X CONVEGNO
DELL'ASSOCIAZIONE RETE ITALIANA LCA
Reggio Calabria
22-24 settembre 2021

Rete Italiana LCA

LIFE CYCLE METHODOLOGIES AND SOCIAL AGRARIAN METABOLISM APPROACH TO ASSESS AGROECOLOGY PRACTICES IN MEDITERRANEAN OLIVE GROWING: A METHODOLOGICAL FRAMEWORK IN THE INTERNATIONAL "SUSTAINOLIVE" PROJECT

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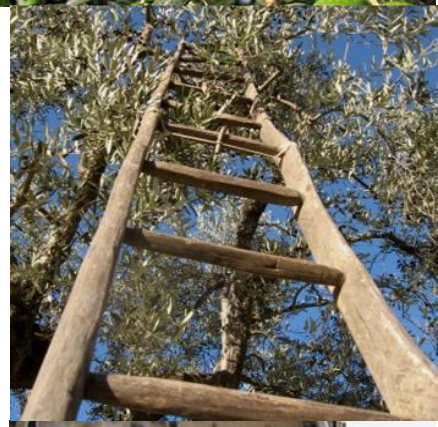
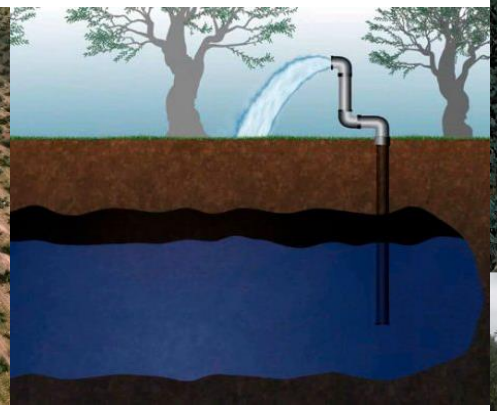
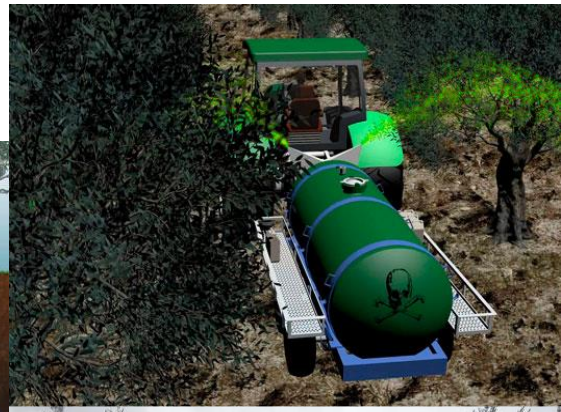



CONTEXT AND BACKGROUND

- Olive growing ecologically, economically, and socially identifies the Mediterranean rural regions and represents a significant development opportunity.
- Europe concentrates approximately 70% of the world's olive oil production. Tunisia and Morocco contribute 10% of world production. In total, 7.7 million hectares are accounted for in the Mediterranean basin. **Cultivation of the olive tree is the backbone of socio-economic and cultural life of many regions of the Mediterranean Basin.**
- However, high production costs, yields variability, climate change and low market prices of olive oil are critical aspects. The intensification of olive production processes has tried to solve these problems, on but it resulted in oversimplified landscapes with low-nature-value.

ECOLOGICAL AND SOCIO-ECONOMIC ISSUES LINKED TO OLIVE GROWING




Ecological and socioeconomic issues: erosion and loss of soil fertility - biodiversity loss and landscape degradation - water overexploitation - air, water and soil pollution / health risk exposure - working conditions - costs management

What's the agenda?



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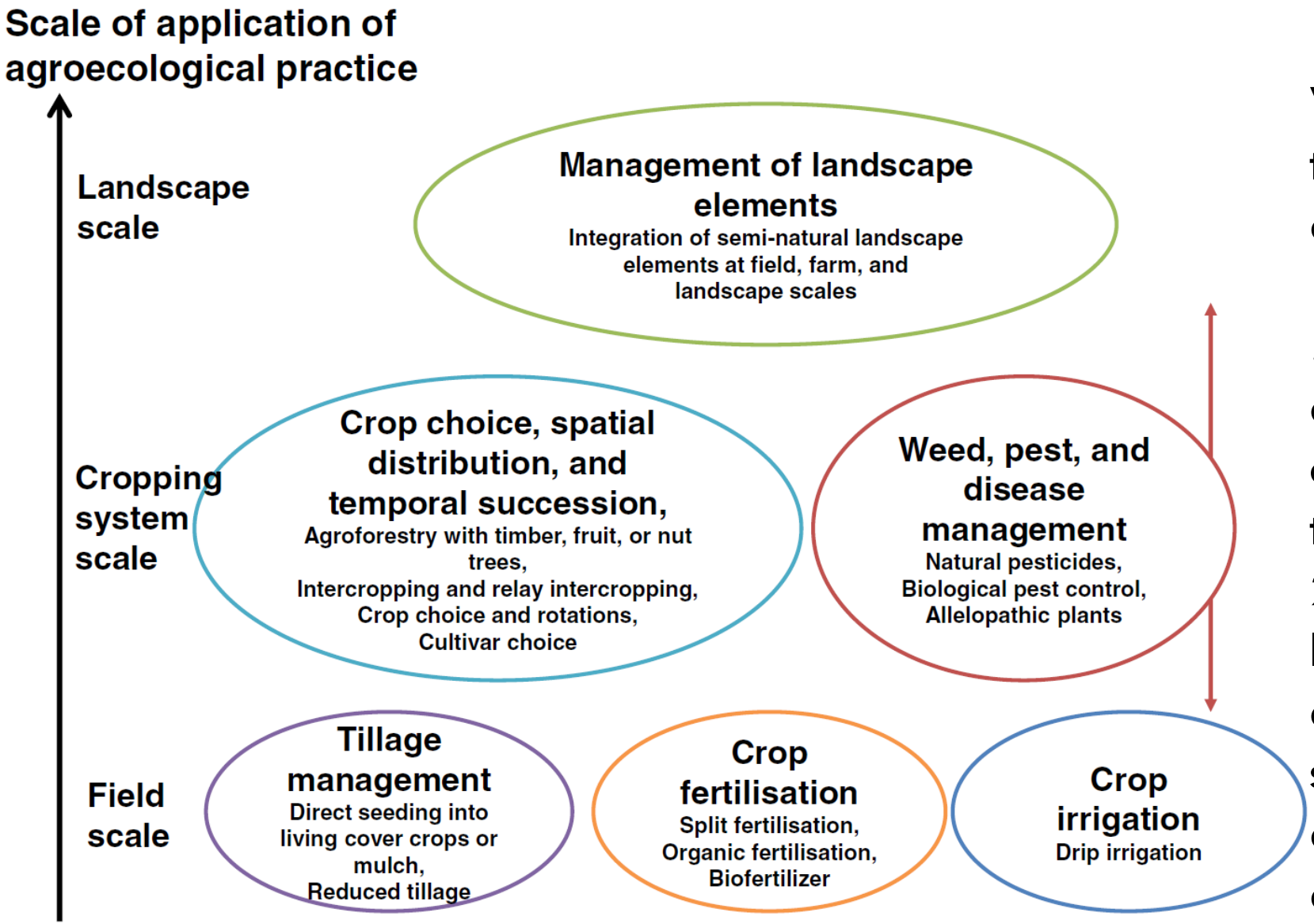
AGROECOLOGICAL PRACTICES

…preserving the environment, as well as the agricultural ecosystems, meeting consumers' needs, paying attention to workers' wellbeing and other social issues, by adapting or modifying managerial and organizational features is the real challenge for current agri-food productions

…balancing profitability while reducing environmental impacts is of utmost importance, and it requires suitable tools for farmers to organize and manage their business to reach these purposes



Source: Wezel et al. 2013

What new paths for assessing the implications of agroecology as comprehensively as possible?

…despite a wide assortment of definitions, indicators, guidelines exist in scientific literature and technical reports (Mottet et al, 2020), some scholars glimpse a **lack of approaches to combine** different perspectives on sustainability, to clarify economic and social aspects (D'Annolfo et al, 2017; Landert et al, 2020)

PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA
Co-funded by the Horizon 2020 Framework Programme of the European Union
Call: Section 1 – Farming Systems 2018
Topic 2: Improving the sustainability of Mediterranean agro-ecosystems
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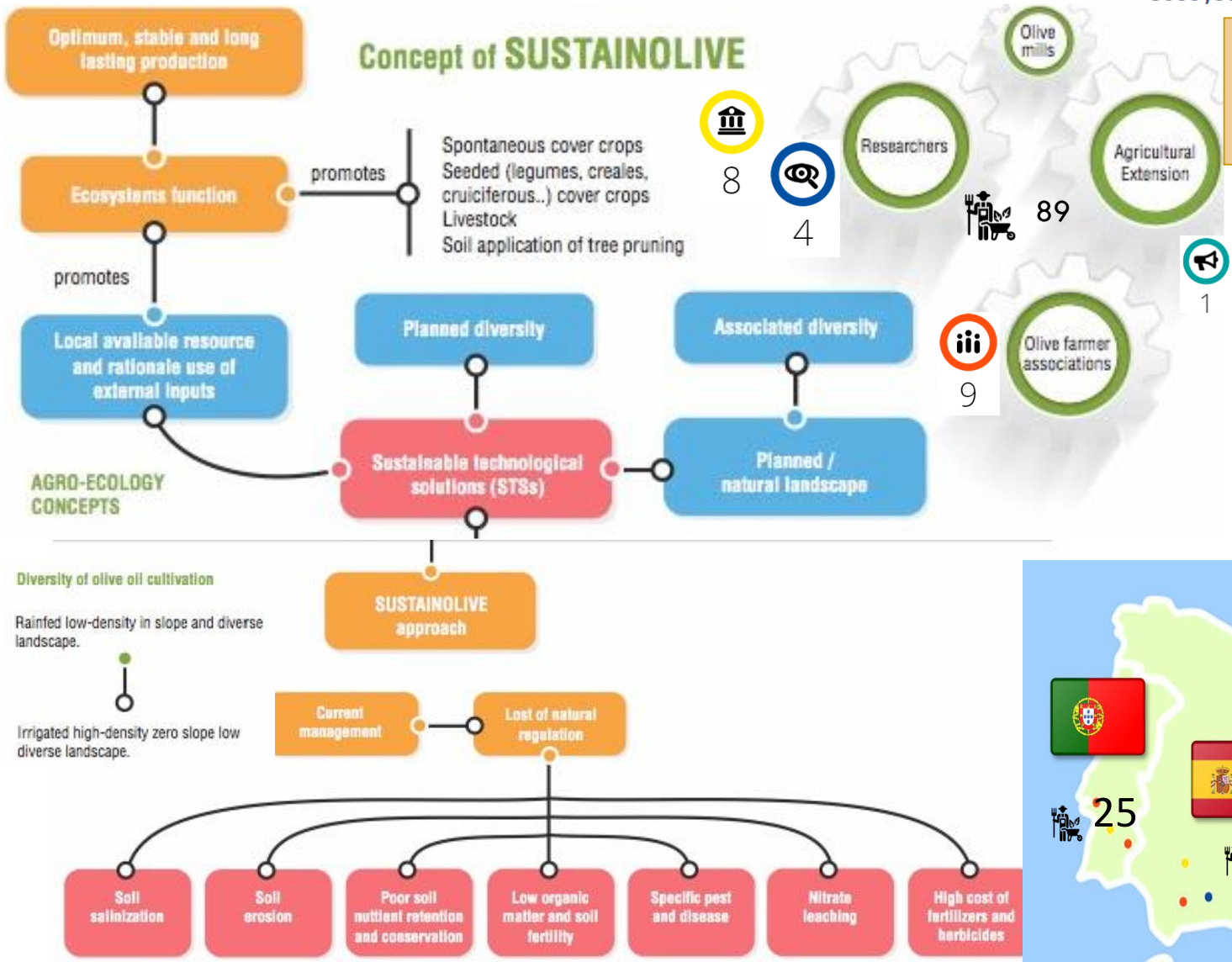
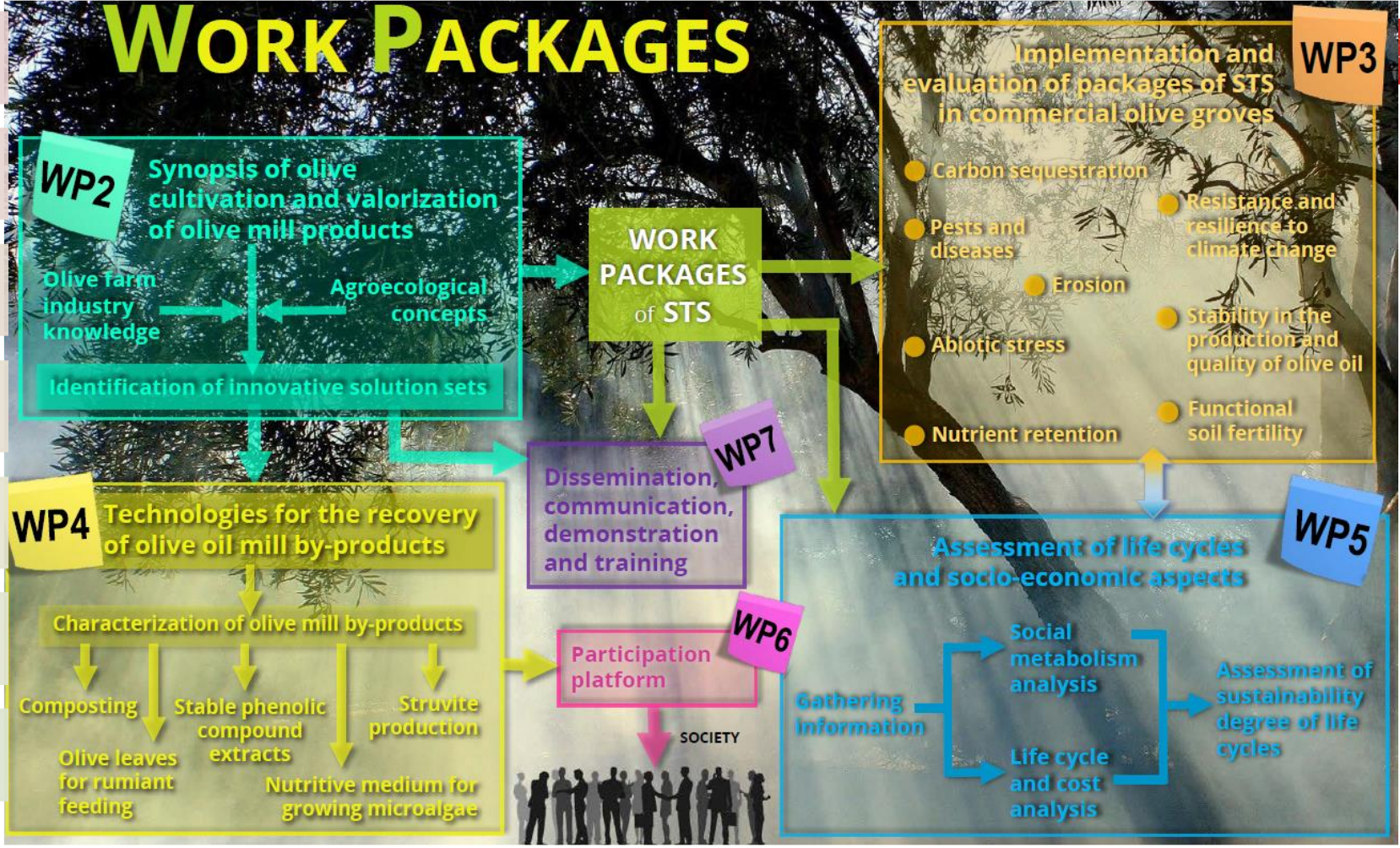
Novel approaches to promote the SUSTAINability of OLIVE cultivation in the Mediterranean

Sustainable solution sets in management practices, based on agro-ecological concepts and in effective and active exchange of knowledge in the main actors of the sector ***inter-transdisciplinary multi-actor approach*** → SUSTAINOLIVE combines different types of knowledge (e.g. scientific, empirical, traditional) and disciplines (ranging all the way from engineering to the humanities) to provide practical solutions that address the complexity in the olive sector.



WP1	• Project coordination and administration
WP2	• Synopsis of olive cultivation and valorization of olive mill products • Identification of STSs
WP3	• Implementation and evaluation of packages of STSs in commercial olive groves
WP4	• Technologies for the recovery of olive oil mill by-products
WP5	• Assessment of life cycles and socio-economic aspects
WP6	• Participation platform
WP7	• Dissemination, communication, demonstration and training



EXAMPLES OF SUSTAINABLE TECHNOLOGICAL SOLUTIONS (STS):

- spontaneous or seeded temporary green covers; - livestock integration; - pruning trees and destination of pruning waste; - organic fertilization; - landscape diversity; - sustainable use of water

WP5 – Assessment of Life Cycle and Socio-Economic Aspects

Task 5.1 Data collection and inventories (M18-M30)

Task 5.2 Social Agrarian Metabolism of STSs and non-STSs olive farms (M30-M48)

Task 5.3 Life Cycle Assessment (LCA) of STSs and non-STSs farms to evaluate environmental impacts (M30-M48)

Task 5.4 Life Cycle Costing (LCC) analysis of STSs and non-STSs farms to evaluate economic performances (M30-M46)

Task 5.5 Social Life Cycle Assessment (sLCA) of STSs and non-STSs farms to analyse implications for human well-being and social aspects (M30-M46)

SAM sustainability indicators: $ISAM_1$, $ISAM_2$, $ISAM_3$, etc.

LCA sustainability indicators: $ILCA_1$, $ILCA_2$, $ILCA_3$, etc.

LCC sustainability indicators: $ILCC_1$, $ILCC_2$, $ILCC_3$, etc.

sLCA sustainability indicators: $IsLCA_1$, $IsLCA_2$, $IsLCA_3$, etc.

Task 5.6 Multi Criteria Decision Analysis (MCDA) to integrate results (M28-M48)

Task 5.1 Data collection and inventories

Leaders: UNIRC (Italy) and UPO (Spain)

Qualitative and quantitative data collection about production processes of STSs, and non-STSs olive farms; inputs and outputs data will be collected directly from results of previous WPs (WP2 and Wp3, but also WP4, if that's the case)

All data necessary to perform the assessment methodologies, that will be the object of the other tasks

Interviews will also provide qualitative information about farm contexts, organisational aspects, working environment, typology of employment, and information of STSs and non-STSs olive farms.

Primary sources
direct or indirect interviews; questionnaries/ technical survey

Secondary sources
Statistics, official reports, scientific literature

With involvement of all partner who implement the STSs identified for sustainability analysis

Task 5.1 Data collection and inventories

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This project is part of the PRIMA programme supported by the European Union

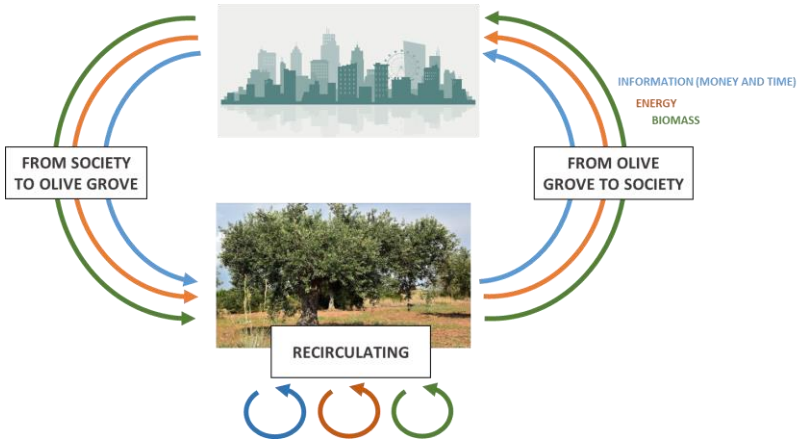
PT 5

WORK PACKAGE 5

Socio-economic and Life-Cycle assessment of the STSs

LCSA data collection – Questionnaire for non-STSs olive grove

LEADER - UNIRC / UPO



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This project is part of the PRIMA programme supported by the European Union

WP5 Socio-economic and Life-Cycle assessment of the STSs

1

QUESTIONNAIRE FOR LIFE CYCLE AND SOCIAL AGRARIAN METABOLISM SURVEYS

Dear participant,

SUSTAINOLIVE is an international scientific project involving researchers and organisations from many Mediterranean countries. It is aimed at improving the sustainability of the olive oil sector, through the implementation and promotion of a set of innovative sustainable management solutions, based on agro-ecological concepts, as well as in the exchange of knowledge and participation of multiple associates and end users.

The purpose of the present interview is to gath6er all suitable and relevant data to assess the sustainability of current farming systems, compared with sustainable technological innovations. The assessment methodologies that will be applied are Life Cycle Assessment (LCA), Life Cycle Costing LCC), Social Life Cycle Assessment (SLCA) and Life Cycle Sustainability Assessment (LCSA) to assess all the impacts generated from cradle to grave. Furthermore, the Social Agrarian Metabolism (SAM) will assess the exchange of energy, materials, and information that agroecosystems perform with their socio-ecological environment.

The survey will take approximatively 30 minutes to be conducted.

Your personal data will be used only for scientific research purposes by the universities and organisations involved in the project SUSTAINOLIVE. We will always make sure that any sharing of collected data is done in compliance with international data protection laws, and under terms that protect your privacy and the confidentiality of your data. For further information about the project, please visit https://sustainolive.eu/.

The questionnaire is composed by four sections:

- *Section A, about general data of the farm and olive grove (8 paragraphs of questions)*
- *Section B, about agro-economic data (14 paragraphs of questions)*
- *Section C, about agro-ecological data (3 paragraphs of questions)*
- *Section D, about livestock associated to olive growing.*

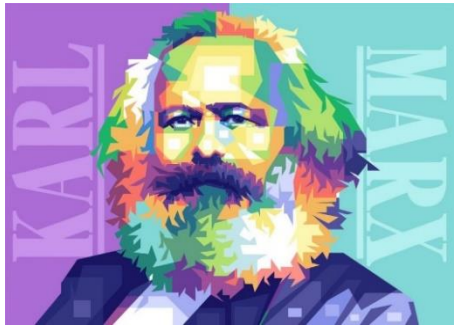
For this survey, the respondent should be a technical consultant/agronomist of the company, or the owner or the manager of the business.

Farm identification from WP2 database *(to be completed by the interviewer)*	**STS** ☐ **Non STS** ☐
Farm ID	
Farm Name	
Plot #	

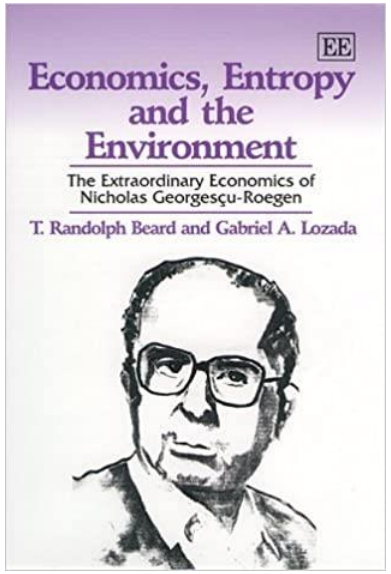
Task 5.2 – Implementation of Social Agrarian Metabolism (SAM)

SAM recalls the concept of "biophysical accounting" to measure the mutual dependences incurred during the interaction between nature and society by measuring biophysical **fund-flow** integrated and reproductive to identify the optimal configuration of land uses, livestock densities, and other elements characterizing agrarian systems.

Social Metabolism refers to the set of theories and methodological tools that allow analyzing a society's biophysical behavior



"… metabolism between man and nature as mediated by the labour process"



Social Metabolism is the way in which human societies organize their exchanges of energy and materials with their natural environment with the purpose of reversing the entropic process they are subject to, like all living beings.

Task 5.2 – Implementation of Social Agrarian Metabolism (SAM)

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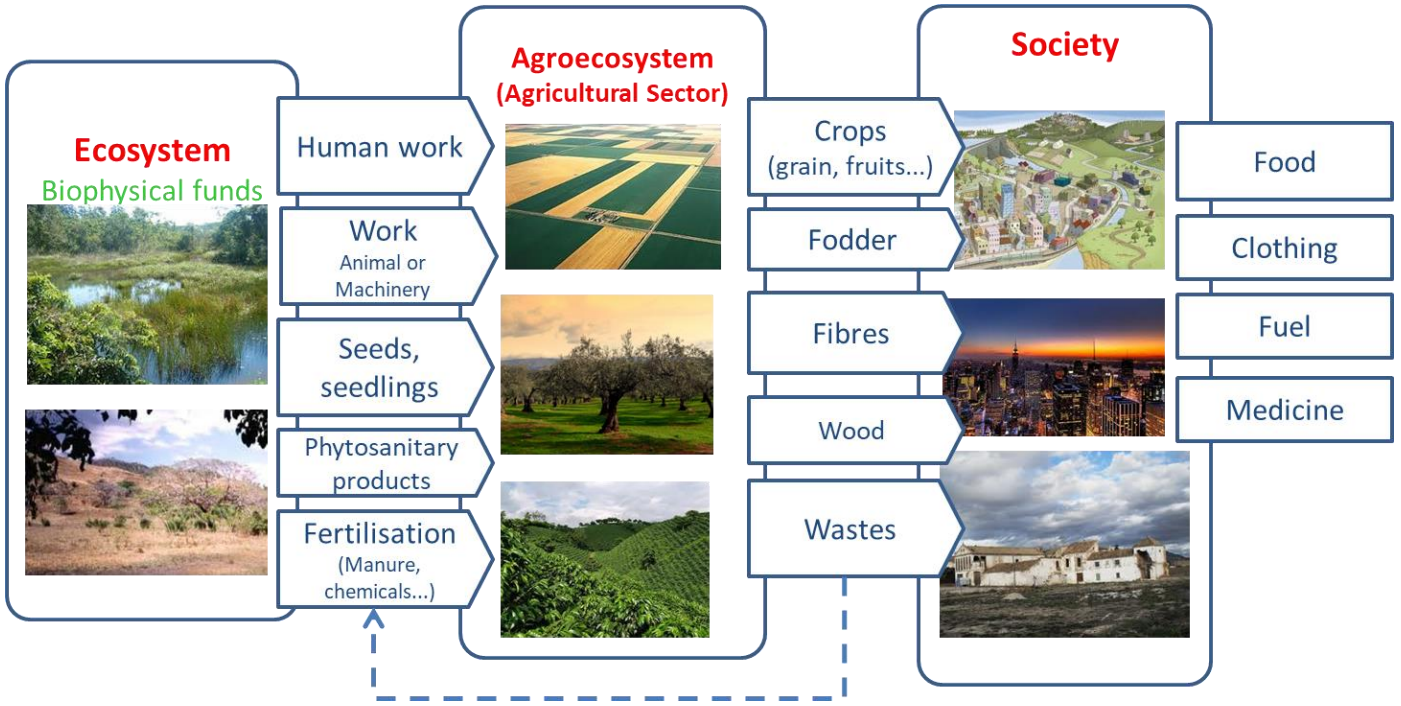
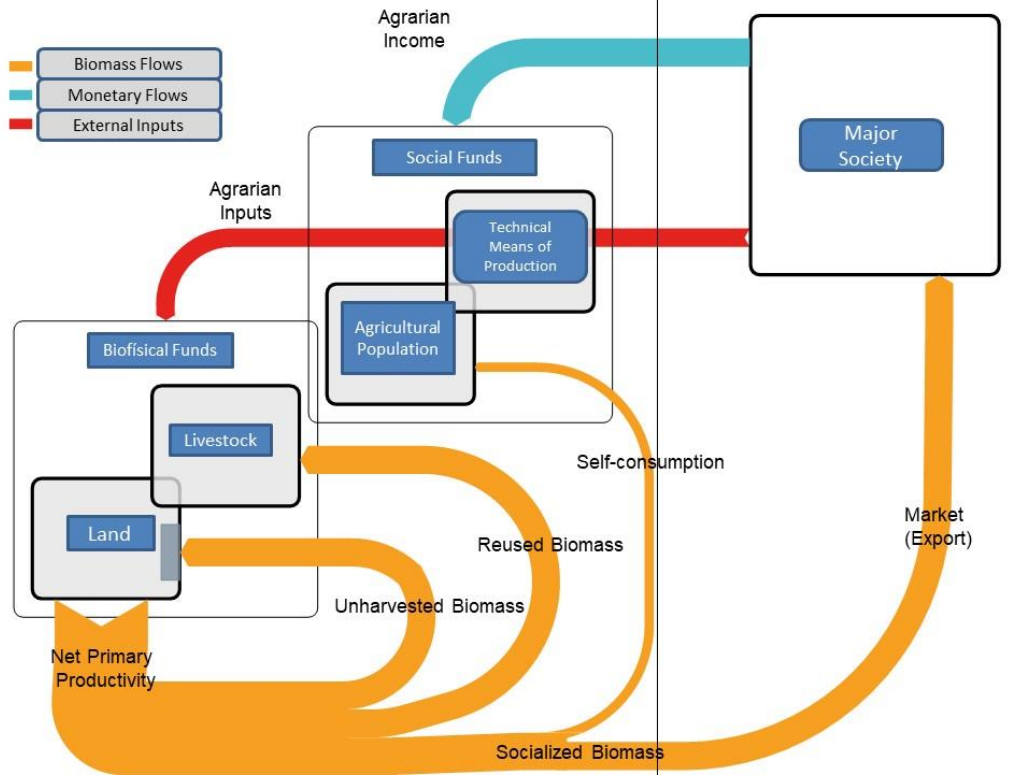
SAM = exchange of energy, materials and information that agroecosystems perform with their socio-ecological environment.

Agroecosystems = manipulated and artificialized by human beings in order to capture and convert solar energy into different forms of biomass





Source: González de Molina et al. (2020).

Agroecological "Energy Return On Investment" - EROIs

EROI

UhB / TIC

Biodiversity

Estimates the extent to which energy invested in the agroecosystem contributes to sustaining food chains of heterotrophic species

AB / TIC

Woodening

Estimates whether the energy added to the system is contributing to the storing of energy in the system

NPPact / TIC

Productivity

Estimates the real productive capacity of the agroecosystem

LEGEND

NPPact: actual Net Primary Production

TIC: total input consumed = RuB + UhB + EI

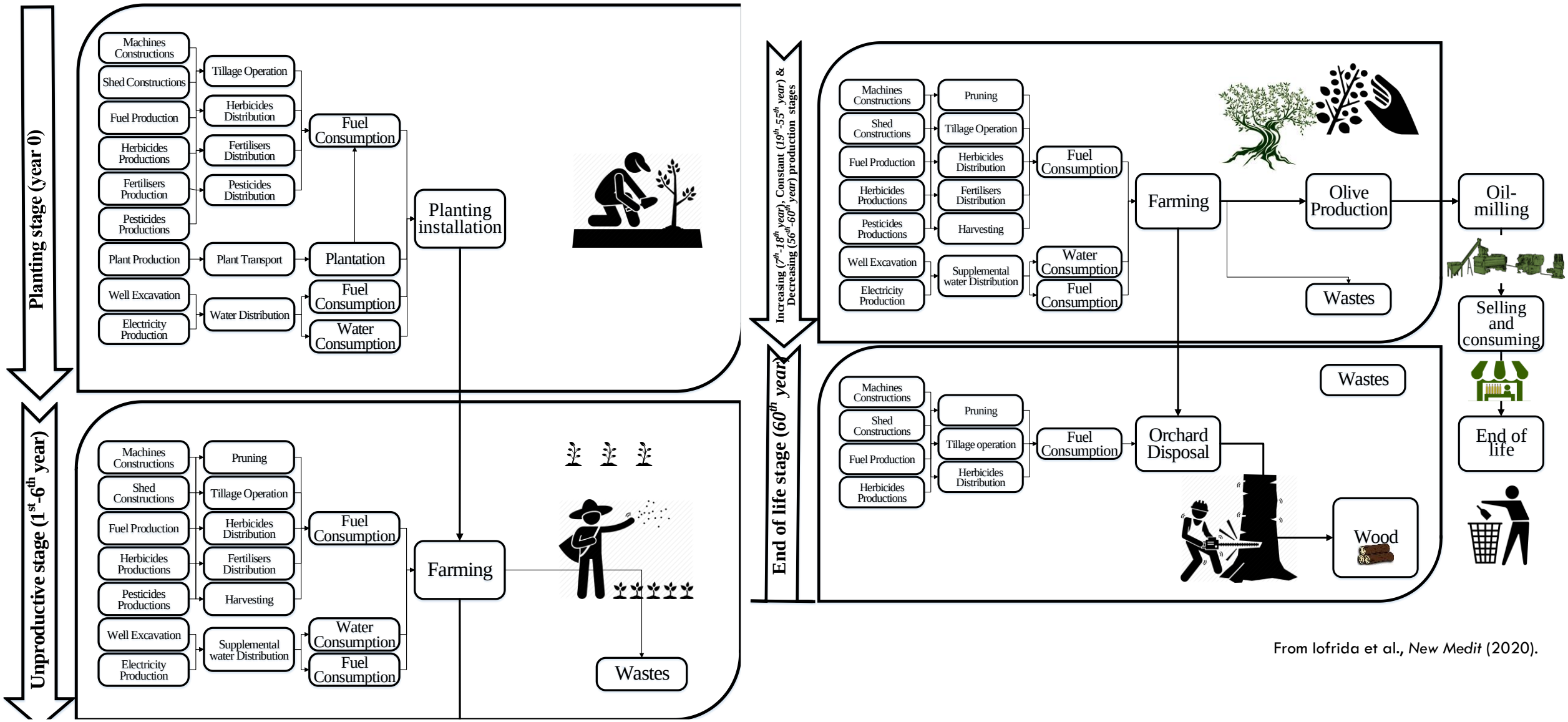
RuB: Reused biomass is the phytomass that is intentionally restored to the agroecosystem.

UhB: Unharvested biomass is the phytomass that is restored to the agroecosystem by abandonment.

EI: External inputs such as fertilizers, pesticides, machinery, feed, human labor and everything that originates outside the agroecosystem.

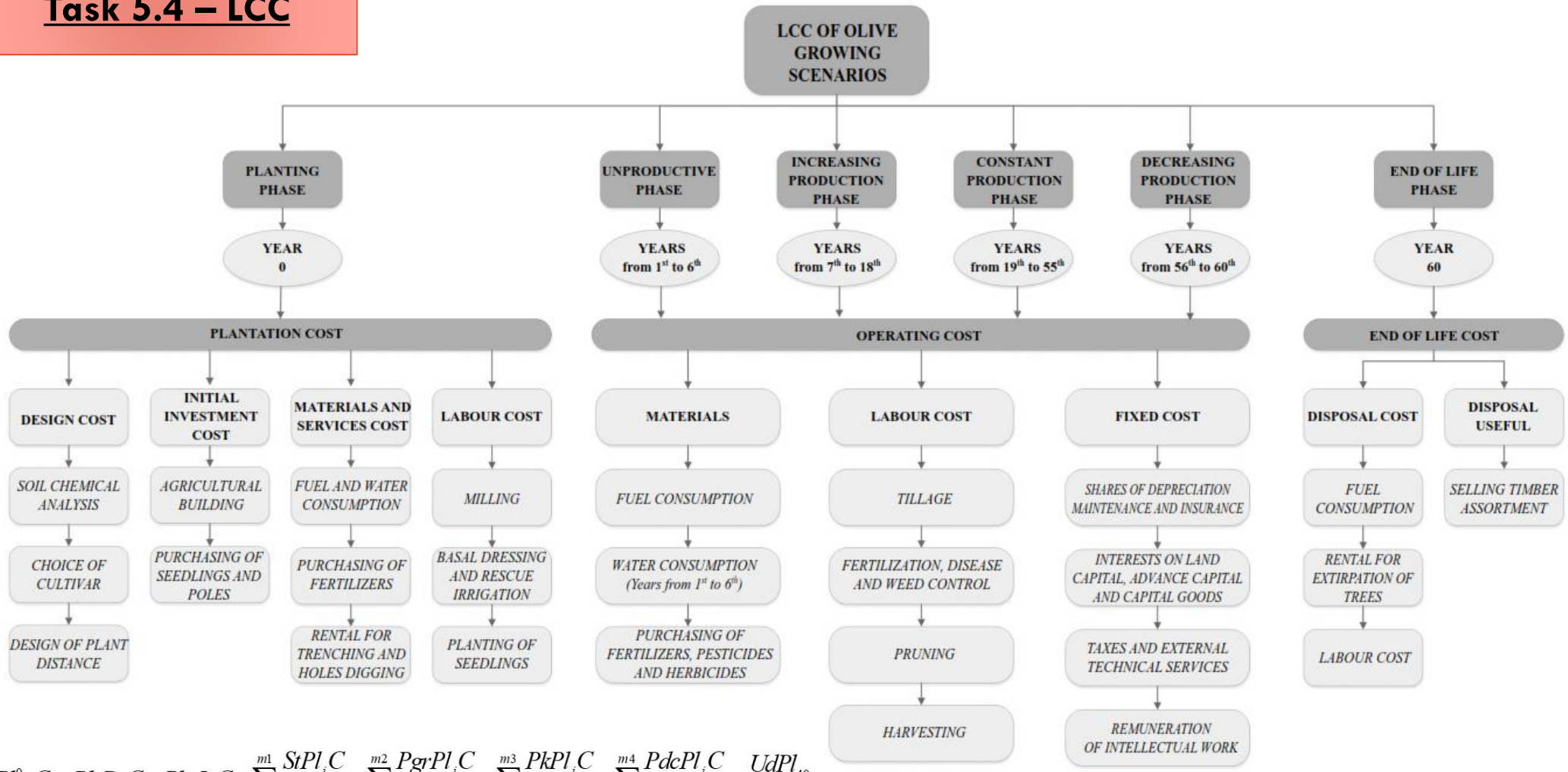
AB: Accumulated Biomass refers to the portion of phytomass that accumulates annually in the aerial structure and in the roots of perennial species, i.e., forest trees, woody crops, and shrubs.

Task 5.3 – LCA



From Iofrida et al., *New Medit* (2020).

Task 5.4 – LCC



$$Pl^{0}_{TH}C = Pl_{0}DsC + Pl_{0}InC + \sum_{j=1}^{m1}\frac{StPl_{j}C}{(1+r)^{j}} + \sum_{j=1}^{m2}\frac{Pgr{\cdot}Pl_{j}C}{(1+r)^{j}} + \sum_{j=1}^{m3}\frac{PkPl_{j}C}{(1+r)^{j}} + \sum_{j=1}^{m4}\frac{PdcPl_{j}C}{(1+r)^{j}} + \frac{UdPl_{40}}{(1+r)^{40}}$$

- $Pl^{0}_{TH}C$: **Discounted Total Cost of Planting**
- $Pl_{0}DsC$: Planting Design Cost
- $Pl_{0}InC$: Planting Installation Cost
- $\sum_{j=1}^{m1}\frac{StPl_{j}C}{(1+r)^{j}}$: Discounted Starting System Cost
- $\sum_{j=1}^{m2}\frac{Pgr{\cdot}Pl_{j}C}{(1+r)^{j}}$: Discounted Production Cost - *growing phase*
- $\sum_{j=1}^{m3}\frac{PkPl_{j}C}{(1+r)^{j}}$: Discounted Production Cost - *constant phase*
- $\sum_{j=1}^{m4}\frac{PdcPl_{j}C}{(1+r)^{j}}$: Discounted Production Cost - *decreasing phase*
- $\frac{UdPl_{40}}{(1+r)^{40}}$: Discounted Useful for disposal

From Stillitano et al., *Bulgarian Journal of Agricultural Science*, 22(4) (2016) 517-526

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EXAMPLE - STS PROCESS (GRAZING LIVESTOCKS)

Number of sheeps ha^{-1}
40

Manure release on field
30.000* Kg ha^{-1}

Avoided fertilizers
1000* Kg ha^{-1}

Avoided Erbicides
4* Kg ha^{-1}

Current hourly wage (10€)

Month(s) of the year

Number of temporary farm workers - 1
Number of permanent farm workers - 0
Number of working day per hectare – 60

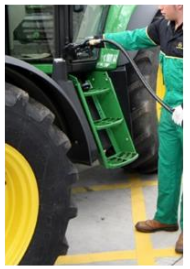
*15t/t lw/ a

EXAMPLE - STS PROCESS (SHREDDED PRUNING TREE)

Number of operations
(1° operations ha-1 year-1)

Number of temporary farm workers - 0
Number of permanent farm workers - 1
Number of working day per hectare – 1

Fuel consumption per hectare
(40 l of fuel)



Time period

Duration (8 h)

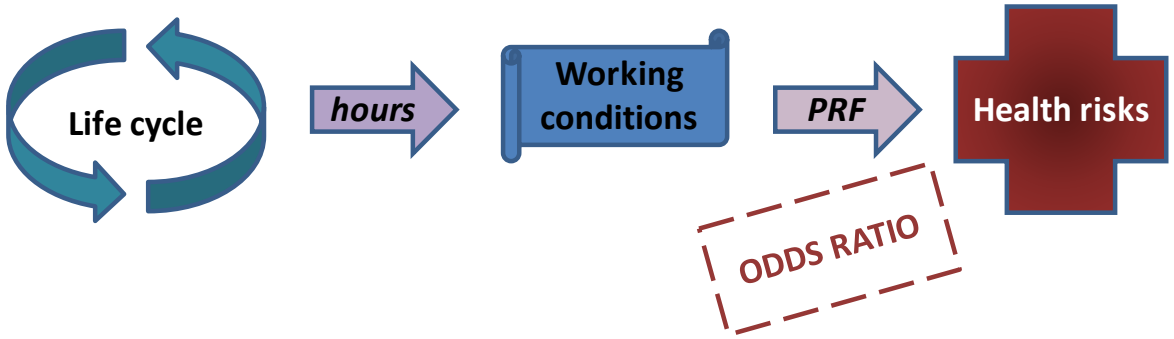
Unit price of fuel (1,3€ l^{-1})
Current hourly wage (10€)

Wood chips in the soil
(3800 kg/ha)

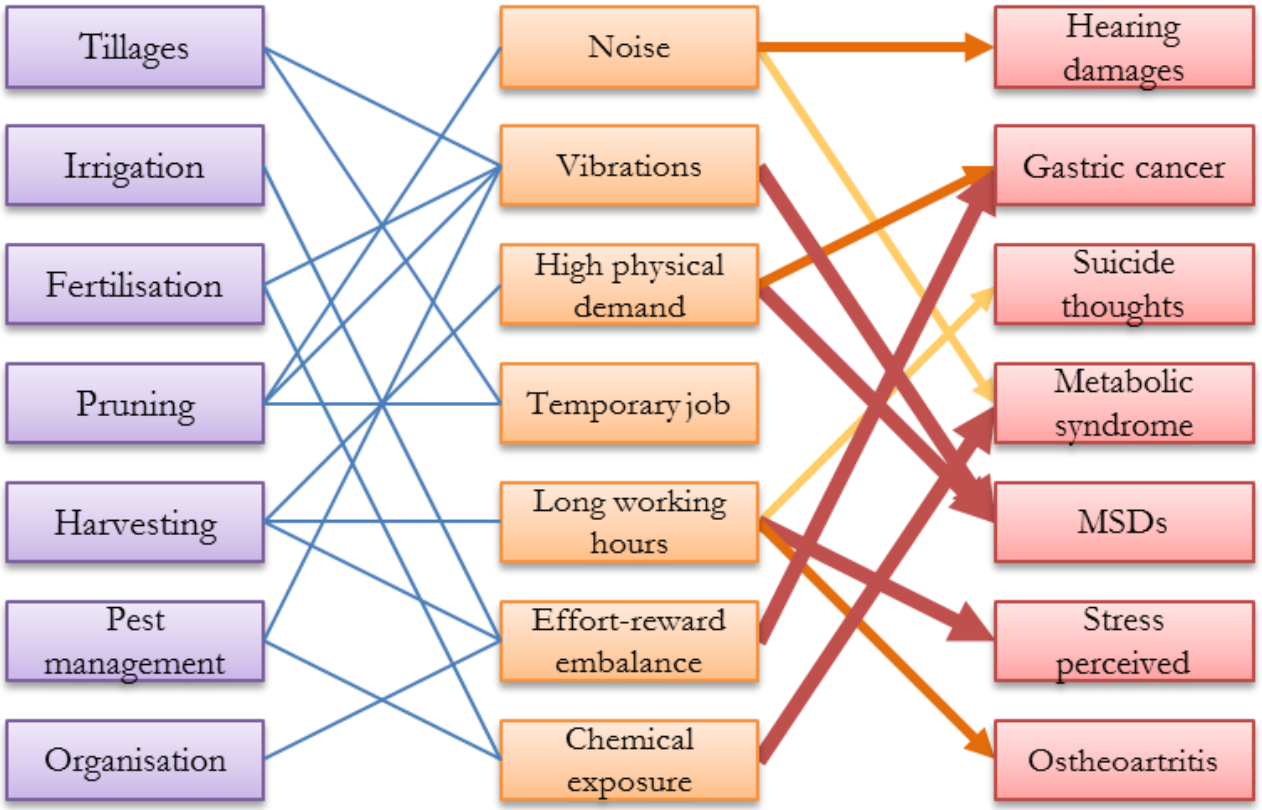
Types of machinery
(Carraro SX 9900 - 85 HP)

Avoided fertilizers
300* Kg ha^{-1}

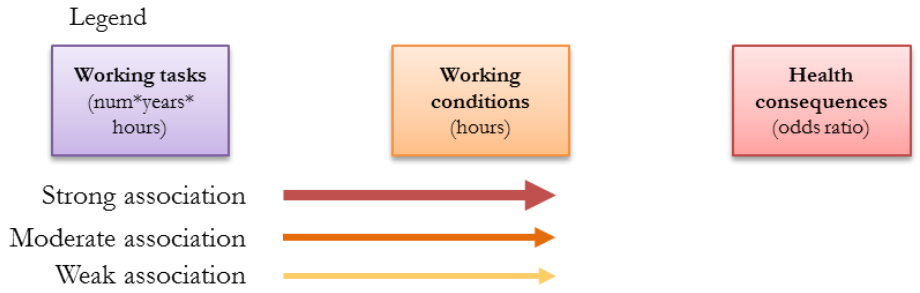
Task 5.5 Example of sLCA framework – PsychoSocial Risk Factors



«Psychosocial risks can be defined as those aspects of work planning and management – and their relative social and environmental contexts – that can POTENTIALLY lead to physical or psychological damages" (Cox and Griffiths, 1995:69)

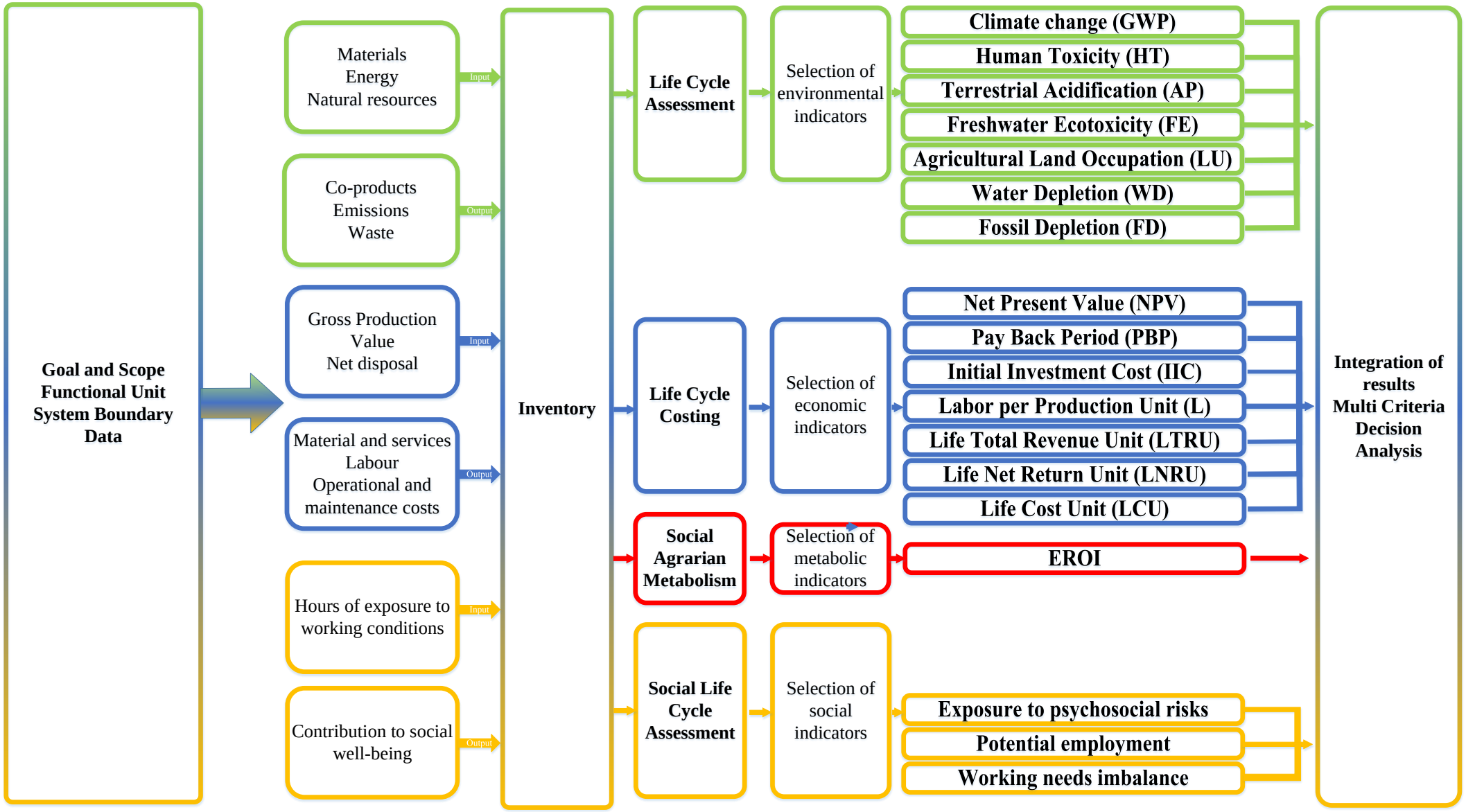


- ✓ Cause-effects relationships
- ✓ Statistical validity
- ✓ Impact directly linked to the life cycle

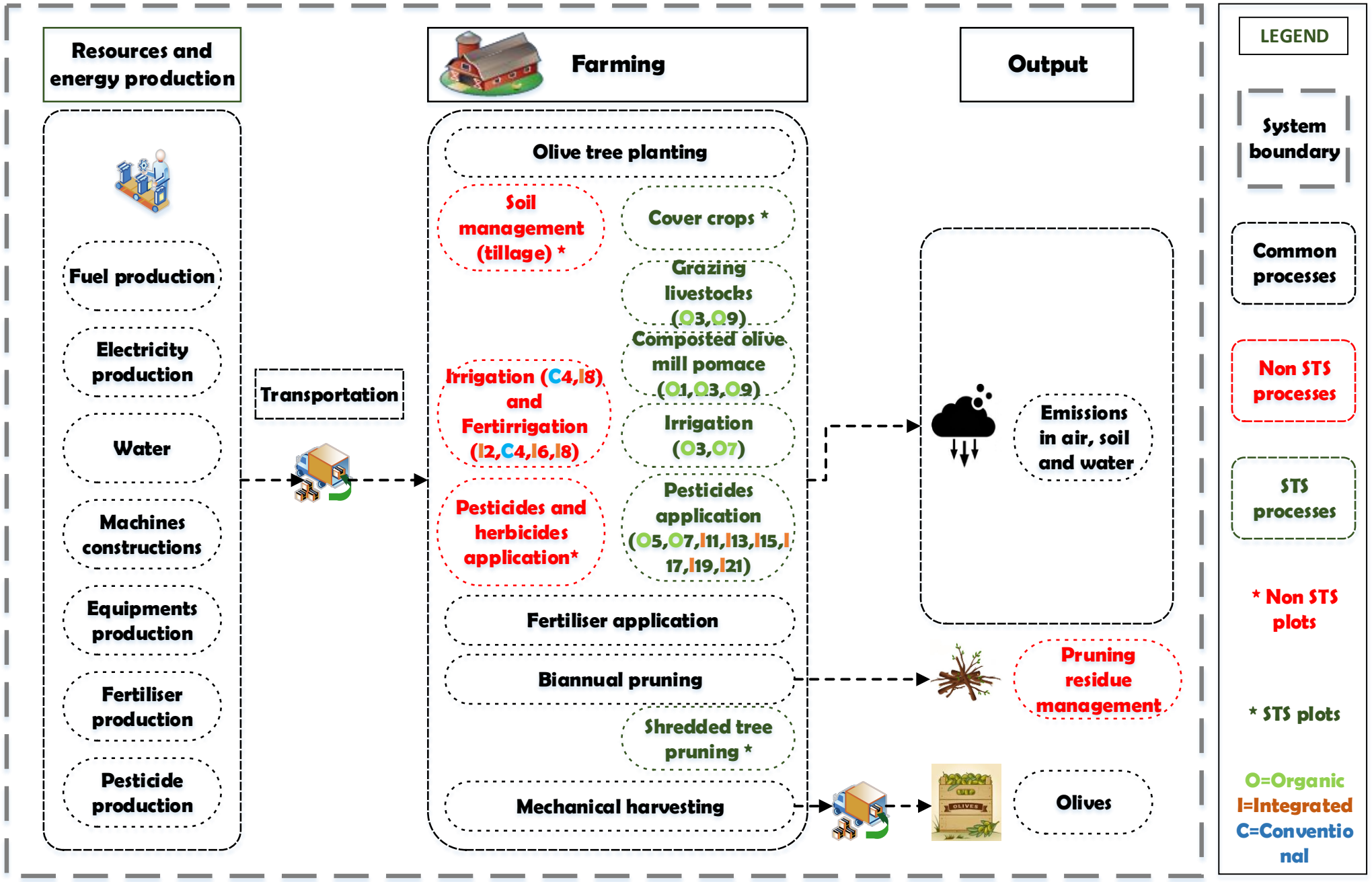


From Iofrida et al., *International Journal of Life Cycle Assessment*, 24(4) (2019) 767-780.

Task 5.6 Example of Integration of results framework



Adapted from De Luca et al. *(2018) Journal of Cleaner Production, 17*, 1187-1202; Falcone et al. 2016, Sustainability, 8, 793.
De Luca et al. Integrated Environmental and Assessment Management 2015, 11(3), 383–396


Resources and energy production
Fuel production
Electricity production
Water
Machines constructions
Equipments production
Fertiliser production
Pesticide production
Transportation
Farming
Olive tree planting
Soil management (tillage) *
Cover crops *
Grazing livestocks (O3,O9)
Composted olive mill pomace (O1,O3,O9)
Irrigation (C4,I8) and Fertirrigation (I2,C4,I6,I8)
Irrigation (O3,O7)
Pesticides and herbicides application*
Pesticides application (O5,O7,I11,I13,I15,I17,I19,I21)
Fertiliser application
Biannual pruning
Shredded tree pruning *
Mechanical harvesting
Output
Emissions in air, soil and water
Pruning residue management
Olives
LEGEND
System boundary
Common processes
Non STS processes
STS processes
* Non STS plots
* STS plots
O=Organic
I=Integrated
C=Conventional

AMBITION, INNOVATION POTENTIAL AND EXPECTED IMPACTS OF SUSTAINOLIVE

Exploring and implementing **alternative STSs based on agro-ecological concepts** to promote sustainability in olive groves. Low-input systems with high productivity and less environmental impacts.

Integration of ecological, agronomical, territorial and socio-economic knowledge to design and assess efficient productive systems that are based on agro-ecological principles.

Enhancing the sustainability of olive groves by improving their adaptability to different regional and local contexts.

A more diversified olive oil land-use system, which supports the delivery of multiple ecosystems services and that considers mixed cropping-livestock activities.

Applying a **holistic approach** to assess sustainability using joint ecological and socio-economic criteria and creating innovation by an inter- and trans-disciplinary multi-actor approach.

GRAZIE PER L'ATTENZIONE!

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