OSMO – a collaborative network testing knowledge and tools for resource-efficient soil health management

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Euroopan maaseudun kehittämisen maatalousrahasto: Eurooppa investoi maaseutualueisiin
Elinkeino-, liikenne- ja ympäristökeskus
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eurofins Viljavuuspalvelu
ecovin
SOIL FOOD
Rikalan Säätiö
Luonnonmukaisen tuotannon edistämissäätiö

What is soil health?

Agricultural goods	Soil-based delivery processes
Food and fibre	Nutrient capture and cycling
	OM input decomposition
	SOM dynamics
	Soil structure maintenance
	Biological population regulation

Non-agricultural services	Soil-based delivery processes
Water quality and supply	Soil structure maintenance
	Nutrient cycling
Erosion control	Soil structure maintenance
Atmospheric composition and climate regulation	SOM dynamics
Pollutant attenuation and degradation	Decomposition
	Nutrient cycling
Non-agricultural pest and disease control	Biological population regulation
Biodiversity conservation	Habitat provision
	Biological population regulation

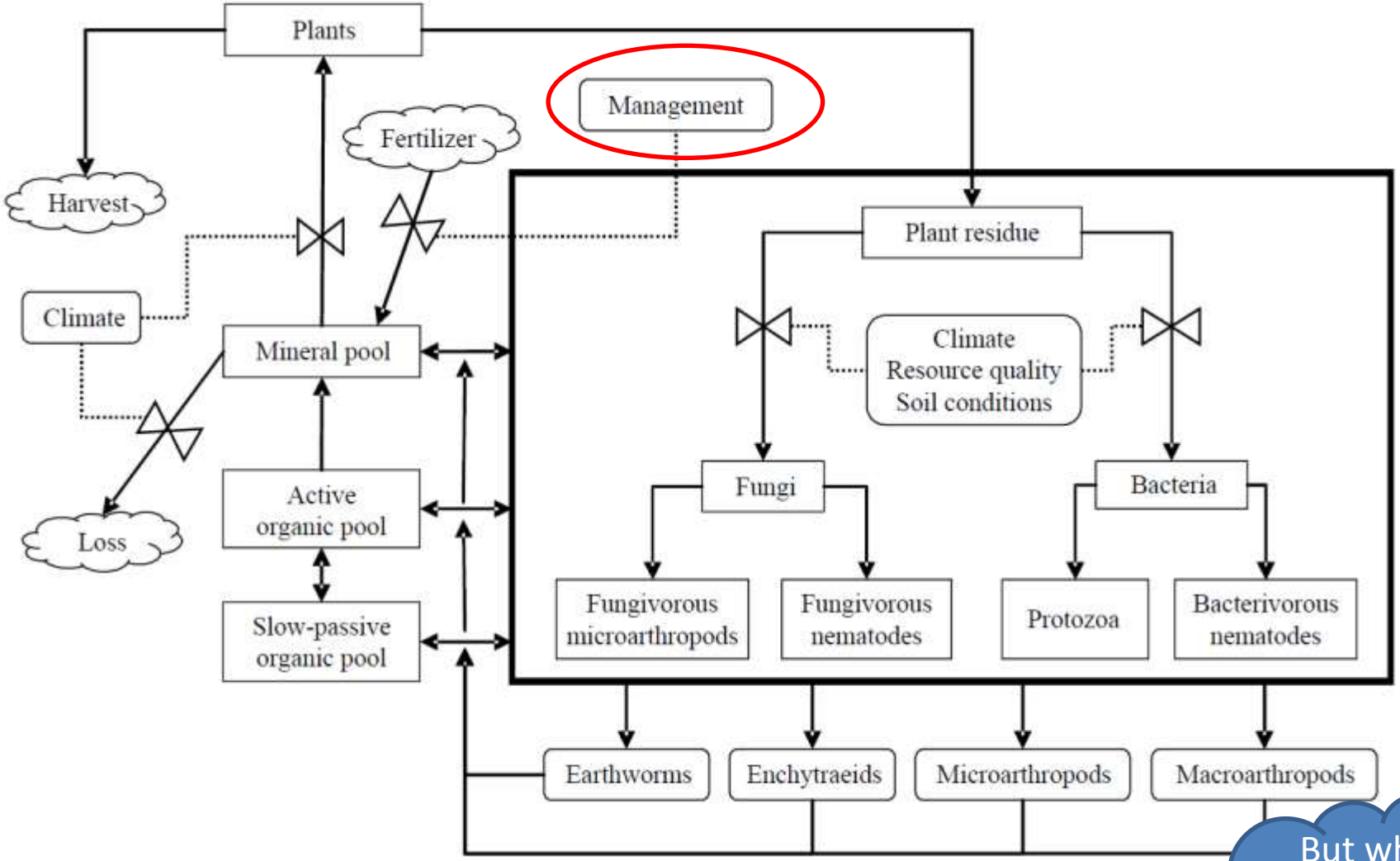
Aggregate Ecosystem functions	Functional Assemblages
1. C transformations	Decomposers • fungi • bacteria • microbivores • detritivores
2. Nutrient cycling	Nutrient transformers • decomposers • element transformers • N-fixers • mycorrhizae
3. Soil structure maintenance	Ecosystem engineers • megafauna • macrofauna • fungi • bacteria
4. Biological population regulation	Biocontrollers • predators • microbivores • hyperparasites

But why doesn't this field grow well?

Soil health in agricultural systems

M. G. Kibblewhite[1], K. Ritz[1] and M. J. Swift[2,3,*]

What is soil health?



Soil health in agricultural systems

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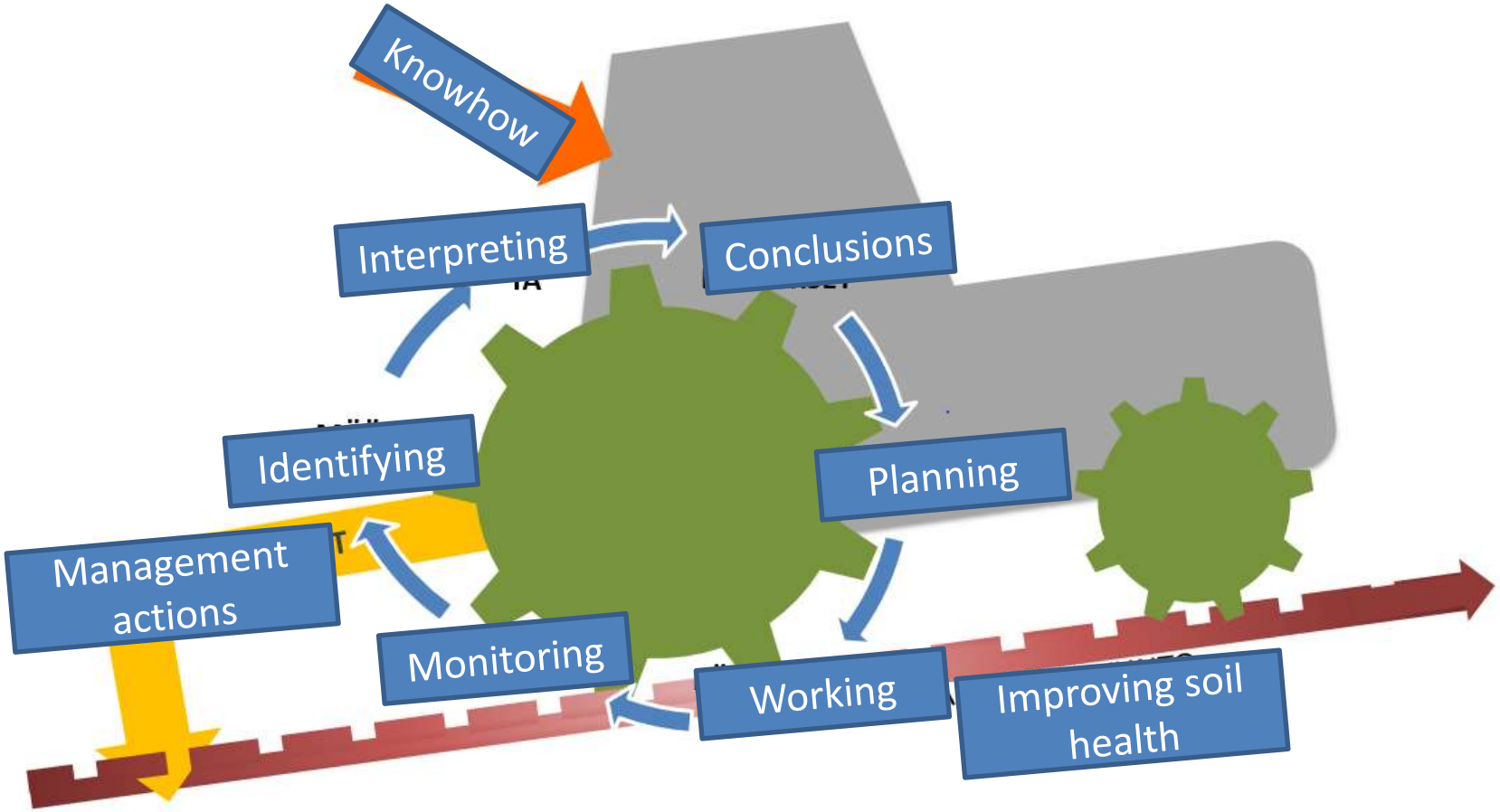
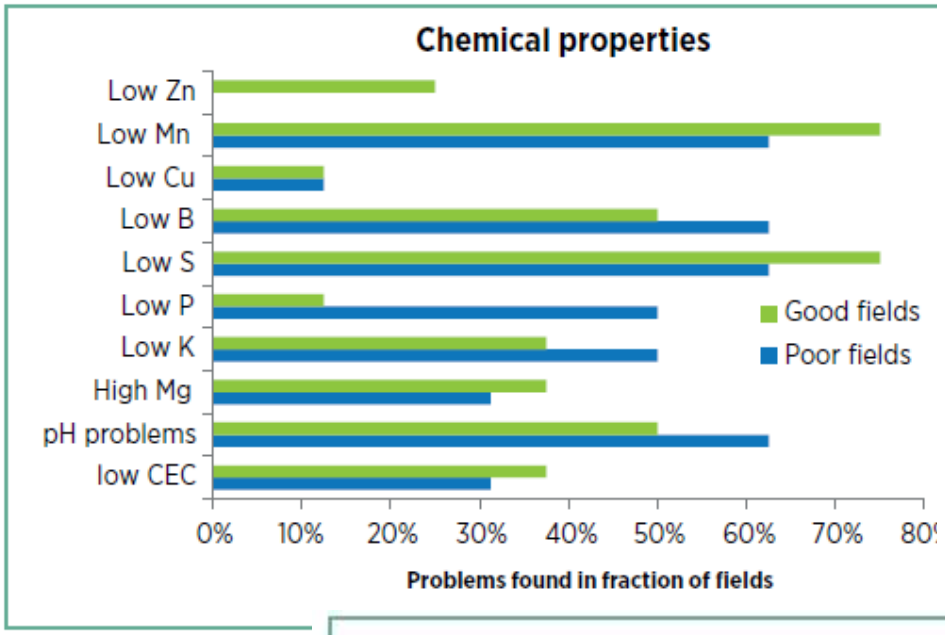
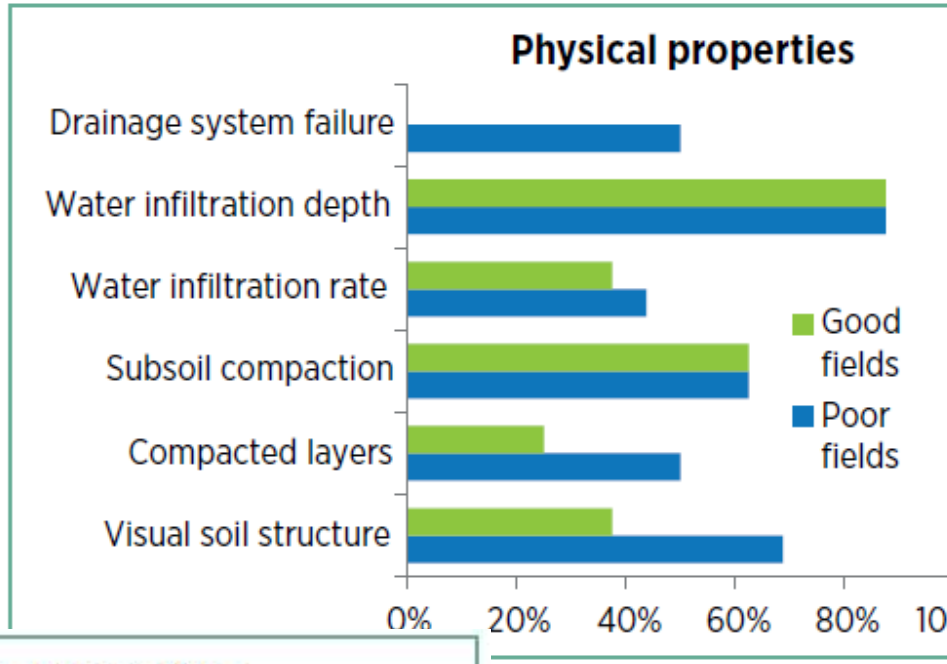
But why doesn't this field grow well?

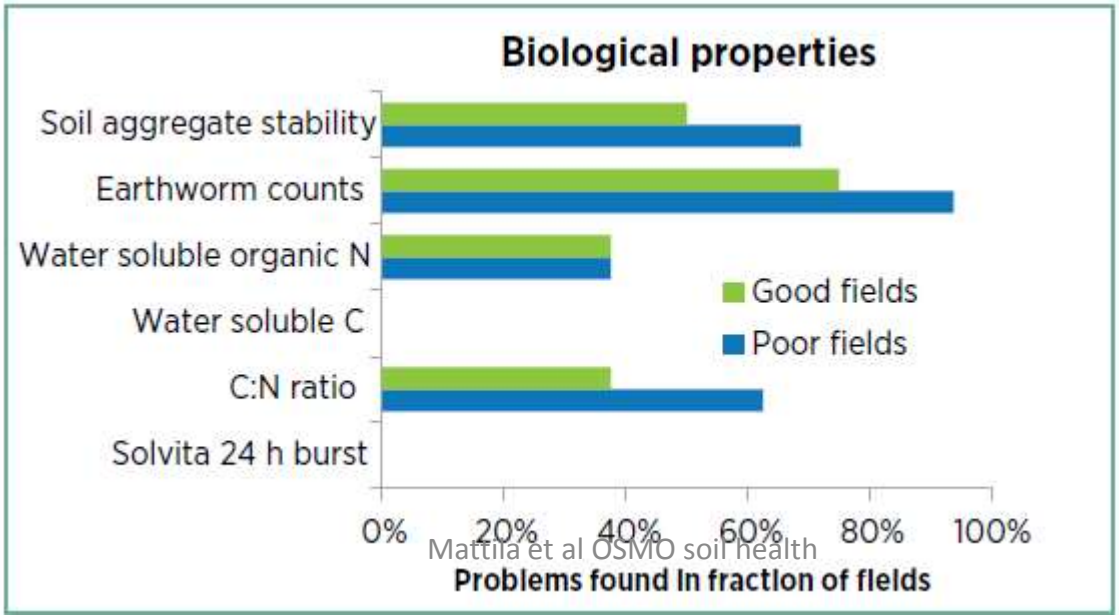
How to manage for soil health?



A small survey of ”problem fields” on eight farms



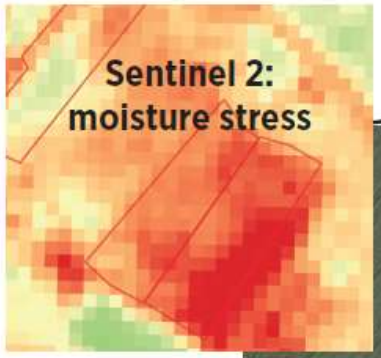


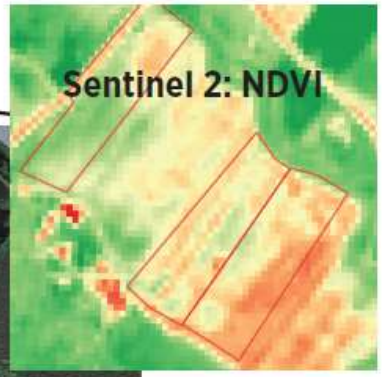


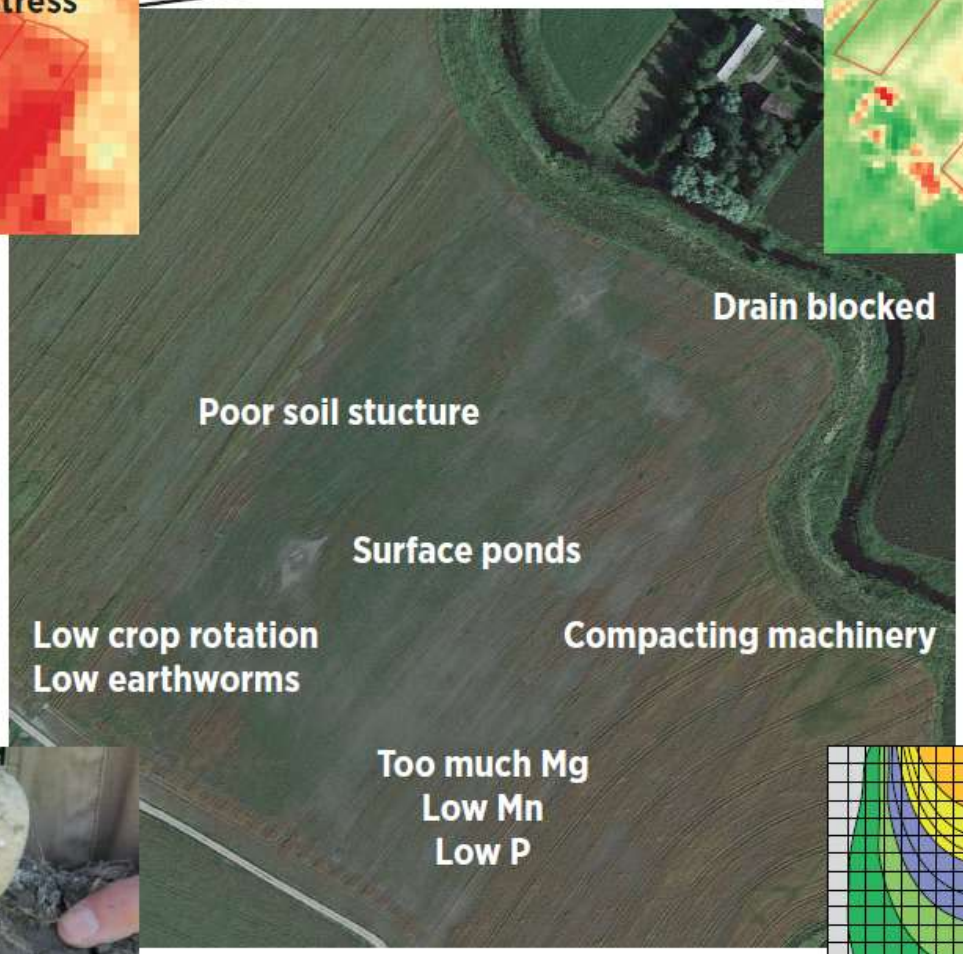
Questions to be answered

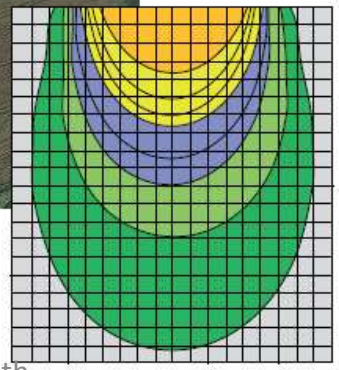
- What is wrong?
- Why? X 5
- What can be done to fix this?
- Does it work?
- Does it pay?

Example field Ju 2015









- Drain repair
- Land levelling
- Gypsum
- Subsoiling
- Cover crop
- Winter wheat
- Manganese
- Microbes

→ Results ???

Extension of research

- 5 learning groups of c.a. 20 farms each
- 6 months of intensive learning on soil health and making a soil management plan; field days
- Support for management

Tools

- Estimating cation exchange capacity, %-saturation and dispersion risks from conventional soil tests, calculating liming and organic matter increase amounts
- Whole farm soil compaction risk screening
- **Multiple criteria crop rotation evaluator**
- **Whole farm soil management plan**
- Decision making guide for prioritizing investments to soil health

Multiple criteria crop rotation evaluator

Crop rotation comparison

Farm

Date

Conventional production

Rotation 1

Crop	Area		kg/ha	€/kg	costs €/ha	Gross profit €/ha	€/lohko	Work amount h Spring	Summe	Autumn
Barley	25	ha	4000	0,130	437	591	14 787	2	0	2,5
Malting barley	25	ha	4000	0,140	441	627	15 684	2	0	2,5
Oats	25	ha	4000	0,130	402	626	15 646	2	0	2,5
Spring wheat	25	ha	4000	0,140	508	560	13 989	2	0	2,5
Rye		ha	4000	0,170	488	740	0	0	0	3,5
Rape seed		ha	1500	0,340	367	741	0	2	0	2,5
Winter rape seed		ha	2500	0,340	425	1023	0	0	1	2,5
Field bean		ha	3000	0,202	433	771	0	2	0	2,5
Green manure		ha	6000	0,000	75	379	0	0	2	0
Fodder ley		ha	6000	0,041	104	650	0	0	4	0
Ecological area		ha	4000	0,000	75	445	0	0	1	0
Cover crops		ha	2000		26	74	0	0	0	0
Total	100	ha		**Gross profit**		€	60 106	200	0	250
						€/ha	**601 €**	2	0	**2,5**

			Score
Soil health score	-1	pistettä/ha	-
Gross profit	601 €	€/ha	55
N balance	-109	kg/ha	-
C balance	-0,107	t/ha/v	15
Weeds perennial	0,25		38
Weeds spring	1,75		54
Weeds autumn	0		25
Work spring	2	h/ha	50
Work summer	0	h/ha	-
Work autumn	2,5	h/ha	63

Rotation 2

Crop	Area		kg/ha	€/kg	costs €/ha	Gross profit €/ha	€/lohko	Work amount h Spring	Summe	Autumn
Barley		ha	4000	0,130	437	591	0	2	0	2,5
Malting barley		ha	4000	0,140	441	627	0	2	0	2,5
Oats	20	ha	4000	0,130	402	626	12 517	2	0	2,5
Spring wheat		ha	4000	0,140	508	560	0	2	0	2,5
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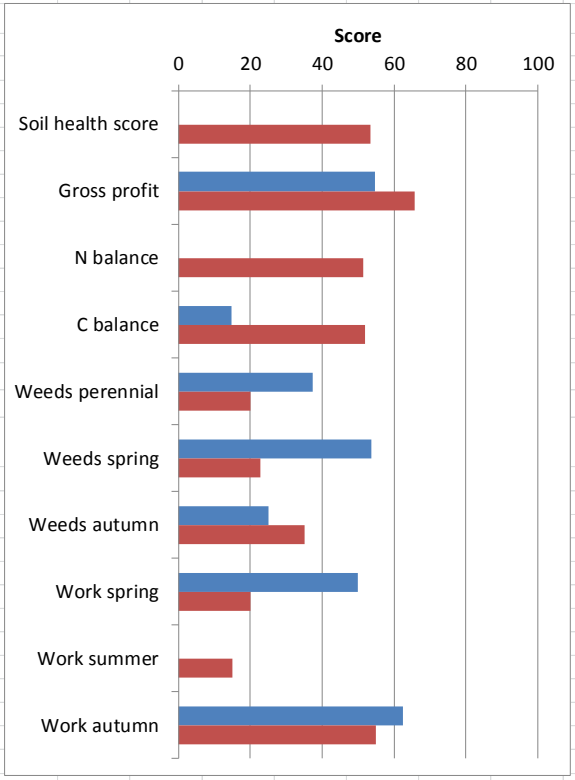
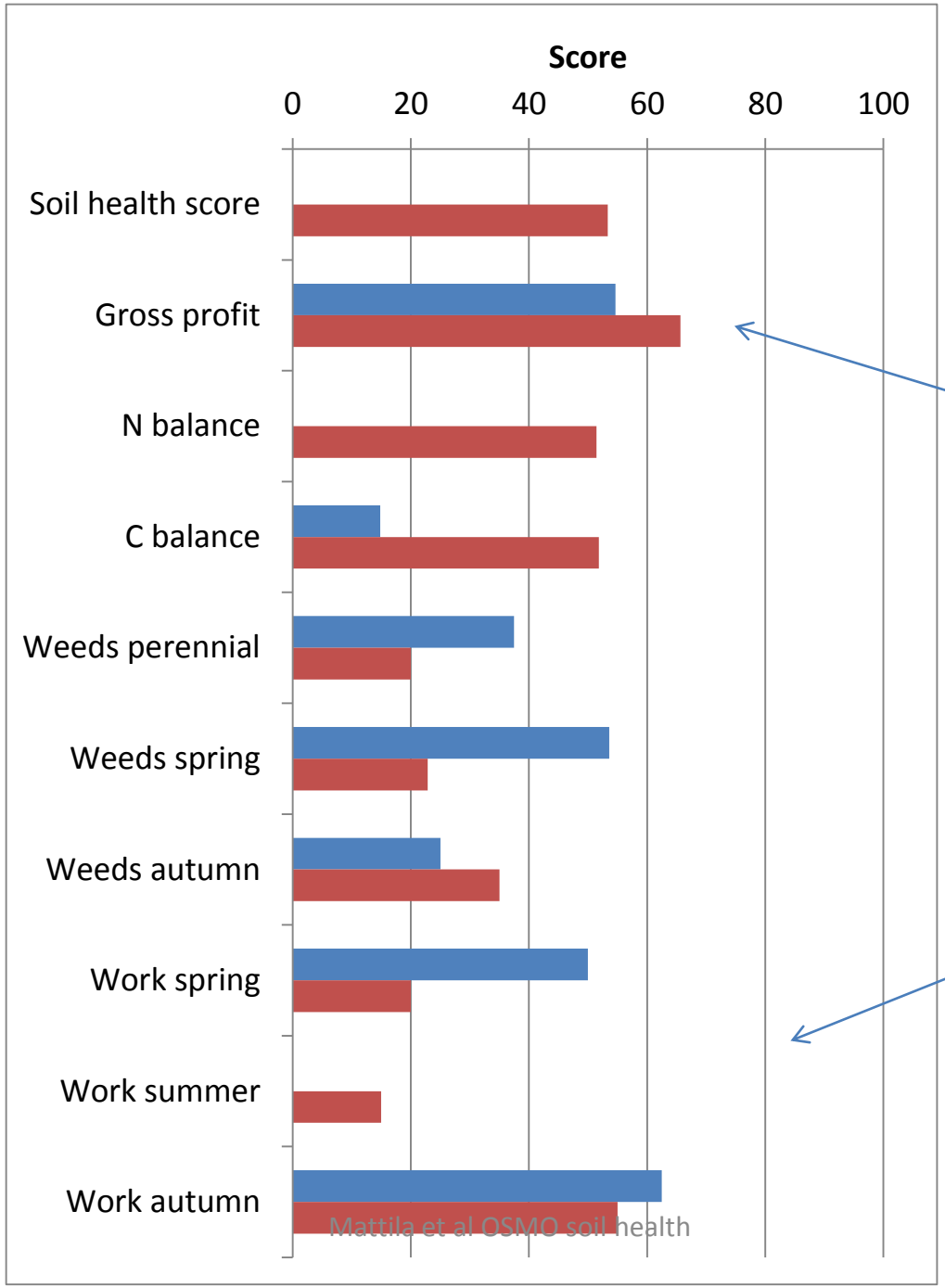
Green manure	20	ha	6000	0,000	75	379	7 580	0	2	0
Fodder ley		ha	6000	0,041	104	650	0	0	4	0
Ecological area		ha	4000	0,000	75	445	0	0	2	0
Cover crops	40	ha	2000		26	74	1 460	0	0	0
Total	100	ha		**Gross profit**		€	72 234	80	60	220
						€/ha	**722 €**	0,8	0,6	**2,2**

			Score
Soil health score	0,6	pistettä/ha	53
Gross profit	722 €	€/ha	66
N balance	-23	kg/ha	51
C balance	0,374	t/ha/v	52
Weeds perennial	-0,8		20
Weeds spring	-0,4		23
Weeds autumn	0,4		35
Work spring	0,8	h/ha	20
Work summer	0,6	h/ha	15
Work autumn	2,2	h/ha	55



Compari-son of two crop rotations



Whole farm soil management plan

Farm soil management

Farm Year

Chemical

Field	CEC	pH	Ca/Mg	P	K	B, S	Zn, Cu	Mn
Pa 0	8	1			1	1		1
He 0	33	1	-1			1		
Ha 0	35			1	1	1		
Ju 0	37	1	-1	1	1			1
Hy 0	38		-1					1
Lu 0	5				1	1		1
Kä 0	41	-1	-1	1	1	1	1	
Sa 0	14	1	-1		1			1

Physical

Field	Type	Ditches	Drainage	Compaction	Surface shape	Structure		
Pa 0	Light	1	1	1	1			
He 0	Heavy		1	1		1		
Ha 0	Heavy			1	1			
0	Light							
Ju 0	Heavy	1	1	1	1	1		
Hy 0	Heavy	1	1	1	1	1		
Lu 0	Light		1	1		1		
Kä 0	Heavy		1		1			
Sa 0	Medium		1	1		1		
0	Light							
0	Light							
0	Light							
0	Light							

Biological

Field	OM %	Roots	Worms	Aggregate	Smell	Rotation	ha	
Pa 0	5,6		1	1		Grass	1	
He 0	6,5	1	1	1		Cereals	5	
Ha 0	32	1	1	1		Root crops	1	
0						Beans	1	
Ju 0	7,3	1	1			Cover crops		
Hy 0	8,9	1	1				-181	kg C/ha
Lu 0	2,9	1	1	1		OM	-43	years
Kä 0	36	1	1	1		change 1 %		
Sa 0	5,4							

Actions

Chemical

Lime / soil improvers

Field	Material	Area	t/ha	€/t	€
Pa 0					0
He 0					0
Ha 0					0
0					0
Ju 0					0
Hy 0					0
Lu 0					0
Kä 0					0
Sa 0					0
0					0
0					0
0					0
0					0

Trace fertilizers

Mixture	€/ha	€
		0
		0
		0
		0
		0
		0
		0
		0
		0
		0
		0
		0
		0

Physical

Drainage, subsoiling

	Action	Area	€/ha	€
Pa 0		0		0
He 0		0	100	0
Ha 0		0		0
0		0		0
Ju 0		0	100	0
Hy 0		0	100	0
Lu 0		0	200	0
Kä 0		0	100	0
Sa 0		0	100	0
0		0		0
0		0	100	0
0		0		0
0		0	100	0

Equipment needs

Purchase	€

Biological

Crop rotation changes	€
	0
	0
	0
	0
	0
	0

Total cost	€/ha
All	- € - €
Top 5	- € - €

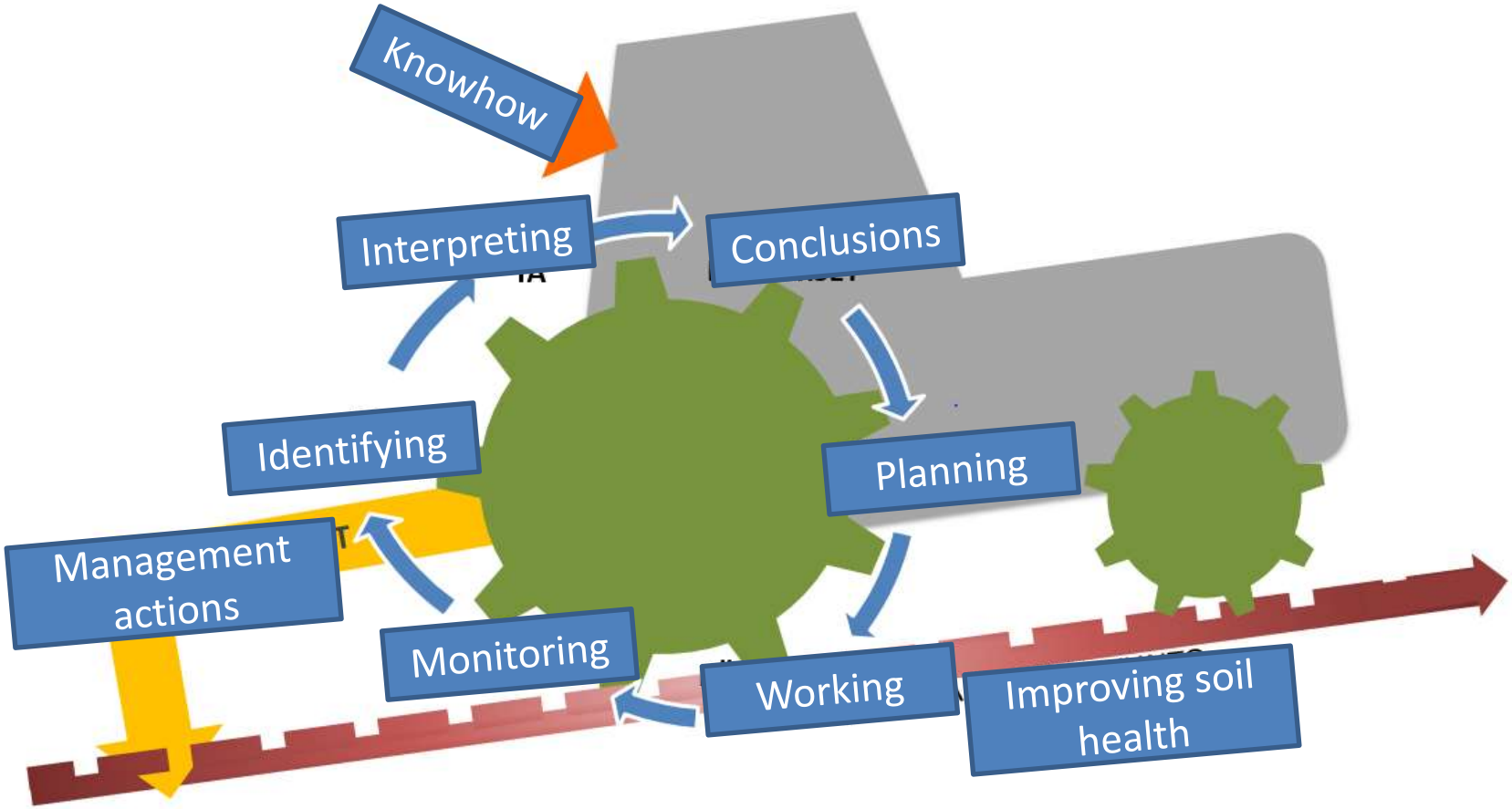
Top 5 actions

	Action	€	Assumed impact	Monitoring
1				

Is organic agriculture up to the challenge?

- Organic farming does not automatically solve all problems
- In organic farming, the impacts of soil (un)health are larger
  - There is a strong incentive for a farmer to learn more about soils

Continuous process: 2016 cycle done, 2017 monitoring starts



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