

Tbilisi 2022 Abstract Submission

Title

The impact of weather and irrigation systems on grape production in South Africa

I want to submit an abstract for:

Conference Presentation

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Keywords

South Africa, grape yields, weather, irrigation, machine learning

Research Question

What is the impact of weather (temperature, precipitation and radiation) and of different irrigation systems on yields of different grape varieties in South African wine regions.

Methods

We apply artificial neural networks to develop models for selected grape varieties. A non-linear regression model is built, which uses a classic feed forward artificial neural network algorithm.

Results

Irrigation in general has a positive impact on yields. Flood irrigation has a significant positive impact in general, sprinkle or micro even a negative one for some grape varieties.

Abstract

Context: Climate Change and Yields in the South African Wine Industry
South Africa has been identified as being one of the vulnerable regions with a low capacity to respond to climate change (Benhin, 2006), with climate change predicted to lead to warmer and drier conditions for the country's vineyards by 2050 and to heatwaves which can have an important impact on the quantity and quality of grapes and the styles of wine (Bonnardot et al., 2008; Deloire, 2010; Vink et al, 2012). Additionally, large climatic differences between coastal areas and inland mountain areas in South Africa (Midgley et al., 2015) will lead to

differences in yields of certain grape varieties. In this context, irrigation might play a key role and can help to standardize yields and quality of grapes in years when rainfall is too low (Santos et al., 2020).

Research Question

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Literature Review

There is scant research on irrigation and the impact on (quantitative) yields. Only Ginestar et al. (1998) focus on sap-flow sensors and yields of Shiraz, while Intrigliolo et al. (2010) look at timing and the amount of irrigation for Tempranillo yields. A single paper by Myburgh (2005) focuses on irrigation in South Africa, investigating the timing of irrigation of Sauvignon Blanc and Chenin Blanc in South Africa's Coastal Region and its impact on yields but, like several enological papers, focuses mainly on grape quality. The same holds true for Hunter et al. (2014) who deal with vine water relations and grape ripeness levels, Ojeda et al. (2002), Castellarin et al. (2007a; 2007b), Girona et al. (2009) who study the effect of water deficits, Roby and Matthews (2004) who look at water deficits and irrigation, and Reynolds and Naylor (1994) who examine grapevine response to water stress duration. This paper attempts to fill this research gap by focusing on the impact of irrigation systems (in addition to weather) on grape yields in South Africa.

Theoretical approach

We simplify a production function approach by assuming, that labour (N), capital (K), other Inputs (all but weather) (In) remain constant, and only the factor "other inputs" (weather) and the factor "land" vary. As irrigation is seen as a major determinant of land productivity, we split land into dryland and the wetland (irrigated land), which is further divided into irrigation systems, differing in the level of control, farm size, institutional setting and technology, the latter being "flood irrigation", "drip irrigation", "micro irrigation", "sprinkle irrigation" and "other kinds of irrigation", with the aim of exploring whether one system is better than the other in increasing grape yields for a specific region and grape variety. Technological change is captured by a Trend variable.

Data

We use monthly weather data, taken from local weather stations covering the South African wine regions of Breedekloof, Little Karoo, Malmesbury, Olifants River, Orange River, Paarl, Robertson, Stellenbosch, and Worcester, provided by the Agricultural Research Council.

Data on irrigation, including different kinds of irrigation schemes, is provided by from VinPro.

The data on yields and other control variables is provided by SA Wine Industry Information & Systems (SAWIS, 2002-2014). We focus on ten grape varieties (five white and five red) and cover the years 2001 to 2018.

Results

See abstract submission.

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