

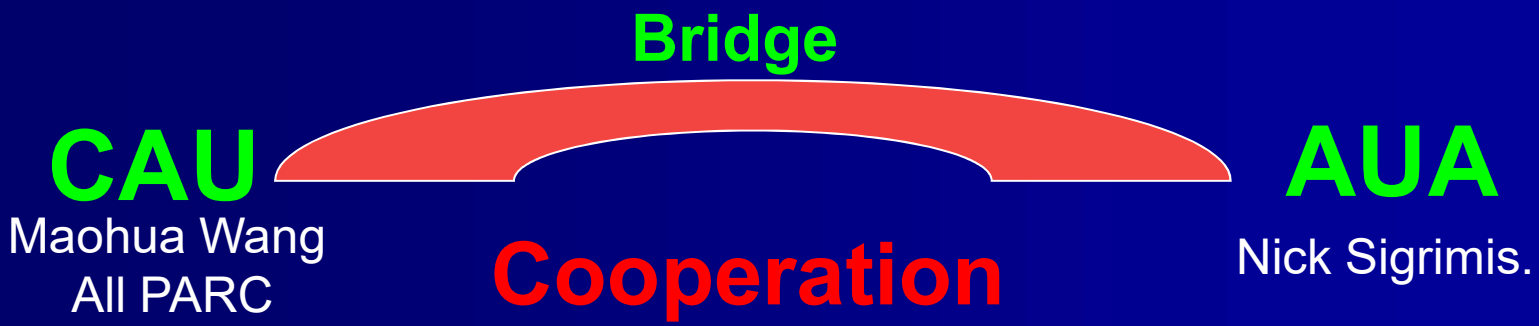


TEAP PROGRAM – EU/CHINA 3/11/2016



Tree **FERT-IRRIGATION**-SDAU

MACQU WEB SERVICES for GHs & Irrigation
MACQU-of-Things
IOT-MOT



**Water Policies in Europe. Water pricing farmers do not like...
must discuss how to conform to water saving without supercharging**

WHAT TO DISCUSS **值得讨论的问题**

Problems in China & Sustainable Development

SCPI, Water is a finite resource (more crops per drop)

Irrigation Application Systems, *drippers vs micro-sprinklers*

Water saving methods WUE, WUFE=water use and Fertiliser efficiency

IOT & Smart Irrigation

- Sensing & smart sensors
- Low Cost high capacity machines
- Web Technologies-From Cloud to Earth
- Knowledge bridge & Universities near Production-research in farms

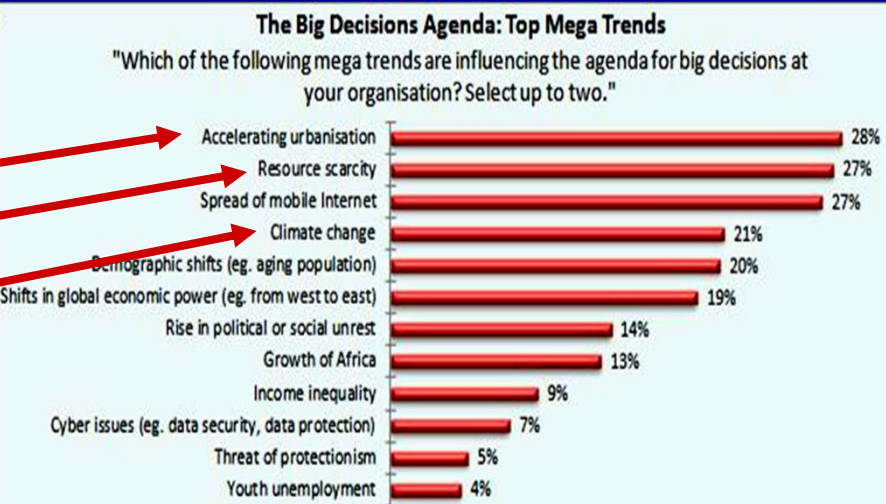
THE PROBLEMS OF THE WORLD

- **FOOD and Health for ALL! – The Environment we live-in**
- World population will expand to 9 billion by 2050, requiring **100% increase** in **food** land-productivity
- The **biological footprint** and Climate change is already pressing! to save the **Earth** and our **future**.
- For ten leading food crops, about **40% is lost to pest & diseases**
- Huge water use in Agriculture, **70%** of surface water

Humanitarian Emergencies:

(disaster if we do not take measures)

- *Rapid urbanizations,*
- *resource scarcity and*
- *climate change*



However Consumer's Demand for more vegetables of high quality at low cost -the present Market driver

PROSPER PEOPLE
Food security and safety

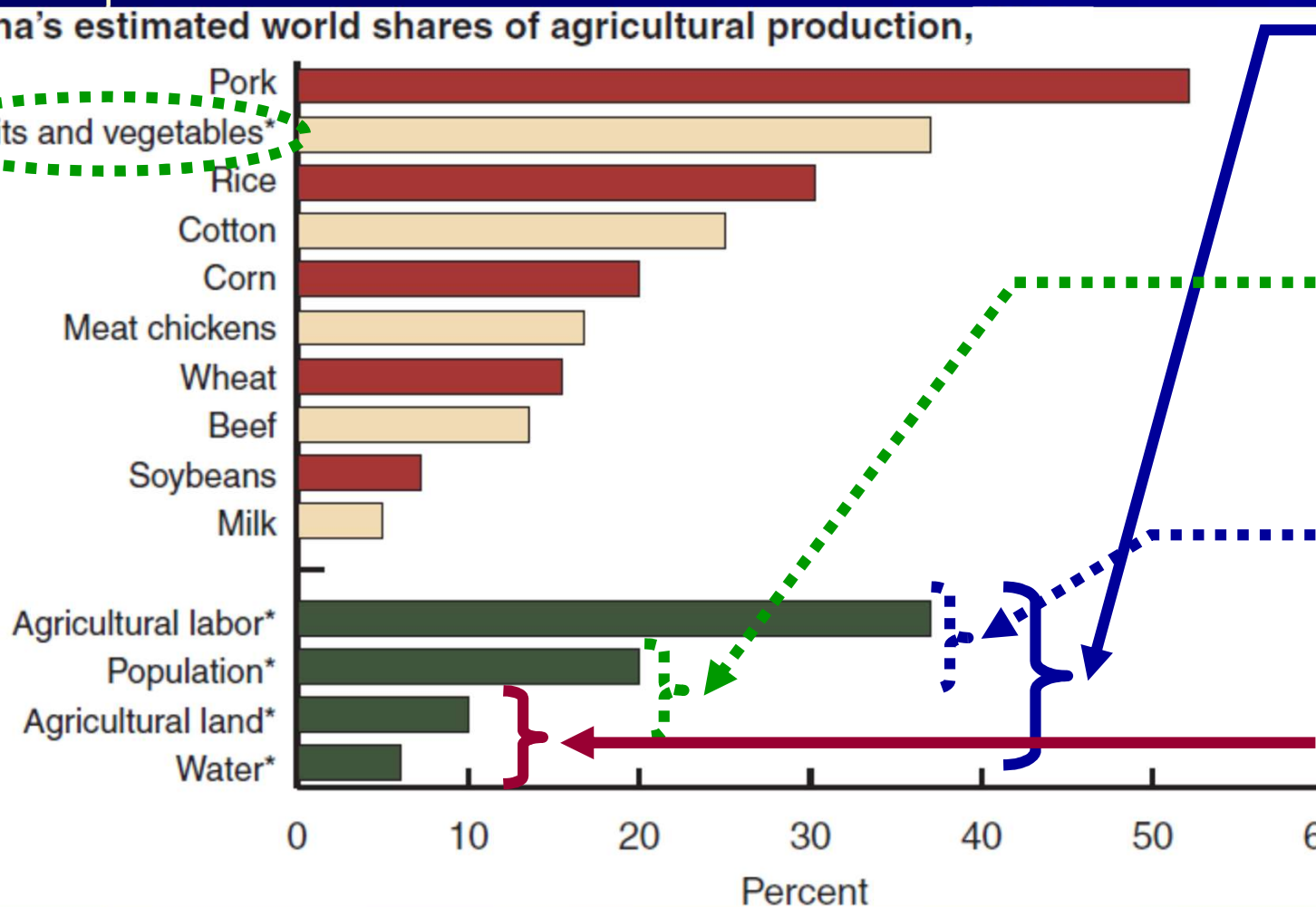
To satisfy of each consumer by providing transparent and tailored information about agrifood products.

MARKET
Quality
Safety

Knowledge for High Resolution Management is the key to meet Market Requirements and secure Prosperity

Vital for ensuring China is the Sustainable Crop Intensification

1. Sustainable growth, 2. Expansion in farm size 3. Increased mechanization /modernization, 4. Sustainable management of agricultural resources



1. Sustainable SCPI.

Agricultural productivity growth, through further investment in research and development

2. Expansion in farm size (need innovative social solution i.e hybrid of private with Farmers' Union (PPP=Public, Private, People).

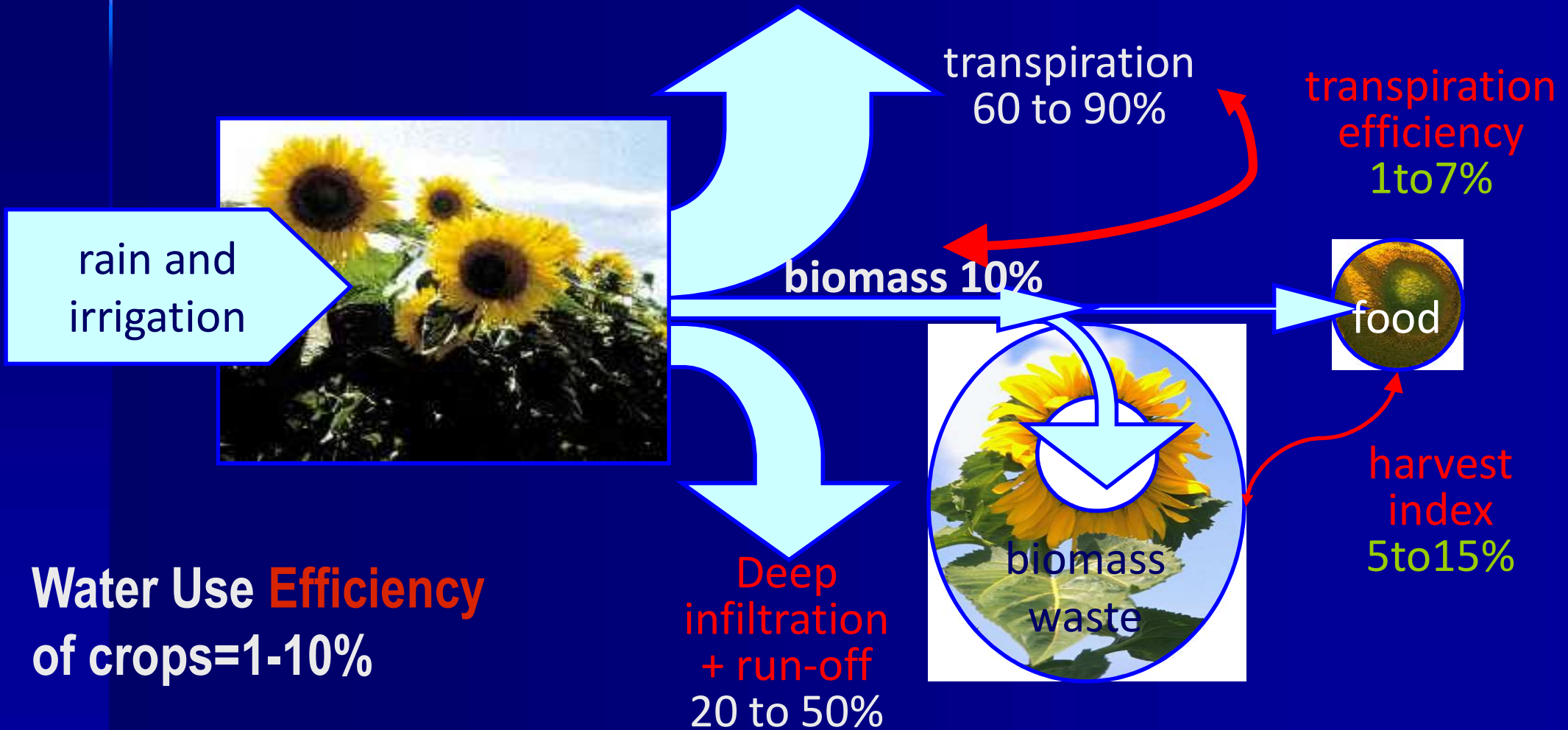
3. Increased mechanization /modernization, i.e. Farmers' life style and Farmer Income.

4. SCPI, sustainable management of agricultural resources & inputs

SCPI, Water is a finite resource (more crops per drop)

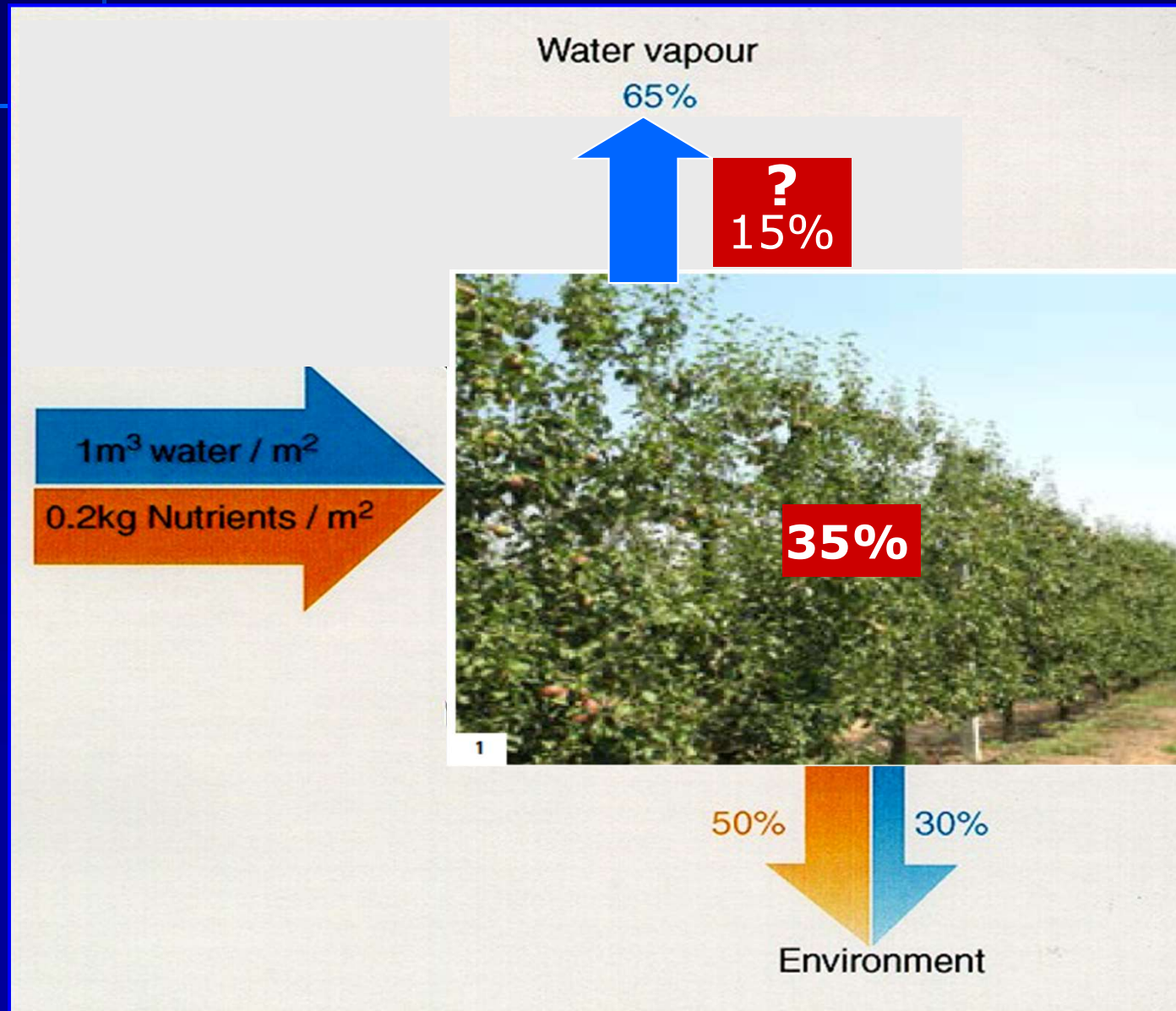
Water Used by crops

Water Use **Efficiency**
of crops=1-10%



SCPI, Water is a finite resource (more crops per drop)

Typical yearly fluxes of Water and Fertilizers in a modern Orchard

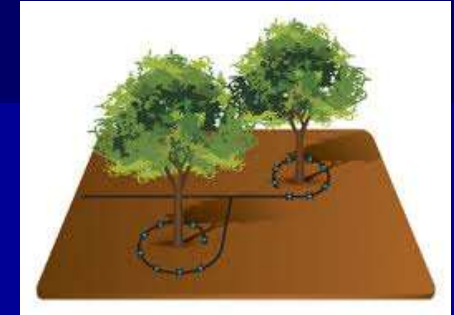


How much
can we save
out of 30%
water and 50%
Fertilizers?

Irrigation Application Systems, *drippers vs micro-sprinklers*

1. Drippers around the trunk of the tree

- adjust number of drippers for different plant water needs, or
- adjustable water rate drippers, -buried drippers)



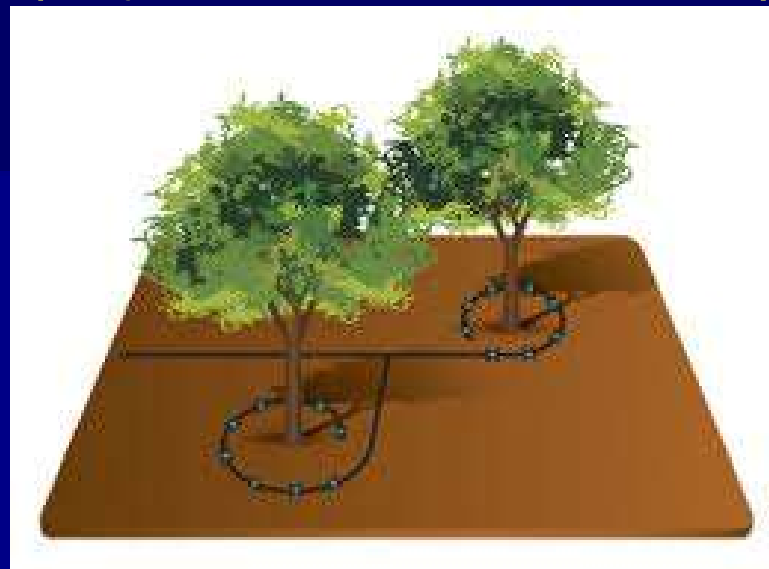
2. Micro-sprinklers (Up 30-50 cm from ground and Umbrella coverage

- popups (adjustable wet angle)
- Fixed off-ground
- Removable)



Irrigation Application Systems, *drippers vs micro-sprinklers*

1. Drippers around the trunk of the tree (*adjustable, water save*)



2. Micro-sprinklers (*more weeds, more water loss, hanging...*)



More evaporation



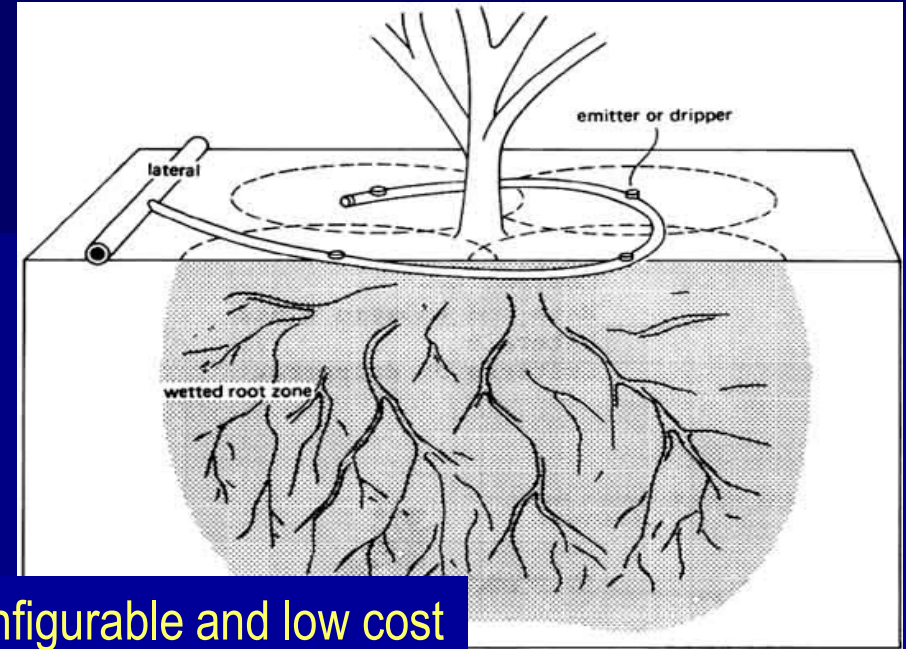
MANY TYPES OF SPRINKLERS TO MATCH THE TREES AND THE SOIL



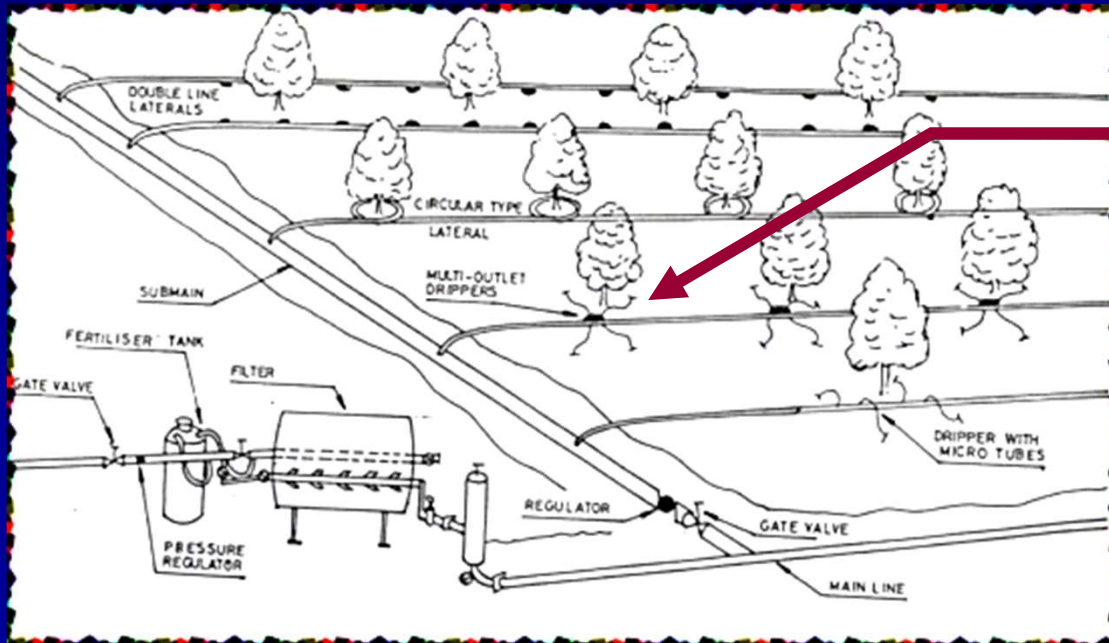
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Irrigation Application Systems, *drippers vs micro-sprinklers*

TREE IRRIGATION SYSTEM WITH DRIPPERS



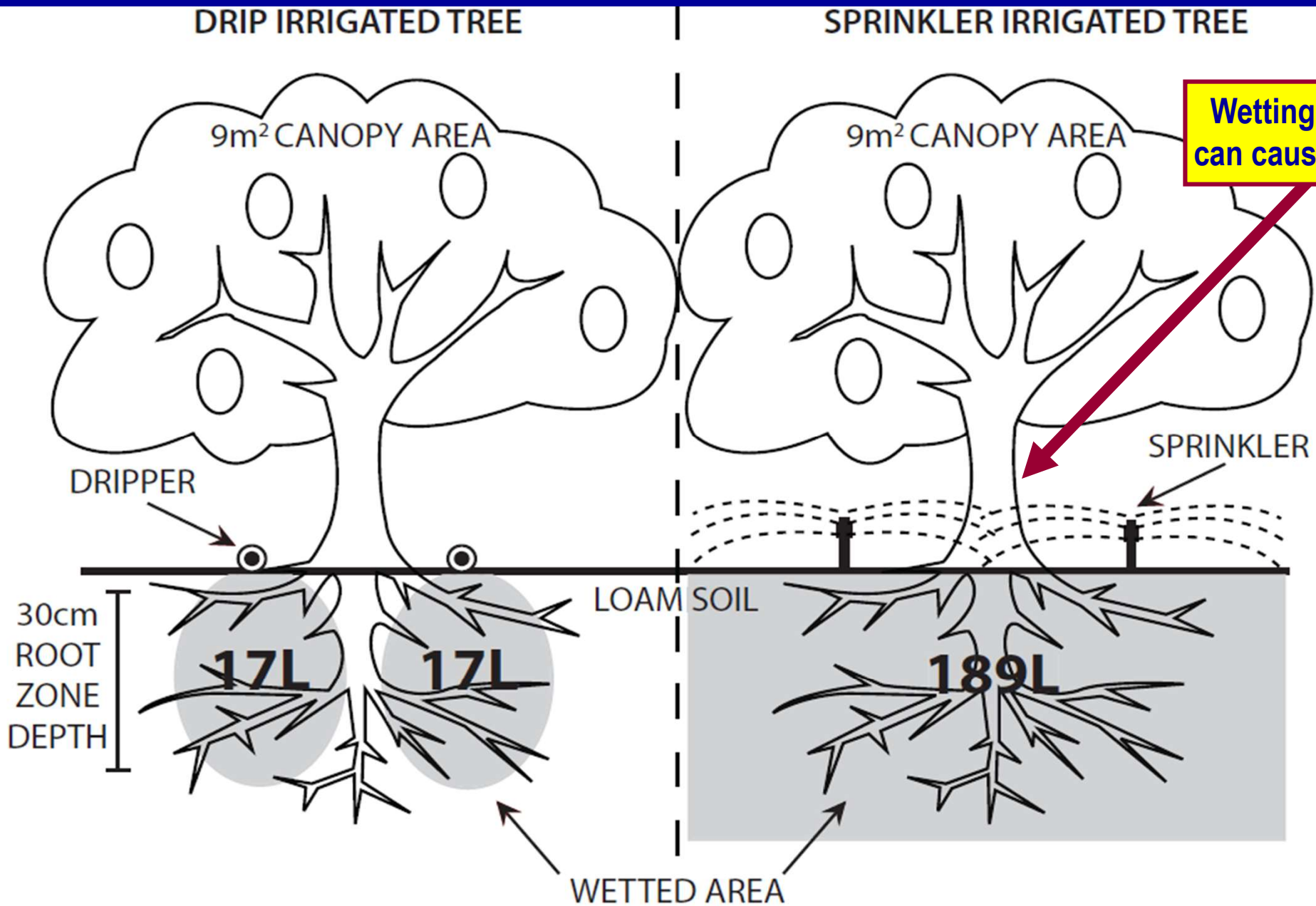
Most adjustable-configurable and low cost



Different dripper styles applications must be designed per case of tree types and local conditions

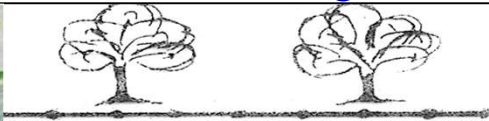
Irrigation Application Systems, *drippers vs micro-sprinklers*

drippers vs micro-sprinklers can give more than 50% savings



Irrigation Application Systems, *drippers vs micro-sprinklers*

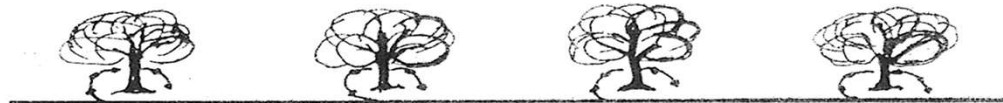
All different possibilities for arrangement of lateral pipes in tree irrigation:



4



5



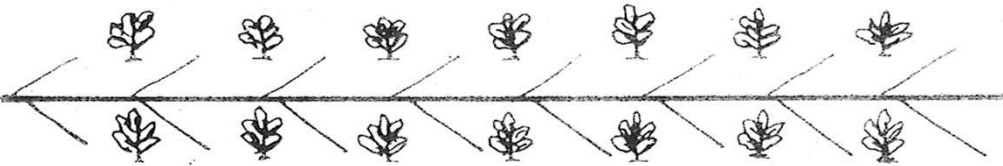
6



7



8



1. *Simple straight Line,*

2. *Double straight Line,*

3. *Simple straight Line with multiple exit drippers,*

4. *Maeander layout,*

5. *Mixed straight-cyclic layout,*
most flexible to adjust per tree,

6. *semicircle layout,*

7. *circled layout,*
lowest cost not adjustable

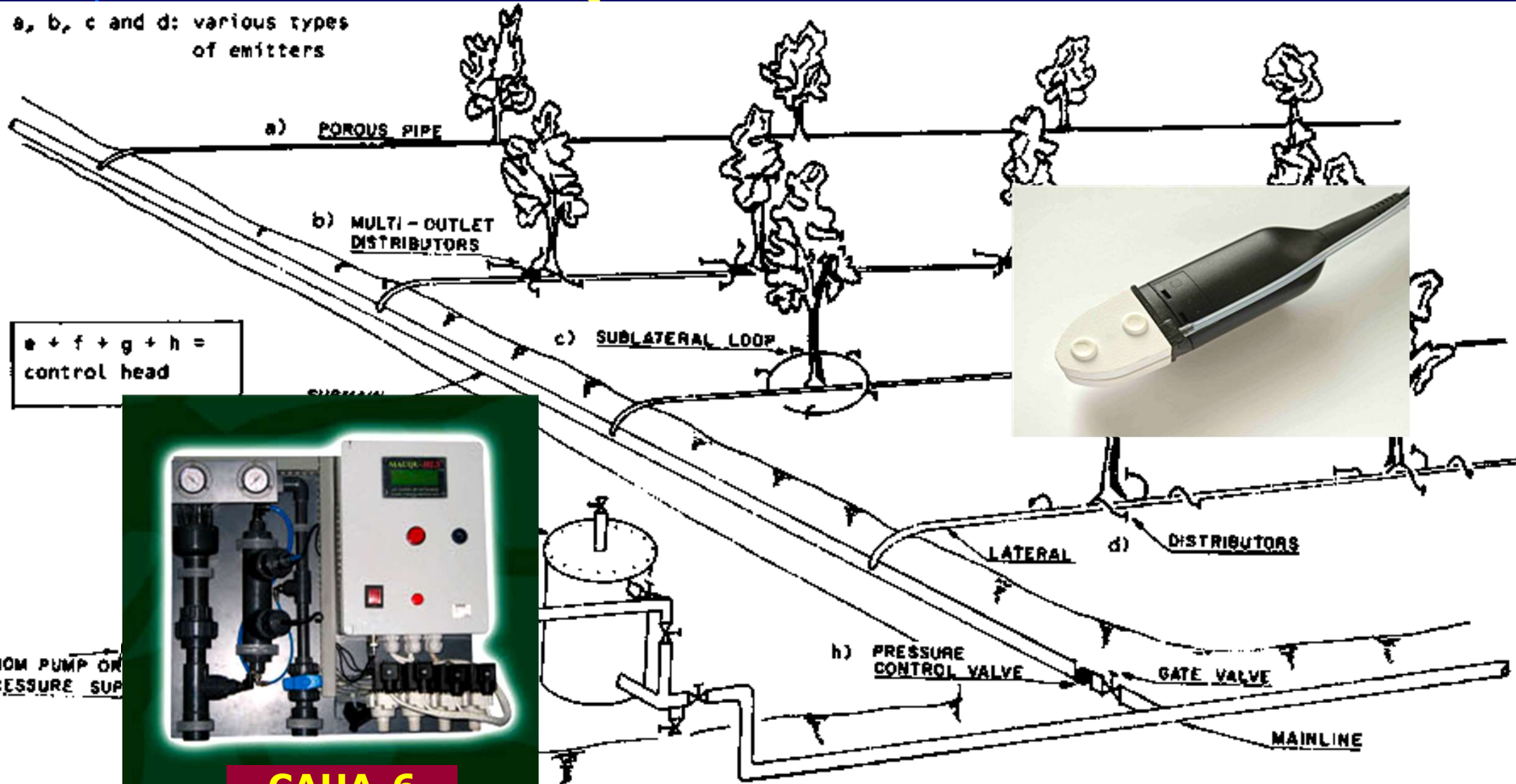
1. *fish-bone shape*

Irrigation Application Systems, *drippers vs micro-sprinklers*

COMPLETE TREE IRRIGATION SYSTEM USING SMART IRRIGATION

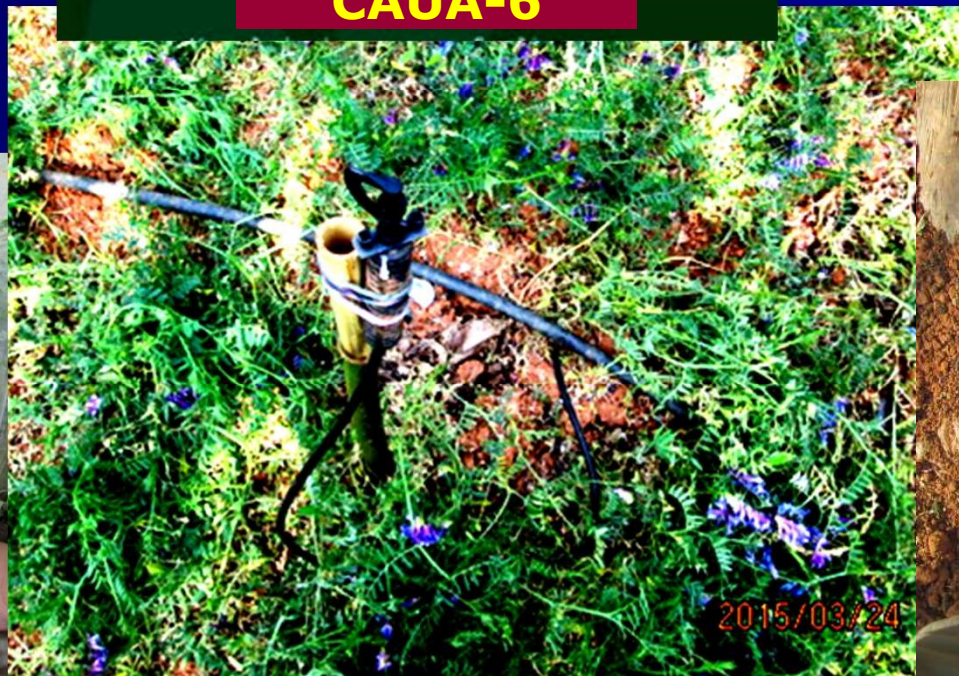
POWERED BY **MACQU TECHNOLOGY OF CAUA-6**

a, b, c and d: various types of emitters



CAUA-6

FROM PUMP OR
PRESSURE SUP



Sustainable Development – National importance for Labor Intensive Process & high Value





Draught effects



Farmworkers install a drip irrigation system in a peach orchard in Yuba City, California. Many farmers in the area are switching to drip irrigation system in efforts to conserve water



Irrigation system design

Water

The peach is drought resistant and can grow even without irrigation, however, in order to obtain an economical crop with good quality, it requires a quantity of 500-700 mm of water. In a young orchard, the irrigation is the same as for apples, almonds and other deciduous trees.

In a mature orchard, there are various recommendations for early and late peaches. The factor is according to the following table:

	Factor						
	April	May	June	July	August	Sept	
Early peaches	0.4	0.7	0.7	0.5	0.4	0.4	
Late peaches	0.4	0.5	0.6	0.7	0.8	0.8	
	Irrigation Rate (mm/day)						
	April	May	June	July	August	Sept	
Early peaches	1.5	3.0	3.5	2.0	2.0	1.5	
Mid-season	1.5	3.0	4.0	4.0	2.0	2.0	
Late peaches	1.5	2.5	3.0	3.5	5.0	5.0	

3. Dripping recommendations:

- ▶ One lateral per row with 4.0 liter/h drippers 1 meter apart.
- ▶ Irrigation times should be every 1-3 days. It is possible also to use pulse irrigation.

A general guideline for splitting K application in fertigation programs for peaches

Growth stage	Share of K ₂ O at stage (%)
Leaf emergence	15
Flowering	20
Fruit-set	25
Fruit growth	25
Fruit maturation	15
Total	100

Advantages of Drippers (for permanent crops)

- **Improved water management**
- **Potential energy savings**
- **Ideal for establishing orchards and vineyards.**
- **Fertilizer application through the irrigation system**
- **Easier weed control** if compared to full coverage irrigation systems.
- **Yield and quality enhancement,**
- **Lower cost than sprinkler or micro-sprinkler systems.**
- **Reduced Insect problems**

Irrigation Application Systems, *drippers vs micro-sprinklers*

Advantages of Microsprinklers

Compared to Sprinklers

- **High application efficiency**
- **Reduced wetted area & less weed growth**
- **Lower initial cost**
- **Lower energy costs** due to lower pressures.

Compared to Drippers

- **Anti-Freeze protection** (greater than drip systems), *when such danger exists*
- **Often preferred over drip systems** in areas with coarse textured soils
- Provide an **economical method of applying agrochemicals** on a timely basis
- higher flow rates/area than drip systems, and **the run time required is less**. This is important for multi-zone systems

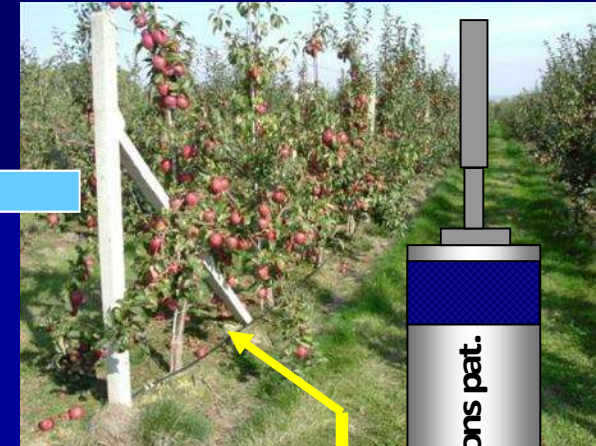


Water saving methods, *WUE*, *WUFE*

Tree irrigation

Definitions

Water Transfer Efficiency (WTE):



Water Application Efficiency WAE (Wf):

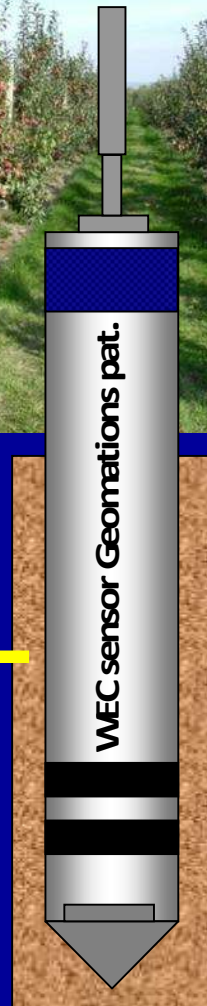
Water Use Efficiency (WUE):

How much water per Unit of Product (i.e. 50LT water per kg Orange)

Water Use and Fertilizer Efficiency (WUFE):

WUE: *Water Use Efficiency*, and
FUE: *Fertilizer Use Efficiency*

*maximum crop yield per dollar \$ of fertilizer), that is,
minimum cost of production*



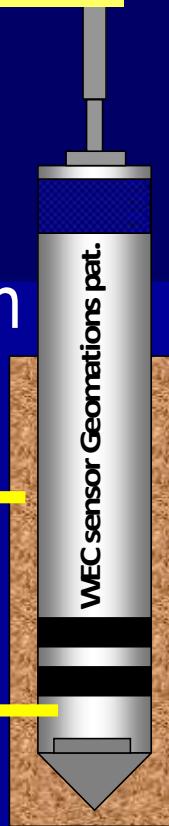
Water saving methods, *WUE, WUFE*

Methods of Water management.

Standard Methods

Supply water when the VWC is at the limit of Water Availability for each crop. It depends on soil and crop.

Sensor driven (threshold VWC)



Modern Intelligent Methods-smart Fert-Irrigation



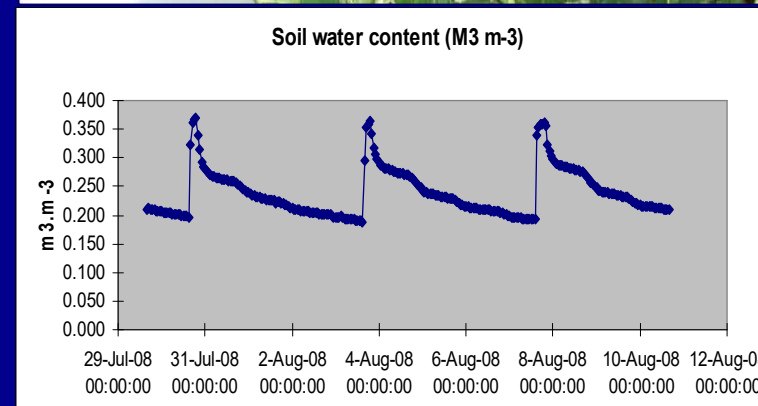
Deficit Irrigation (DI): water saving (small water stress without loss of yield).

Regulated Deficit Irrigation (RDI): Water supplied at deficit for specific effects on Quality (i.e. the vineyards)

Ultimate Regulated Deficit Irrigation (N. Sigrimis): Apply **Dynamic Balance and Moderate** the Deficit (play with water & Fertilizers for specific effect including the IPM, that is **GAP for crop water management.**

Precision Irrigation FLOW-AID, a sensing node and a thick client service, 精确灌溉 FLOW-AID, 传感器节点和客户服务

The User may select optional command paths i.e. approve first through his mobile the action SaaS recommends, before it is applied on his farm.





One weather station Per 100 hectares



One soil sensor Per 0.1 to 1 ha



IOT & Smart Irrigation- *Low Cost high capacity machines*

Big Orchard
-Many different trees
-Different soils
-Big Regional Level
CAUA-12



CAUA-12E
Web Intelligent
Ferti-Irrigation



CAUA-12
Web Intelligent
Ferti-Irrigation

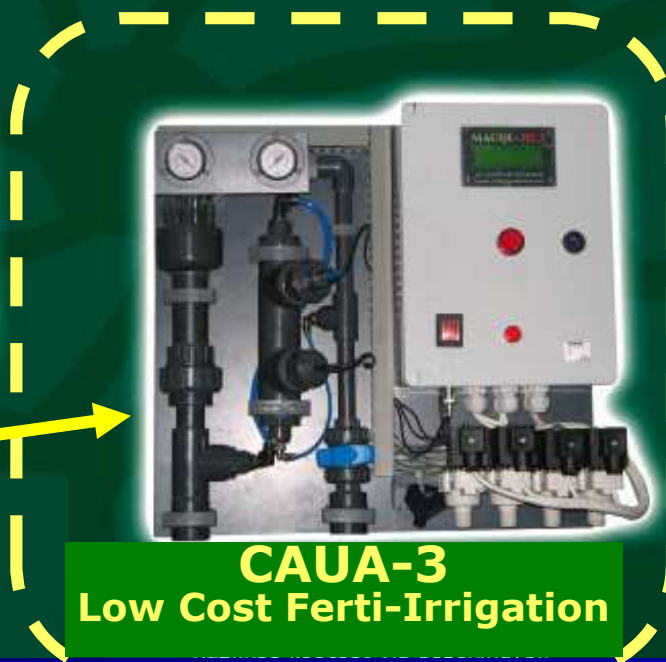


CAUA-12S
Web Intelligent
Ferti-Irrigation

Medium Orchard
-Two different trees
-More than 10 hectares
CAUA-6



CAUA-6
Web Intelligent
Ferti-Irrigation



CAUA-3
Low Cost Ferti-Irrigation

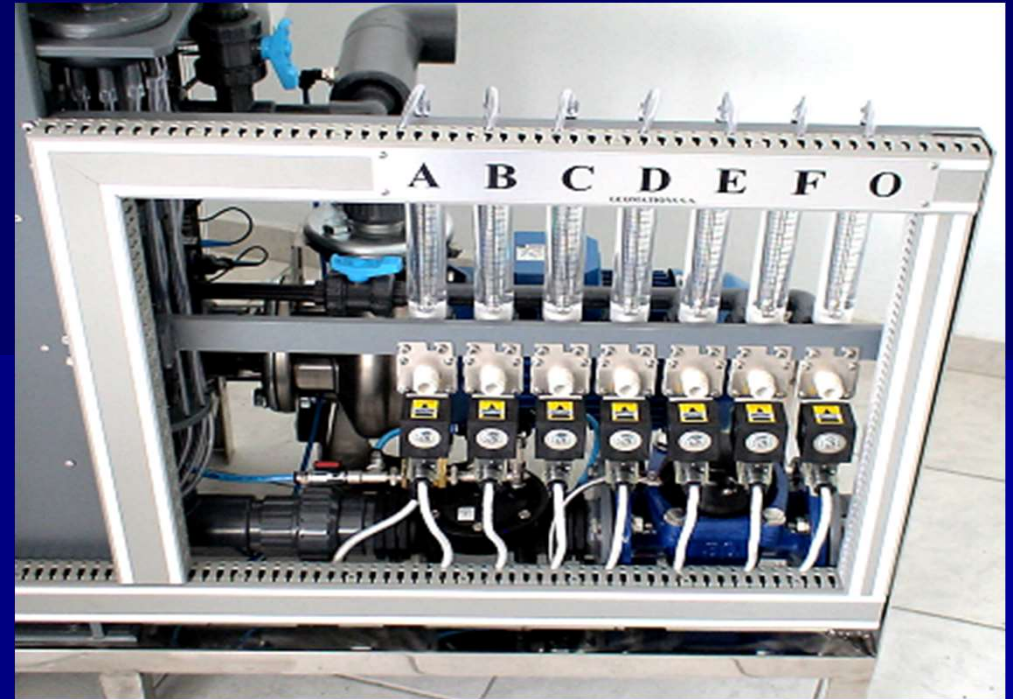


MACQU-HR
0-3m³/h

Small Orchard
-One type of trees
-1 to 10 hectares
CAUA-3
Or smartphone!

MACQU scada technology for Precision Irrigation and Fertilization synthesis in GHS
High End MACQU-H50S (web connected)

MACQU-H50



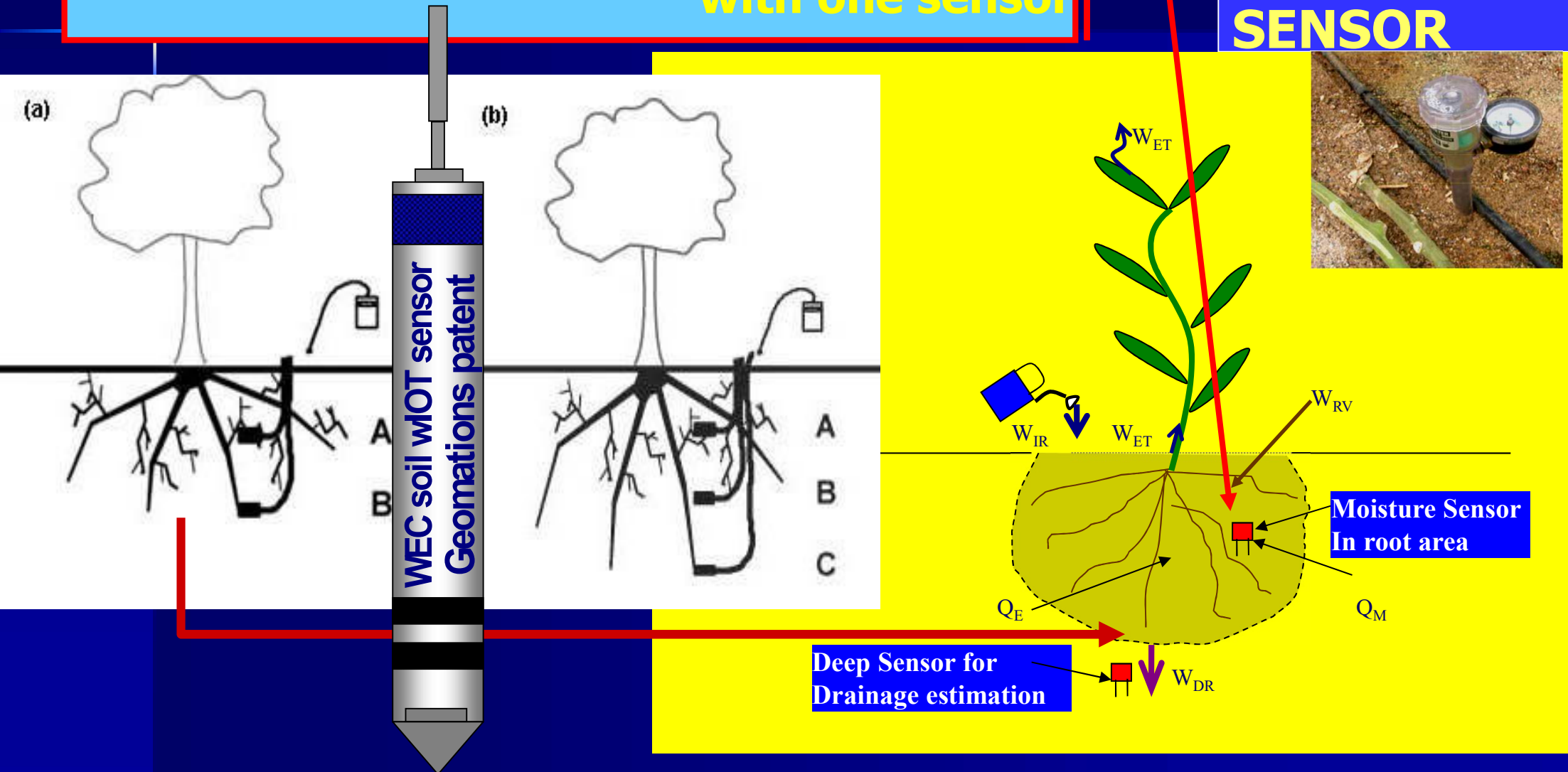
Possible Transformation at Low Cost to double Farmers' income



IOT & Smart Irrigation - Sensing & smart sensors

How can we determine an equivalent root volume and conduct material balance **with one sensor**

SMART IRRIGATION SENSOR



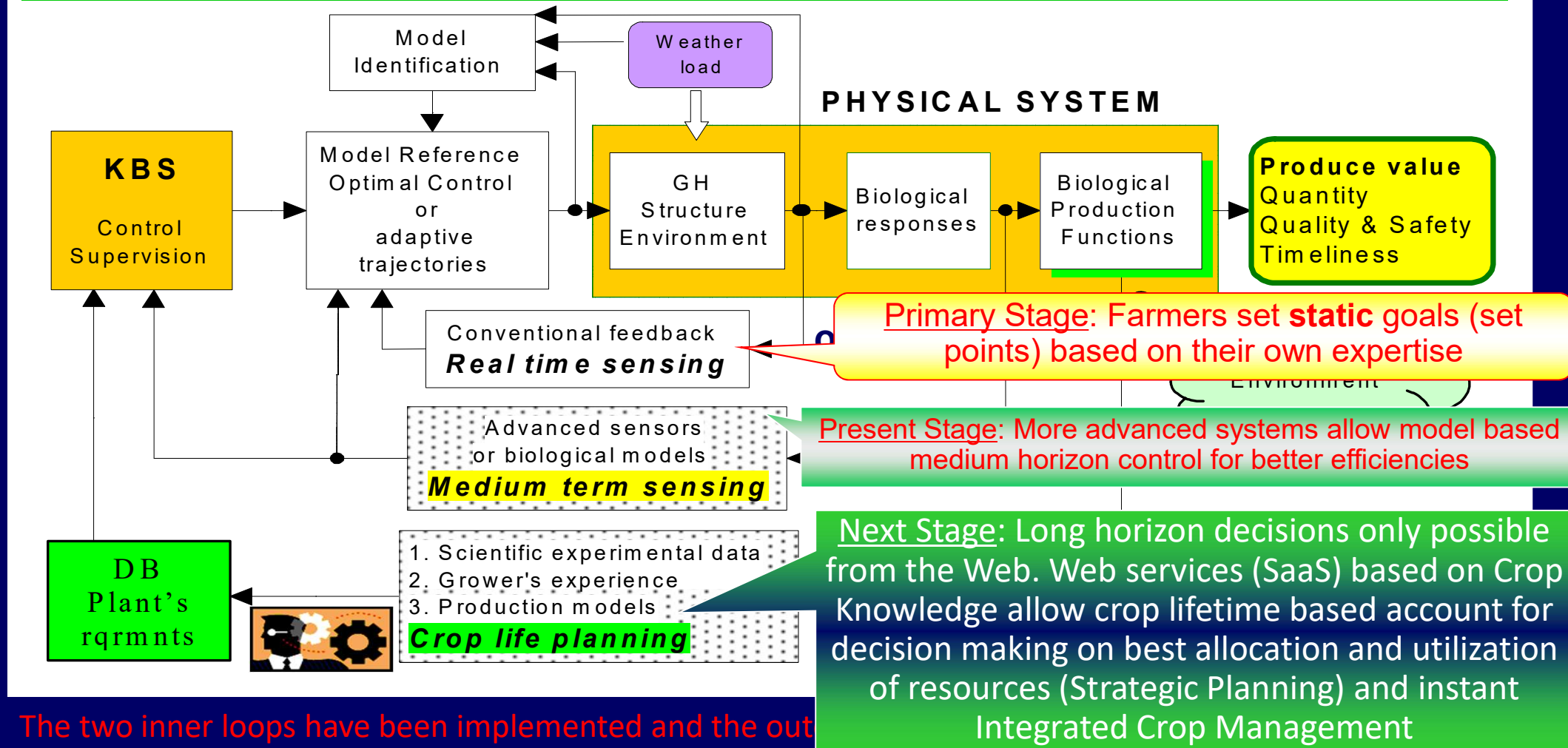
From short horizon to long horizon & web Intelligence

-从短期计划到长远计划以及网络智能的应用

Cloud based Knowledge service platform--云知识服务平台

GREENHOUSE CONTROL AND MANAGEMENT AT DIFFERENT LEVELS

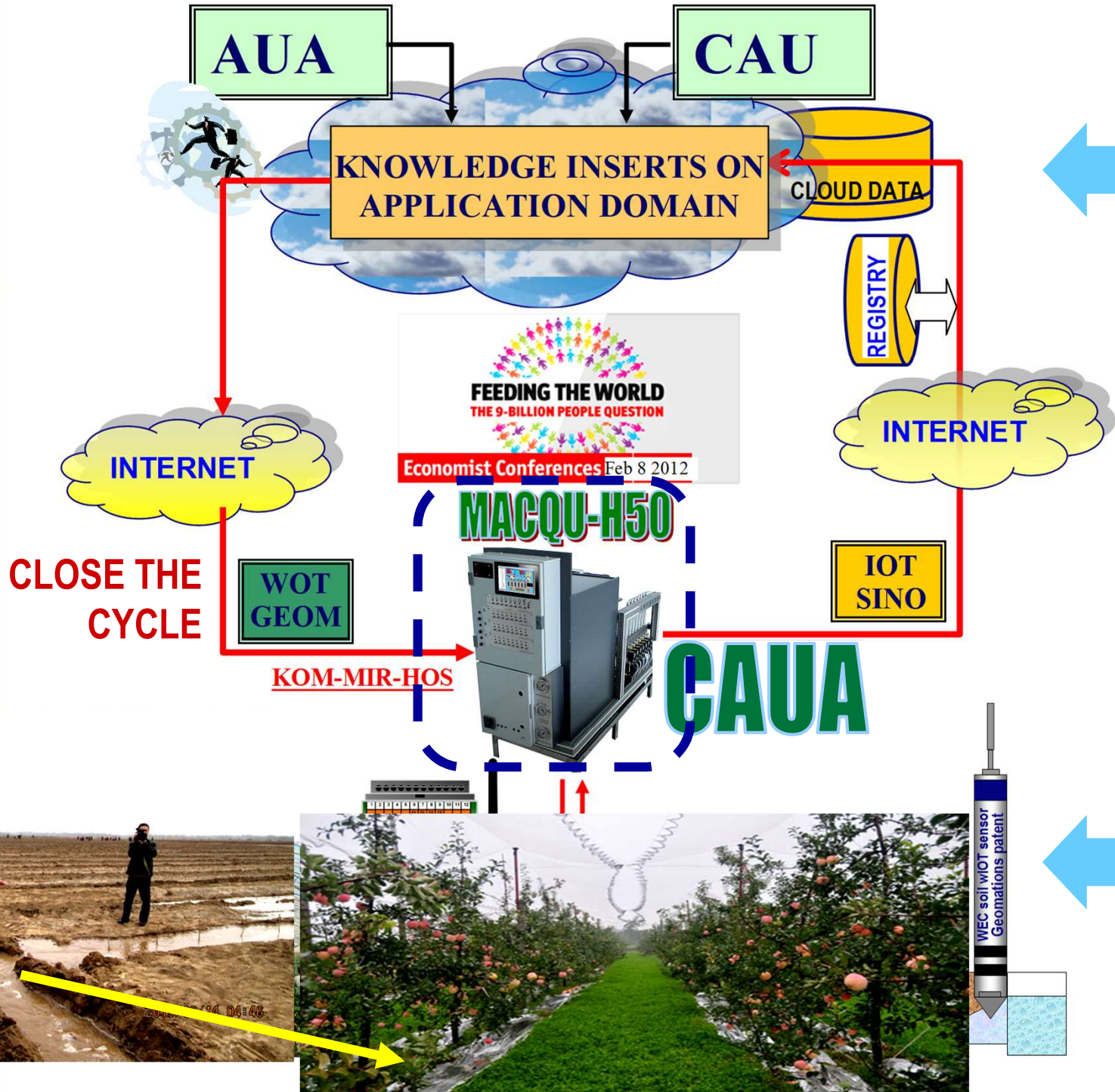
不同级别的温室控制和管理



EU-Sino-Greece Cooperation

IOT & Smart Irrigation- Knowledge bridge

& Universities near Production-research in farms

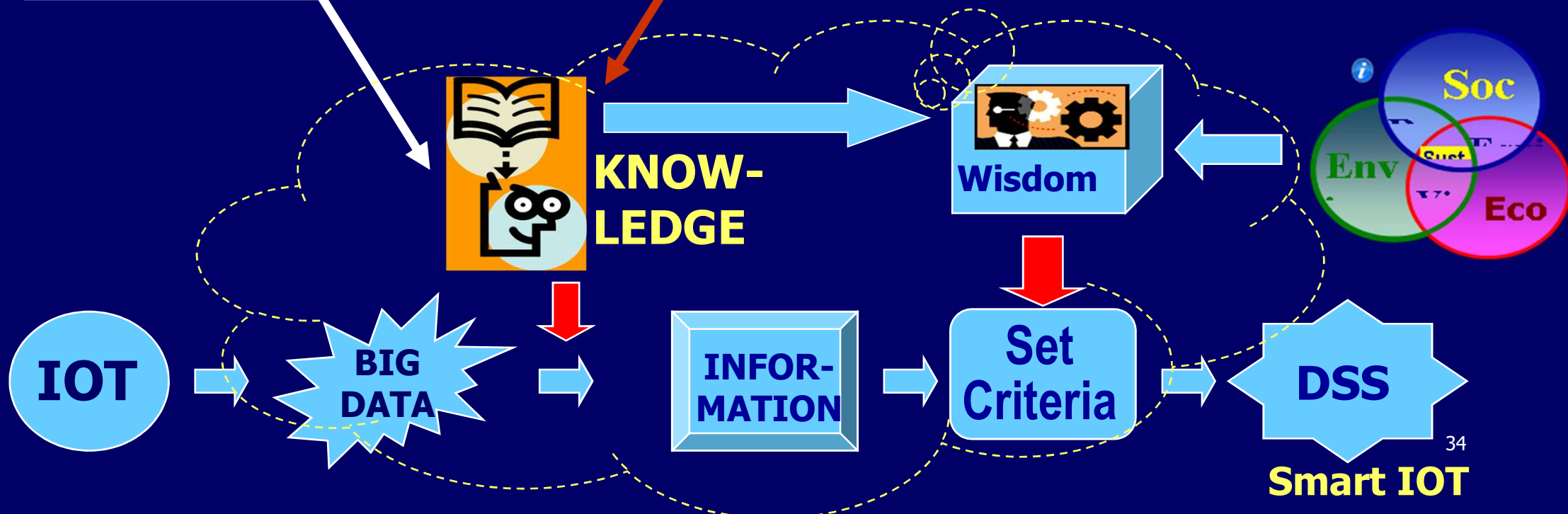


System Architecture

- Ground base Autonomous Systems
 - E2I: Embedded **Evolving** Intelligence
- Hypermarket web Services
- Cloud IaaS for easy maintenance
- IOT → ODT (One-Dollar a Thing)

Science can change the trend in world crisis.
Politicians will have to cooperate more with scientists

Science can drive Sustainable Agriculture



N. Epitropakis South Heraklio has decreased fertilizers and Water 30% and increased production by 20%



AUA-Our Collaborative Environment-CAU 希腊农业大学-我们的合作环境-中国农业大学

Prof Wang in a commercial Greenhouse in Greece





Nature
Conservancy 
Protecting nature. Preserving life.™
nature.org



Snake River at Grand Teton National Park, Wyoming.

© Ian Shive

DESCRIPTION OF PROBLEMS TO SOLVE

- 1. Problem description & Photo**
- 2. When it appears**
- 3. Percentage of damage**
- 4. Per-Year Variability**