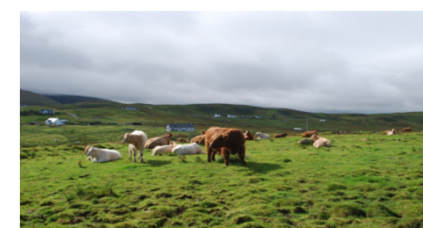




Programme:	Soil and Nutrient Network	
11.30am	Tea & Coffee	
11.40am	Introduction to SNN	Gillian McKnight
12.00noon	Priority Catchments	Peter Wright SEPA
12.20pm	Valuing Your Soils	Joanna Cloy
12.45pm	Lunch	
1.45pm	Flowerburn Mains	Soils Practical



International Year of Soils



2015

International
Year of Soils



Soil Functions



- Nutrient cycling
- Regulates ecosystem functioning through soil organic matter, soil carbon sequestration, emission of gases (GHG), nutrient availability, modifying soil structure and water, supporting vegetation & provides genetic diversity eg penicillin & amoxycillin

Soil Organic Matter



- Soil carbon is the second largest carbon store on earth
- 25% of all living organism live in the soil
- Diminished capacity within the soil ecosystem to function

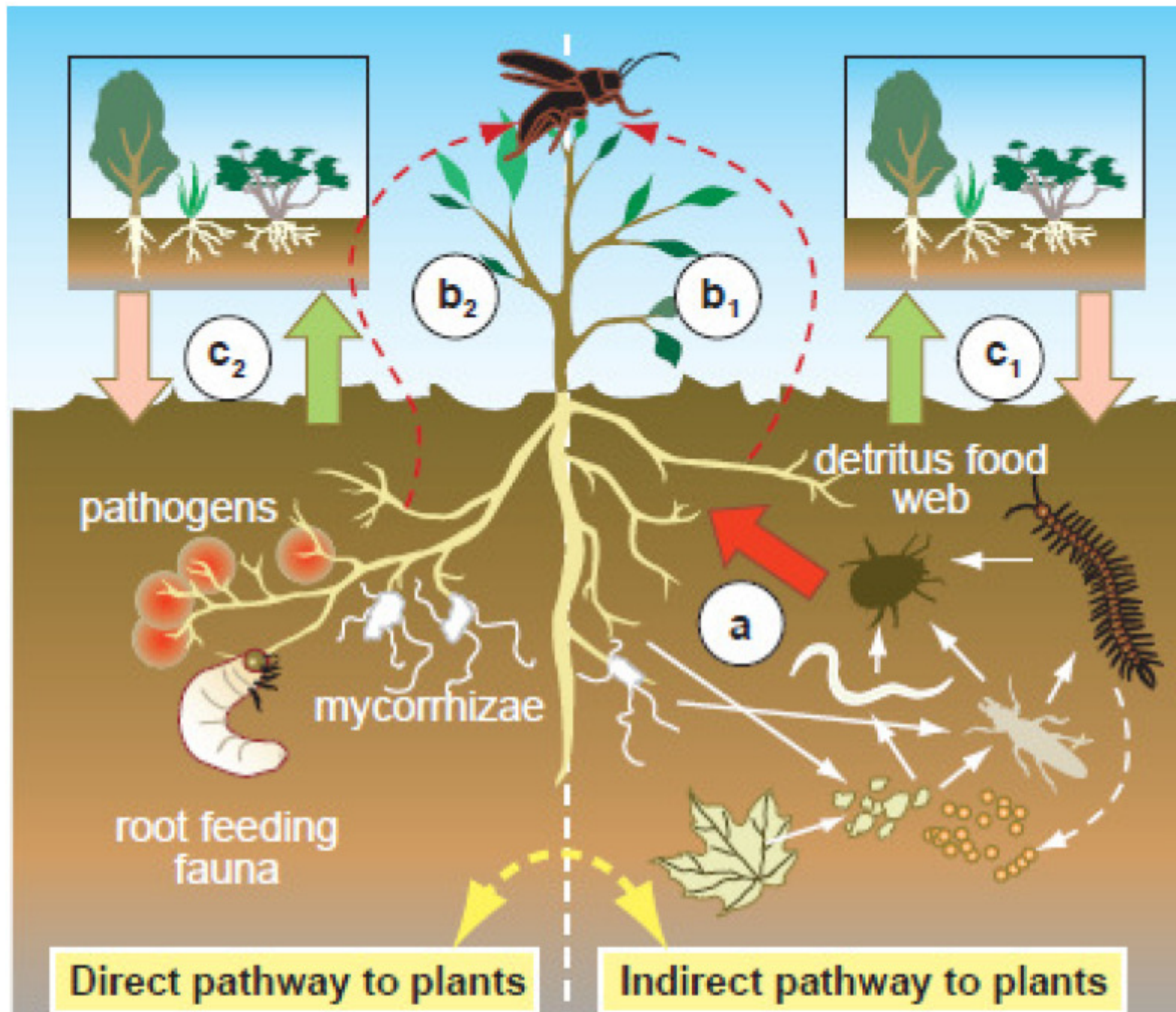
Soil Biodiversity – a food web



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- Micro fauna - bacteria, fungi, protozoa, nematodes
- Meso fauna – mites, springtails
- Macro fauna – earthworms, beetles, spiders, larvae
- Plant roots

Linkages between plants and soil organisms



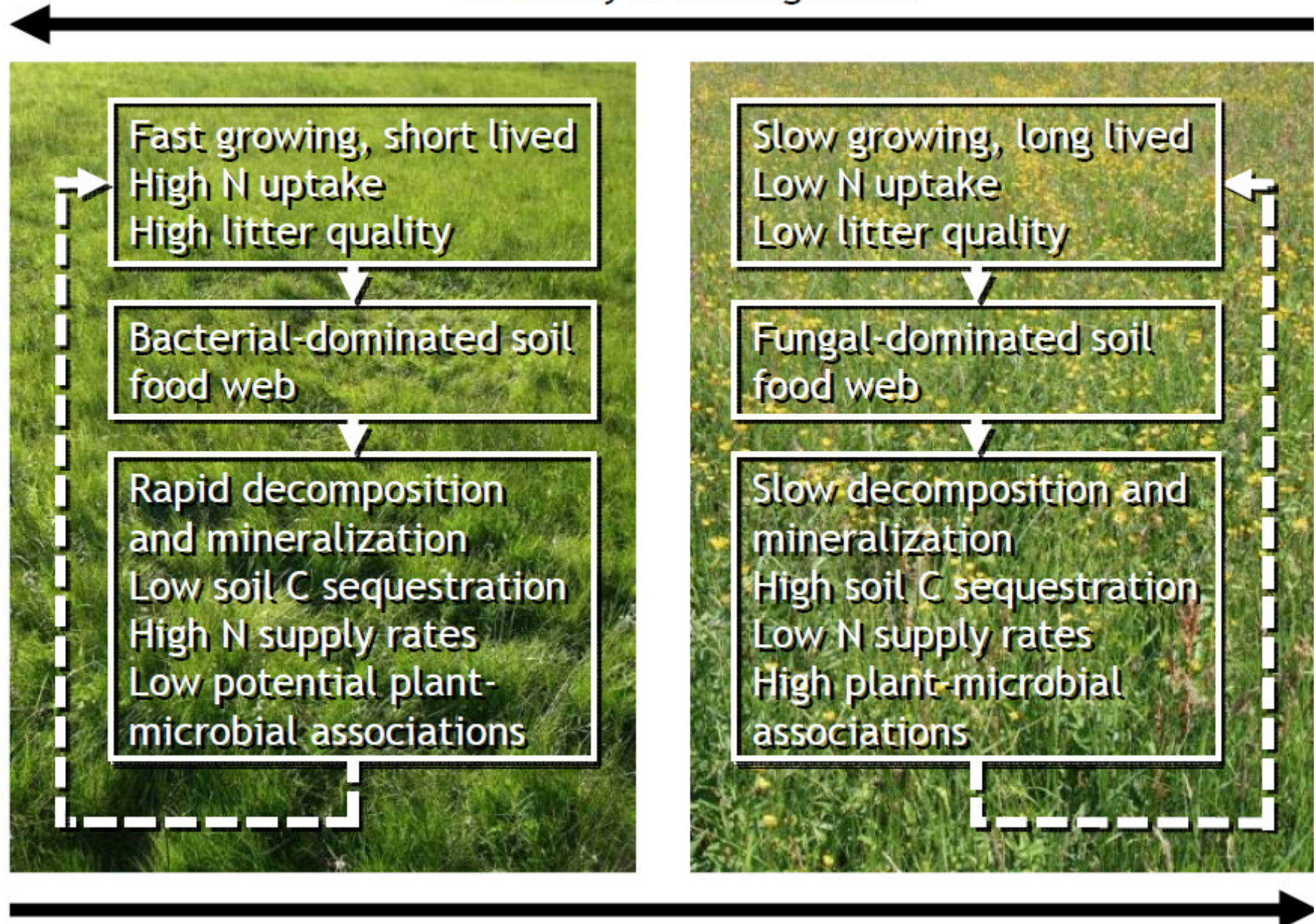
A functioning ecosystem?



- Soils and soil organisms make up a complex micro-ecosystem
- Uniform and intensively managed fields have lower diversity of soils, soil organisms etc
- Soil biodiversity trends are similar to above ground biodiversity - which is also declining

Aboveground - belowground linkages

Intensity of management



Farming & Soil Health



- We know a lot about soil physical structure, pH, nutrient levels, aeration, drainage & compaction
- We do not know a lot about soil biodiversity, soil biological functions and carbon sequestration

Farming & Soil Health



- How do farm operations affect
 - Soil bacteria
 - Soil fungi
 - Soil carbon

Farming & Soil health



- Soil structure = soil organic matter = a major carbon store, up to 50% historic losses through intensive management
- Erosion – loss of soils into other systems eg aquatic
- Compaction – reduces activity of soil micro-organisms and crop growth

Soil biota & management



- the bacterial to fungal ratio is increased by application of nitrogen
- A high bacterial to fungal ratio in soils reduces nutrient retention
- cultivation reduces fungal hyphae
- nitrogen leaching increases with reduced fungi

Farming & Soil health



- In the UK it is estimated that 2.9 million tonnes of soil are eroded each year
- It can take 500 years to replace 25 mm (1 inch) of topsoil
- Chemicals – in UK 31,000 tonnes of chemicals are applied annually which disrupt soil organisms & enter soil, water and air

Management & soil biota



- pesticides affect non target organisms ie beneficial plants, microbes & fungi eg glyphosate reduces grassland mycorrhiza both directly & indirectly

“a change in soil health resulting in diminished capacity of the ecosystem to provide goods & services” = soil degradation (James Hutton Institute)

Cropping



- Continuous cropping depletes soil organic matter which reduces soil biodiversity = loss of genetic diversity
- Impacts on soil biodiversity is highest where agriculture is most intensive and population is highest

Cropping



- Integrated pest control reduces environmental impact compared to conventional systems but
- Organic systems support significantly higher soil biota functions than conventional systems

Integrated Crop Management



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- <https://consult.scotland.gov.uk/cap-reform-and-crop-policy/9a1bb2d9/>

Pollinating Insects



More sustainable farming?



- Sustainable intensification
- Less intensive farming methods
- Add value - local suppliers & markets
- Quality v quantity of produce

High Nature Value Farming



- Low-intensity pasture systems
- Landscape and historical features such as natural floodplains, hedges, ditches, ponds, woods
- Co-exists with habitats and species

Organic Farming Study findings



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- Greater plant biodiversity
- More invertebrate biodiversity
 - Beetles, spiders, bees, and butterflies
- Enhanced soil life biodiversity
 - Soil microbial biomass, mycorrhizae abundance, earthworms
- More birdlife biodiversity
 - Particularly invertebrate feeders
- Increased mammal biodiversity
 - Total bat activity significantly higher on organic farms

Integrated Crop Management



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The European Agricultural Fund
for Rural Development
Europe investing in rural areas



Scottish Government
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Crop Trial Plots



Soil & Nutrient Network Farm



- Flowerburn Mains
- Soils = Eathie
- Mixed farming
- Traditional rotations



Soil Maps



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- Alluvial soil
- Brown calcareous soil
- Brown forest soil
- Brown forest soil with gleying
- Brown magnesian soil
- Calcareous gley
- Noncalcareous gley
- Humic gley
- Magnesian gley
- Peaty gley
- Humus podzol
- Humus-iron podzol
- Iron podzol
- Peaty podzol
- Peaty ranker
- Peat
- Sand and shingle
- Shingle
- Podzolic ranker
- Brown ranker
- Noncalcareous regosol
- Alpine podzol
- Subalpine podzol
- Saline alluvial soil
- Saline gley
- Made up ground
- Skeletal soil



The European Agricultural Fund
for Rural Development
Europe investing in rural areas



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Land Capability



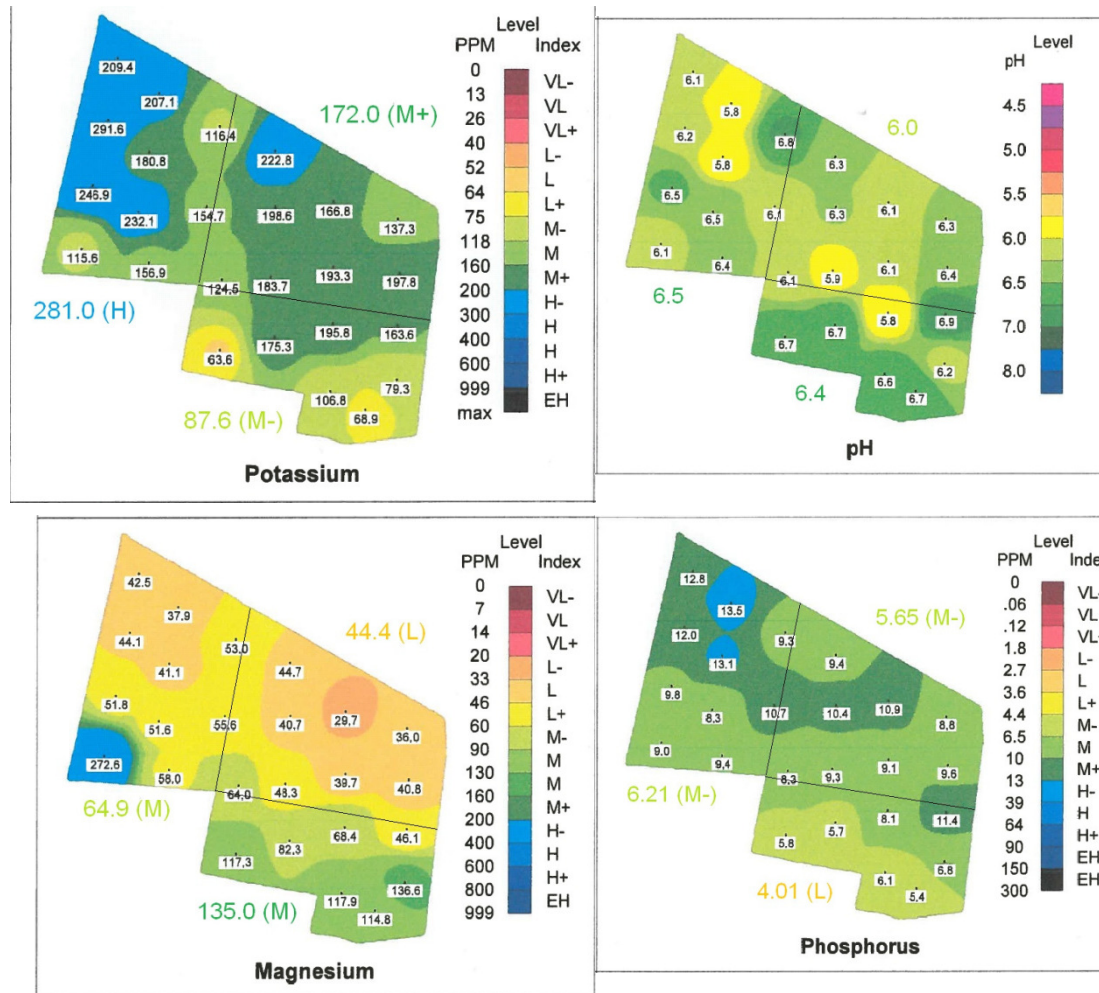
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Soil mapping spatial variability



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Soil Quality



Grasslands



- Grasslands play a major role in carbon sequestration
- Fungi increase with soil organic matter (carbon) - helps restore natural grasslands
- Total carbon can be higher in forestry but the below ground can be greater in grasslands - the most stable carbon is below ground.

Grasslands



- Greater storage of carbon can be achieved through increasing nitrogen fixing legumes, which absorb rather than release carbon to the atmosphere; and by using deeper rooting plants

Grassland Biodiversity



- Species losses in grasslands as a result of
 - high soil fertility
 - loss of fungal activity & mycorrhiza
 - seed bank limitations
 - lack of soil micro-fauna

Grassland Biodiversity



- Grassland restoration achieved through
 - cessation of fertiliser
 - cut & remove sward with aftermath grazing
 - over-sowing or slot seeding
 - use of yellow rattle (hemi-parasitic)
 - enhance mycorrhiza
 - can take c20 years
 - depends on soils and seed bank

Cross Compliance GAEC



Poaching & Trampling

GBR19 Breach

GAEC 5 Breach



Water Margins



Water Margins



Diffuse Pollution Assessment



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GBR19 Breach

GAEC 5 Breach



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Diffuse Pollution



Farming & Water Scotland



A screenshot of the Farming & Water Scotland website. The browser address bar shows 'http://www.sruc.ac.uk/info/120693/farming_and_water_scotland'. The website header includes the SRUC logo and 'Scotland's Rural College'. A navigation bar has links for 'Study at SRUC', 'Research', 'SAC Consulting', 'Veterinary Services', 'Alumni and Friends', and 'About SRUC'. The main content area is titled 'Farming & Water Scotland' and includes a paragraph about reducing diffuse pollution risks. Below this is a section 'Further information and links' with a grid of eight topic tiles: 'Diffuse Pollution', 'Soils & Nutrients', 'Livestock', 'Arable', 'Scotland's Water', 'PEPFAA Code', 'Funding & Grants', and 'Know the Rules'. Each tile has a representative image. At the bottom of the website are logos for the Scottish Government, SRUC, SEPA, dpmag, and NFU Scotland. The browser's taskbar at the bottom shows various open applications and the system clock indicating 08:18 on 15/02/2017.

Farming & Water Scotland



A screenshot of the Farming & Water Scotland Facebook page. The browser address bar shows the URL 'https://www.facebook.com/Farming-Water-Scotland-937466743016387'. The page header includes the name 'Farming & Water Scotland' and a search bar. The left sidebar contains the page's profile picture, name, and a list of navigation links: Home, About, Photos, Likes, Videos, Events, and Posts. The main content area features a cover photo with the text 'FARMING & WATER SCOTLAND Know the Rules' and a description about helping farmers with regulations. Below the cover photo are two smaller images: a muddy stream and a cow in a field. The right sidebar shows a list of people who like the page, including Claudia Cooper, Jeremy Roberts, Kerrie Urquhart, and John Mackenzie. The bottom of the page shows a Windows taskbar with various application icons and a system clock indicating 08:15 on 15/02/2017.



SRDP Priorities



- Enhancing the rural economy
- Supporting agricultural businesses
- Protecting and improving the natural environment
- Addressing the impact of climate change
- Supporting rural communities

Options



- Flooding – to reduce flood risk
- Conversion of Land at Risk of Flooding or Erosion to Low Input Grassland
- Beetlebanks/Grass Strips/Water Margins in arable fields

Arable Options



- Unharvested crops / Wild Bird Cover
- Forage brassica crops for farmland birds
- Unharvested conservation headlands for wildlife
- Retention of winter stubbles for wildlife
- Stubbles followed by green manure in arable rotation

Species Rich Grassland



- Creation and Management
- Capital Payment
- Restoration Capital Payment

Hedges



- Creation & Management
- Capital grant planting
- Management

Thank You

