

Land Management:
Drainage/Water Table control
Pat Tuohy, Owen Fenton

An Analysis of Abatement Potential of Greenhouse Gas Emissions in Irish Agriculture 2021-2030

Prepared by the Teagasc Greenhouse Gas Working Group

Gary J. Lanigan & Trevor Donnellan (eds.)

Authors:

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June 2018

Teagasc, Oak Park, Carlow



Tithe an
Oireachtais
Houses of the
Oireachtas

Tuarascáil ón gComhchoiste um Ghníomhú ar son na hAeráide
An tAthrú Aeráide: Comhdhearcadh Traspháirtí don Ghníomhú
Márta 2019

Report of the Joint Committee on Climate Action
Climate Change: A Cross-Party Consensus for Action
March 2019

CLIMATE ACTION PLAN 2019

To Tackle Climate Breakdown



Rialtas na hÉireann
Government of Ireland

Role of Land Drainage/ Water table control

- **Teagasc GHG Working Group-MACC**
 - **Measure 10:** Draining Wet Mineral Soils
 - » *Measure 7: Extended Grazing*
 - **Measure 17:** Water Table Manipulation of Organic Soils
 - » Also referred to as Rewetting

Mineral or organic soils?

- **Mineral soils** are derived from mineral matter-sand, silt, clay with little organic matter

Organic

- **Peats** possess an organic layer with at least 20% Organic Carbon (OC) and a minimum thickness of 40 cm.
- **Histic soils** have a peaty (>20% OC) (O) horizon that has a thickness of 7.5 or more

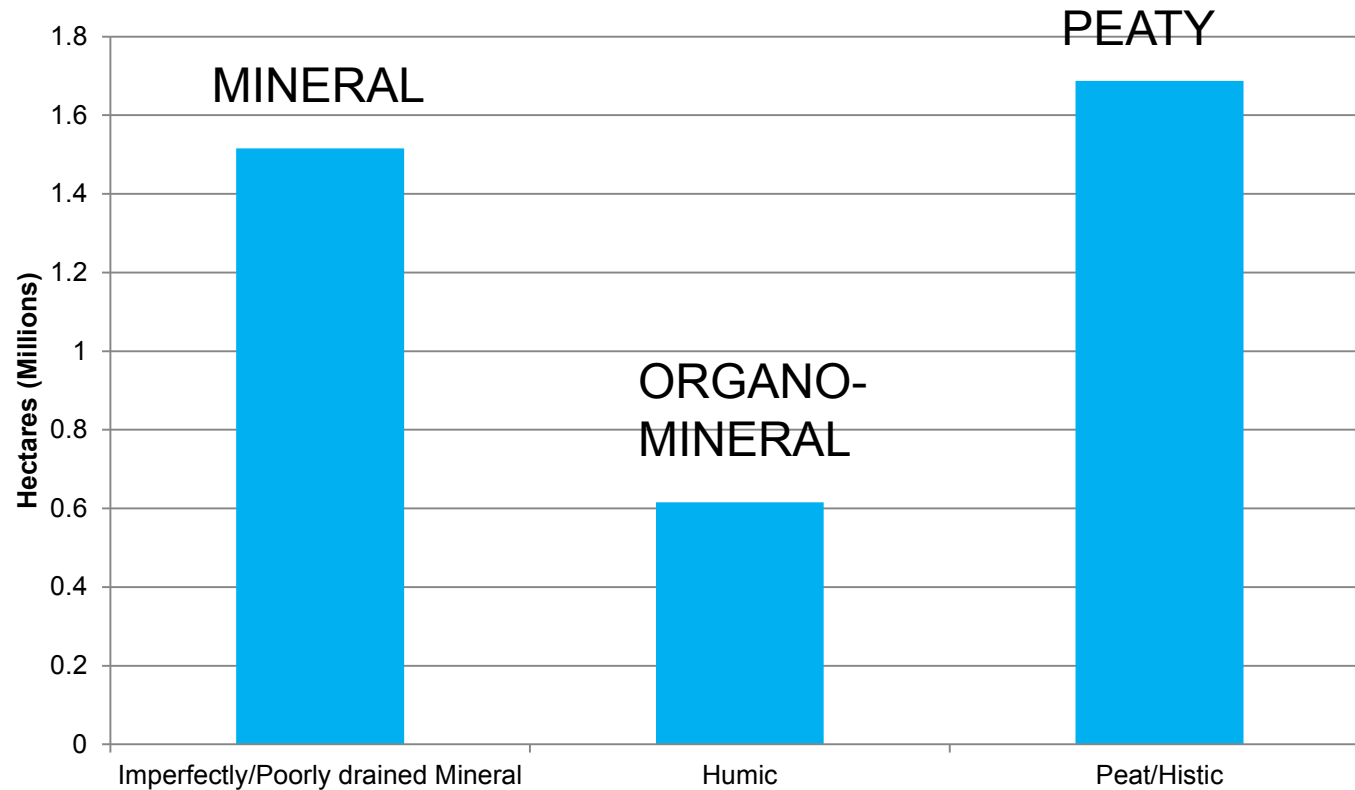
Organo/mineral

- **Humic soils** contain an A horizon with significantly more organic matter, than mineral matter. Minimum thickness is 7.5 cm and OC content is lower (depending on the clay content)

http://gis.teagasc.ie/soils/downloads/SIS_Final_Technical_Report_10.pdf



Mineral or Organic soils?



Mapped within Irish Soil Information System at 1:125,000

- That is not at the scale needed.
- Current work using satellite imagery

Role of Land Drainage

- Measure 10: Draining Wet Mineral soils
- *“one-third of Irish land area can be classified as poorly draining...Assuming that one-third of this area (i.e. 10% of total grassland area) was drained by 2030”*

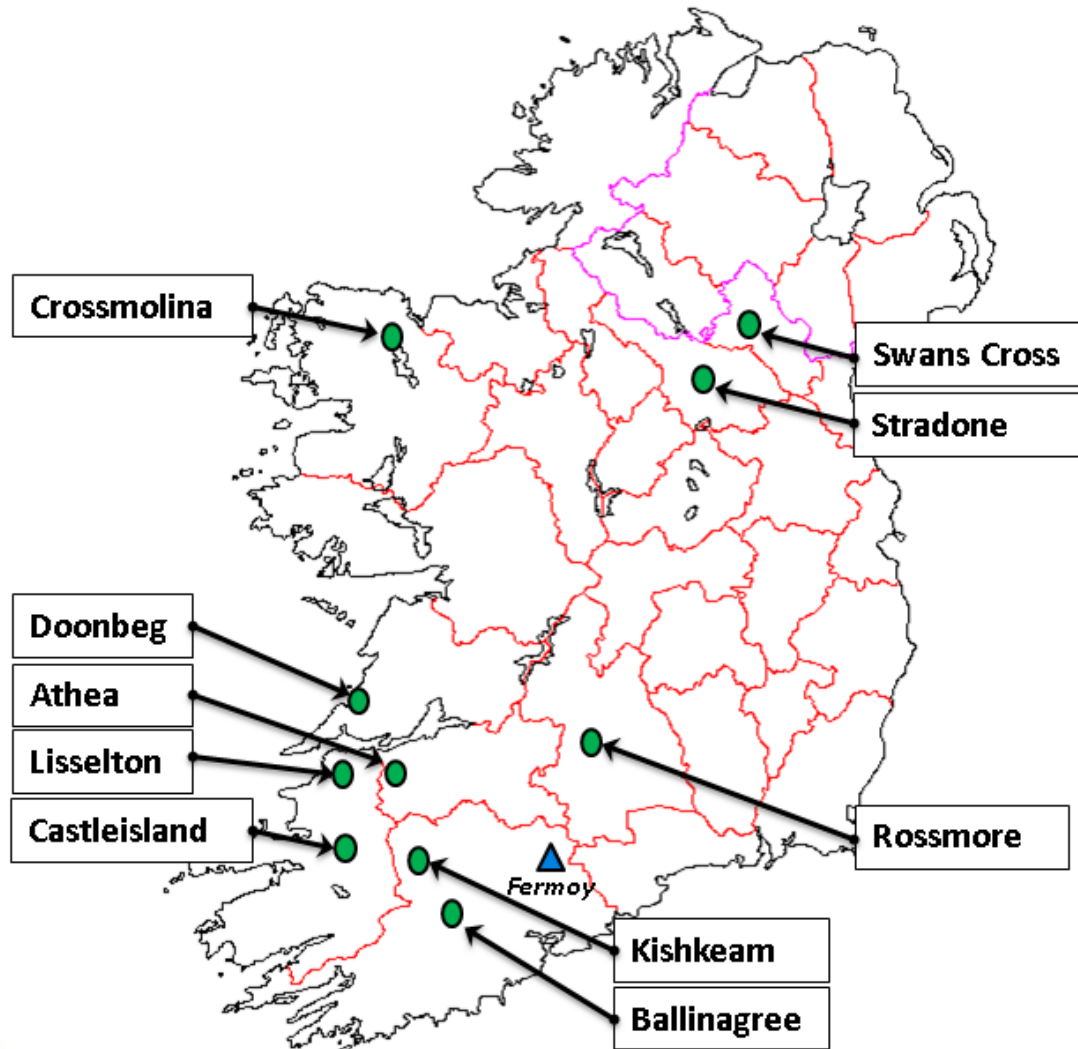
- Nature of Measure: Reducing N₂O Emissions
- Cost € per t/CO₂ Eq: €16.2
- Mitigation Mt CO₂ Eq: 0.197
- Cost €M: €6.1

Role of Land Drainage

- Measure 7: Extended Grazing
- *“production systems that either require improved drainage or could benefit from on-off grazing...The measure was assessed on 20% of grassland area”*

- Nature of Measure: Production Efficiency
- Cost € per t/CO₂ Eq: -€96
- Mitigation Mt CO₂ Eq: 0.065
- Cost €M: -€6.3

Heavy Soils Programme Farms



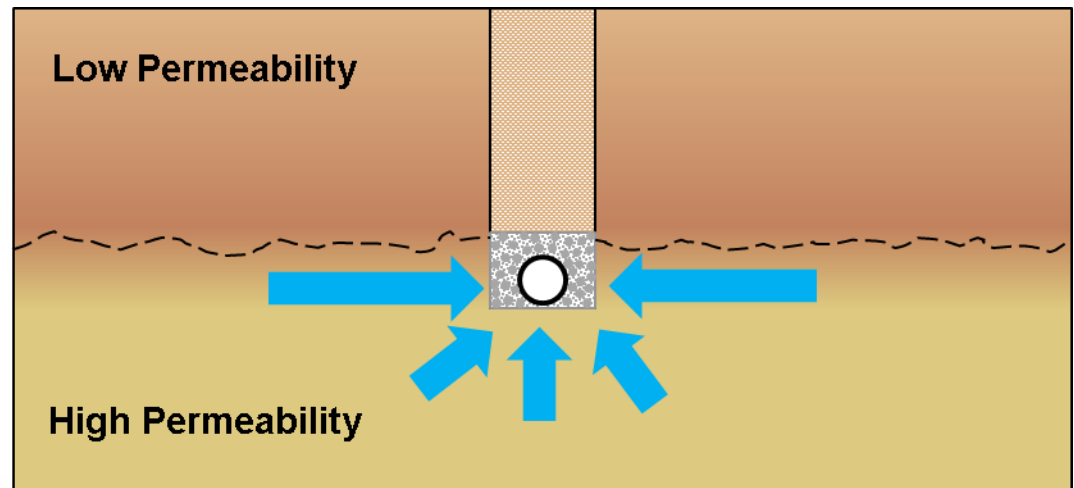
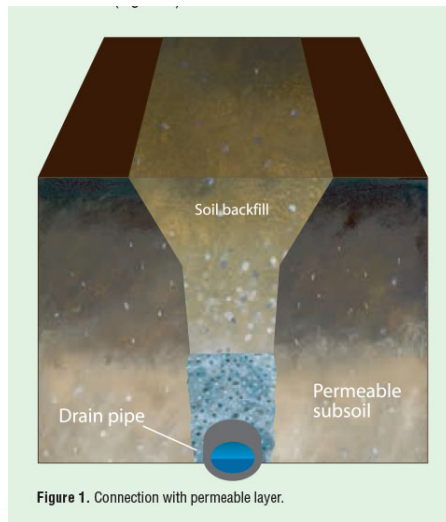
Types of drainage system

- The depth and type of drain to be installed depends entirely on the interpretation soil characteristics.
- Two principle types are distinguished:
 - **Groundwater drainage system:** A network of deeply installed piped drains exploiting permeable layers
 - **Shallow Drainage system:** Where soil is heavy and infiltration of water is impeded at all depths and permeability needs to be improved



Groundwater Drainage System

- A Groundwater drainage system is a network of field drains collecting groundwater which can move through soil layers of high permeability
- They work by exploiting the natural capacity for movement of water at a certain depth in certain soils
- By “tapping” into this natural capacity for water movement the system works by lowering the watertable and reducing the amount of water stored in the soil



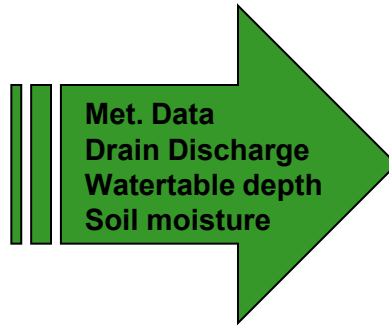
Shallow Drainage System

- A shallow drainage system is a network of field drains in tandem with surface disruption techniques which promote water infiltration and drainage
- Used where soil permeability is low at all depths and aims to introduce new pathways for water movement in the soil
- Methods include: Mole drainage, gravel mole drainage, sub-soiling (pan busting) and land forming

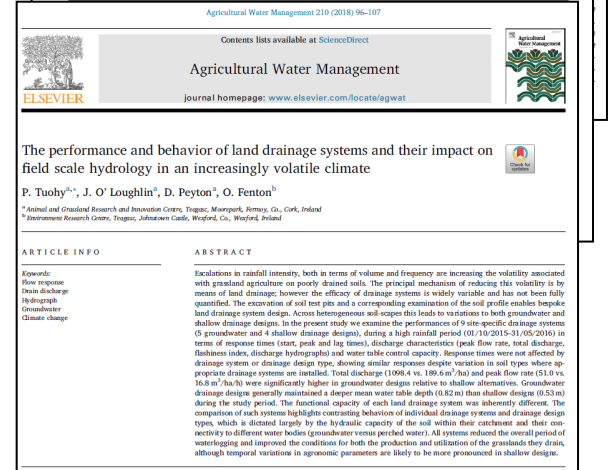
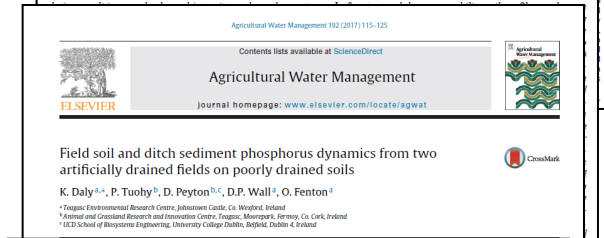
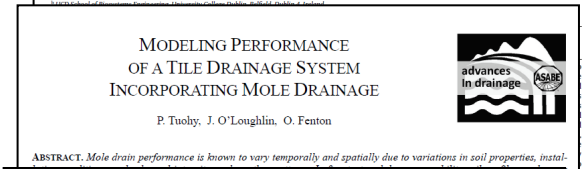


Land Drainage Research/Design

Drainage System monitoring



- “All systems are shown to reduce the overall period of waterlogging and improve surface conditions”



Dissemination, Extension, Training

Coape Environment & Land Use Programme
Johnstown Castle

Animal & Grassland Research and Innovation Centre
Moorepark

Moorepark Dairy Levy Research Update

Land Drainage - A farmer's practical guide to draining grassland in Ireland

Moorepark Animal & Grassland Research and Innovation Centre
Moorepark 13 Open Day
Wednesday 3rd July 2013
Series 23

Teagasc, Kerry, Aurivo, Dairygold logos.

Coape Environment & Land Use Programme
Johnstown Castle

Animal & Grassland Research and Innovation Centre
Moorepark

Moorepark Dairy Levy Research Update

Teagasc Heavy Soils Programme Open Days

Moorepark Animal & Grassland Research and Innovation Centre

Con & Neill Lehane, Ballinacree, Co. Cork - 6th May 2015
Sean O' Riordan, Kiskadeem, Co. Cork - 20 May 2015
Donal & Michael Keene, Lissofan, Co. Kerry - 13th May 2015
Alan Wood, Crossmurnin, Co. Mayo - 2nd September 2015

Series No. 29

Teagasc, Kerry, Aurivo, Dairygold logos.

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Land Drainage: MAINTENANCE Q&A

- ✓ Why do drainage systems stop performing?
- ✓ How can I ensure future ease of maintenance?
- ✓ How are open drains maintained?
- ✓ What methods unblock drains?
- ✓ What time of year should field and open drains be maintained?

Teagasc logo.

PAC NEWS The Voice Of Agricultural Contractors

March / April 2015 03

Getting the most from Land Drainage

soil management

Today's Farm

Mole and gravel mole drainage

IRISH FARM BUSINESS - DAIRYING

LAND DRAINAGE COSTS & BENEFITS

Site investigation is crucial to diagnosing drainage problems. Drainage is an expensive business, so make sure you have the right solution and that it makes business sense to invest in drainage. writes James O'Loughlin and Pat Tuohy (Animal & Grassland Research and Innovation Centre)

Winning the war on water

We travel to Macroom to find out how good drainage has transformed Con and Neill Lehane's farm

Darragh McCullough PUBLISHED

IFM FORAGE AND NUTRITION Guide 2016

Pat Tuohy, Owen Fenton and James O' Loughlin, Teagasc

LAND DRAINAGE GUIDELINES

Approximately 49.5% (3.4 million hectares) of the total land area of Ireland is classified as 'marginal land', which is affected by natural limitations related to its soil, topography, relief and climate. The major limitation is its poor drainage status, and much is in need of artificial drainage if its productivity is to be improved. In wet years poorly drained soils may never dry out as persistent rainfall maintains high soil moisture content

- Low permeability in the subsoil (or a layer of the subsoil);
- High water table due to low-lying position and poor/poorly-maintained outfall;
- Upward movement of water from seepage and springs.

OBJECTIVES OF LAND DRAINAGE
To achieve effective drainage, the works will have to

Grass yields are limited due to the adverse effect of excess water and a lack of air at rooting depth, which limits plant respiration and growth. In cases of prolonged water-logging, plants will eventually die due to a lack of oxygen in the root zone. Furthermore, waterlogged soils are impassable to machinery and livestock traffic for long periods, due to high soil moisture content and reduced soil strength. This reduces the number of grazing days and hinders silage harvesting, thus introducing higher

TEAGASC MANUAL ON DRAINAGE - and Soil Management

Price €40, or €20 for Teagasc clients

A Best Practice Manual for Ireland's Farmers

Teagasc logo.

IRISH FARMERS JOURNAL

News | Beef | Dairy | Sheep | Tillage | Agribusiness | Mac

Tough spring for heavy-soil farmers

Farmers in the Teagasc Heavy Soils Programme are starting grazing now after a wet spring, writes Peter Varley.

By Peter Varley on 24 March 2015

Sub soiling solving water issues in Kiskeam

Deep drainage no good for this North Cork site so sub soiling is the option taken.

By Jack Kennedy on 21 May 2015

Deep drainage works on permeable soil

This field was dried out using deep drainage. Here is a guide to how it works.

By Paul Mooney on 12 March 2015

Questions and answers on land drainage

Land drainage divides up into two broad types: deep and shallow. A decision on which is used in any field comes down to soil type. Here I outline how each system works and typical cost.

By Paul Mooney on 20 February 2014

Drainage systems carefully chosen for heavy soil farms

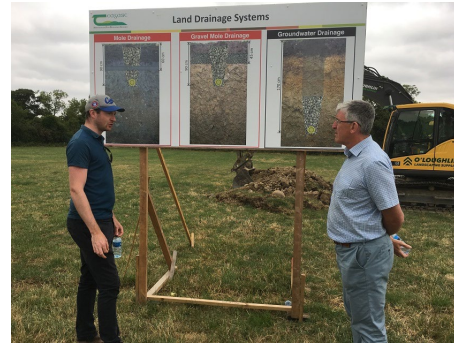
Drainage work and reseedling has now been carried out on the farms participating in the Heavy Soils Programme, guided by the soil layers observed in trial holes dug as deep as 3m.

By Paul Mooney on 20 February 2014

Dissemination, Extension, Training

Land Drainage Training Course

Heavy Soils Research Programme
www.teagasc.ie/heavysoils
Agricultural Land Drainage - Theory and Design



DairyBEEF2019
Sustainable grass-based production

Land drainage design in Ireland

Pat Tuohy

Teagasc,
Johnstown Castle,
Co. Wexford.

Activities on Farm Demonstration Activities
This is a European approved training course for farmers and landowners.

Tuesday, 21st May 11am



YouTube: Land Drainage on your farm; 47,000 + views



AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY

Role of Land Drainage

- Measure 17: Water table manipulation of organic soils
- *“if drainage was stopped completely and natural water table conditions were restored (on) 40,000 Ha of rewetted grassland”*

- Nature of Measure: Rewetting of 40,000 Ha of Organic grassland soils
- Cost € per t/CO₂ Eq: €10.9
- Mitigation Mt CO₂ Eq: 0.44
- Cost €M: €4.84

Rewetting is a confusing term:

Rewetting also means just controlling the water-table at different times of the year while still farming.

Emission Factors

In 2014 temperate zone emission factor revisions were published in the IPCC Wetlands Supplement.

Default values for direct CO₂ emissions of artificially drained **histic** soils were:

- increased by a factor of 1.6 for cropland
- factors ranging from 14 to 24 for grassland

No default value for humic soils

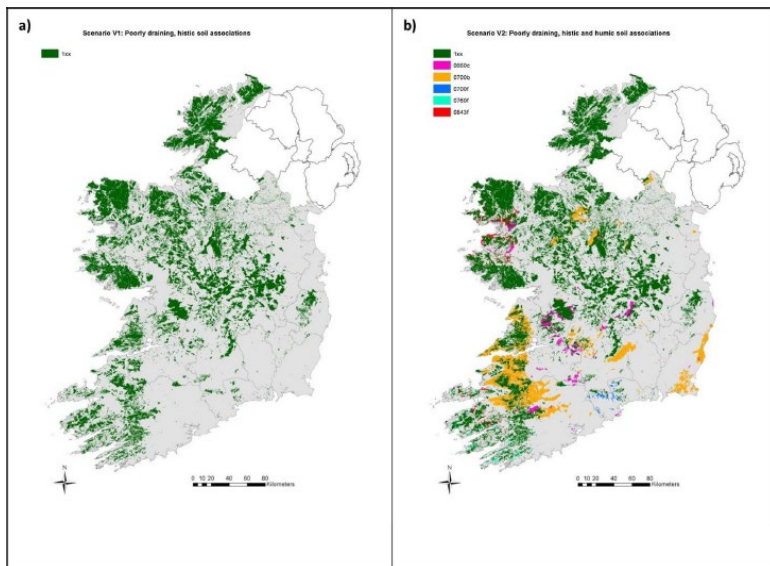
This highlights the role of drained organic soils as emission hotspots.

Peat-Land Area

<i>Peatland category</i>	<i>hectares</i>
Natural peatlands	269,270 ^a
Cutover peatlands (affected by domestic turf-cutting)	612,380 ^a
Afforested peatland	301,700 ^b
Farmed peatland (grassland and cropland)	295,000 ^c
Industrial cutaway peatlands	70,000 ^d
Rehabilitated cutaway	18,000

(O' Sullivan et al. 2018)

- “The (assumed) total area of drained (peat)/histic soils was 370,000 ha (under agriculture)” **(GHG-MACC)**”
- Map of peat areas under agricultural management are required to identify areas suitable for reduced management intensity to attain LULUCF carbon credits



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Environmental Science and Policy

journal homepage: www.elsevier.com/locate/envsci



Assessing the role of artificially drained agricultural land for climate change mitigation in Ireland



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Land Use Policy

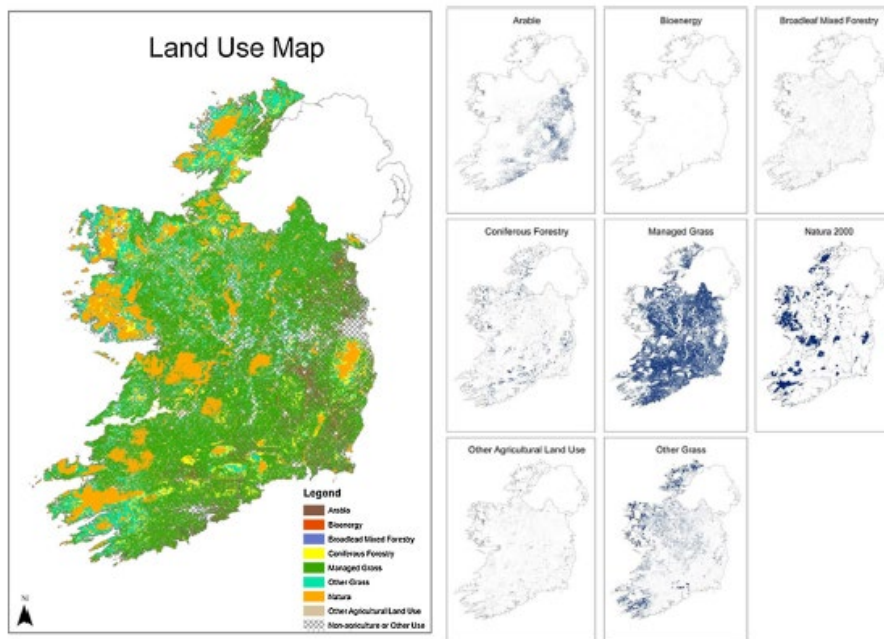
journal homepage: www.elsevier.com/locate/landusepol



Functional Land Management for managing soil functions: A case-study of the trade-off between primary productivity and carbon storage in response to the intervention of drainage systems in Ireland



L. O'Sullivan^{a,b}, R.E. Creamer^c, R. Fealy^d, G. Lanigan^b, I. Simo^c, O. Fenton^b, J. Carfrae^e, R.P.O. Schulte^{c,*}



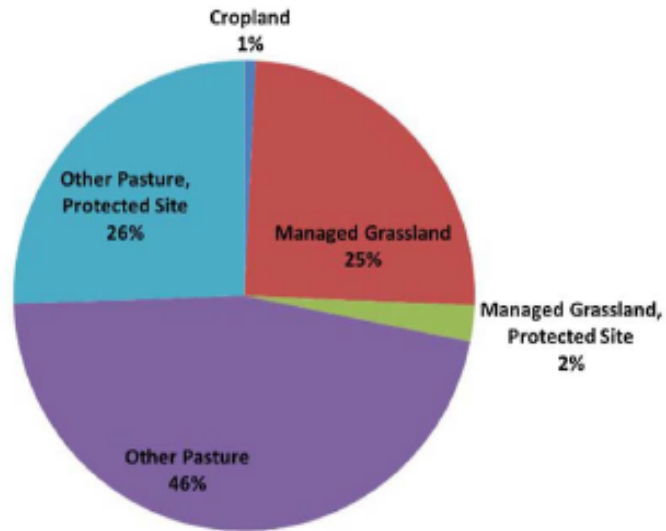
Produced maps of:

- Land Use
- Soil drainage
- Soil drainage crossed with land use

Totals Across LANDUSE:

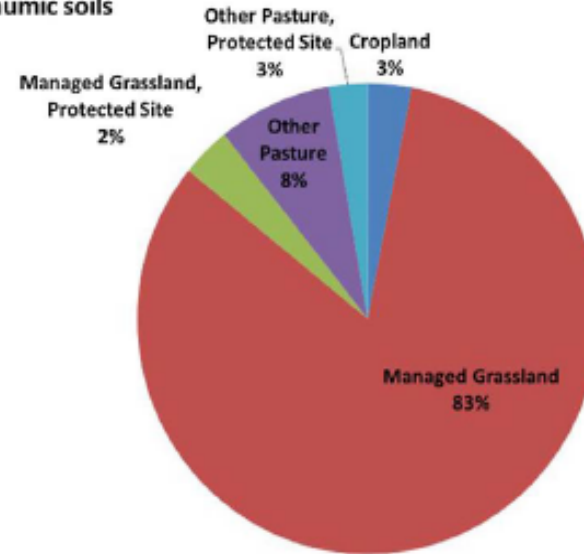
Agricultural land use,
histic soils

a)



Agricultural land use,
humic soils

b)



BUT ALREADY ARTIFICIALLY DRAINED subgroups predicted:

370,000 ha of histic soils drained (assumed)

426,000 ha of humic soils drained (assumed)

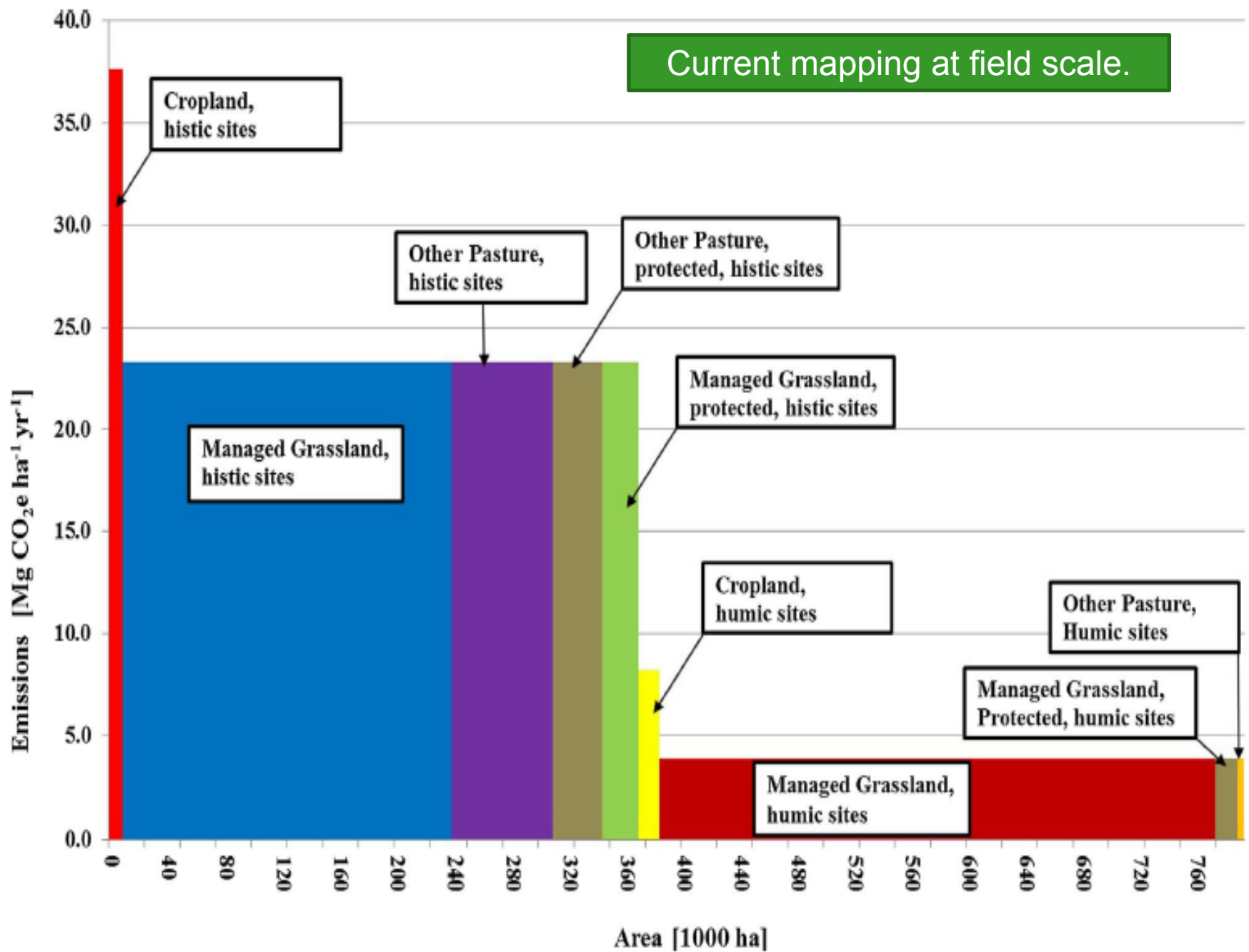
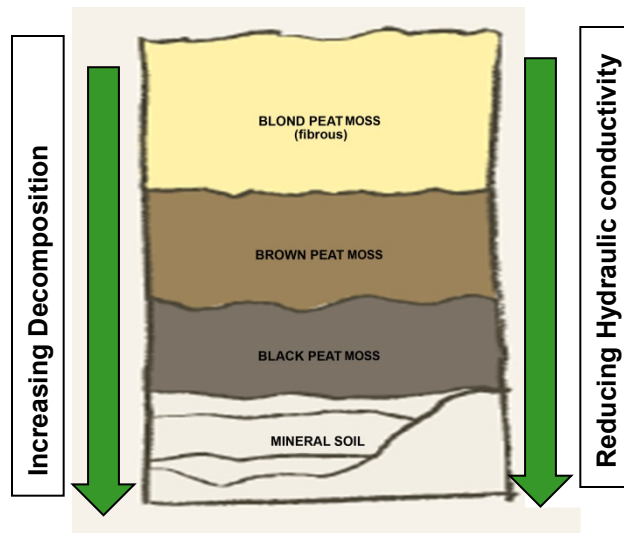


Fig. 3. Area of and GHG gas emissions from of carbon rich soils in Ireland drained for agriculture. The size of each coloured area corresponds to total emissions from the respective land use/soil combination.

Peat Drainage

- Drainage of peats can be particularly challenging and large investment is often required to achieve trafficability levels required for farming practices
- Practical problems associated with peat drainage:
 - **Variation** in hydraulic conductivity and water retention
 - Low bearing capacity: Access/Trafficability
 - High water retention capacity → drain spacing
 - Sinking of drains
 - Subsidence of surface upon drainage



Summary

Calculated **annual** drainage emissions were:

8.7 Tg CO₂e from histic

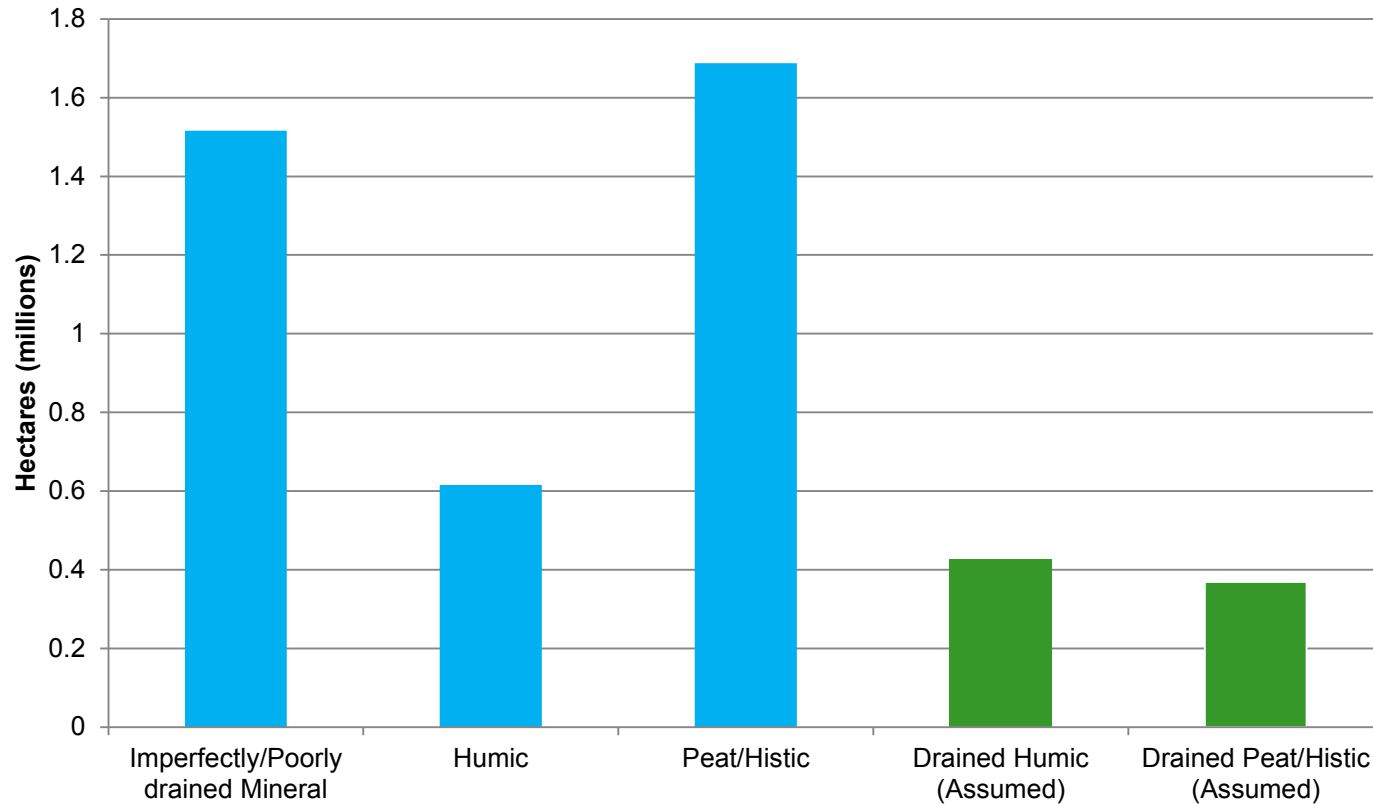
1.8 Tg CO₂e from humic soils

Emissions from humic soils should be considered in new drainage projects

Further research should also explore the site suitability, cost effectiveness, as well as trade-offs and co-benefits of rewetting.

- National policy - recognizes the importance of preserving **organic (histic) and humic soils'** carbon stock, this requires data that is not readily available.
- We do not know the area of drained organic soil in Ireland
- We do not know how much has already reverted to “undrained” conditions
- What is the climate change mitigation potential of water table control in these areas?

Summary



Questions?