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Projetos de Sustentabilidade na Industria do Vinho - Chile

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Atualmente

- **Problemas surgem na intersecao de mudanca climática e sustentabilidade**
- **Modelos matemáticos e tecnología para estudar como impacta na performance das organizacoes**

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- Founder and Former Subject Editor Journal of Cleaner Production (Q1 – Elsevier, A1 CAPES)
- Managing Guest Editor European Journal of Operational Research (Q1 – Elsevier, A1 CAPES)
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- (BOD) - Steering Committee Network+ Food Security - UK

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Agenda

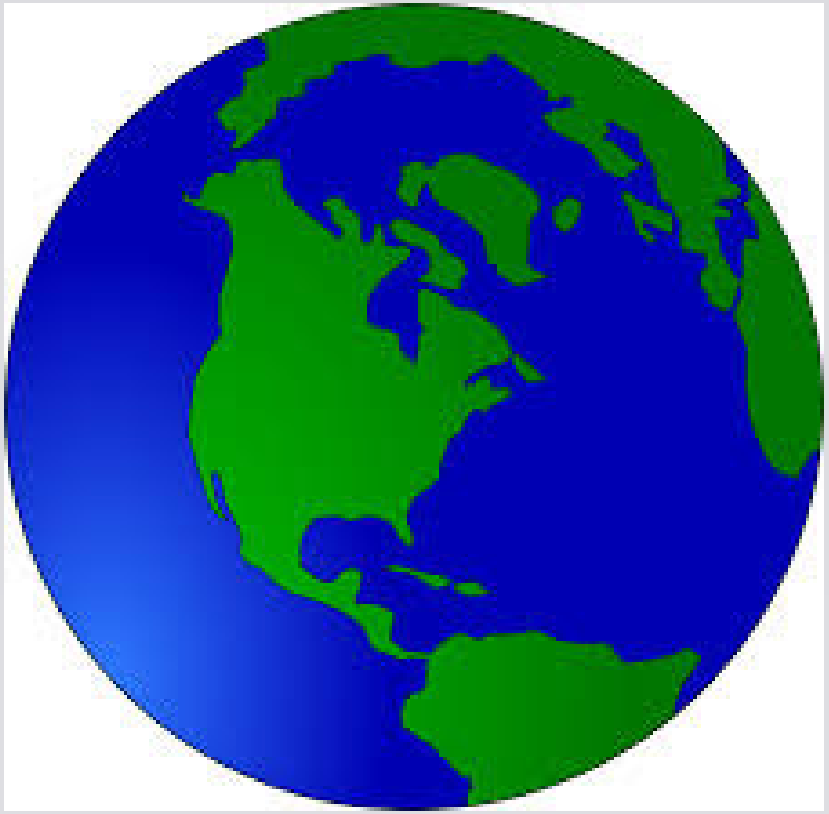
- A Industria do Vinho no mundo e o caso do Chile
- Principais desafíos (e oportunidades) da industria do vinho
  - Externos
  - Internos
- Facing challenges and taking opportunities da industria no chile (Alguns projetos na industria do vinho)
- Conclusoes

A Industria do Vinho no mundo e o caso do Chile

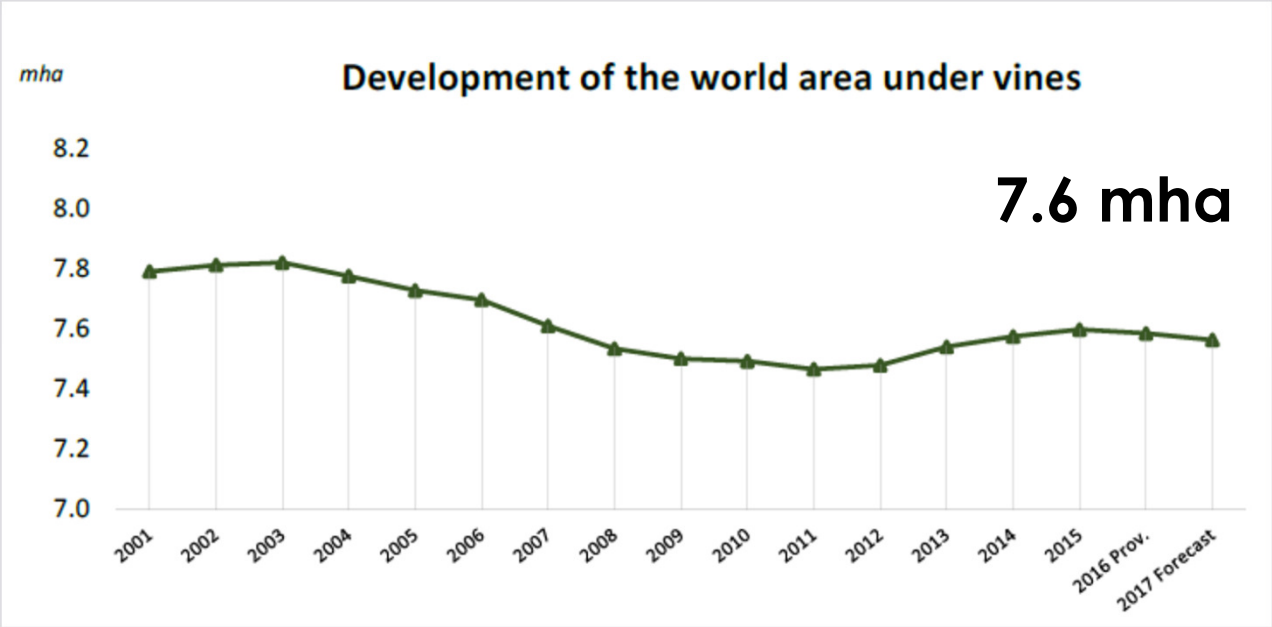
O que entendemos por industria do vino?

Análise da producao e consumo no mundo

Caracterizando a industria do vinho chilena



World area under vines (evoluicao)



Abbreviations:
kha: thousands of hectares
mha: millions of hectares
khl: thousands of hectolitres
mhl: millions of hectolitres
bn: billion
m: million
EUR: euros

Europa vinhas - 5 principales

Total 3.3 mha

>80%

Areas under vines[a] in European vineyards

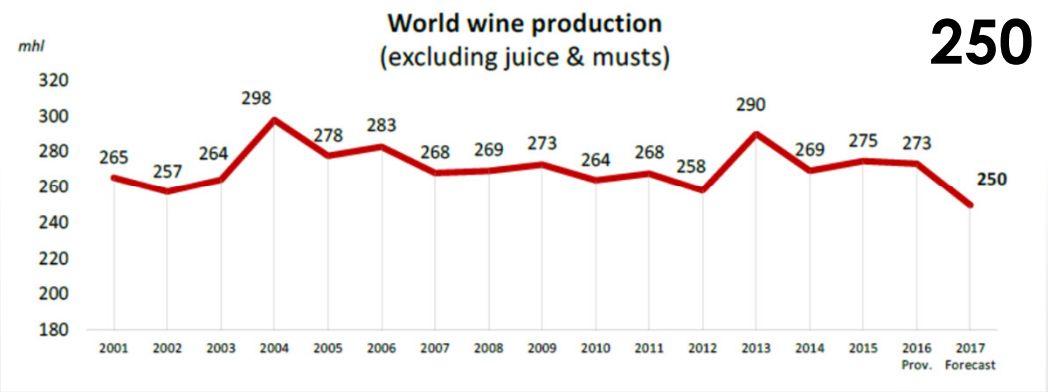
kha	2014	2015	2016[b]	2017[c]	2017/2016 Variation
Spain	975	974	975	967	-8.2
France	789	785	786	787	0.9
Italy	690	682	690	695	5.0
Portugal	224	204	195	194	-1.5
Romania	192	191	191	191	-0.1

Total areas under vines[a] outside Europe **>50%**

kha	2014	2015	2016[b]	2017[c]	2017/2016 Variation
China	813	847	864	870	5.9
Turkey	502	497	468	448	-19.7
United States	450	446	441	441	0.3
Argentina	228	225	224	223	-1.2
Chile	213	214	209	209	0.0

Fora Europa – 5 principais

(Uva para vinho, mesa, passa)

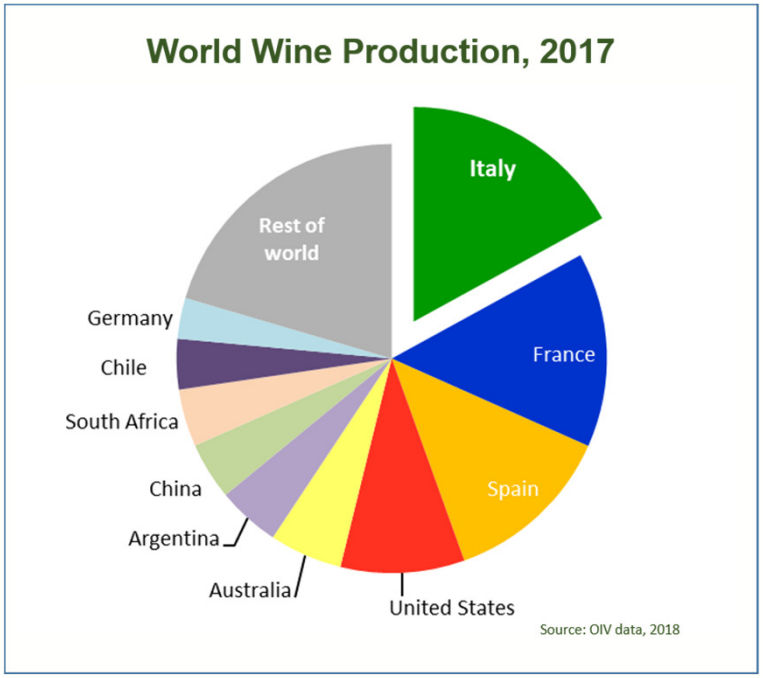


250 mhl

2017

Producao Vinho - Mundo

Principais produtores



App 80%

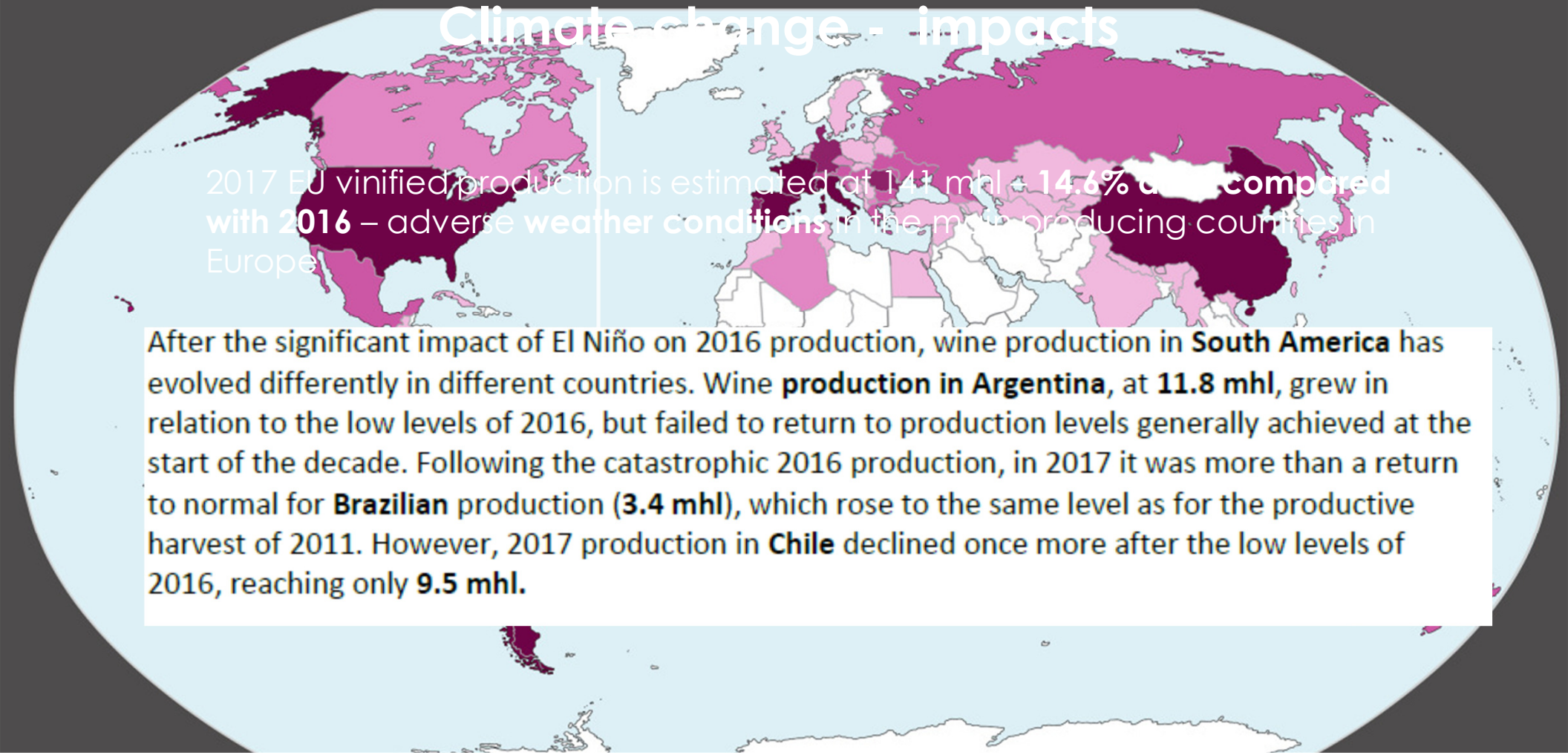
Wine production (excluding juice and musts) [a]

mhl	2013	2014	2015	2016[b]	2017[c]	2017/2016 Variation in volume	2017/2016 Variation in %
Italy	54.0	44.2	50.0	50.9	42.5	-8.4	-17%
France	42.1	46.5	47.0	45.4	36.7	-8.7	-19%
Spain	45.3	39.5	37.7	40.0	32.1	-7.9	-20%
United States[d]	24.4	23.1	21.7	23.6	23.3	-0.3	-1%
Australia	12.3	11.9	11.9	13.0	13.7	0.7	5%
Argentina	15.0	15.2	13.4	9.4	11.8	2.4	25%
China	11.8	11.6	11.5	11.4	10.8	-0.6	-5%
South Africa	11.0	11.5	11.2	10.5	10.8	0.3	3%
Chile	12.8	9.9	12.9	10.1	9.5	-0.7	-6%
Germany	8.4	9.2	8.9	9.0	7.7	-1.3	-15%

Producao Vinho – Principais 10

Global Wine Production

Climate change - impacts



2017 EU vinified production is estimated at 141 mhl – **14.6% down compared with 2016** – adverse **weather conditions** in the main producing countries in Europe

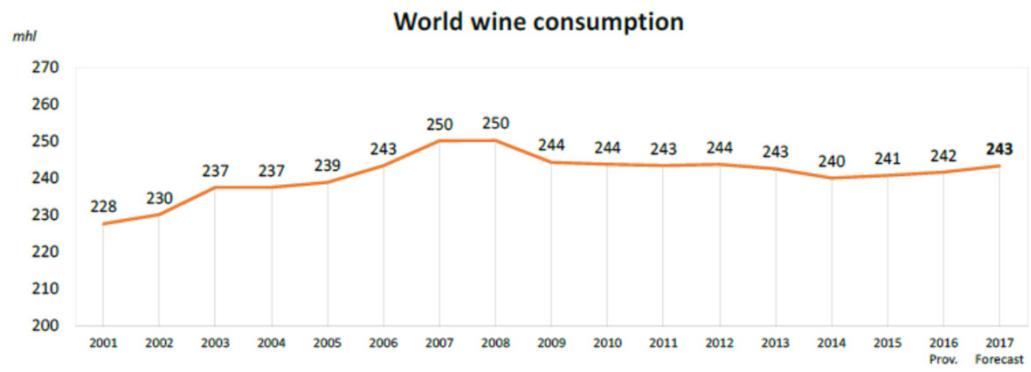
After the significant impact of El Niño on 2016 production, wine production in **South America** has evolved differently in different countries. Wine **production in Argentina**, at **11.8 mhl**, grew in relation to the low levels of 2016, but failed to return to production levels generally achieved at the start of the decade. Following the catastrophic 2016 production, in 2017 it was more than a return to normal for **Brazilian** production (**3.4 mhl**), which rose to the same level as for the productive harvest of 2011. However, 2017 production in **Chile** declined once more after the low levels of 2016, reaching only **9.5 mhl.**

Consumo mundial vinho

24.3 bilhoes litros
32.4 bilhoes garrafas 0.75

Milhoes de hectolitros

243



2017

Principais consumidores – 17 paises

- The **primary** wine-consuming countries are the USA, France, Italy and Germany
- An **increasing** consumption in new consumer countries in **Asia and Latin America**, which still have a **very low per capita consumption rat**e.

App 80%

mhl	2013	2014	2015	2016[b]	2017[c]	2017/2016 Variation in volume	2017/2016 Variation in %
United States	30.8	30.6	30.9	31.7	32.6	0.9	2.9%
France	27.8	27.5	27.3	27.1	27.0	-0.1	-0.4%
Italy	20.8	19.5	21.4	22.4	22.6	0.2	0.9%
Germany	20.4	20.3	19.6	20.1	20.2	0.1	0.3%
China*	16.5	15.5	16.2	17.3	17.9	0.6	3.5%
United Kingdom	12.7	12.6	12.7	12.9	12.7	-0.2	-1.4%
Spain	9.8	9.9	10.0	9.9	10.3	0.3	3.1%
Argentina	10.4	9.9	10.3	9.4	8.9	-0.5	-5.2%
Russia	10.4	9.6	9.2	9.1	8.9	-0.2	-2.5%
Australia	5.4	5.4	5.5	5.5	5.8	0.3	4.9%
Canada	4.9	4.7	4.9	5.0	4.9	-0.1	-1.7%
Portugal	4.2	4.3	4.8	4.6	4.5	-0.1	-2.0%
South Africa	3.7	4.0	4.3	4.4	4.5	0.1	2.4%
Romania	4.6	4.7	4.0	3.8	4.1	0.3	8.5%
Japan	3.4	3.5	3.5	3.5	3.5	0.0	0.0%
Netherlands	3.3	3.4	3.5	3.4	3.5	0.1	2.2%
Brazil	3.5	3.2	3.3	3.1	3.3	0.2	6.0%

Principais exportadores – 10 paises

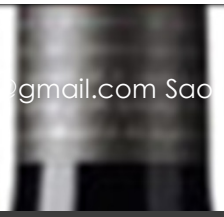
54%

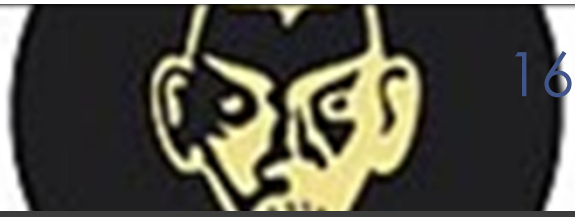
Main wine exporters (excluding juice and musts)

	Volume (mhl)		Value (m EUR)	
	2016	2017	2016	2017
Spain	24.4	22.1	2,649	2,814
Italy	20.6	21.4	5,582	5,873
France	14.4	15.4	8,263	8,989
Chile	9.1	9.8	1,668	1,741
Australia	7.5	8.0	1,543	1,727
South Africa	4.3	4.5	602	583
Germany	3.8	3.8	936	926
United States	3.8	3.3	1,415	1,280
Portugal	2.8	3.0	723	752
New Zealand	2.1	2.5	1,017	1,054

Importadores

	Volume (mhl)		Value (m EUR)	
	2016	2017	2016	2017
Germany	15.2	15.2	2,510	2,469
United Kingdom	13.5	13.2	3,499	3,453
United States	11.1	11.8	5,009	5,190
France	7.6	7.6	741	812
China	6.4	7.5	2,143	2,458
Russia	4.0	4.5	662	878
Netherlands	4.0	4.4	980	1,139
Canada	4.2	4.1	1,604	1,653
Belgium	3.1	3.1	902	897
Japan	2.7	2.6	1,343	1,388





Chile – caracterizando a industria do vinho

- In 2017 Chile
  - was the world's nineth largest wine producer
  - was fourth in the world ranking of wine-exporting countries,
  - **Chile (last two years) exports around 100 per cent of its wine production**
    - 2016: 1,668 milhoes de Euros
    - 2017: 1,741 milhoes de Euros
    - (2013: 70% around 8 thousands of hectoliters, worthing 1,388 millions of euros (OIV, May 2015).

Chilean wine industry

- With **150 destination countries and 1.5 billion consumers** per year, Chilean wines are positioned as the country's most emblematic and best known world ambassador (with the USA, the UK, and Canada being the most important markets.).
- **World's most globalized wine industry**, with great flexibility, innovation and a long-term commitment to quality and service second to none.
- Wine exports make up 2.6 per cent of Chile's total exports and 14 per cent of exports in the forestry-agriculture-livestock sector

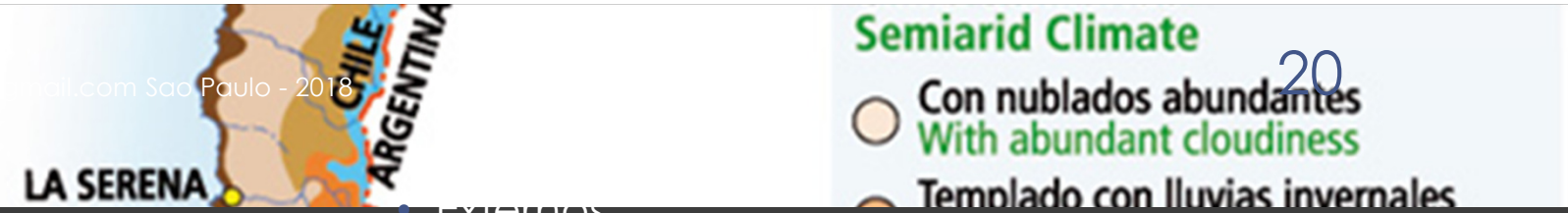
Casillero del Diablo

Chile and wine production

- The sector has more than **260 companies** with annual exports greater than US$50,000, 21 per cent of which export more than 100,000 UF (approx. US$4.2 million) per year. This means that the majority **– 79 per cent – of Chile's wine exporters are small- and medium-sized companies**.
- From a domestic perspective, the wine industry operates in several regions of the country, from the Coquimbo Region in the north to the **Araucania Region** in the south. **The Maule and O'Higgins re**gions have the greatest concentration of area planted to vine (53.4 per cent), although the **Metropolitan, Valparaiso and Biob**io regions also have a significant amount. The industry's continuous development and geographic diversification have attracted both domestic and foreign investment to historically less-developed zones such as the Maule Region, which had previously been overlooked as an area worthy of investment. This development has also benefited the many agents involved in the value chain, including suppliers of materials, technology and complementary services, and particularly the large number of grape growers, most of whom are small producers.
- At the same time, the wine industry continues to be a major source of tax revenue for the government through the Alcohol Law (ILA). Over the past five years (2005-2009), the Wine ILA accounted for an average of 0.21 per cent of the country's total tax revenue. In 2009 alone, the wine ILA generated tax revenues of US$58 million.

Chile

- The main **competitors** at a global scale to the **Chilean** wines are USA, Australia, South Africa, New Zealand, Argentina, France, Italy, and Spain.
- **Concha y Toro** company with its 45 million liters of wines per year is the largest domestic producer of Chile and one of the most important producer of the world (Humphreys, 2015).
- Currently the export of wines requires high standards within which highlights obtain the product generating the least possible impact.



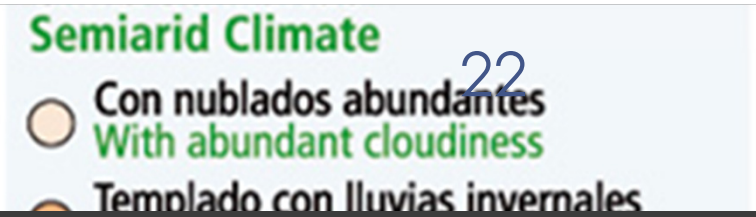
Principais desafíos (e oportunidades) da industria do vino

- Externos
  - **Mudancas no perfil do consumidor – social and environmental awarness**
  - Cambio Climático
  - Concorrencia
  - Endurecimento da regulamentacao/leis no contexto mundial
- Internos
  - Falta integración/coordinacao na cadeia de suprimentos
  - Gerenciamento dos Custos
  - Adopcao de tecnología para melhorar produtividade e lucro

Consumidores e mercado – mudanza de paradigma

- The Chilean industry's primary target markets are the USA, the UK and Canada. The main consumer-level trends in those markets are B A change in consumer habits. The new consumers are intelligent, they seek good value, and spend more time socializing at home, especially as a result of the global economic crisis. They are trading down for personal consumption, but trading up with friends and family. For example, 53 per cent of the consumers in the USA are dining at home more often. Television food channels and food-related blogs are increasing in popularity. Once the crisis has passed, we can expect that these consumers will return to higher priced wines, although they will not reach the same levels they did in the late 1990s and early 2000s.
- A new segment has appeared. **The "Millennials" are consumers from 21 to 29 years of age and represent 70 million consumers in the USA alone. 40 per cent of the wine they drink is imported.** They learn and communicate on-line. These new consumers drive the new trends.
- Consumers have greater access to a broader range of wines through new products and distribution channels, such as on-line sales.
- **Consumers are increasingly more sophisticated and informed. They seek out natural, sustainable and organic products.**
- **New trends lean toward wines with lower alcohol levels and a greater consumption of white and rose´ wines.**
- Social networks (Facebook, Twitter and blogs) are increasingly important and allow low-cost, high-frequency communication with bloggers and consumers around the world.

1400 km



Climate change

The analysis of climate change (CC) impact on the three dimensions of sustainability (i.e. social, environmental and economic ones) have been analysed for different contexts and by means of several methodologies in scientific literature.

- **the potential variation in cultivar distribution**
- the variation of vine productivity
- **the potential spread of pests and plant infections**
- or the impact on phenological activity

Competition

- Chilean wines face very high levels of competition in the different world markets from many appellations and brands, and **its average prices are substantially lower than those of its competitors.**
- As a consequence, the **industry's present profitability levels are low, and there is an urgent need to elevate the premium positioning and average prices to achieve a sustainable return in the long term.**
- **Making decisive progress toward positioning Chile as a world-class appellation for the production of premium and superior wines, gaining additional image and value is the only possible response to the competitive challenges the industry face today**. This is a key requirement for the health and long-term sustainability of Wines of Chile.

Preco e rentabilidade menor

premium and superior wines

New strategy - opportunity

- The Chilean wine industry **is preparing a new strategic plan** and **international marketing strategy for 2020+** aiming guidelines for a vigorous ten-year course of international development and defines the industry's vision, mission, positioning, strategic objectives, opportunities and plans of action with a new strategic marketing perspective.
- The industry is willing to developed the plan in conjunction with the wineries and key industry members, and with the conviction that this new strategy should advance toward a more significant participation in the **world's premium wine segment.** Aiming to develop this new strategic plan and **international marketing strategy, the trade association Wines of Chile**, is hiring a new consultancy company, and you are part of this team.

Image and marketing

- **Wines of Chile** trade association has set the objective of becoming the **number one producer of premium, sustainable, and diverse wines of the New World** by 2020, increasing the value of bottled wine exports over the course of the decade to **US$3 billion**
- Over the past decade, **wine has become the major ambassador of Chile** in the minds of foreign consumers – as is reflected in the latest studies conducted by the **Fundacion Imagen de Chile** – regarding the perception and knowledge of the country in its principal markets of interest.
- Wine adds **positive and valuable characteristics to the country image** and facilitates the export of new products.

Facing challenges and opportunities - Alguns projetos na industria do vino do Chile

Facing climate change, sustainability and produtivity - tecnología e modelos avanzados para melhorar a previsao de coleita

→

Facing increasing environmental awareness – LCA-based approaches – proceso, procedimentos

→

Melhorando procesos chaves na cadeia de suprimentos - Integracao de tecnología blockchain

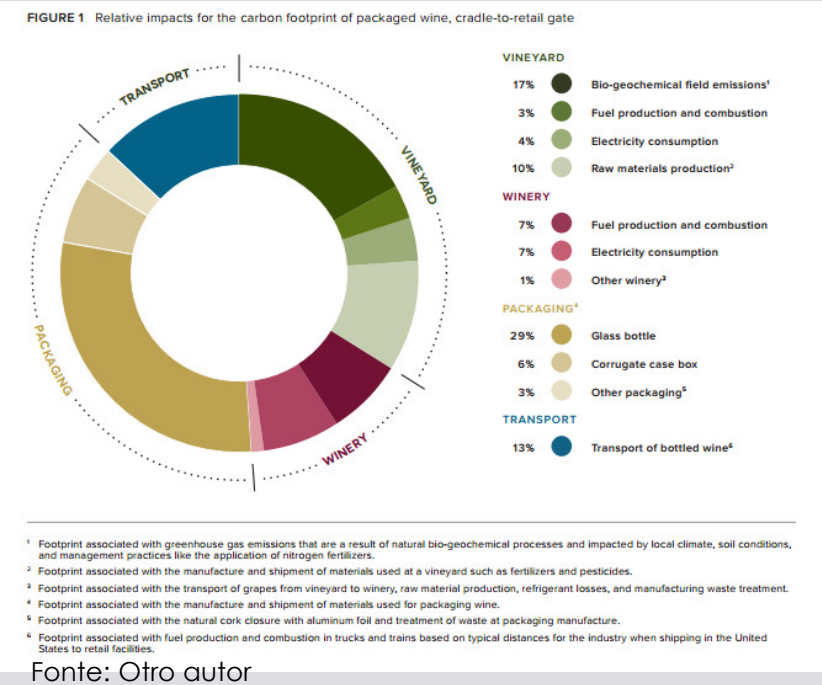
Some challenges - sustainability

- Bottles of Chilean wine are exported to more than 150 countries of Europe, Asia, Latin-America and other regions.
- **During the entire wine life cycle, water and energy are consumed, carbon is generated and many other environmental and social impacts need to be considered.**
- **In addition, the lack of mechanisms for traceability of the different techniques used in the winery industry does not resolve the problem "of low visibility, non-authentic and inaccurate transactions for tracing and tracking the movement of wines in a supply chain."(Mahinderjit-Singh, Xue, & Zhanhuai, 2005)**

volume of emissions of greenhouse gases (GHG), waste minimization, water consumption, toxicity, and pollution, working conditions, costs, economic growth, among others.

Pegada de carbono e hidrica – 0.75l

Carbon footprint garrafa de vinho cradle-to-retail gate



Fonte: Otro autor

30%

15%

40%

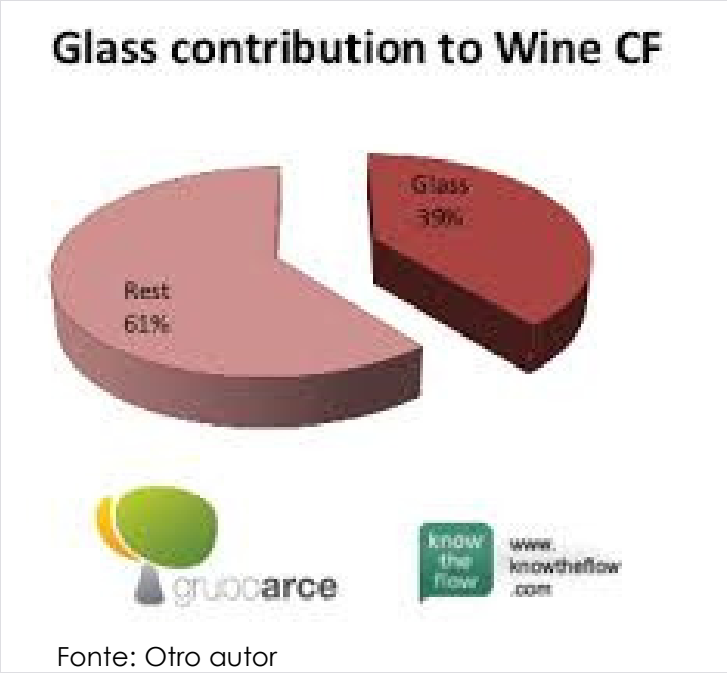
15%

Consumo mundial

175 bilhoes de km ou 4,3 milhoes de voltas a terra ou 80 bilhoes de carros/dia circulando nas cidadess

Vidro – contribuicao pegada carbono

80% vinho consumido em restaurantes é **by glass** – equivale a **600 milhoes de garrafas**



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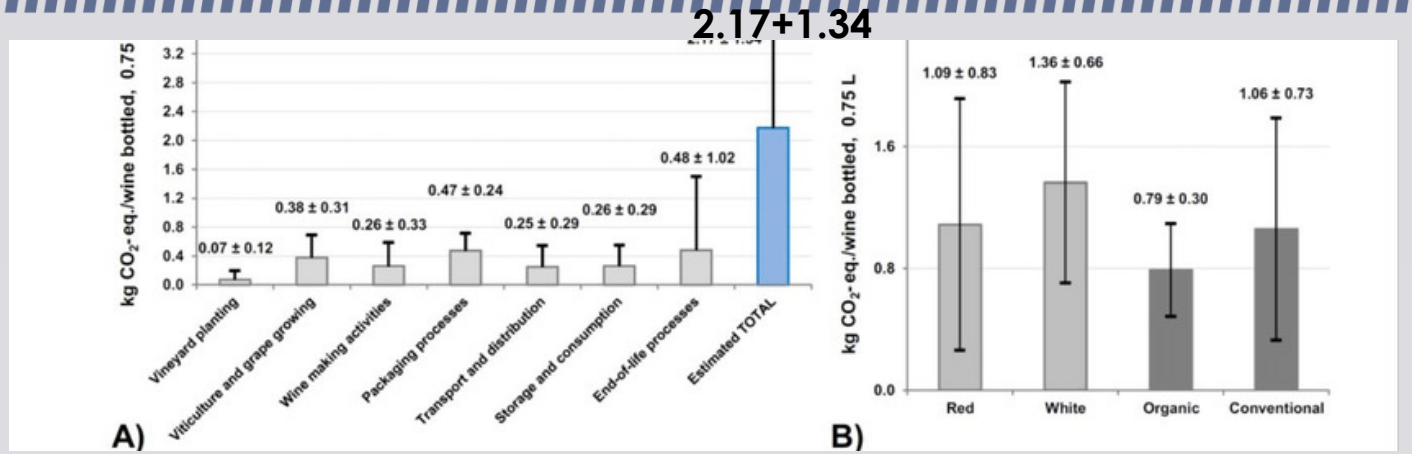


cradle to grave approach

Wine Sector Report: Analysis of GHG Emissions of **Western Cape** wine grape production, 2015, Pieter Janse van Vuuren

Cuidado: nem toda garrafa gera o mesmo impacto

desborre, brotación, foliación, floración, fecundación, envero, y maduración, donde luego de ésta, tiene lugar la vendimia (la cosecha).

Sustainability in the wine industry – Chile PREPARING FOR THE WORLD BATTLE

- Very recently, the Chilean wine industry has launched the **Certified Sustainable Wine of Chi**le initiative to address the economic, social and environmental issues in this industry (www.sustentavid.org). As a non-mandatory code of conduct for the industry, until 2013, 43 vineyard companies were certified. In addition, according to 2012 numbers, around 55% of the total wine that Chile exports comes from certified vineyards (www.sustentavid.org).
- The metrics considered in this code follows international standards such as the system proposed by Business Social Compliance Initiative (BSCI) and Wine in Moderation initiative.
- Klohr, Fleuchaus, & Theuvsen, 2013) made an interesting study addressing the differences between the sustainability certifications programs implemented in many wine companies around the world.

toward sustainable farming and business practices, whether organic, biodynamic, or a combination; and **these environmental strategies can work toward a differentiation of their brand at retail or serve to optimizing the economic return** on investments with cost reductions

Complexity – second phase strategy - project

- As we can see, in many cases, life cycle and the supporting supply chain crosses several borders, countries, states, companies and cultures that makes difficult to follow the flow of raw materials, parts, components and products as well as to associate customers to war material providers
- This supply chain complexity makes that traditional laws and regulations aimed at controlling the producer within the limits of a country become less effective for the efficient management of global sustainable impacts.
- This point highlight many questions about: **(a) how advanced technology could support the traceability of products; (b) how visibility can contribute to better understand the impacts of disruptions in the supply chain, and (c) how decision-makers can manage a supply chain with multiple actors, multiple suppliers, supported by a diversity of technology and objectives**.

Investimento, mudanca no gerenciamento

Facing climate change, sustainability and productivity - tecnología e modelos avanzados para melhorar a **previsao de coleita**

sebastian.cespedes@gmail.com - 2019

Como vender um projeto de sustentabilidade???

Intelligent Decision Support System

- Sistemas de TICs
- Sensores
- Modelos matematicos
- Métodologías/procedimientos (BP)

PREVISAO DE COLEITA

Desarrollar un **sistema integrado** de **sensores de bajo costo** que permita realizar mediciones periódicas de los parámetros críticos que pueden influir en el volumen de cosecha y la calidad de la uva en los viñedos, con el fin de mejorar la predicción de cosecha y optimizar el uso de recursos a lo largo de la cadena de abastecimiento de la industria vitivinícola.

Desarrollar un **sistema inteligente** para apoyar la predicción del volumen de cosecha en viñedos a través de la integración de **datos de diversas fuentes** con **sistemas de sensores** y **técnicas** de **análisis y optimización** avanzada de datos.

Modelos de predicción de volumen de cosecha utilizando métodos basados **en inteligencia artificial**, basado principalmente en la información histórica.

System Project - A partial list of questions that the proposed system has to answering

- Correlation (and degree of influence) between different physical, biological and chemical factors associated with a micro level vineyard (quadrant) and the quality of the grape, harvest volume and productivity. For example, color and phenolic characteristics (compounds);
- Integral traceability, based on IoT and disruptive technology deployed on fields, key raw material, parts, components and products, and final products (grapes to vinery) should be properly monitored to ensure food security, but also to contribute to analyze key sustainable performance indicators such as, carbon footprint, water footprint;
- What is the most productive vineyard and quadrant and that has the highest yield crop? Why?
- What is the correlation among quadrant, quality of grapes, and yield crop?

Project – Complexity/Challenges

- Organizacao
  - Interdisciplinar
    - Enologos, biólogos, químicos, engenheiros, economistas, computologos, data scientists
- Innovacao
- Pesquisa

Marco teórico - disciplinas

Modelos otimizacao e forecasting

Gestao da Cadena de Suprimentos

Balanced Scorecard

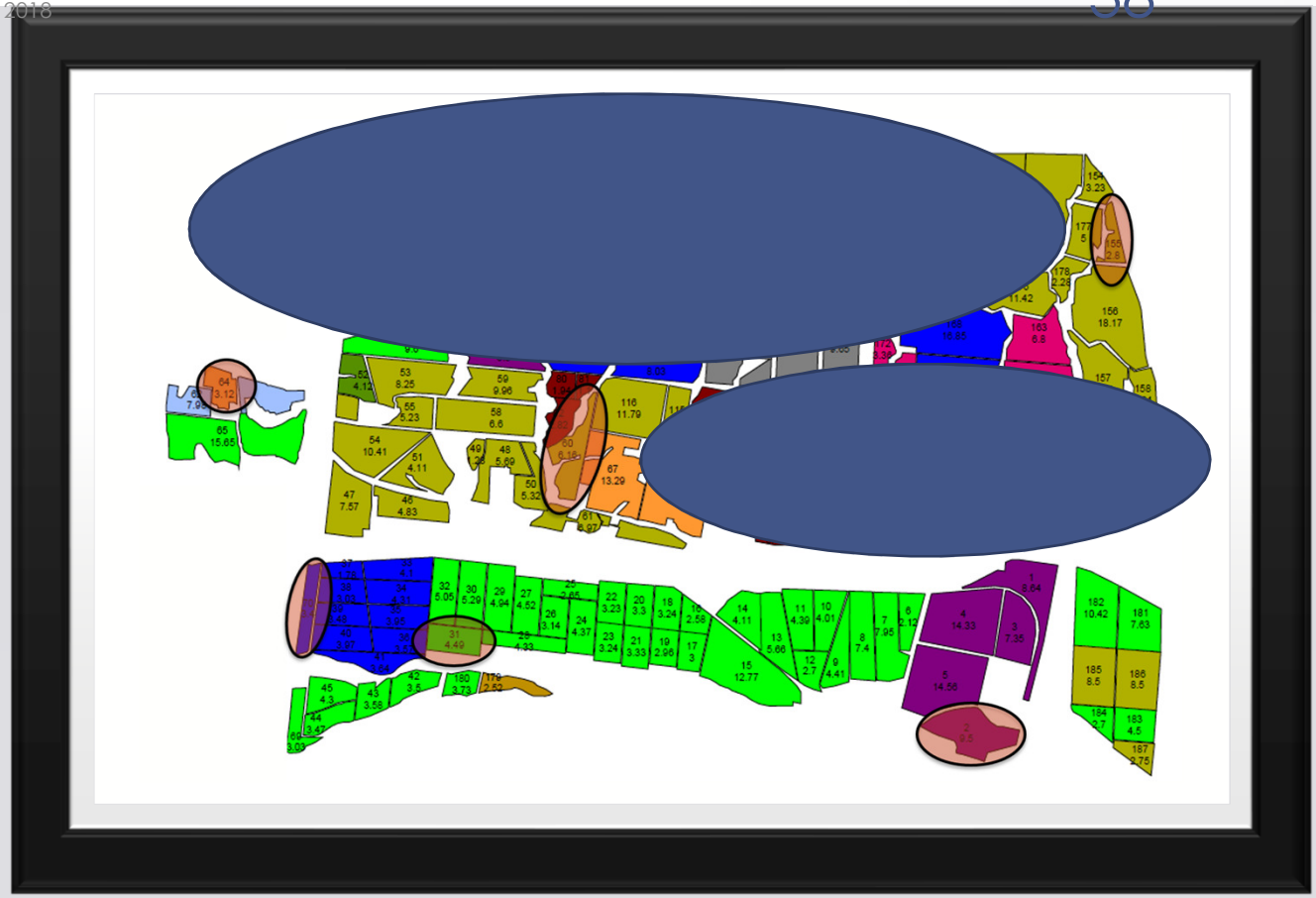
Sustentabilidade

TICs e Sistemas de Informacao

Fonte: Outro autor, adaptada

A partir de set de sensores on-site, moveis y aereos

- Cada cuartel pode ser de varias hectáreas
- Cada hectárea pode conter entre 1000 y 4000 plantas



Parámetros - monitorar

Etapa	Instrumento	Parámetro
Viticultura	Sonda multisensor FDR y TDR	Humedad. Estado hídrico del suelo
	Pluviómetro	Lluvia (mm)
	Termómetro digital, sondas.	Temperatura promedio (°C)
	Anemómetro o Anemógrafo	Fuerza y dirección del viento
	Pirheliómetro o Sensor DNI	Radiación solar (kJ-m-d)
Cosecha	Refractómetro	Madurez uva (°Brix). Total Solidos Solubles
	Alcoholímetro, Mustímetro	Grado alcohólico del mosto
	pHmetro	pH del mosto
Vinificación	Ensayos químicos	Acidez total (g/L), Antocianinas (pigmento), Contenido polifenol
	Vinómetro	Grado alcohólico del vino
	pHmetro	pH del vino

Supply Chain em estudo (modelo conceitual simples) – impacto em procesos

Viticultura → Cosecha → Vinificación → Envasado → Distribucao

- Procesos:

-Cuidado de viñedos -Riego -Fertilización -Monitoreo	-Recolección de uva -Traspaso a pozos de bodega	-Fermentación controlada -Ensayos químicos	-Embotellado y envasado - Embalaje	-Comercialización -Exportación

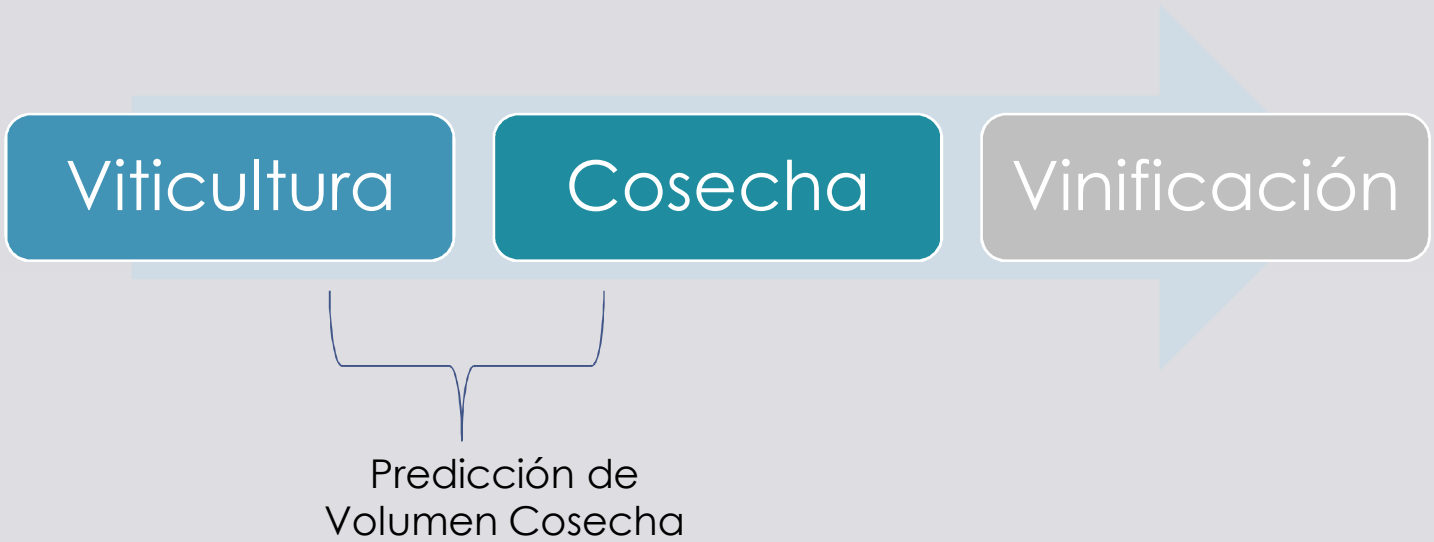
Supply Chain em estudo (modelo conceitual simples) – impacto em procesos

Carbon emissions
Waste generation
Energy consumption
Water consumption

Local sensor | Cuadrante | Viñedo | Cosecha | Vinificación

Fuonte: Elaboracao propria

Cadena (SC) en estudio – foco Volumen Cosecha

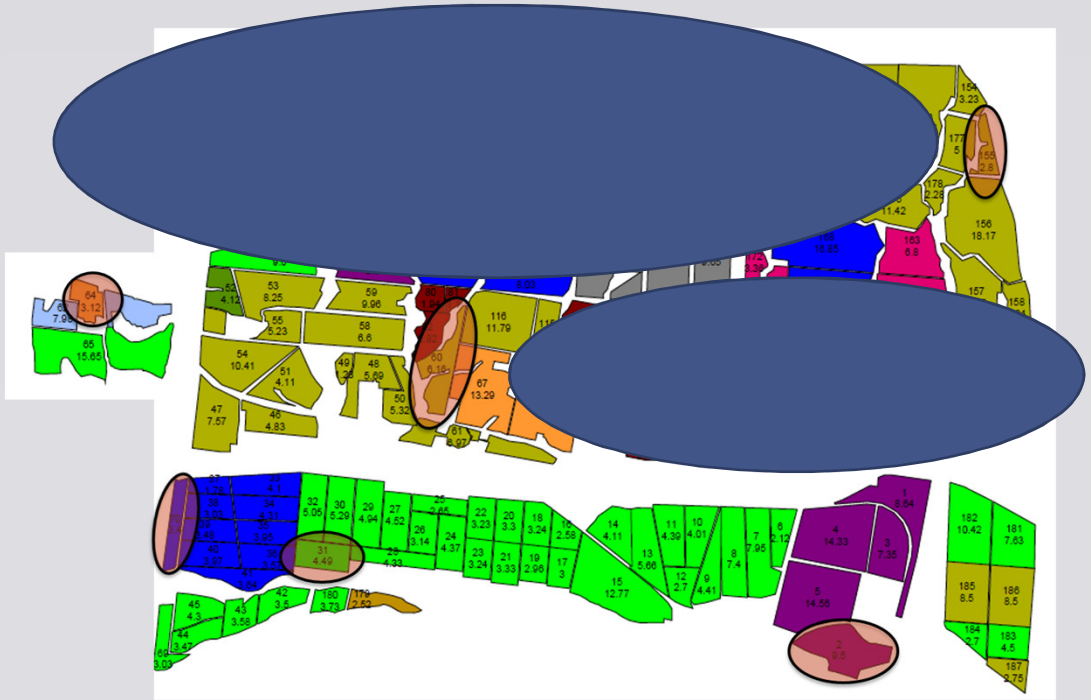


Definición de lugar a muestrear

FUNDO

Cuarteles seleccionados

Cuartel	Conducción	Cultivar	Año plantación	Superficie (ha)
2	Tipo 1	Uva 1		10,0
31	Tipo 2	Uva 2		5,0
60	Tipo 3	Uva 3		6,0
64	Tipo 4	Uva 4		4,0
70	Tipo 5	Uva 5		4,5
155	Tipo 6	Uva 6		3,5
				33,0



Metodología de muestreo

- MONTAJE DE PARCELAS

Cantidad de parcelas a muestrear

Cuartel	Aptitud	Densidad (plantas/ha)	Parcelas teóricas a contar	Cantidad contada	% muestreado
2	Genérico	2.100	49	30	0,3
31	Genérico	1.000	25	27	0,5
60	Premium	4.000	24	24	0,75
64	Súper Premium	3.500	23	12	0,5
70	Genérico	1.500	22	18	0,4
155	Premium	3.500	18	9	0,3

Fuente: Elaboración propia

Problema-Oportunidade

- Existen tres razoes para desenvolver um **sistema integrado de sensores**:
- (a) Melhorar a qualidade **dos datos** para os modelos de previssao e a qualidade da informacao de volume de coleta. (Fang, Hain, Zhan, & Anderson, 2016; Ines, Das, Hansen, & Njoku, 2013; Yan et al., 2013)
- (b) **Agregacao de valor para outros procesos agrícolas**. Los datos recolectados, no solo son importantes para el proceso de predicción de volumen de cosecha, también pueden ser usados de manera complementaria con otros propósitos.
- (c) **Costos tecnología actual.** Existen sensores para diversas aplicaciones en la industria agrícola, sin embargo existen pocos desarrollos para la industria vitivinícola, debe sumarse a ello, costos normalmente prohibitivos.

Conclusoes – perguntas

Obrigado!!!

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