

## Towards a More Sustainable Water Efficient Protected Cultivation in arid areas

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Wageningen UR Greenhouse Horticulture

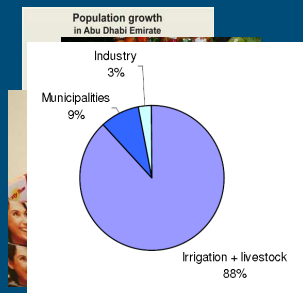


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## Issues related to protected horticulture in arid areas

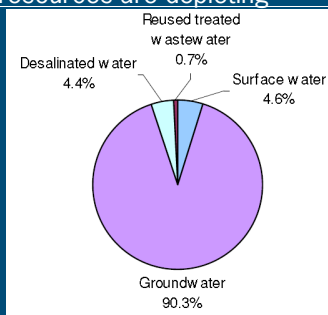
- Water use
- Need for production increase
- Food safety
- High quality demand



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## Water resources are depleting



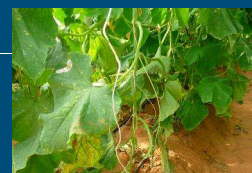
FAO Water report 34 (2009)

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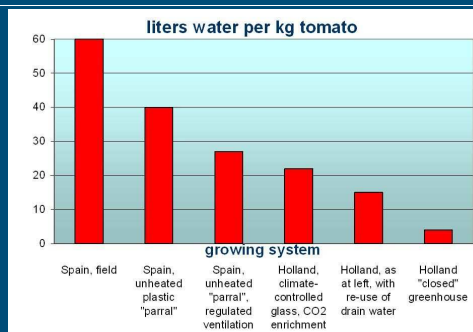
## Increasing water efficiency: "More crop per drop"

- Irrigation of the plants
- Cooling of the greenhouses (natural ventilation is not an option)
- Alternative water resources



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## Water use efficiency



increasing control of production factors

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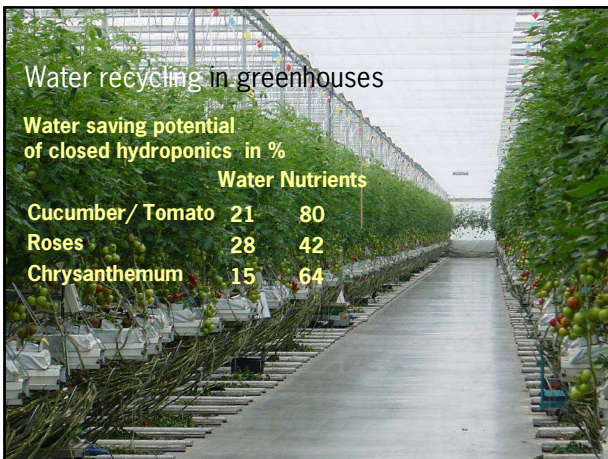
## Hydroponics / soilless culture



### Water recycling in greenhouses

Water saving potential of closed hydroponics in %

	Water	Nutrients
Cucumber/ Tomato	21	80
Roses	28	42
Chrysanthemum	15	64



### Cooling methods

- Natural ventilation
- Evaporative cooling ( pad and fan or misting)
- Mechanical cooling (AC)

### Pad and fan

- + Low investment costs
- + Proven technology
- Water use
- Climatic distribution
- Salt and sand accumulation
- Electricity use
- Biological control hardly possible
- Minimum temperature == dewpoint temperature outside air



### Effect of salt on pad



### Conditioning from below the tables (1)



### Conditioning from below the tables (2)



## Coolers above the crop



## Water efficient greenhouse: Closed greenhouse

No air exchange with outside

- Cooling system
- Air treatment unit
- Fogging
- CO<sub>2</sub> enrichment
- Covering (no vents)



## Comparison pad &amp; fan &lt;-&gt; closed greenhouse

	P&F	Closed greenhouse
Transpiration (l)	1200	1063
Evaporative cooling (l)	3260	6
Water loss (l)	4460	180

-95% less water use

## Comparison pad &amp; fan &lt;-&gt; closed greenhouse

	P&F	Closed greenhouse
Max temperature (°C)	34.8	30.5
Biomass production (kg)	11.4	19.9
Carbon dioxide (kg)	-	34
Cooling need (MJ)	-	3900

 +75% dry matter  
361 kWh (COP=3)

## Water efficient greenhouse

- + Low water use ↓ of 80%
- + Low pesticide use
- + High CO<sub>2</sub> levels ↑ 100% production increase
- High energy consumption
- Complex technology
- KSA: 7 GJ



## Conclusions

- Technique increases water efficiency (less water and a higher production)
- Technique increases quality
- Technique should be tested and demonstrated under local circumstances
- Capacity building is essential



## Economics

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### Is a sustainable protected horticulture in arid regions economically feasible?

Dr. Ir. Josée Campen

**Introduction**  
Protected horticulture is a sustainable agricultural system. It allows for a high level of productivity and quality of produce, while reducing the use of pesticides and fertilizers. It is a key element of sustainable agriculture.

**Assumptions**  
The analysis is based on the following assumptions:  
- The price of tomatoes is 1.00 EUR/kg.  
- The cost of production is 0.40 EUR/kg.  
- The yield is 10 kg/m<sup>2</sup>.

**Economic analysis**  
The gross income (GI) is calculated as follows:  
GI = Price × Yield = 1.00 EUR/kg × 10 kg/m<sup>2</sup> = 10.00 EUR/m<sup>2</sup>

The net income (NI) is calculated as follows:  
NI = GI - Cost = 10.00 EUR/m<sup>2</sup> - 4.00 EUR/m<sup>2</sup> = 6.00 EUR/m<sup>2</sup>

The net income is positive, indicating that protected horticulture is economically feasible in arid regions.

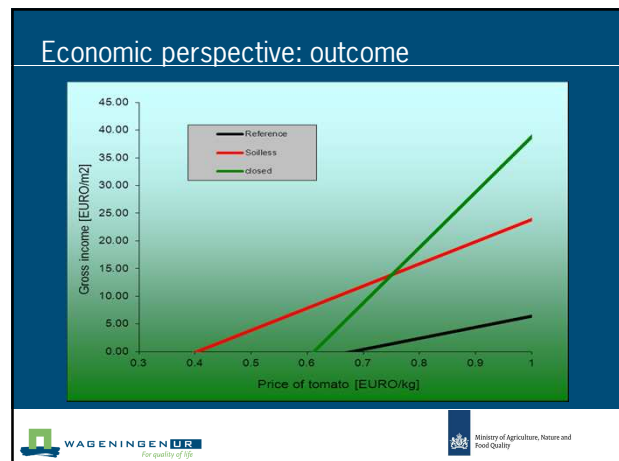
**Conclusion**  
Protected horticulture is a sustainable agricultural system that can be economically feasible in arid regions. It allows for a high level of productivity and quality of produce, while reducing the use of pesticides and fertilizers. It is a key element of sustainable agriculture.

**References**  
- Campen, J. (2010). Is a sustainable protected horticulture in arid regions economically feasible? Wageningen UR.

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## Economic perspective: outcome



Thank for your attention!

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