Vineyard Production Cycle with SPA

Area 1 – SPA Overview

Lesson 2 – Use Cases / Case Study

Sequence ID – 10

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Co-funded by the Erasmus+ Programme of the European Union

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DISCLAIMER

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Marco Vieri, Daniele Sarri, Stefania Lombardo, Marco Rimediotti, Riccardo Lisci, Valentina De Pascale, Eleonora Salvini, Carolina Perna, Andrea Pagliai, *Vineyards production cycle with SPA technologies*, © 2020 Author(s), CC BY-SA 4.0 International, DOI 10.36253/978-88-5518-044-3.10, in Marco Vieri (edited by), *SPARKLE - Entrepreneurship for Sustainable Precision Agriculture*, © 2020 Author(s), content CC BY-SA 4.0 International, metadata CC0 1.0 Universal, published by Firenze University Press, ISSN 2704-6095 (online), eISBN 978-88-5518-042-9, DOI 10.36253/978-88-5518-044-3

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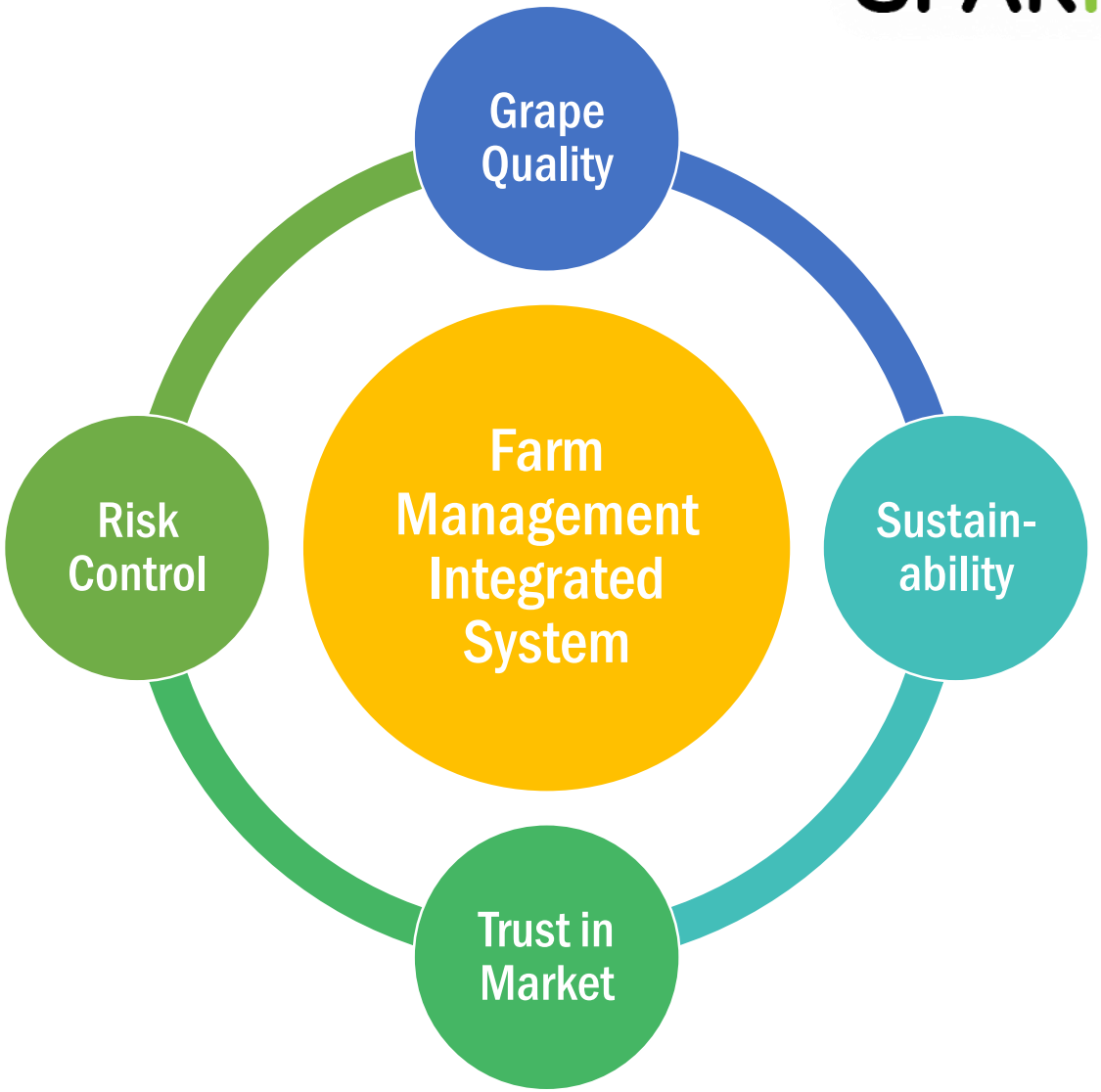
Overview

The use of Precision Agriculture in viticulture has had a strong evolution over the last years, following the need to control risks of pests and climate change. The great variability of the specific environments, dimensions, and infrastructures has sparked more research and development of market-ready technologies, when compared to tillage crops. In viticulture, the core of innovation is risk control for pests and climate, dangerous events with Internet of Things (IoT) technologies on the one hand, and the vines' health management by monitoring and agronomic farming practice on the other.

- For the high value chain of wine, traceability, sustainability, and key indices are fundamental.
- Local digital / high tech platforms are essential for the increase of PA technologies' adoption in the grape and wine value chain.

1. Added Value of SPA in Viticulture

- Control spatial variability of vine growth
- Control risks due to climate change
- Control sustainability of the chain
- Gain positive trust in the market



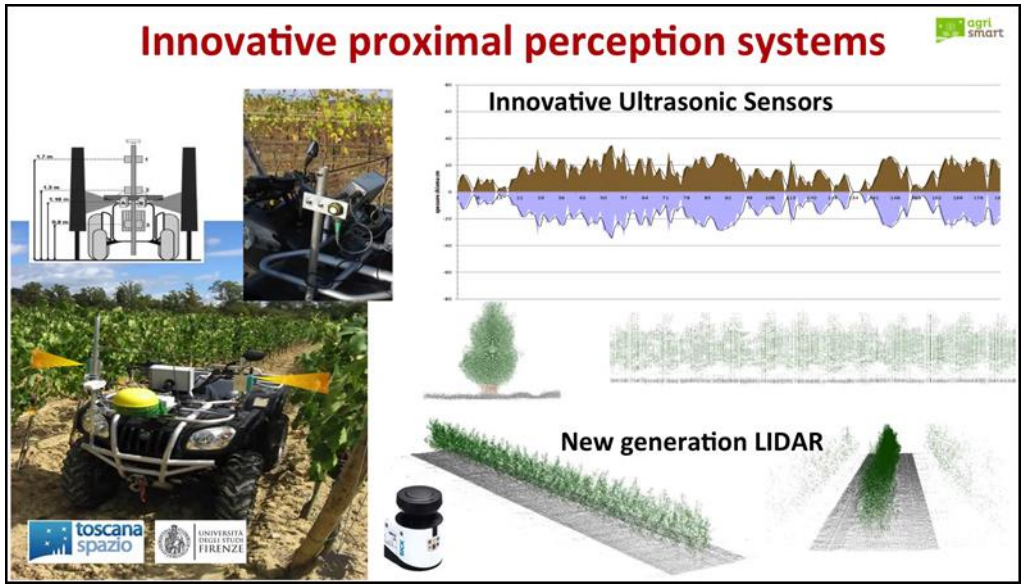
2. Sustainable Precision Viticulture Technological view

2.1 Monitoring Technologies - Sensors and Network

A wide number of technologies are used in viticulture monitoring: from satellites, planes, and unmanned aerial vehicles (UAV's), to close-range devices mounted on terrain vehicles (tractor) or fixed onto the plant.

The aim is to continuously monitor vine and grape status to precisely manage the different operations:

- Climate and Pest Risks control is a strategic aim today;
- Quality control of the seasonal vine growth allows control and uniformity of the physiological status to obtain high quality grapes;
    - Quality control of the grapes gives information for the logistics of the harvest and traceability for the productive chain;

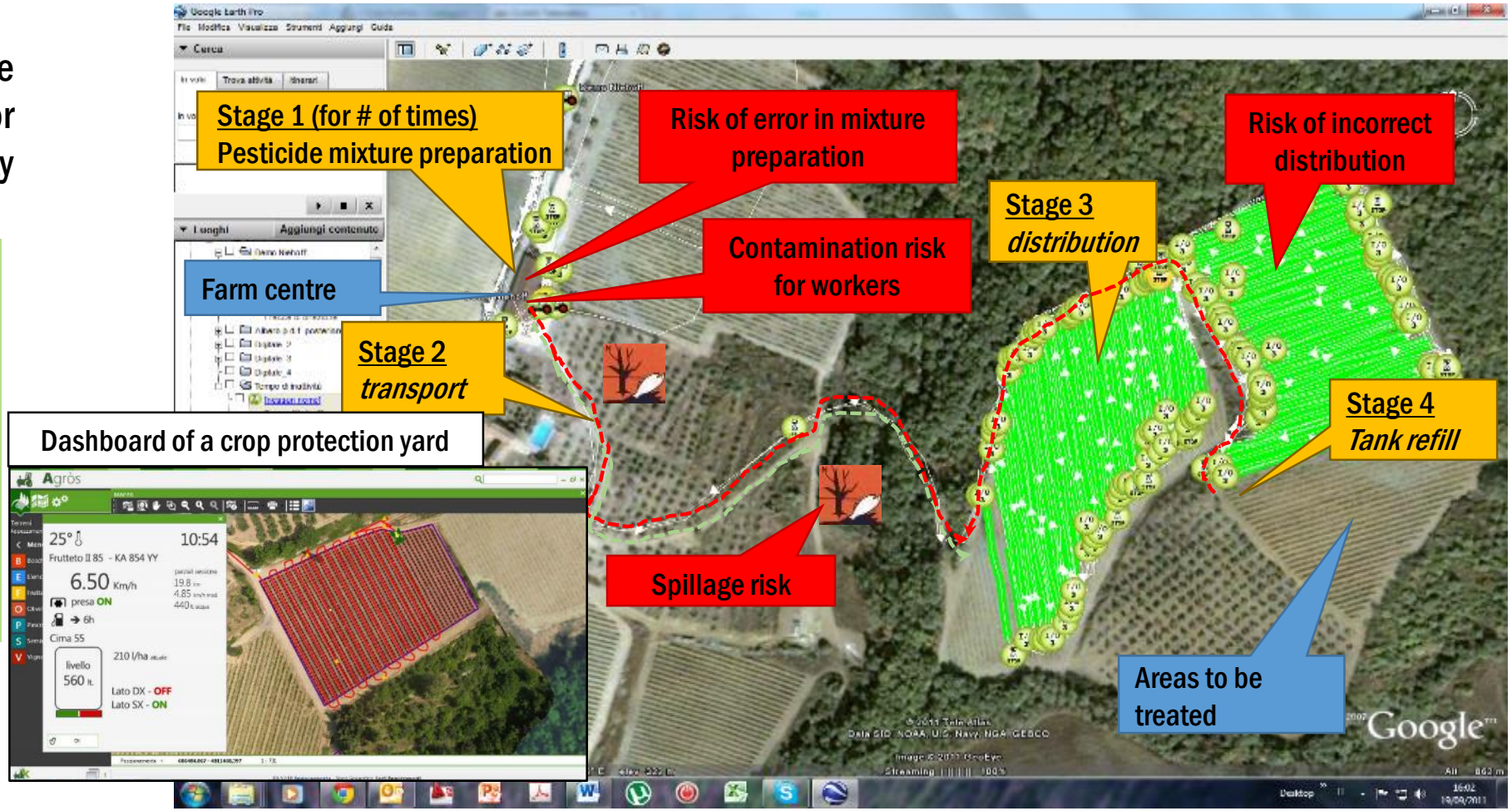


2. Sustainable Precision Viticulture Technological view

2.1 Monitoring Technologies - Telemetry and traceability

Traceability allows to enhance the process and is a key value for production chain quality assessment.

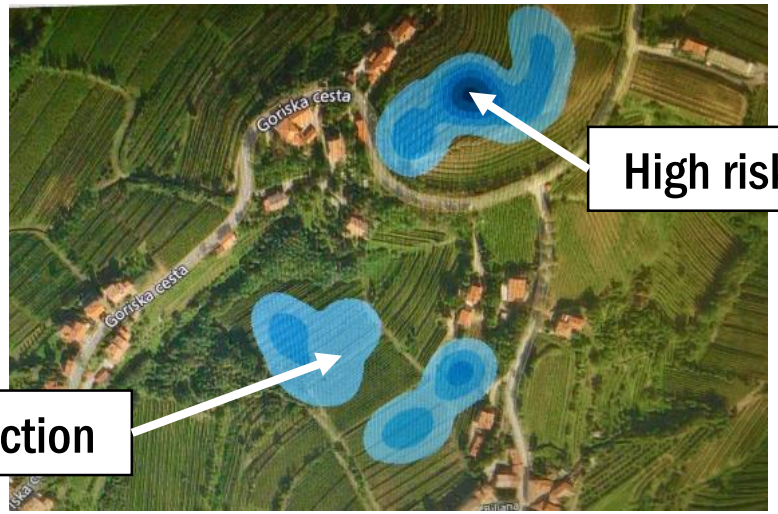
Telemetry permits the collection of measurements or other data at remote or inaccessible points and their automatic transmission to receiving equipment for monitoring. It allow, for example, to tracking remotely the tractor in the field



2. Sustainable Precision Viticulture Technological view

2.2 DSS for pests and climate control

Decision Support Systems (DSS) are fundamental for sustainable management of climate and pest control.
Risk outbreak sites' identification, definition of the degree of risk, and timing allow to control a vineyard's health and avoid waste in resources, time, etc..



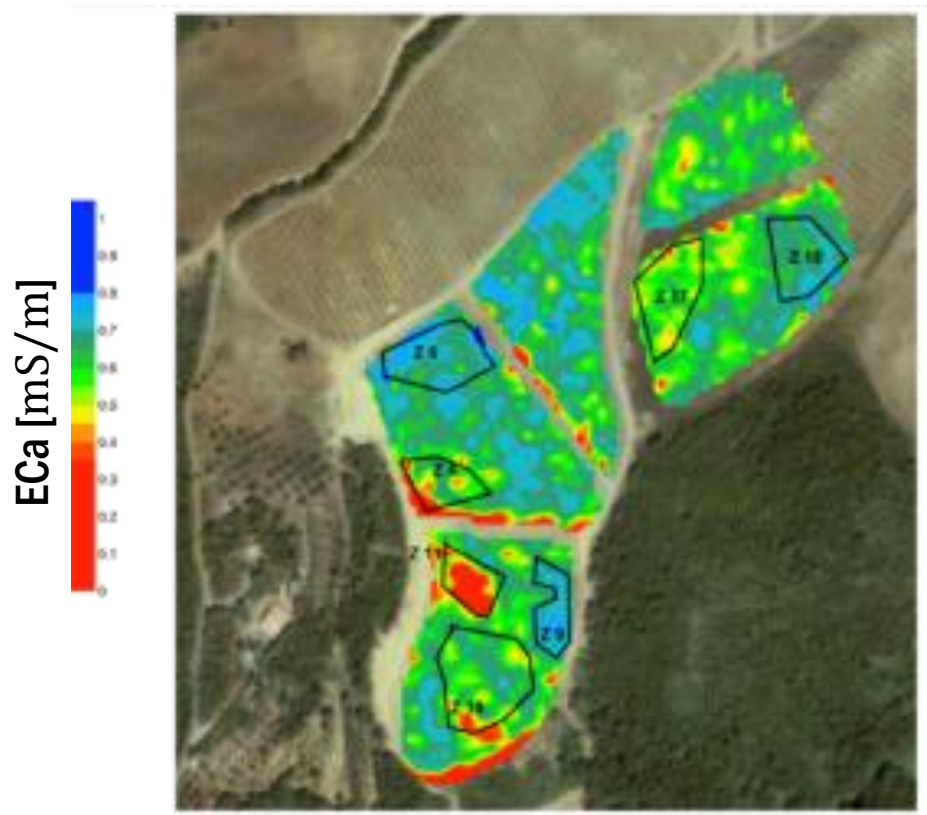
Spatial disease map

Unmanned aerial vehicle equipped with a spraying system for crop protection in hard to reach scenarios

2. Sustainable Precision Viticulture Technological view

2.3 Variable Rate Treatments – Fertilizing

Different soils have a different availability of water and nutrients. Soil practices are precisely managed to ensure optimal vine growth and maximize quality.



Site-specific variable rate technology for nutrient spreading based on prescription maps made using health data or soil apparent electrical conductivity (ECa).

2. Sustainable Precision Viticulture Technological view

2.3 Variable Rate Treatments – Irrigation and mulching with cover crops

A site specific irrigation may ensure best vine growth while saving water. Moreover, it can allow for a quality increase through controlled stress induction techniques.

Cover crops are becoming more and more important to control soil and water waste through mulching management.

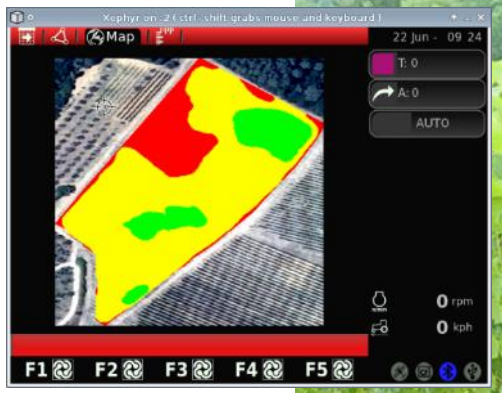
Irrigation map

Example of a vineyard with a variable rate irrigation system and mulching in the vine rows to reduce evaporation

2. Sustainable Precision Viticulture Technological view

2.3 Variable Rate Treatments – Canopy management

Leaf removal is a controlled method for vine health and aeration/insolation of bunches production area. The management is site-specific in relation to the different conditions, needs, and oenological goals.

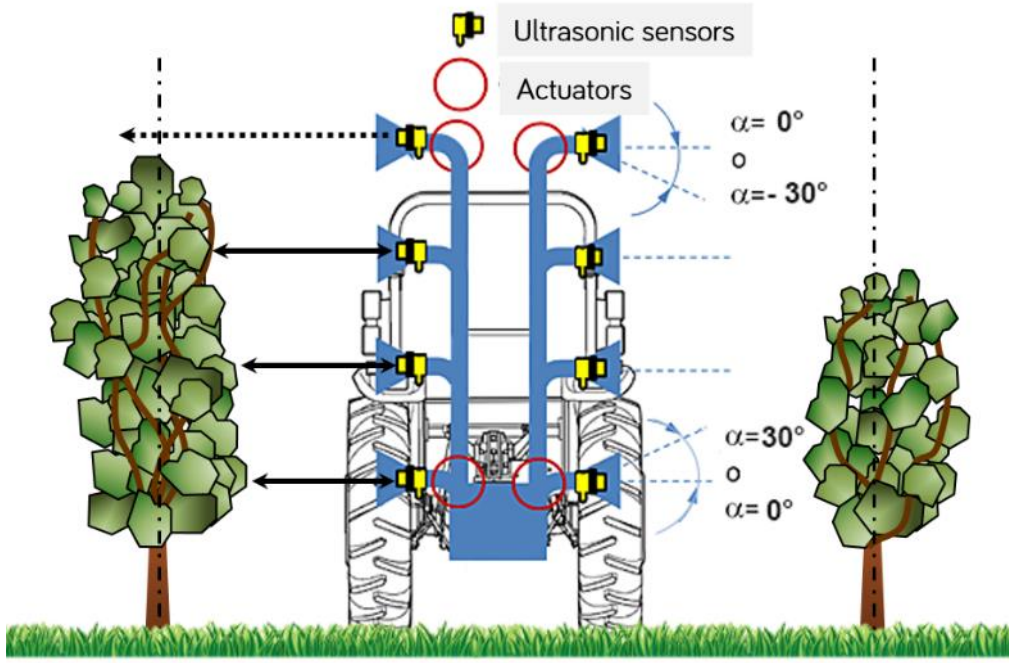


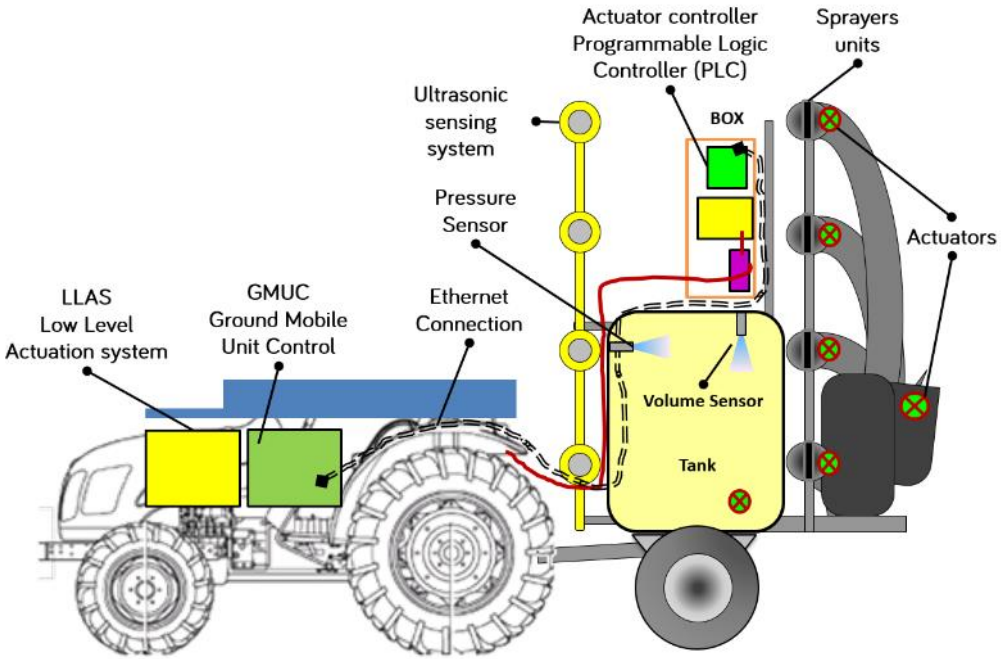
Vineyard leaf stripper with automatic tracking treating the canopy

2. Sustainable Precision Viticulture Technological view

2.3 Variable Rate Treatments – Spraying chemicals

About 80% of used chemicals, nutrients, and nutraceutical new substances goes to waste during crop protection. Precise application on only the specific target canopy can drastically reduce this waste.





Example of variable rate sprayers with sensing systems to scan the canopy features

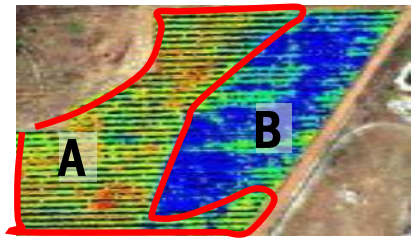
2. Sustainable Precision Viticulture Technological view

2.3 Variable Rate Treatments – Differential grape harvest

In the conventional management of vineyards, there are often wide differences in grape ripeness and thus in quality.

A differential grape harvest could preserve only the best quality ones.

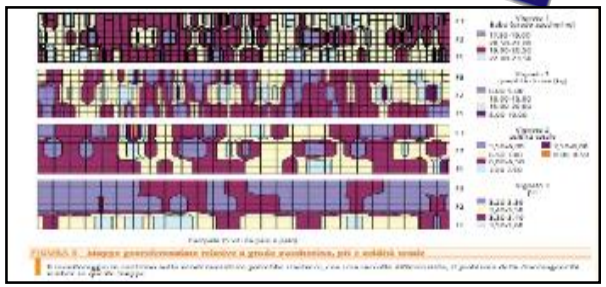
A map is loaded onto a USB flash drive, then in an onboard controller mounted in a machine equipped with GNSS technology. The grape harvester knows its position and reads the map to determine A and B quality grape areas. Automatically, the harvester moves its conveyor to the right or to the left according to the map information.



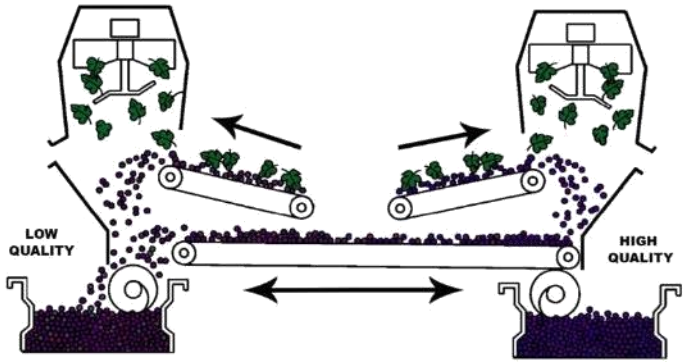
Flash memory

GNSS receiver

Transversal conveyor



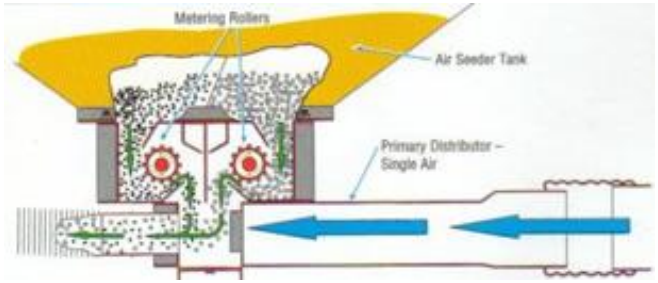
Sugar content map (°Brix)



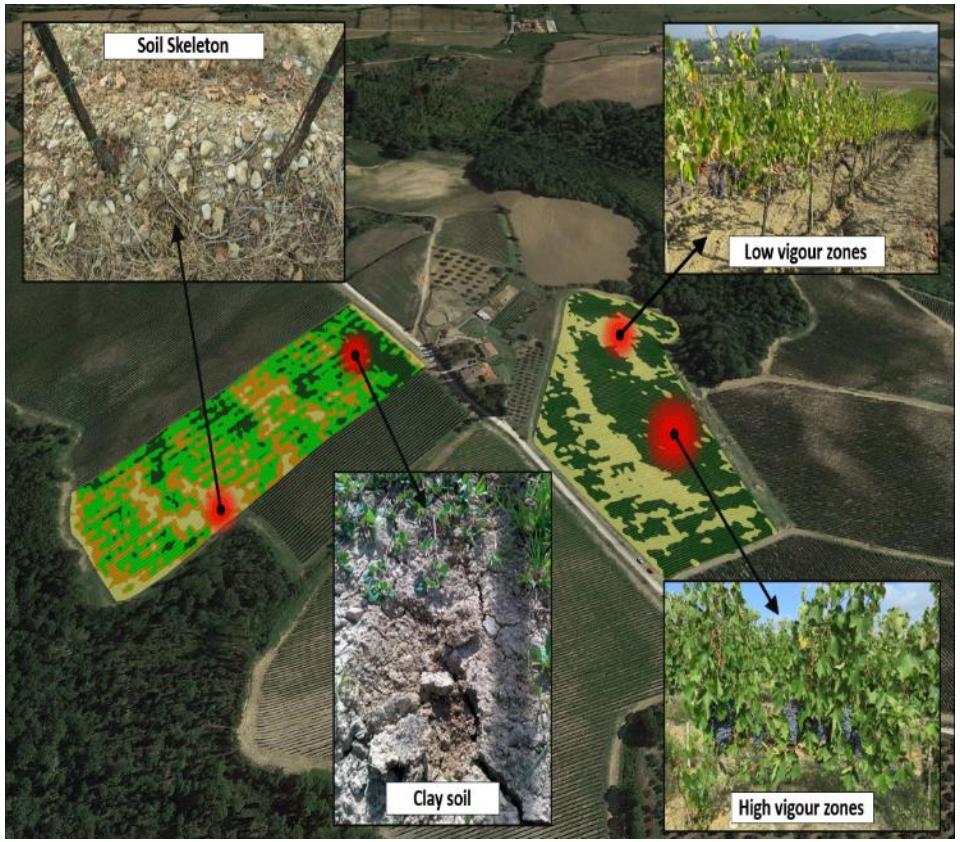
2. Sustainable Precision Viticulture Technological view

2.3 Variable Rate Treatments – Seeding Inter-row Winter Cover Crops

Cover crops are becoming more and more important to absorb solar energy, to prevent rain splash erosion, to fix nitrogen, and to introduce organic matter to the soil system.
Monocots reduce vine health, *legumes* improve vine health, and *Sinapis arvensis* plough the soil. All produce organic inputs and enhance water and soil conservation.



Schematic of a variable rate seeder: this solution allows seed mixing, specific seed selection, and the variation of the amount of seeds per unit.



Within variability : variation in soils and canopy growth

3. The local Digital Platform for SPV

Regional digital platforms devoted to SPV are arising as a Digital Hub for Wineries.

Monitoring

Aerial surveys:

RGB, Multispectral, Hyperspectral cameras

Data collection on crops:

Physiological measurements
Health indices NDVI - NDRE

Data collection on soil:

Conductivity profiles and drills
Laboratory analysis

Data collection from weather stations:

Atmospheric pressure
Temperature
Rainfall
Humidity
Wind intensity
Solar radiation
Dew point
Leaf wetness

Data processing

Services to companies and stakeholders

Digital maps with a 1 m² mesh:

Orthophoto (4 cm / pixel)
Vegetation maps and NDVI
Pedological maps

Hydrological modelling:

Water maps [field capacity (FC), point of withering (WP), Water available for plants (AWC)]
Saturated hydraulic permeability (Ksat)
Weather maps
Prescription maps
Telemetry fleet control
Field books

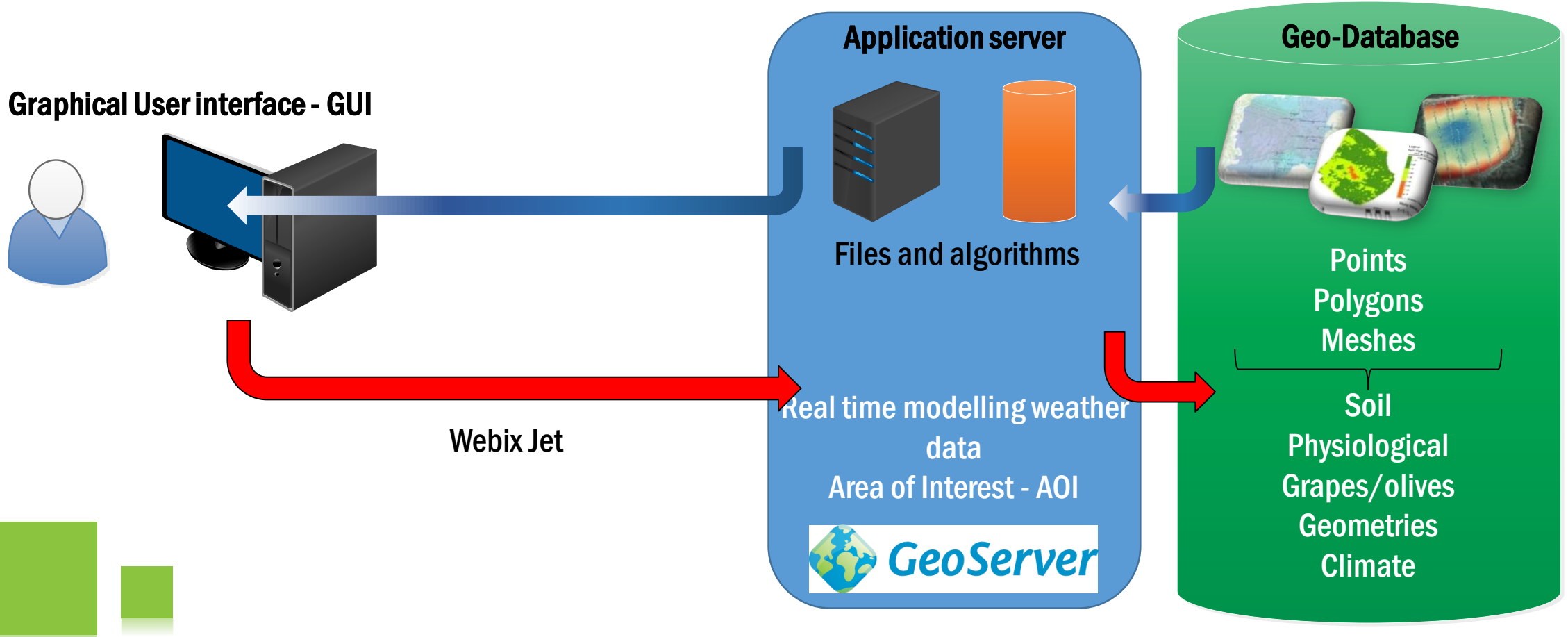
DSS Services - Decision Support System for:

Crop protection alarms
Logistic decisions support for the collection of products
Analytical accounting of georeferenced parcels
Traceability
Typicality
Identification of biodiversity footprints

Field activities

3. The local Digital Platform for SPV

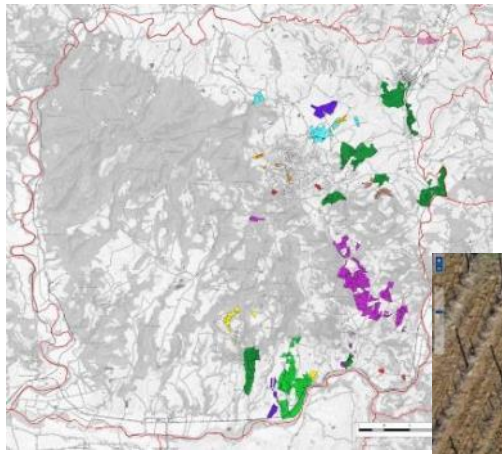
Regional digital platforms devoted to SPV are arising as a Digital Hub for Wineries.



3. The local Digital Platform for SPV

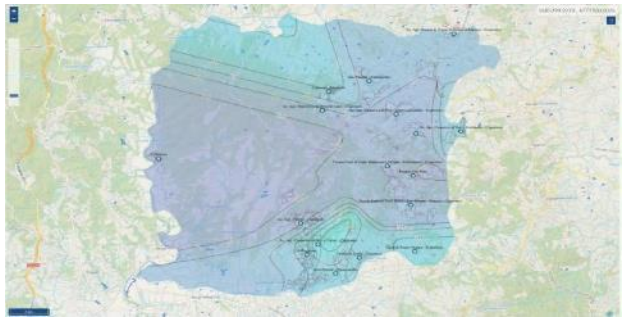
For example the OENOSMART digital platform devoted to SPV in Brunello di Montalcino Area in Tuscany Italy:

- Micro-weather station network with shared metadata to have an integrated monitoring of weather parameters in all sites of the whole area
- Open to all wineries
- Respects GDPR (Data Protection laws)



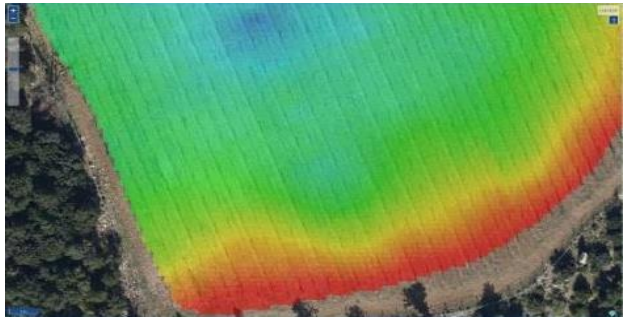
Monitoring district

Pedological maps and soil zoning

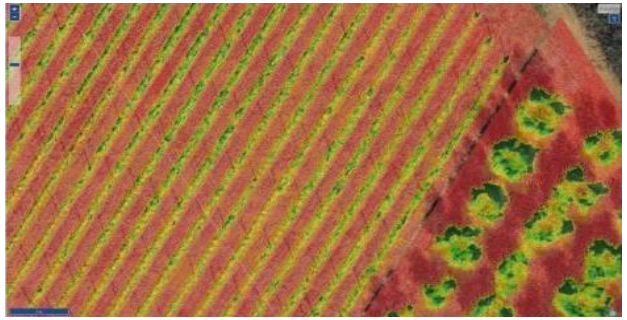


Weather-climate maps

Ortophoto



Pedological maps



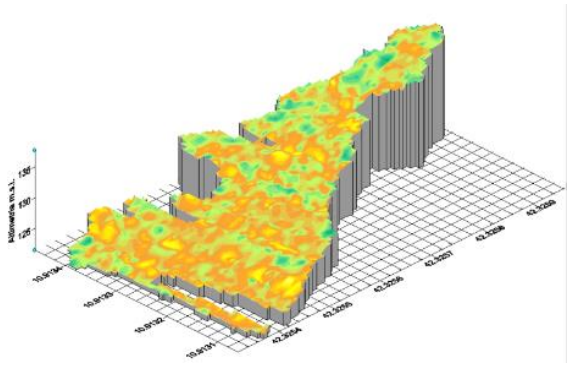
Crop indices NDVI - NDRE

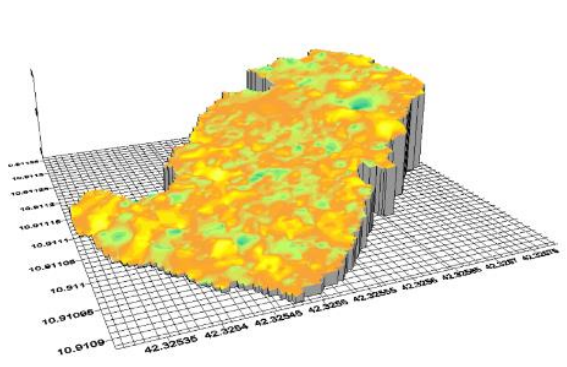
4. SPA Everywhere and for Everyone

Inclusive approach - service companies allow family farms to have equal opportunities to use SPA and High Technology as big ones.

Additional services for the smallholder farms

Family farm “Altura”, vineyard surfaces <2,5 ha, Giglio Island





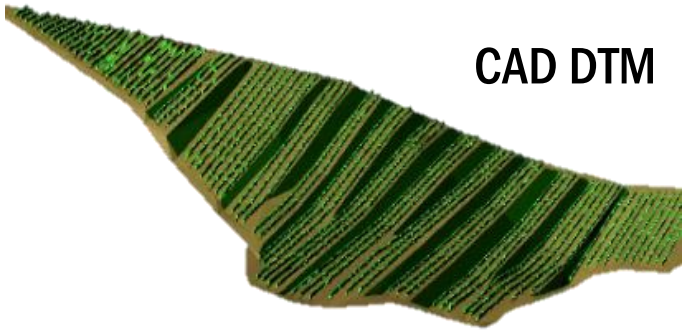
Manual survey of vine health to characterize variability in vineyards

5. Innovation

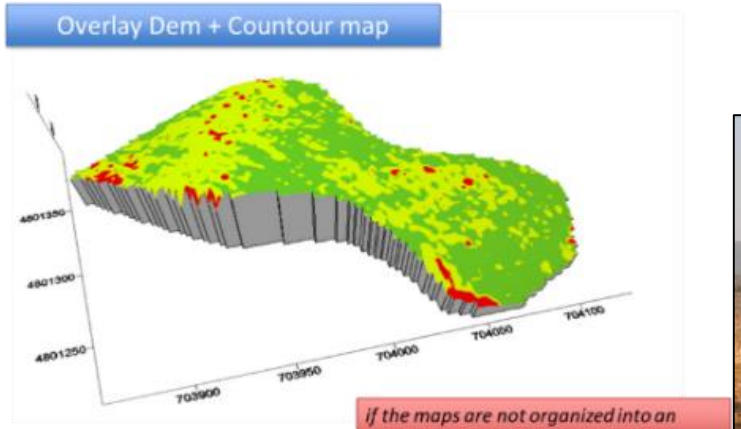
5.1 Design new vineyard with SPV tools

The design of new vineyards involves the use of satellite-assisted systems that optimize the slope modelling and transplant phase.

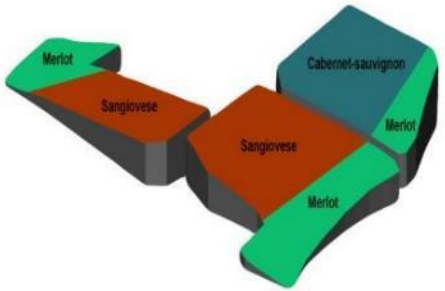
The CAD digital elevation model (DEM) and digital terrain model (DTM) constitute the base on which the entire subsequent management phase of the vineyard is built.



CAD DTM



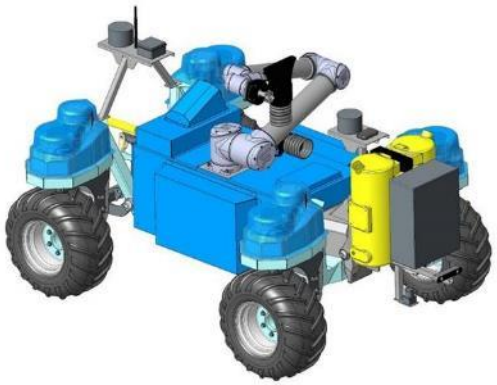
if the maps are not organized into an overall project are unnecessary

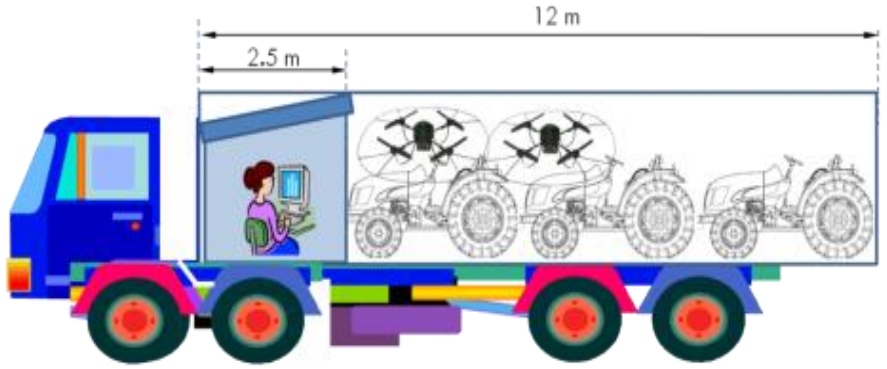


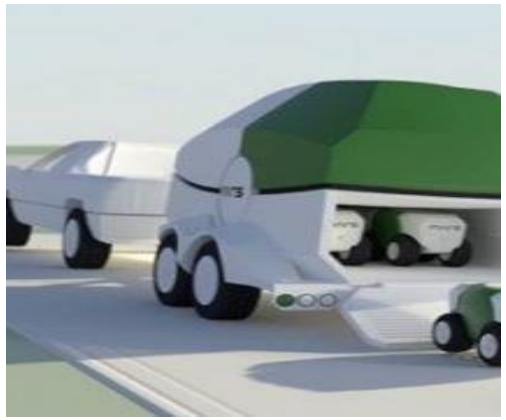
5. Innovation

5.2 Robots for SPV

The possibility to use robots in automatic field operations is becoming more and more feasible. The most probable scenario is that services companies that manage fleets of robots will be operating in the vineyards.







5. Innovation

5.2 Robots for SPV

ucdaviscaes.wordpress.com/tag/drone

crops-robots.eu

www.naio-technologies.com

wall-ye.com

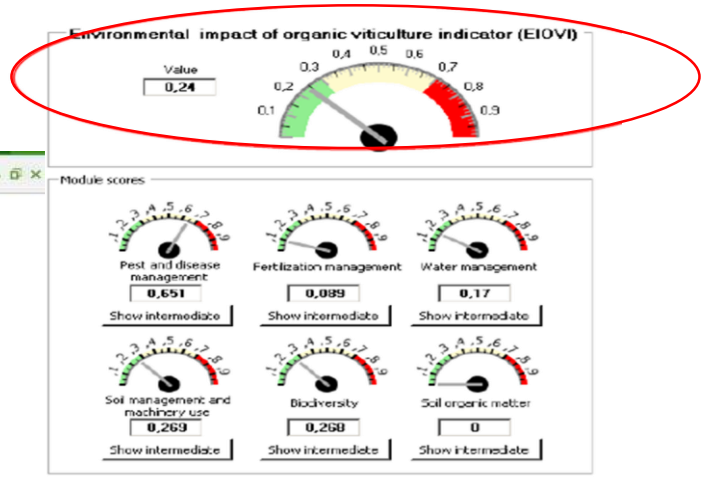
www.vinerobot.eu

rheaproject.eu

5. Innovation

5.3 Key Performance Indicators (KPIs) for the process

Farm dashboard with on time emission and consumption indices compared with conventional practices



A communicative tachymeter to externally highlight sustainability indicators:
ROS, WFP, CFP, LCA, ...

5. Innovation

5.3 KPIs for the process

SPARKLE

The Mazzei winery experience in using SPA especially in protection operations

26%
COST REDUCTION

36%
LESS CHEMICALS APPLIED

38% WATER SAVING

Results of the experience of Marchesi Mazzei farm over 3 years of adoption of the farm dashboard

Further Reading

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- Precision Viticulture: Cutting Edge Solutions for Vintage Problems available at: www.tvsprecisionviticulture.com.au/uploads/web_pages/TVSWhitepaperV10.pdf

- Precision Viticulture Tools to Production of High Quality Grapes. 2017 Scientific Papers. Series B, Horticulture. Vol. LXI, 2017 available at: horticulturejournal.usamv.ro/pdf/2017/Art30.pdf