UNIMORE
UNIVERSITÀ DEGLI STUDI DI MODENA E REGGIO EMILIA

UNIVERSITÀ DEGLI STUDI DI BRESCIA

AGROFOOD LAB

Quantitative Models for Biodiversity Analysis in Agroecosystem

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IS BIODIVERSITY A CURRENT ISSUE?

- Over the last decade, major international agencies and institutions have established the key role played by natural capital in new sustainable development strategies

- Need to support the adoption of sustainable agricultural practices to protect, enhance and restore biodiversity as a key element of natural capital

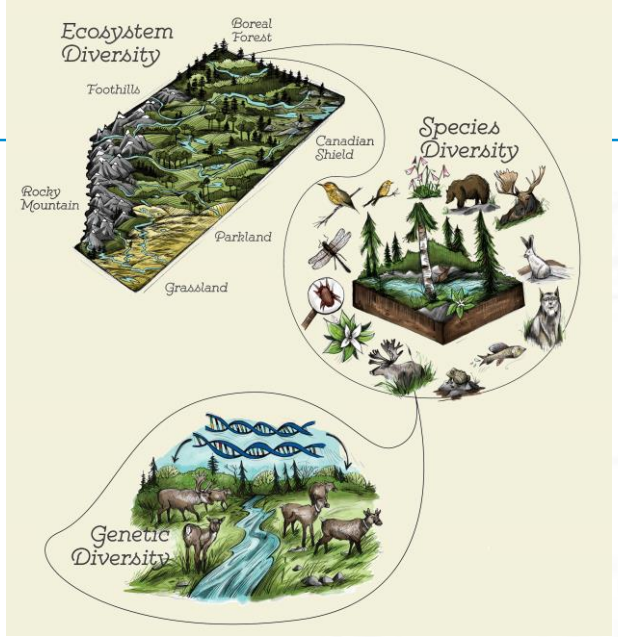
- Conservative approach ➔ natural capital has a value in itself
- Utilitarian approach ➔ focus is the value the natural capital biodiversity has for humans

PROJECT OBJECTIVE

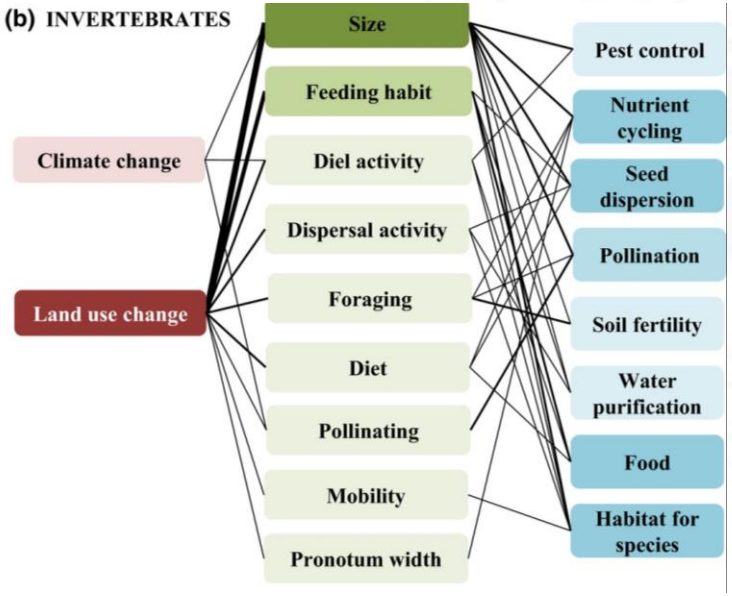
- A general framework for biodiversity quantitative assessment in agroecosystems as a **key player** in the process of **genesis and provision of ecosystem services** (e.g., soil microbiota, spontaneous and cultivated flora, landscape)

FUNCTIONAL DIVERSITY

- Biodiversity
  - Diversity of life forms in all ecosystems (aquatic, terrestrial, marine and others)
    - Within species
    - Between species
    - Ecosystems



- Functional diversity
  - Diversity of traits found in organisms determining their response and influence on ecosystem dynamics
  - Effects of traits on ecosystem processes and services are mediated by the type, extent, and relative abundance of functional attributes in a community



HOW TO EXIT FROM A GLOOMY WOOD

- State of the art:
  - Far away from knowledge and established and shared conceptual tools to bridge the knowledge gap between biodiversity and ecosystem services

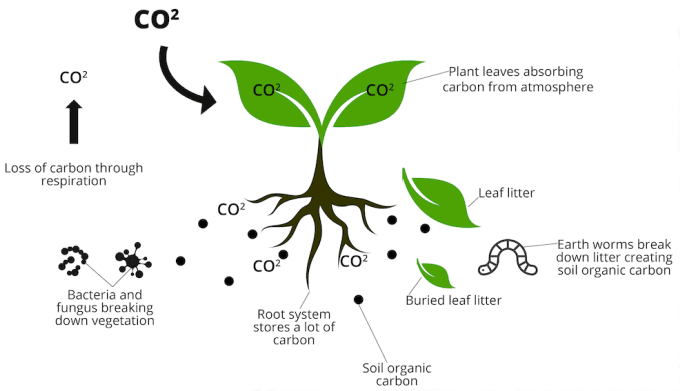
- Exit strategy to fill the knowledge gap:
  - Bottom-up approach
    - Biodiversity ➔ Ecosystem function ➔ Ecosystem services
  - Top-down approach
    - Biodiversity & (Ecosystem function) & Ecosystem services

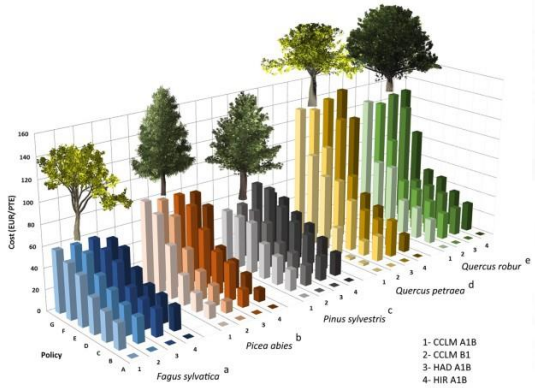
BOTTOM-UP APPROACH

- Ecosystem function ➔ Ecosystem services

  e.g. Carbon sequestration ➔ Climate regulation

- Bottom-up approach
  - Ecosystem function is **explained** by biological entities
    - Traits
      - e.g. Plant photosynthetic rate
    - Species
      - e.g. High capacity of Oaks of capturing carbon
    - Groups of species
      - e.g. Hardwood forests capture more carbon than coniferous forests



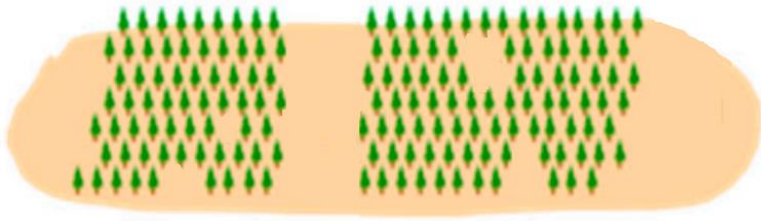


TOP-DOWN APPROACH

- Ecosystem function & Ecosystem services

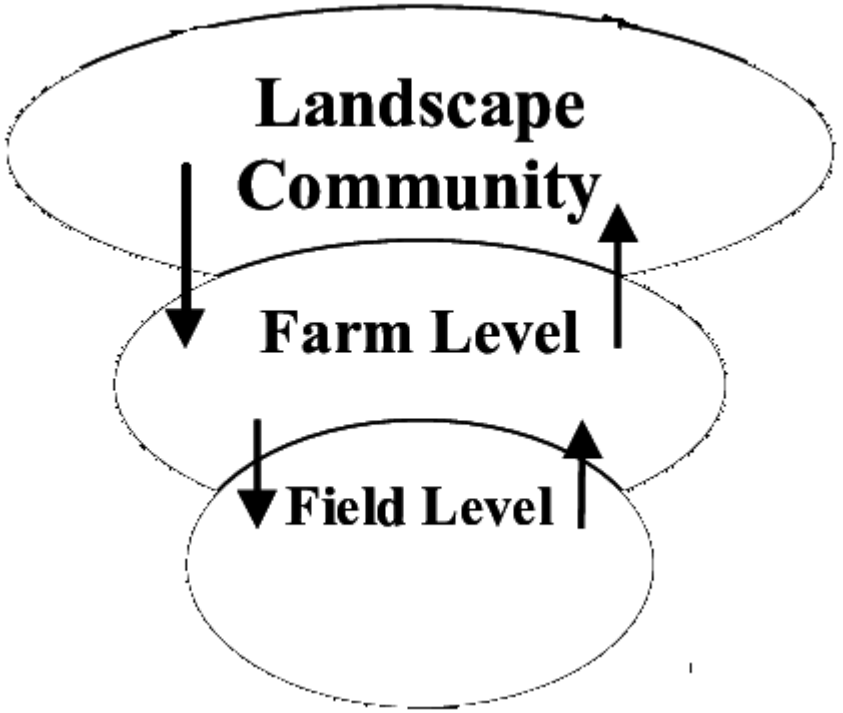
  e.g. Carbon sequestration & Climate regulation

  - **Top-down approach**
    - Ecosystem function is **correlated** with structures that are supposed to be proxies of functional entities
    - Structures
      - Properties of the landscape
        - e.g. Homogeneous forests capture more carbon
      - Properties of biotic communities (e.g. biodiversity indices)
        - e.g. High diversity in plant species decreases carbon sequestration



CASE STUDIES

- Environmental unit level
  - Monospecific approaches
  - Exploration of the approaches to investigate the niche dimensions characterizing each species
    - *Case study*
      - *Popillia japonica*



- Farm level
  - Interactions existing between multiple abiotic communities and the possible influences deriving from environmental determinants
    - *Case study*
      - *Soil biological quality assessment*
      - *Response of the arthropod community to soil characteristics and management*

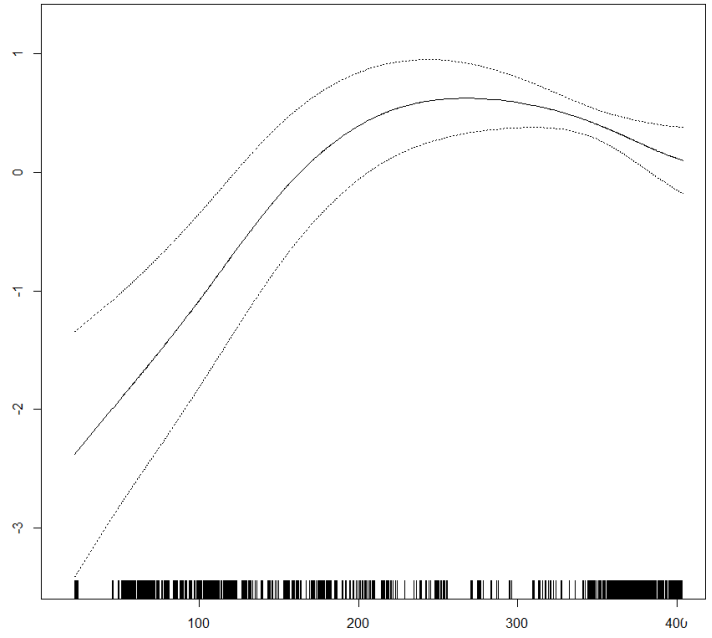
HABITAT SUITABILITY OF *POPILLIA JAPONICA*

- Quantification of the contribution of geopedolological and meteorological variables to the habitat selection
- Logistic regression on larvae presence in soil coring (>8800 sites)

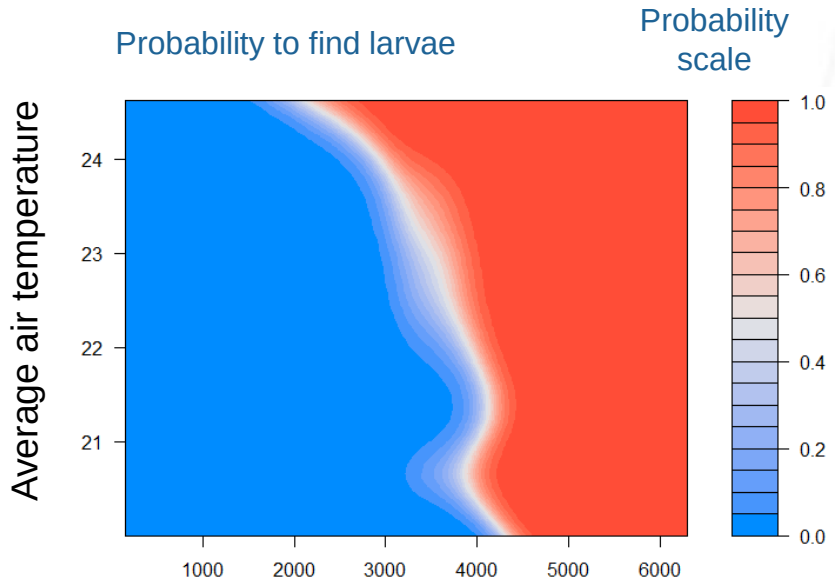
Variables
Intercepts
Early sampling [Y/N]
Soil PH
Distance from the first establishment (meters)
Year form the establishment in tthe area (# of years)
Cumulated rain (** low p-value)
Average Relative Humidity
Average Air Temperature
Average Soil Water
Average Minimum Soil Water
Average Maximum Soil Water
Number of Hours at Soil Water < 0.15
Average Minimum Soil Temperature
Average Maximum Soil Temperature
Warm degree days soil temperature > 15°C
Number of Hours at Soil Temperature < 10°C
Warm Degree Days Soil Temperature > 15°C

HABITAT SUITABILITY OF *POPILLIA JAPONICA*

- Representation of niche dimensions allows to represent interactions between species
- Generalized additive models



Cumulated rain



Number of Hours at Soil Temperature < 10°C

SOIL BIOLOGICAL QUALITY ASSESSMENT

- Influence of meteorological variables and management practices on “Qualità biologica del suolo” (QBS)-ar Index

- QBS-ar:
  - Based on “biological forms” of edaphic microarthropods
  - Different species are grouped according to their morphological characteristics

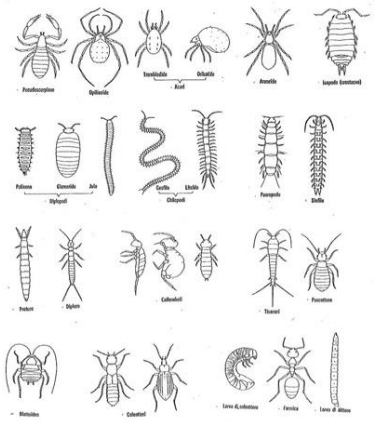


Table 4. Results of the bidirectional stepwise linear regression model.

Coefficient.	Estimate	Standard Error	*p*-Value
Intercept	64.82	20.36	0.0023
Organic farming	40.21	13.08	0.0031
# of days daily max temperature < 20 C	-3.21	2.26	0.1614
# of days daily max temperature > 30 C	-4.89	1.57	0.0028
total cumulative precipitation (mm)	0.23	0.13	0.0777
high precipitation period [Y/N]	-40.78	21.87	0.0668

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Article

Soil Biological Quality Assessment to Improve Decision Support in the Wine Sector

Isabella Ghiglieno [1,*], Anna Simonetto [2], Pierluigi Donna [3], Marco Tonni [3], Leonardo Valenti [1], Floriana Bedussi [4] and Gianni Gilioli [2]

70 vineyards

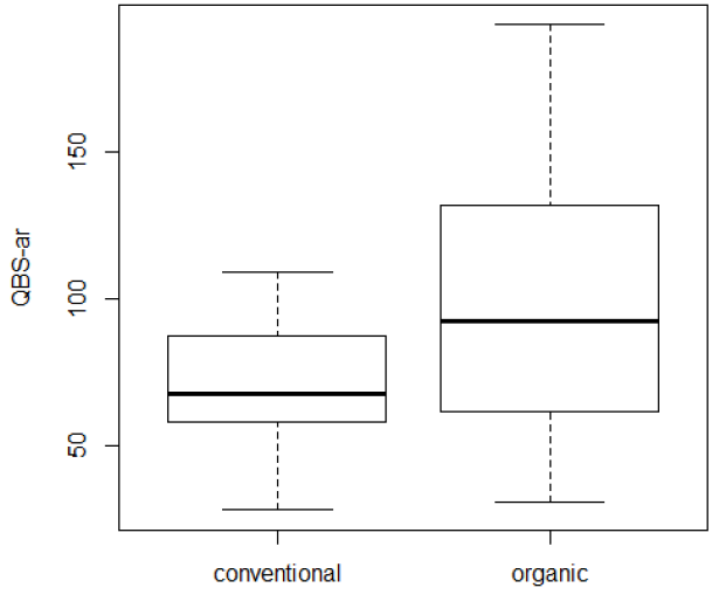

Figure 3. Boxplot of QBS-ar distribution according to farming system.

SPECIES CO-OCCURRENCE AND MANAGEMENT PRACTICES

- Influence of meteorological variables on niche defined by species co-occurrence pattern

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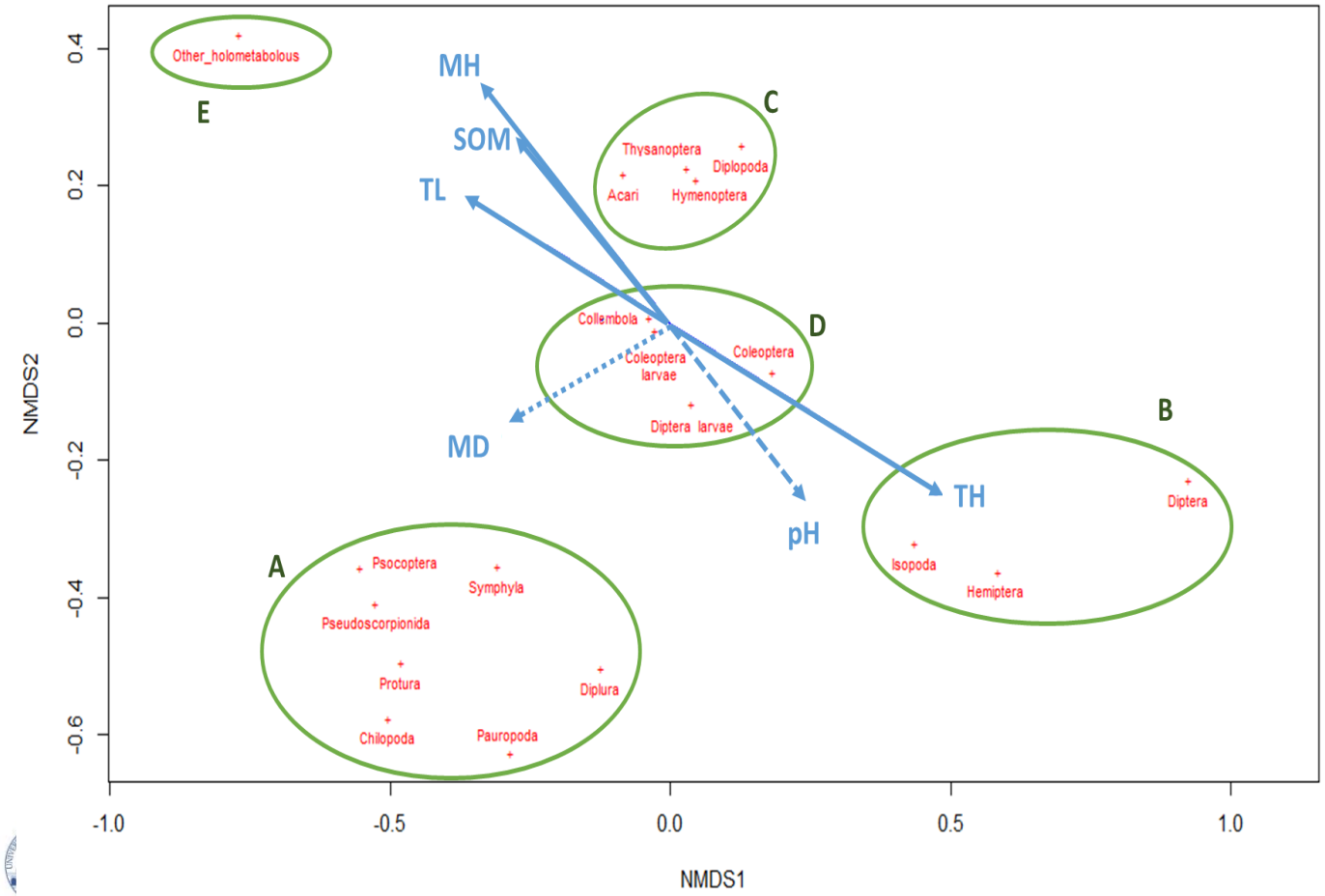
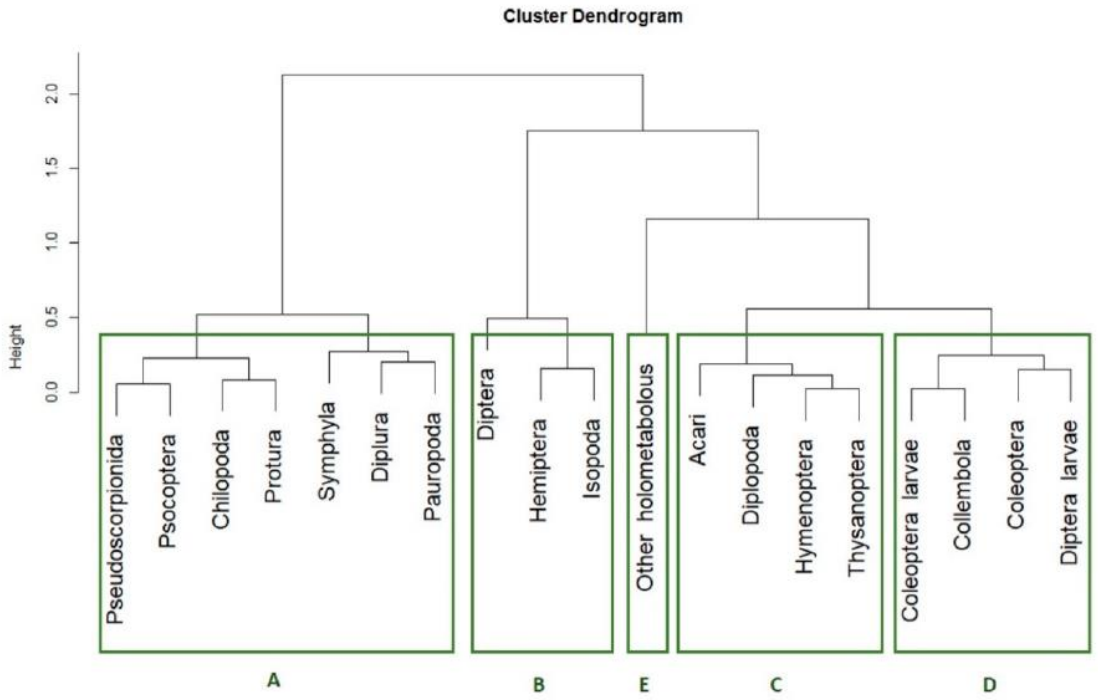
Article

Response of the Arthropod Community to Soil Characteristics and Management in the Franciacorta Viticultural Area (Lombardy, Italy)

Isabella Ghiglieno [1], Anna Simonetto [1,*], Francesca Orlando [1], Pierluigi Donna [2], Marco Tonni [2], Leonardo Valenti [3] and Gianni Gilioli [1]

Non-metric multidimensional scaling





SPECIES CO-OCCURRENCE AND MANAGEMENT PRACTICES

- Influence of management practices on soil biodiversity

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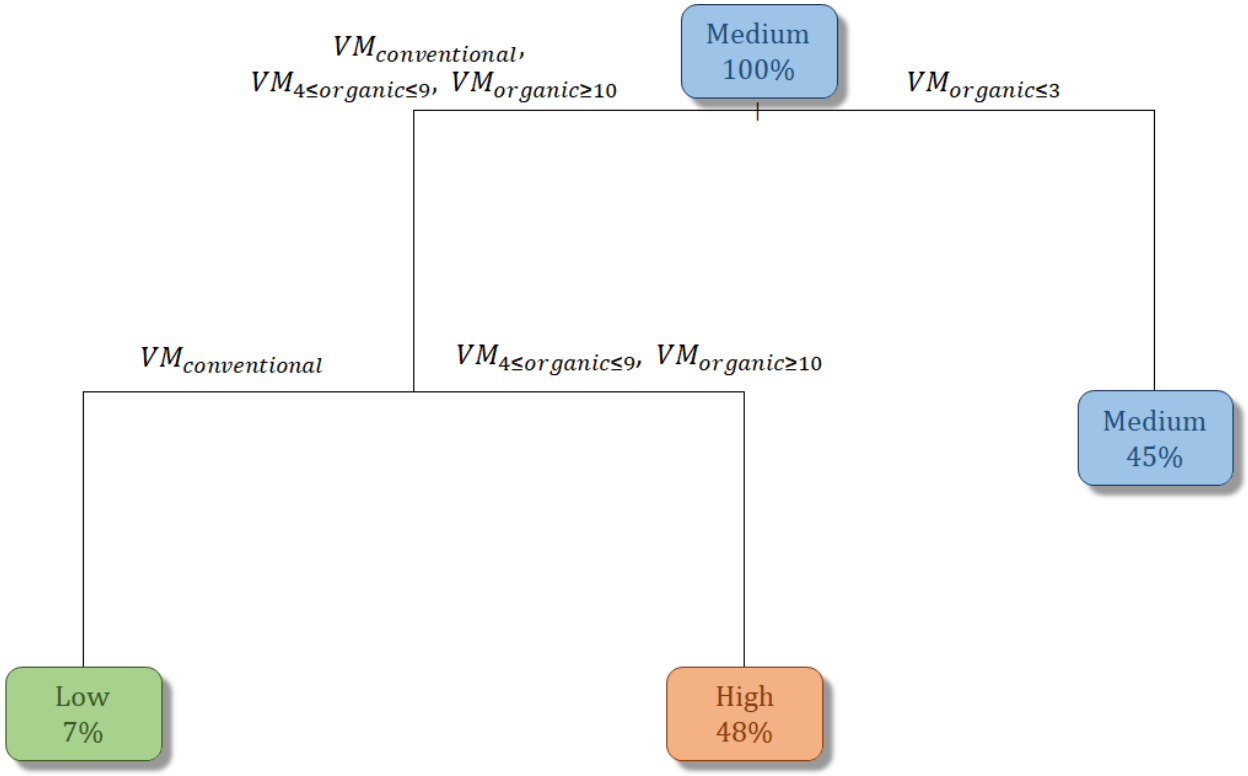
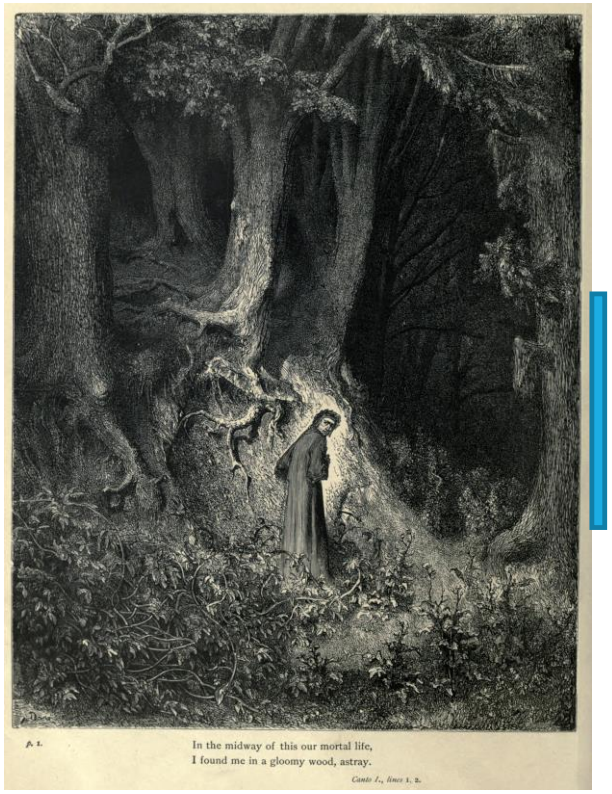


FUTURE DEVELOPMENTS

"*Biodiversity and ecosystem services are at the heart of many solutions for sustainable increases in agricultural productivity that not only deliver better outcomes for food and nutrition security but also reduce externalities of production*" (FAO, 2016)



A clear and scientific-based framework forms the foundation for finding light at the end of the gloomy wood

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