

# Data Science Hackathon Workshop - 2023

## DESAFIOS E RESOLUÇÃO DE PROBLEMAS COM CIÊNCIA DE DADOS EM RECURSOS NATURAIS E AMBIENTE

Workshop público no âmbito do programa de Mestrado em Green Data Science

### The challenges on supporting decision making practices based on data in agriculture *- water use/management in vitiviniculture-*

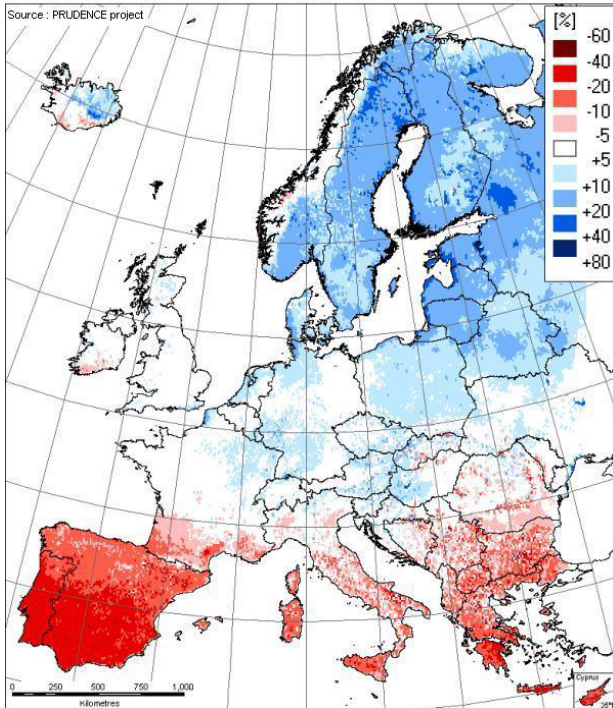
**J. Miguel Costa**  
**LEAF, Instituto Superior de Agronomia**  
**Universidade de Lisboa**



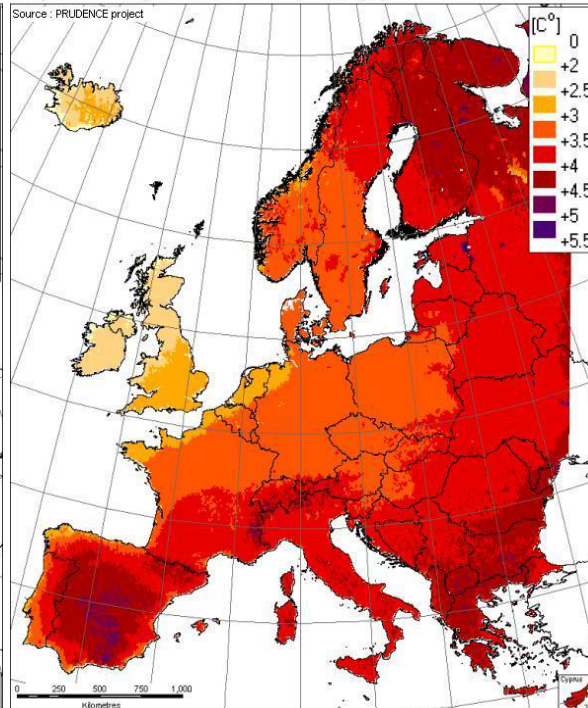
# Climate change and Mediterranean agriculture increasing risks for Mediterranean countries

## EC-project Prudence (2004)

Precipitation: change in annual amount [%]



Temperature: change in mean annual temperature [C°]



↓↓ 25% precipitação

↑↑ + 2,5-3°C T<sub>ar</sub>

↑ T<sub>Solo</sub>

## Área de vinha (2022)

950,000 ha - Espanha

812,000 ha - França

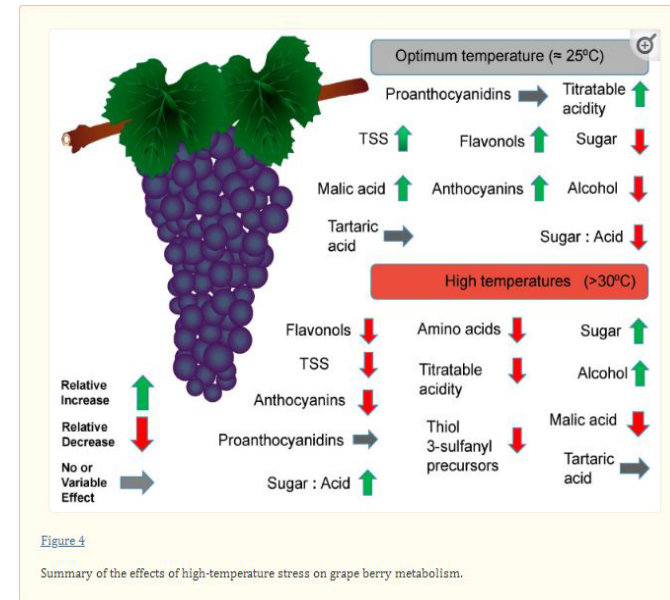
712,200 ha - Itália

178,000 ha - PT

# More extreme climatic conditions ...



Alentejo



Venious et al. 2020



Douro



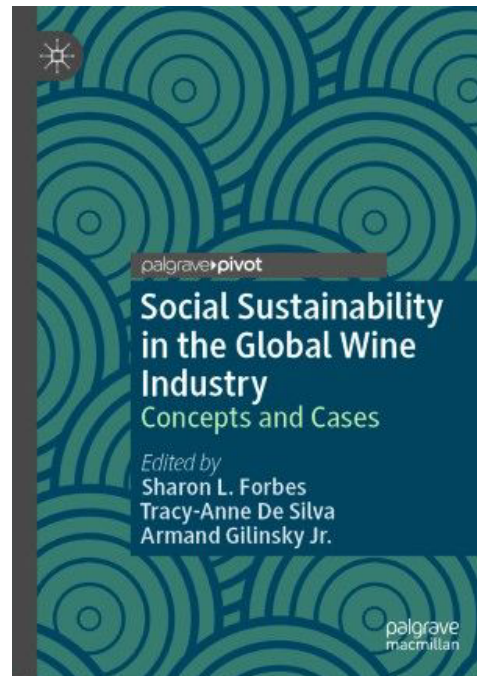
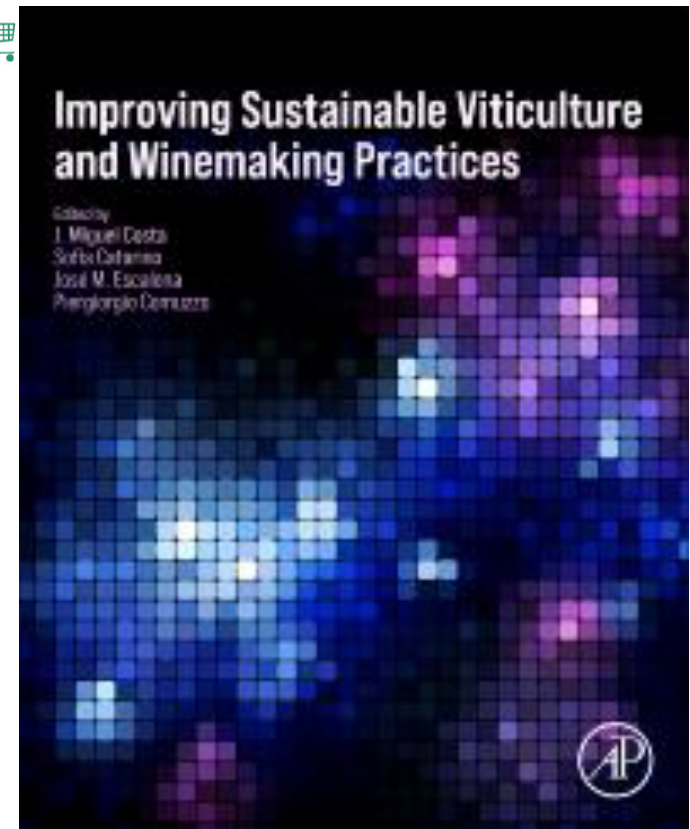
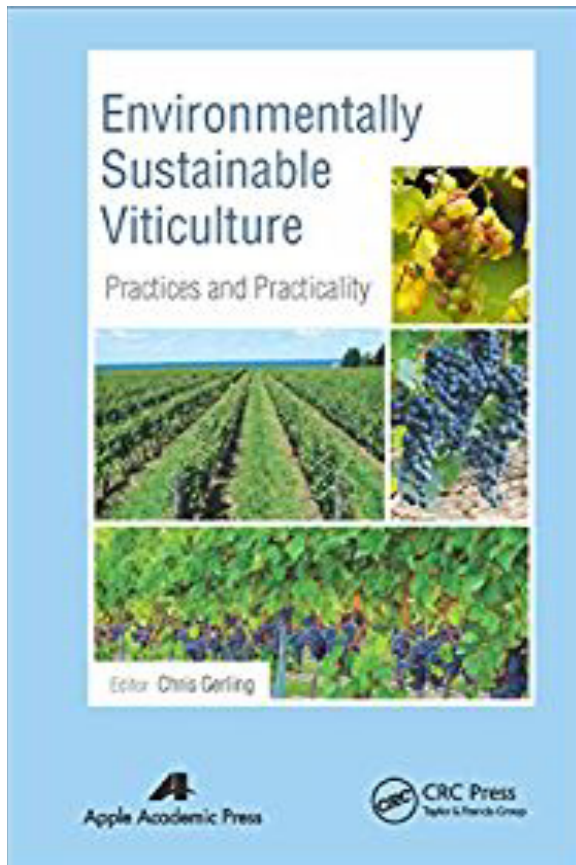
**Douro: “Sem rega arriscamo-nos a ficar com hectares e hectares de vinhas mortas”**

Regime jurídico da rega no Douro foi atualizado, mas não é consensual. Especialista da UTAD garante que é uma questão de sobrevivência da videira

ADVID, 2020

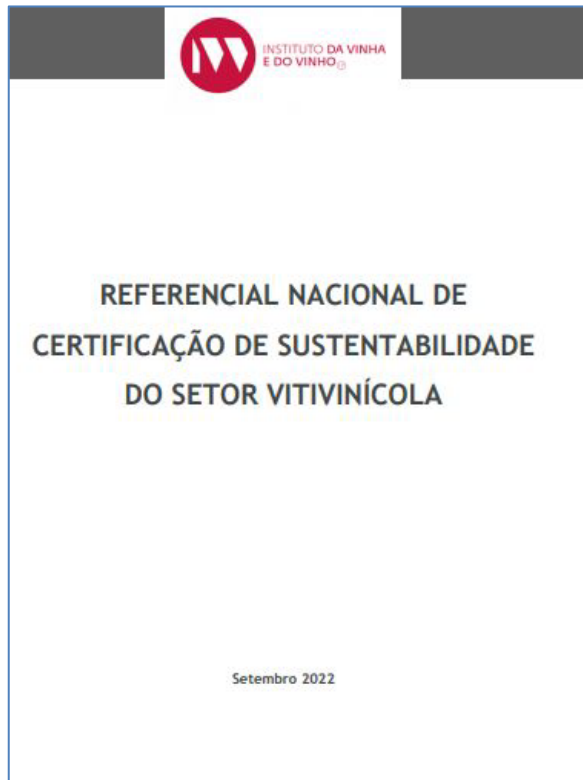
# Increasing public awareness and legislation

WHAT IS THE CIRCULAR ECONOMY?



# Certification

- Referencial Nacional de Certificação de Sustentabilidade do Sector Vitivinícola & Programa de Sustentabilidade dos vinhos do Alentejo



[https://www.ivv.gov.pt/np4/786/%7B\\$clientServletPath%7D/?newsId=10176&fileName=IVV\\_Referencial\\_Sustentabilidade\\_IVV.pdf](https://www.ivv.gov.pt/np4/786/%7B$clientServletPath%7D/?newsId=10176&fileName=IVV_Referencial_Sustentabilidade_IVV.pdf)

# Some critical indicators for Portuguese agriculture



## COMO SE PODE MONITORIZAR E GERIR O QUE NÃO SE MEDE COM RIGOR?

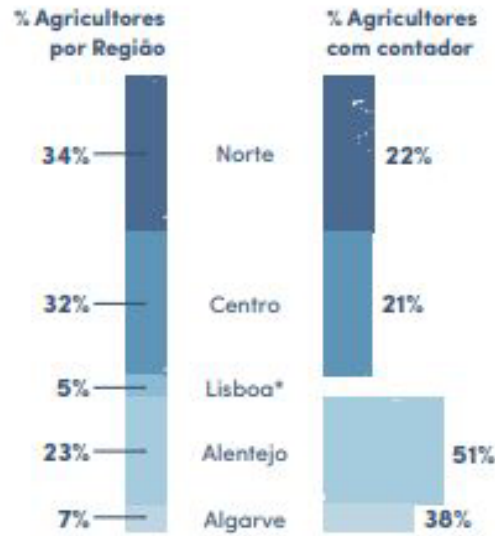
# 71%

Não tem contador de saída de água (caudalímetro)

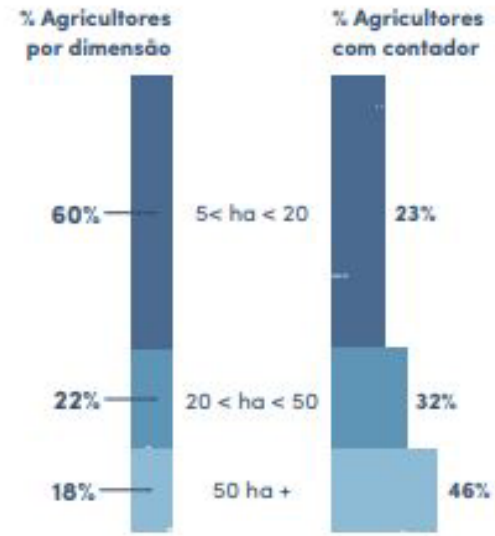
### QUEM TEM CONTADOR DE SAÍDA DE ÁGUA?

[Neste inquérito, os agricultores que têm contador (29%) representam 44% da superfície de regadio]

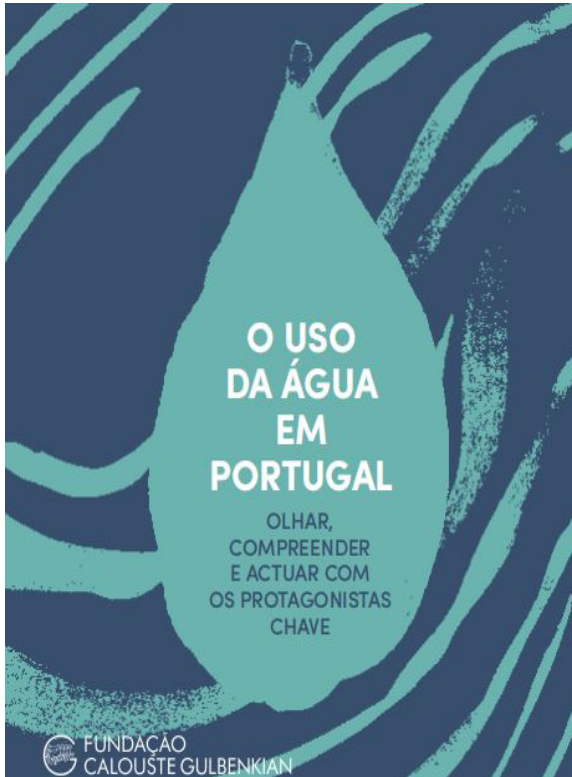
#### ZOOM IN REGIÕES



#### POR DIMENSÃO



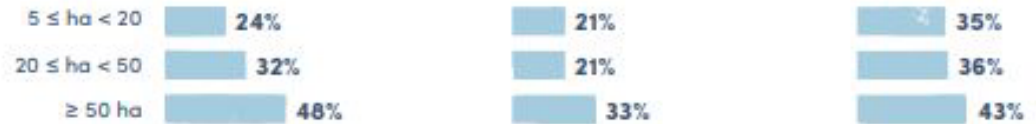
Norte (N=113); Centro (N=159); Alentejo (N=142); Algarve (N=47)  
\* Sub-amostra Lisboa sem relevância estatística



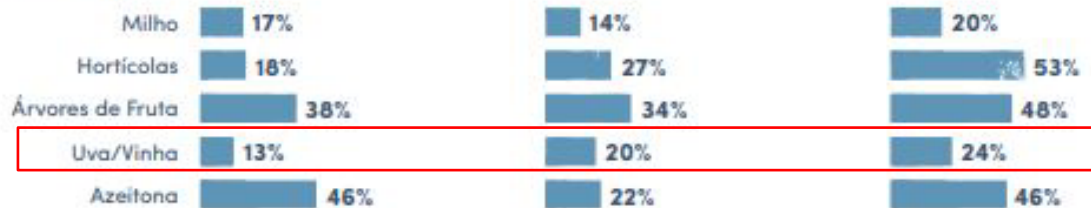
## AGRITECH NO CONTROLO DA REGA: A ADOÇÃO DE NOVOS EQUIPAMENTOS AINDA É EMBRIONÁRIA



### POR DIMENSÃO



### POR PRINCIPAIS CULTURAS\*



# Available data on irrigation water use shows variations

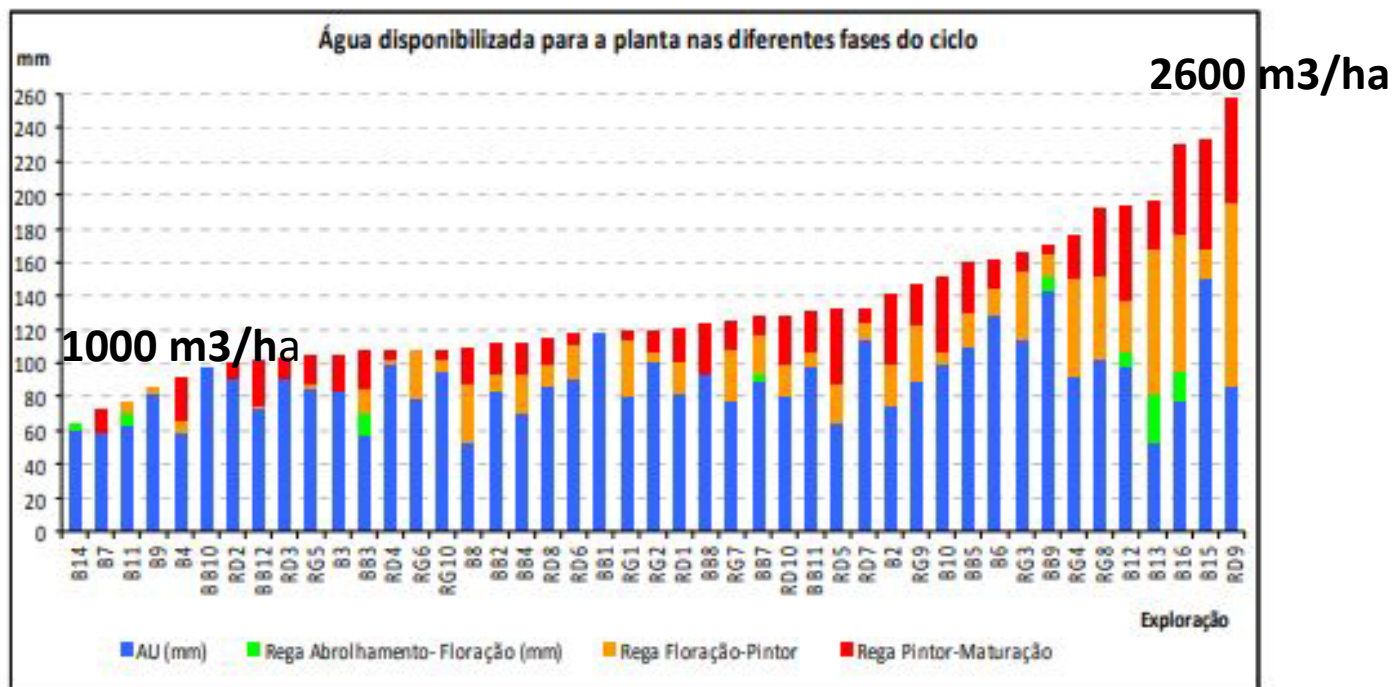


Fig. 18- Água disponibilizada para a planta durante o ciclo e por fase.

Facilmente se pode concluir da grande variabilidade de volume de água de rega aplicadas por unidade de área em cada exploração agrícola, ou seja, o volume de água aplicado na mesma casta, na mesma campanha de rega variou entre aproximadamente 11,8 mm e 163,7 mm/ano. Este foi o parâmetro utilizado para definir o indicador de rendimento (Fig 18 e 19).

## COTR-ATEVA 2009.

[https://www.ateva.pt/ateva\\_site\\_media/cms\\_page\\_media/58/Boas%20Praticas%20de%20gest%C3%A3o%20da%20Rega%20da%20Vinha.pdf](https://www.ateva.pt/ateva_site_media/cms_page_media/58/Boas%20Praticas%20de%20gest%C3%A3o%20da%20Rega%20da%20Vinha.pdf)



# Available data on irrigation water use shows variations

*Clima e volumes de água de rega aplicados ao longo de três anos consecutivos em condições de rega deficitária sustentada (SDI) implementada num ensaio conduzido numa vinha comercial da região do Alentejo (Reguengos) (Costa et al., 2019). Precipitação média (mm); Evapotranspiração de referência ( $ET_0$ );  $T_{air}$  – temperatura do ar; Volumes de rega: dotação aplicada durante o período de rega. A gestão da rega deficitária foi baseada em limiares na medição do potencial hidrico foliar de base (limiares entre  $-0.4$  a.)  $0.5$  MPa.*

Year	Mean/ Max $T_{air}$ (Jun - Aug) (°C)	Rainfall during dormancy period (Oct - Feb) (mm)	Rainfall during growth period (Mar - Aug) (mm)	Cumulative $ET_0$ (Mar - Aug) (mm)	SDI irrigation volume (May/Jun - Aug) (mm)
2013	24.5/34.3	308	255	820	111
2014	23.2/32.8	321	157	776	67
2015	24.9/34.6	288	95	940	165

**670 m<sup>3</sup>/ha - 1650 m<sup>3</sup>/ha**

# Available data on irrigation water use shows variations :

Indicative values (m<sup>3</sup>/ha) proposed by EDIA for Table and Wine grape

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<b>Rega</b> (ano médio)	<ul style="list-style-type: none"><li>• <b>Uva de mesa</b> – 5,000 m<sup>3</sup> a 6,000 m<sup>3</sup>.</li><li>• <b>Uva de vinho</b> – 2,500 m<sup>3</sup> a 3,000 m<sup>3</sup>.</li></ul>	<b>EDIA (2015; 2017)</b>
<b>Rega</b> (ano médio)	<ul style="list-style-type: none"><li>• <b>Uva de mesa</b> – 4.500 m<sup>3</sup>/ha a 5.000 m<sup>3</sup>/ha.</li><li>• <b>Uva de vinho</b> – 2.000 m<sup>3</sup>/ha a 2.500 m<sup>3</sup>/ha.</li></ul>	<b>EDIA (2020)</b>
<b>Rega</b> (ano médio)	<ul style="list-style-type: none"><li>• <b>Uva de mesa</b> – Dotação autorizada em Alqueva 5 200 m<sup>3</sup>/ha.</li><li>• <b>Uva de vinho</b> - Dotação autorizada em Alqueva 2 100 m<sup>3</sup>/ ha.</li></ul>	<b>EDIA (2022)</b>

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2000 - 3000m<sup>3</sup>/ha

# Difficult to find data on irrigated areas in Portugal

**Quadro 1.** Evolução da área total de vinha, área regada e do Índice de Secura, tendo com referência à região de Évora, adaptado a uma reserva útil (RU) de 200 mm, para a região do Alentejo e para o período compreendido entre 1988 e 2018.

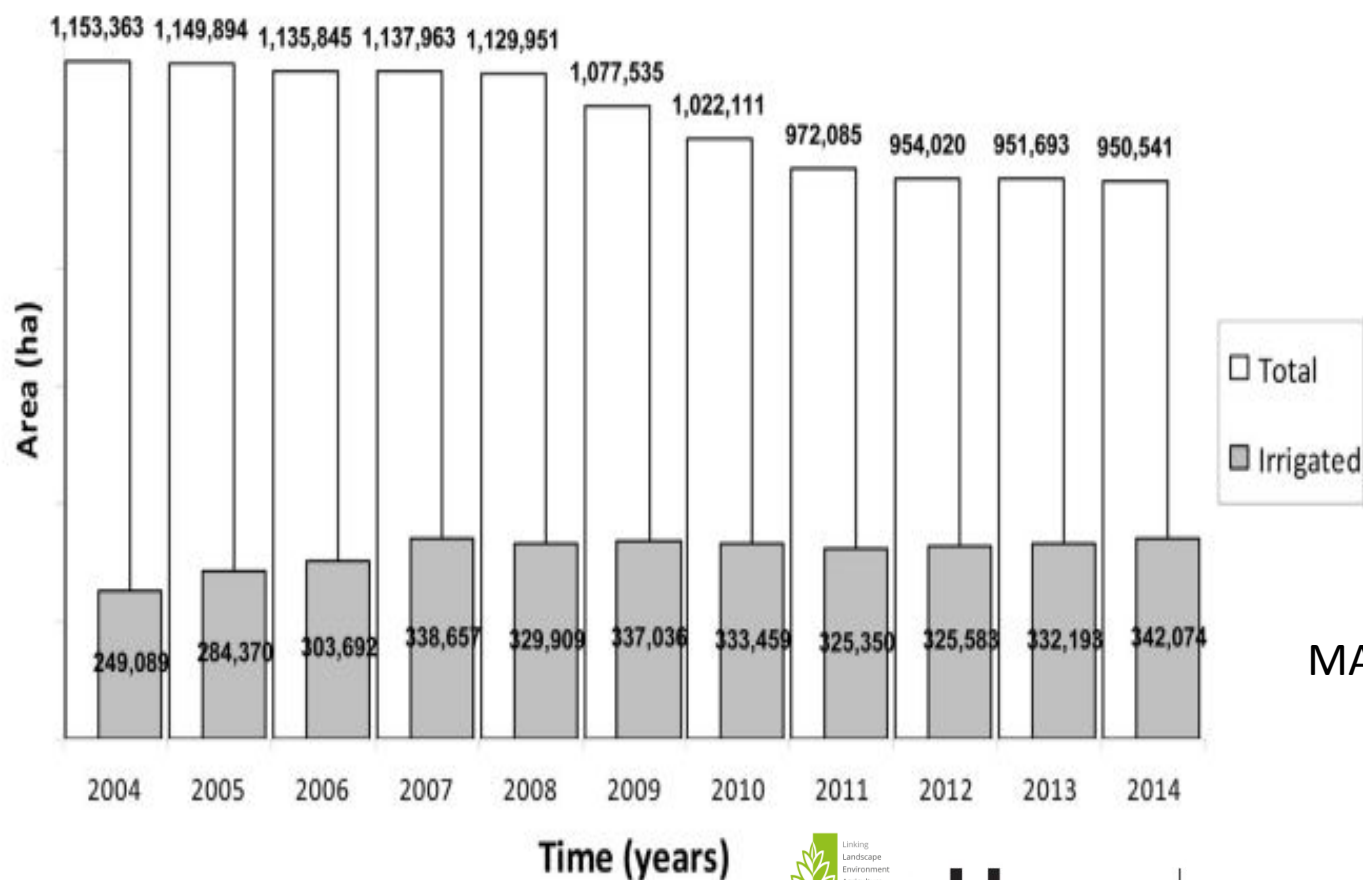
Ano	Área de vinha	Área regada	Índice de Secura <sup>d</sup> (mm; RU=200mm)
1988	5,038 <sup>a</sup>	-	-44.1
1989	11,510 <sup>a</sup>	-	-77.3
1998	-	372 <sup>b</sup>	-151.7
1999	13,457 <sup>c</sup>	629 <sup>b</sup>	-200.0
2000	16,123 <sup>c</sup>	1387 <sup>b</sup>	-82.7
2001	18,420 <sup>c</sup>	2265 <sup>b</sup>	-200.0
2002	20,760 <sup>c</sup>	25% da area total <sup>b</sup>	-149.3
2005	22,655 <sup>c</sup>	-	-200.0
2013	20,425 <sup>c</sup>	-	-200.0
2016	23,000 <sup>c</sup>	10.000	-200.0
2018	24,544 <sup>c</sup>	>50% da área	-162.9

- a) Correia (2015)
- b) CVR ([http://www.sapecagro.pt/download/A\\_rega\\_da\\_Vinha\\_no\\_Alentejo.pdf](http://www.sapecagro.pt/download/A_rega_da_Vinha_no_Alentejo.pdf))
- c) IVV (<https://www.ivv.gov.pt/np4/35/>)
- d) Riou *et al.*, (1994); Tonietto e Carbonneau (2004)

Costa et al. 2019 . GESTÃO DA ÁGUA PARA UMA VITIVINICULTURA SUSTENTÁVEL NO SUL DE PORTUGAL Simp. de Vitivinicultura do Alentejo, 15-17 Maio, 2019, Évora

# Irrigated viticulture expands in the Mediterranean region (area in ha)

Irrigation helps to mitigate climate change effects (34% in Spain)  
(Gambetta et al. 2020)



MAPA (2015)

# In Australia... statistics from 2015...!



*Footnote(s): Data not collected for 2011, 2013 and 2014 seasons.*

*Source(s): Vineyards, Australia 2014-15*

## KEY WATER SOURCE AND METHODS FINDINGS

- In 2015, 440,000 megalitres of water was used to irrigate vineyards, an 18% increase since the 2012 season due to dry conditions. The principal water source used was irrigation channels or irrigation pipelines, accounting for 208,000 megalitres applied.
- Vineyards in South Australia accounted for 46% (or 203,000 megalitres) of total water use, followed by New South Wales with 32% (or 140,000 megalitres) and Victoria with 20% (or 86,500 megalitres).
- Watering by drip or micro spray remained the most popular method with 112,000 hectares of vineyards watered this way nationally, a fall of 7% since the 2012 season.
- More detailed information is available in datacubes under the Downloads tab

# In Australia... statistics from 2015... Vineyard Census!

## OVERVIEW

The Vineyards Census is conducted on behalf of the Australian Grape and Wine Authority (AGWA).

Frequency: The Vineyards Census was conducted annually for the 11 years prior to 2009, with a Vineyards Survey being conducted for the 2009 reference period. For the 2010 reference period another Vineyards Census was conducted with the next, and last, conducted in 2012. AGWA have agreed to fund the Vineyards Census for 2015 and again in 2017.

Scope: The Vineyards Census is sent to all establishments identified as undertaking viticulture activity. These are establishments for whom a special vineyards flag is set on the ABS Business Register (ABR), or who have an Australian and New Zealand Standard Industrial Classification (ANZSIC) code of 0131 (grape growing) or who show areas of vineyards on the Agricultural Survey/Census or more recently, the Rural Environment and Agricultural Commodities Survey.

Statistical unit: Data is collected at the establishment level.

Major commodity categories:

- Area of vines at harvest (area bearing, area not yet bearing (planted or grafted before the harvest), and area not yet bearing (planted or grafted after the harvest))
- Production of red and white wine grapes;
- Area of varieties removed;
- Area of wine grapes left on the vine or dropped on the ground at maturity; and
- Sources, method and volume of water used for watering wine grapes.

## PURPOSE

The main purpose of the Vineyards Census is to collect varietal data on the main grape varieties grown in Australia as identified by the client Australian Grape Wine Authority (AGWA). The output from the Vineyard Census is produced at national, state and Australian Geographical Indication (GI) Region levels.

For each variety, the major data items collected include:

- Area of vines at harvest (area bearing, area not yet bearing (planted or grafted before the harvest), and area not yet bearing (planted or grafted after the harvest))
- Production of wine grapes;
- Area of varieties removed;
- Area of wine grapes left on the vine or dropped on the ground at maturity; and
- Sources, method and volume of water used for watering wine grapes.

The output from the Vineyards Census is essential for research and analysis by government and industry bodies involved in policy development, legislation, planning and infrastructure and by those directly involved in the grape and wine industries.

<https://www.abs.gov.au/AUSSTATS/abs@.nsf/DSSbyCollectionid/AB1EF401A9A4CA51CA2570F30010359A?opendocument>

# Water use/ waste water at the wineries

**QUADRO II.** Water consumption / waste water production in the winery during the vinification process based on literature (Costa et al. 2020)

Volume water (L) /wine produced (L)	Source
1	Andreottola et al. (2009); Rochard and Kerner (2009); Welz et al. (2016); Da Ros et al., (2016)
1-4	Shepherd et al. (2001); Duarte et al. (2004); Vlyssides et al. (2005); Fernández et al. (2007); Stephano et al. (2008); Andreottola et al. (2009); Bolzonella et al. (2010); Lucas et al. (2010); Amienyo et al. (2014); CSWA (2014); Radke et al. (2015); Roman-Sanchez et al. (2015); Oliveira and Duarte (2016); Da Ros et al. (2016); Oliveira et al., (2019); Esporão (2017).
4-8	Kumar and Kookana (2006); Andreottola et al. (2009); Mosse et al. (2011); Da Ros et al. (2016)
>8	Van Schoor (2005); Kumar and Christen (2009); Andreottola et al. (2009); Dillon (2011); Da Ros et al. (2016)

Costa et al. 2020 . <https://doi.org/10.1051/ctv/20203501001>

In the case of Portugal... about 6.0 million hL  
How much water is used per bottle of wine  
worldwide? - If you consider 1 L per Liter wine in the  
winery? :



**6 to 24,000,000 hL**



# Water use in the winery

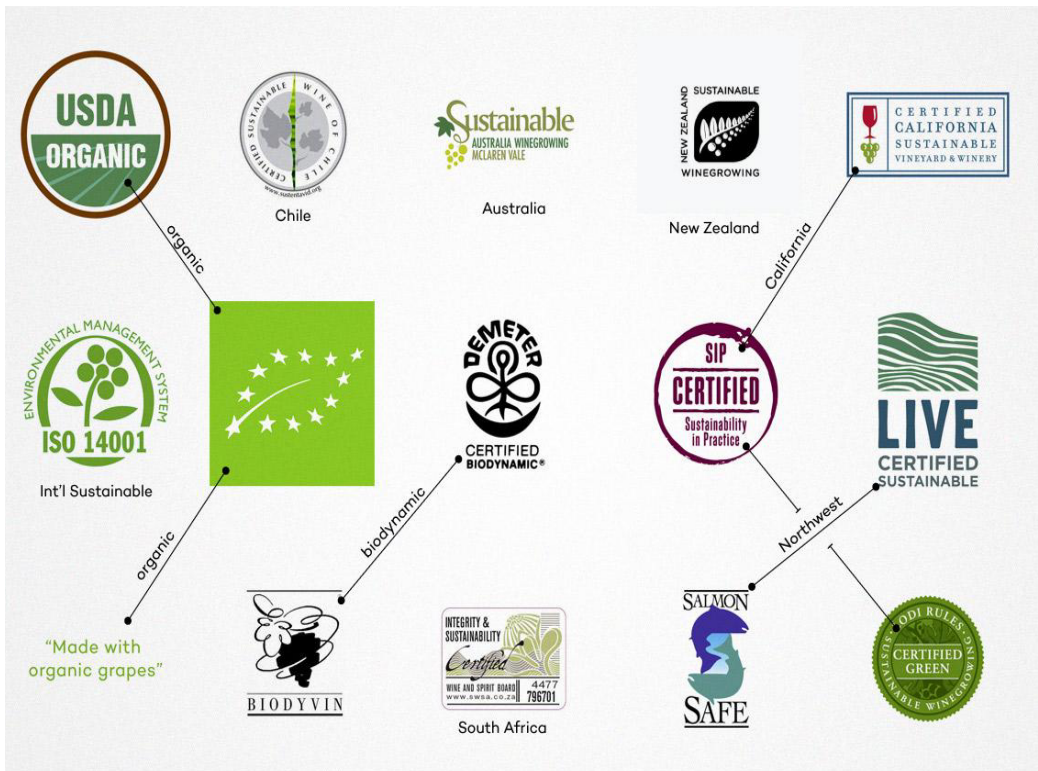
Water use at the winery depends on:

- 1) winery dimension,
- 2) type of wine (e.g. red, white or special wines)
- 3) available cleaning and winemaking technologies
- 4) established practices

This may justify to a great extent why water use (e.g. L of water/L of wine produced) can vary widely with the region, company and country (Oliveira et al., 2022).

# Certification and audits also demand data

Water use is used to evaluate companies performance



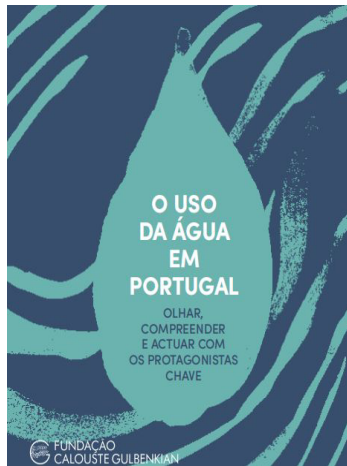
# Future

- Better statistics on the irrigated area , varietal water use, production systems, technologies);
- Improved monitoring and farm and regional levels attending to the heterogeneity of the regions and farms (visits, questionnaires, remote sensing?)
- Decision making supported by data? Which stakeholders to count with?

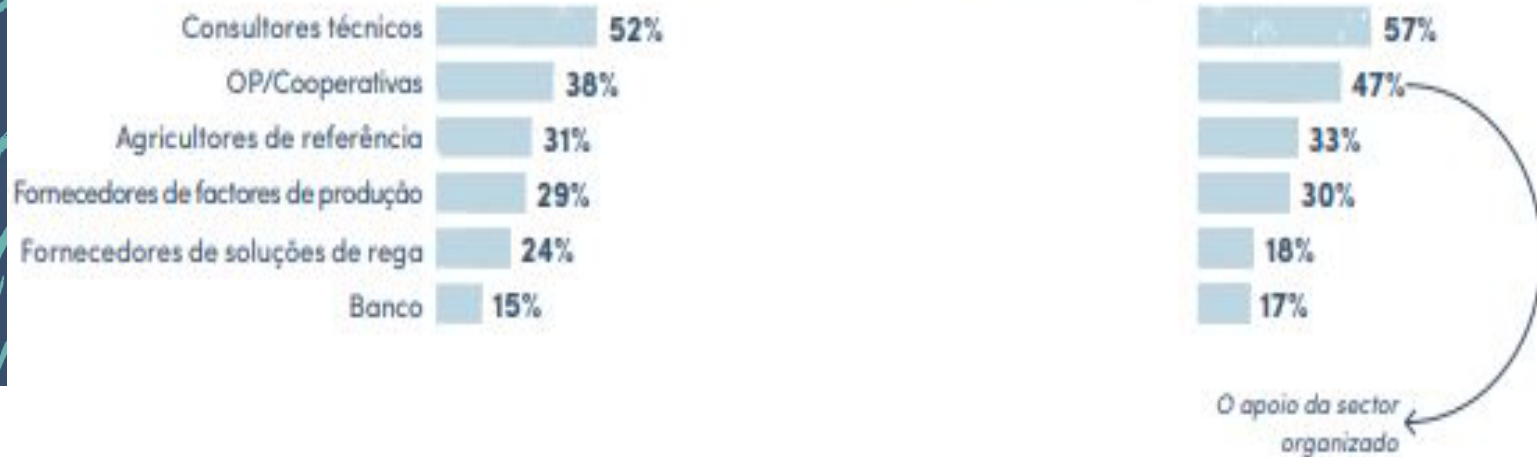
Direções regionais, Associações do sector (ex. ATEVA, AVIPE), COTR, municipalities, IFAP – Instituto de Financiamento da Agricultura e Pescas, Fenareg – Federação Nacional de Regantes de Portugal, Comunidades Intermunicipais, Empresas de Consultoria e Projeto

# Who can help to support the decision

## In Portugal...



### EM QUEM CONFIAM PARA A TOMADA DE DECISÕES



However , Caja Rural in Almeria, Rabobank in the Netherlands or the BNP paribas in FRance are actively doing reports and statistical data bases to support investments in the setor of horticulture and viticulture

**Thank you!**

