

Exploring some possible impacts of climatic changes on viticulture

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Abstract. Viticulture is a significant economic value in numerous countries. Environment assumes an imperative part in the terroir of a given wine area, as it emphatically controls overhang microclimate, plant development, plant physiology, yield, and berry structure, which together decide wine ascribes and typicity. New difficulties are, nonetheless, anticipated to emerge from environmental change, as grapevine development is profoundly subject to climate and environmental conditions. Changes in viticultural reasonableness in the course of the last many years, for viticulture overall or the utilization of explicit assortments, have effectively been accounted for in some wine districts. Despite spatially heterogeneous effects, environmental change is expected to intensify these new patterns of reasonableness for wine creation. These movements might reshape the geological appropriation of wine districts, while wine typicity may likewise be compromised much of the time. Changing environments will subsequently encourage the execution of opportune, reasonable, and savvy transformation methodologies, which ought to likewise be arranged and tuned to nearby circumstances for a compelling gamble decrease. Although the capability of the different variation choices isn't yet completely explored, meriting further exploration exercises, their reception will be of most extreme pertinence to keep up with the financial and ecological supportability of the exceptional valuable viticulture and winemaking area in Europe.

1 Introduction

A short portrayal of the worldwide viticulture and winemaking area is given forthright to more readily comprehend its significance on the planet's economy. As point by point in the most recent report of the International Organization of Vine, it is assessed that the world

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grape plantations cover an area of roughly 7.449 million ha (Aurand, 2019). These five nations address roughly one-half of the worldwide grape plantation region (Dagatti et.al., 2018). From a similar report, it tends to be inferred that the time development of the world grape plantation region went through a by and large descending pattern in the course of the most recent twenty years. The frail recuperation from 2012 to 2014 was then trailed by another decay from that point (Mathey et.al., 2021). Adjustment of the grape plantation region, or a marginally diminishing pattern, is seen during the most recent five years in the vast majority of the nations where viticulture is a pertinent area, aside from the powerful decreases in Turkey and Iran. In any case, a few nations show a reasonable development of the grape plantation region, principally China and India. Albeit the wine exchange, in volume, has been steady beginning around 2011, wine exchange financial worth has been developing constantly to arrive at a record-breaking worth of roughly EUR 30,000 million out of 2018 (Neethling et.al., 2019).

Topographically, grapevines are generally developed on six out of seven landmasses, between scopes 4° and 51° in the Northern Hemisphere and somewhere in the range of 6° and 45° in the Southern Hemisphere, and across a huge variety of environments (maritime, warm maritime, change mild, mainland, cold mainland, Mediterranean, subtropical, lessened tropical, parched, and hyper-bone-dry environments), however with the larger part happening in calm environment locales (Fraga et. al., 2019).

Grapevine assortments and scion/rootstock mixes have different soil inclinations that at last decide the attributes of the created wine. Soil physical and substance properties intensely impact grapevine improvement and grape berry creation (Sgubin et.al., 2018). The significance of these nearby scale pedoclimatic attributes has been perceived in all winemaking areas, some of the time over hundreds of years, as plant cultivators have constantly adjusted neighborhood viticultural rehearses, somewhat observationally, to best suit they are encompassing ecological circumstances (Vilanova et.al., 2019). The dirt plant-climate continuum generally decides the results from a grape plantation. Other than pedoclimatic conditions, biotic elements, like the impact of bugs and sicknesses; the job of useful biodiversity in the grape plantation; and agro-the executives rehearses, to be specific, scion and rootstock decision, pruning, squeezing, supporting, garnish, or diminishing, assume a significant part in grapevine development, advancement, and berry value (Molitor et.al., 2014).

In light of the previously mentioned cooperations, the idea of terroir has been broadly embraced. As "Terroir is an idea which alludes to an area where aggregate information on the connections between the recognizable physical and natural climate and applied viticulture and oenological rehearses creates, giving particular qualities to the items starting from this area. Terroir incorporates explicit soil, geology, environment, scene attributes, and biodiversity highlights". Thusly, the terroir fundamentally influences grapevine improvement and berry piece and has been acknowledged as a vital perspective in deciding the wine quality and typicity of a given area (Duchêne et.al., 2010).

Considering the wide-going extent of the current survey, a comprehensive aggregation of all past investigations in the field isn't attainable, not even of the latest examinations. The fundamental objective is to give a refreshed outline of this point based on the aftereffects of pertinent and illustrative examination, which might be valuable for analysts and scholastics, yet in addition for partners and leaders. Albeit the attention is generally on viticulture, the majority of the conversation can be smoothly induced to other wine areas that share comparative ecological circumstances.

Grapevine improvement is connected with a couple of periods of its conceptive and vegetative cycles. Under the conditions of various regular viticultural districts, the grapevine vegetative cycle connects north of one whole year, however its regenerative cycle happens for an impressive time allotment (Chuine et.al., 2004). The regenerative cycle regulates a

couple of huge emotional and quantitative properties, for instance, the quantity of grape bundles in the following year. The vegetative cycle fuses two basic successive periods: the dormancy time frame and the creating season. The impact of barometrical compelling on the grapevine can be apportioned into two different time scales. Eventually, the climate, which connects with the quantifiable allotment of the different air factors over long stretch periods (numerous years) at a given region, chooses the bioclimatic envelope of that region and its viticultural suitability (Bonfante et.al., 2017). Macroclimates are determinants of the wine topography and the dispersal of grapevine arrangements, however mesoclimates and microclimates advance different terroir units, with various wine characters and assortments. The wide extent of climate driven scales, as well as the spatial unpredictability and transient components in viticulture, have at this point been recorded (Lazoglou et.al., 2018). For now, atmospheric conditions essentially oversee the whole grapevine improvement process, as it requires sensible temperatures, radiation abilities, and term, as well as express levels of water availability all through its advancement cycle, finally, affecting yield, biomass creation, berry credits, and wine development and flavor. The improvement of atmospheric conditions in a given region can be used to expect close by/commonplace grapevine limits, for instance, yield or phenology (Santos et.al., 2019).

Among every air component, air temperature is viewed as the most significant in driving the development and improvement of grapevines, in situations where water, radiation, and supplement prerequisites of the plant are satisfied. From the climatological perspective, the dispersion of conventional viticultural areas overall is predominantly bound to a belt characterized by the isotherms of normal developing season temperatures of 12-13 °C and 22-24 °C, underlining the key pretended by temperature on viticultural appropriateness. Developing season temperatures under 12-13 °C regularly happen in locales with developing seasons excessively short for appropriate plant improvement, with ordinarily low sun-powered radiation levels and inadequate hotness amassing. From leaf tumble to the start of spring, grapevines are lethargic and comprise altogether of woody tissue, with minimal physiological action. This period incorporates two sub-periods that are constrained by endogenous and exogenous warm factors required for torpidity discharge. The primary sub-period (endo-torpidity) is set off by chilling amassing (chill units) during pre-winter/winter, while the second sub-time frame (eco-lethargy) is driven by heat aggregation until bud break. Accordingly, the colder time of year chill is a significant condition for grapevine development advancement, as cold advances bud torpidity, other than different cycles, for example, day length shortening and maturing of the photosynthetic dynamic pieces of the plants. From pre-spring to late winter, the collection of day-by-day means temperatures over 7 to 10 °C by and large advance torpidity break and the beginning of the grapevine developing cycle.

During the developing season, grapevines go through consistent changes as far as morphology and physiology. The length of the developing season for every assortment is straightforwardly connected with the developing season mean air temperature, however, it very well might be moreover connected to soil dampness and harvest the board rehearses. Offensive occasions during the veraison-development period, for example, heatwaves, can essentially impact sugar amassing and may prompt a decline in anthocyanin biosynthesis and content. Optional metabolites, all the more explicitly phenolics, because of their commitment to shading, flavor, smell, surface, astringency, and adjustment of wine, as well as cancer prevention agent properties, are critical for organic product quality and wine creation. High temperatures may likewise prompt significant misfortunes, as they additionally impact the amalgamation of unstable mixtures, which unequivocally add to the tangible person of wines. In harvest time, the steady shortening of the day length and diminishing of temperatures elevate acclimation to frosty temperatures in winter. During this stage, the movement of starches, amino acids, natural acids, and a few minerals from passes on to lasting organs

(trunk and roots) arrives at its greatest. This period, considered as a method for surviving, commonly harmonizes with the summed up leaf senescence, trailed by leaf fall and the resulting lethargy period.

The previously mentioned impacts of environment and climate on grapevines have been portrayed by a few agro-climatic lists. They regularly give nearer connections between the grapevine advancement and climatic circumstances than individual air factors, like month-to-month mean temperatures, radiation, or precipitation (Flexas et.al., 2010). These lists were created to coordinate the plant-climate cooperations, in this manner following the plant physiological improvement all the more intently. The previously mentioned cozy connections between grapevine improvement and climate/environment make viticulture especially powerless against environmental change and helpless to its adverse effects. Through the blend of (i) by and large expanding air temperatures and (ii) shift of the maturing time frame toward prior (typically hotter pieces of the period), environmental change has a two-crease sway from the new past warming, particularly clear during the aging time frame (Greer et.al., 2011).

Recorded temperature patterns for the primary viticultural areas overall show that the developing means temperatures expanded by 1.3 °C and 1.7 °C. Related to expanding temperatures in the course of the most recent couple of many years, adjustments in the grapevine development and physiological improvement have been reported. Changing environments are consequently affecting grapevine yield, as well as berry and wine quality. In such a manner, it was observed that higher temperatures during the developing season advanced a reduction in the grape berry all out corrosiveness content, up patterns in sugar content or likely liquor, and a decoupling among mechanical and organic development (Stocker et.al., 2014).

Environmental change in the 21st century, worldwide and provincial environment models, is in everyday concurrence with the noticed patterns throughout the most recent many years, prompting significant effects on viticulture. In certain locales, environmental change should be advantageous for viticulture, for example, because of higher organic product development and opening new regions for development, though the effect may be adverse in different districts by testing the capacity for satisfactory grape development and wine creation. Changes in the spatial examples and worldly systems of temperature and precipitation may essentially alter current viticultural bioclimatic zones in Europe (Wilson, 2007). Soil temperature directly affects the vegetative parts of the hydrodynamics, which influence the happening rate, which is such a long way under-appraised in the measurement of conceivable environmental change consequences for plant water use. These expansions in pressure-driven conductance have been ascribed to changes in layer smoothness and penetrability or changes in water consistency, yet probably are a blend of both. For a grape plantation circumstance, endeavors have been made to appraise these as of now theoretical changes, and the outcomes show significant potential impacts on happening.

The current viticulture districts in southern Europe might go through a decrease in their viticultural reasonableness, essentially because of serious dryness. These areas may without a doubt turn out to be unnecessarily dry for top-notch winemaking and, in a few most outrageous cases, will require serious water systems. It was equally shown that expanded summer dryness in southern Europe will prompt yield decrease, for the most part, because of the synergistic impact of warming and drying (Roed, 2007).

Reasonable transformation estimates should be applied by the winemaking area to confront environmental change impacts, primarily by arranging sufficient systems at provincial/nearby scales, especially in locales that will encounter the most unfavorable effects (Picard et.al., 2017). Grapevine cultivators are turning out to be step by step more mindful of the dangers, though ideal and key preparation against its adverse consequences might give upper hands. All things considered, it depends on the partners and leaders to make

a move against environmental change. Some variation measures in viticulture are examined in the accompanying subsections, albeit a comprehensive conversation isn't imagined. Even though changes in oenological practices may likewise have significant variation potential, they are out of the extent of the current survey. By and large, the adequacy of each action firmly relies upon the neighborhood circumstance and local environmental change signal. The general methodology should continuously be the reception of a mix of neighborhood answers for adapt to a worldwide issue. The adverse consequences of outrageous hotness, water shortage, and high irradiance in grape plantations encourage momentary variation procedures, for example, the utilization of exogenous mixtures that could keep up with, or even improve, plant development and advancement under these ecological burdens.

The water system is utilized to improve and normalize crop yield and quality, at whatever point precipitation is too low to even consider meeting the characterized grapevine water necessities. The administration of the grape plantation water system depends on shortfall water system (DI) methodologies (e.g., controlled deficiency water system, supported shortage water system, halfway root drying) to exploit the connection between grapevine water status and the yield/quality. Thinking about these procedures, the trickle water system is by and large executed as the most productive water-saving strategy, even though sprinkler and wrinkle water system frameworks are as yet being utilized.

Transient variation measures can be considered as an essential security procedure against environmental change and are generally centered around explicit dangers. Transient transformation techniques are thus characterized as grape plantation intercessions that can be applied inside a grapevine developing season. These actions by and large infer changes in administration practices, and some of them are momentarily illustrated in the accompanying sub-areas. Those are the development or social practice, security against outrageous hotness, and the water system focuses. Long haul variation systems are measures utilized by cultivators to adjust to environmental change all through a few developing seasons or before the planting of a grape plantation. In actuality, the grapevine as a lasting harvest remains financially useful for quite some time. The reception of some drawn-out variation measures might be essential, even though their application may likewise bring critical financial effects. Albeit huge changes in bioclimatic circumstances are relied upon to happen in the future, the capability of the different variation methodologies might, in any case, forestall sensational changes in viticultural appropriateness. A few instances of long-haul variation techniques are given in the accompanying sub-areas.

2 Methods

The applied methodology for the following article is a qualitative review of the studies regarding the current topic. The literature deals with viticulture and its impact on the climate and environment. Additionally, the study aims to discuss the recent strategies of the global viticulture. Data was gathered from various open-access online databases. The platforms utilized to collect the information on the selected topic included: Google Scholar, PubMed, ScienceDirect, and other studies and facts concerning the study. Relevant keywords were employed to recruit information. The conjunction of two or more keywords was used for searching to obtain the relevant data on the topic. Moreover, the studies and other research papers referred to the chosen studies, those studies and research were counted to discuss the potential impacts of the techniques, mainly based on viticulture and viniculture. However, the studies that did not sufficiently enlighten the concept of important impacts on viticulture, as changes in the temperature and precipitation patterns were included in the review.

3 Discussion

Environmental change has impact on plant yield and quality. Temperature patterns of the new past, zeroing in on viticultural locales, show that the developing season implies temperatures have expanded internationally by around 1.3°C and by 1.7°C from in Europe. Some European viticultural areas, in Italy, Germany, and France, concentrate on currently announced shortenings of the developing season and prior phenological occasions. Comparable changes were likewise detailed in some Australian viticultural areas. Besides, propels in the phenological occasions bringing about aging during a hotter period can adversely affect wine quality, they showed that higher temperatures during the developing season in North East Slovenia advanced a huge diminishing in the complete acidity content of early-aging assortments.

Environmental change projections for the 21st century are relied upon to critically affect viticulture, as changes in the temperature and precipitation examples may essentially adjust the current viticultural drafting in Europe. Late environmental change concentrates. For Alsace, France, indicating an increment in the developing season temperature, utilizing a multimodel gathering for the Douro Valley (Portugal), showed that springtime warming might prompt prior budburst under a future hotter environment, which might influence wine quality. Furthermore, future projections for this equivalent district, propose higher grapevine yields and wine creations, yet additionally, recommend expanded dangers of bugs and sicknesses. The contends that winemaking districts under incredibly hot temperatures might prompt a huge expansion in the gamble of organoleptic debasement and wine deterioration. Under a future hotter environment, higher temperatures might repress the arrangement of anthocyanin, subsequently diminishing grape tone and expanding the volatilization of smell compounds. Future changes in the least temperatures during maturing in the Iberian Peninsula were additionally detailed, recommending a reduction in wine quality.

In future situations, a reduction in the appropriateness of the current winemaking districts in southern Europe could likewise be anticipated. Southern European winegrapes are equally expected to confront unfavorable circumstances because of serious dryness. These areas might turn out to be unnecessarily dry for great winemaking, or even unsatisfactory for grapevine development without an adequate water system. They expressed that locales like Alentejo, Andalucía, Mancha, Sicily, Puglia, and Campania will experience the ill effects of water deficiencies. The additionally showed expanded summer dryness in southern Europe. As an outline, featured the adverse consequences of environmental change in Spanish viticulture, which might bring about expanded water interest because of the water system. Camps and tracked down a diminishing in winegrape yield for northeastern Spain that can be ascribed to water shortfalls. In a review for Serbia, distinguished changes that might require an extra grape plantation water system. Notwithstanding a bringing down of wine quality, expected in the future for some southern European winemaking locales, changes in the interannual changeability and limits might build the abnormality of the yields, with unfavorable consequences for the entire winemaking area.

The upgraded concentrations of CO₂ later on, as such, are relied upon to emphatically affect the grapevine advancement cycle and yield ascribes. Higher CO₂ will advance a reduction in plant happening, which will more often than not overcompensate for the expanded soil dissipation, bringing about decreased evapotranspiration later on the environment. This aberrant impact of CO₂ increment will be joined with the immediate impact of an increment in carbon compound gathering, which may accordingly give a positive reaction to environmental change.

Even though investigation on possible effects of environmental change on viticulture is as of now generally created, when contrasted with different yields, some significant information holes remain. The utilization of environment projection datasets connected to grapevine recreation models addresses the most doable methodology for foreseeing plant conduct and creation in the future, which can be supplemented by environment chamber tests,

among others, for the model turn of events, adjustment, and approval. In such a manner, more tests completed under comparative circumstances and estimating similar factors are required for a superior examination among review and evaluation of impacts. Regardless, the assessment of environmental change impacts on any developed yield is touchy to vulnerabilities later on environment projections, getting from model definitions, sub-network scale processes, model introductions, characteristic inclinations, radiative compelling situations, and different sources. Regular inconstancy of the environment framework needs additionally be considered, expanding the degree of vulnerability with expanding distance into what's to come. These vulnerabilities should be all the more completely joined in the environmental change projections and effect evaluations, utilizing more thorough probabilistic and hazard examinations. This data ought to likewise be better conveyed to partners and leaders, rather than giving just gathering implies or other focal propensity measures, which can be misdirecting and may hinder or mislead a powerful variation.

4 Conclusion

Even though grapevines have a variety of methods for surviving, their improvement is unambiguously constrained by climate and environment, over a wide scope of cycles and timetables. Viticultural suitability has effectively been accounted for quite a long time in locales around the world. A few changes have effectively been seen on various levels by the winemaking area. The Business Report refers that viticulturists are now encountering critical changes in their grape plantations and are now reacting. Among the variations considered most critical in numerous locales are changed in grape plantation areas, grapevine assortments, and some development practices to keep away from more grounded anomaly underway and forestall an increment in the market instability. As a rule, environmental change is seen as a significant gamble for viticulture, compromising now and again, or testing by and large, viticulture and the winemaking area. The reception of ideal, financially savvy, and appropriate transformation methodologies may fundamentally add to gamble with decrease, along these lines diminishing the weakness of the area and upgrading its strength under an evolving environment. Even though the capability of the different variation choices in lessening negative effects involves numerous vulnerabilities and requests further exploration, the execution of a mix of successful measures in the grape plantation, tuned to neighborhood terroirs and nearby environmental change projections, will add to the future ecological and financial maintainability of existing wine locales. For that reason, the correspondence stations between science, partners, and buyers ought to be improved to upgrade the limit building and information move to the wine area and increment acknowledgment to essential changes by the purchaser.

The environmental change, plants are confronting progressively warm and dry developing circumstances. The plant is, in any case, a plant of the Mediterranean beginning, which is very much adjusted to these circumstances. Nonetheless, higher temperatures shift phenology and the maturing time frame to a period in the season that is less good for the creation of value wine and progressively dry circumstances lead to yield decrease. In certain circumstances, it advances wine quality, specifically for the creation of red table wines, while unnecessary water pressure might endanger wine quality. Variations to environmental change remember alterations for plant material and viticultural procedures which delay phenology and grape aging and increment dry season resilience. The utilization of late-maturing and dry season safe plant material (assortments, clones, and rootstocks) is harmless to the ecosystem and savvy apparatus for transformation. The huge hereditary variety in plants for these characteristics comprises a valuable asset to keep on creating top-notch wines with maintainable yields in an evolving climate.

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