IRRIGATION AND TERROIR: TWO OPPOSITE CONCEPTS? POINT OF VIEW OF INTERNATIONAL EXPERTS AND FRENCH CONSUMERS.

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Abstract:
At long term, qualitative irrigation seems to be the most systematic, if not the best, cultural practice for dealing with climate change and yield increases without decrease grape quality. Given this backdrop, the acceptance or irrigation within the frameworks of the terroir definition takes a central place. Consistently, the objective of this work is to evaluate this compatibility. Since irrigation is basically a social practice, it is important to understand it from a sociological point of view. To meet this commitment, a qualitative questionnaire was implemented: standard personal interviews with no frequency (subject surveyed once) with a multi-topic research (omnibus research). 18 participants to the 19th G*i*ESCO Meeting were selected as participants to the questionnaire. In a second instance, a quantitative questionnaire was evaluated: depth or intensive questionnaire with close-ended questions. In parallel, 512 French wine consumers participate to an Internet survey. This way, subject was approached from a twofold perspective: qualified researchers and French wine regular consumers. Results show that surveyed expert seems to agree (in 63% of cases) with the idea of not changing a terroir by adding water under a controlled management of the water status in the vine. Level of agreement seems to be related with expert's provenance and therefore expert's observations in their local weather. Finally, concerning consumer's approach, the level of implication in wine seems to play a role in accepting irrigation; consumers not implicated on wine don't have a formed opinion whereas implicated consumers showed both; for and against a reasoned irrigation as a tool to deal against climate change. Moreover, within qualified consumers, age could serve for explaining the acceptance of irrigation: young (≤35 years old) and medium consumers (from 36 to 64 years old) were more likely to accept irrigation and a different grape variety to preserve wine quality.

Keywords
Irrigation, Terroir, International experts, French consumers

1 INTRODUCTION

In different parts of the world, generations of people have built up their local identity, have developed an "expertise" or know-how and have produced typical products with a specific landscape that reflects interactions between natural resources and production systems. In terms of wine as a quality product, this authenticity is highly recognized and consumers become increasingly interested in quality linked to geographical origin, traditions and typicality. The Food and Agriculture Organization (FAO) consider in the works of Vandecandelaere and al. (2010) that this not only represents a heritage to be preserved, but also has a market value in its own right. In this scenario, an agricultural definition of terroir seems to be a complete approach for the study and characterization of the link among a product, a place and the inhabitants. Since 2010 the general assembly of the International Organization of Vine and Wine (OIV) establish by consensus with his members a worldwide definition of terroir (Resolution OIV/VITI 333/2010, 2010). Notwithstanding this text, is still difficult to determine if a specific grape production feats into this terroir definition on a scientific basis because many factors are involved (such as specific soil, topography, climate, landscape characteristics and biodiversity features) and all of them are in constant interaction. This complexity hinders the study of terroir.
In the light of the above, many authors (e.g. Van Leeuwen and Seguin, 2006; Ribérau-Gayon and Peynaud, 1960; Seguin, 1986) agree that a quality terroir in France is constituted by those terroirs who permits a complete but quite slow maturation of cultivars and certain regularity in quality in the various vintages. Van Leeuwen and Seguin (2006) states that vine water intake conditions are a key factor in understanding the effect of the terroir on grape quality potential because the main terroir factors are involved and interact (climate, soil, grapevine). Authors agree that the best harvest quality is achieved with a moderate and regular water supply (Barbeau, 2008; Deloire and al., 2006; Van Leeuwen and Seguin, 2006). A slight water deficit during the second half of the cycle has proved to be favorable to quality (Van Leeuwen and al., 2004; Ojeda and al., 2004). A direct causal relationship seems to exist between the terroir concept and irrigation.

The irrigation practice needs to be contextualized since is not an advisable practice for all regions. In areas where irrigation is not indispensable (as in large parts of European vineyards) the monitoring of water status is achieved, to a limited extent, through the management of soil tillage and vine training system (Ojeda, 2007). However, in areas with low rainfall and high temperatures, like the majority of wine-producing countries of the "new world", or even in areas with high occasionally dryness drought; irrigation became an essential technique for growing vines (Ojeda, 2007). This is why, under the qualitative perspective of the "terroir" concept, many European geographical indications (AOC, PGI) takes carefully into consideration the complex interactions between vines and water supply and how this can be oriented by different agronomic practices, in order to achieve different quality wines.
However, for many people, irrigation might be opposite to the "terroir" concept since it is not a traditional cultural practice in many European regions, continent where this concept was conceived. In France, this debate took several years of deliberation until the French National Institute for Origin and Quality (INAO) finally recognized the qualitative potential of irrigation in 2006. Notwithstanding this recognition, irrigation is still understood as a quantitative agronomic practice and its compatibility with the AOC production system, and by this, with the "terroir" concept is still not fully accepted for all actors of the wine industry.
Setting out from this premise, this work pretends to identify the perceptions that both, researchers and consumers have with regard to an irrigation strategy tended to improve wine quality for the production of AOC wines. Authors consider that this knowledge will serve to integrate irrigation with the terroir concept for the production of quality wines.

2 MATERIALS AND METHODS

Irrigation is basically a social practice since human beings develop it. In this sense, it is important to understand it from a sociological point of view. To meet this commitment, a qualitative questionnaire was implemented: standard personal interviews with no frequency (subject surveyed once) with a multi-topic research (omnibus research). 18 participants to the 19th G*i*ESCO Meeting (Group of international Experts of vitivinicultural Systems for CoOperation held at Gruissan – France in June 2015) were selected as participants to the questionnaire. On a second instance, a quantitative questionnaire was evaluated: depth or intensive questionnaire with close-ended questions. 512 French wine consumers participate to an Internet survey. This way, subject was approached from a twofold perspective: qualified researchers and French wine regular consumers.

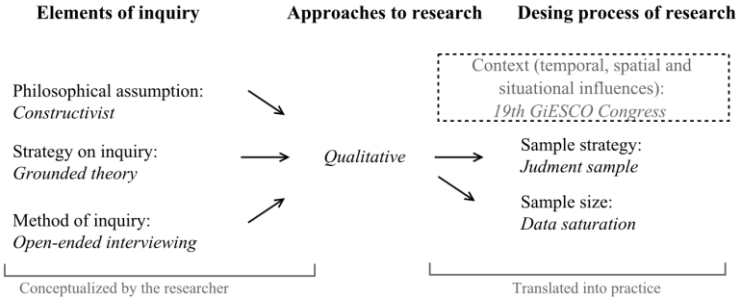

Figure 1- Methodology of inquiry for the qualitative research. Elements of inquiry leading to qualitative approach and the design process; personal interviews in the 19th GiESCO Congress. Source: adapted from J. W. Creswell (2008)

2.1. Qualitative questionnaire: qualified researcher's approach

This part of the research project adopts a *social constructivism* perspective. In this sense, focus is placed on developing subjective meanings based in the experiences-meanings of respondents on the field of irrigation. In practice, the goal of the research is to rely as much as possible on the participant's views of irrigation practice for qualitative production of AOC wines. Accordingly, questions stated become broad and general so that participants construct the meaning of a situation, a meaning typically forgotten in discussions or interactions with other persons. Concerning the strategy of inquiry a *grounded theory method (GTM)* was adopted following the approach of Charmaz (2006). Finally, for the method of inquiry, a *semi-structured questionnaire* (Mason, 2002) *with open-ended questions* (Charmaz, 2006) was implemented.
The context of this part of the research project was confined to the 19th International Meeting of Viticulture GiESCO in 2015 (France). A *judgment sample* strategy (Creswell, 2008a; Marshall, 1996; Salamanca and Martín-Crespo, 2007; Serbia, 2007) was implemented to select experts within GiESCO attenders. Since the strategy of inquiry is based in the grounded theory method (GTM), participants in the study need it all to have experienced the process (Creswell, 2008), meaning that they need to have proved knowledge in irrigation or vine ecophysiology. In this sense, the amount of articles published by participants in related fields served as criteria for determining competitive respondents. As a results, experts interviewed come from 9 different nationalities (Argentina, France, Greece, New Zealand, Portugal, Spain, Switzerland, Uruguay and USA) which assured a diverse approach; 39% of participants

come from the "New world" whereas the other 61% had an "Old world" approach in terms of wine. Regarding the organization type, 57% of selected respondent worked in "public organization" whereas 33% in "private organization" and the resting 10% worked in "semi-public organizations". Finally, concerning the type of position, 48% of respondents worked in "research institutes", 43% in "universities" and the resting 9% in "private companies". This methodology allows having an accurate representativeness of the academic community (experts from different nationalities and different approaches). The academic context of the conference permit participant to quickly deliver a position on the subject and no further clarification or additional information was mainly necessary. Finally, it's important to mention that *data saturation* is the guiding principle followed for sample size.
For analyzing the results of the qualitative questionnaire data was analyzed following the GTM and responses were presented in graphics. Consistently, the data collected is then "coded" according to the methodology descripted by Charmaz (2006). Theoretical sampling is used to obtain further selective data to refine and fill out major codes or categories emerging from data. The iterations continue until theoretical saturation, when no more properties of the category appear during data collection. Finally, graphics could be elaborated presenting the emerging parameters described by respondents.

2.2. Quantitative questionnaire: consumer's approach.

In this second part of the study, the perspective adopted for the questionnaire design is *post-positivism approach*. Under this assumption the problems review begins with a theory. Then, data is collected either to support or refute the theory. This way, the philosophy adopted was deterministic and reductionist since intent is to identify causes that determine effects or outcomes and reduce them into a small, discrete set of ideas to test. Concerning the strategy of inquiry a *survey strategy* is adopted. Finally, for the method of inquiry, a *structured questionnaire* (Mason, 2002) *with close-ended questions* (Charmaz, 2006) was implemented.

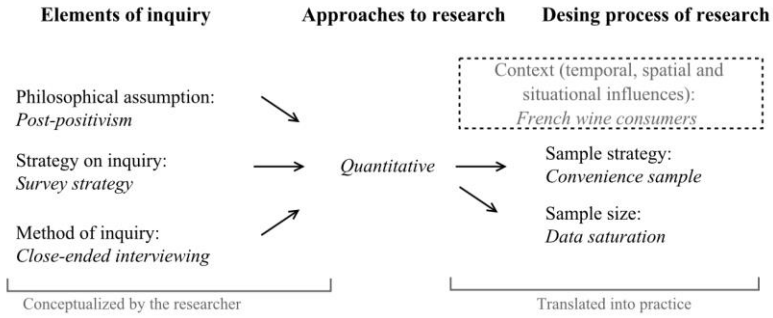

Figure 2- Methodology of inquiry for the quantitative research. Elements of inquiry leading to qualitative approach and the design process; impersonal interviews for Frech wine consumers. Source: adapted from J. W. Creswell (2008)

The context of this part of the research project was confined to the whole French territory with a national interview for French wine consumers. The work was conducted on September 2015 from 512 surveys on the Internet. The questionnaire is based on previous works (Jourjon and Symoneaux, 2012, 2014; Wilson and Jourjon, 2012) that show the relevance of the concept of "consumer's involvement" and the concept of "involvement in environmental issues" as a criterion for consumer segmentation and so; this segmentation was used to analyze the responses. Results were already published by Alvarez Gei, S. and al. (2016). Dissemination of the questionnaire was done to a *convenience sample* (Creswell, 2008a; Marshall, 1996; Salamanca and Martín-Crespo, 2007; Serbia, 2007). Finally, sample size was determined by the guiding principles of *data saturation* although not being proclaimed.
For analyzing the results of the quantitative questionnaire responses using a Likert scale (totally agree, agree…etc…) were converted into quantitative values and a Hierarchical Component Analysis allowed to define 3 meta-variables from the 12 questions of the survey; "consumer's profile", "level of implication on environment" and "level of implication on wine". In a second step, 3 variables related with irrigation were considered in the light of the meta-variables. Results were examined using chi-squared tests. Treatments were performed through R 3.2.3 statistical software and the package FactoMineR. Chi-square analyses were performed to test independence between the variables. Next the Pearson residuals were calculated, witch measure the departure of each combination from independence.

3 RESULTS AND DISCUSSION:

3.1 Qualitative questionnaire: qualified researcher's approach

From all experts interviewed, 71% consider that actuals terroirs will not be the same in future. Differences between "old world" and "new world" approaches weren't significant. Accordingly; the study of climate, the study of type of planting material, the adaptation of cultural practices and the plant water management, were spontaneously evoked, among other variables, as relevant parameters for identifying future new terroirs.

In this context, were current terroirs are expected to evolve; irrigation arise as the best ponded key points in dealing with water stress and grape maturation (score: 3.06, σ: 0.97; scores were calculated as: $x_1W_1+x_2W_2+\ldots+x_nW_n$; where w = weight of ranked position applied in reverse; and x = response count for answer choice being placed in the first place, σ: Standard Deviation) among "genetic material" (2.82, σ: 1.06), "training system" (2.88, σ: 0,.97) and "enological practices"(1.29, σ: 0,97). However, when experts who consider that actuals terroirs will be the same terroirs of tomorrow (25% of respondents) were asked to ponder the importance of the same key points, they gave a mayor importance to "genetic material" (placing it in the first place 60% of times). Concerning irrigation, in general, the same experts place it in 3rd place after "genetic material" and "training system".

Expert surveyed were "completely agreed" 63% of cases with the idea of not changing a terroir by adding water under a controlled management of the water status in the vine. A no negligible 31% declared to be "partially agreed", 6% neither agree nor diagree and no actor was in disagreeing. Concerning those who were "partially agreed" (31%), could be appropriate to indicate that a good majority (80%) comes from humid climates ("sub-humid": DI − 1 and "humid": DI – 2, "very dry": DI + 2 ≤ and "moderately dry": DI + 1 according to DI index; Tonietto and Carbonneau, 2004).

Even if no conclusion can be drawn in relation to "old world" and "new world" regions and respondents answers, the evaluation of the climatic change intensity seems to be related to experts observations in their local weather, which incidentally are different between them. In this sense, experts coming from humid climates where those less likely to agree with the idea of a terroir is not change by adding water under a controlled management of the water status in the vine. On the other hand, respondents who come from dry climates where irrigation is a common practice advice to center a terroir strategy for quality wines in irrigation for terroirs where irrigation is indispensable.

Respondents mainly characterize the water-vine relationship with qualitative (57%) descriptors. The most popular category was "quality and typicality" ("quality" as emerging parameters was largely mentioned; fr=8). "Water intake" was the second best mentioned category; emerging parameters were: "stress", "deficit", "hydrological regulation", "water stress management", and "transpiration". Finally, we can conclude saying that the vine-water relation was largely thought as "resulting variables" for the production of wine, being "quality" the larger emerging parameter spontaneously mentioned. This result evidences the weight expert conferees to water management in the qualitative production of wines. Knowing that unmeasured irrigation directly affects the functioning variables described by Barbeau (2008) (by affecting water intake, precocity and vigor); changes in the resulting variables (yield, berry composition at harvest and quality and typicality) can be expected in this context. However, a controlled irrigation management doesn't necessary produce changes in yield and can certainly improve quality. It is evident then that experts were capable to distinguish between common irrigation and a "qualitative irrigation management", as usually referred in the questionnaire. Moreover, experts generally conceive water management as a qualitative element with large impacts in the resulting variables of Barbeau (2008). Finally, the water-vine relationship was mainly described with qualitative factors, meaning that there's a link between irrigation and quality according to experts.

3.2 Quantitative questionnaire: consumer's approach.

Consumers involved in wine (qualified consumers) seem to have divided opinions concerning irrigation: a majority seems to agree in that an irrigation management strategy can be adapted with the quality concept of AOC wines. On the other contrary, the rest of qualified consumers are either against this idea, either they don't have a formed opinion. Finally, non-qualified consumers don't have any formed opinion concerned irrigation and mid-qualified consumers are mainly favorable of an irrigation management strategy for AOC wines. In regard consumer's age, senior consumers (> 65 years old) are more likely to disagree with irrigation for AOC wines. On the other hand, young consumers (>35 years old) are more likely to agree with the possibility of irrigating.

A relation between the acceptance of irrigation and the level of implication on wine could be established. Basically, non-qualified wine consumers don´t have a formed opinion whereas qualified consumers do. Moreover, qualified consumers seem to have divided opinions concerning irrigation and a small majority seems to agree in that an irrigation management strategy can be adapted with the quality concept of AOC wines. In addition, age seems to impinge on the acceptance of irrigation since senior consumers (> 65 years old) are more likely to disagree with the idea of irrigate vines whereas young consumers (>35 years old) are more likely to accept it.

Concerning the impact that irrigation might have on wine's price, in general, all consumers manifested to be undecided when asked if they would pay less for a wine issued from an irrigated plot. However, consumers involved in wine (Vin3) showed a more formed opinion and a second majority of them considered to pay the same or more for a wine issued from irrigation. Finally, the minority of qualified consumers chose to pay lower prices for wines issued from irrigation. This same uncertainty was manifested for all age segments. Nonetheless, it can be pointed out that young consumers were more willing to pay higher or equal prices for a wine issued from an irrigated plot. On the contrary, senior consumers were more likely to pay lower prices for wines issued from irrigation.

Finally, regarding price, no direct relation can be done between irrigation and price of wines issued form irrigated plot. That is to say, consumers have no concrete opinion when they were asked if they would pay less for a bottle of wine issued from an irrigated plot. However, there is a second majority of involved consumers (Vin3) who are more

likely to pay the same price or a higher one for a wine issued from irrigated plots. Consistently, the minority of qualified consumers chose to pay lower prices for wines issued from irrigation.

4 CONCLUSIONS

One interesting point to note from the interview experience is the idea that local experience (regarding the local research fields of experts) impact in the global appreciation of climate change. In general, experts who come from dry climates where irrigation is a common practice are those more likely to accept and valorize of irrigation. It could be also tested at consumer level. The acceptance of irrigation and its compatibility with the terroir concept seems to be related to the capacity that different actors may have to distinguish between common irrigation and a "qualitative irrigation management". In general, experts could make that difference and supports a qualitative irrigation management in AOC regions for the improvement of quality when needed. On the other hand, the acceptance of irrigation by consumers is mainly related to their implication on wine (qualified consumers where more likely to demonstrate in favour of irrigation) but also to age (>35 years old consumers in general agree with irrigating).
Knowing that experts agree in general with the idea of not changing a terroir by adding water under a controlled management of the water status in the vine and that they largely describe the water-vine relationship with qualitative descriptors, it can be stated that irrigation show a qualitative potential for the production of wines. Moreover, result show that in general there's not a pejorative perception of consumers regarding irrigation in terms of price (general consumers have no concrete opinion when they were asked if they would pay less for a bottle of wine issued from an irrigated plot where a second majority of involved consumers manifested to be more likely to pay the same price or a higher one for a wine issued from irrigated plots). In this sense, irrigation seems to have a great potential for improving the quality of wines.
To conclude, as general assumption it can be construe that there is compatibility between irrigation and the terroir concept based on the acceptance of the idea of not changing a terroir by adding water under a "qualitative irrigation management" and the evocation of "quality" induced by the vine-water relationship from the perspective of experts. Besides, there are no elements to believe that a qualitative irrigation management would have negative impact from a consumers perspective (if messages is correctly adapted to the different publics of consumers). This means that, if irrigation practice can be implemented in a vineyard, irrigation and terroir are not opposite concepts, but also that they can work in synergy to increase wine's quality.

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