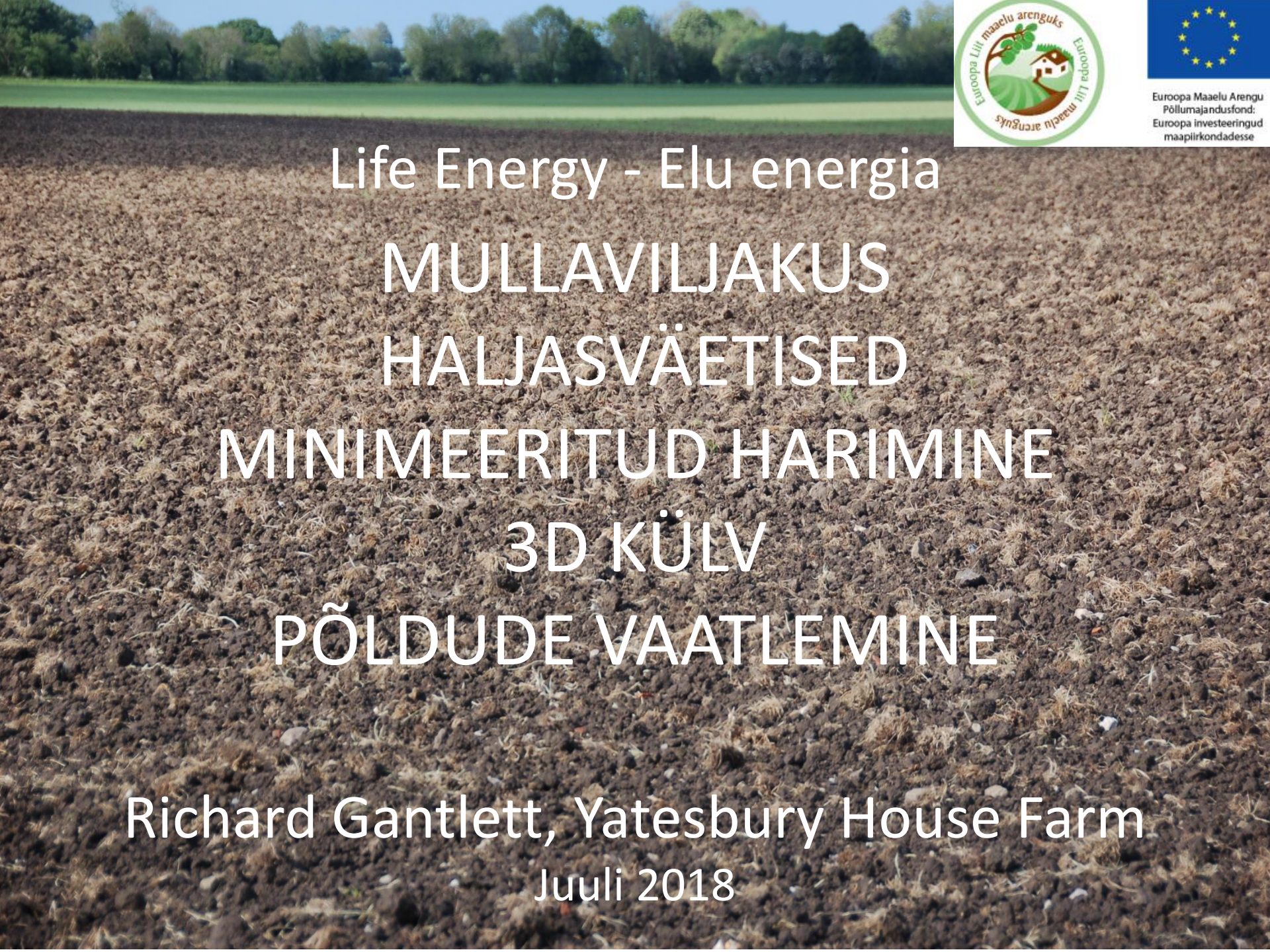


Euroopa Maaelu Arengu Põllumajandusfond: Euroopa investeeringud maapiirkondadesse

Life Energy - Elu energia

MULLAVILJAKUS
HALJASVÄETISED
MINIMEERITUD HARIMINE
3D KÜLV
PÕLDUDE VAATLEMINE

Richard Gantlett, Yatesbury House Farm

Juuli 2018

YATESBURY HOUSE FARM

Silty clay loam, over lower chalk

Rain fall:

680mm –

810mm p.a.

Here it is in good shape.

There is plenty of opportunity for slumping of soils or baking solid of wet soils.

YATESBURY HOUSE FARM

Started Organic Conversion 1998	**647 ha**
Mostly Cereals	**281 ha**
Fertility building Diverse leys	**216 ha**
Pasture permanent	**115 ha**
Woodland	**36 ha**
Aberdeen Angus Pedigree Suckler Herd	**280 head**
Farmers/Staff	**2 plus me**

YATESBURY HOUSE FARM

bio-dynamic

Our dynamic system

The resilience of the farm and its ability to produce food is embedded in the life, energy and quality of the soil.

- We have a dedicated team constantly striving to improve the farm.
- Light cultivations, no ploughing since 2003
- Diverse Ley mixture of 33 varieties of 24 species and Bio-cultivations
- Tread lightly with 4 cylinder tractors, satellite guided, latest precision innovation
- 3D sowing
- Dynamic grazing
- Working sustainably, organically andBiodynamically
- High Biomass Rotation
- Research both economic and scientific
- Closed farm to most inputs except, bulls, Seed, FSC wood chip, cattle minerals

Põllumajandusettevõtte vastupidavus ja võime toota toitu on seotud mulla elu, energia ja kvaliteediga

Context

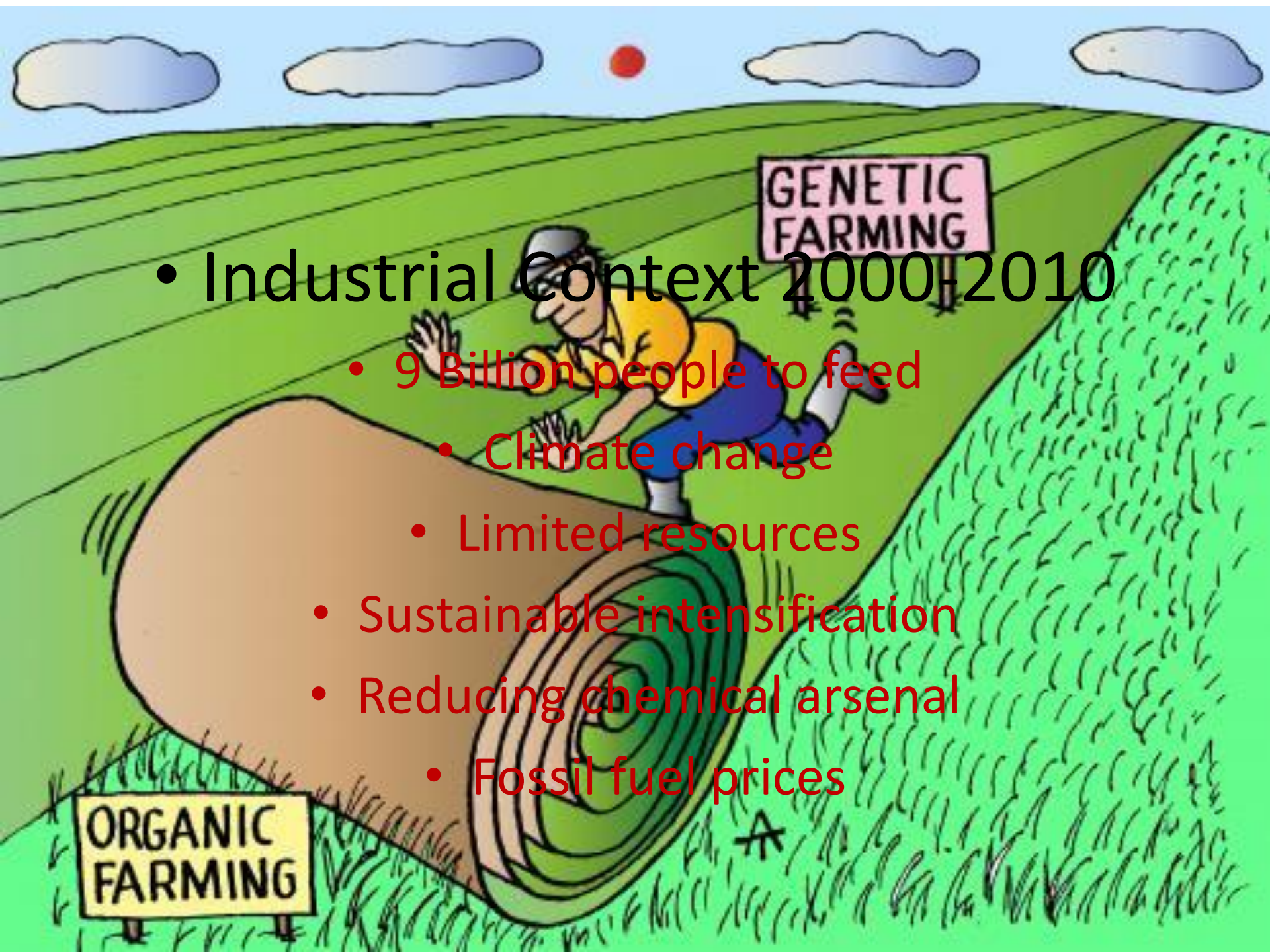
Produce and Sell food that doesn't come back

To people that do

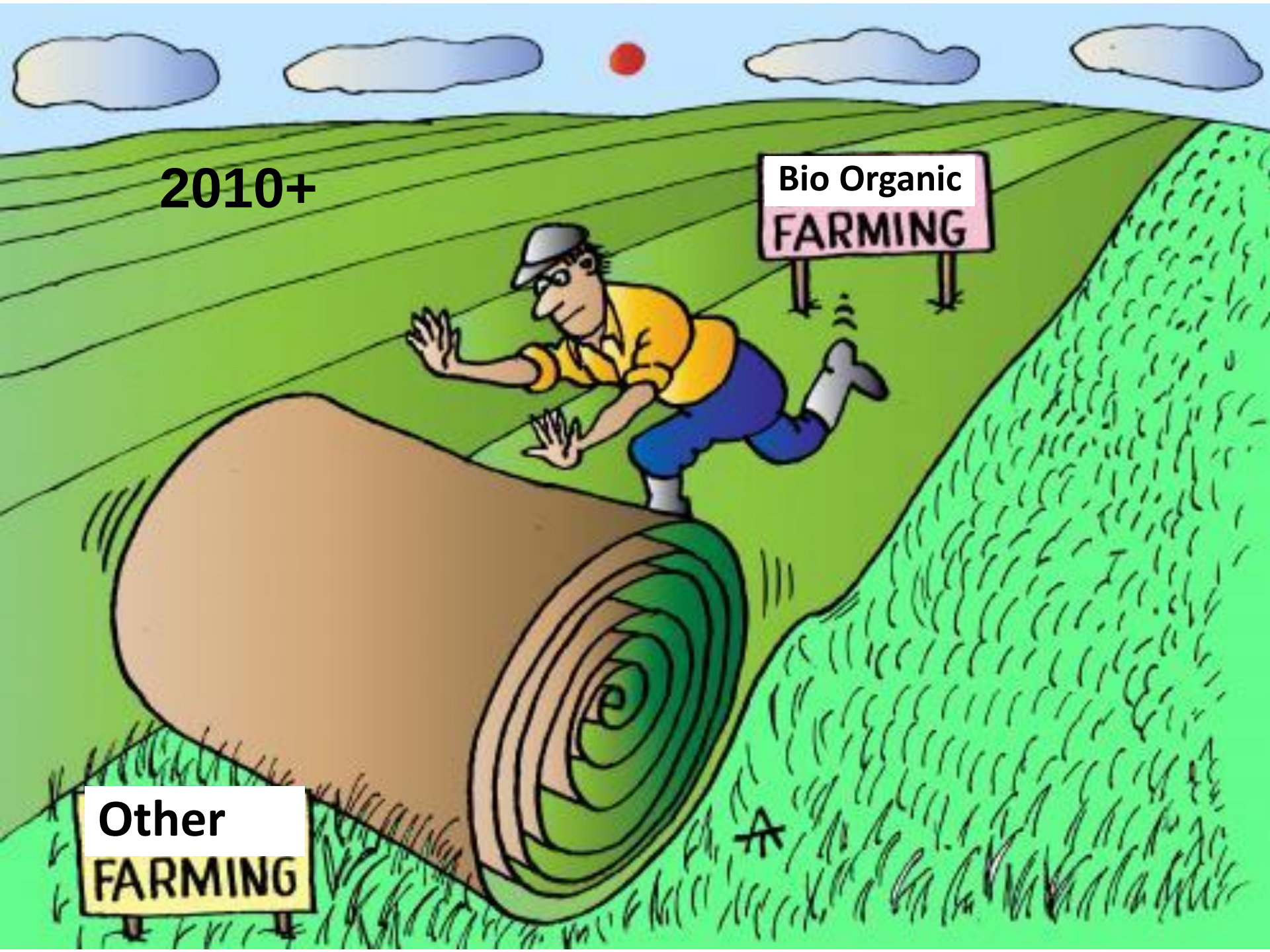
- **Quality**
- **Resilience**
- **Story- Marketing**
- **Persistance= sustainability?**

Sisu

Toota ja müüa toitu, mis ei tule tagasi
Inimestele, kes tulevad tagasi



- Industrial Context 2000-2010
  - 9 Billion people to feed
  - Climate change
  - Limited resources
  - Sustainable intensification
  - Reducing chemical arsenal
  - Fossil fuel prices


2010+
Bio Organic
FARMING
Other
FARMING

If you condense everything in farming, agriculture, food production down to one word what would you choose?

Kui te peaksite panema talupidamise, põllumajanduse ja toidu tootmise ühte sõnasse, siis millise te valiksite?

Indeed, what word summarises the goal of our endeavours as farmers?

Tõepoolest, milline sõna võtab kokku meie kui põllumajandustootjate eesmärgi?

Education is about confidence- Haridus tähendab enesekindluse andmist

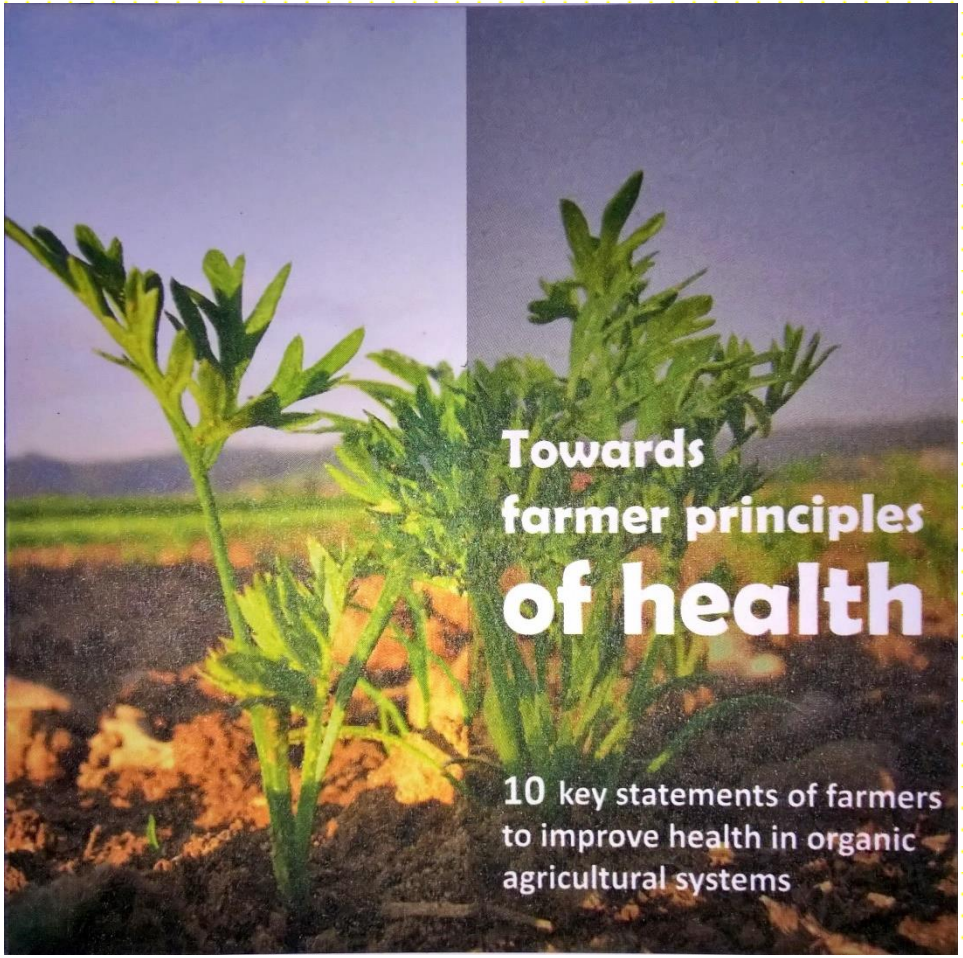
Food production is about…?

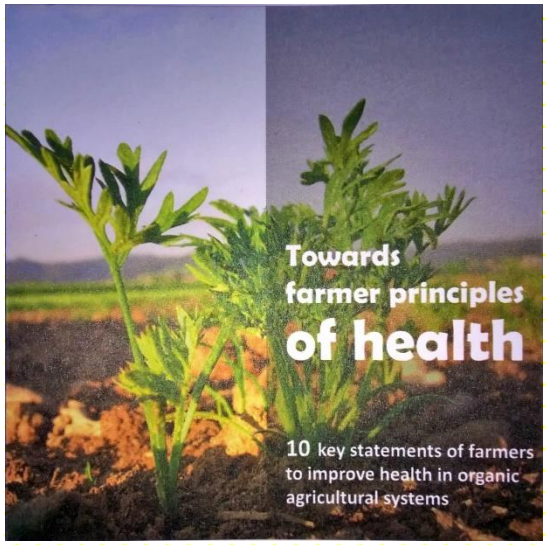
-Toidutootmine on …?

HEALTH

TERVIS

Health Project- Terviseprojekt





Health Project
Terviseprojekt

1. Soil Health
2. Biodiversity
3. Systems thinking
4. Observation skills
5. Intuition and self observation
6. Overview
7. Long-term thinking and acting
8. Shifting goals
9. Impart Health
10. Indicators

1. Mulla tervis
2. Bioloogiline mitmekesisus
3. Süsteemne lähenemine
4. Oskus vaadelda
5. Intuitsioon ja enesevaatlemine
6. Ülevaade
7. Pikaajaline mõtlemine ja tegutsemine
8. Eesmärkide muutmine
9. Mitte ainult inimeste tervis
10. Indikaatorid

This Healthy Project
Terviseprojekt

- It's about **sharing** knowledge,
- See on teadmiste jagamine
  - John may have the best idea today but next year Sheila may have the best idea,
  - Johnil võib täna olla parim idee, kuid järgmisel aastal võib Sheilal olla parim idee
- **t**ogether **e**veryone **a**chieves **m**ore. That's why I am here
- koos saavutab meist igaüks rohkem
- sellepärast olen ka mina siin

Where did I start on this process?
Science
Science is the systematic organisation of knowledge through testable ideas.

Biology

(*the study of* Life)
Bioloogia on elu uurimine

Physics is the interaction of substances and energy
Chemistry is the study of the matter of substances

All of the scientific studies of
Chemistry, Biology, Physics, Geology, Quantum Physics, Ecology,
Phenology to name a few,
must be used in combination not in isolation.
Science is a development of ideas not a static list of facts
Teadus on ideede arendamine, mitte faktide nimekiri

Challenge everything

Küsi endalt iga asja kohta

(a good scientist is good at asking questions)

- God, grant me the serenity to accept the things I cannot change;
- the courage to change the things I can;
- and the **wisdom** to **know the difference**
-

Jumal, anna mulle rahu, et nõustuda asjadega, mida ma ei saa muuta; julgust muuta asju, mida ma võin; ja tarkust, et märgata erinevust

Though as Winston Churchill said
Science should be on tap
Not on top

School of Agriculture Policy and Development

University of Reading

High Biomass Rotations: Soil health, weed burden & crop production

Richard Gantlett | Martin Lukac | Hannah Jones | Irene Mueller-Harvey

Background

- The aim of this research is to assess the economic justification for increased input of organic matter (OM).
- The project will utilise an established crop rotation at Yatesbury House Farm over a period of 5 years.
- Huntley-Palmers scholarship fund is part funding this research.

Objectives

To determine whether high biomass can :

(1) reduce the weed burden,

(2) increase the yield and quality of the grain and forage crops

(3) improve soil quality (physically in terms of structure and water holding capacity, chemically in terms of availability of nutrients and biologically in terms of active living biota)

Also to determine which are the most effective, long lasting additions of biomass/organic matter.

Experimental approach

Four fields have been chosen across the rotation to assess the whole rotation on a space for time basis, each has one research area, being subdivided into three replicates of four randomised 8m–width plots (Figure 1). Each plot has one of two treatments (standard or enhanced OM) or one of two controls (positive (DL) or negative (tilled)) .

Figure 1: Trial design per field: Three blocks of four plots

Table 1: Details of rotation standard and enhanced OM treatment

Field in 2014	Rot. Year	Crop	Standard Treatment	Enhanced Organic Matter Treatment
Long Barrow	i)	Diverse ley (DL)	Mowed for hay/silage	Topped after 15th June to promote lignin production and reduce weed seed set
	ii)	DL	Grazed	Grazed
Hut Field	iii)	Spelt	Remove straw	Chop & incorporate straw
	iv)	Spring wheat	Remove straw	Chop & incorporate straw
Fifty Acres	v)	Wheat & beans, Summer fallow	Harvested as forage silage	Cut and mulched as green manure Grow mustard mulch for following bean crop
	vi)	Winter Beans	Fallow over winter	Green cover over winter
Croft Field	vii)	Spring barley u/s with DL	Harvest as wholecrop	Chop & spread straw and green material

Variables to be measured

A baseline survey of soil organic carbon, soil structure and organic matter fractionation and then annually:

1. Soil physical integrity and water relations in drought & flood
2. Plant health, rooting depth & residue quality
3. Weed density & species
4. Harvested forage, straw or grain, yield and quality

Expectations

Economic analysis will then determine if the enhanced organic matter, organic rotation is cost effective.

Contact information
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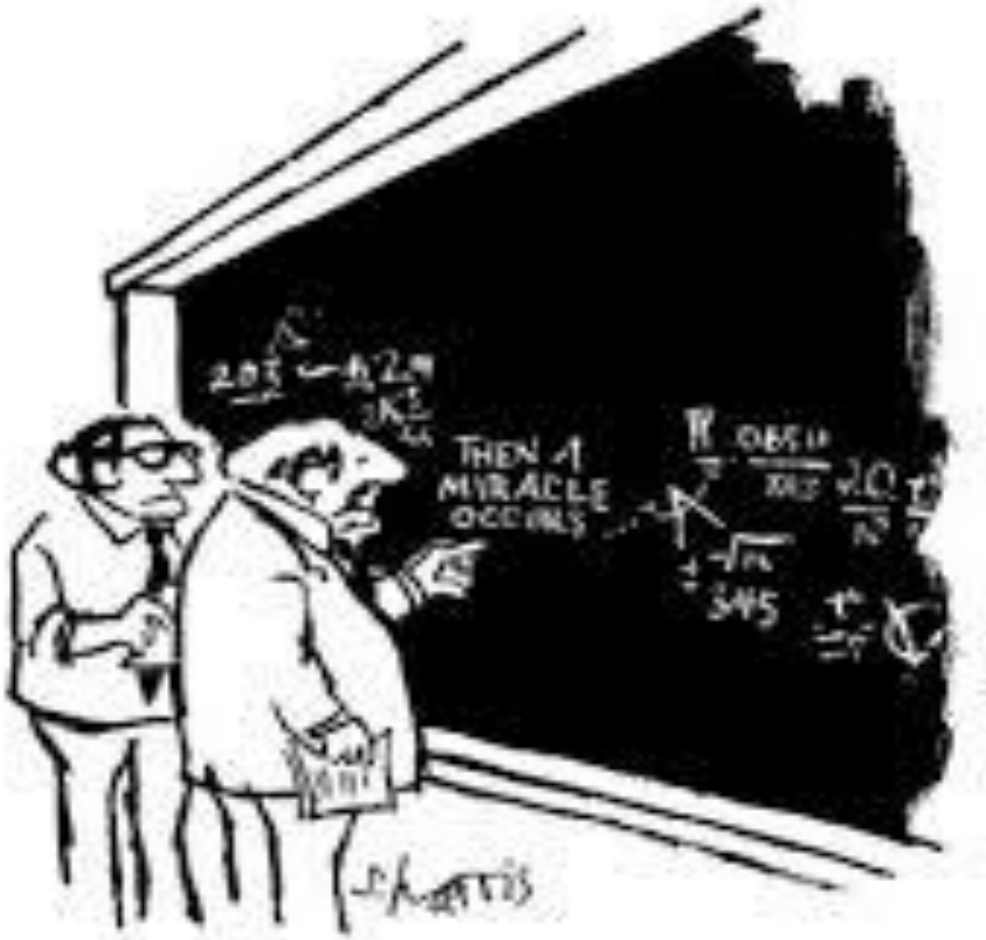
Bio-Dynamics

(*from the Greek Life-Energy*)

Richard Gantlett, Yatesbury House Farm



"I think you should be more explicit here in step two."

Bio-Dynamics sees the plant in its overall context, not just isolated in a piece of soil (Podolinsky 1989)

The influences on the plant
of
the soil,
the water
and air in the soil and atmosphere,
light and warmth of the sun,
gravity of the moon
and other forces beyond are all considered
Perhaps most important is the Farmer/Grower

The Australian Bio-Dynamic Method

This is an agro ecological farming system that has been developed by

Alex Podolinsky

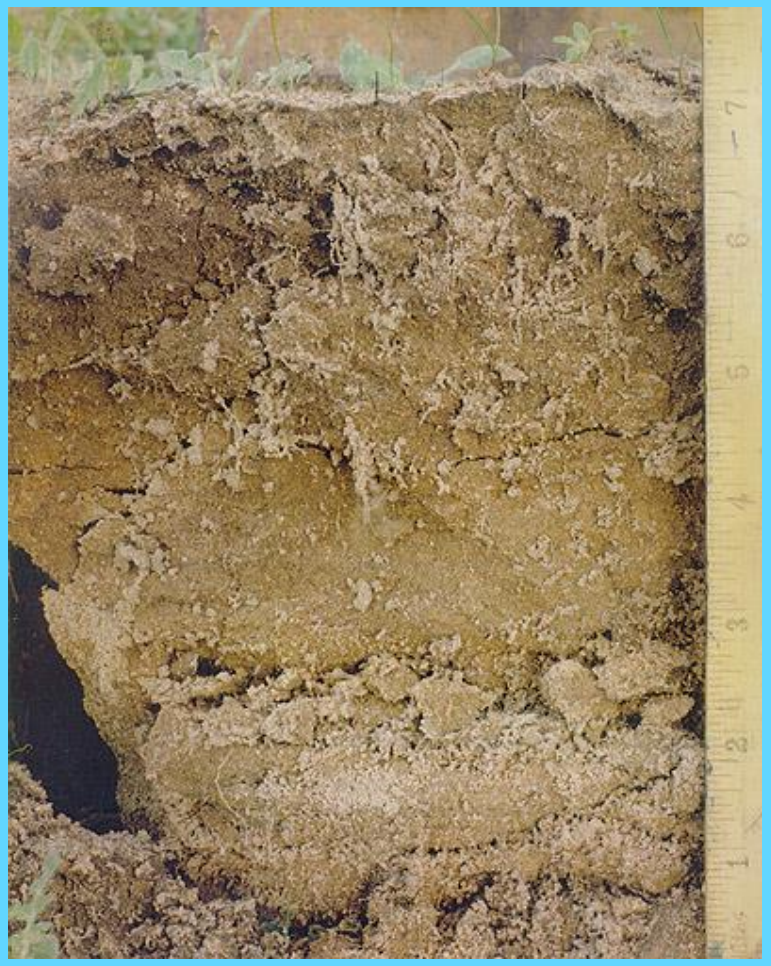
and used by

farmers, growers, viticulturists and orchardists around the world.

It is probably the single largest agroecological system on the planet.

Since 1952

The same soil showing typical result of one year of Australian bio-dynamic method activation, building soil structure and humus



Bio-Dynamic soil has continuing pasture growth, whereas, 20 meters distant, conventional soil and plants are under moisture stress.

Picture 1. Trevor Cobbledick's Bio-Dynamic pasture, 3 months no rain.

Picture 2. Neighbour's conventionally grown pasture, 3 months no rain.

Foundation for this method of agriculture is understanding and supporting the production of humus in the soil.

However, there is no such thing as "permanent" humus.

Humus exists only at the height of a PROCESS of continuous becoming.

"Permanent" Humus would be dead material (like peat) - nothing better than organic matter of little dynamic consequence.

Alex Podolinsky

The Yatesbury Bio-Dynamic Method

1. **Soil Care:**
2. **Weeds Care**
3. **Plant Care**
4. **Farm Care**

1. **Hoolitse mulla eest**
2. **Kanna hoolt umbrohtude eest**
3. **Hoolitse taimede eest**
4. **Hoolitse talu eest**

None of these Business systems run in isolation

Water

Air

Nutrients

Chickens

Cattle

Sheep

Pigs

Forest

Grassland

Cropping

Horticulture

Animals

Plants

What is fertility and why rotate

Thanks to friends of the earth

Fertility and Crop Rotation

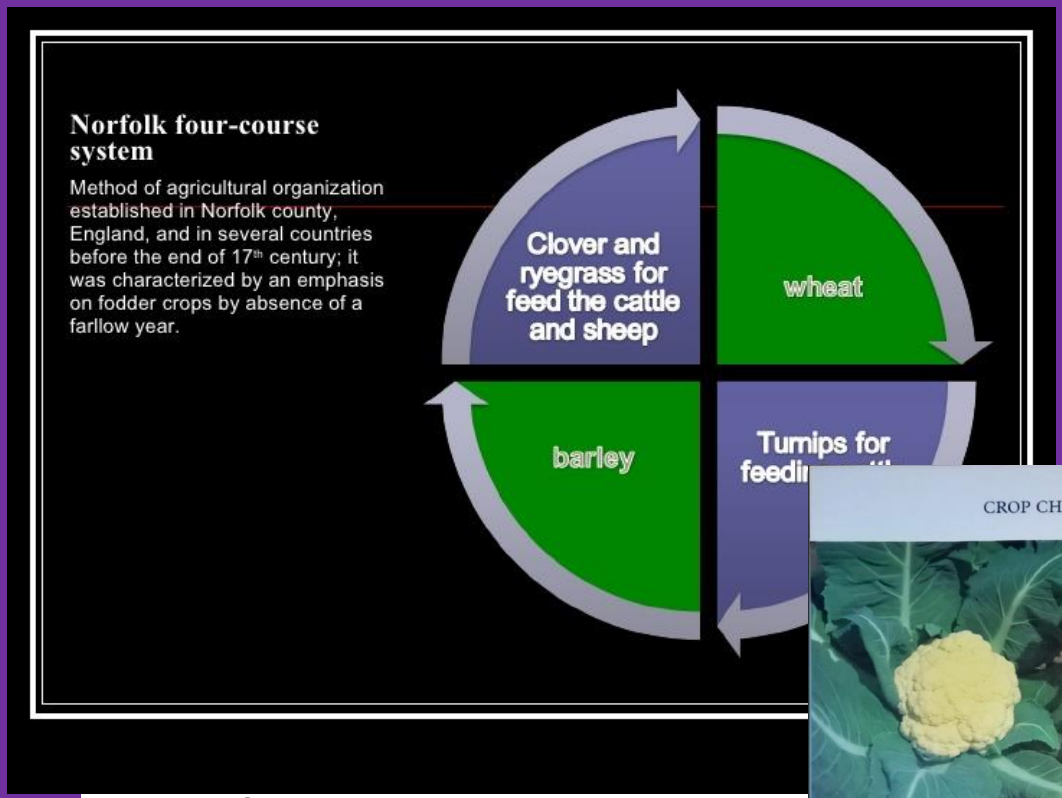
- Health in plants and animals
- What is fertility in animals?
- What is fertility in plants?
- What is fertility in soil

- Shumei!
- It is adding diversity in a time over space arrangement
- Easier than diversity all the time
- Ease of harvesting
- Avoid a build up of
  - Disease
  - Weeds
  - Pests
- Some plants take some add

Crop Rotations

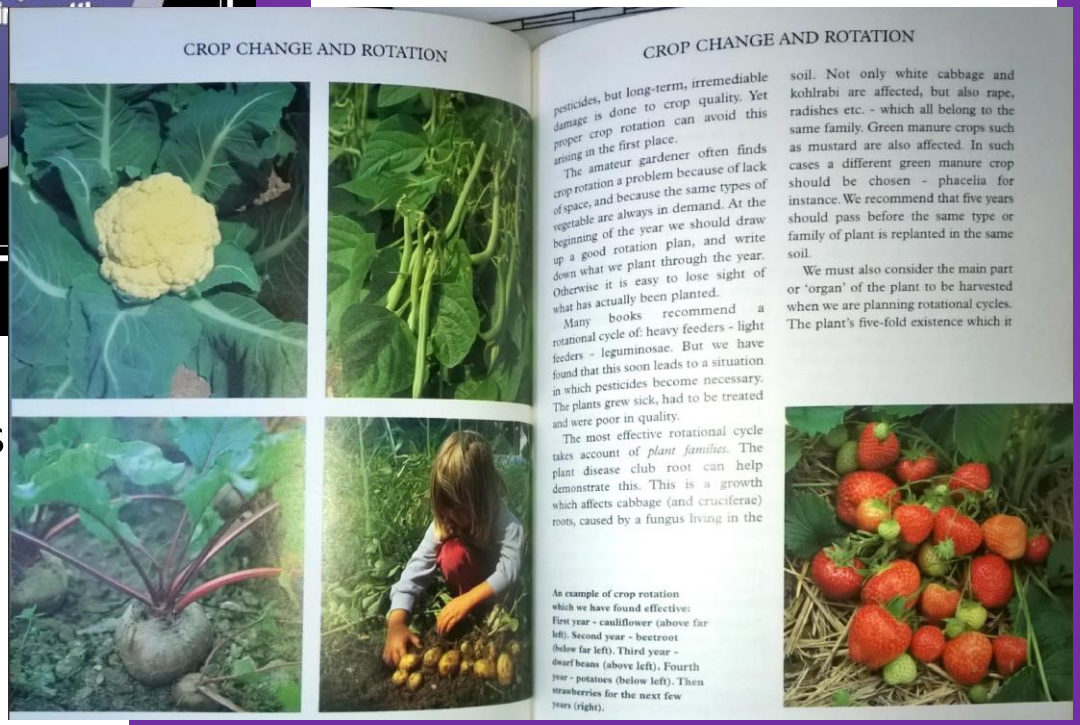
- *Rotation of crops…is the most effective means yet devised for keeping land free of weeds.*
- *No other method of weed control, mechanical, chemical, or biological, is so economical or so easily practiced as a well-arranged sequence of tillage and cropping.”*
- —C.E. Leighty.1938 Yearbook of Agriculture

- Must be planning
- Must be flexible
- Consider
  - costs
  - Income
  - Quality
  - Nutrients
  - Workload
  - Diverse to outsmart weeds
  - Labour
  - Machinery
  - Storage
  - Skills
  - Market



- Maria Thun

Leaf, root, fruit, seed, flower



Typical Organic Rotation

- 2 years red clover & rye grass
- Wheat
- Barley undersown

Look to Nature

- Does Nature rotate?
- How does nature fix Nitrogen?
- Uses diversity in situ
- Fixed by Bacteria and spread by Manure

Bi cropping Wheat and Beans at Yatesbury

Other possibilities
Peas and Oats or Barley
Lentils and Camelina
Mixtures of varieties, Composite cross populations

Nitrogen cycle-the driver of rotations

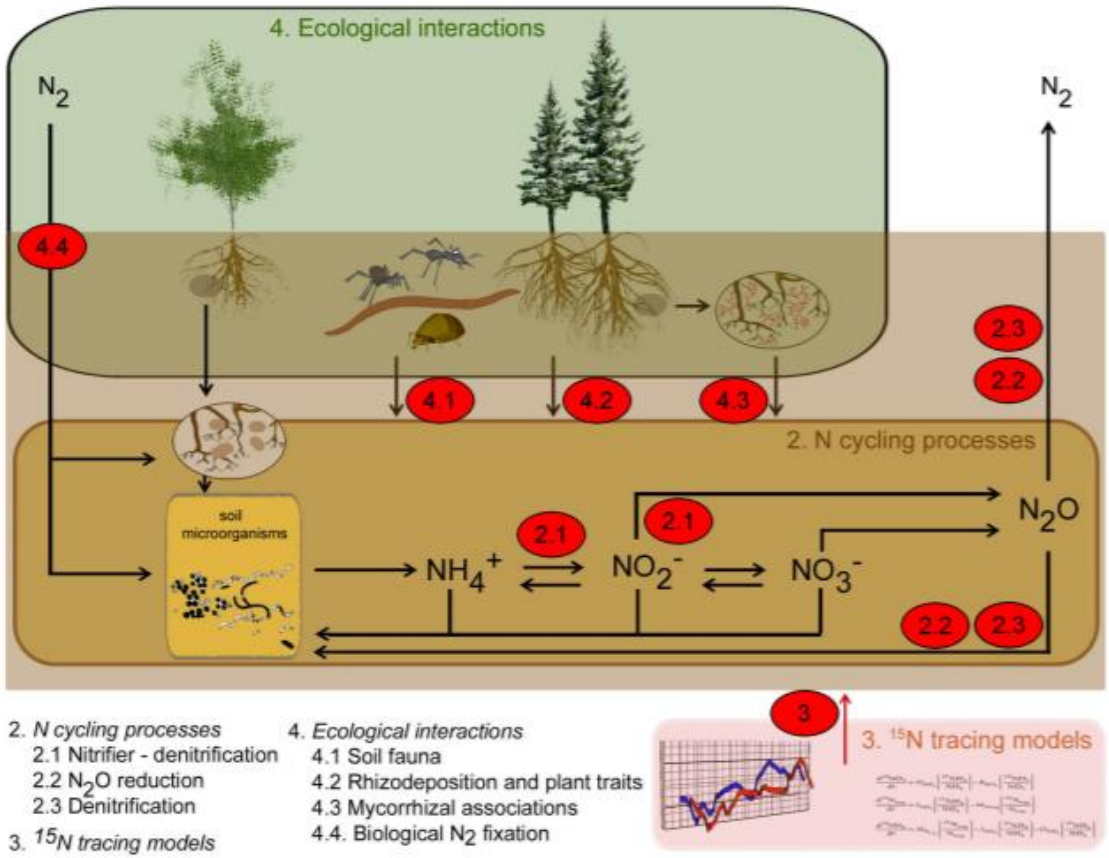


Figure 1. New insights and key challenges with respect to the soil N cycle, as identified in this paper. These include three N cycling processes (Sects. 2.1–2.3), a modelling challenge (Sect. 3), and four pathways through which ecological interactions might affect N cycling processes (Sects. 4.1–4.4).

Plant Feeding

Figure 1

Nutrients in stable soil material

Plant feeding through mycorrhizae

Plant drinking through transpiration

Plants only take up as much nutient as they need

and separately drink as much water as they need

Balanced plants

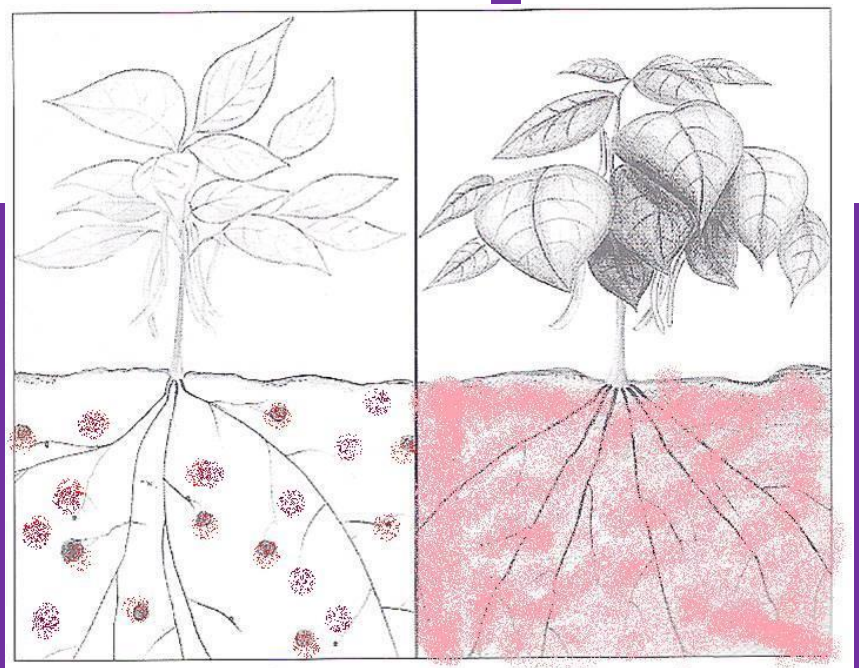


Figure 1 Figure 2

Figure 2

Nutrients in soil water

Plants take up food through transpiration i.e. Force fed

This causes cell bloating

Indicated by blue green leaf colour

Leads to pest and disease access

bitterness in fruits/leaves (see area a round cow pats which cows won't eat).

Why rotate? Fertility good for weeds too?

Weed Seed Bank Management

- What are your weed challenges?
- Weeds are good indicators of some soil condition/problems

- Encourage predation & degradation
- Weed life cycle fresh seed, seed bank, seedlings
- Blackgrass 80% decline/annum with no seed return
- Wild oat 50%
- 60 seeds per plant
- Plan=Whole crop, rouging, fallow
- Carabid. Beetle
- Blind weeding after 6+12 days
- Poaching major cause of dock est.
- Beans &Lucerne aggravate docks
- Spring fallow good for dock control?

Rotations and the fertility cycle

Summary

- Diversity
- In space
- Or time
- Driven by Nitrogen
- Legumes
- Manure
- Weed Management
- Market

INNOVATION for AGRICULTURE

A clear solution for farmers

CATCHMENT SENSITIVE FARMING

Innovation for Agriculture
Action for the River Kennet and
Catchment Sensitive Farming

present

Improving Soil Health

Thursday 19th January 2017

Soil Structure
Soil Quality
Mulla struktuur
Mulla kvaliteet

The most important constituent of soil?

With out food we live for

weeks

Without water for

days

Without air for

minutes

Air


Worms and minibeasts?

BSSS

Photo

Competition

Jackie Stroud: Earthworm in action! Earthworm feeding at night on surface organic matter (crop residues)

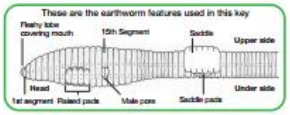
Key to common British earthworms

By David T. Jones and Chris N. Lowe

OPAL EXPLORE NATURE

Start here

These are the earthworm features used in this key



Is it more than 2cm long, AND does it have a clearly developed saddle?

The saddle is usually a different colour to the rest of the body, and slightly wider

YES → Is the whole body clearly stripy on its upper surface when moving?

It has dark red bands, with a narrower pale pink or yellowish band in between

YES → Is it greenish (dark green, yellowish green or muddy green)?

YES →

3. Green worm green form *Allolobophora chlorotica*

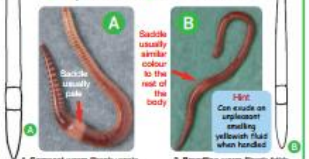
Hints
Often curls up in the hand
Yellow ring on body
Has 3 pairs of sucker-like discs (see 13)
Can exude a yellow fluid when handled

NO → It is not a mature earthworm - you can't identify it with this guide. At least 50% of the earthworms you find will be immature

YES →

Stripy earthworms

Which description best matches your worm? Is the body:
A Longer and wider or B Shorter and narrower?



1. Compost worm *Eisenia veneta* 2. Brandling worm *Eisenia fetida*

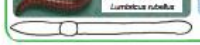
Hint Line drawings show the typical sizes of the adult earthworms

Is the body from the first segment to the saddle partly or entirely pale in colour (whitish, pink or grey)? It may have some reddish or dark segments

YES → **Pale earthworms**

NO → Return to start

Hint
Sometimes slightly flattens its tail into a paddle shape



4. Redhead worm *Lumbricus rubellus*

NO → Is the upper surface of the body, from the first segment to the saddle, entirely dark in colour (dark red, purplish red or chestnut brown)?

YES → **Red earthworms**

NO → Is the earthworm longer than 8cm when NOT moving?

YES → Are the male pores visible?

YES →

NO →

Hint
Often a dark purplish head, the rear end of the body is often much paler

5. Black-headed worm *Aporrectodea longa*

Which description best matches your worm? Is the body:
A Long and relatively thin or B Long and relatively fat?

Hint
A stout worm, of ten as thick as a pencil

6. Lab worm *Lumbricus terrestris*

Are the male pores visible?

YES → Is the swelling around the male pores covering only one segment?

YES →

7. Octagonal-tailed worm *Dendrobaena octaedra*

NO → Is the swelling around the male pores broad, covering the entire width of adjacent segments?

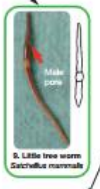
YES →

You have probably found a rare worm which is not in this key. Record it as unidentified

NO → Is a raised whitish gland visible on the underside between the saddle and head?

YES →

8. Chestnut worm *Lumbricus castaneus*



9. Little tree worm *Dendrobaena mammalis*

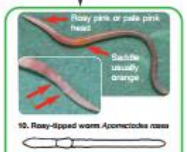
Hints
The front end up to the saddle is usually in three distinct shades: pink or pale grey, then whitish, and then darker grey.
The saddle pads usually form a two-humped ridge across three segments, but these can be difficult to see.

11. Grey worm *Aporrectodea caliginosa*

NO → Does it have a yellow ring towards the head?

NO → Does the worm have this colour combination?

NO →



10. Rosy-tipped worm *Aporrectodea rosea*

Hints
The head is usually rosy pink or pale pink up to the male pores
Often has 2 or more whitish raised pads before the male pores. The saddle is usually orange, and can be wider towards the rear end

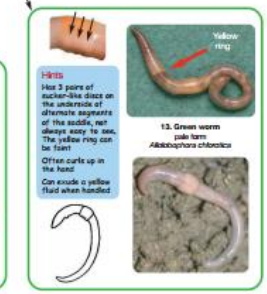
YES → Distinct yellow tail

Are the last four or five segments distinctly yellow?

Tail not yellow or only slightly yellow

YES →

12. Blue-grey worm *Octolasion cyaneum*



13. Green worm pale form *Allolobophora chlorotica*

Photographs by: Harry Taylor and Chris N. Lowe. Illustrations by: David T. Jones. Text by: David T. Jones[1,2], Chris N. Lowe, Harry Taylor[3], Paul Eggleton[4], Stephen Brooker[4], Emma Sherlock[4], Simon Norman[5], Louise Parker[6], Rebecca Foley[6], James Bone[7], Martin Heach[7], Nick Voulvoulis[8], Linda Davies[8], Carolina Bachelor[8]. [1] Imperial College London. [2] Natural History Museum. [3] Environment Agency. [4] Field Studies Council. [5] University of Central Lancashire. Supported by the Esmee Fairbairn Foundation.

FSC

The OPAL Soil and Earthworm Survey

Imperial College London

Introduction

Soil is one of the world's most precious natural resources. It is made up of water, air, minerals and organic matter, and is vital for plant survival and crop production. Soil also provides a home for a vast array of animals including earthworms, stores and filters water and provides a foundation for buildings, and therefore is important in many ways.

This fold-out guide is designed to take you through the process described below, and will refer you to the accompanying workbook for further guidance or to record data. Before you start the survey read pages 2-3 of the accompanying workbook. The survey starts by selecting your location, and recording some site characteristics (Section A). You are then asked to dig a soil "pit", and collect and separate immature and adult earthworms into groups (Section B). The next step focuses on soil properties (Section C). Following this, all adult earthworms from the soil and the pit can be studied (Section D). If you still have more time available, search for earthworms elsewhere or report any other organisms you encounter in your pit (Section E). Submit all data to the OPAL website (Section F).

The survey should preferably be performed in pairs. You are provided with enough material to sample 2 locations. You can photocopy pages 6 and 7 of the workbook for data from the second location. Try to locate your second pit in an area close by, but which looks different from the first.

The survey starts here

A Site characteristics

Choose a location to carry out your survey. Select a position to dig your soil pit. Now go to the workbook and record the pit's location, site characteristics and other information on page 6.

B Dig the soil pit

If you find glass, metal or other sharp objects, stop immediately and dig another pit elsewhere

Measure a 20cm x 20cm square and dig the soil pit to a depth of 10cm. For details on how to do this refer to page 4 of the workbook. Place the removed soil on a plastic bin bag and put any earthworms in a container.

Look at each earthworm and see if it has a well-developed saddle. Sort all earthworms found in the removed soil into 2 groups, those with saddles (adults) and those without saddles (immatures), and count the numbers in each group. Now go to page 7 of the workbook and record these numbers in Questions B1 and B2. Please rinse all earthworms with water, and return the immatures to the soil (not the pit).

If you have a camera, when you see this symbol take a photo to upload to the website

To extract the deep burrowing earthworms, mix one of the mustard sachets provided into 750ml of water and pour into the pit (this is not toxic to the earthworms). Time how long it takes until the water has drained away (up to 3 minutes). Now go to page 7 of the workbook to record this (Question B3). Collect any earthworms that emerge. Sort, count and rinse them as previously. Now go to page 7 of the workbook to record this (Questions B4 and B5).

C Soil properties

Test the properties of the soil (Questions 7-18, record on page 7 of the workbook).

7 How many plant roots are there in the soil that you have removed?

- No roots
- A few roots
- Lots of roots

8 Can you see any objects in the soil that do not look like they should naturally be there? Remember to take care when handling the soil.

- Construction material e.g. brick, concrete, cement, mortar
- Metal e.g. wire, sheeting, tin
- Glass e.g. broken bottles, other glass
- Cut wood
- Other
- None

9 Push the pointed end of a pencil or pen into the soil surface. How hard was it to push it into the soil?

- Easy
- Difficult
- Very difficult

10 Take a small amount of soil from the pit about the size of a 2p piece and put it on something waterproof. Open the sachet of vinegar and pour a few drops onto the soil.

If the soil fizzes it means it contains a mineral salt called calcium carbonate $CaCO_3$.

Does the soil fizz? Record 'yes' or 'no' in the workbook.

11 Take a handful of soil in the palm of your hand and squeeze it. How moist is the soil?

- Dry – no water (loose soil does not stick together when squeezed)

- Moist – no visible water (water does not drip out of the soil when squeezed)

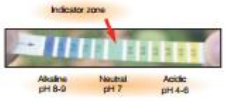
- Wet – water visible (water runs/drips out of the soil when squeezed)

12 Find out the soil's pH. Place 1cm of the removed soil into a container. Add enough water to cover the soil and stir the mixture for about a minute.

Holding the pH test strip by the arrow, completely immerse the strip in the soil solution for roughly three seconds.

Remove and quickly rinse with fresh water from the same bottle.

Hold the strip up to the light and compare the indicator zone (unprinted area) to the colour scale. Read off the printed pH value and record it.



13 Follow the Key to soil texture (see right) to find the texture of the soil.

Record the soil type in the workbook.

14 Smell the soil ribbon, does the soil have:

- A sour, putrid or chemical smell?
- No smell?
- An earthy, sweet, fresh smell?

15 What colour is the soil ribbon? Choose the nearest colour match.

D Earthworms

Using the earthworm record sheet provided on page 7 of the workbook, record the length (using the ruler provided on the guide) and colour of each adult earthworm. Using the key overleaf, and with the help of the magnifier provided in the pack, identify and record the species of each adult earthworm found.

E Additional search

If there are no earthworms in your pit and you still have more time available record the other organisms in the pit (page 8 of the workbook). Then search for earthworms in habitats within 5 metres of your pit as described on page 4 of the workbook. Follow the process outlined in Section D for any earthworms found.

When you have finished return the soil to the pit, replace any turf carefully and leave the area tidy. Take any litter away with you.

F Data submission

Upload your results and images to the OPAL website:
www.OPALexplorenature.org

Key to soil texture start here

Put some soil about the same volume as an egg in the palm of your hand. Add drops of water and work the soil with your fingers to break down any lumps. Add sufficient water until the soil is evenly moist and feels like putty. A

Squeeze the soil in your palm. Can you form it into a ball? A

- NO → a Sand
- YES → Can you pinch the ball to make a flat ribbon of about 3mm thickness? A
  - NO → b Loamy sand
  - YES → Now feed the ribbon through your hand so that it supports its own weight. A
    - Is the soil 'ribbon' less than 2.5cm long before it breaks?
      - YES → Take a pinch of soil and add water to make it very wet. Rub it between your fingers. How gritty does the soil feel?
        - Very gritty → c Sandy loam
        - In between → d Silty loam
        - Very smooth → e Loam
      - NO → Is the soil 'ribbon' between 2.5cm and 5cm long before it breaks?
        - YES → Take a pinch of soil and add water to make it very wet. Rub it between your fingers. How gritty does the soil feel?
          - Very gritty → f Sandy clay loam
          - In between → g Silty clay loam
          - Very smooth → h Clay loam
        - NO → Is the soil 'ribbon' longer than 5cm before it breaks?
          - YES → Take a pinch of soil and add water to make it very wet. Rub it between your fingers. How gritty does the soil feel?
            - Very gritty → i Sandy clay
            - In between → j Silty clay
            - Very smooth → k Clay

Safe fieldwork

We don't advise you to work on your own. Make sure that you know what to do in an emergency. Take a responsible friend who can help if things go wrong. Ensure that you have permission from the landowner to dig holes on their land. Wear plastic gloves and wash your hands before eating. Cover any open wounds before starting the activity.

FSC Designed by FSC Publications www.field-studies-council.org

OPAL EXPLORE NATURE

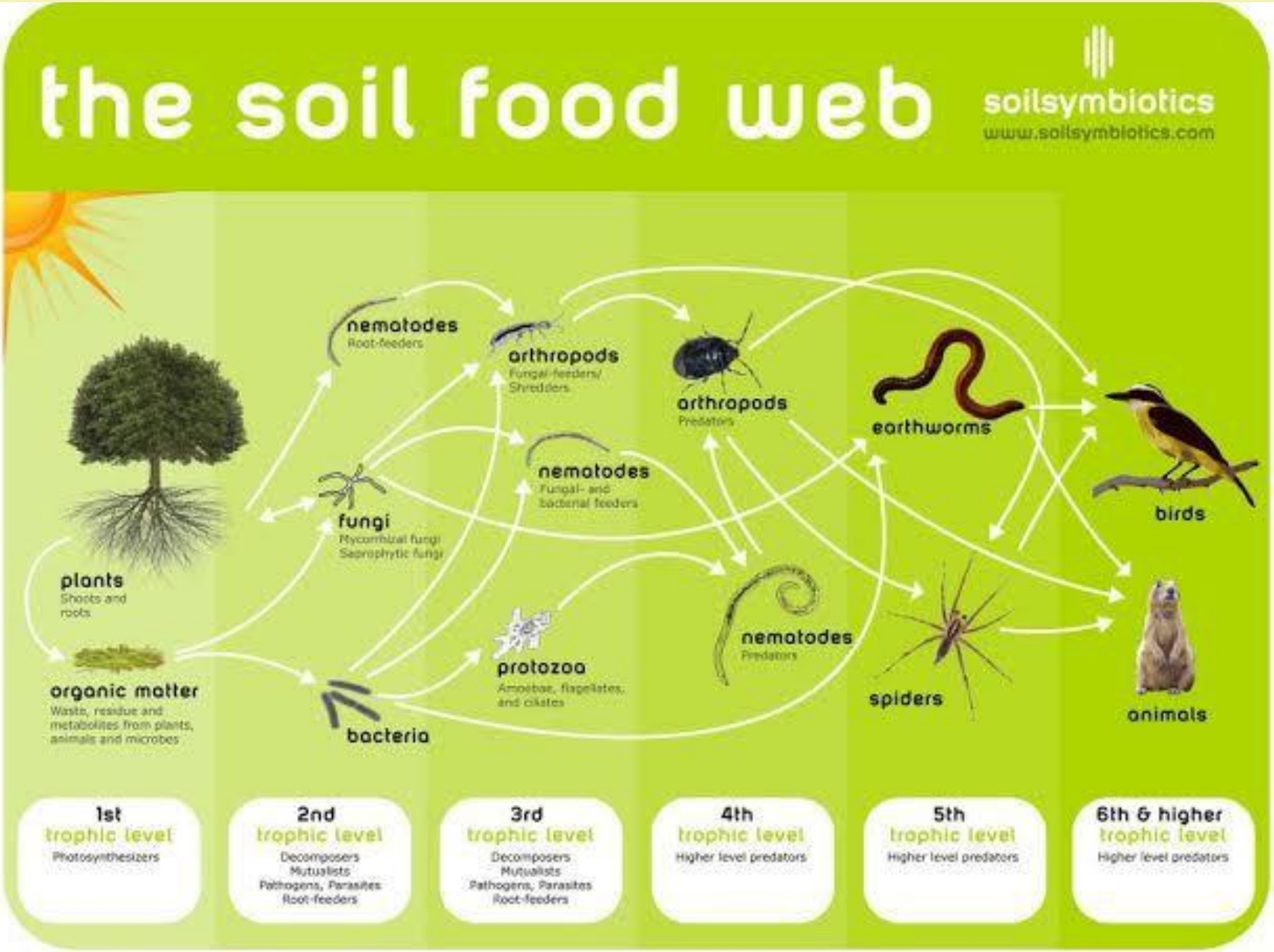
Open Air Laboratories (OPAL) is a new partnership initiative which is encouraging people to spend more time outside understanding the world around them. OPAL wants to get everybody involved in exploring, studying but most of all enjoying their local environment. OPAL will be running a programme of events and activities until the end of 2012. To find out more about events in your region please visit the website:

www.OPALexplorenature.org

LOTTERY FUNDED

Photographs by: Martin Heach, Simon Norman[1], Louise Parker[1]. Text by: Martin Heach, Nick Voulvoulis[2], James Bone[3], Laura Edwards[3], Elizabeth Stevens[3], Declan Beresford[3], Tatiana Bourdin[3], David Jones[4], Paul Eggleton[4], Stephen Brooker[4], Simon Norman[5], Louise Parker[6], Rebecca Farley[6], Mark Cawdrey[7], Linda Davies[2], Carolina Bachelor[2]. [1] Imperial College London. [2] Natural History Museum. [3] Environment Agency. [4] Field Studies Council.

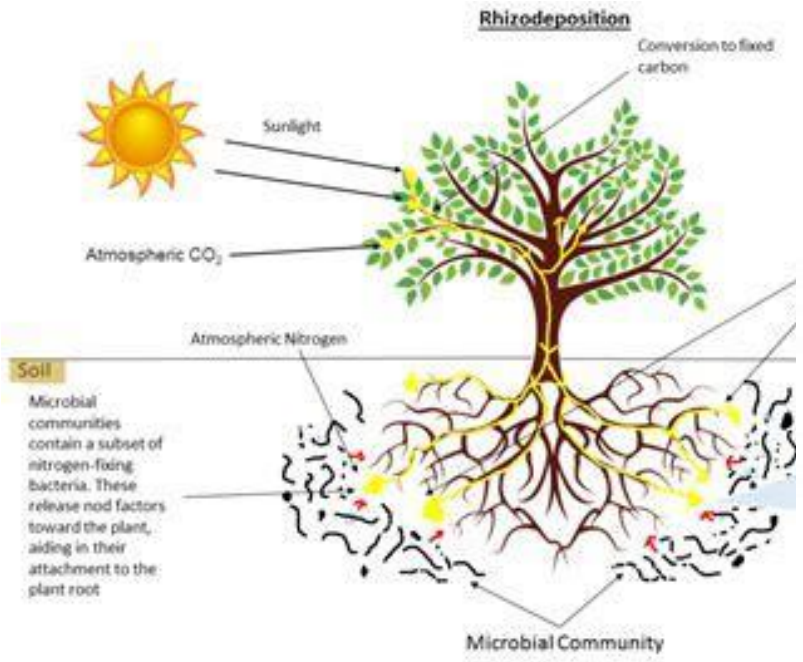
https://www.opalexplorenature.org/sites/default/files/7/file/soil-survey-field-guide-2014.pdf


the soil food web
soilsymbiotics
www.soilsymbiotics.com
nematodes
Root-feeders
arthropods
Fungal-feeders/
Shredders
arthropods
Predators
earthworms
birds
nematodes
Fungal- and
bacterial feeders
fungi
Mycorrhizal fungi
Saprophytic fungi
plants
Shoots and
roots
organic matter
Waste, residue and
metabolites from plants,
animals and microbes
protozoa
Amoebae, flagellates,
and ciliates
nematodes
Predators
spiders
animals
bacteria
1st
trophic level
Photosynthesizers
2nd
trophic level
Decomposers
Mutualists
Pathogens, Parasites
Root-feeders
3rd
trophic level
Decomposers
Mutualists
Pathogens, Parasites
Root-feeders
4th
trophic level
Higher level predators
5th
trophic level
Higher level predators
6th & higher
trophic level
Higher level predators

Soil-Root Biome

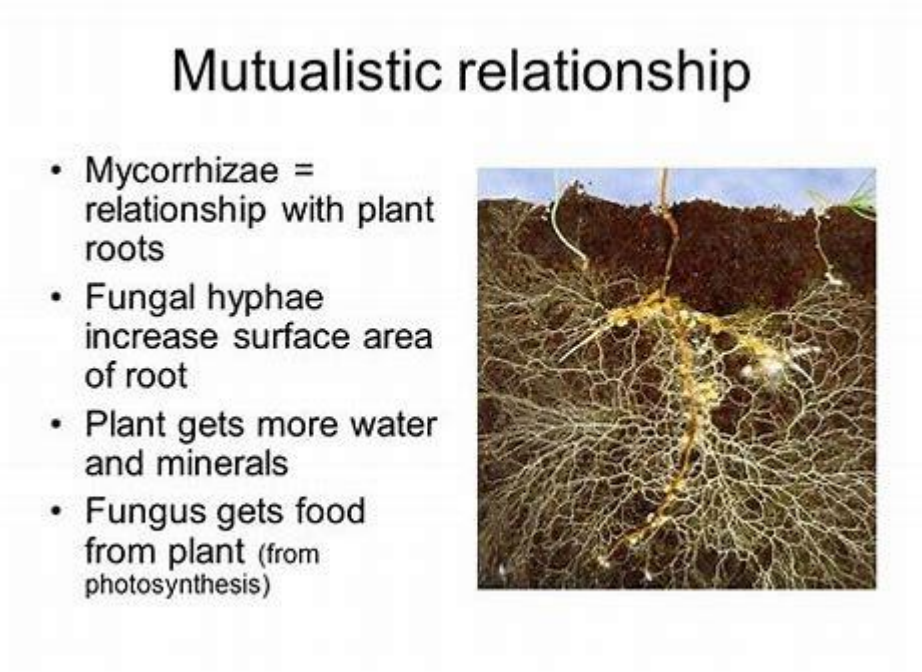
Bacteria

- Eg. Legumes



Fungi

- Eg. Arbuscular Mycorrhiza



Ian Davenport: In arid and semi-arid regions, cyanobacteria use light and water to grow filaments that bind soil particles together, forming a crust that helps to prevent erosion. Photo from Diamantina, Australia.

Soil Structure Soil Quality

- Air
- Earthworms
- Life –soil organism web
- ….plants too
- ….grazing animals

What's the point of showing you the variety of life in the soil?

Miks rääkida mitmekesisest elust mullas?

They provide ecosystem services

- That means the life in the soil allows the soil to provide the functions we expect…

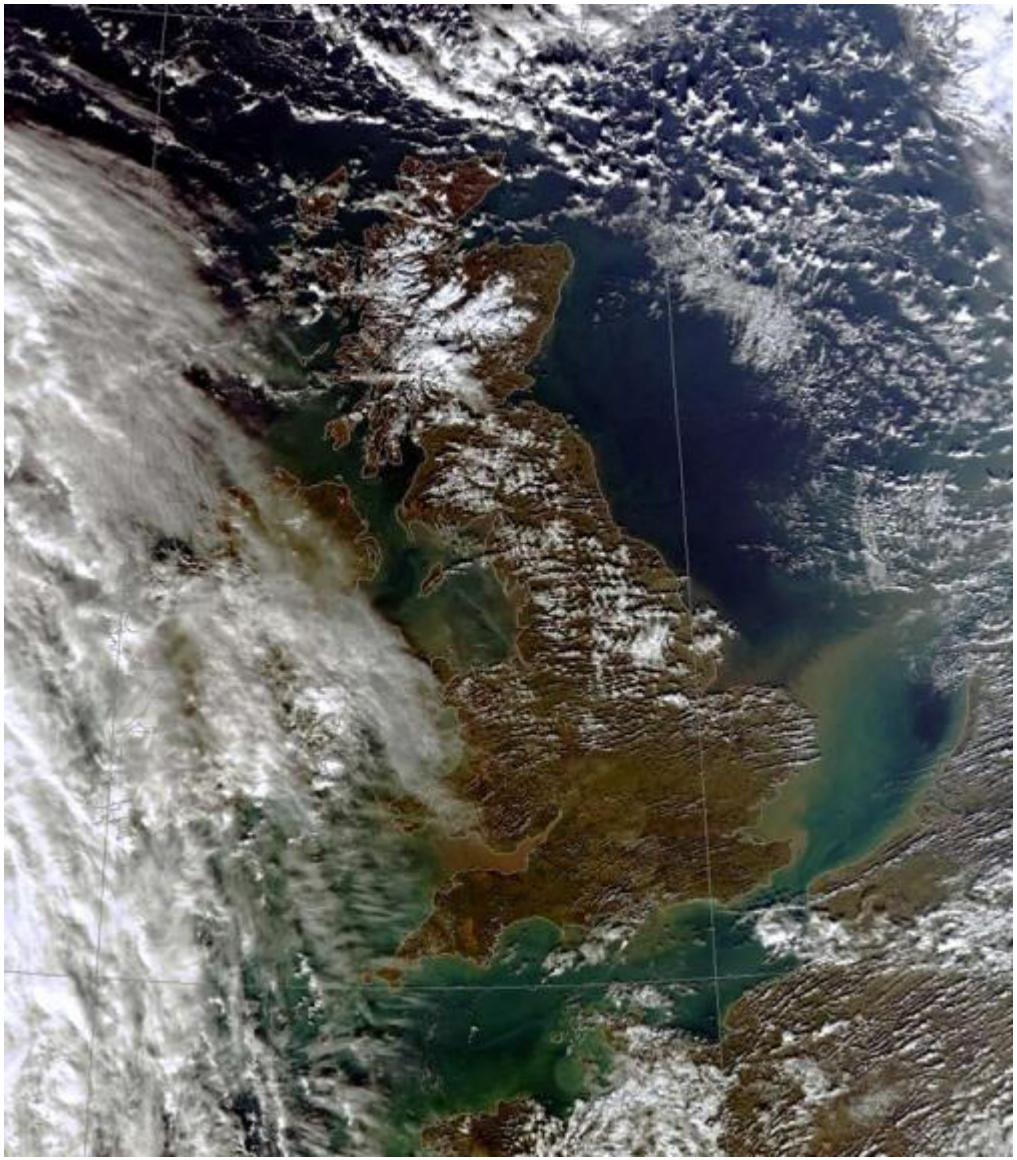
Nad pakuvad ökosüsteemiteenuseid

- See tähendab, et elu mullas võimaldab mullal pakkuda funktsioone, mida me ootame ...

Function	Mechanism	Remediation following failure
Provides structure	AMF exudates stick soil particles together in an organised fashion with moisture and air	Feed soil fungus food, these are the more recalcitrant compounds rather than fresh green plant material which makes bacterial food
Provides air and water ingress	OM feeds Biota which arrange soil particles, adding structure by gluing particles together the gaps between the structure allow air in Particularly apparent in earthworm activity	Develop SOM by feeding soil biota
Stores water	The physical lattice that is created by the soil biota provides holes for air and water to occupy	Develop SOM by feeding soil biota
Provides food for Plants	AMF, EMF access nutrients for plants	Develop SOM by feeding soil biota
Stores food for plants	Nutrients are attached to mineral particles which are also protected by the particles	Develop SOM by feeding soil biota
Prevents flooding of rivers	As the soil absorbs more water it takes longer to percolate to the river therefore water from high rainfall events become dispersed	Develop SOM by feeding soil biota
Stores Carbon for the planet	Dead plants animals and sea creatures have formed old and ancient rocks, soils and peats all of these resulted in the locking up of cardbon. Particularly in soil which are in permafrost.	Develop SOM by feeding soil biota and protect the carbon in the soil
Suppresses soil borne plant pathogens	(Janvier, Villeneuve et al. 2007, Senechkin, van Overbeek et al. 2014, van Bruggen 2015)	Develop SOM by feeding soil biota
Soil tills more easily	Why? Because the soil particle – organic bond is weaker than the soil particle – soil particle bond except when the soil is in solution?	Develop SOM by feeding soil biota
Warms soil faster	Darker colour of organic soils absorb light	Develop SOM by feeding soil biota
Prevent salinisation	Due to reduced surface evaporation in organic soils?	Develop SOM by feeding soil biota

Why am I banging on about all this?

Brown plumes of soil seen flowing into the coastal zone (Jones 2016).



What is the most critical element to organic farming (except 0xygen!)?

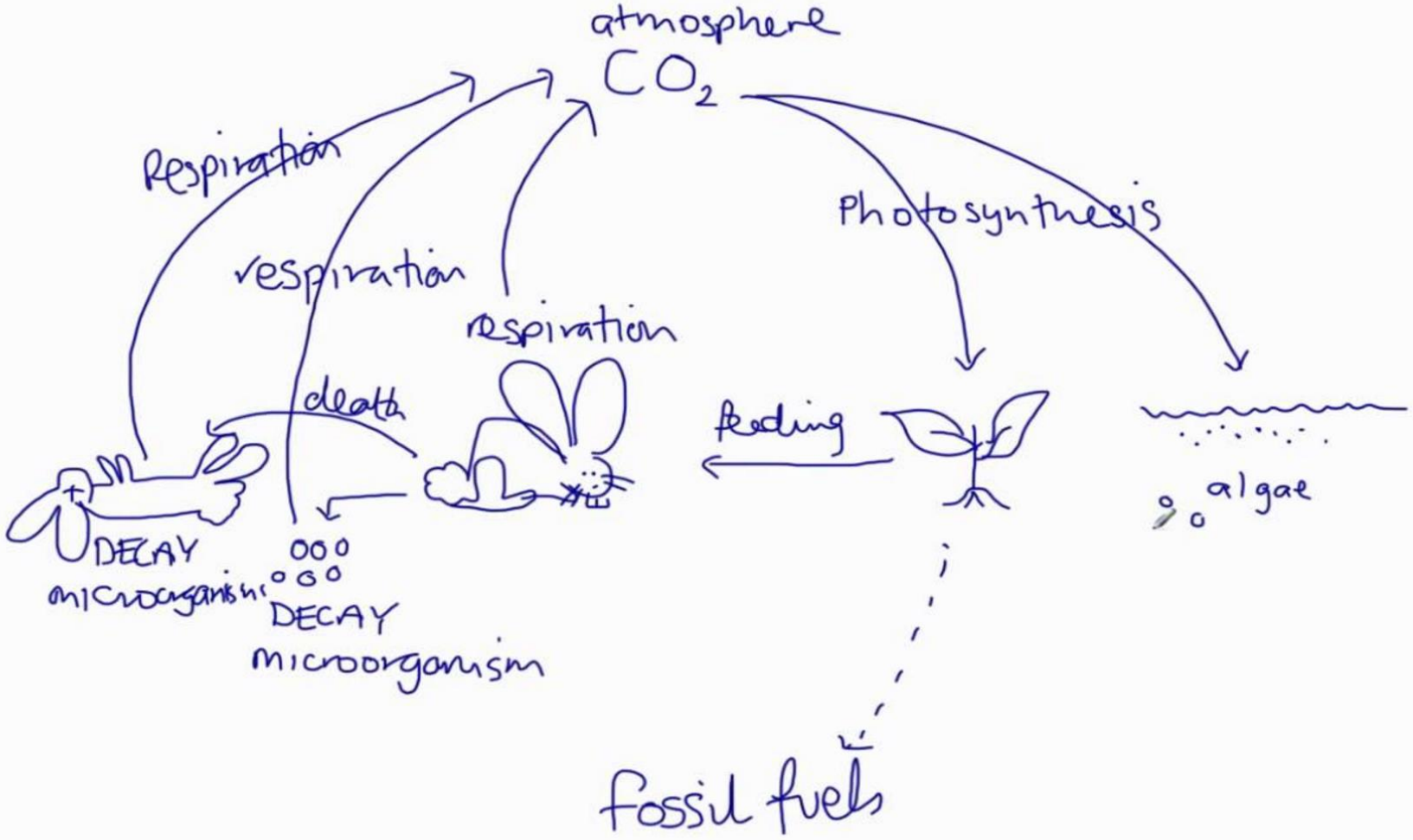
- or indeed to life on Earth

Why is carbon important?

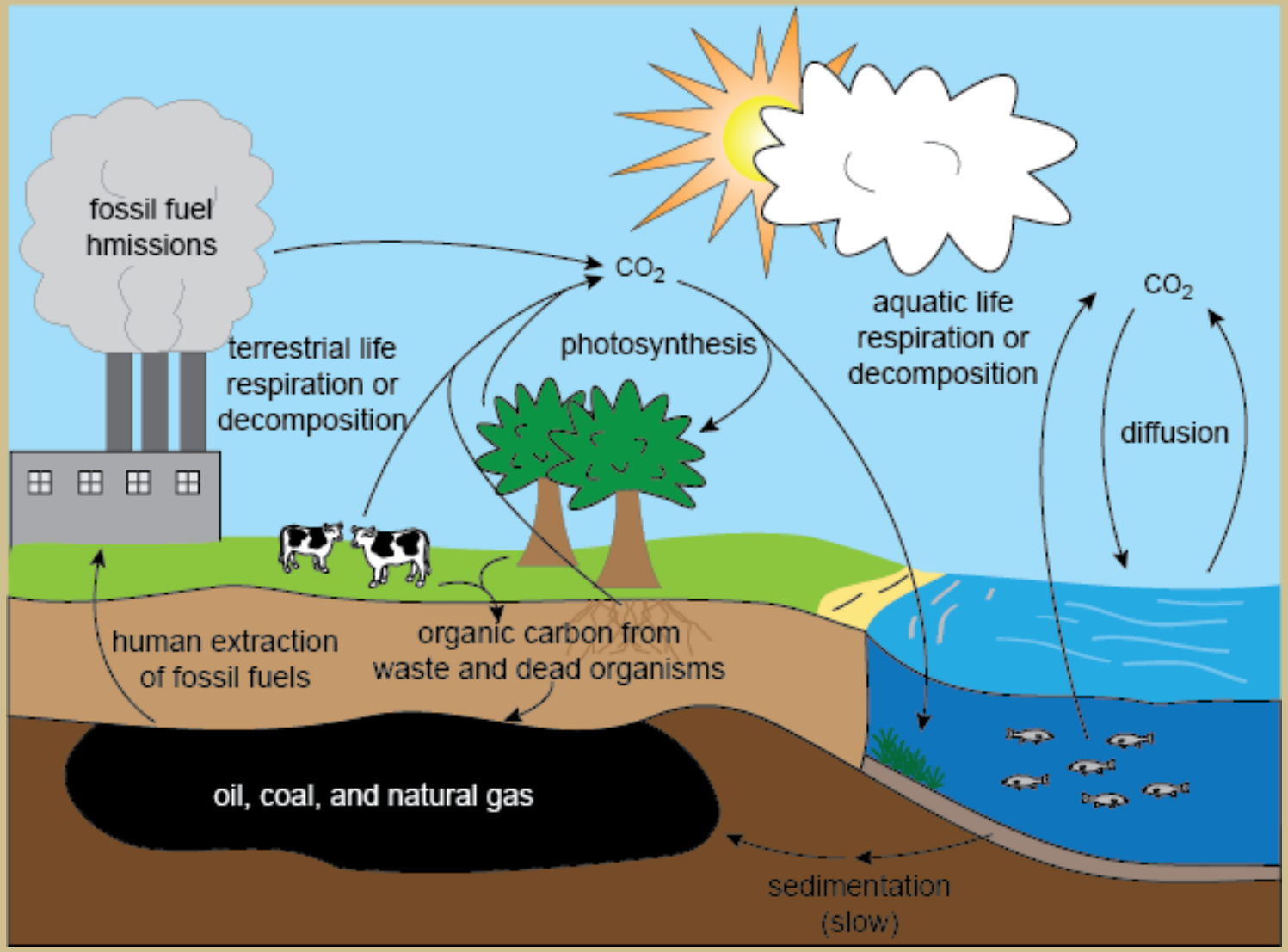
Where do we find it?

Life Energy-CARBON **CYCLE**

Richard Gantlett



CARBON **CYCLE**



http://www.shmoop.com/ecology/carbon-cycle.html

CARBON **CYCLE**

SCI www.soci.org C Gougoulias, JM Clark, LJ Shaw

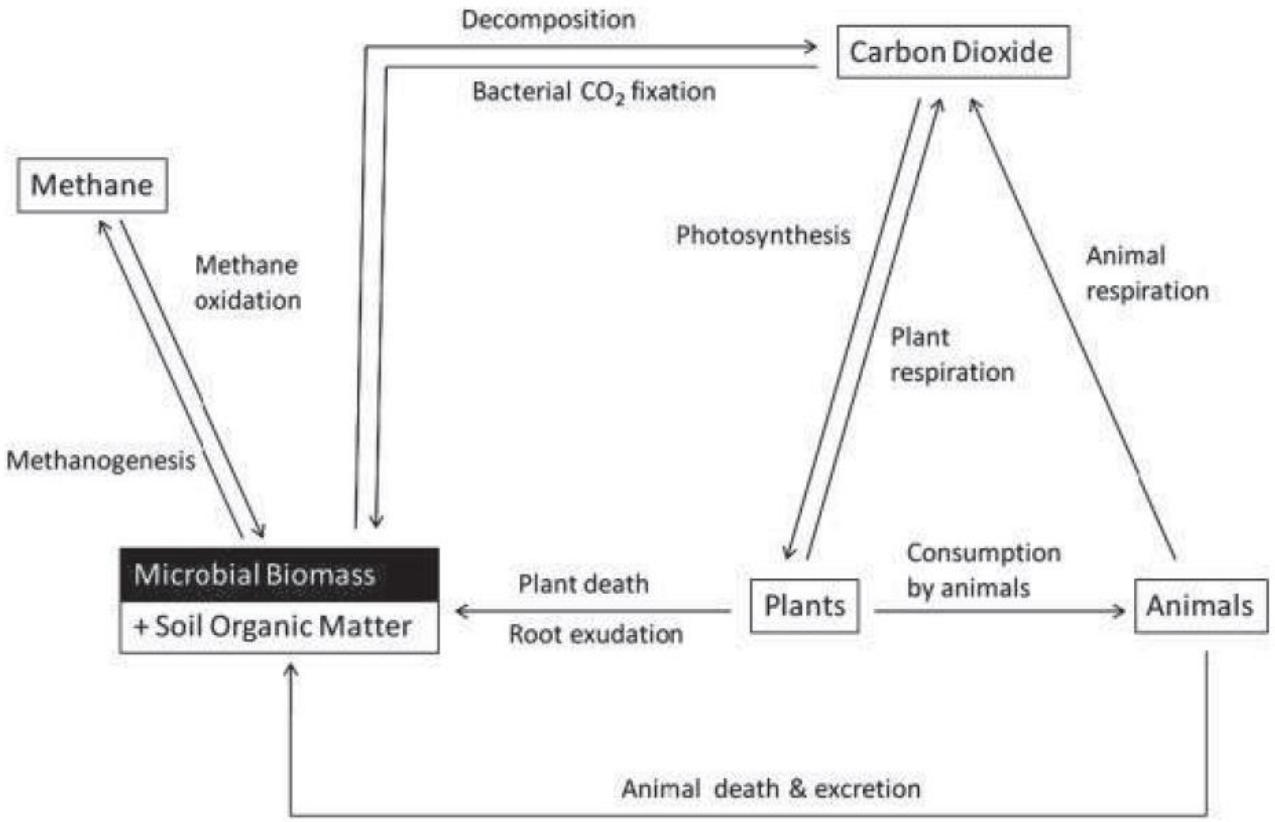


Figure 1. The terrestrial carbon cycle with the major processes mediated by soil microorganisms (adapted from Prosser[125]).

The role of soil microbes in the global carbon cycle: tracking the below-ground microbial processing of plant-derived carbon for manipulating carbon dynamics in agricultural. Christos Gougoulias, Joanna M Clark and Liz J Shaw, (2014)

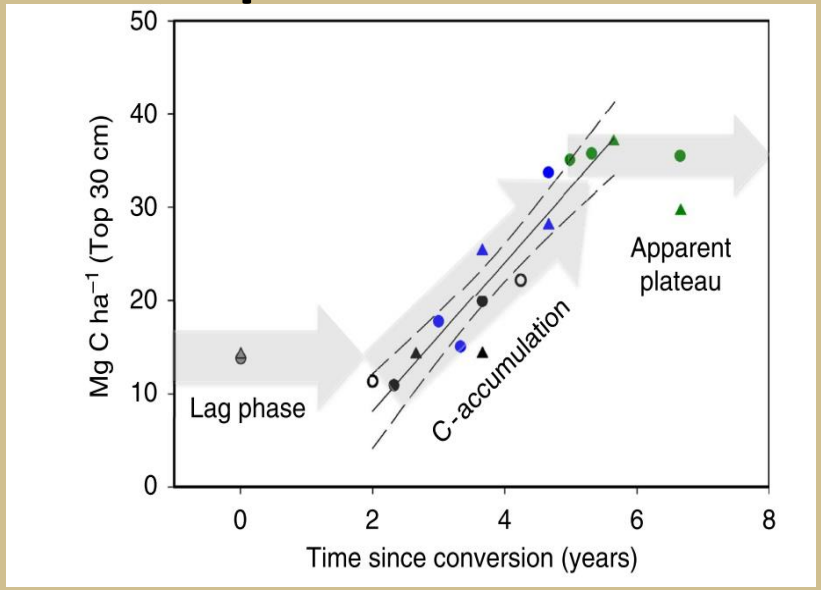
Carbon Sequestration?

What is it?

- Examples
- Is it possible short term?

- Sedimentation
- Black soil
- Trees
- Fossil fuels
- Peat
- Recalcitrant
- Humus?

Carbon Sequestration



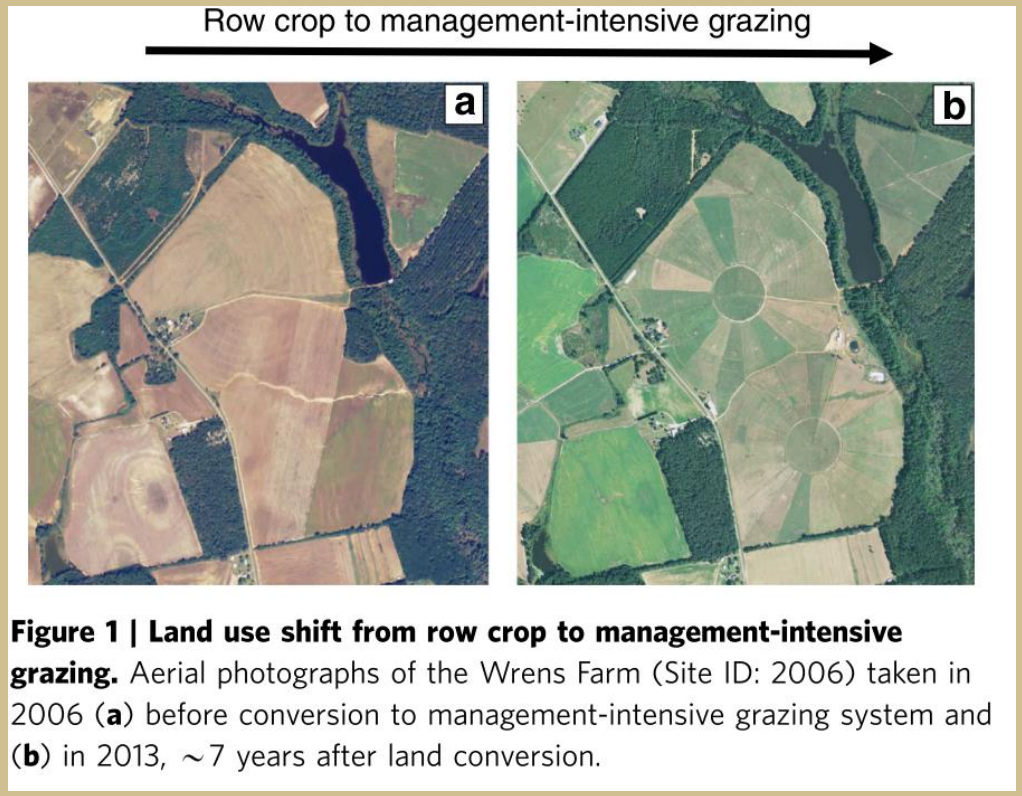


Figure 1 | Land use shift from row crop to management-intensive grazing. Aerial photographs of the Wrens Farm (Site ID: 2006) taken in 2006 (**a**) before conversion to management-intensive grazing system and (**b**) in 2013, ~7 years after land conversion.

Figure 9 Soil carbon rapidly increases with conversion of row crop to intensive grazing (Machmuller, Kramer et al. 2015)

Soil carbon (MgC/ha) content shown for the top 30cm of farms converted in 2006 (green symbols), 2008 (blue symbols) and 2009 (black symbols) and a control farm currently in row crop (grey symbols). Samples from soil pits and soil cores are distinguished by circles and triangles, respectively; open versus closed black circles are from different locations on the 2009 farm. The linear regression (solid line: r2¼0.88, Po0.0001) and 95% confidence intervals (dashed lines) are for data between 2 and 6 years since conversion only. The grey-shaded arrows represent our interpretation of soil carbon change in this system on the basis of current data.

Traditional view of Soil Structure Soil Quality Assessment

- **Study site**
- **Use a spade**
- **Soil sampling and P & K**
- **Plant bioassay**
- **Decomposition experiment**
- **Sequence data analysis**
- **DNA extraction and sequencing**
- **Soil Respiration**
- **Water infiltration rate**
- **Penetrometer assessments**
- **Bulk density**
- **Slake test**
- **Organic Matter tests (CaCo3)**

Soil Health Test (farmers' perception)

- **Observe**
- **Map**
- **Good/Bad**
- **Yield/Quality/Weed**
- **Water after heavy rain**
- **Water in draught**
- **Wheelings**
- **Animals**
- **Use a fork**
- **Active perception (of plants and soil)**

Adding Carbon

Sheet Composting

Green waste composting

Wood chip bedding

Fixing it from the atmosphere through enhanced biomass rotation

2.Preparations

500

- A soil inoculant
- Fresh cow manure transformed over Winter in the soil into pure colloidal substance
- Stirred in warm water
- Sprayed on moist soil

501

- Finely ground quartz crystal
- Sprayed as fine mist on sunny morning
- Used to stem excessive wateriness or overgrowth in plants
- Greatly enhances light metabolism
- Results in crisper more upright plants with more flavour, higher sugar, better keeping qualities
- Better resistance to fungus etc.

502-507 Compost Preparations

We use prepared 500 which has compost preparations added to it in store to ensure the whole farm receives them each year

Stirring and spraying

Life Energy-CARBON **CYCLE**

Richard Gantlett

Remember I asked you, What's the point of showing you the variety of life in the soil?

They provide ecosystem services

Such as

- water storage
- Soil structure
- Drainage
- Nutrient cycling
- Flood prevention

They all need food to live

and those bugs that don't eat other bugs

will eat living or dead plants.

- BIOMASS =
- Green manures
- Cover crops
- Crop residues
- Grass leys
- Pasture
- Diverse Leys
- Herbal Leys
- Imported material

3. Dynamic Grass Management

Spreading cow manure:
let cows do the work as much as possible with rotational grazing
Move cows every 6 days by electric fence.
This also ensures the plants don't regrow during that grazing period so all one growth is fed off together.

Cow pats contain soluble nitrogen (like bag nitrogen) which can over feed plants causing thin plant cell walls allowing access by pests and disease.

Spreading cow pats with the topper rollers or harrowing, prevents over feeding of plants.

Diverse Ley Mixture-

4 %	(32)	certified Puna II chicory
1 %	(8)	Ribgrass forage herb
1 %	(8)	Yarrow forage herb
2 %	(16)	Sheeps Parsley forage herb
4 %	(32)	Burnet forage herb
4 %	(32)	certified TRINTELLA ORGANIC tet. per. ryegrass
4 %	(32)	certified DRUMBO ORGANIC perennial ryegrass
2 %	(16)	certified Greystone tall fescue
2 %	(16)	certified Kora tall fescue
2 %	(16)	certified Rossa meadow fescue
2 %	(16)	certified MINTO ORGANIC meadow fescue
2 %	(16)	certified Prairial cocksfoot
7 %	(56)	certified WINNETOU ORGANIC timothy
7 %	(56)	certified Erecta timothy
1 %	(8)	certified Gorby persian clover
1 %	(8)	certified MARCO POLO ORGANIC persian clover
2 %	(16)	certified Contea crimson Clover
2 %	(16)	certified ROSA ORGANIC crimson clover
2 %	(16)	certified Oberhaun Stadters birdsfoot trefoil
2 %	(16)	certified Virgo Pajbjerg yellow trefoil
1 %	(8)	certified Fee luceme
1 %	(8)	certified HUNTER RIVER ORGANIC luceme
17 %	(136)	commercial ESPARSETTE ORGANIC sainfoin
7 %	(56)	certified Aurora aislike clover
2 %	(16)	certified Aberdal white clover
1 %	(8)	certified Alice white clover
1 %	(8)	certified ORGANIC NEMUNIAI white clover
4 %	(32)	certified Aberace wild white clover
4 %	(32)	certified Merula red clover
4 %	(32)	certified Milvus red clover
2 %	(16)	certified QUINEQUELI ORGANIC red clover
2 %	(16)	certified FORMICA ORGANIC red clover

Cover Crops
Catch Crops
Green Manures

Plants and Roots

Plants and Roots

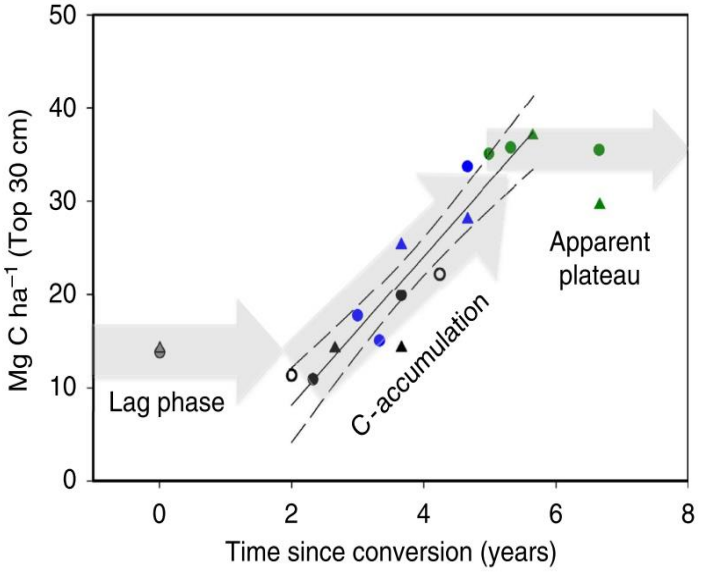
Where's the wall chart?

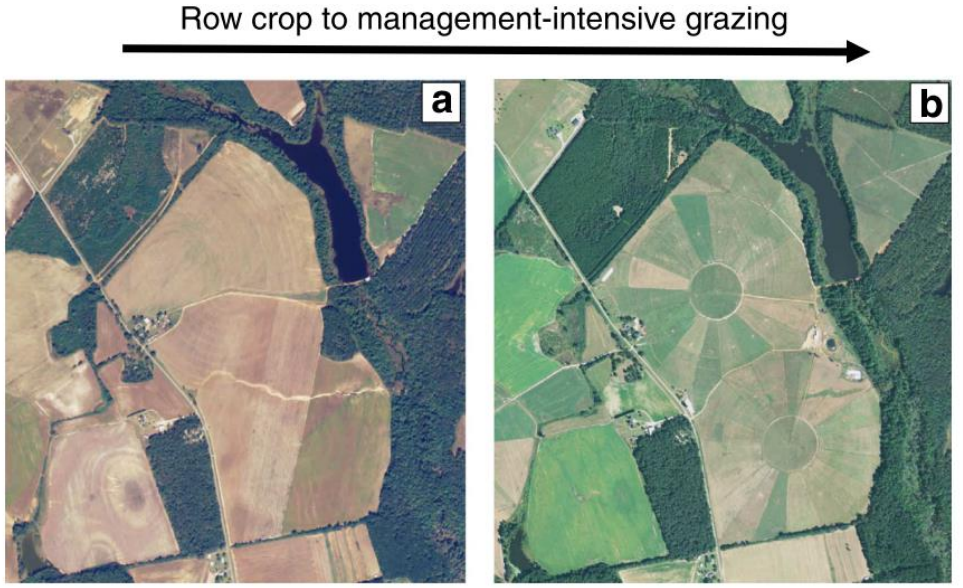
Plants and Roots

How far down do your roots go?

Plants and Roots and SEEDS

Carbon Sequestration





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They all need food to live,

We need to feed the soil.

- BIOMASS =
- Green manures
- Cover crops
- Crop residues
- Grass leys
- Pasture
- Diverse Leys
- Herbal Leys
- Imported material

Farmers are harvesters of the Sun's energy

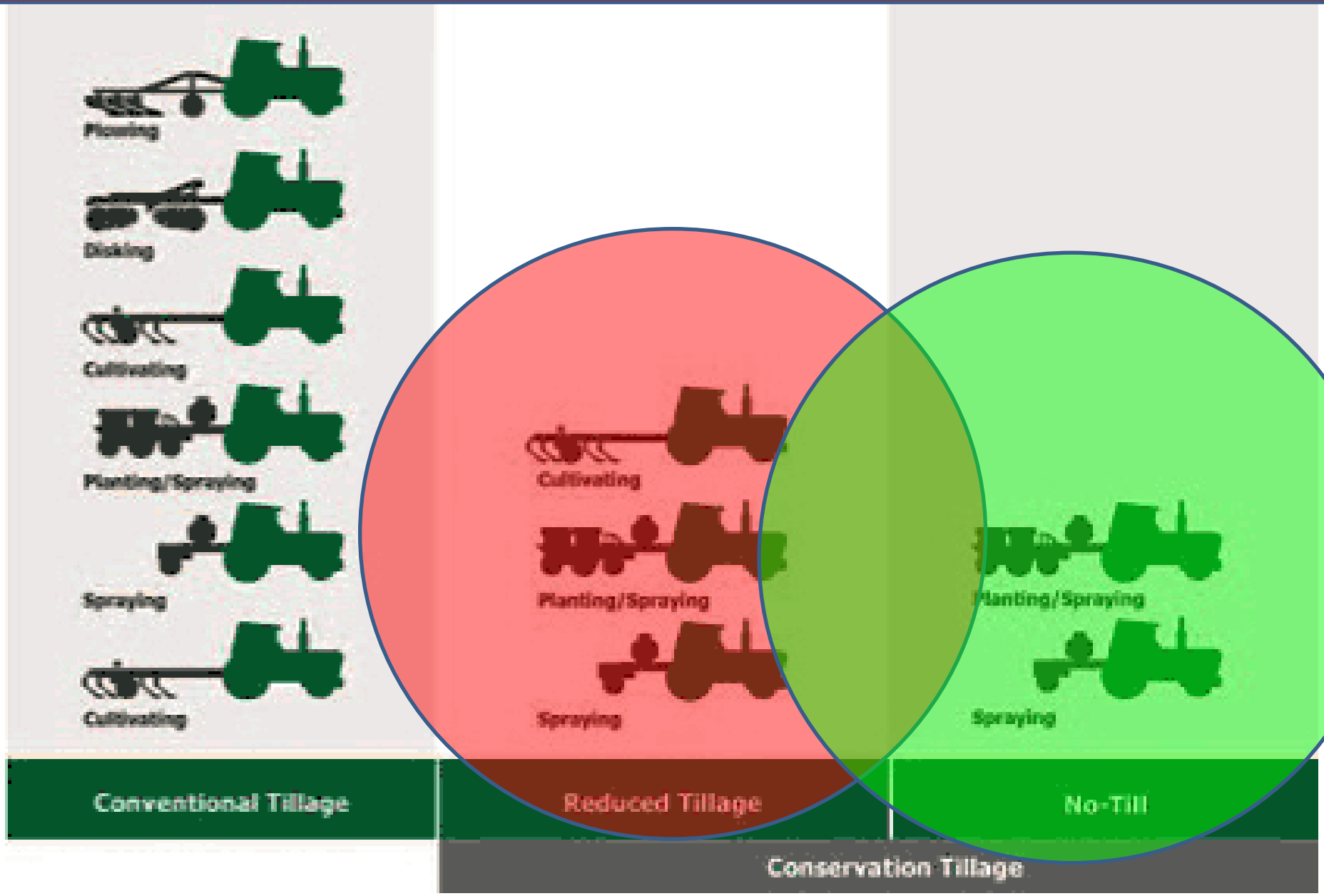
- All life comes from the Sun's energy

TILLAGE

Sow seeds
Provide a seedbed
Weed
Control perennial weeds
Control annual weeds
Incorporate organic matter
Remove compaction
Aerate
Allow water infiltration
Nitrification
Harvest

Compacts the soil
Damages soil structure
Kills soil organisms
Releases carbon
Eutrophication
Erosion
Uses fossil fuels

good or bad, why till the soil?



www.methodfinder.net/principles91.html


2003
7220

Why not plough?

- Me
- It won’t work on my soil…
- Better timeliness
- Kinder on soil life, bugs are depth specific
- Not burying seeds to store for the future
- Bad ploughing is expensive cultivating
- Buries residues is an anaerobic layer
- Creates a plough pan
- Turns soil into concrete
- Encourages docks and couch grass, perennial weeds

Deep Cultivations for repairing the soil only, not used now

Mulla parandamiseks sügavkobestamine, mida ei kasutata enam

As farmers we are constantly working with the soil and this often has detrimental effects, we need to work to repair the damage we have done through machinery and animal traffic.

Physiotheropy, we gently lift the soil
Füsioteraapia, me õrnalt tõsta pinnast

Soil Rehabilitator.
Pinnase rehabilitator
3m 130hp

Diverse Green Manures

bio cultivations

34 or more varieties 23 species, of herbs, legumes and grasses

What is possible? **Mis on võimalik?**
Cultivated Diverse Pasture Ley, **Kultiveeritud paljuliigiline lühiajaline rohumaa**
October 2011

First Pass into Winter Cover
Spring 19th April 2018
Esimene talvise taimkatte harimine

2nd Pass of cultivator next day
Järgmisel päeval teine harimine

3rd Pass of cultivator with spring roller

Kolmas harimine vedru põllurulliga

4th or 5th Pass over soil to Sow

depending how fine you need the seed bed

Same cultivator, spring tine particularly good in Autumn

4th or 5th Pass over soil to Sow

depending how fine you need the seed bed

Lemken Thorit, fixed tine (jäiga piiga) particularly good in Spring

Reducing machinery cultivations
Harimiste vähendamine

Create Seedbed for next crop *and* **Weed** *and* **Sow seeds**

Looge järgmise kultuuri külviks sobivad tingimused, tegelege umbrohutõrjega ja külvake

Ensure Moist and warm environment for germination

Tagage niiskus ja soe keskkond idanemise jaoks

Allow Root access to soil

Aidake taimedel kasvama hakata

Multitasking where possible

Võimaluse korral mitu tööd korraga

Make/adapt your own machinery

Tee / kohanda oma masinaid

Option After Sowing
Harrow Comb

Undersowing after sowing cereal or beans
or in Autumn keeping grass lumps dry to die off

Spring Barley sown 30nd April 2018
Undersown with Diverse Ley Mix 22th May 2018

Spring Beans sown 22nd April 2018
Undersown with Diverse Ley Mix 26th April 2018

Cultivating Pasture

1 90 degrees

or

2 90 degrees

3 45 degrees

4 Sow @ 45 degrees

Make Hay-Sweet spot
„Tee heina kuni päike paistab“

Capillary action
Kapillaarne tegevus

- Rolling
- Seeding with Lemken in Spring
  - Insulated layer,
  - Moisture underneath (Draw on board)

Rullimine

Külv Lemkeniga kevadel

Isoleeritud kiht

Niiskus allpool

Crops can do their own weed control

WEED CONTROL **Weeds are the enemy of crops and agricultural output worldwide. Organic and conventional farmers have their respective weed control strategies, either through the use of fuel guzzling, CO2 producing machines or environmentally harmful chemicals. Research from the University of Copenhagen now suggests that the war on weeds can be conducted more sustainably by asjusting sowing patterns and crop density.**

Wheat sowed in a field with high weed pressure provided by rapeseed. Left photo: Low crop density, crops sowed in rows. Middle photo: High crop density, crops sowed in rows. Right photo: High crop density, crops sowed in grid pattern.

- http://plen.ku.dk/english/news/2015/crops/
- (Olsen, Kristensen et al. 2005)
- (Weiner, Griepentrog et al. 2001)
- (Weiner, Andersen et al. 2010)

Draw a grid pattern…

Features: universal seed hopper; adapted cultivator to seeder; no depth wheels; broadcasting and or under shoe

Omadused: universaalne seemnepunker; külvikule kohandatud kultivaator; ratasteta, hajuskülv

No Till in Organic Farming
means having either a
living or a dead mulch

No till mahepõllumajanduses
tähendab, et kasutatakse
kas elavat või surnud multši

So it is all about weed control-organic farming's number one challenge

Seega on tegemist umbrohu kontrollimisega - mahepõllunduse number üks väljakutsega

Roller Crimper, Rodale Institute

A Different Way of Farming

Life Energy-Tillage and 3D sowing

Richard Gantlett

Living Mulch

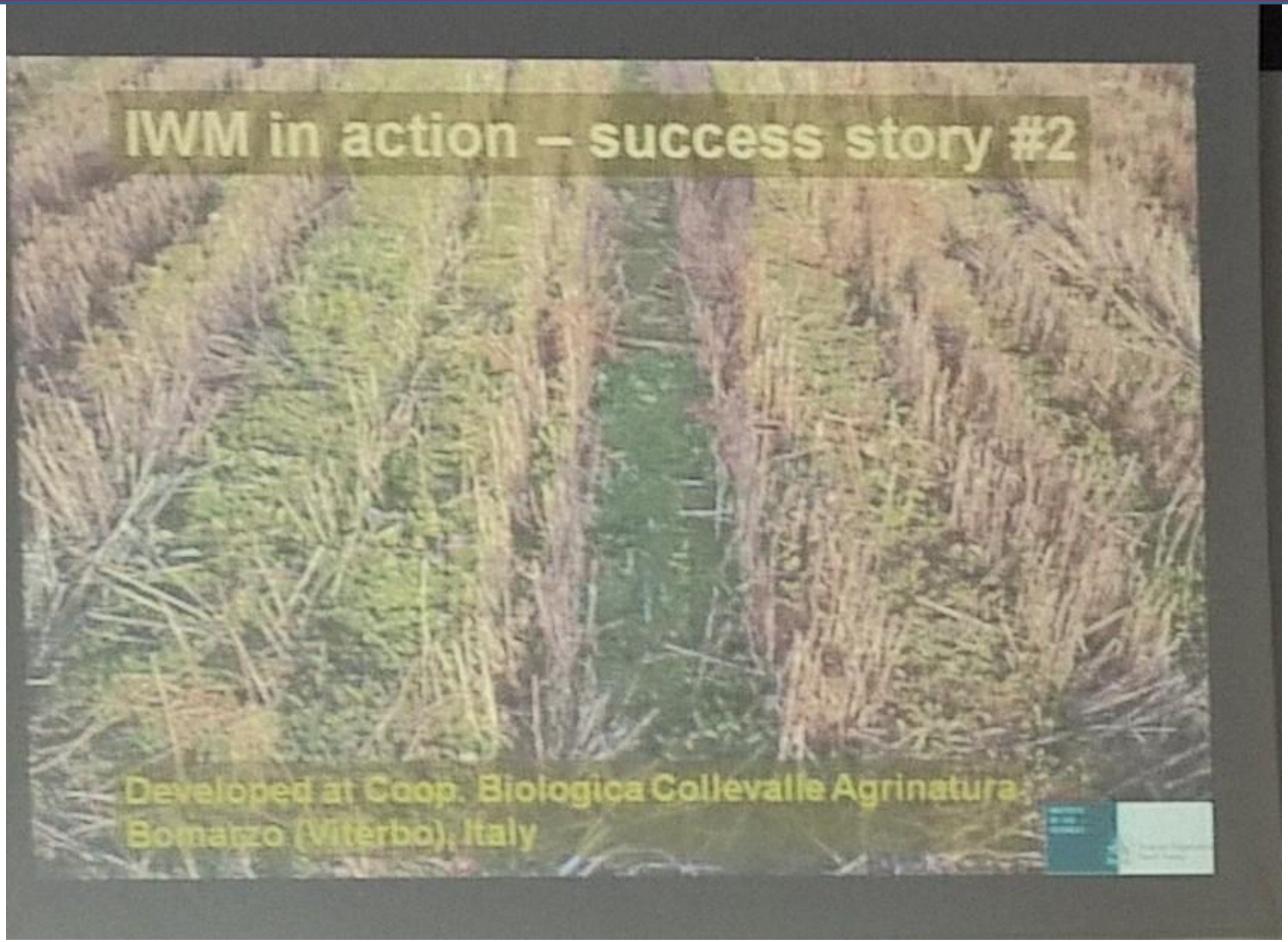
Yatesbury 2004
- Under sow yellow trefoil in faba bean then sow Winter wheat

Yatesbury 2008
- White clover established, sow Winter wheat into it in November….

Yatesbury 2017
- Yellow trefoil etc. into oats then sow faba bean into shallow rooting clover?
- Use Lemken to sow into mulch?

Italy
- Roots not competing with crop
- Tap root + shallow fibrous root
- 50% seed rate of durum wheat sown end Oct
- 15% yield reduction
- Wide rows to reduce competition between wheat and sub

U Pisa, Paolo Barberi
- Living mulch needs diverse crops not both tap roots
- Wheat is shallow rooting sub-terrainean clover has tap root


IWM in action – success story #2
Developed at Coop. Biologica Collevalle Agrinatura,
Bomarzo (Viterbo), Italy

Relay cropping- System Cameleon Sweden Ribaharimine?

- John Pawsey

School of Agriculture Policy and Development

University of Reading

High Biomass Rotations: Soil health, weed burden & crop production

Richard Gantlett | Martin Lukac | Hannah Jones | Irene Mueller-Harvey

Background

- The aim of this research is to assess the economic justification for increased input of organic matter (OM).
- The project will utilise an established crop rotation at Yatesbury House Farm over a period of 5 years.
- Huntley-Palmers scholarship fund is part funding this research.

Objectives

To determine whether high biomass can :

(1) reduce the weed burden,

(2) increase the yield and quality of the grain and forage crops

(3) improve soil quality (physically in terms of structure and water holding capacity, chemically in terms of availability of nutrients and biologically in terms of active living biota)

Also to determine which are the most effective, long lasting additions of biomass/organic matter.

Experimental approach

Four fields have been chosen across the rotation to assess the whole rotation on a space for time basis, each has one research area, being subdivided into three replicates of four randomised 8m–width plots (Figure 1). Each plot has one of two treatments (standard or enhanced OM) or one of two controls (positive (DL) or negative (tilled)) .

Figure 1: Trial design per field: Three blocks of four plots

Table 1: Details of rotation standard and enhanced OM treatment

Field in 2014	Rot. Year	Crop	Standard Treatment	Enhanced Organic Matter Treatment
Long Barrow	i)	Diverse ley (DL)	Mowed for hay/silage	Topped after 15th June to promote lignin production and reduce weed seed set
	ii)	DL	Grazed	Grazed
Hut Field	iii)	Spelt	Remove straw	Chop & incorporate straw
	iv)	Spring wheat	Remove straw	Chop & incorporate straw
Fifty Acres	v)	Wheat & beans, Summer fallow	Harvested as forage silage	Cut and mulched as green manure Grow mustard mulch for following bean crop
	vi)	Winter Beans	Fallow over winter	Green cover over winter
Croft Field	vii)	Spring barley u/s with DL	Harvest as wholecrop	Chop & spread straw and green material

Variables to be measured

A baseline survey of soil organic carbon, soil structure and organic matter fractionation and then annually:

1. Soil physical integrity and water relations in drought & flood
2. Plant health, rooting depth & residue quality
3. Weed density & species
4. Harvested forage, straw or grain, yield and quality

Expectations

Economic analysis will then determine if the enhanced organic matter, organic rotation is cost effective.

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Selective Attention Test

- https://www.youtube.com/watch?v=vJG698U2Mvo

1. Active Perception

Conscious recognition

Preceiving the process behind what one sees

See a field of plants perceive the roots and life organisation in the plants and soil

Correct plant colour and expression,
no blue green of water fed plants
and a verticality / uprightness in the plants

Pasture pre cutting

Pasture regrowth

Spring malting barley, Alex Podolinsky inspecting our first and second Demeter crops for Bio-Dynamic whiskey

The result is in the quality of the product

YATESBURY HOUSE FARM

Silty clay loam, over lower chalk

Rain fall:

680mm –

810mm p.a.

Here it is in good shape.

There is plenty of opportunity for slumping of soils or baking solid of wet soils.

YATESBURY HOUSE FARM

bio-dynamic

Started Organic Conversion 1998	**647 ha**
Mostly Cereals	**281 ha**
Fertility building Diverse leys	**216 ha**
Pasture permanent	**115 ha**
Woodland	**36 ha**
Aberdeen Angus Pedigree Suckler Herd	**280 head**
Staff	**2 plus me**

YATESBURY HOUSE FARM

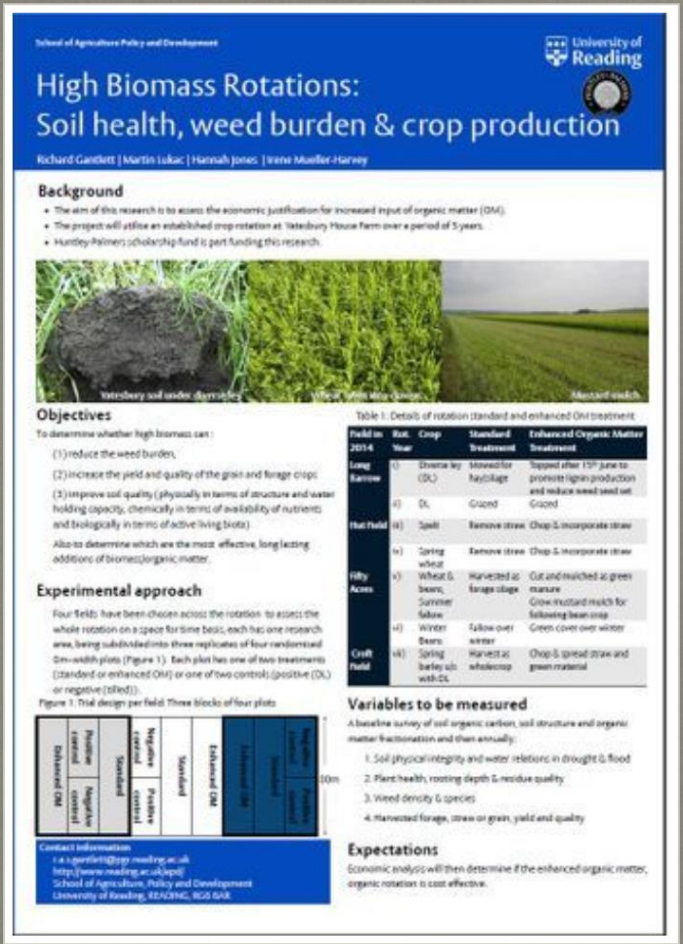
Our dynamic system

The resilience of the farm and its ability to produce food is embedded in the life, energy and quality of the soil.

- We have a dedicated team constantly striving to improve the farm.
- Light cultivations, no ploughing since 2003
- Diverse Ley mixture of 33 varieties of 24 species and Bio-cultivations
- Tread lightly with 4 cylinder tractors, satellite guided, latest precision innovation
- 3D sowing
- Dynamic grazing
- Working sustainably, organically andBiodynamically
- High Biomass Rotation
- Research both economic and scientific
- Closed farm to most inputs except, bulls, Seed, FSC wood chip, cattle minerals

YATESBURY HOUSE FARM

Farm Projects



High Biomass Rotations:
Soil health, weed burden & crop production

Richard Gantlett | Martin Lukac | Hannah Jones | Irene Mueller-Harvey

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Experimental approach

Four fields have been chosen across the rotation to assess the whole rotation on a space for time basis, each has one research area, being subdivided into three replicates of four randomised 5m-width plots (Figure 1). Each plot has one of two treatments (standard or enhanced OM) or one of two controls (positive (DL) or negative (tilled)).

Figure 1. Trial design per field. Three blocks of four plots

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Expectations

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- Organic Farm Conversion 1998
- Aberdeen Angus suckler herd 1998
- Landwise, LAND management in loWland catchments for Integrated flood riSk rEduction, University of Reading (NERC) 2017-2022
- Satellite farm Agri-Epi Centre, (The Agricultural Engineering Precision Innovation Centre) 2017-22
- PUR Project, Woodland Trust 2017
- Health Network, Organic Research Centre 2016
- OK Net Arable, (Organic Knowledge Arable Network), Organic Research Centre 2015-17
- Wood dust cattle bedding 2015
- High Biomass Rotation Research, impacts on Soil Health, Crop Production and Weed Burden, Huntley and Palmer Scholarship Fund, University of Reading, April 2014-2020
- Higher Level Stewardship, Natural England 2013-2023
- England Woodland Grant Scheme 2013-2043
- Environmental Stewardship, Organic and Higher Level 2013-2023
- LegumeLink Farm Partner, Organic Research Centre 2010-2013
- Zero Fossil Fuel Goal 2010
- Demeter conversion 2005
- Working with lighter/smaller machines 2004
- No plough biodyn tillage 2003
- Working Biodynamically 2002
- Wheat and Faba Bean cropping mix 2002
- Countryside Stewardship 2000-2010
- Diverse Leys and Bio-cultivations 2000
- Fully bedded yard system for cattle replacing slurry system 1998

YATESBURY HOUSE FARM

GOALS

1. **To be Sustainable**
   - To leave the whole farm, but particularly the soil, in a better condition than that in which we found it. Our planet comes first.
   - To ensure all our farmers are motivated in all ways to producing a farming profit which is sustainable.
   - To work towards being a Zero Fossil Energy Farm.

2. **Produce Healthy Vital Food**
   - Healthy, lively soil means healthy plants and healthy and nutritious food. This leads to more resilient farming. Animals are the catalyst of soil fertility they help to build soil life, increasing numbers and diversity of soil biota. A healthy soil needs feeding.
   - Look to N**ature's** systems that work, (millions of years of practice). Use diverse populations, which ensure flexibility. Have a **balance** of pests and predators with a diverse rotation to prevent weed exploitation. Extensive animal ranging and **Animal welfare** is paramount. Remember the unseen predators e.g. phages, bacteria, nematodes.
   - **Research, prepare, plan, prevent (not cure),** take the long view
   - Whole **closed farm** approach, including hedges, woods, ground water and sky

3. **Customer Satisfaction**
   - Selling **food** that does not come back, to customers that do.
   - To produce the best quality food that we can.
   - To work closely with a keen group of interested customers

4. **Promote a thriving community: farm; village; and beyond**
   - Through employment, communication and education.

Challenge everything
Küsi endalt iga asja kohta
(a good scientist is good at asking questions)

- God, grant me the serenity to accept the things I cannot change;
- the courage to change the things I can;
- and the **wisdom** to **know the difference**
-

Issand, anna mulle rahu, et nõustuda asjadega, mida ma ei saa muuta; julgust muuta asju, mida ma võin; ja tarkust, et märgata erinevust


OOM
OOM
OOOM
OOM
IS THAT COW MEDITATING?
DYSLEXIC--
CARTOONSTOCK
.com

Farmers are harvesters of the Sun's energy

All life comes from the Sun's energy

Life and Energy
Elu ja energia

Be the Change you want to see
Olge ise see muudatus, mida soovite näha

Passionate Flourishing Progressive
Kirglik Õitsev Progressivne

Tänan kuulamast

Richard Gantlett