

## WINE AND CLIMATE CHANGE: HOW CLIMATE CHANGE MAY RESHUFFLE THE CARDS OF THE WORLDWIDE VITICULTURE?

The next COP, which aims to reach a new global agreement on the post-2020 emissions reductions to keep the global warming below 2°C, will take place in Paris. As France is worldwide renowned for its fine wines, we found particularly relevant to raise public awareness on the impacts of climate change on viticulture. Beyond being an economic asset wine production is also a fundamental piece of French culture and identity, and because of the effects of Climate change, the French economy would be affected and some territories will lose important shares of their culture.

The conference was opened by Hervé Quénol, which is research supervisor at CNRS where he manages the LETG - Rennes - COSTEL laboratory (Climate and land cover analyses using remote sensing). His intervention focused on the impacts of climate change on wine over different scales: global, territorial, local.

In introduction, he explained that Climate Change forecasts show that a 1-degree increase of the global temperature would move wines 200 km Northward or to 150 m in height. However the wine depends mainly on local climate conditions; and the modeling of global climate change is too approximate for a local scale. Therefore studying the effects of climate change on the wine needs to be undertaken with territorial and local models, which take into account impacts on the phenological cycle of vine (buddburst, flowering, ripeness), on the composition of grapes (sugar and alcohol contents) and on the modifications of the growing areas.

He emphasized then that the vine is an excellent marker of climate change because it gives annually data about its cultivation, which have been recorded for centuries. For example, it has already been proven that flowering and harvesting tends to start earlier and earlier, or that the sugar content of grapes is increasing. Hervé Quénol also presented some maps from research papers showing the displacement of grapevine-cultivated areas in Europe in 2050. For instance, South of France and especially the Rhone Valley would not be suitable for growing wines anymore.

Hervé Quénol presented afterwards results from his research: the variability of the impacts of climate change on local scales is equivalent as on a global scale. For instance, forecasts around Bordeaux show that within a 20-squared-km area, the temperature increase in 2050 could range from 1.1 to 1.6 °C.

Thus, local mitigation strategies need to be implemented in both short and long terms. They could concern: irrigation, varieties, soil management, winemaking techniques, etc. Studying these strategies is one of the objectives of Hervé Quénol's program LIFE-ADVCLIM: ADaptation of VIticulture to CLIMate Change, high resolution observations of adaptation scenarii for viticulture.

The conference was then held by Joël Rochard from the French Institute of Wine. He adopted a more political approach through its experience in mitigation concerning wine makers and public authorities.

He started presenting advantages and disadvantages of climate change on vineyards. The positive point being the development of vintage champagnes. He then explained that an increase of 1-degree means an earlier date of harvest, by 10 days, but this is not a general rule and could not be apply for each case (3 or 4° C don't mean 30 or 40 days earlier). This underlined the high uncertainties on the effects of Climate Change on vine.

As done previously by Hervé Quénol, he presented graphs showing the correlations between pH, sugar level, alcohol level with temperature. All are pertinent indicators of the effects of Global Warming: for example the sugar level has been increasing for the last 30 years.

He presents concrete acts for a wine grower in order to ward off a slight increase (1°C) of the temperature, such as rootstock, pruning / stripping, density...

He concluded proposing methods to limit the impact of the wine sector on the environment (for example: lightweight bottles).

Our last speaker was Marie-Claude Pichery, an economics professor at University of Bourgogne. She brought an economic point of view, as she is a member of the European Association of Wine Economists and has specific interests in prices and production costs of viticulture.

She made an overview of the risks linked to climate change and strategies to prevent and mitigate them:

- Hydric stress (necessary but must not last for too long), Irrigation would be the best solution but it is sometimes forbidden for some AOC (a term of controlled origin). Moreover, this arises the issue of water supply.
- Augmentation of the risk of freezing for the vine (earlier flowering time and late frosts). Some winegrowers install some gas heaters above their vines, which obviously cannot be considered as a sustainable solution!
- Risk of more frequent hail episodes. The risk incurred is uneven. Hail can just hurt the vine, which implies additional adaptation work, or destroy them. The winegrower will have then to replant vine and consequently lose two years of works. It is worth noting that hail remains a local risk and could easily be mitigated by dividing vines on distant fields.
- Fly damages: fruit flies bite grapes causing their death. Presently, the best solution remains human surveillance when there are doubts about fly's presence.

She concluded by emphasizing that in any case, a balance needs to be found between risk and treatment. Insurances cannot be viable solutions as the prices of insurances rise with increased risks. Climate change leads to a more expensive exploitation of the vineyard. For instance, during dry periods, winegrowers have to use refrigerated trucks to store the harvest, which was not the case before. Likewise, the cleaning frequency increases. These additional expenses involve a loss of profitability for wine producers.

Our event ended by a Degustation of Wine, done by an oenologist and with two particular wines, as they have already changed because of the Climate Change. Our intent was to show how wine will taste in the future years and how it could affect consumers' tastes and habits.

This conference aimed to show how the wine will evolve in France due to Climate change effects. The speakers provided answers on these themes with three major focus: geographical thanks to Hervé Quenol, technical through the explanations given by Joël Rochard and, finally, economical with Marie Claude Pichéry's intervention. To conclude, the conference showed that wine will evolve in any case in France, no matter on how high will be the mitigation strategies. However, these effects are already well-known, as well as the solutions to prevent dramatic economic decline and technical evolution.