

Live from the regions

Vine irrigation in the former Languedoc-Roussillon region: production potential maintained through water savings

In a context of recurring water deficits, rational irrigation of vineyards has been put forward as an appropriate solution to stabilise production (in terms of volume and quality) and to maintain the production tool sustainably. In the Languedoc-Roussillon winegrowing basin, the largest in France, two public aid schemes financed by the European Union have been in place since 2007 to encourage irrigation operators to adopt better practices. The first has led to the installation of an efficient drip irrigation system on more than 23,700 hectares of vines. The second, encouraging farmers to modernise their network, has generated water savings that have been redistributed partly to the water environment and the rest to the creation of new water systems.

The vine, the first irrigated crop in the former Languedoc-Roussillon

Despite a very sharp decline over the last forty years linked to the fall in consumption of "basic" wines, the Languedoc-Roussillon (LR) wine-producing area remains the largest in France, with a surface area of more than 220,000 hectares in production¹, which has now stabilised (Figure ❶). It represents nearly 30% of the arable area of the region with 14,300 farms whose production has averaged around 12.5 million hectolitres over the last decade. This production generates a turnover of around 1,150 million euros, i.e. around 50% of the basin's gross agricultural product. The contribution of the wine sector to the local economy and employment therefore remains substantial and must be safeguarded.

With more than 32,000 hectares in 2017, of which approximately 13,000 hectares have been irrigated since 2010 (Figure ❷), the vine is now, according to a study by the AIRMF², the leading irrigated crop in the LR basin, thereby accounting for over 40% of the irrigated surface area, ahead of fruit and vegetables.

A vineyard confronting climate change

While the average yield of the vineyard was around 75hl/ha in the 1980s (with a predominance of table wines), this figure fell to 56 hl/ha over the period from 2000 to 2019, with continuing marked variability between harvests (around 10 hl/ha).

A closer look at developments reveals a drop in production since 2015, with an alarming minimum of 44 hl/ha reached in 2017.

The structural evolution of the vineyard and the qualitative realignment of its production, with the replacement of highly productive grape varieties such as Aramon by qualitative varieties (Merlot, Syrah, Chardonnay) partly explain the drop in yields recorded (Figure ❸). However, this ceased to be the case over the last twenty years or so, because the quality of the grape varieties has been structurally stabilised. Moreover, thanks to efforts made to restructure, the wine economy of the LR basin has come out of the recurrent crisis and has returned to a certain level of prosperity, as these conditions help to promote greater attention to cultivation practices and to maintain satisfactory productivity.

1. Source : Agreste, 2017.

2. Association des irrigants des régions méditerranéennes françaises/French Mediterranean Regions Irrigators' Association.

In this context, climatic factors emerge as the primary explanation for the drop in yields observed since the early 2000s. Thus, there is clear evidence of a correlation between this downward trend and the changes observed in these meteorological factors (increased temperatures and evapotranspiration, decreased rainfall), particularly during the growing cycle. Changes in the rainfall pattern, with a decrease in effective rainfall and increasingly uneven distribution that increases the frequency of very long dry periods, accentuate a marked trend towards an early decline in soil water reserves. All of these phenomena are particularly detrimental to the growth of the grapes. It should also be noted that an excessive water deficit during the ripening period can have negative consequences on the chemical composition of the grapes (ripening obstructions) and the sensory profile of the wines.

Rational irrigation of vines or management of water stress as a response to climate change

In this context of recurring water deficits, which are having an increasingly obvious impact on harvest volumes but also sometimes on the quality of the wines, rational irrigation of the vines has been highlighted as an appropriate solution to regulate production (both quantitative and qualitative aspects) and to conserve the production tool sustainably. Particularly relevant in vineyards dedicated to the "mid-range" sector (varietal wines with a protected geographical indication (PGI) in particular), it must be precisely controlled to fulfil the minimum requirements of the vine, when these are not fulfilled by rainfall.

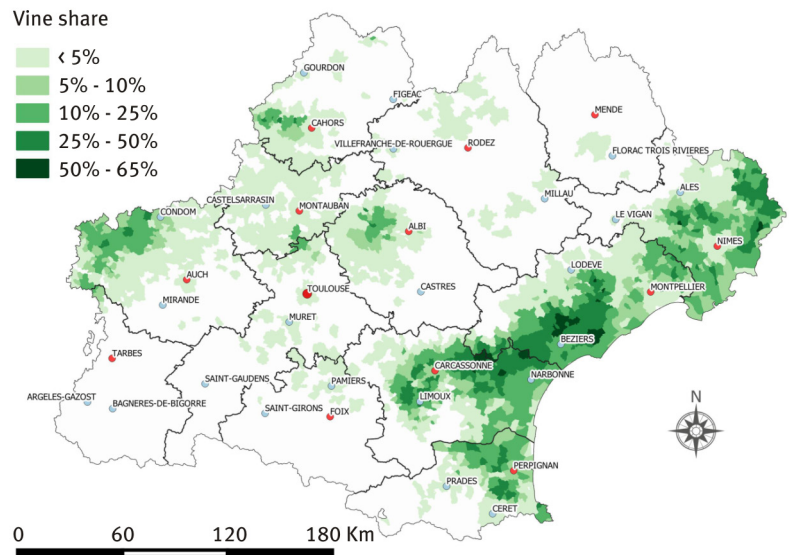
In fact, although the vine is a drought-tolerant plant, its mechanisms for adapting to water stress can be developed only if the latter becomes established gradually.

In an ideal water cycle, the necessary water is provided by rainfall and the soil's water reserve. Thus, rational irrigation in the vineyard should be used only when there is no rain and the soil's water reserves have been consumed, based on recommended annual volumes of between 500 m³ and 1,000 m³/ha, with split daily or weekly supplies, preferably using localized drip irrigation.

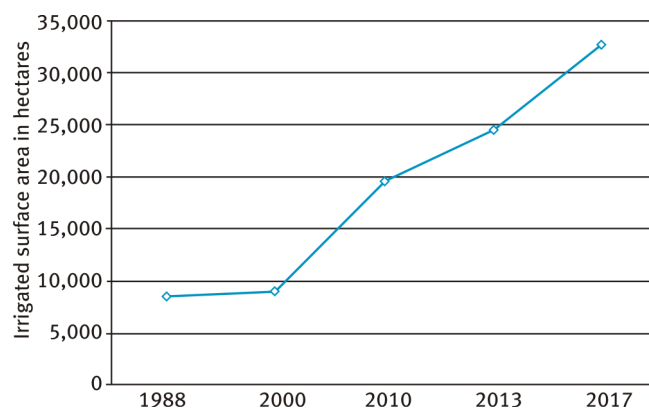
Consequently, depending on the production target, the climatic year and the type of soil, irrigation is not required every year. To achieve rational management of vineyard irrigation, the winegrower needs to establish a water cycle that matches his production target and use gauges that will enable him to monitor the evolution of the water status of his plots.

In order to achieve controlled irrigation, from 2014 a support programme has been operational for "new irrigator" winegrowers, in parallel with the introduction of new irrigated areas. This programme, established through the partnership of the chambers of agriculture with the Bas-Rhône and Languedoc Regional Development Company and the French Institute of Vine and Wine, has been supported by the Region, the former Languedoc-Roussillon, and the Rhone-Mediterranean-Corsica Water Agency, and is designed to:

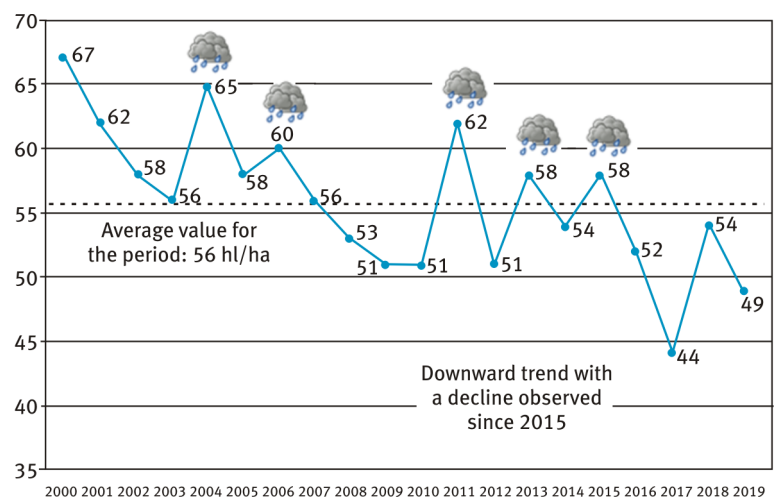
1 Vine density per district in Occitanie (as a percentage of the district area) - 2018 (source: DRAAF Occitanie, IGN BD Carto®, Customs CVI 2018).



2 Evolution of irrigated wine-growing areas in Languedoc-Roussillon from 1988 to 2017 (source: RGA 1988, 2000, 2010, Agreste 2013, AIRMF 2017).



3 Evolution of average vine yields in Languedoc-Roussillon since 2000 (hl/ha). Source: Rendements FranceAgriMer.



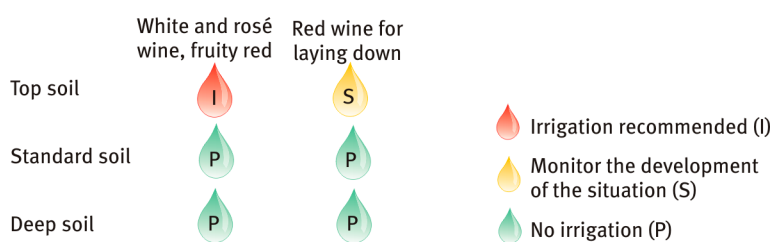
- ▶ make winegrowers aware of rational and economical water management to conserve local resources;
- ▶ enable them to acquire the specific knowledge necessary for the balance between water constraints and production targets (Figure 4).

Rational irrigation is of course not the only solution. Other accompanying adaptive measures are also needed, such as the selection of grape varieties, clones and graft stocks that are more resistant to drought. New approaches to soil maintenance, through their positive agronomic effects (water retention, improvement of organic matter, etc.) are also being encouraged as part of the vineyard's adaptation to climate change. All of these adaptation techniques are being studied by research teams as part of the LACCAGE research project coordinated by the French National Research Institute for Agriculture, Food and the Environment (INRAE)³.

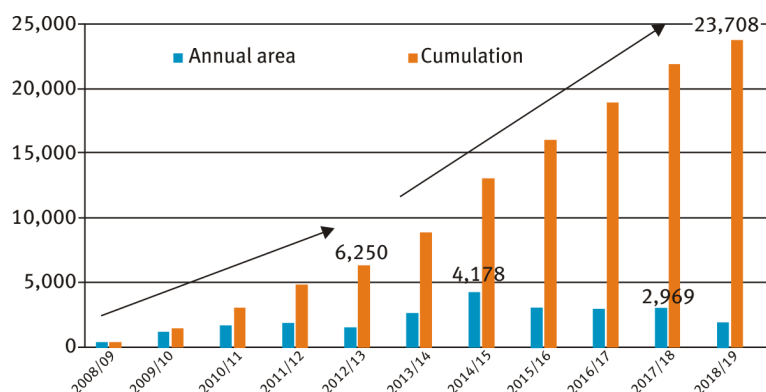
Reconciling the protection of the agricultural economy and the conservation of water resources

Irrigation of wine-producing vines is strictly regulated. It is governed by decree no. 2006-1526 and 1527 of 4/12/2006 supplemented by decree 2017-1327 of 8/09/2017 specific to the vines in areas producing appellation of origin wines (AOC/AOP)⁴. One of the key principles enshrined in these texts is the ban on irrigation from 15 August (veraison) until the harvest.

4 Example of a recommendation for launching irrigation (source: Newsletter of the Chamber of Agriculture of the Hérault).



5 Evolution of surface areas equipped with drip irrigation from 2008 to 2018 in the Languedoc-Roussillon basin, based on aid for vineyard restructuring (source: FAM).



Certain public policies contribute to the development of irrigation in the vineyard. For example, there is the aid offered since 2008 within the framework of the wine CMO⁵. This scheme allows winegrowers to benefit from financial support to equip plots with drip irrigation as part of a support for vineyard restructuring. The aim of the programme financed by the European Agricultural Guarantee Fund (EAGF) is to strengthen the competitiveness of wine-growing businesses, and the adaptation of vineyards to climate change is one way of contributing to this. This aid is awarded by FranceAgriMer on a flat-rate basis, up to eight hundred euros per hectare. It is paid on presentation of proof of an entitlement to take water from water resources or of membership of a collective supply network, and a routine on-the-spot check is also carried out.

In ten years, more than 23,700 ha of vines have been fitted with an efficient drip irrigation system as part of this programme, i.e. an average of 2,900 ha per year (Figure 5).

Alongside this measure managed by FranceAgriMer, another European programme of the Common Agricultural Policy (CAP), dedicated to rural development, provides support for the area of vineyard irrigation. It mobilises the financial packages of the European Agricultural Fund for Rural Development (EAFRD). An instrument of the second pillar of the CAP, it contributes to the competitiveness of farming, the sustainable management of natural resources and the fight against climate change, while also responding to the needs of local and regional development and the attractiveness of rural areas.

The first support programme through the French Rural Development Programme (PDRH) 2007-2013 supported agricultural water-saving projects through measure 125 B1, divided into two sub-measures. Of these two measures, only 125 B1b was implemented for the modernisation of collective irrigation networks, in particular gravity-fed canals, which are very common and linked to the history of water management in the Languedoc-Roussillon basin (Figure 6).

In the face of climate change, there has been a clear and significant demand for water requirements to be met in the wine sector since 2006-2007, the period during which the first feasibility studies for irrigation projects were carried out.

Consequently, Languedoc-Roussillon has fulfilled all the conditions necessary to negotiate additional agricultural water support measures:

- advanced territorial structuring in the coordinated management of the resource at the level of catchment areas (water development and management plans, river contracts, etc.);
- studies of the volumes of water withdrawn from 2010 onwards, the basis for future water resource management plans (WRMP) for a return to a quantitative balance in line with the European Water Framework Directive (WFD);

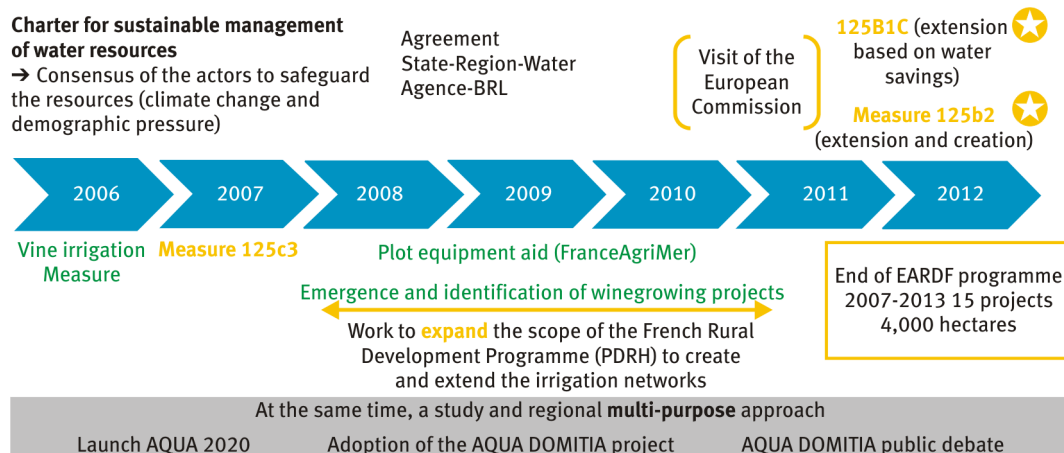
3. The LACCAGE project (Long term adaptation to climate change in viticulture and enology) - <https://www6.inrae.fr/laccage/>

4. AOC: appellation d'origine contrôlée (CDO: Controlled Designation of Origin); AOP: appellation d'origine protégée/PDO Protected Designation of Origin.

5. Common Market Organisation (national support programme for the sector submitted to the European Commission in June 2008 and extended until 2020).

⑥ A look back at the history of hydraulic measures of the European Agricultural Fund for Rural Development (EAFRD).

Source: Occitanie Region.



- significant water savings made during the 2007-2013 programming period;
- a strong political will of the Region with the five LR departments joining together in the Aqua 2020 approach to the management of the resource that reconciles the demands of usage and the preservation of aquatic environments. One of the aspects of this regional approach is the Aqua Domitia raw water conveyance system project, in response to the need for secure use (drinking water, tourism, agriculture) and to protect the environment by replacing withdrawals;
- a tool made available to project leaders: the Regional Hydraulic Network.

After several years of negotiations with the European Commission and on-site visits, the value of integrated irrigation in the Mediterranean sector was confirmed and two measures were added to PDRH:

- Measure 125 B1c "Extension of irrigation systems without increasing the volumes withdrawn, based on the reuse of part of water savings";
- Measure 125 B2 "Creation/extension of collective networks with the increase in volumes withdrawn" without environmental impact, from abundant (Rhône) or secure resources (reservoirs).

The first flagship wine project supported by the Languedoc-Roussillon Region during this EAFRD programme was the one implemented by the ASA ⁶ "Les canaux de Saint-André et du Poujoula/ Canals of Saint-André and the Poujoula" in Roquebrun (Hérault) in 2012: from 6.3 million cubic meters taken from the Orb for the gravity-fed irrigation of 50 ha, the ASA reduced its annual withdrawal to 2.8 million cubic meters and made it possible to supply pressurised water to 350 ha of drip irrigated ⁷ vineyards (photo ①).

Measure 125 B2 results in the creation of new water networks that respect water resources and aquatic environments in response to climate change and water stress on crops (arboriculture, market gardening and viticulture): fifteen collective irrigation projects will therefore be supported by the end of the programme for 4,000 equipped hectares (2.7 million cubic meters deployed and 16.4 million euros of investment, including 6.57 million euros from EAFRD).

Thus, between 2007 and 2014, including the transition year between the two EAFRD programmes, 108 million cubic meters were saved and helped to restore water bodies to a good state of health; in addition, 4,836 ha are the subject of new irrigated areas with the support of 112 project leaders. The EAFRD has been called on to provide € 14 million out of € 39 million of investment in water supply for agriculture, while the Region has contributed about € 7 million (excluding studies) to match the contribution of the Departments.

The complementarity of water-saving measures and economic support measures for agricultural areas is undeniable. These two measures are inextricably linked within the regional policy rolled out in the water management and agriculture sector.

The second EAFRD programme 2014-2020 is described in the Languedoc-Roussillon Rural Development Programme (RDP) where the pair of measures "water savings/new irrigated hectares" (TO4.3.2 ⁸/TO4.3.3 ⁹) was renewed under very tightly regulated conditions: protected resource, irrigation management, assessed environmental impact, proven agricultural value, etc.

It is reported that between 2015 and 2018, 77 agricultural water projects were implemented, or even partly completed, and saved 69 million cubic meters of water

6. Association syndicale autorisée/Authorised user association.

7. Source: First Regional Water Conferences - presentation by A. Castel (Chairperson of the ASA) and Y. Gilbert (SMVOL), 25 May 2016.

8. TO 432: Type of operation support to water infrastructure: achieving water savings and substitution of existing withdrawals.

9. TO 433: Type of operation support for water infrastructure: extension, creation of networks and storage facilities in response to drought and climate change (collective and individual strands).

① Young drip irrigated vine seedling.



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savings, and 5,776 new hectares were planned. These projects represent a total investment of € 68 million, of which € 17 million is provided by the Occitanie Region and € 13 million by EAFRD.

As the programme ends in 2020, the two calls for projects remaining will achieve results similar to the first programme in terms of support for the number of projects and expected water savings.

As has been evident for over ten years, the momentum driving agricultural water supply in the Occitanie region of the former Languedoc-Roussillon remains vigorous and dynamic. It is the result of a consensus achieved among all the actors in the region: economic tools (cooperative cellars) and professional farming organisations, managers of collective irrigation networks (ASA in particular), local authorities in conjunction with local water management bodies (local water commissions, environment managers), financial partners (Europe, Region, Departments, Water Agency, FranceAgriMer) and State services (DDTM and DREAL, etc.¹⁰).

Between 2007 and 2018, both EAFRD programmes have already been implemented:

- 177 million cubic meters of annual savings made by irrigation network managers to assist environmental objectives (WFD);

- 8.7 million cubic meters, i.e. 5% of the savings made, reused between 2013 and 2018 for the redeployment of irrigation networks to ensure the sustainability of farms and sectors in the Languedoc-Roussillon basin.

The use of irrigation projects as a mechanism for water savings: momentum to be continued

Already highlighted during the “H2O 2030, the water-sharing initiative”¹¹ led by the Occitanie Region to prepare its action plan for water, the demand for wine irrigation remains very strong in the Mediterranean strip of the new greater Occitanie Region. Furthermore, this demand has been taken up by the Departments (Aude, Gard, Hérault) which have recently launched forward planning or future studies in order to identify more precisely raw water requirements in relation to climate change within their territories and to study solutions as a first approach.

The former Languedoc-Roussillon is, with the Provence-Alpes-Côte d'Azur region, one of the sectors of the Rhone-Mediterranean basin which has contributed the most over the last ten years to the considerable water savings of more than two thirds achieved by the agricultural sector¹², in particular through the modernisation of the canals.

10. DDTM: Departmental Directorate of Territories and the Sea; DREAL: Regional Directorate for the Environment, Planning and Housing.

11. H2O 2030, l'eau en partage <https://www.laregion.fr/-H2030->

12. Source: Dashboard of the SDAGE Rhône-Méditerranée 2016-2021 (Rhône-Mediterranean Water Development and Management Master Plan).

TESTIMONY OF THE PÉZILLA-LA-RIVIÈRE IRRIGATION CANAL ASA

Testimony gathered in the Pyrénées Orientales department, chosen in 2007 as a study area for the Vulcain project*, a future-oriented analysis of the vulnerability of a region to global change, as it includes not only hydro-systems representative of the Mediterranean context but also one of the most challenging socio-economic contexts in the Languedoc-Roussillon region, in terms of demand and available water resources.

The vine, historically non-irrigated, suffers from a lack of water in this area and this is evident in the low production volumes. The winegrowers of this department are keen to adapt their vineyards and, in conjunction with the actors in their regions, to roll out new, water-saving irrigation networks that are managed in such a way as to maintain these terroirs, which are subject to increasingly recurrent droughts.

In the heart of Roussillon, in the Têt valley, the Pézilla la Rivière irrigation canal ASA wanted to take action in this new context by modernising and extending its irrigation network. Like many canals in this department, the origin of the Pézilla canal is lost in the mists of time, the first mention of the canal dating back to 1411. The ASA's membership perimeter today is 750 hectares, to which 260 hectares of irrigated vineyards are currently being added. The project led by ASA includes the modernisation of its network which, by generating nearly 2 million m³ of water savings per year, will make it possible to remobilise about 300,000 m³ for drip irrigation of the vines, leaving 1.7 million m³ in the river to contribute to the restoration of the quantitative balance of the body of water. The Pézilla la Rivière ASA project suggests that it is possible to reconcile the socio-economic stakes of a territory with the environmental stakes, a concept of which its chairperson, André Garrigue, is already convinced:

"In view of the recent dry years that we have gone through and knowing the risks linked to climate change, we felt it was imperative to take action in order to secure the livelihood of our winegrowers, to ensure the sustainability of our economic activities of our community but also the quality of its environment.

... Initiated within the framework of the Catalan eco-park, with the municipality of Pézilla, but also supported by the Chamber of Agriculture and Perpignan Méditerranée Métropole, our project is moving forward.

Following a diagnostic study of the state of our network, we have identified measures that will lead to significant water savings. The subsidies granted by the Region, the Department and the Water Agency to improve the water-tightness of our networks and to install a system of automated valves will enable us to adjust the withdrawal from the river to comply with the strict water requirements of our canal. Without this 80% public funding, our organisation would not be able to make such investments. Part of the water savings generated will be used for watering the vines and most of it will be returned to the river for aquatic life, so it's a worthy project!"

* Projet Vulcain:

<https://www.brgm.fr/projet/vulcain-vulnerabilite-hydrosystemes-soumis-changement-global-zone-mediterraneeenne>

It is important to credit agriculture in regional projects with part of these volumes saved for the benefit of aquatic environments. There is room for manoeuvre with the water savings that still need to be made in collective networks, particularly gravity-fed systems. They should make it possible to pursue the redeployment of networks to help ensure that agriculture can be maintained while meeting environmental objectives.

At present, about ten projects have been finalised (substitution and/or extension) and are awaiting funding for their implementation (2,000 to 2,500 ha). Beyond these projects, potential demand remains very high (estimated at over 20,000 ha) and will need to be supported in the short term by the formalisation of these requirements. A similar action framework to the current one is needed for the next programming period. ■

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