ECONOMIC ASSESSMENT OF EL CARRACILLO MAR SYSTEM BY EVALUATION INDICATORS. LOS ARENALES AQUIFER, CASTILLA Y LEÓN, SPAIN

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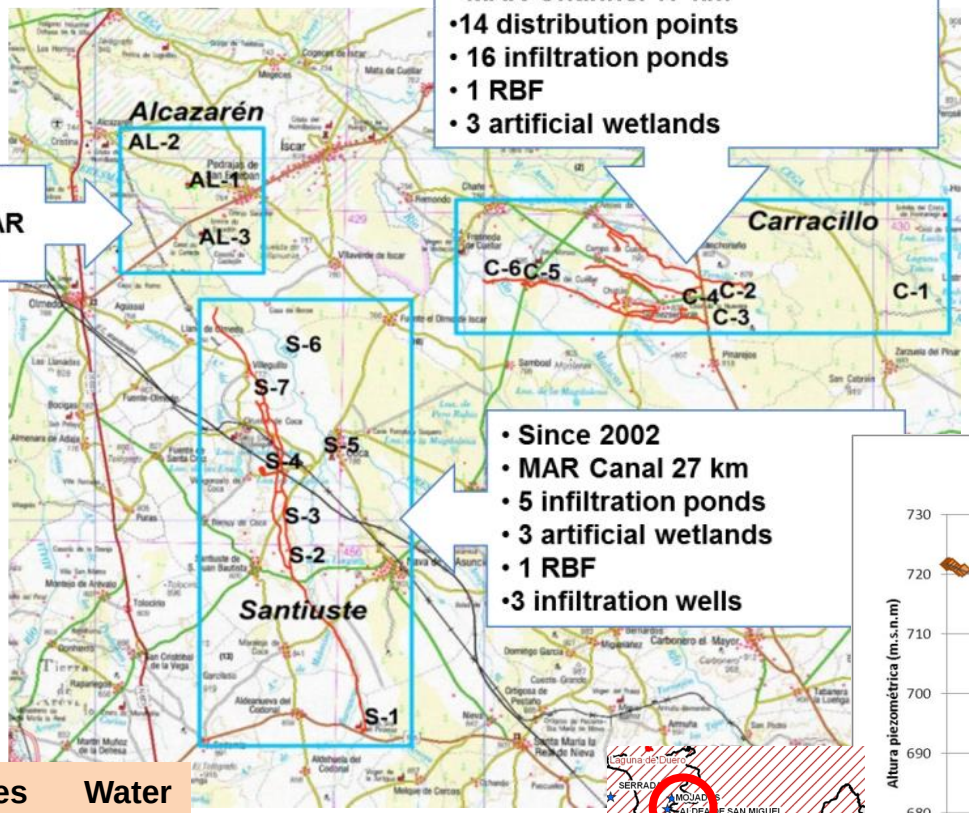
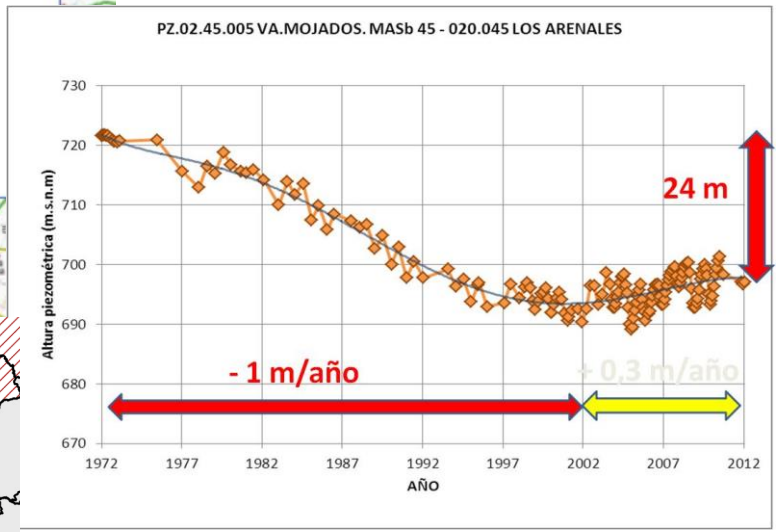
MAR AT LOS ARENALES AQUIFER

- Since 2003
- MAR Channel 17 km
- 14 distribution points
- 16 infiltration ponds
- 1 RBF
- 3 artificial wetlands

- Since 2012
- 1 RBF > SAT-MAR
- Channel 5.5 km

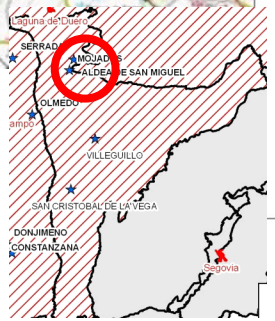


- Since 2002
- MAR Canal 27 km
- 5 infiltration ponds
- 3 artificial wetlands
- 1 RBF
- 3 infiltration wells



Los Arenales Water body: 2,400 km², 96 villages in Valladolid, Segovia & Ávila. 46,000 inhabitants.

Ie = 1,3



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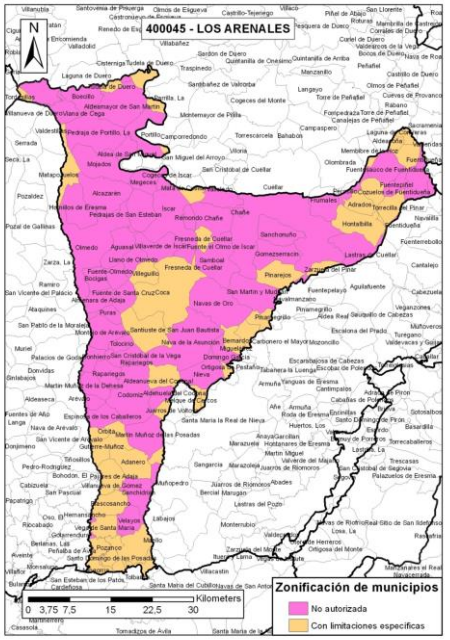
NEW RIVER BASIN PLAN´S PROPOSALS

- **Zonification for bodiesin a bad water status**
- **Zonification according to exploitation index**
- **Limitations for water use**
- **Monitoring of affected water bodies**
- **GW extraction control**
- **Regulations for MAR R.D. 478/2013, de 21 de junio (Normativa del Plan)**



Art. 66 Enhancement of Groundwater users communities (CUAS): MAR with natural water authorization. *2. Any* ***permission for recharge*** *will require setting up an* ***irrigation community*** *for those receiving benefits from the regulation license*

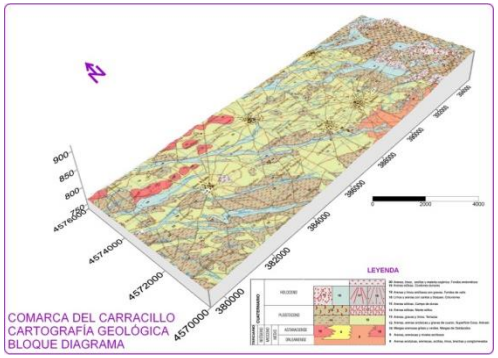
Art. 62. Groundwater masses in a bad quality status *would be* ***declared in risk. The own river basin evaluation will be taken into account,***

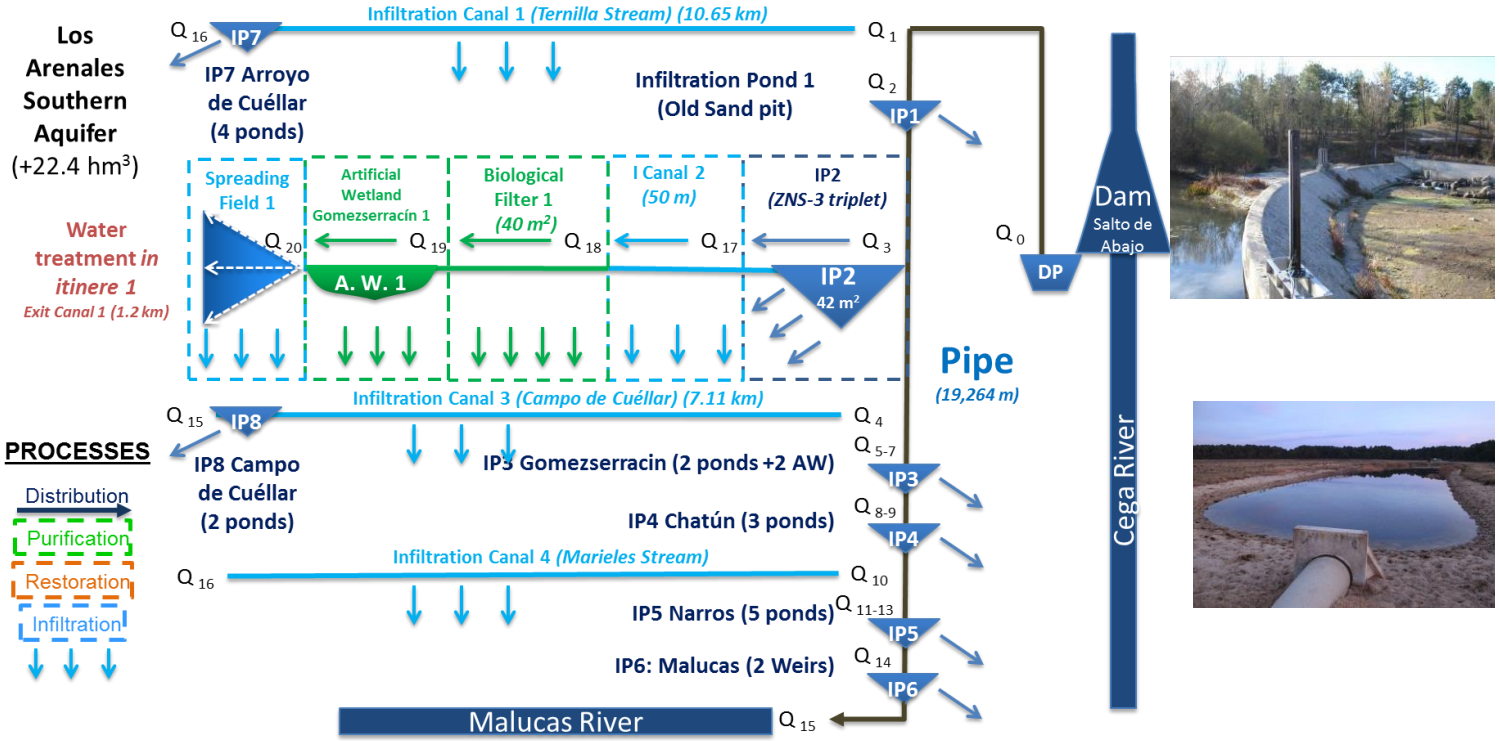
Without external data considerations

Arenales water mass zonification

Unauthorized zone	Zone with specific limitations
TM with Ie (Rc/Rd)>75% applyes Art. 64	To be defined by CHD
Difficulties for new extractions permission	To be defined by CHD

EL CARRACILLO SCHEME





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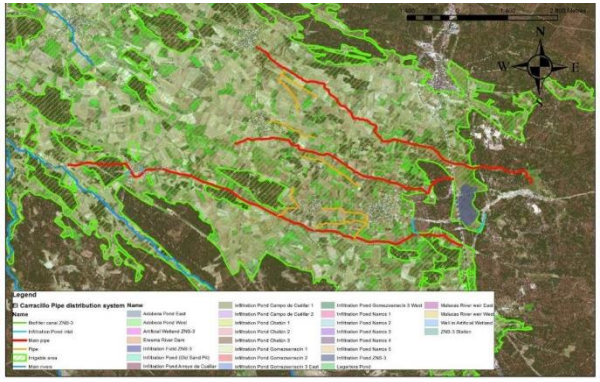
AGRICULTURE IN EL CARRACILLO

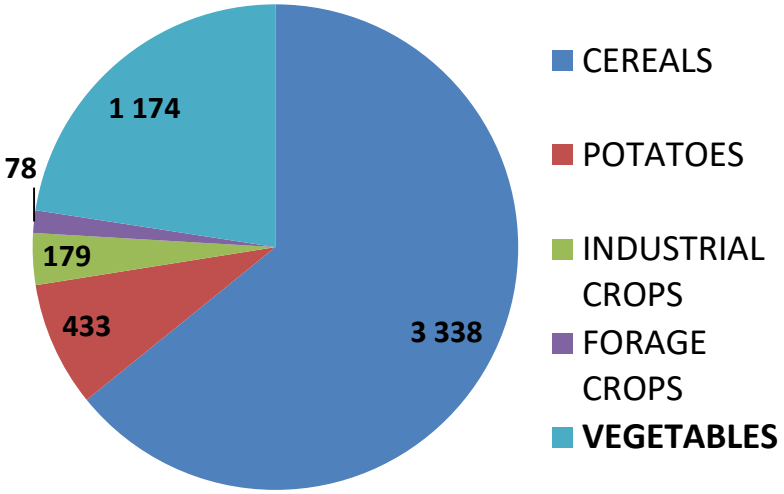


✓ **3,500 hectares** are irrigated in 11 municipalities

DRIVING FORCE OF THE LOCAL ECONOMY: AGRICULTURE

Carracillo district ranks up in the Spanish agriculture for its production of **horticultural products** (**80%** of vegetable production of Segovia and **30%** of Castilla y León)

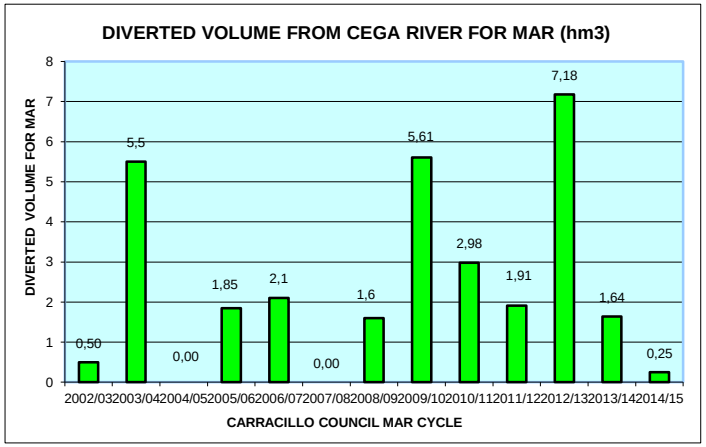
CROP DISTRIBUTION (ha)



✓ **First producer** in Spain of **strawberry mother plants**: About 600 hectares produce 60 M units.

PROBLEM: DECREASED WATER TABLE
INCREASES EXPENSES FOR IRRIGATION USERS
SOLUTION: MANAGED AQUIFER RECHARGE

MAR CONTRIBUTION



FINANCIAL DATA

- **Total cost of the site: 5,273,999 €**
- **Unitary cost (€/Ha): 684.93 €/ha**
- **Unitary cost (€/m³): 0.167 € (13 years)**

- ✓ Recharge amount: **31.47 hm³ (13 years)**
- ✓ Water processed by MAR facility (unitary): **24.18 m³/ha·13years**

Carracillo shield. What are concessions like?

- River basin civil servants supervise the gate to divert water from Cega river, managed by the irrigation community
- There is an specific allowance period revisable yearly
- An environmental minimum flow rate must be respected: 6,898 l/s (initial permision)
- Maximum divertion: 1,370 l/s from January to April (2nd allowance)

The total flow rate minor than 22,4 hm³/año

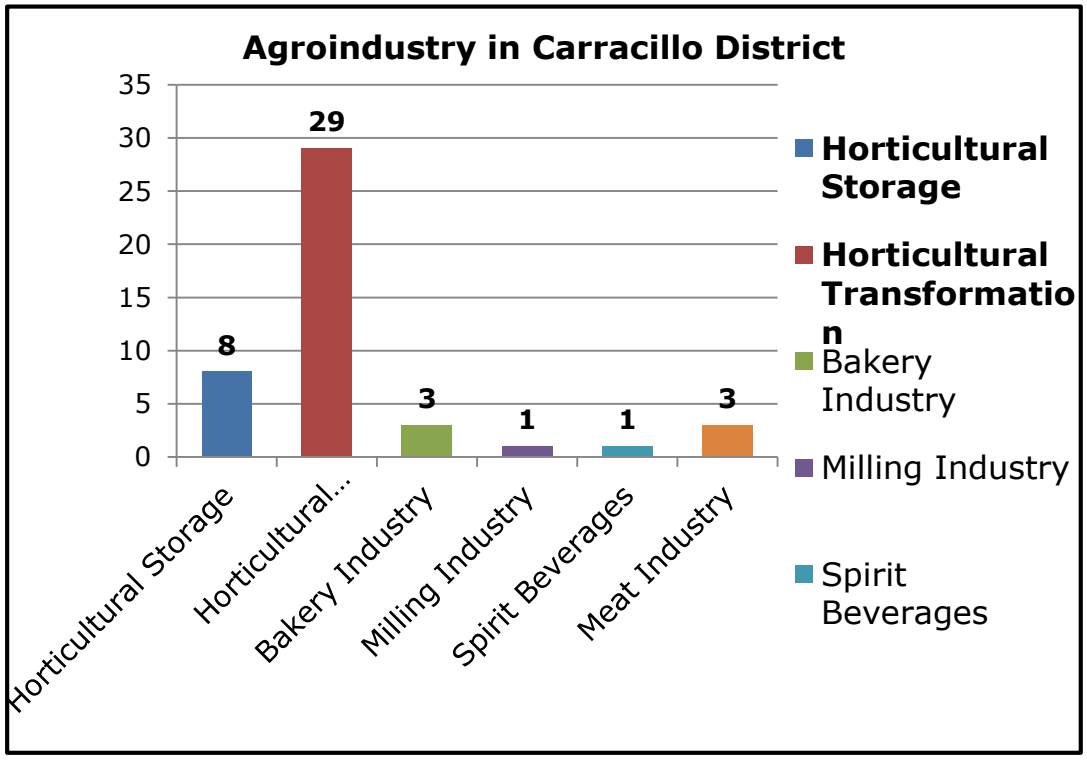
Flow meter controlled in real time

- ✓ legal requirement
- ✓ useful for analyses and studies

MAR & AGROINDUSTRY

AGROINDUSTRY: VEGETABLES PACKING AND EXPORTATION

Horticultural industries stand out with a turnover of about **45 M€**



Safe yield *vs* Water mining

"INDUSTRY-STATE OF AQUIFER" DEPENDANCE

- ✓ Irrigation: 3,500 ha out of 7,586
- ✓ 713 communers
- ✓ Mean annual aquifer extraction: 8 hm^3/year
- ✓ Effect of MAR: 314.3 m^3/ ha out of 1,318 m^3/ ha extractions average

23,8% Irrigation water comes from MAR

MAR & AGROINDUSTRY

MAR ROLE IN CARRACILLO: BOOSTING RURAL DEVELOPMENT

Irrigated agriculture **plays a "vital" role in rural employment**:

Regional Rural Area

- **0.46 Agroindustries/km²**
- **0.67 workers/km² in Agricultural sector**
- **0.81 workers/km² in Industry sector**

Carracillo District

- **1.28 Agroindustries/km²**
- **2.38 workers/km² in Agricultural sector**
- **2.74 workers/km² in Industry sector**

Employment opportunities are **multiplied by three**

3X

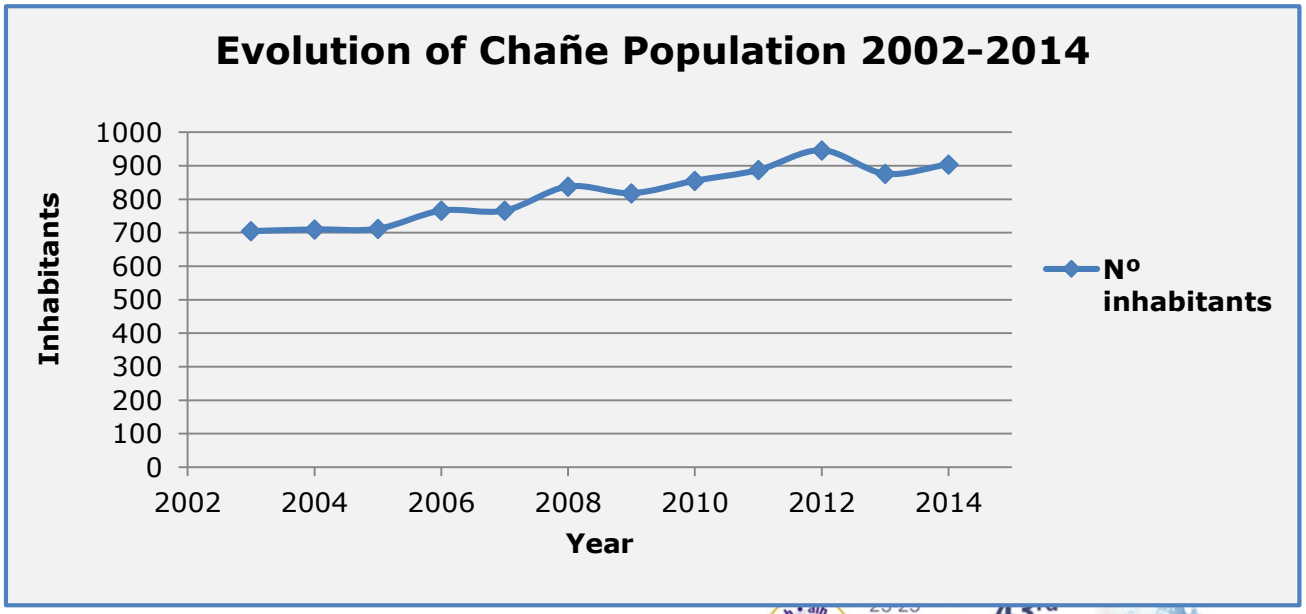
Source: Itacyl, 2015

Strawberry and vegetables industries generate about 700 direct jobs and 3,000 indirect jobs

MAR & AGROINDUSTRY

MAR ROLE IN CARRACILLO: BOOSTING RURAL DEVELOPMENT

- ✓ High employment rates contribute to the **attachment of population** in rural areas. Since 2000 the population in the region has increased by an average of -6%.
- ✓ *Examples with considerable increases; e.g. since MAR began the municipality of Chañe´s population has increased up to +28%*



Source: INE, 2014

MAR BENEFITS FARMERS

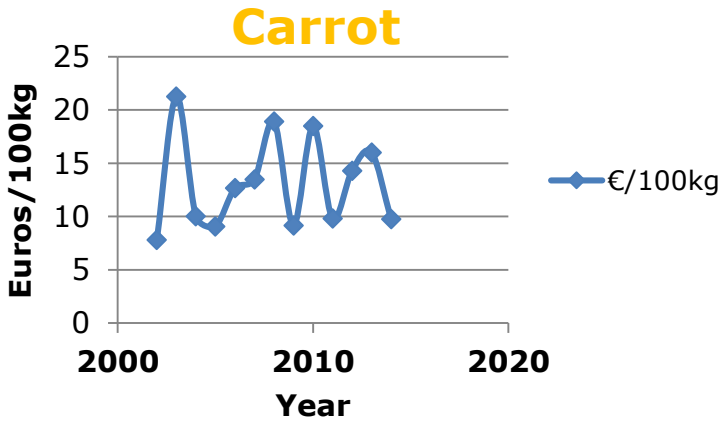
MAR increases **water availability** allowing the transformation of dry lands into irrigated lands, leading to **greater productions**: **2-3 x**

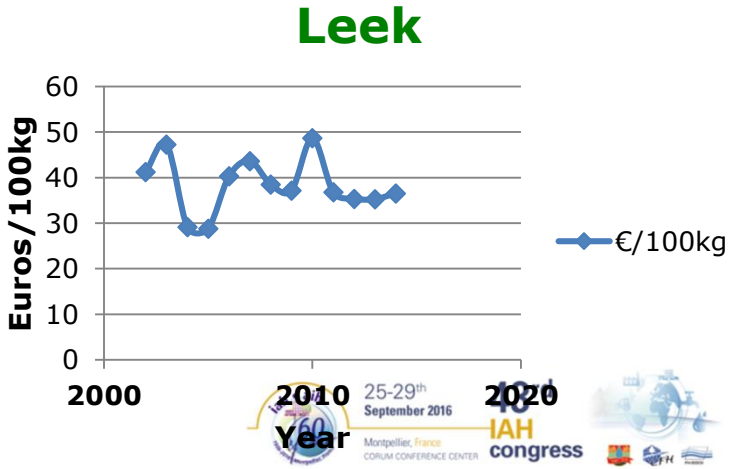
	Crop Yield (kg/ha)	
	Rainfed	Irrigated
Potato	28,472	48,431
Garlic	5,649	11,058
Sweet melon	7,978	26,478
Wheat	2,977	4,610
Barley	2,446	3,654
Oats	1,906	3,413
Rye	1,789	3,272

Source: Junta de Castilla y león, 2014

Yields per hectare get **duplicated** in most cases, and even **tripled** e.g. for sweet melon.

BUT…PRICE PAID TO GROWERS …..OOPS





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MAR BENEFITS FARMERS

ENERGY CONSUMPTION SAVINGS BY MAR

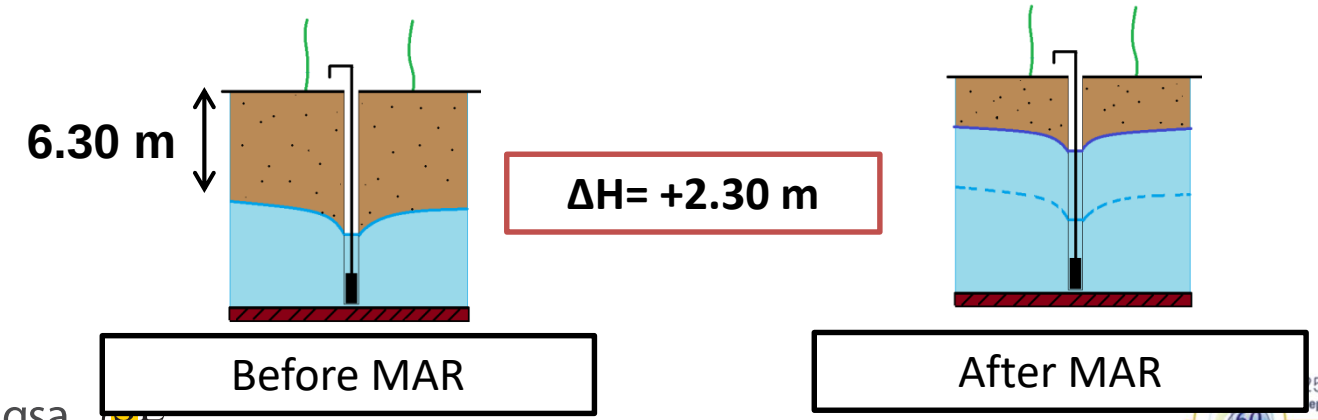
Approximately **40% of the total costs** of irrigated farming come from **energy expenditure**. Pumping energy consumption depends on:

- Energy efficiency of the system
- Depth of the water table
- Height of the application
- Water preassure required
- Maximum water flow volume demand and frequency
- …

MAR

Carracillo District (pilot scale)

- ✓ Nº of wells: 314
- ✓ Mean output water flow volume : 9,957 m^3 per well and year
- ✓ Mean water table depth before MAR: 6.30 m
- ✓ Mean water table depth after MAR: **4.00 m**



MAR BENEFITS FARMERS

What does a 2.30 m water table raise represents in energetic terms?

314 wells – Q ≈ 9957 m^3/year and well - ΔH = +2,30 m

	Before MAR	After MAR	MAR savings
Energy consumption (kWh)	76,430	48,430	-28,000 kWh
Energy cost (€/year)	8,180	5,180	->3,000 €

Energy savings of 36%

-36%

CONCLUSIVE REMARKS

1) The Agro-industry development at Los Arenales aquifer is closely related to MAR (the aquifer was declared provisionally over-exploited in 1995)
2) MAR has positive effects on job creation and economic growth
3) MAR plays a vital role in avoiding rural depopulation
4) MAR improves yields and productions, balancing the lower prices
5) Improvements in water irrigation systems enhance the efficiency, the environmental conditions, time disponibility, supply guarantee and, in short, better economic results
6) MAR techniques provide savings in energy consumption (-36%) enhancing the energy efficiency and raising farmer´s incomes
7) It is recommended an energy audit to provide a significant improvement in energy efficiency and savings

THANK YOU FOR YOUR ATTENTION

Montpellier 2016 Sept. 28th

…See you in Madrid 2019

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