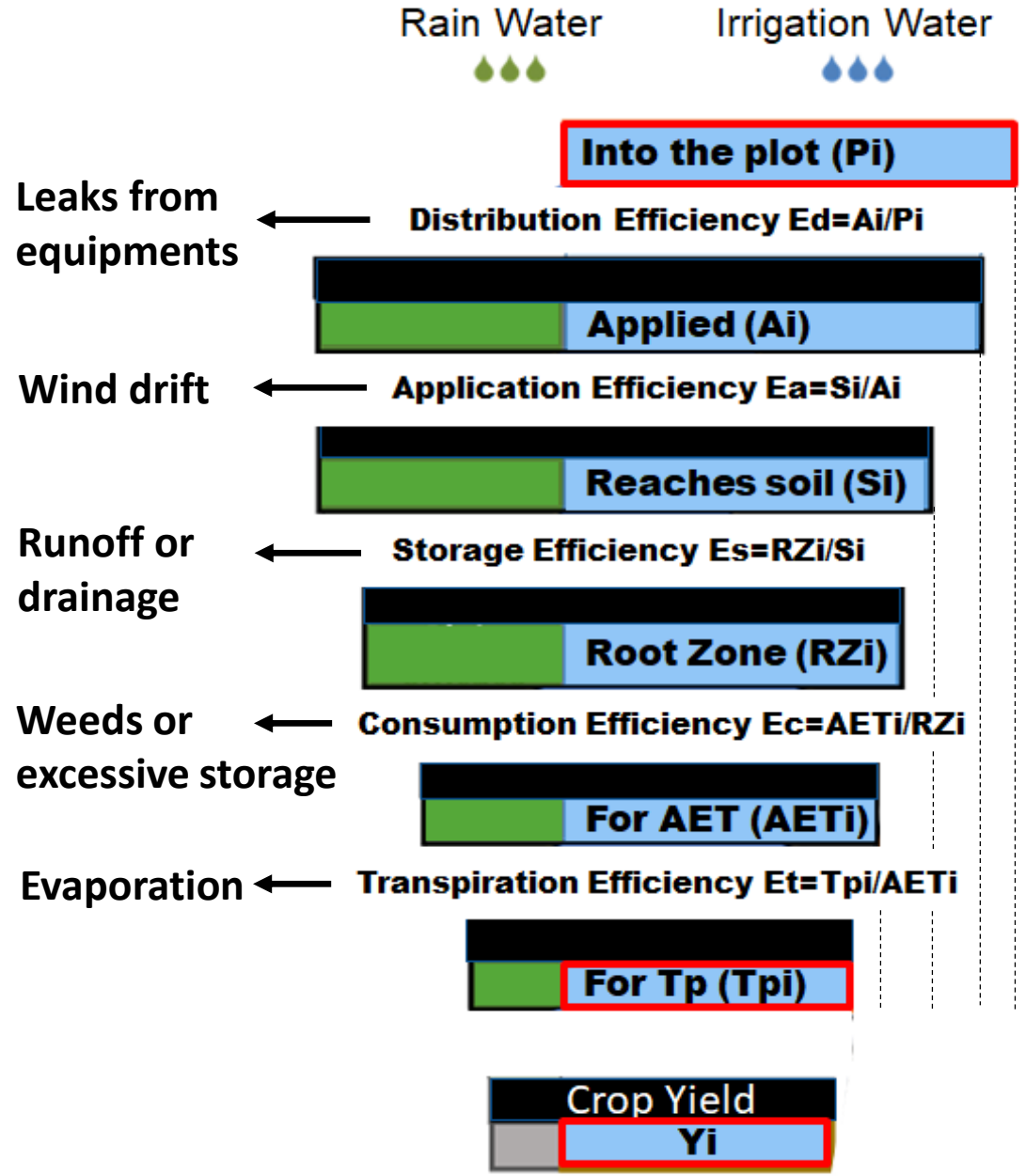
*Dedicated module that handles irrigation water efficiency*

***Tactical improvements*** *vs. Tactical losses*

*Improving irrigation strategy by tuning irrigation scenarios*

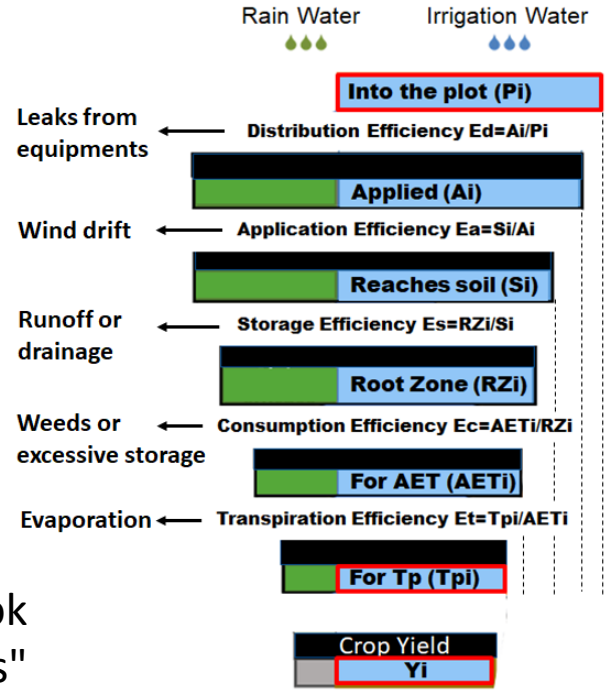
"Then I should definitely increase my irrigation water efficiency"

"Yes buddy and you should really start by reducing the losses"



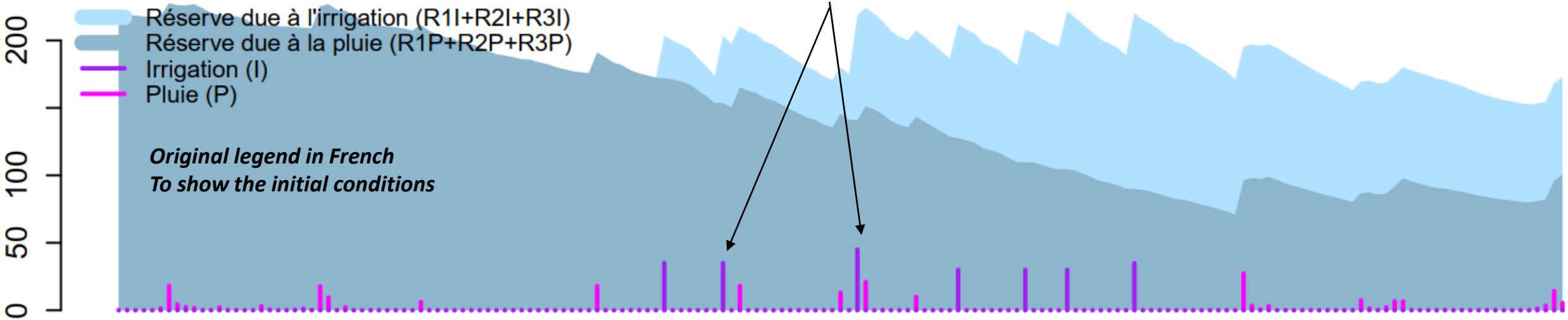
# Water savings from improvements of…
# Irrigation efficiency

**Efficiency module**
**Output example 1**



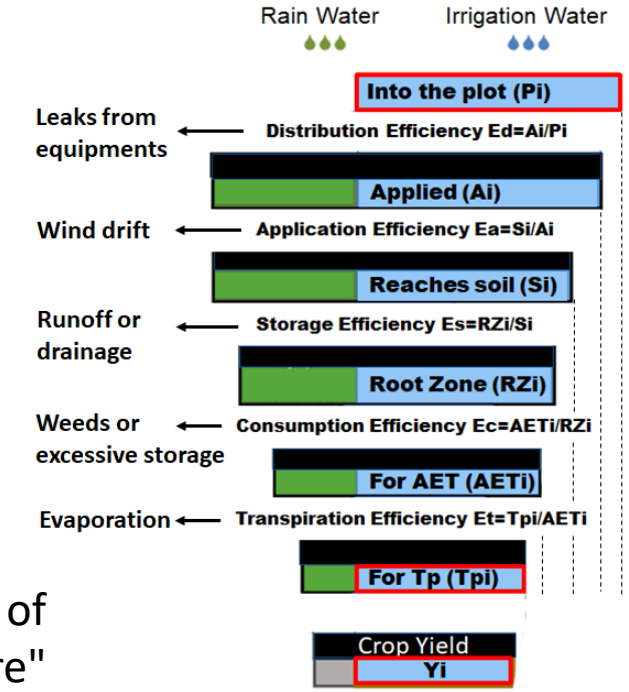

***Total soil profile reserve from sowing to harvest (mm)***

"Ahem these irrigations took place just before rain events"



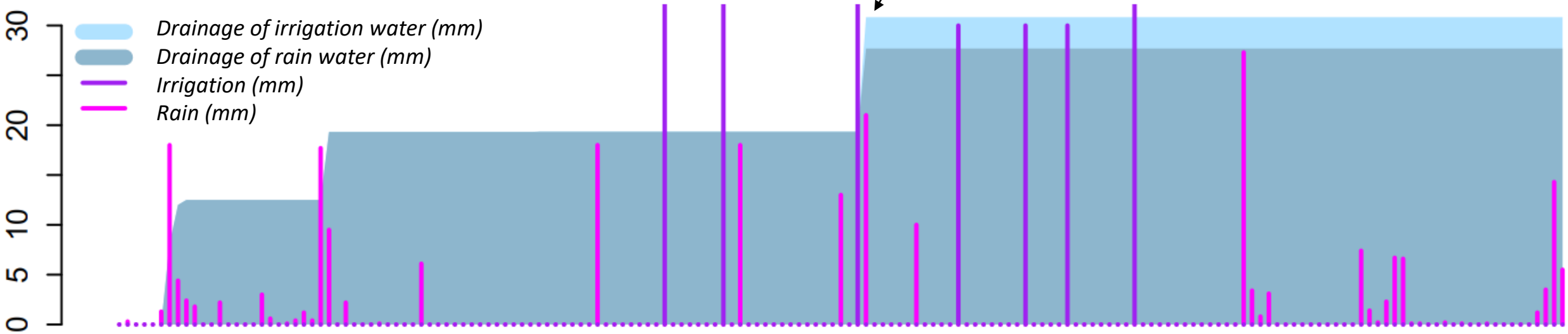
# Water savings from improvements of…
# Irrigation efficiency

**Efficiency module**
**Output example 2**



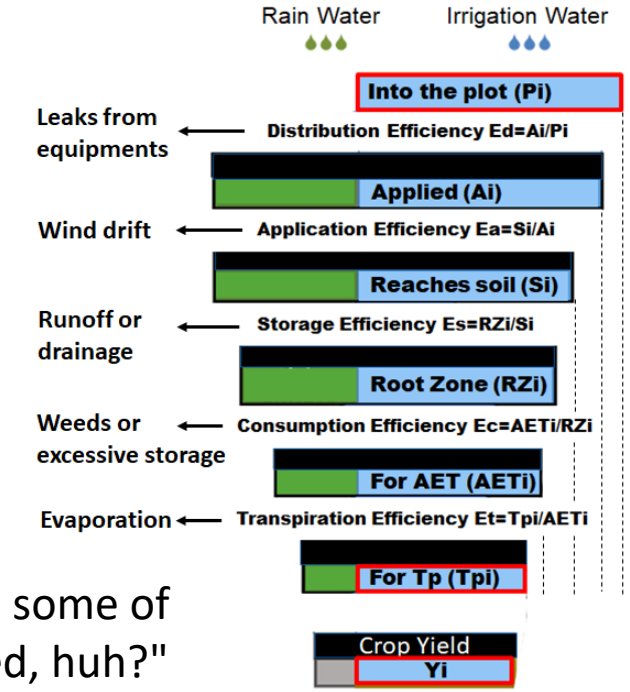

***Cumulative deep drainage from sowing to harvest (mm)***

"Ok there was drainage of irrigation water here"



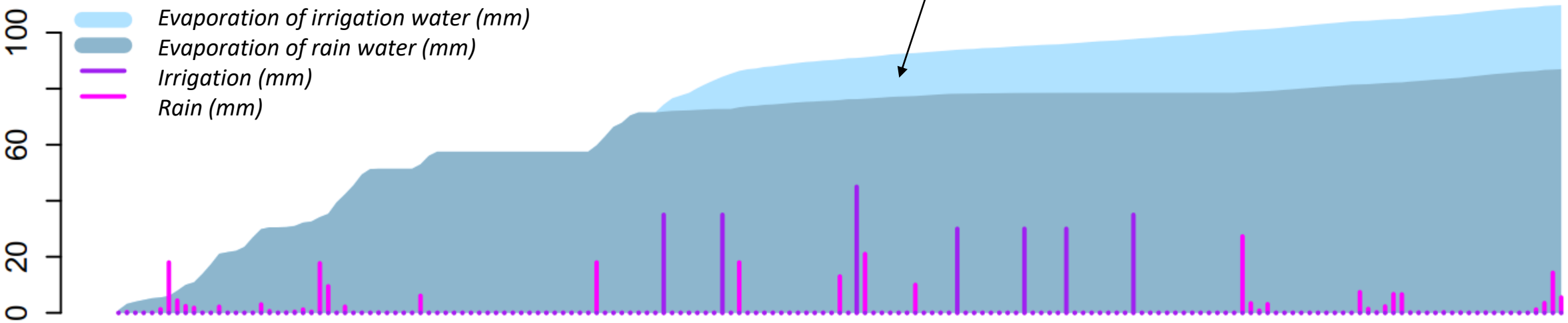
# Water savings from improvements of...
# Irrigation efficiency

**Efficiency module**
**Output example 3**



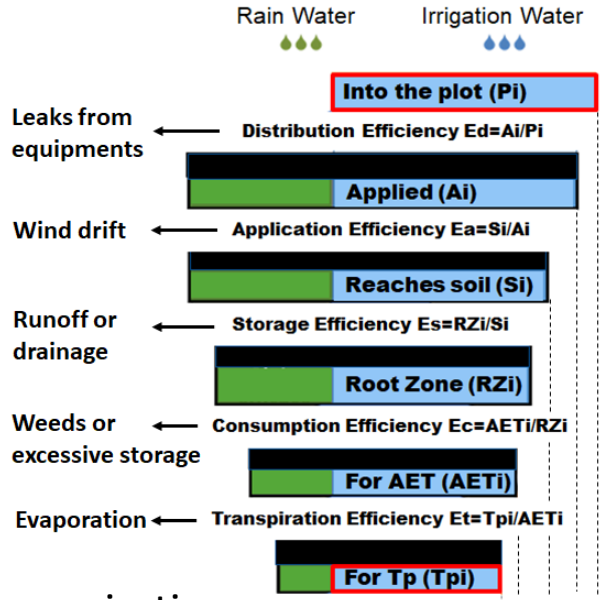

***Cumulative soil evaporation from sowing to harvest (mm)***

"Some of it is evaporated, some of it expectedly transpirated, huh?"



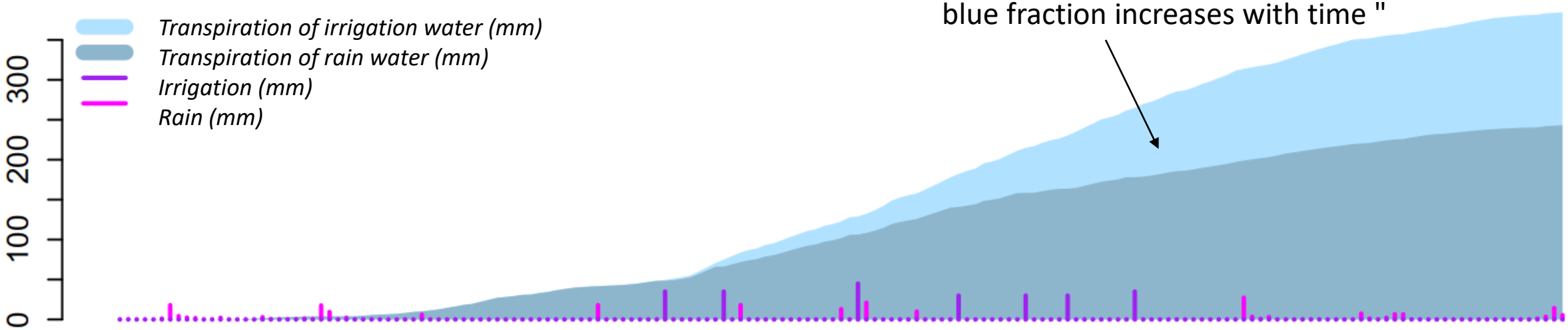
# Water savings from improvements of…
# Irrigation efficiency

**Efficiency module**
**Output example 4**




***Cumulative crop transpiration from sowing to harvest (mm)***

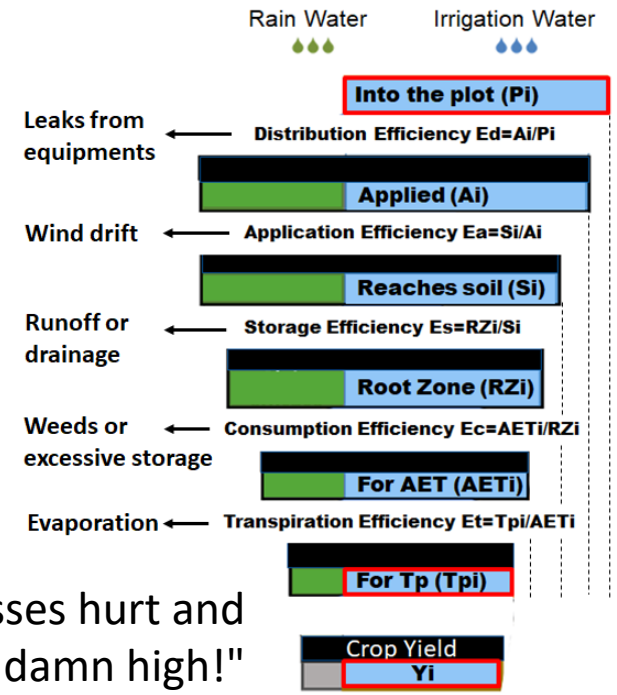
"Seems good as more transpiration than evaporation occurs AND the pale blue fraction increases with time "



# Water savings from improvements of…

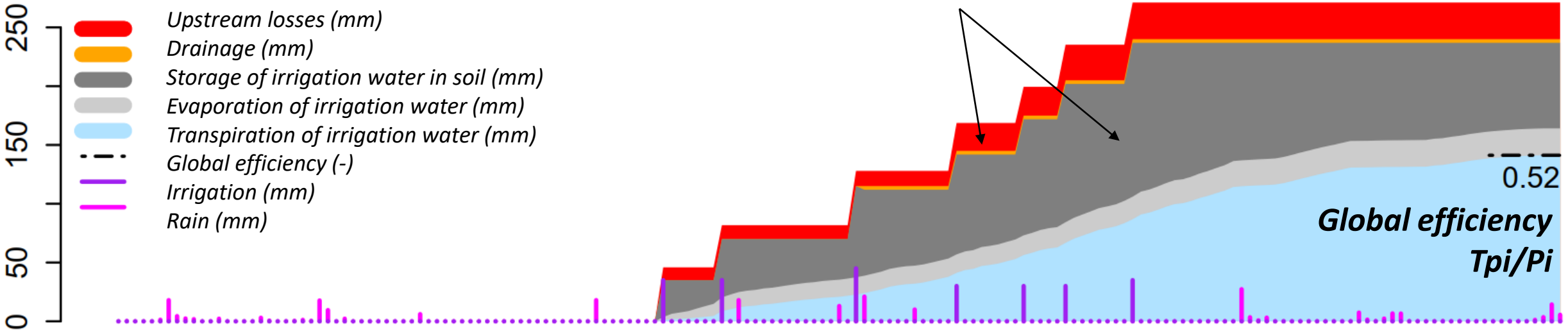
# Irrigation efficiency

**Efficiency module**
**Output example 4**




***Summary of the key terms in the efficiency cascade scheme***

"Ouch my upstream losses hurt and irrigation storage is so damn high!"



# Water savings from improvements of...
# Irrigation efficiency

"I need to evaluate or reformulate my irrigation strategies, especially in a context of limited resource availability"

" Optirrig is here for you, and can be tuned to save water by improving irrigation efficiency... but instead of an autograph I made a little drawing for you"

# Water savings from improvements of...
# Irrigation efficiency

"Think about it:

1- Maximum crop yield is obtained for higher irrigation amounts than these of maximum irrigation efficiency

2- Reducing irrigation to improve efficiency is a virtous behavious that may need/deserve a financial reward"