Economic and climate challenges in the Mendoza wine region

Argentina's Mendoza region produces world-famous wine, making it one of the largest wine producers in Latin America. But like many wine-producing regions, Mendoza faces challenges as the climate changes and water demand increases. Smallholder producers could be particularly hard hit. Though they produce a majority of the region's wine grapes, they don't reap the economic benefit of the international growth in wine demand. Smallholders also are increasingly vulnerable in their water supply due to emerging climate conditions.

As observed by Carlsen et al. (2016), it "covers only half of the story" to focus on potential climate impacts alone; socio-economic conditions also evolve over time. An evaluation on how to adapt water supply policies to climate change should consider the current socio-economic struggles to ensure a sustainable future and economically thriving outcome.

This brief provides an initial overview of the Mendoza wine production region by examining the literature on production history, economic difficulties of small wine-grape growers, current climate-related challenges, and water-related policies. This overview describes existing socio-economic vulnerabilities, in particular for small growers in the wine industry. It also identifies the challenges in water supply regulations that are based on historical, and more consistent, water conditions, as well as a trend towards more frequent and more extreme drought events.

The study described in this brief confirms the need for robust approaches that inform decision-making about longer-term climate vulnerabilities, about more adaptive water management policies and about preparations for potential economic impacts on the regional economy.

The Mendoza wine region: from quantity to quality

Driven by domestic demand and price control regulations, wine supply and production growth in the Mendoza region of Argentina has historically been dictated by the quantity, and not the quality, of wine. Figure 1 provides an annotated historic timeline of wine production in the region.

The introduction of high yield varieties increased production of low quality wine grapes in the 1970s (Biondolillo 1999). In addition, minimum price controls at the national level prevented wine supply from adjusting to changes in demand. The large domestic production of low-price wine promoted the growth of lower quality wine, causing an increasing overstock that led to an increase in quantity and a progressive reduction of prices over time. In the 1980s, the overstock of wine was so substantial and so lacked international quality standards that it generated a crisis for the sector, resulting in the closure of many wineries and the eradication of 100,000 hectares of wine grapes, 35,000 hectares of which were Malbec vines (Richard-Jorba 2008; Richard-Jorba 2010; Rivera Medina 2006).

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The Mendoza region of Argentina is one the largest wine producers in Latin America, but it faces challenges ahead as the climate changes.

This turning point for the industry came at a tremendous socio-economic cost for the growers and the region. However, this experience birthed a new platform for wine production that focused on quality and improved the international reputation of Argentinean wine.

Today, Mendoza's main economic activity is wine production (Castex et al. 2015). Despite its dry climate, 4.8% of the territory is composed of an irrigation oasis that contains most of the agricultural production, including wine grapes, and 95% of the population of the Mendoza province (Boninsegna and Villalba 2006; Masiokas et al. 2006; Reta 2003; Yapura and Salomon 2015) . Mendoza is the main wine producing region of Argentina: 72% of the country's wines and musts[1] and 69% of its grapes come from there. Most wine exports go to markets in North and South America, the Netherlands, the U.K. and Japan.

Mendoza's signature wine is Malbec, and it is the world's main producer of Malbec wine grapes. Figure 3 shows that 60% of Malbec wine is produced in the Mendoza region. Data from Wine Spectator magazine illustrates the gradual increase in both quality score value and bottle prices of Mendoza wines since the 1980s crisis (Figure 4) and illustrates that the region's push to increase the quality of wine and sales around the world has helped Malbec gain international recognition.

The plight of the small grower

Not all growers benefit from this improvement in international reputation. A large portion of small growers are still struggling to produce wine grapes with acceptable international standards, leaving them particularly vulnerable to external shocks such as changes in the value of the Argentine

1 Must is freshly pressed fruit juice that usually comes from grapes. It contains the skins, seeds, and stems of grapes and is the first step in winemaking.

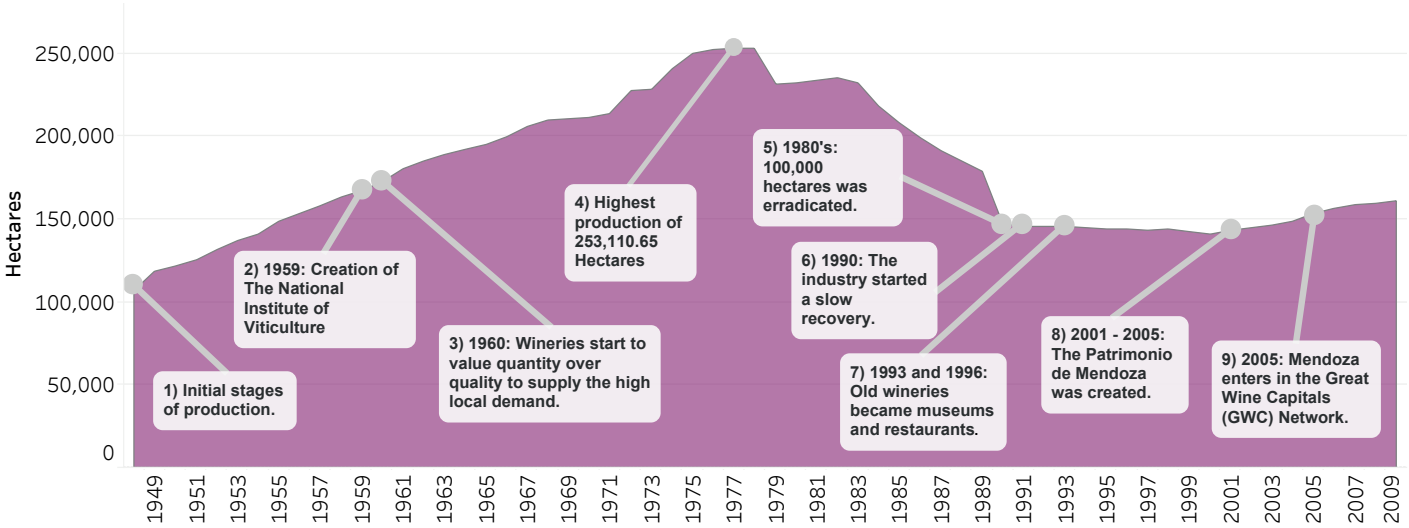

Figure 1: Hectares of wine grapes produced over time and key historical events.
Prepared by the author based on the information from Richard-Jorba 2008; Richard-Jorba 2010; Richard-Jorba 2006; Moretti-Baldín 2008; Rivera Medina 2006.

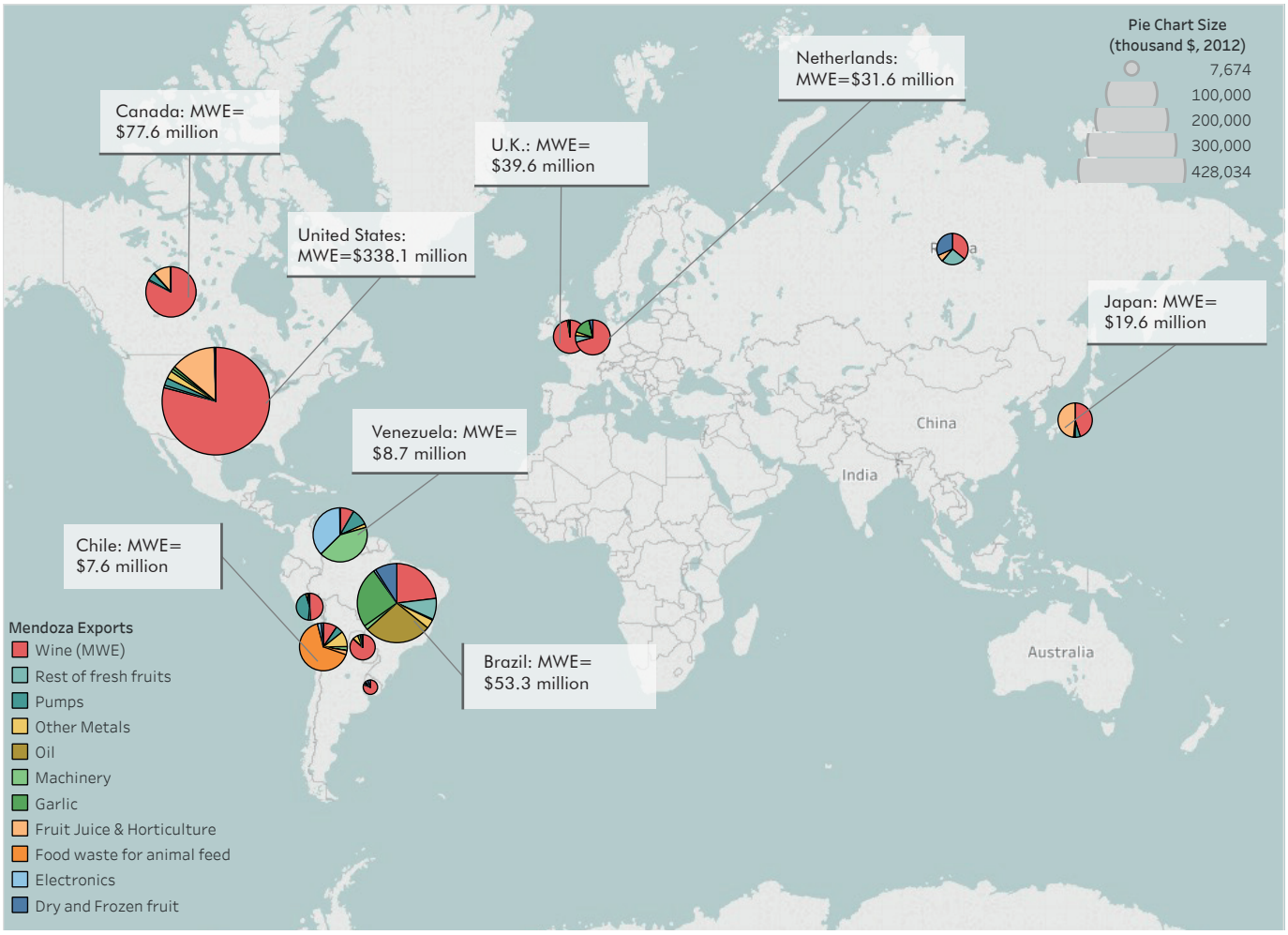

Figure 2: Mendoza exports from various sectors and Mendoza Wine Exports (MWE) for main export countries.
Prepared by the author based on the information from Gobierno de Mendoza (2016)

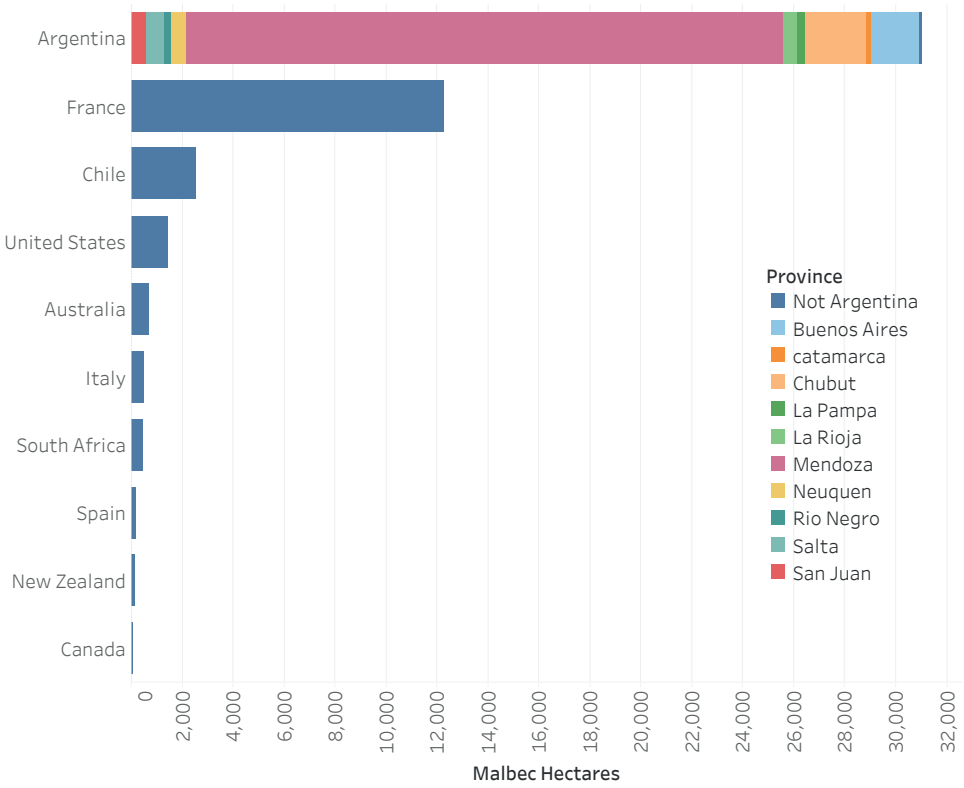

Figure 3: Top 10 producers of Malbec wine grapes.
Prepared by author based on information from Anderson and Aryal (2013).

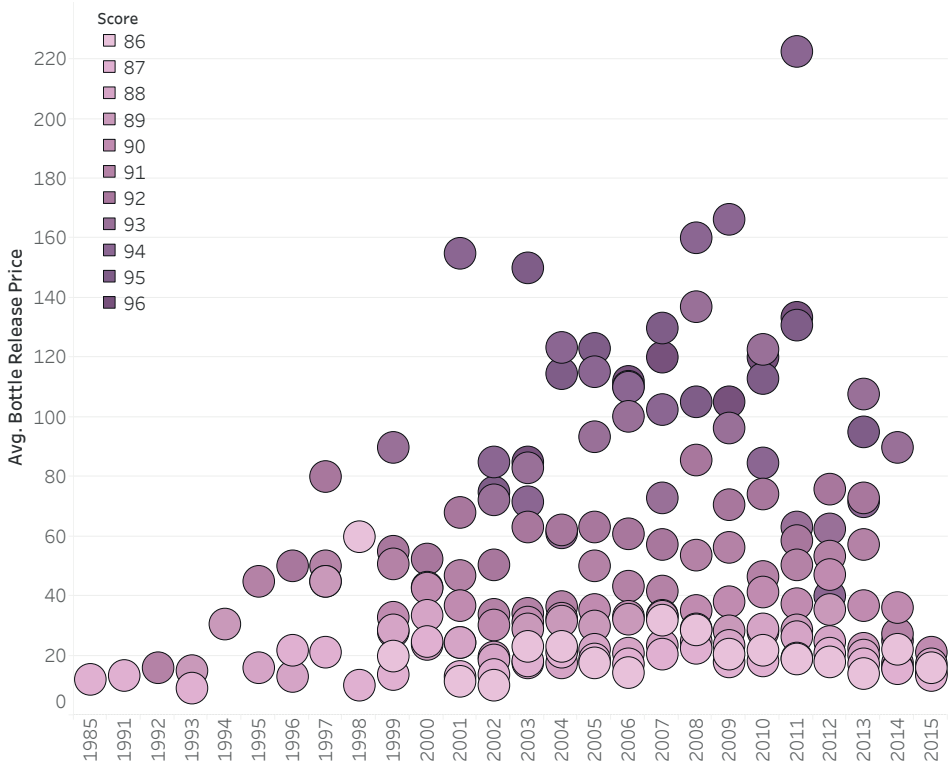

Figure 4:
Prepared by author based on information from Wine Spectator Database (2016)

peso against the dollar. A majority of the wine produced in Argentina – as much as 95% some years – is low quality, low value and produced by thousands of small producers and families (Biondolillo 2008). Small growers are struggling to be as competitive as large growers in their production. To do so, they reduce costs by cutting out practices that ensure vine health and by progressively decreasing grape quality; this causes the value of the wine to decrease even further.

Any changes that affect the wine industry will have a great impact on a large portion of the families in this sector.

One of the main economic challenges for wine production in Mendoza is how to prevent the widening of the current gap of quality standards between large and small growers, and how to instill changes in small grower production choices for better economic efficiency and wine grape quality.

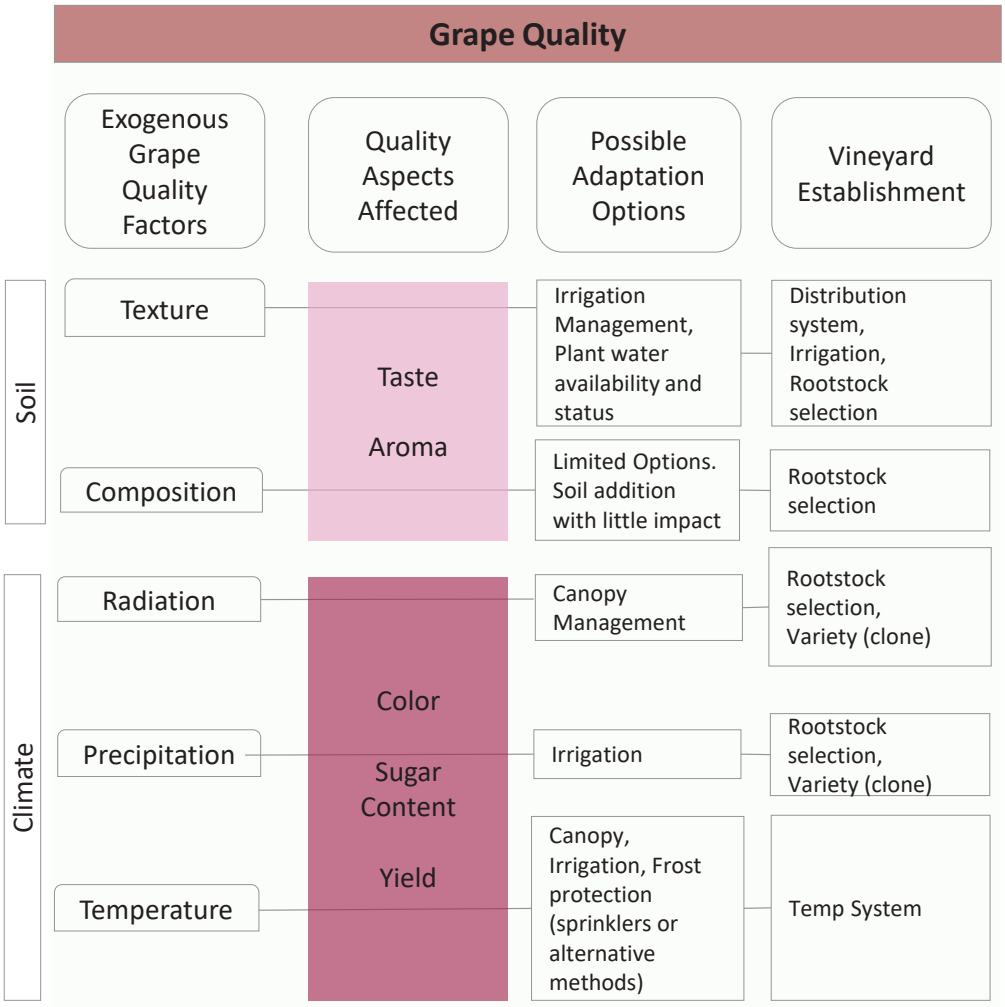

Figure 5: Wine Quality Aspects.
Prepared by author based on information from an interview with wine phenology experts from the Department of Viticulture and Enology at the University of California, Davis.

Climate challenges

The Mendoza region's limited rainfall means accurate irrigation timing is critical to most wine production systems. Due to their specialized soil and climate condition, grapes are particularly adapted to Mediterranean climates and sensitive to changes in temperature, precipitation, and solar radiation (Figure 5). Around the world, climate change is affecting the phenology and the composition of grape vines by causing an earlier ripening and by increasing the sugar concentration of grapes (Mira de Orduña 2010; Nicholas 2014; Thach and Matz 2004; Viers et al. 2013; Webb et al. 2013; Webb et al. 2012)

The literature on wine phenology[2] shows no significant climate change impacts on Malbec wine grape phenology. But it does show that water shortages are the main vulnerability for Malbec wine (Castex et al. 2015).

Mendoza's terroir is characterized by its high altitude in the Andean foothills, where the best wines are produced between 1,524 and 3,000 meters above sea level (Adelsheim et al. 2016). The mountain soil has low organic material, is formed by rock and alluvial clay, and provides good drainage. Most vine roots cannot reach the groundwater and therefore need to be irrigated (Adelsheim et al. 2016). High altitude terroirs with very little rainfall (200 to 250 mm annually) allow controlled irrigation and makes snow precipitation in the mountains a crucial water supply source. About 70% to 80% of surface and groundwater in the summer comes from seasonal snow melt and glaciers (Castex et al. 2015). A distinct characteristic of the Mendoza wine region is the presence of the "oasis" sustained by a supply of shallow groundwater that is fed by snowmelt in the surrounding mountains. The agricultural sector uses 80% of the available groundwater, and 70% of all agriculture is wine (Morábito et al. 2009).

Climate projections for the region indicate three main impacts: increases of rainfall and decreases in snow precipitation in the valley, along with reductions of glacier area in the surrounding mountains. Decreases in snowfall reduce surface and groundwater available for irrigation (Salas et al. 2012). The literature also reports on glacier area reduction and changes in snow precipitation for the region and how water supply can sharply change once glacier areas start disappearing (Boninsegna and Llop 2015; Castex et al. 2015; Kaser et al. 2010). In addition, water use has been highly inefficient (Kaser et al. 2010).

Mendoza's water resources rely on surface water supplied from snowmelt and the interaction with groundwater; this enables the creation of a natural phenomenon, the oasis. The climate impacts on snow precipitation and glacier melting – as well as the region's increased use of groundwater – pose environmental challenges for the region's wine sector. Understanding the interaction of these two components is necessary to preserve the oasis, a crucial water supply source for the region.

2 Phenology is the study of cyclic and seasonal natural phenomena, especially in relation to climate and plant and animal life.

Box1: California Groundwater Sustainability Management Act

Regional Water Management ties financial support from the State to a process that allows stakeholders from self-identified hydrologic regions to develop integrated plans and identify broadly supported water management actions.

In California, the Sustainable Groundwater Management Act requires self-identified Groundwater Sustainability Agencies to propose actions, in the form of a Groundwater Sustainability Plan that ensures that past historic groundwater overdraft is halted and reversed. This plan is intended to be developed in concert with local stakeholders so that all parties accept actions to enhance aquifer recharge or limit the volume of permitted groundwater pumping. The aim is to avoid the need for formal, state mandated adjudication. This reform focuses on local water management decision-making authority, reserving oversight for the State.

Water governance challenges

High altitude wine production relies heavily on mountain snow precipitation in the winter to provide water supply in summer and spring. Consequently, water supply in Mendoza has been managed for more than a century. In 1884, a water law called "Ley de Aguas de Mendoza" was created to distribute water based on registered land in production.

With some modifications, this is still the main law for distributing water. The Departamento General de Irrigación (DGI) is one of the oldest water management institutions in Latin America (Richard Lee 1990). DGI is responsible for supplying water to producers and for fulfilling other water demands, as well as granting access to groundwater sources. They are in charge of planning and preparing for future changes in climate and water demands.

Mendoza faces similar challenges to California in regards to water planning. Both regions rely on mountain snowmelt for their water supply and have a long history of regulating that supply[3]. Both regions also face frequent consecutive droughts causing an increase in the use of groundwater.

In the last few years[4], California has transitioned to a regional water management regulation for groundwater sources (Box 1). Mendoza could learn from the California regulatory framework, with the aim of obtaining the knowledge and tools to ensure the sustainability of the system. Changes in the regulation of surface and groundwater supply would require an investment from policy-makers; it would mean not only updating surface water regulations and monitoring groundwater pumping, but also implementing restrictions on farmers' use. Such changes can be controversial but possible, as demonstrated in California.

Updating current regulations is key to ensuring Mendoza has a sustainable water supply in the future. Policy-makers have a difficult task ahead of them in implementing water supply restrictions that will impact wine-grape growers – and hence, the main economic activity for the region.

Conclusion

Despite the wine industry's enormous efforts to recover from the crisis of the 1980s and improve wine quality, there are still several challenges that need to be addressed to ensure the economic sustainability of the Mendoza region. Thousands of small-farm families produce the majority of the wine grapes and yet are struggling to reap the benefits of the region's improved international reputation. Supporting an economically sustainable production of good quality wine that benefits small growers can also benefit the region's wine reputation. From a policy perspective, evaluating the impact differences on small and large growers can illuminate current socioeconomic vulnerabilities of the region and thus inform strategies with more equitable outcomes.

Water supply conditions have changed, and the current water law cannot easily address the new challenges related to changes in climate conditions. Groundwater access is somewhat regulated but, as is the case in California, further work is needed to ensure the sustainability of groundwater sources. Water managers need to juggle between the difficult tasks of implementing a groundwater regulatory system while dealing with drought. The California Groundwater Sustainability Management Act could be an example for water managers in Mendoza to consider to ensure a reliable water supply for the region while conserving the ecological sustainability of groundwater resources (California Department of Water Resources n.d.).

As presented in this document, the Mendoza region has many challenges, but each of those challenges also has potential solutions. A large production system of high-value, irrigated agricultural crops is not isolated from the regional economy. Because of its history, economy, and perhaps climate, growers' size and type has bifurcated: a few growers are large and economically efficient, and a large majority of growers struggle to maintain wine grapes that meet international quality standards.

When implementing new strategies and regulations, decision-makers need to evaluate the key actors in this economy and who will be affected by new policies – or, more importantly, who will be excluded. Innovative scientific analysis, such as the Robust Decision Support Framework (Bresney and Escobar 2017), could provide the means for decision-makers to examine the future climate impacts on the hydrology, evaluate sustainable water management strategies, and support small wine-growers for a thriving economy in a sustainable environment.

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This discussion brief was written by Laura Forni. It is a an output of the SEI-US Water Group. To learn more about potential applications of SEI's Water Evaluation And Planning (WEAP) system, visit http://weap21.org/.

Published by:
Stockholm Environment Institute
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2018

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