Life Cycle Assessment of olive cultivation in Italy: comparison of three management systems

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BioEcon

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SUSTAINFARM

Innovative and sustainable intensification of integrated food and non-food systems to develop climate-resilient agro-ecosystems in Europe

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The aim of this study was to

evaluate the potential environmental life-cycle impacts of olives produced in three management systems of olive tree integrated with natural grassland

Agroforestry is a collective name for land-use systems and technologies **where woody perennials** (trees, shrubs, palms, bamboos, etc.) are deliberately **used on the same land-management units as agricultural crops and/or animals**, in some form of spatial arrangement or temporal sequence. In agroforestry systems there **are both ecological and economical interactions** between the different components

Why olives???

- Olive cultivation is one of the key crops in Italy
- Italy is in the **third place** in the world, behind Spain and Greece
- Olives are in the **second place**, behind the wheat cultivation

Why agroforestry???

- Fertile soils
- Less chemicals and cleaner groundwater
- Vital habitat for animals
- Poverty reduction
- Climate change mitigation

Life Cycle Assessment is a technique for assessment of product or service impact on the environment during the entire “life cycle”
– from raw material to waste management.

The LCA methodology is defined in ISO 14000 series of standards
– according to ISO 14040

Collected data were implemented to software and analysed

SimaPro 8.4 software (Pré Consultants, 2006)

Ecoinvent database 3.3

The functional unit is one kilogram of olives at the farmgate

Table 1. Olives production at different farming management systems

Plant production	silvopastoral		organic		traditional		Average Italian farm
	area (ha)	yield (t)	area (ha)	yield (t)	area (ha)	yield (t)	yield (t)
Olives	1	3.64	4.5	2.2	8.5	7.05	4.3

Table 2. Olives production at different farming management systems

Plant production	silvopastoral	organic	traditional	Average Italian farm
Trees density	135	200	529	250
Animals	177 sheep	-	-	-
Fertiliser type	dung 0.33 kg / day urine 2.9 kg / day	Manure 4000 kg/ha	Mineral 500 kg/ha	NPK 75-25-30 kg/ha liquid manure 2 m^3/ha solid manure 2 t/ha
Plant protection type	Biologic copper, annual treatment (1.701 kg)	-	Copper oxide 11 kg/ha Insecticide 2 l /ha	16.75 kg a.i./ha
Transport	0.200	0.100	0.300	0.200
Mowing	-	-	1	1
irrigation	-	-	500 m^3	300 m^3

Mondo Macchina

<u>The productive phase of the orchard includes:</u>
machine operations, corresponding infrastructure, fuel use and sheds

<u>Machine operations in the productive phase are:</u>
soil cultivation (mulching, mowing), fertiliser and pesticide application, harvesting and irrigation

Table 3. Estimated on field emissions caused by fertilization and irrigation

Agricultural practice	On field emissions	Methodology	Unit/ha/yr	silvopastoral	organic	traditional
Fertilization	Dinitrogen monoxide (N_2O)	EEA/EMEP (2013)	kg	-	0.0005	0.00031
	Carbon dioxide ($CO_{2)}$	WFLDB-Guidelines	kg	-	-	0.03118
	Ammonia (NH_3)	EEA/EMEP (2013)	kg	0.00892	-	0.00103
	Nitric oxide	EEA/EMEP (2013)	kg	0.01235	0.0342	0.00024
Irrigation	Water	WFLDB-Guidelines	m^3	-	-	0.14

EEA- European Environmental Agency
EMEP- European Monitoring and Evaluation Programme
WFLDB - Methodological Guidelines for the Life Cycle Inventory of Agricultural Products

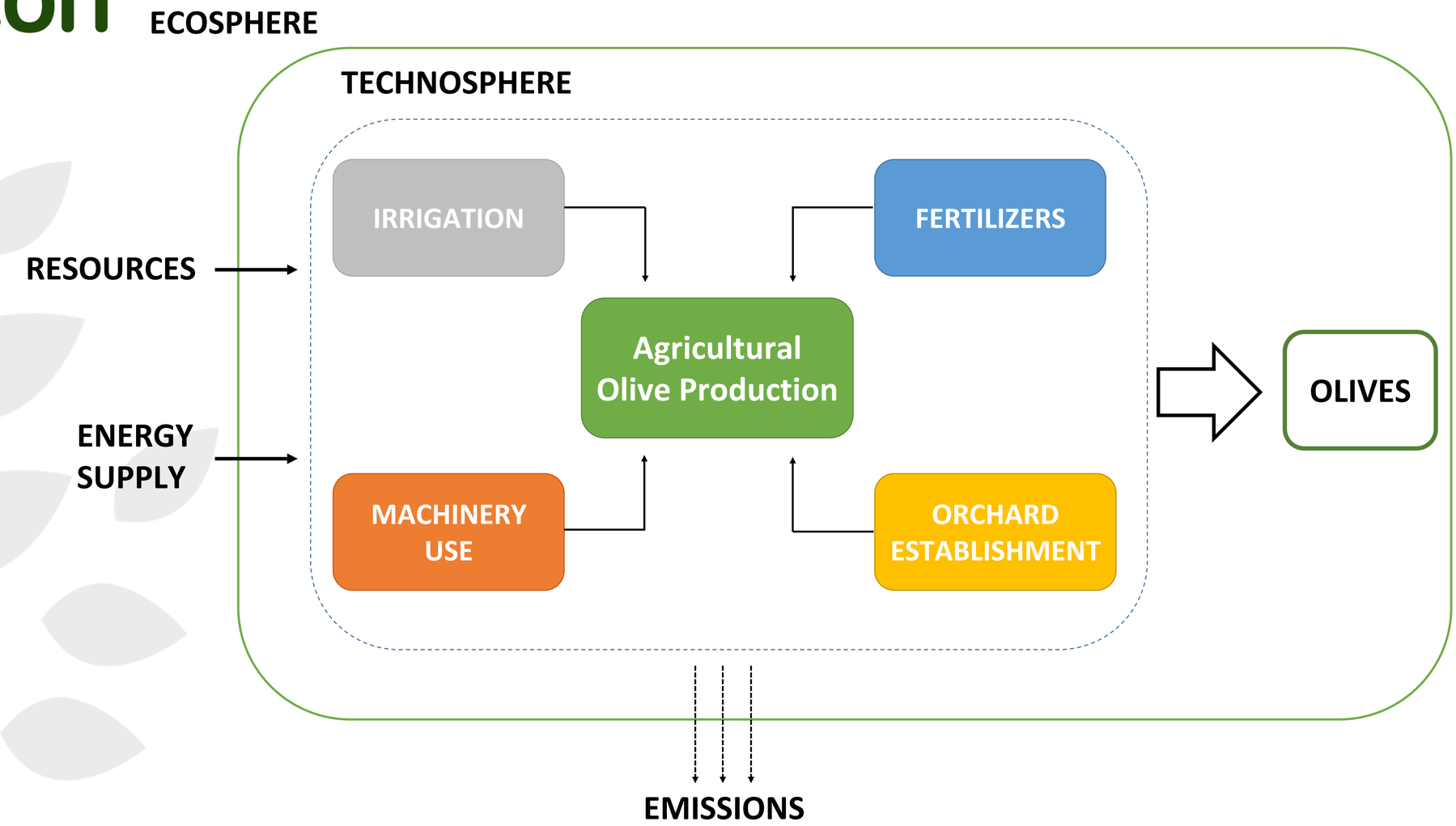

Figure 1. General flow diagram for the agricultural olive production systems

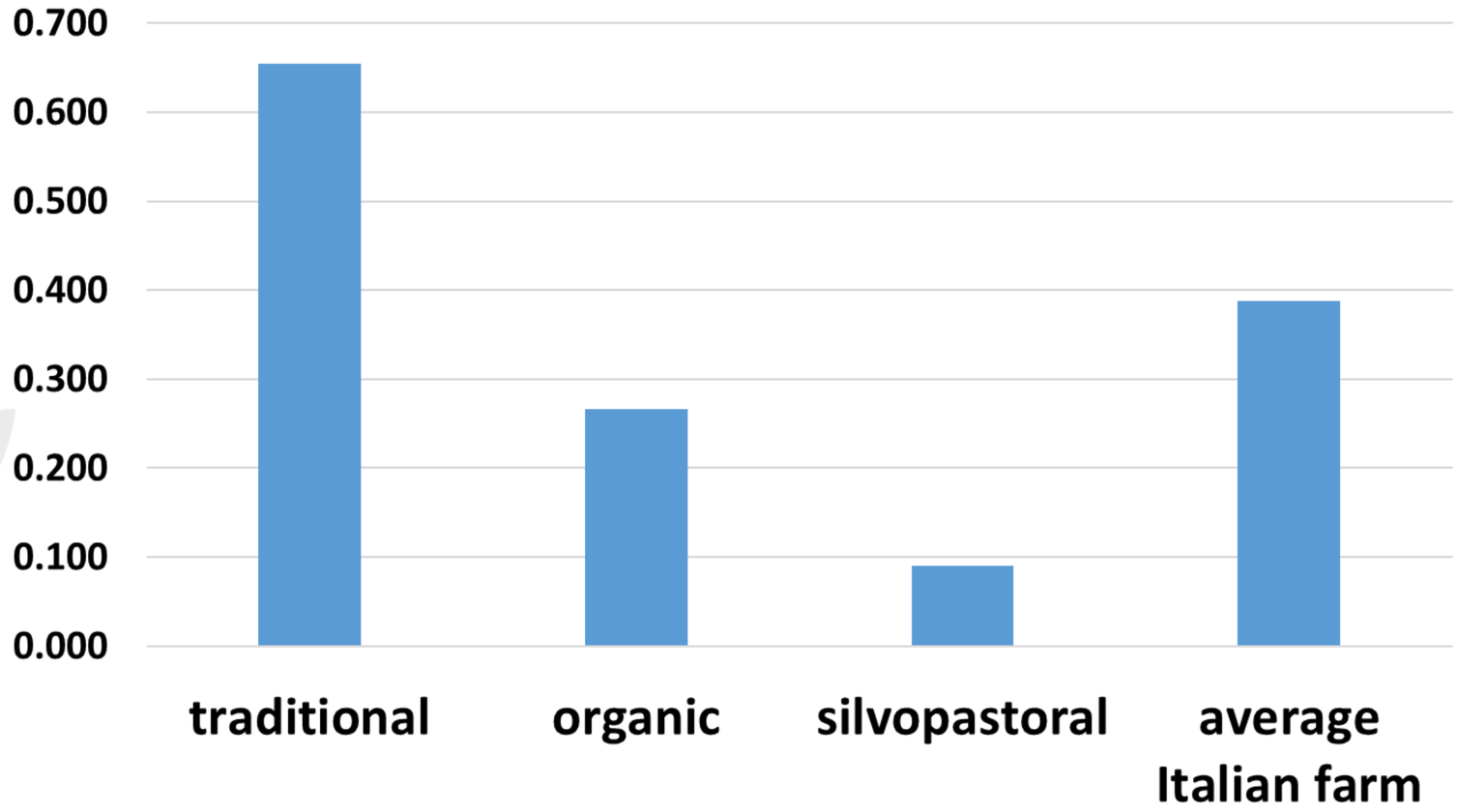

Figure 2. Global worming potential (kg CO_2 eq)

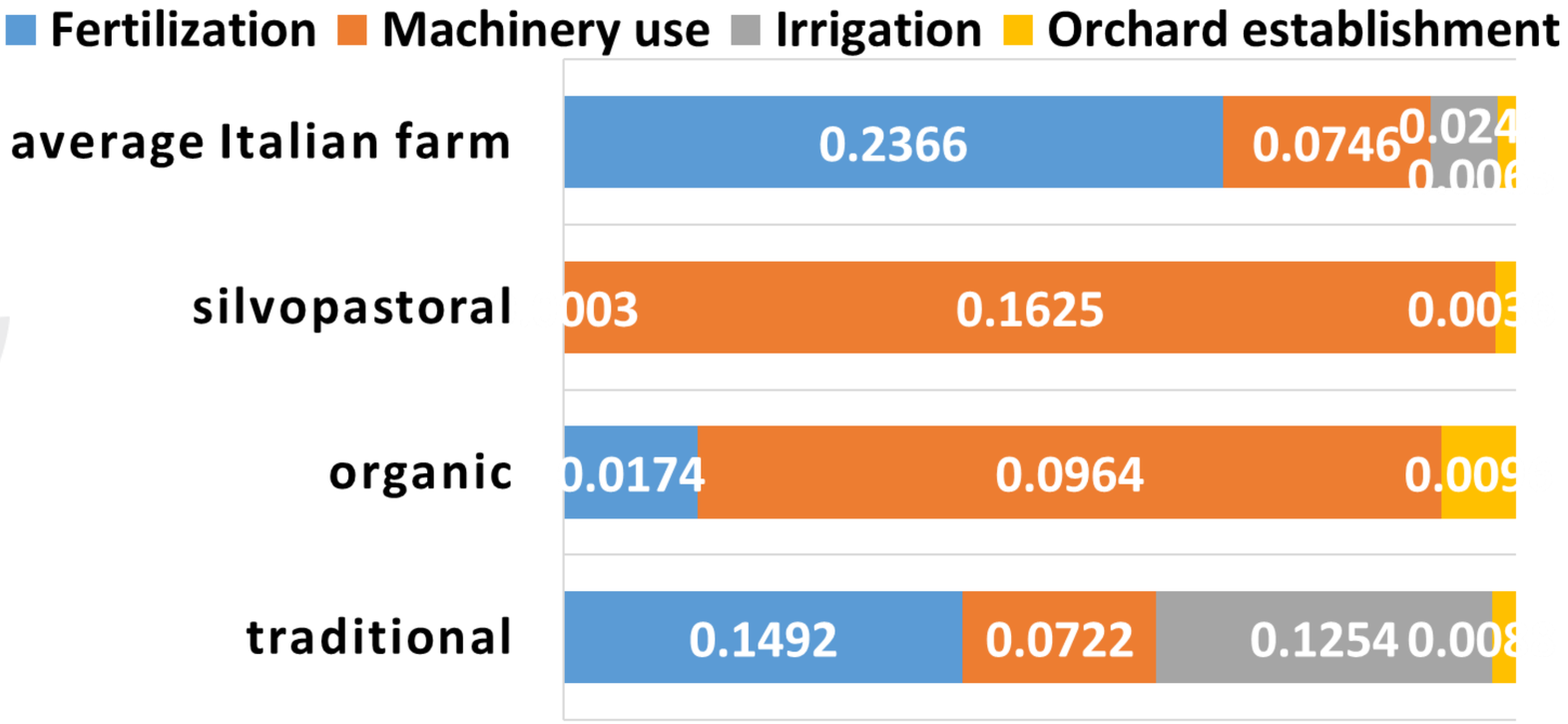

Figure 3. Impact of agricultural practices on GWP (kg CO_2 eq)

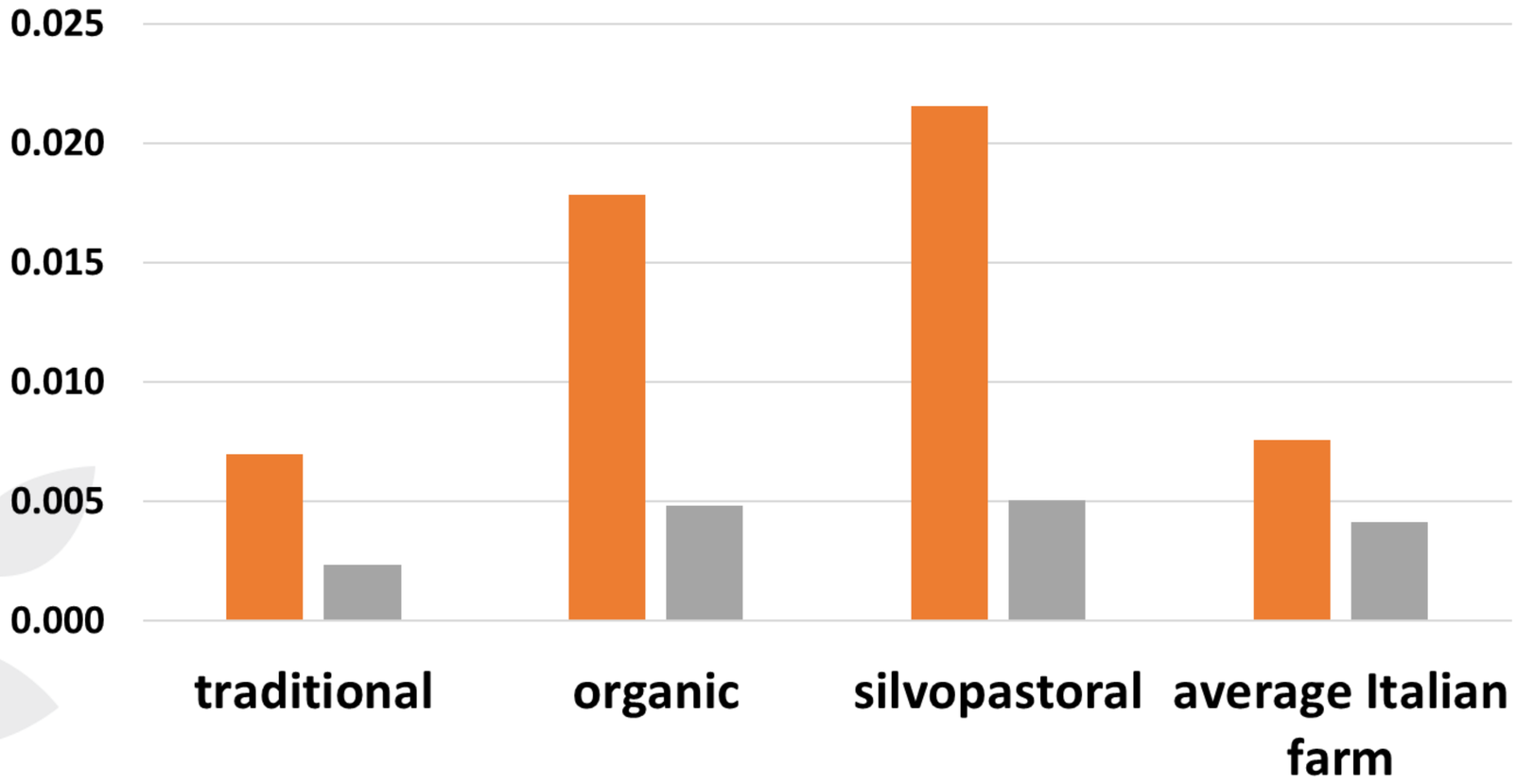

Figure 4. The acidification (kg SO_2 eq) and eutrophication (kg PO_4 eq) potentials for olives production

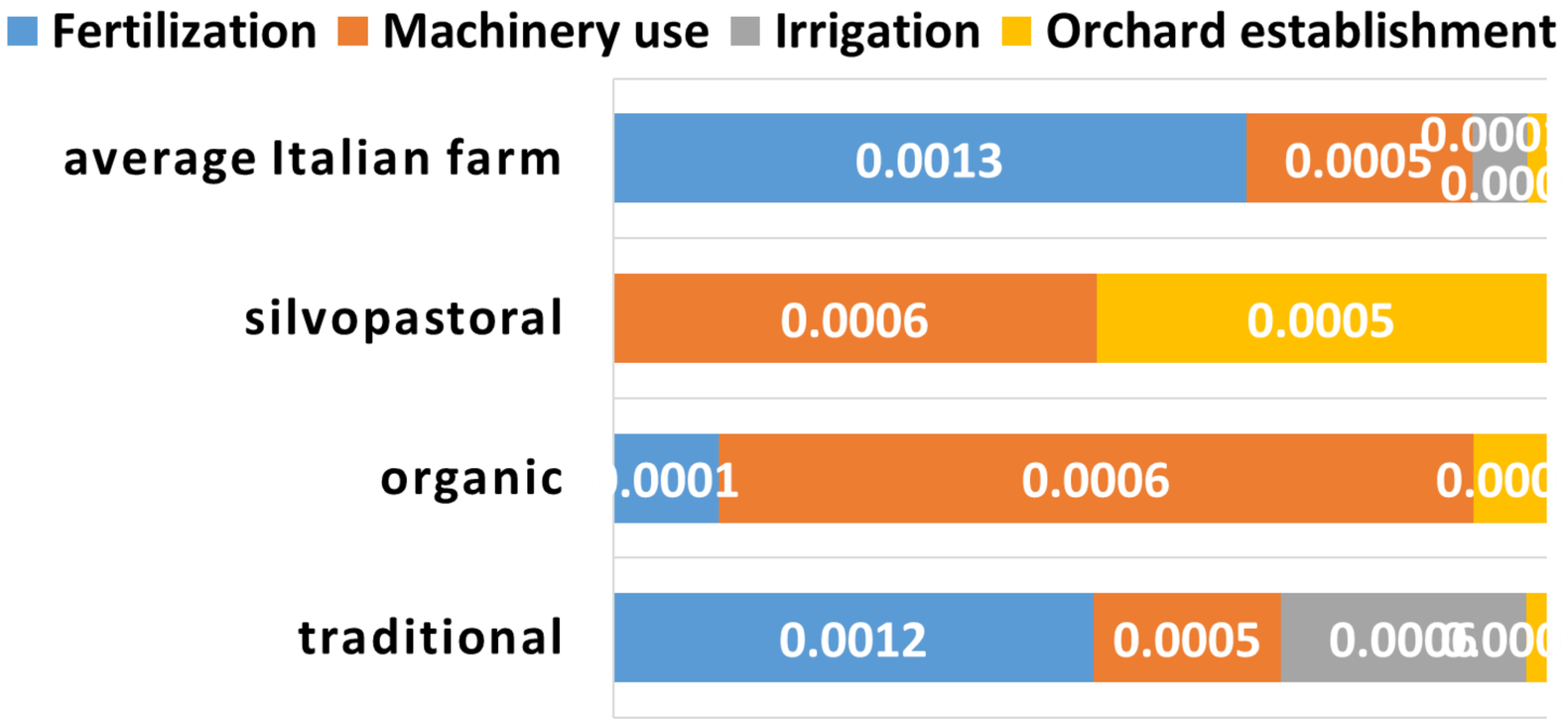

Figure 5. Impact of agricultural practices on acidification (kg SO_2 eq)

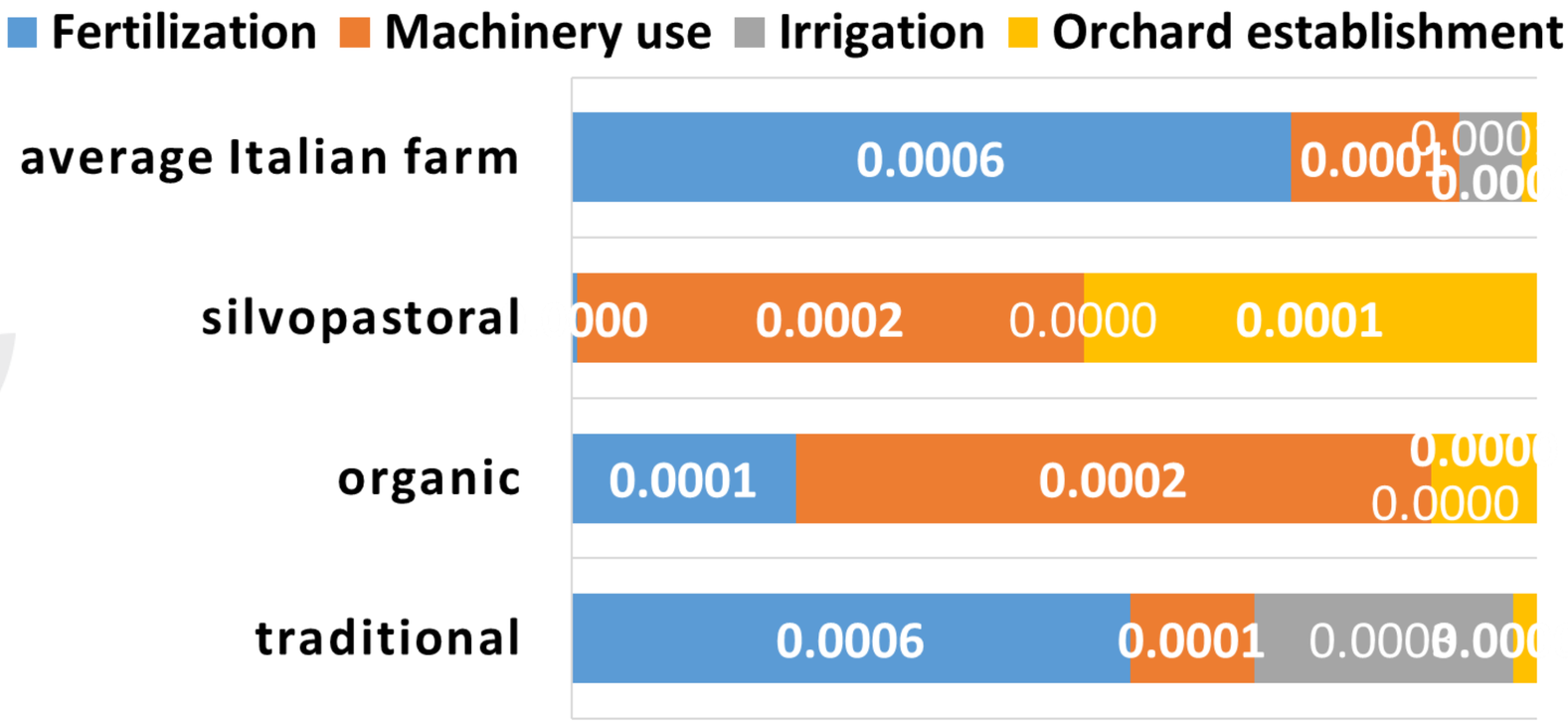

Figure 6. Impact of agricultural practices on eutrophication (kg PO_4 - eq)

Conclusion

Among all agricultural practises, **fertilization has the highest environmental impact** followed by machinery use.

In this case **organic farm** had the smallest impact on environment due to low transportation and fertiliser application.

Thank you for your attention

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