

**DYNAMIC SOD MULCHING AND USE
OF RECYCLED AMENDMENTS
TO INCREASE BIODIVERSITY, RESILIENCE AND SUSTAINABILITY
OF INTENSIVE ORGANIC FRUIT ORCHARDS AND VINEYARDS**

Guidelines for economic assessment

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DOMINO PROJECT

GUIDELINES FOR EXPERIMENTAL PRACTICE

Evaluating innovations for a sustainable intensification of organic orchard and vineyard

The aim of this handbook of experimental guidelines is to provide a common method for the analyses performed in the framework of the DOMINO project on practices for sustainable management of organic apple orchard and vineyard under field conditions.

Analysis refer to the economic assesement of the introduced practices including both the produciton costs and the ecosystem services value.

Indication are provided for activities run either in structured experimental stations as well as in farm trials.



A. Assessment of economic value of ecosystem services

1. Definitions

Ecosystem services are defined as services provided by the natural environment that benefit people. They provide outputs or outcomes that directly and indirectly affect human wellbeing, and these considerations can link well to taking an economic approach. United Nations' Millennium Ecosystem Assessment (MA) strongly supported the use of an ecosystems approach and provided a substantial evidence base for policy-making. The MA set out a typology of ecosystem services under four broad headings:

- 1) Provisioning Services are ecosystem services that describe the material or energy outputs from ecosystems. They include food, water and other resources;
- 2) Regulating Services are services that ecosystems provide by acting as regulators eg. regulating the quality of air and soil or by providing flood and disease control;
- 3) Cultural services are nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience, including, e.g., knowledge systems, social relations, and aesthetic values;
- 4) Supporting services are services that are necessary for the maintenance of all other ecosystem services. Some examples include biomass production, production of atmospheric oxygen, soil formation and retention, nutrient cycling, water cycling, and provisioning of habitat.

Within the wide list of possible types of ecoservices for each of the above mentioned four services, we have selected those that are likely to be affected by the innovation practices proposed/tested by the DOMINO project and that will be the object of the assessment.



These services are:

1) Provisioning Services

- **Food:** Ecosystems provide the conditions for producing food. Food comes principally from managed agro-ecosystems, thus this is an important and general parameter to evaluate how new management practices can affect such service.
- **Raw materials and Medicinal resources:** Ecosystems provide a great diversity of materials for construction and fuel (e.g. wood, biofuels), or plant materials useful for nutraceutical purposes (e.g. essential oils) that are directly derived from wild and cultivated plant species. Ecosystems and biodiversity provide many plants used as traditional medicines as well as providing the raw materials for the pharmaceutical industry.

2) Regulating Services

- **Waste and waste-water treatment:** Through the biological activity of microorganisms in the soil, most waste is broken down. Thereby pathogens (disease causing microbes) are eliminated, and the level of pollution is reduced. On the other side, organic wastes can provide nutrients that would be lost or could potentially pollute the environment. Ecosystems such as wetlands filter both human and animal waste and act as a natural buffer to the surrounding environment.
- **Pollination:** Insects and wind pollinate plants and trees which is essential for the development of fruits, vegetables and seeds. Animal pollination is an ecosystem service mainly provided by insects (sometimes also by some birds and bats) which can be promoted or not by orchard management.
- **Biological control:** Ecosystems are important for regulating pests and vector borne diseases that attack plants, animals and people. Ecosystems regulate pests and diseases through the activities of predators and parasites. Birds, bats, flies, wasps, frogs and fungi all act as natural controls.



3) Cultural services

- Recreation and mental and physical health: Walking and playing sports in green space is not only a good form of physical exercise but also lets people relax. The role that green space plays in maintaining mental and physical health is increasingly being recognized, despite difficulties of measurement.
- Aesthetic appreciation and inspiration for culture, art and design: Language, knowledge and the natural environment have been intimately related throughout human history. Biodiversity, ecosystems and natural landscapes have been the source of inspiration for much of our art, culture and increasingly for science.

4) Supporting services

- Soil nutrients: Because many provisioning services depend on soil fertility, the cycle of nutrients, particularly nitrogen, influences indirectly human well-being in many ways.
- Photosynthesis: Photosynthesis, besides representing the basis for plant growth and production, produces oxygen necessary for most living organisms.

2. Methodology

2.1 Perception of ecosystem services

To perform the qualitative assessment of the potential impacts of DOMINO innovative orchards management on the ecosystem services listed above, we need to ask the project partners and the farmers involved in the project, at least those that are also hosting trials, to provide an initial evaluation of the innovation/s introduced in the orchard by the project. This will be done by filling the following checklist of services having in mind to answer to the following question:

How do you perceive/believe that the new agricultural techniques proposed/tested by DOMINO will affect the ecosystem services?



The assessment shall be done first considering the current management practices (baseline) applied in the orchard. Then, the same assessment shall be done for each specific management innovation, with reference to the baseline.

The following quality scores shall be used to fill the table:

- ++ Potential significant positive effect
- + Potential positive effect
- 0 Negligible effect
- Potential negative effect
- Potential significant negative effect
- ? Gaps in evidence



Innovative orchards management: from **Organic Baseline** (organic INPUT sostitution) to **Organic 3.0** (Sustainable INPUT)

Category	Baseline	Innovation 1	Innovation 2	Innovation 3	Innovation 4
	Organic baseline	Cover crop Interrow	Recycled materials	Row living mulch	Temporary net covering the row
Provisioning services					
Food					
Raw materials and Medicinal resources					
Regulating services					
Pest					
Disease					
Water purification and waste treatment					
Pollination					
Cultural Services					
Recreation & tourism					
Aesthetic value					
Supporting Services					
Soil nutrients					
Photosynthesis					



The assessment shall be performed at the beginning of the trial (before) to collect the perception of the impact of the innovations, **and at the end of the trial**, to collect the real assessment of their impact. This will provide a sort of sociological appraisal of the ecoservices and will be used in conjunction with the following biophysical evaluation.

2.2 Biophysical evaluation of ecosystem services

The following table contains the parameters planned to be measured in the different trials that will be used to assess the value of each ecoservice. The table will be filled answering to the following questions: What to measure? How to measure? (both already defined) How to assess on the basis of biophysical information?

Here we suggest a workflow that will address these questions. The three stages in this process (focused on biophysical aspects) are: 1) quantification of ecosystem services, 2) mapping of ecosystem services, and 3) assessment of ecosystem services where biophysical assessment is one part of a wider integrated assessment in addition to social and economic parts.

This evaluation will be performed when the relative data will be available.



Category	Major parameters	Possible parameters
Provisioning services		
Food	Yield and fruit quality data	
Raw materials and Medicinal resources	Yield and other data related to interrow and row productions	
Regulating services		
Pest	Damage/control data, biodiversity data, soil coverage/ weeds control data	
Disease	Damage/control data, biodiversity data	
Water purification and waste treatment	Local fertilizers use data	
Pollination	Yield/flowering, Biodiversity data	
Cultural Services		
Recreation & tourism	Dedicated short questionnaire for visitors to the fields/trials	Accessibility of quiet areas for resident population. (n°) Area that could be used for private gardening or for sitting in, playing in and enjoying (e.g. agritourism) (n°)
Aesthetic value	Dedicated short questionnaire for visitors to the fields/trials	Aesthetic pleasure deriving from the presence of other plants in the orchard (score from 1 to 5)
Supporting Services		
Soil nutrients	Nutrients dynamic in soil, soil analyses	
Photosynthesis	Soil coverage, biomass production data	



B. Assessment of economic value of ecosystem services

The main objective of the task is to compare the production costs due to the innovation practices introduced by the project in the different producing regions participating in the DOMINO Project. It will be done by collecting the data from the trial sites and comparing them with the baseline (current organic) practices. The following tables (available also in Excel format) can be used as template and the data included as examples to be followed for collecting the data during the season.

Table 1 - Example for innovation of organic mulch application on an area of 0,5 ha.											
Only operations and activities strictly connected with introduction of innovation should be included.											
Cultivated fruit species and varietyapples...Jonagold.....											
Date	Operation or activity	Number of man hours	Type of machines used	Number of machinery hours	Material used in the operation (application)	Unit	Value of units of materials used	Notes	Price paid for unit of material	Cost of man	Sum of costs
	mulching - distribution of mulch in orchard with manual loading and distribution, 3 workers	22.5	tractor with small single-axle trailer (about 2,5 cubic meter of bulk capacity)	5.5	mulch from chopped wood (branches after pruning) and shredded leaves	m ³	18	7 passes of tractor with trailer, about 0,2 ha covered -space within tree rows only	30	13.5	843.75
	continuation of mulching - manual loading and distribution, 3 workers	22.5	tractor with small single-axle trailer (about 2,5 cubic meter of bulk capacity)	5.5	mulch from chopped wood (branches after pruning) and shredded leaves	m ³	18	7 passes of tractor with trailer - about 0,2 ha covered -space within tree rows only	30	13.5	843.75
	continuation of mulching - manual loading and distribution, 3 workers	10.5	tractor with small single-axle trailer (about 2,5 cubic meter of bulk capacity)	2.5	mulch from chopped wood (branches after pruning) and shredded leaves	m ³	9	4 passes of tractor with trailer - about 0,1 ha covered -space within tree rows only. Mulching completed.	30	13.5	411.75
					diesel fuel	liters	13		5.15		66.95



Table 2 - Example for innovation of living mulch application on an area of 1,0 ha.											
Only operations and activities strictly connected with introduction of innovation should be included.											
Cultivated fruit species and varietiesapples...Golden Delicious.....											
Date	Operation or activity	Number of man hours	Type of machines used	Number of machinery hours	Material used in the operation (application)	Unit	Value of units of materials used	Notes	Price paid for unit of material	Cost of man hours	Sum of costs
	Harrowing - as an extra operation for preparations for sowing plants within tree rows.	2	tractor with harrow	2	diesel fuel	lters	12	1 pass per 1 ha field under tree rows only	5.15	13.5	88.8
	Rotavation - as an extra operation for preparations for sowing plants within tree rows.	2	tractor with rotary tiller	2	diesel fuel	lters	12	1 pass per 1 ha field under tree rows only	5.15		61.8
	Sowing of fine wild flowers seeds	2	tractor with special seeder	2	seeds of wild flowers	kg	0.5	Mix of various wild flowers species with small seeds	160	13.5	107
					diesel fuel	lters	11		5.15		56.65
	Sowing of medium and bigger wild flowers seeds	2	tractor with special seeder	2	seeds of wild flowers	kg	2	Mix of various wild flowers species with bigger seeds	80	13.5	187
					diesel fuel	lters	11		5.15		56.65