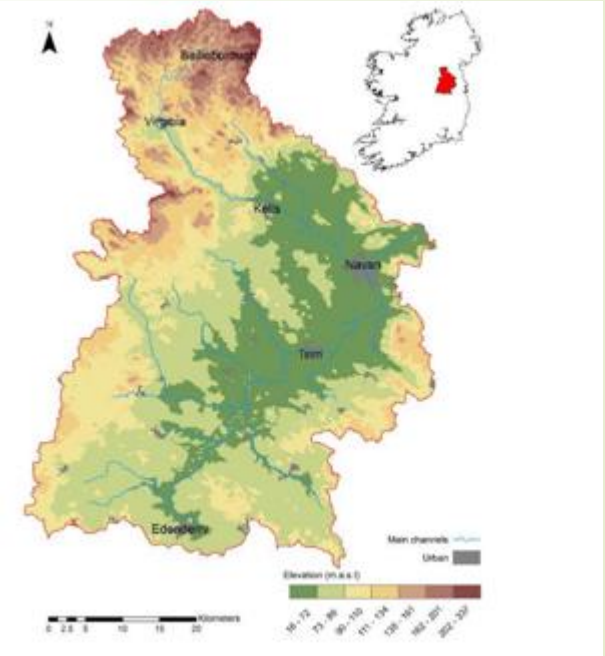
Modelling the environmental impacts of agricultural intensification in the Boyne Catchment

- Global Warming Potential
- Acidification Potential



- Dr. Daniel Courtney

Model description

- Life Cycle Assessment
- Deterministic agri-environmental model devised by Cranfield University.
- Environmental Impacts of agricultural production.
- Processes beyond the farm gate e.g transport and processing of products are not included

Food Harvest 2020 Targets

- Dairy Sector: increase of 50% in milk output
- Beef Sector: No volume increase specified, but 20% increase in value of product
- Sheep Sector: No volume increase, 20% in value of product
- Pig Sector: 50% increase in value of output (volume of output increase unspecified)

Results for the implementation of Food Harvest 2020 in Boyne Catchment

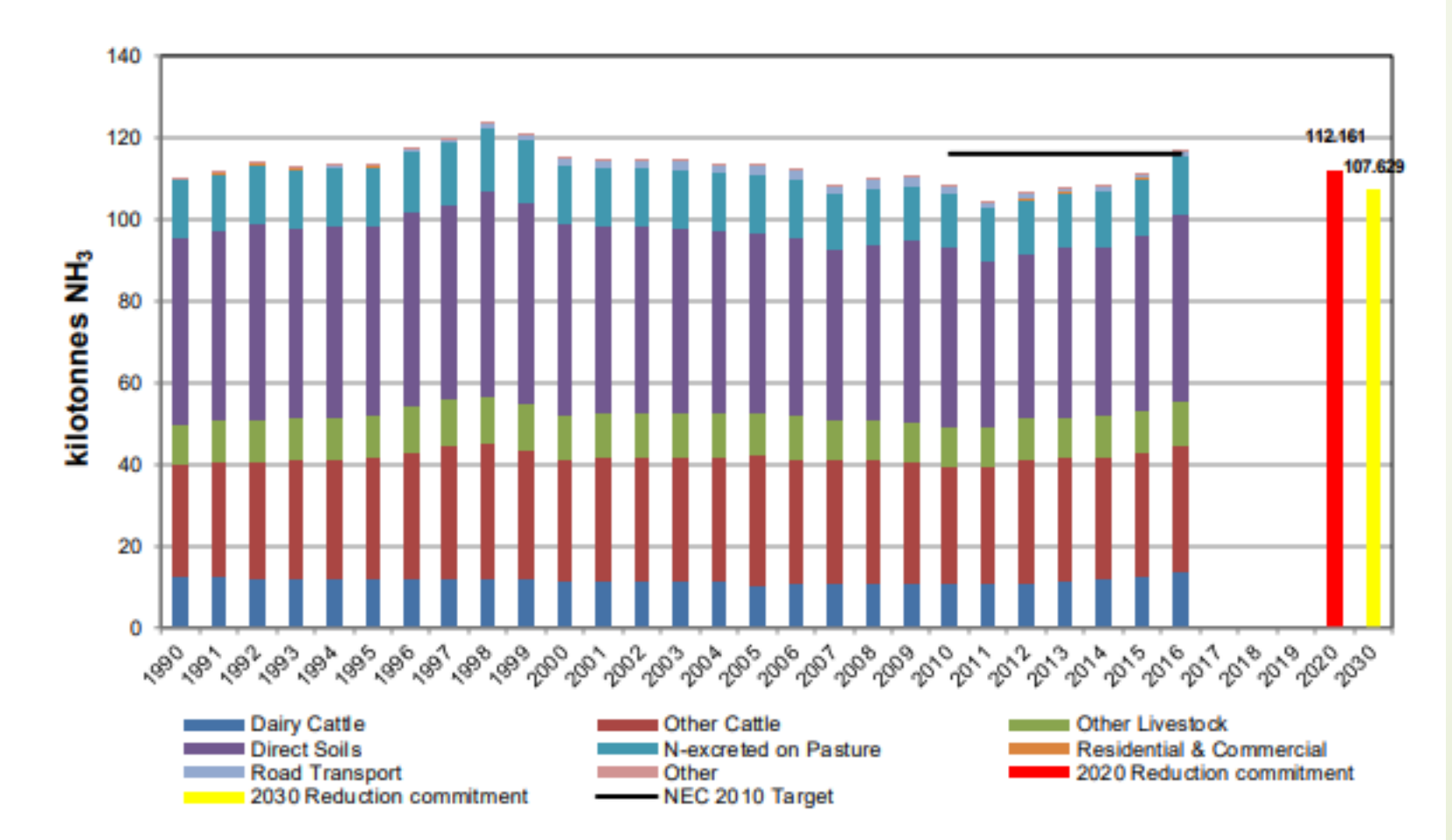
- Global Warming Potential – increases by 7%
- Acidification Potential – increases by 10%

Atmospheric Pollution associated with intensive agriculture

- **Greenhouse gases**: Carbon dioxide, Methane, Nitrous Oxide
- Agriculture responsible for 32% of greenhouse gas emission

- **Ammonia**: Ammonia (NH3) emissions are associated with acid deposition and formation of secondary particulate matter.
- Limits are set by the National Emissions Ceilings Directive
- Limit of 116 kt – was breached for the first time in 2016
- Annual limit for period 2020-2029 lowered to 112kt.

History of national ammonia emissions



What is the environmental damage caused by Ammonia?

- Ammonia Deposition negatively affects biodiversity
- Certain species and habitats particularly susceptible
- Bog and peatland habitats made up of lichens and mosses
- Can be damaged by even low concentrations of ammonia

Types of deposition from the atmosphere

- Ammonia – non-persistent in the atmosphere
- Dry deposition – in the form of gaseous ammonia (NH3) – normally

downwind from the site

- Wet deposition – in the ammonium ionic form (NH4+) – usually associated with precipitation
- Deposition of other chemical forms – mainly particulate matter

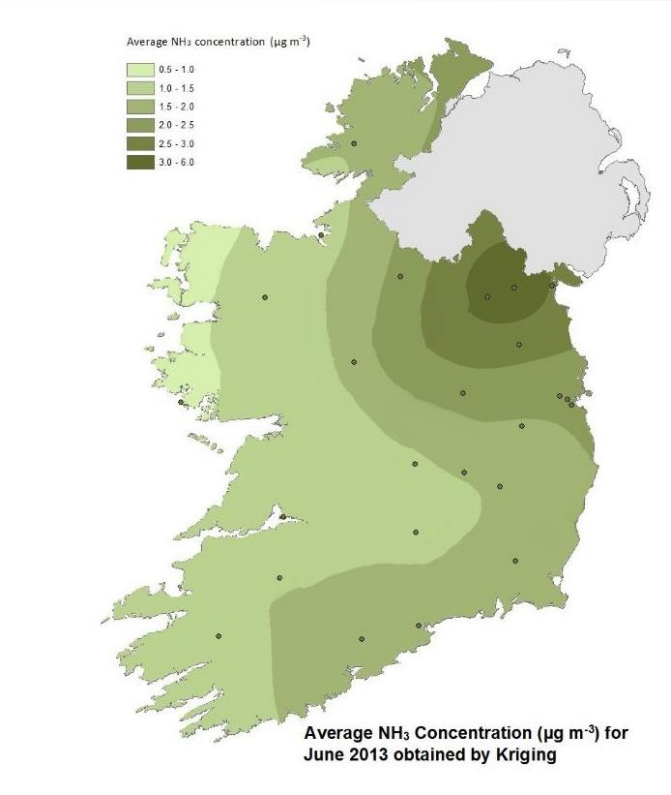
Special Areas of Conservation

- Some species and habitats susceptible to ammonia pollution
- Directly toxic to leaves of sensitive plants (stomata)
- Raised bogs
- Damage to lichens
- Damage to Sphagnum moss.
- Mosses and lichens are damaged by even low levels of Ammonia.
- Several SACs in the Boyne Catchment

Sources of Ammonia

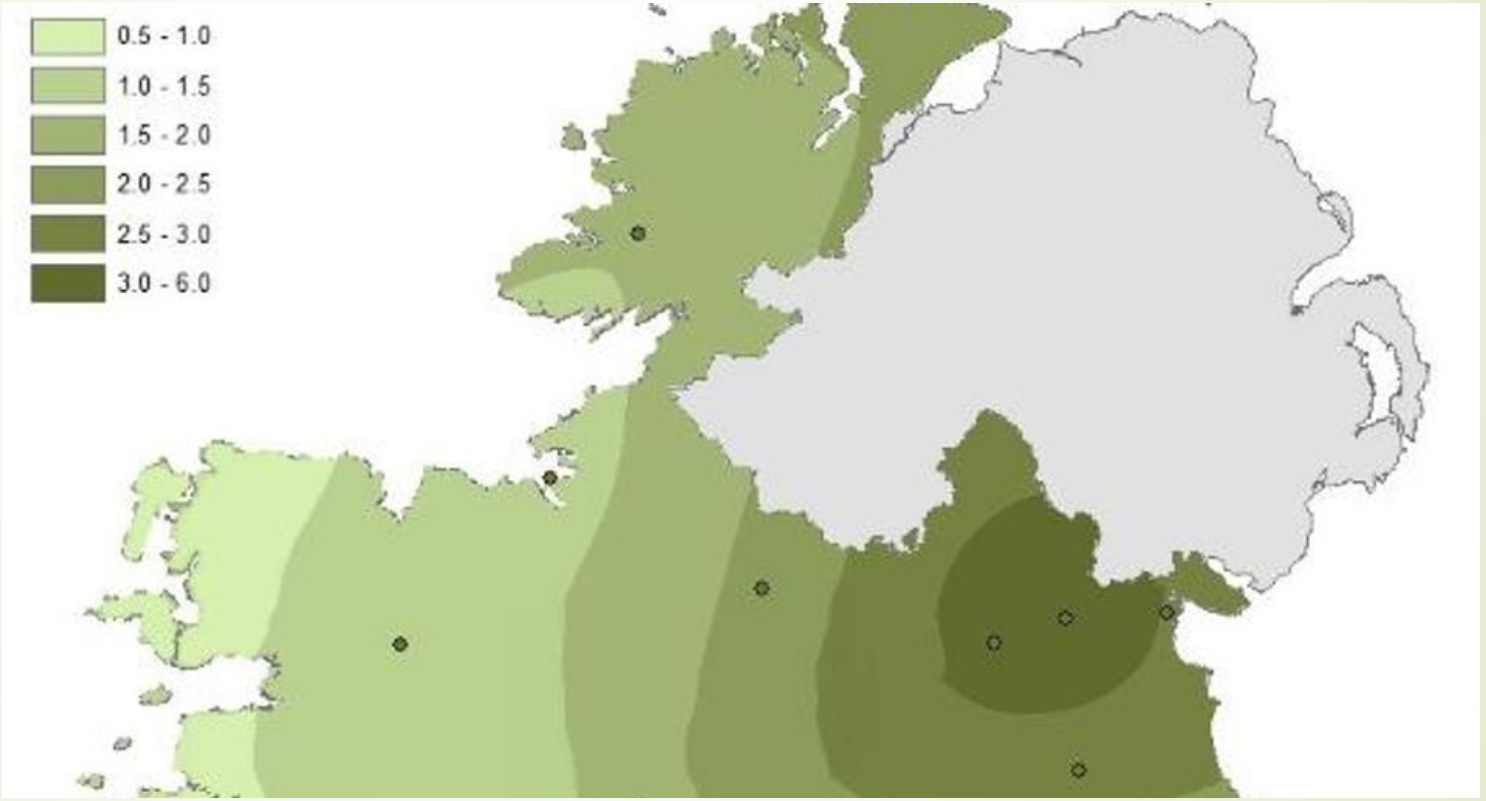
- 98% of ammonia emissions attributable to agriculture
- Manure and Slurry storage and spreading
- Nitrogen Fertilizers – mainly Urea and Calcium Ammonium Nitrate

Ammonia concentration – June 2013: Very high in the Boyne Catchment



Source: www.ucd/ammonia

Increasing concentration NH3 – west to east
Emission rate faster than deposition rate



Boyne Catchment June 2013 – high NH3 concentration – Why?

- High intensity livestock production systems – mainly cattle and pigs
- Spreading of slurry after first cut silage
- Application of synthetic Nitrogen fertilizer – mostly ammonium nitrate
- Dry soil conditions
- Meteorological conditions favouring volatilisation of ammonia from fields

EU Natura 2000 sites in the Boyne Catchment

- Special Areas of Conservation (SAC) – several in the catchment
- Killyconny (Cloghbally) Bog – active raised bog

Killycunny Raised Bog – a Special Area of Conservation (SAC)

Ling Heather (Calluna vulgaris) damaged by ammonia deposition - bleaching

Source: www.apis.ac.uk

Healthy Ling or Common Heather

Healthy Sphagnum moss in a raised bog

Sphagnum moss – healthy and damaged

Source: Irish Times, E. McSweeney

Seasonal and diurnal effects

- Spring is the best time to spread slurry – because of low level evapotranspiration (c. 1mm per day on dry days) leads to low level volatilisation of ammonia
- Summer spreading of slurry may lead to high concentration of ammonia in the atmosphere due to high level evapotranspiration (c. 3mm per day on dry days)
- Daily volatilisation of ammonia is usually highest in the afternoon – particularly with drying conditions.

Interventions to reduce NH3 emission levels

After slurry spreading on grass ammonia is emitted to the atmosphere from drying leaf surfaces.

- Spreading slurry in spring rather than summer (lower evapotranspiration in spring)
- Avoidance of spreading in very dry weather
- Low emission slurry spreading systems

High ammonia emission slurry spreading Splash plate spreading method

Low ammonia emission slurry spreading: trailing shoe band spreading method

Low ammonia emission slurry spreading: Disk soil injection method

Finally….

- Food Harvest 2020 intensification programme will have an adverse impact on sensitive ecosystems in the Boyne Catchment
- Very low concentrations of ammonia in the air…even 2 parts per billion can damage sensitive species
- Every field where slurry is spread is a source for ammonia emission
- Low emission slurry spreading technology should become enforced by regulation.