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Assessment and Mapping of the Drainage Status of Ireland's Peatlands

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Abstract: Peatlands are an important part of ecosystems that provide benefits for biodiversity conservation, water regulation, and carbon sequestration. However, human activities such as land drainage, peat extraction, and agricultural conversion have significantly degraded these peatlands. This degradation has transformed peatlands from carbon sinks into sources of greenhouse gas emissions, mainly when converted to grasslands. In alignment with the EU Paris Agreement to reduce greenhouse gas (GHG) emissions, various initiatives have been implemented to manage, restore, and monitor emissions from Ireland's peatlands. A lack of comprehensive information about peatland drainage conditions poses a challenge for accurately mapping Ireland's peatland. This research accesses and maps the peatland's drainage status (shallow or deep) through remote sensing technology (i.e., drones), on-field vegetation surveys, and hydrological monitoring. The peatland site was surveyed to assess and map the vegetation and drainage changes. Peat depth and scorecard results classified the site fields in terms of wet vegetation species and hydrology. The outcome of the research gives baseline to indicate peatland site shallow or deeply drained based on drone and on field surveying.

Keywords: Peatlands, Drainage Status, Remote Sensing, Peatland Vegetation, GHG emissions

1. Introduction

Peatlands are a type of wetland where waterlogging conditions prevent the full decomposition of organic matter (Yli-Halla et al., 2022). This partially decomposed organic matter is known as peat, and it forms deposits over extensive sections called bogs (Tuohy et al., 2023). Anthropogenic activities, i.e., artificial drainage, peat extraction, and land use for agriculture, have caused significant degradation of peatlands (Huang et al., 2021) . Degraded peatlands account for 4-5 % of global GHG anthropogenic emissions (Strack et al., 2022).

Ireland is covered 21-23 % by peatlands, mainly comprising of blanket bog, raised bog, and fen, which store over 2 billion tonnes of carbon stocks (Wilson et al., 2022). As a result of artificial drainage for land use, i.e., agriculture, etc, peatlands can become a source of water pollution, and the water table position is lowered, which causes organic carbon oxidation (Flynn et al., 2015). Water table position fluctuations result in uncertainty about the GHG emissions from peat soils and make it challenging to map peat depth and emissions.

According to Land Use, Land Use Change, and Forestry (LULUCF) reporting, Ireland is tracking emissions from its 5% of peatland area. Climate Action Plan 2025 shows that 339,000 ha of grasslands on drained organic soils consist of 141,000 ha of drained area. Apart from these, other unmanaged peatlands are not explored for GHG emissions, and their situation is alarming due to the degradation. (Tiemeyer et al., 2016) study shows that peat soil overshadowed by grasslands reported high GHG emissions. These drained organic soils are an emissions source and a major threat to climate change; therefore, managing and restoring them is Ireland's top priority to address climate change, to reduce net LULUCF emissions by 0.626 $MtCO_2eq.$ by 2030.

However, the exact drainage and emissions status of drained organic soils is unknown. (Tuohy et al., 2023) concluded that reported GHG emissions can be overestimated due to the uncertainty of drainage status of nationally reported drained peatlands on grasslands. Peatlands are being effectively evaluated and mapped in terms of vegetation cover, hydrology, and GHG emissions using advanced remote sensing techniques such as drones. Therefore, this research study aims to map the peatland site (blanket bog) overshadowed by grassland in Ireland. Peat depth, vegetation cover, and drainage status will be key parameters used to assess and map the peat soil condition. Assessment and mapping of the peatland site will indicate the peatlands' condition for GHG emissions.

2. Methodology

The research study site is located in North Kerry, Ireland, and consists of blanket bog and grassland over peat soils. Initially, a drone LiDAR survey was done to assess the site condition in terms of vegetation cover and drainage. To quantify the peat soil, the peat depth of the sites was recorded using the metal probing method. Scorecards based on the ecological, hydrological, and threat sections were used to assess the site vegetation and drainage conditions. Scorecards were surveyed by walking in the

'W' manner in the blanket bog and grassland categorized fields.

3. Results and Discussion

The peat depth at the study site was initially measured and found to vary up to 2.6 meters across the area. The LiDAR drone data, the recorded peat depths, helped characterize the site as comprising bog and grassland overlying peat soils. Peat depth was a crucial parameter for assessing peat condition, as peat thickness is influenced by soil moisture and the position of the water table.

Scorecard survey results showed that blanket bog fields scored in the range of 6 and 8 out of 10. These results show a variation from ordinary bog to pristine bog conditions, where vegetation is dominated by bog mosses and lichens. Grassland fields scored in the range of 3 and 8 out of 10, allowing them to be categorized as either wet grassland or improved grassland. Wet grassland fields were dominated by mosses, rushes, sedges, and similar vegetation. In contrast, wetland species were rare in the improved grassland fields, indicating drier conditions and evidence of nutrient input.

An open and infield drainage ditch system in the fields was identified through the scorecard to assess the water table position for shallow or deep water table for emissions. Fields with higher vegetation and hydrological scores appeared to be shallowly drained, while those with lower scores were likely deeply drained.

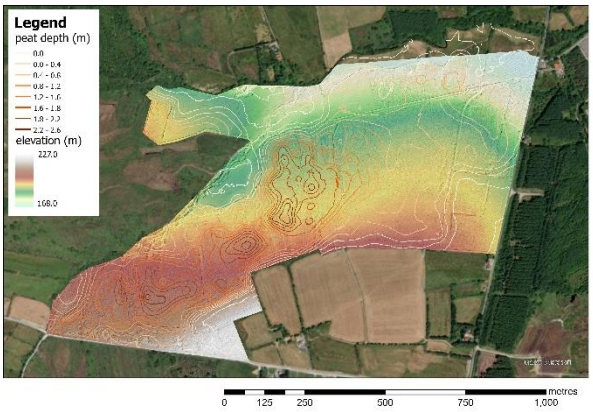

Figure 1. Peat depth map of the site

4. Conclusion and Future Work

The study results, comprising peat depth, vegetation, and hydrology, provided an initial foundation for assessing and mapping the drainage status of the peatland site. Bog and grassland fields with high survey scores were dominated by vegetation species indicative of wet conditions. These high-scoring fields appeared to be wet, with the water table close to the surface, suggesting shallow drainage. While fields exhibiting dry conditions had lower water tables, indicating deeper drainage.

Overall, the research study results enabled the preliminary classification of fields based on their drainage status. They also established a baseline for future research aimed at refining peatland classification in terms of shallow or deep drainage. Future research work for this study includes:

- Installation of dip wells across the site to monitor water table levels.
- Seasonal drone surveys and scorecard assessments to track changes in vegetation and drainage status over time.

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