



Quantification of ecological services for sustainable agriculture

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Managing semi-natural habitats and on-farm biodiversity to optimise ecological services
Collaborative Project

Deliverable D3.2

Report on execution of data collection in case studies



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This deliverable relates to Task 3.2 Case study data collection

- Task 3.2.1 Habitat mapping and management survey
- Task 3.2.2 Pest control survey
- Task 3.2.3 Pollination survey
- Task 3.2.4 Other key ecosystem services

and Task 3.3 Farming practices survey

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1 Executive summary

This document lists the type, number and replication of the field-based studies conducted in QuESSA to measure ecosystem services. These studies were conducted according to the protocols described in Deliverable 3.1.

Levels of pest control were measured in eight countries using artificial prey items (sentinels) in wheat, oilseed rape, sunflowers, vines, olives, pumpkins and pears. Each of these studies was conducted in 18 landscape sectors (1 km radius circle) per region of which a focal field located in the centre was selected, with six replicates of each type of bordering semi-natural habitat (SNH). Five generic sentinels were used in the majority of case studies to measure pest control. These were comprised of wither insect prey (*Caliphora* larvae, *Ephestia* moth eggs on the ground and crop) or weed seeds (*Chenopodium album* and *Poa trivialis*). A number of crop-specific sentinels were also used in individual case studies that represented the main pests. Sentinels were deployed on 1-3 occasions during the main growth period. For most case studies the generic sentinels and some crop specific ones were deployed in 2014 and 2015.

Pollination levels were measured in six countries for oilseed rape, sunflowers, pumpkins and pears. Pollination was only measured in 2014. Measurements were made of yield, pollination (seed set) for open (wind/self and insect pollination), hand (maximum pollination) and bagged (wind/self only). Visitation rates and type of pollinators were also recorded using timed visits.

Landscape aesthetics were measured in six countries using photographs of same type of SNH on four occasions. These were appraised by the public in an internet-based survey.

Soil erosion was measured in vines in France in 14 fields. Aspects of soil fertility was measured in five countries in 18-36 fields on one occasion.

Two ecosystem dis-services were measured: weed invasion in Sunflowers in Italy and bird damage in pears in the Netherlands.

Eight countries collected data on management inputs to the focal field and landscape sector for 11 case studies.

2 Introduction

This reports is the product for D3.2 on execution of data collection in pre-selected crops and SNH, and in the farming landscape in case studies of pest control, pollination and other ecosystem services, as well as on the farming practices. Sampling design, detailed methods of investigations and quantification of the ecosystem services are available in D3.1 and D3.3 of the QuESSA project.

3 Studied crops and SNH

3.1 Data collection in pre-selected crops and SNH

Table 1. Overview of case study crops and investigated principal ecosystem services (pollination, pest control or both) and the nature and number of respective bordering habitats.

Country	Partner	Ecosystem Service	Study crop	Bordering SNH type	# Fields
Switzerland	FDEA-ART	Pollination and Pest control	oilseed rape	WL ¹	6
Switzerland	FDEA-ART	Pollination and Pest control	oilseed rape	HL ¹	6
Switzerland	FDEA-ART	Pollination and Pest control	oilseed rape	Control ¹	6
United Kingdom	GWCT	pollination	oilseed rape	WA ¹	6
United Kingdom	GWCT	pollination	oilseed rape	WL	6
United Kingdom	GWCT	pollination	oilseed rape	HL	6
United Kingdom	GWCT	pest control	wheat	WA	6
United Kingdom	GWCT	pest control	wheat	WL	6
United Kingdom	GWCT	pest control	wheat	HL	6
Estonia	EULS	Pollination and Pest control	oilseed rape	WL	6
Estonia	EULS	Pollination and Pest control	oilseed rape	HL	6
Estonia	EULS	Pollination and Pest control	oilseed rape	Control	6
France	BxScAgro	pest control	vine	WA	6
France	BxScAgro	pest control	vine	HL	6
France	BxScAgro	pest control	vine	Control	6
Italy	SSSA	pollination	sunflower	WL	6
Italy	SSSA	pollination	sunflower	HL	6
Italy	SSSA	pollination	sunflower	Control	6
Italy	UniPi	pest control	olive	WA	6
Italy	UniPi	pest control	olive	HA	6
Italy	UniPi	pest control	olive	Control	6
Germany	UKL	Pollination and Pest control	pumpkin	W	6
Germany	UKL	Pollination and Pest control	pumpkin	H	6
Germany	UKL	Pollination and Pest control	pumpkin	Control	6
Hungary	SZIE	pest control	wheat	WL/WA	6
Hungary	SZIE	pest control	wheat	HL/HA	6
Hungary	SZIE	pest control	wheat	Control	6
Hungary	SZIE	pest control	sunflower	WL/WA	6
Hungary	SZIE	pest control	sunflower	HL/HA	6
Hungary	SZIE	pest control	sunflower	Control	6
Netherlands	DLO	Pollination and Pest control	pear	WL/WA	6
Netherlands	DLO	Pollination and Pest control	pear	HL/HA	6
Netherlands	DLO	Pollination and Pest control	pear	Control	6

¹ WL = Woody Linear, HL = Herbaceous Linear, WA = Woody Areal, Control = other crop

Data collection for the pest control ecosystem service

The ecosystem pest control was investigated in fields with both sentinel techniques and measurements of control of crop specific pests.

3.2 Sentinels data

3.2.1 2014

Table 2. Overview table of deployed sentinel system to measures predation in the case studies. The number of round indicates the temporal repetition within the study year, and the exposition (exposed on) whether the prey was proposed on the ground of the field or on the crop plant. Numbers are for the number of fields for each case study and prey type.

Partner	Study crop	# Rounds	Prey Exposed on	Apera spica-venti	Aphids	Calliphora larvae	Chenopodium album	Ephestia eggs	Ephestia eggs	Galium aparine	Poa trivialis	Psylla pyri
				Ground		Ground	Ground	Ground	Plant	Ground	Ground	Plant
BxScAgro	Vine med	2				18	18	18	18		18	
BxScAgro	Vine oceanic	2				18	18	18	18		18	
EULS	Oil seed rape	1				36		18	18			
EULS	Oil seed rape	2					18				18	
FDEA-ART	Oil seed rape	2					18				18	
FDEA-ART	Oil seed rape	3				18		18	18			
GWCT	Wheat	2			18	18	18	18	18		18	
SSSA	Sunflower	1					14				14	
SSSA	Olive	2				36		36	36			
SZIE-PC	Winter wheat	2		18			18			18	18	
SZIE-PC	Winter wheat	3				18		18	18			
UKL	Pumpkin	2				18	18	18	18		18	
DLO	Pear	1										18
DLO	Pear	2				18	18	18	18		18	

3.2.2 2015

Table 3. Overview table of deployed sentinel system to measures predation in the case studies. The number of round indicates the temporal repetition within the study year, and the exposition (exposed on) whether the prey was proposed on the ground of the field or on the crop plant. Numbers are for the number of fields for each case study and prey type.

Partner	Study crop	# Rounds	Prey	Adoxophyes orana	Aphids	Calliphora larvae	Chaenopodium album	Ephestia eggs	Ephestia eggs	Lucilia sericata	Meligethes Larvae	Poa trivialis
				Plant	Plant	Ground	Ground	Ground	Plant	Ground	Ground	Ground
BxScAgro	Vine med	2					18					18
BxScAgro	Vine med	3				18		18	18			
BxScAgro	Vine oceanic	1										
BxScAgro	Vine oceanic	2					18					18
BxScAgro	Vine oceanic	3				18		18	18			
DLO	Pear	1		18				54				
DLO	Pear	2							54			
EULS	Oilseed rape	1				18						
FDEA-ART	Oil seed rape	1				10		10			10	
GWCT	Winter wheat	2			18	18	18	18	18	18		18
SSSA	Sunflower	1					8					8
SZIE-PC	Winter wheat	1				18	18	18	18			18
UKL	Pumpkin	1				18		18	18			

3.3 Crop specific pest control

3.3.1 2014

Table 4. Overview table of crop specific pest (and pest control) measurements. Measurement indicates unit of assessment (number of larvae, predation on larvae, etc.) and the number of fields (# Fields) that were measured in each case study.

Partner	Study crop	Crop specific pest	Measurement	Method	# Traps	# Fields
BxScAgro	vine	European Grapevine Moth	Density of adults	Trapping Method	1/field	18
BxScAgro	vine	European Grapevine Moth	Density of larvae	field counts	160 grapes / field	18
BxScAgro	vine	European Grapevine Moth	Predation of larvae	dummy larvae	40 / field	18
BxScAgro	vine	European Grapevine Moth	Density of adults	Trapping Method	1/field	18
BxScAgro	vine	European Grapevine Moth	Density of larvae	field counts	160 grapes / field	18
BxScAgro	vine	European Grapevine Moth	Parasitism of larvae	not tested (pop level extremely low)	(Leer)	18
BxScAgro	vine	European Grapevine Moth	Predation of larvae	dummy larvae	40 / field	18
BxScAgro	vine	Green leafhopper	Density of adults	Trapping Method	1/field	18
BxScAgro	vine	Green leafhopper	Density of larvae	field counts	200 leaves / field	18
BxScAgro	vine	Green leafhopper	Predation of larvae	aphid cards	8 / field	18
BxScAgro	vine	Green leafhopper	Density of adults	Trapping Method	1/field	18
BxScAgro	vine	Green leafhopper	Density of larvae	field counts	200 leaves / field	18
BxScAgro	vine	Green leafhopper	Predation of larvae	aphid cards	8 / field	18
EULS	oilseed rape	Cabbage seed weevil	Abundance of larvae	Incubation in emergence traps	5 plants	18
EULS	oilseed rape	Cabbage seed weevil	Parasitisation of larvae	Incubation in emergence traps	5 plants	18
EULS	oilseed rape	Pollen beetle	Density of adults	Pan traps	1	18
EULS	oilseed rape	Pollen beetle	Density of adults	Tapping Method	10 plants	18
EULS	oilseed rape	Pollen beetle	Density of larvae	Dissection from flowers	all flowers 5 plants	18
EULS	oilseed rape	Pollen beetle	Density of larvae	Funnel	1	18
EULS	oilseed rape	Pollen beetle	Parasitisation of larvae	Flower dissection==> dissection	1	18
EULS	oilseed rape	Pollen beetle	Parasitisation of larvae	Funnel ==> Dissection	1	18
EULS	oilseed rape	Pollen beetle	Plant Damage	Nr./% blind stalks	10 plants	18
EULS	oilseed rape	Pollen beetle	Predation of larvae	Funnel/Cylinder traps	1	18
FDEA-ART	oilseed rape	Pollen beetle	Density of adults	Tapping Method	10 plants	18

FDEA-ART	oilseed rape	Pollen beetle	Density of larvae	Funnel	1	18
FDEA-ART	oilseed rape	Pollen beetle	Parasitation of larvae	Funnel ==> Dissection	1	18
FDEA-ART	oilseed rape	Pollen beetle	Plant Damage	Nr./% blind stalks	10 plants	18
FDEA-ART	oilseed rape	Pollen beetle	Predation of larvae	Funnel/Cylinder traps	1	18
GWCT	Wheat	Cereal aphids	Density of adults	Tiller counts	25 plants	18
GWCT	Wheat	Aphids (Sitobion avenae)	Predation of adults	Sentinel	2 plants	18
GWCT	Wheat	Cereal Leaf beetle	Plant Damage	Observation	25 plants	18
GWCT	Wheat	Orange Blossom Midge	Predation of Drosophila	Sentinel	1 card	18
SSSA	Olive	Olive Fruit fly	Density of larvae / Damage on fruits	Collection of 25 olives	4	18
SZIE-PC	winter wheat	Cereal leaf beetle	Plant Damage	% of leaf damage	bunch of plants	18
UKL	pumpkin	Aphids	density of aphids and their enemies	counting	on 5-20 leaves	18
UKL	pumpkin	Aphids	pest control tests	cage - no cage	1 leaf of a plant	15

3.3.2 2015

Table 5. Overview table of crop specific pest (and pest control) measurements. Measurement indicates unit of assessment (number of larvae, predation on larvae, etc.) and the number of fields (# Fields) that were measured in each case study.

Partner	Study crop	Crop specific pest	Measurement	Method	# Traps	# Fields
BxScAgro	Vine	European Grapevine Moth	Density of adults	Trapping Method	1/field	18
BxScAgro	Vine	European Grapevine Moth	Density of larvae	field counts	160 grapes / field	18
BxScAgro	Vine	European Grapevine Moth	Parasitism of larvae	(Leer)	(Leer)	18
BxScAgro	Vine	European Grapevine Moth	Predation of larvae	dummy larvae	40 / field	18
BxScAgro	Vine	Green leafhopper	Density of adults	Trapping Method	1/field	18
BxScAgro	Vine	Green leafhopper	Density of larvae	field counts	200 leaves / field	18
BxScAgro	Vine	Green leafhopper	Predation of larvae	aphid cards	8 / field	18
DLO	Pear	Pear psylla	Density of larvae	Berlese funnel	100 leaves per sample	18
FDEA-ART	Oil seed rape	Pollen beetle	Density of larvae	Funnel	1	10
FDEA-ART	Oil seed rape	Pollen beetle	Parasitism on larvae	Funnel/Cylinder traps	1	10
FDEA-ART	Oil seed rape	Pollen beetle	Predation of larvae	Funnel/Cylinder traps	1	10

GWCT	Winter wheat	Cereal aphids	Density	Observation	25 tillers per distance	18
GWCT	Wheat	Aphids (<i>Sitobion avenae</i>)	Predation of adults	Sentinel	2 plants	18
GWCT	Winter wheat	Cereal leaf beetle	Density & %leaf damage	Observation	25 tillers per distance	24
SSSA-PC	Olive	olive fruit fly	Predation on pupae	3 treatments	2 traps with 3 treat.	18
SZIE-PC	Winter wheat	Cereal leaf beetle	Density of larvae	counting [# of larvae (/ # of eggs)]	bunch of plants (max. 10)	18
SZIE-PC	Winter wheat	Cereal leaf beetle	Plant Damage	% of leaf damage	bunch of plants (max. 10)	18
UKL	Pumpkin	aphid (<i>Aphis fabae</i>)	population growth	standardized infestation	NA	18
UKL	Pumpkin	aphids	Density	counting on leaves	NA	18

4 Data collection pollination

4.1 2014

Table 6. Overview of all measured pollination variables for each case study. For each bordering SNH type the number of fields is provided as well as the respective number of distances in fields that were assessed (general) and number of subplot/measured plants entities for each treatment (yield/open pollination/bagging/hand pollination/visitation rate).

General					Yield			Open pollination		Bag	Hand	Visitation rate		
Partner	Study crop	Bordering SNH	# Fields	# Dis-tance	Sampling per distance	Response	# plants	# flowers/plant	Response variables			# Rounds	# observations	Method
FDEA-ART	OSR	WL	6	4	20 plants	seed mass	288	20	fruit/seed set	1	1	2	96	Plot survey
FDEA-ART	OSR	HL	6	4	20 plants	seed mass	288	20	fruit/seed set	1	1	2	96	Plot survey
FDEA-ART	OSR	NO	6	4	20 plants	seed mass	288	20	fruit/seed set	1	1	2	96	Plot survey
GWCT	OSR	WA	6	4	15 plants	seed mass	48	20	fruit/seed set	1	1	1	96	Plot survey
GWCT	OSR	WL	6	4	15 plants	seed mass	48	20	fruit/seed set	1	1	1	96	Plot survey
GWCT	OSR	HL	6	4	15 plants	seed mass	46	20	fruit/seed set	1	1	1	96	Plot survey
SSSA	SUN	WL	6	4	64 plants	seed mass	192	NA	# of fertile seeds	NA	NA	2	96	Plot survey
SSSA	SUN	HL	6	4	64 plants	seed mass	192	NA	# of fertile seeds	NA	NA	2	96	Plot survey
SSSA	SUN	NO	6	4	64 plants	seed mass	192	NA	# of fertile seeds	NA	NA	2	96	Plot survey
SZIE	SUN	WL	6	4	64 plants	seed mass	192	NA	# of fertile seeds	NA	NA	2	96	Plot survey
SZIE	SUN	HL	6	4	64 plants	seed mass	192	NA	# of fertile seeds	NA	NA	2	96	Plot survey
SZIE	SUN	NO	6	4	64 plants	seed mass	192	NA	# of fertile seeds	NA	NA	2	96	Plot survey

UKL	pumpkin	WL	6	4	64 fruit	fruit weight	102	1	number of seeds	1	NA	3	216	video
UKL	pumpkin	HL	6	4	64 fruit	fruit weight	102	1	number of seeds	1	NA	3	216	video
UKL	pumpkin	NO	6	4	64 fruit	fruit weight	102	1	number of seeds	1	NA	3	216	video
DLO	pear	WL	6	4	64 fruit	fruit size	72	1	fruit/seed set, seed weight	1	1	1	72	Plot survey
DLO	pear	HL	6	4	64 fruit	fruit size	72	1	fruit/seed set, seed weight	1	1	1	72	Plot survey
DLO	pear	NO	6	4	64 fruit	fruit size	72	1	fruit/seed set, seed weight	1	1	1	72	Plot survey
EULS	OSR	WL	6	4	20-30 plants	seed mass	288	20	fruit/seed set, seed weight	1	1	2	96	Plot survey
EULS	OSR	HL	6	4	20-30 plants	seed mass	288	20	fruit/seed set, seed weight	1	1	2	96	Plot survey
EULS	OSR	NO	6	4	20-30 plants	seed mass	288	20	fruit/seed set, seed weight	1	1	2	96	Plot survey

4.2 2015

No common data collection about pollination was performed in 2015. Each case study partner was free to complement measures from precedent years according to the results obtained with freely chosen methods but in consultation with the project and work package leaders.

5 Data collection other key services

5.1 Landscape aesthetics

Table 7. An internet survey with standardized multiple choice questions was performed in six countries. This overview table shows the sampling date of photographs for measurement of aesthetic value of landscape plus the number of retained interview for the analysis (# participants).

Country	Study crop	Adjacent crop	# Fields	start vegetation period	2. sampling	3. sampling	4. sampling	# Participants
France	Vineyard	Vineyard	18	31.3.	12.5.	23.6.	23.9.	352
Germany	Pumpkin	Rape seed / wheat	18	10.4.	22.5	3.7.	23.9.	352
Hungary	Sun flower	Rape seed / cereal	18	10.4.	22.5.	3.7.	23.9.	352
Italy	Olive grove	Olive grove	18	31.3.	12.5.	23.6.	23.9.	352
Switzerland	Oilseed rape	Wheat / intensively used grassland	18	15.4.	27.5.	8.7.	23.9.	352
United Kingdom	Wheat	Cereal	18	15.4.	27.5.	8.7.	23.9.	352

5.2 Soil erosion

Table 8. The capacity of SNH to reduce soil erosion was measured in one case study with Astroturf map (cf. D3.1 report on methods to assess other ecosystem services).

Partner	Study crop	# Fields	Method	# rounds	# astroturf mats per site
BxScAgro	Vine	14	astroturf mats soil collection	3	5

5.3 Soil fertility

Table 9. Four partner countries investigated soil fertility with two different methods.

Partner	# fields	method	subsamples per field
EULS	18	soil analysis	20
SZIE	36	soil analysis	20
BxScAgro	36	soil analysis	20
GWCT	35	soil analysis	20
SZIE	18	tea bag decomposition	16

5.4 Biodiversity conservation

No additional sampling was performed. Data collection belongs to WP2 and has been reported in D2.3 report.

5.5 Weed invasion

Table 10. Overview table about the disservice weed invasion, with infield distance, and measurement unit that are identical for both case studies reporting on this function.

Partner	Crop	# Fields	# Distance	# Transect	# Round	Measurement unit	Response
SSSA	Sunflower	30	7	64 plants	1	14m2	weed community composition
SZIE	Sunflower	32	7	64 plants	1	14m2	weed community composition

5.6 Bird damage

Bird damage was assessed using three different approaches in one case study (Netherlands, DLO)

- Social assessment: the disservice bird damage was one of the ecosystem services discussed with fruit growers during the assessment of ecological services
- Quantitative assessment: in 2015 we included bird damage as a quantitative parameter in the evaluation of the harvested fruits
- Qualitative assessment: the fruit growers participating in the project provided information on the presence or absence of bird damage in 2015

Table 11. The damage by birds as disservice was measures with 18 farmer interview and field assessment in the Dutch case study.

Partner	# Orchards	Damage assessed	Farmer interview
DLO	18	1	1

6 Data collection farming practices

The farming practices in case studies were monitored with two questionnaires targeting two different levels of management. The first aimed at the management of investigated focal fields and the second one had the goal to estimate a general farming intensity for the entire landscape sectors.

Table 12. Number of interviews performed to assess farming practices in focus fields and farming intensity in landscape sectors.

Partner	Study crop	# Rounds	# Farm interviews	# Landscape interviews
BxScAgro	Vine	1	36	36
DLO	Pear	1	18	18
EULS	Oilseed rape	1	18	18
FDEA-ART	Oilseed rape	1	18	18
GWCT	Winter wheat	1	18	18
GWCT	Oilseed rape	1	18	18
SSSA	Sunflower	1	18	18
UniPi	Olive	1	18	18
SZIE-PC	Winter wheat	1	18	18
SZIE-PO	Sunflower	1	18	18
UKL	Pumpkin	1	18	18