

CORE Organic Cofund



“SCOOP: Developing intercropping systems with camelina to increase the yield and quality parameters of local underutilized crops”

Deliverable report

D 4.2. Diagrams of mass and energy flows in selected intercropping systems

Authors: Michał Krzyżaniak (UWM), Mariusz J. Stolarski (UWM), Kazimierz Warmiński (UWM), Tomasz Hałgas (BIO), Federica Zanetti (UNIBO), Cristina Micheloni (AIAB), Reyhan Bagdat (CRIFIC),

Olsztyn, Poland

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Introduction

This report presents data on crop production inputs and other logistics operations collected as part of the SCOOP project. These data were subsequently used to develop the energy efficiency assessment, life cycle assessment (LCA), and life cycle costing (LCC) analyses of camelina cultivation, both as a sole crop and in intercropping systems with locally identified companion crops.

The LCA and LCC methodologies for camelina cultivation—conducted as a sole crop and in intercropping systems—were applied to datasets gathered from SCOOP partners in Poland, Italy, and Turkey.

Data collection for the analyses

Yield data for camelina and spelt wheat, cultivated both in sole cropping and in intercropping systems, were obtained from field trials conducted between 2021 and 2024 in Poland, Italy, and Turkey. The locations and detailed methodologies of the trials, along with yield results for camelina and the companion crops, are described in Deliverable 2.2.

Each country selected one companion species for intercropping with camelina:

1. Spelt wheat in Poland.
2. Chickpea in Italy.
3. Fenugreek in Turkey.

Inventory data for crop cultivation

All crops were cultivated under organic farming systems. Since each country followed its own agronomic practices, the system boundaries included different technological processes related to camelina cultivation, companion crop cultivation, and intercropping. A schematic overview of system boundaries is presented in Deliverable 4.1.

To standardise data collection, all project partners received a structured data table (developed by UWM) to be completed with detailed information about the crop production chain. The collected data included agronomic operations, machinery used, input materials, labour time, and associated costs. Data shown in Tables 1–3 were collected by UWM and Biosfera (Poland), AIAB and UNIBO (Italy), and CRIFIC (Turkey). These data will be used in the next stage of the project to assess the energy efficiency, LCA, and LCC of camelina and companion crop production in both sole cropping and intercropping systems.

Table 1. Data from field operations for sole camelina, sole spelt and camelina and spelt intercropping systems in Poland

Operation (process)	sole/inter/both	Amount. of process per hectare	Machinery	Service cost (Euro/ha)	Machinery power kW	Machinery mass (kg)	Machine Working time (hour/ha)	Labour working time (hr/ha)	Labour working cost with cost of social care (hr/ha)	Fuel use (l/ha)	Fuel cost (Euro/L)	Means of productions excluding fuel (ha)	Cost of production means excluding fuel (EUR/L or EUR/kg)	Products (unit/ha) eg. kg/ha	Income (Euro/unit) eg. Euro/kg	Comments
Ploughing	both	1	Case Maxum 140 + plough	28 Euro/ha	140	5845+1680	1.20	1.30	7.5 Euro/hr	20.00	1.53 Euro/l diesel					
manure spreading	both	0.25*	Tractor Case Maxum 140 + spreader Pichon M945	20 Euro/ha	140	5845+8000			7.5 Euro/hr		1.53 Euro/l diesel	cow manure 40 t/ha	from own farm			*onece per four years
lime application	both	0.25*	Tractor Case Maxum 140 + spreader Pichon M945	80 Euro/ha	140	5845+8000	0.2	0.3	7.5 Euro/hr	1.6	1.53 Euro/l diesel	7 t	lime 156.25 Euro t			*onece per four years
tillage, cultivation unit	both	1	Tractor Case Maxum 140 + cultivation unit Batyra 3m		140	5845+1500	1.20	1.30	7.5 Euro/hr	15	1.53 Euro/l diesel					
camelina sowing	sole	1	Tractor Case Maxum 140 + combi drill unit Kverneland Amazone 3m		140	5845+900	0.5	0.6	7.5 Euro/hr	10	1.53 Euro/l diesel	8.3 kg seeds	1500 Euro/t			
spelt sowing	sole	1	Tractor Case Maxum 140 + combi drill unit Kverneland Amazone 3m		140	5845+900	0.6	0.7	7.5 Euro/hr	15	1.53 Euro/l diesel	200 kg seeds	462.5 euro/t			
spelt sowing in intercropping	inter	1	Tractor Case Maxum 140 + combi drill unit Kverneland Amazone 3m		140	5845+900	0.4	0.5	7.5 Euro/hr	15	1.53 Euro/l diesel	140 kg seeds	1.5 Euro/kg			
camelina sowing in intercropping	inter	1	Tractor Case Maxum 140 + Agromasz 3m		140	5845+1500	0.5	0.6	7.5 Euro/hr	12	1.53 Euro/l diesel	6.2 kg seeds	462.5 euro/t			
mechanical weding	both	2							7.5 Euro/hr							
spelt harvest	sole	1	Class Mercator 75	120 Euro/ha	105	6000	1.5	1.6	7.5 Euro/hr	18	1.53 Euro/l diesel	yield 0.809 t (0.735 t after cleaning)		camelina seeds 0,7835 t/ha	325 euro/t	
camelina harvest	sole	1	Combine Class Mercator 75	120 Euro/ha	105	6000	1.5	1.6	7.5 Euro/hr	18	1.53 Euro/l diesel	yield 0.5 t (0.317 t after cleaning)		spelt seeds 0.317 t/ha	1500 euro/t	
cam+spel harvest	inter	1	Combine Class Mercator 75	120 Euro/ha	105	6000	1.5	1.6	7.5 Euro/hr	18	1.53 Euro/l diesel	0.154+0.558 t after cleaning)				
spelt loading	sole	1	Tractor Case Maxum 140 + trailer Gromar 7t		140	5845+1870	0.2	0.3	7.5 Euro/hr	3	1.53 Euro/l diesel					

camelina loading	sole	1	Tractor Case Maxum 140 + trailer Gromar 7t		140	5845+1870	0.2	0.3	7.5 Euro/hr	3	1.53 Euro/l diesel					
camelina = spelt loading	inter	1	Tractor Case Maxum 140 + trailer Gromar 7t		140	5845+1870	0.2	0.3	7.5 Euro/hr	3	1.53 Euro/l diesel					
Seed cleaning and separation	inter	1	Petkus cleaning and separation line	80 Euro/tonne		8530	1	1.1		54.8 kWh*	0.1 Euro/kWh*					*fuel for separation - electricity
Crop insurance	both												25 Euro/ha			
Third Party Liability Insurance	both												1.25 Euro/ha*			* it is a share according to 1ha, this Insurance is calculated for farm
farm/agricultural tax	both												56 Euro/ha			
additional payments/subsites in agriculture	both	1	reimbursement of excise duty included in the price of diesel fuel												40.6 Euro/ha	
subsidies form Common Agricultural Policies	both	1	Basic income support for sustainability (basic income support)												112.4 Euro/ha	
subsidies form Common Agricultural Policies	both	1	Redistributive income support												38.5 Euro/ha	
subsidies form Common Agricultural Policies	both	1	Supplementary basic payment												15.3 Euro/ha	
subsidies form Common Agricultural Policies	both	1	Payments for areas with natural or other specific LFA constraints - zone 1												43.6 euro/ha	
subsidies form Common Agricultural Policies	both	1	Payments for areas with natural or other specific LFA constraints - zone 2												66.3 Euro/ha	
subsidies form Common Agricultural Policies																
subsidies for organic farming	sole	1	organic farming - Package 7. Agricultural crop - camelina												392,75 Euro/ha	
subsidies for organic farming	sole	1	organic farming - Package 7. Agricultural crop - spelt												392,75 Euro/ha	

Table 2. Data from field operations for sole camelina, sole chickpea and camelina and chickpea intercropping systems in Italy

Operation (process)	sole/inter/both	Amount. of process per hectare	Machinery	Service cost (Euro/ha)	Machinery power kW	Machinery mass (kg)	Machine Working time (hour/ha)	Labour working time (hr/ha)	Labour working cost with cost of social care (hr/ha)	Fuel use (l/ha)	Fuel cost (Euro/L)	Means of productions excluding fuel (ha)	Cost of production means excluding fuel (EUR/L or EUR/kg)	Products (unit/ha) eg. kg/ha	Income (Euro/unit) eg. Euro/kg	Comments
Mowing with flail mower	both	1	Fendt 724 + flail mower tmc cancela 8 m	70 Euro/ha	181	7200+3800	0.25	0.27	25 Euro/h	10.00	1.5 Euro/l diesel					
Tillage, tine cultivator	both	1	Fendt 514 + UST 4500 4,5 m	70 Euro/ha	110	6100+3700	0.5	0.55	25 Euro/h	20	1.5 Euro/l diesel		from own farm			
tillage, tine harrow	both	2	Fendt 514 + Lemken 6 m vibrocultor	85	110	6100+1800	30'	33'	25 Euro/h	8	1.5 Euro/l diesel					
camelina sowing	both	1	Fendt 413 + Kuhn Premia 3 m	45	140	5000+740	1.5	0.6	25 Euro/h	7	1.5 Euro/l diesel	12 kg seeds				
Weeding, straw harrow	both	1	Fendt 413 + 6 mt Kockerling straw harrow	28		5000+600	30'			6	1.5 Euro/l diesel					
harvest	camelina	1	Combine harvester Class Lexion 7700	160 Euro/ha	404	16700+2800	30'	32'	25 Euro/h	40	1.5 Euro/l diesel			camelina seeds 0.4 t/ha		
harvest	chickpea	1	Combine harvester Class Lexion 7700	160 Euro/ha	404	16700+2800	30'	32'	25 Euro/h	40	1.5 Euro/l diesel			chickpea seeds 0,7 t/ha		
harvest	inter	1	Combine harvester Class Lexion 7700	160 Euro/ha	404	16700+2800	30'	32'	25 Euro/h	40	1.5 Euro/l diesel			Camelina 0,2 t/ha + chickpea 0,6 t/ha		
loading	both	1	Fendt 514 + CUM 16T		110	6100+4500	0.2	0.3	25 Euro/h	3	1.5 Euro/l diesel					
Seed cleaning and separation	inter	1	Petkus cleaning and separation line	80 Euro/tonne		8530	1	1.1		54.8 kWh*	0.1 Euro/kWh*					*fuel for separation - electricity
Crop insurance	both															
Third Party Liability Insurance	both															
farm/agricultural tax	both															
additional payments/subsites in agriculture	both	1	reimbursement of excise duty included in the price of diesel fuel													
subsidies form Common Agricultural Policies	both	1	Basic income support for sustainability (basic income support)													

subsidies form Common Agricultural Policies	both	1	Redistributive income support													
subsidies form Common Agricultural Policies	both	1	Supplementary basic payment													
subsidies form Common Agricultural Policies	both	1	Payments for areas with natural or other specific LFA constraints - zone 1													
subsidies form Common Agricultural Policies	both	1	Payments for area												169 Euro/ha	
subsidies form Common Agricultural Policies			Payments for area												169 Euro/ha	
subsidies for organic farming	sole	1	organic farming -Agricultural crop - camelina												430 Euro/ha	
subsidies for organic farming	sole	1	organic farming – Agricultural crop – chickpea												430 Euro/ha	

Table 3. Data from field operations for sole camelina, sole fenugreek and camelina and fenugreek intercropping systems in Turkey

Operation (process)	sole/inter/both	Amount of processes per hectare	Machinery	Service cost (Euro/ha)	Machine power kW	Machine mass (kg)	Machine Working time (hour/ha)	Labour working time (hr/ha)	Labour working cost with cost of social care (hr/ha)	Fuel use (l/ha)	Fuel cost (Euro/L)	Means of productions excluding fuel (ha)	Cost of production means excluding fuel (EUR/L or EUR/kg)	Products (unit/ha) eg. kg/ha	Income (Euro/unit) eg. Euro/kg	Comments
tillage+cultivation	both	1	New Holland		135	8000+1000	1.00	1.10	6.61	17.00	1,29 Euro/L					
Sowing camelina (sole)	sole	1	New Holland Td 65+Köymak 2022		48	5000+500	0.4	0.5	6.61	11.35	1,29 Euro/L	10 kg seeds	7,271+3,305+9,915+11,33+1,322+3,305+45,71+77,14-15=144,298 Euro (without fuel)	159,45+11,33+45,71+77,14+5,11+17,05-15=301,24 Euro (included fuel)		
Fenugreek (sole)	sole	1	New Holland Td 65+Köymak 2022		48	5000+500	0.4	0.5	6.61	11.35	1,29 Euro/L	30 kg seeds	154,39 Euro			
Sowing fenugreek (intercropping)	inter	1	New Holland Td 65+Köymak 2022		48	5000+500	0.40	0.50	6.61	11.35	1,29 Euro/L	15 kg seeds	145,82 Euro			
Sowing camelina (intercropping)	inter	1	New Holland Td 65+Köymak 2022		48	5000+500	0.4	0.5	6.61	11.35	1,29 Euro/L	5 kg seeds	138.633			
Fenugreek harvest (sole)	sole	1	New Holand 5,80		167	5800	1.4	1.5	6.61	20	1,29 Euro/L	0,86 t clean				
camelina harvest (sole)	sole	1	New Holand 5,80		167	5800	1.4	1.5	6.61	20	1,29 Euro/L	0,62 t clean				
Harvest (fenugreek+camelina)	both	1	New Holand 5,80		167	5800	1.4	1.5	6.61	20	1,29 Euro/L	0,498(f)+0,348(c) clean				
Fenugreek transport (sole)	sole	1	BMC Professional	for 5 km distance	215	8000	0.15	0.2	6.61	3	1,29 Euro/L					
Camelina transport (sole)	sole	1	BMC Professional	for 5 km distance	215	8000	0.15	0.2	6.61	3	1,29 Euro/L					
Camelina+Fenugreek transport (intercropping)	inter	1	BMC Professional	for 5 km distance	215	8000	0.15	0.2	6.61	3	1,29 Euro/L					

Fenugreek straw baling	sole	1	Sgorbati 350	(25 kg straw balley, double rope) around 2000 kg straw per hectare, 0,74 Euro per bale (cost), around 80 Balley			0.4	0.5	6.61	4	1,29 Euro/L			Seed: fenugreek seeds 0,86 t/ha clean Balley: 1470kg straw per hectare	Seed:614,28 Euro Balley: 43,51 Euro	Seed+Straw=657,79 Euro
Camelina straw baling	sole	1	Sgorbati 350				0.4	0.5	6.61	4	1,29 Euro/L			Seed: camelina 0,62 t/ha clean Balley: 1307 kg straw per hectare	Seed:265,71 Euro Balling: 38,68 Euro	S+S=304,39 Euro
Camelina+fenugreek straw baling	inter	1	Sgorbati 350				0.4	0.5	6.61	4	1,29 Euro/L			Seed=0,498 t/ha(f)+0,348 t/ha (C) Balley:896 kg+695kg=1591 kg	Seed: 355,71 (F)Euro+149,14 (C) Euro Balley:42,28 Euro	S+S=397,99 Euro
Seed cleaning and separation	inter	1	Bühler sortex	45,71 Euro per ton (service procurement) with sortex, 34,28 Euro (with seed screening machines)												
Crop insurance													15 Euro per hectare			
subsidies for organic farming															77,14 Euro/ha	