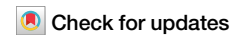


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Priority research questions in global peatland science



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Peatlands are among Earth's largest terrestrial carbon stores and are crucial for climate regulation, biodiversity conservation, and water security. Yet peatlands worldwide are deteriorating under pressures from climate change and human disturbance. Strategic, globally coordinated research is urgently needed to protect, restore and manage peatlands so they can continue to deliver essential ecosystem services. To meet this challenge, here we present a global research prioritisation for peatland science, based on a two-stage online survey and expert voting exercise involving 467 participants from 54 countries. We identify 50 priority research questions spanning carbon dynamics, climate impacts, restoration and management, technological innovation, and community and policy engagement. These questions provide a community-informed agenda to guide peatland research over the next decade. Addressing them will help close critical knowledge gaps, strengthen evidence-based decision making, and support the role of peatlands in achieving global climate and biodiversity goals.

Peatlands are wetland ecosystems characterised by the accumulation of partially decomposed organic matter (peat). Although they cover only 3 to 4% of the Earth's land surface, they store nearly one-third of global soil carbon^{1,2}. This disproportionate carbon storage makes peatlands pivotal in regulating climate by sequestering carbon over millennial timescales. Beyond carbon, peatlands can regulate water regimes by attenuating flood peaks and maintaining base flows, while filtering water and supporting unique biodiversity, including many specialised and endemic species³. They also hold cultural and economic significance in many regions (e.g., as sources of water, traditional foods, fibres, growing media and fuel). However, when peatlands are disturbed or drained they transition from carbon sinks to net carbon sources, releasing CO₂ and other greenhouse gases in addition to losing other ecosystem services^{4–7}. Globally, peatland degradation (primarily through drainage for agriculture or forestry) accounts for an estimated 5–10% of annual anthropogenic CO₂ emissions⁸. Moreover, the peatland net carbon balance is sensitive to shifting environmental conditions, such as changes in surface moisture⁹. These vulnerabilities highlight the urgency of improving our understanding of peatland dynamics to inform conservation and restoration efforts, particularly in line with global climate change targets and maintenance of critical ecosystem services.

Despite their critical ecological functions, peatlands have historically received less scientific and policy attention than ecosystems such as forests or coral reefs. For instance, the impacts of climate change on peatland carbon dynamics were a new addition to the IPCC-AR6 report¹⁰. This historical lack partly reflects their often limited visibility and remoteness and their historical perception as marginal lands of relatively low economic

importance, even though their role in the global carbon cycle and climate regulation has been acknowledged by the scientific community for over 30 years. Their uneven geographical distribution, with extensive peatlands concentrated in a relatively small number of countries, has also likely contributed to patchy awareness and investment. As climate change accelerates and human pressures on land increase, particularly in the tropical region where peatland research is still considered an emerging topic, there is growing interest among scientists, land managers, and policymakers in coordinating peatland research and management efforts. Notably, initiatives such as the Global Peatlands Initiative (GPI), launched in 2016, seek to “save peatlands as the world's largest terrestrial organic carbon stock and to prevent it being emitted into the atmosphere”¹¹. Recent international commitments (e.g., the Kunming-Montreal Global Biodiversity Framework and UNFCCC COP28/29 pledges) still underscore the urgency of preserving carbon-rich ecosystems like peatlands, not only for climate mitigation but also for safeguarding water and biodiversity security in the face of accelerating ecological collapse. Research resources being finite, identifying the most urgent and impactful research questions is crucial for focusing and coordinating efforts across actors. Priority-setting exercises in other fields¹¹ have helped align research agendas with policy needs and emergent issues, but to the best of our knowledge, a community-driven research prioritisation for peatland science has not previously been undertaken.

Here, we address this gap by engaging the global peatland community to identify the priority research questions for the next decade. By drawing on the collective expertise of hundreds of peatland researchers, practitioners and other actors worldwide through a survey, we aim to highlight common

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themes and critical unknowns that, if addressed, would significantly advance peatland science and management. The outcome of this process – a list of priority questions across five themes – is presented to guide a shared agenda for researchers, research funders, and policy-makers to align future work with these priorities, with the ultimate goal of maximising the contribution of peatlands to global Sustainable Development Goals (SDGs), including climate action (SDG13), improving life on land (SDG15), as well as access to clean water (SDG6)¹².

Results

Survey responses and participant demographics

Collectively, 467 people submitted responses to the online survey (Fig. 1, Methods). Participation was geographically broad, with respondents from 54 countries across all inhabited continents. Europe had the largest representation (45% of respondents), followed by Asia (21%), North America (16%), Africa (10%), South America (5%), and Oceania (3%). The top five countries by number of contributors were the United Kingdom (80 respondents), China (53), Russia (39), Canada (33), and the United States (30), together accounting for 50% of respondents and partly aligning with global patterns in peatland extent (Fig. 2). We captured input from tropical peatland-rich nations such as Indonesia (26 respondents) and the Democratic Republic of Congo (26), though some regions (e.g., Amazonia, Nile Basin) were less represented (Fig. 2). Analysis of the peatland regions where respondents reported working shows that many Europe- and North America-based respondents also work beyond their region of residency, across the Americas, Africa and Asia, whereas peatlands in parts of Africa outside the Congo Basin and in Oceania remain relatively under-represented (Supplementary Table 3).

Most respondents (67%) identified as researchers, with additional representation from government (9%), non-governmental organisations or charities (8%), private industry (2%), and others (the remainder either in sectors like forestry/agriculture or not specified). Analysis of respondent job titles (Supplementary Discussion) shows that a majority of respondents whose job roles indicated a discipline were related to environmental and natural sciences and a subset hold explicitly peatland- or wetland-focussed roles. Respondents' peatland experience spanned from relatively new to peatlands (< 1 year, 9%) to long-standing (> 20 years, 18%), with the bulk of participants in intermediate brackets: 2–5 years (26%), 6–10 years (19%) and 11–20 years (22%). The modal age class was 35–44 years (34% of respondents), followed by 25–34 (22%) and 45–54 (21%) years old. Fewer responses were from younger (18–24; 4%) and older (65+; 6%) age cohorts. Approximately 56% of respondents were male and 42% female (with ~1% non-binary or no response) (Supplementary Fig. 2).

Priority questions in global peatland research

The questions were shared with invited experts who prioritised them using a multi-voting system (Fig. 1, “Methods”, Supplementary Methods). The voting was done remotely, individually and anonymously. Points received for each question were summed, and questions were ranked by total score. Below, we present the top 50 research questions identified by the invited experts. We have organised these questions into five thematic groups (Fig. 3), each introduced with a brief overview. The grouping does not reflect any ranking; all questions are considered top priorities, and their ordering here is not hierarchical. Questions marked with an asterisk (*) were among the highest-scoring in the expert prioritisation and are highlighted to help readers identify a smaller subset of priorities.

Theme 1: Peatland carbon dynamics and climate regulation

Peatlands are globally important carbon reservoirs. Decades of research have established that northern peatlands alone store on the order of 450 Pg (billion tonnes) of carbon¹³, with global estimates around 600 Pg of carbon¹. These estimates are regularly updated and refined regionally¹⁴, but large uncertainties remain in basic parameters like the total extent of peatlands (especially in the Tropics), peat depth, and how peatland carbon accumulation rates vary across regions and landscape settings. Estimates of global peatland area and carbon have been revised upward as advances are made to improve peatland extent maps and peat soil characteristics^{2,15–17}. At the same time, an estimated 12% of peatlands globally are degraded, primarily through human disturbance linked to drainage¹, potentially emitting from 1 to 1.92 Gt CO₂-equivalent per year to the end of the 21st century if degradation continues at this rate^{1,18–21}, effectively turning these ecosystems into net carbon sources to the atmosphere. This theme captures questions on fundamental peatland carbon stocks and fluxes, and factors controlling whether peatlands act as carbon sinks or sources. Although framed at a global scale, answering these questions necessarily depends on locally and regionally resolved data, with global syntheses of peatland carbon continually informed by place-based studies and regional assessments. In addition to being identified as priority questions in the prioritisation process, questions on the global extent of peatlands (Q1), their current carbon store (Q2), the environmental conditions that influence and optimise the carbon sink function (Q7) were all in the most commonly submitted questions by respondents to the community survey (Supplementary Table 2), underscoring global concern about peatland extent and carbon emissions and reflecting both the scientific knowledge gaps and the current policy relevance of peatland carbon.

1. *What is the global extent and distribution of peatlands, including those in areas that are currently poorly mapped?*
2. *How much carbon do peatlands store globally?*

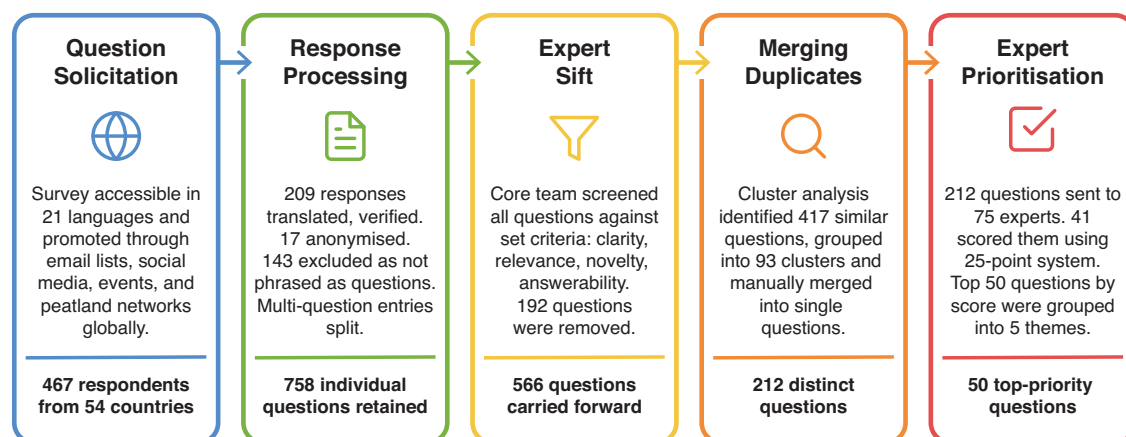


Fig. 1 | Schematic overview of the multi-stage workflow used to derive the list of peatland research priorities. The numbers at the bottom of each box indicate how many questions or respondents were involved at each stage.

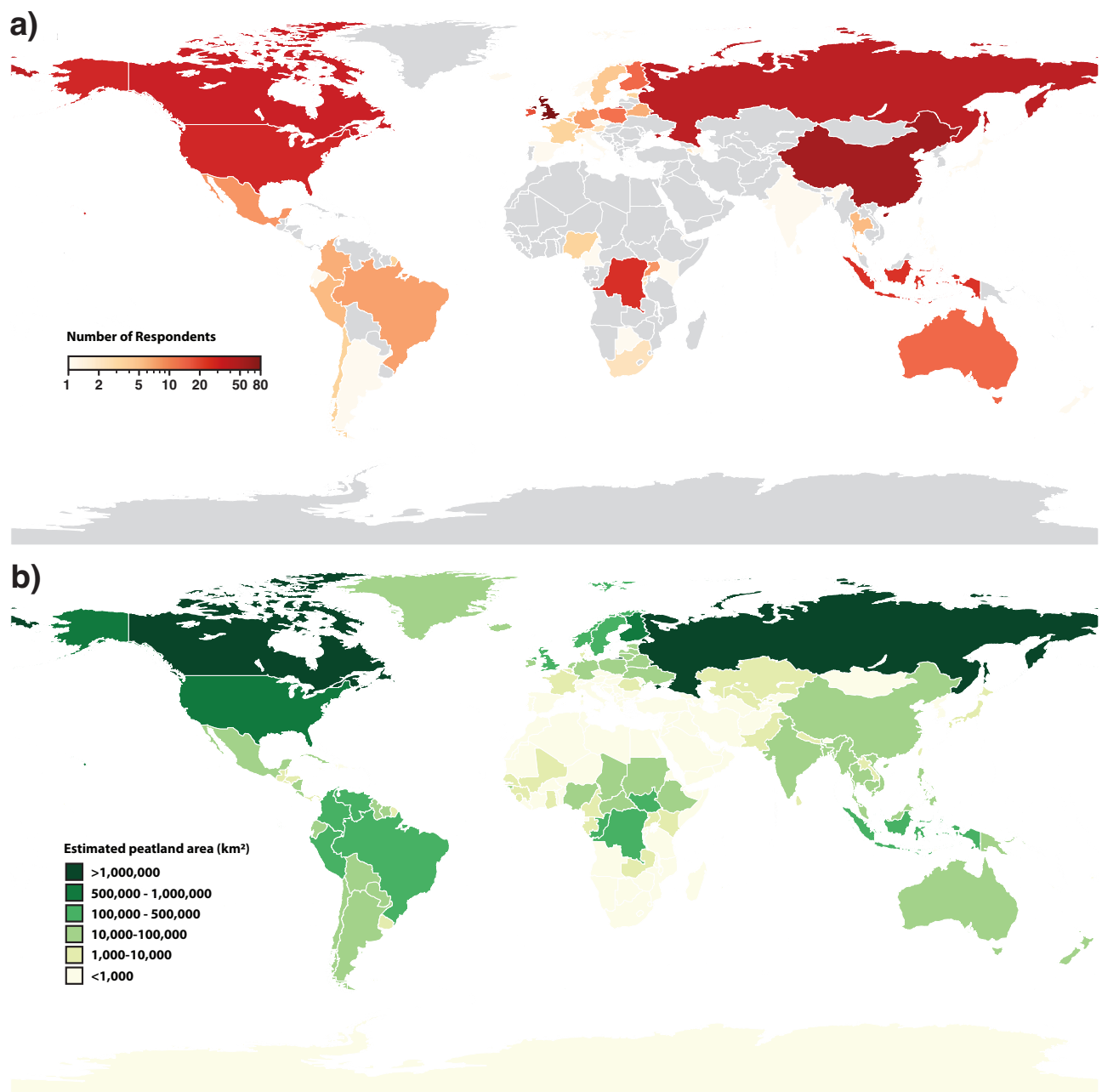
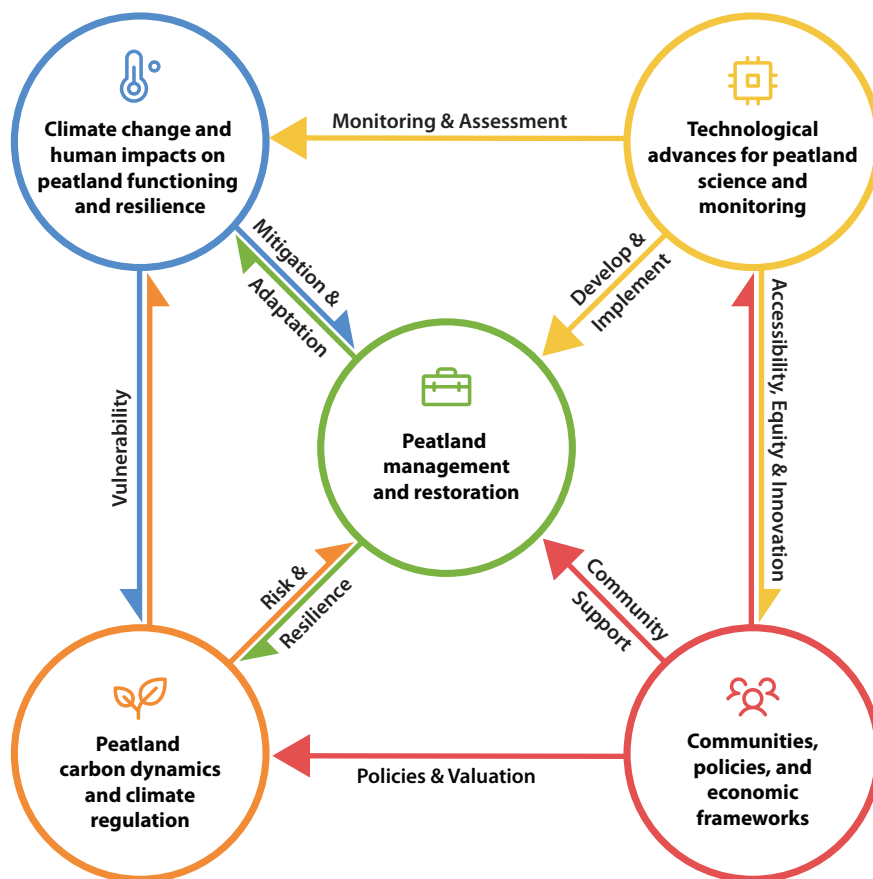


Fig. 2 | Global comparison of survey respondent distribution and estimated peatland extent by country. **a** Number of survey respondents by country ($n = 467$ respondents across 54 countries), shown using a colour scale with \log_{10} transformation applied for visual contrast. Countries with no survey respondents are shown in light grey. **b** Estimated peatland area by country based on the 0.1 probability threshold from Peat-ML, a global 1 km resolution model of peatland presence derived from machine learning using climate, soil, hydrological and topographic

predictors¹⁵. The 0.1 threshold was selected as it provided a balanced and plausible global extent, capturing known peatland regions while limiting likely false positives, and enabling meaningful country-level comparisons. Countries are grouped into six area bins for visual clarity. Both maps use the Natural Earth Admin 0–Countries shapefile (v5.0.0, without boundary lakes) and are displayed using a shared geographic projection (EPSG:4326).

3. *What are the global greenhouse gas emissions from peatlands and how do they vary by peatland type, region and degree of disturbance?
4. What role do peatlands play in regulating global climate and to what extent will protecting peatlands contribute to mitigating climate change?
5. What is the contribution of shallow peatlands to local, regional and global carbon inventories?
6. What is the net carbon budget of undisturbed and disturbed forested peatlands, and how do they contribute to the global carbon cycle compared to forests on mineral soils?
7. What environmental conditions and mechanisms influence the peatland carbon sink function and how can we maintain optimal sequestration rates across peatland types and conditions?
8. What factors control the rate and mechanism of organic matter degradation in peatlands, and how do the associated microbial processes change due to drainage, fires, land use changes, and different climate change scenarios?
9. How do different peatland types differ in terms of function and characteristics, including carbon accumulation?

Fig. 3 | Five themes of priority research questions in global peatland science and their interconnections. The arrows indicate the cross-cutting connections between the themes.



Theme 2: Climate change and human impacts on peatland functioning and resilience

Peatlands and climate change interact in complex ways, with warming, altered precipitation patterns, increased frequency of extreme events, and atmospheric nitrogen deposition affecting peatland resilience²². For instance, modelling and experimental studies for northern peatlands have shown increased peatland plant productivity with elevated CO₂ and/or higher temperatures, but the benefit can be counteracted by accelerated peat decay, reducing long-term carbon storage^{23,24}. Precipitation changes along the tropical belt have been shown to switch peatlands from net carbon sinks to sources²⁵ and predispose them to intense fires, which is a new phenomenon for some peatland-rich areas^{26,27}. Historically, many peatlands have survived past climate oscillations with a degree of resilience²⁸, but there is concern that rapid warming and a combination of pressures beyond climate (e.g., land use practices) could push some peatlands to tipping points or alternative stable states^{8,29}. The ability of peatlands to undermine global climate stability is now widely recognised in global change science and policy and although improvements in datasets, models and global assessments are emerging to understand future peatland vulnerability and feedbacks, there are significant uncertainties at all spatial scales. This theme focuses on how peatlands across climates and land uses will respond to future conditions, including their thresholds of resilience. The theme includes the most commonly submitted question to the community survey: how climate change will impact peatland carbon dynamics (Q11, see Supplementary Table 2).

- 10. How will peatlands across different latitudes, elevations, and hydrological conditions (including permafrost peatlands) respond to climate change and how will these changes impact their extent, processes and overall function?
- 11. *How will climate change impact the carbon balance, carbon storage capacity, and greenhouse gas emissions of peatlands and what are the

mechanisms and factors (e.g., seasonal changes) that influence these processes?

- 12. How will climate change affect peatland vulnerability to fire, and how will changes in fire return intervals influence peatland development and post-fire regeneration?
- 13. What is the resilience of peatland ecosystems across different climate zones and conditions (degraded, restored, pristine) and what indicators can be used to evaluate and monitor this resilience?
- 14. What are the tipping points at which some peatlands shift from carbon sinks to carbon sources, what techniques can be used to determine tipping points and what factors make some peatlands more resistant to change than others?
- 15. What are the climate change thresholds, such as specific temperature or drought levels, at which peatlands in different regions reach tipping points?
- 16. How do we quantify peatland resilience thresholds to disturbance (fire, drought, land use change) and what time frame should resilience thresholds be applied over?

Theme 3: Peatland management and restoration

There is strong international consensus that conserving intact peatlands and restoring degraded ones is essential for meeting climate mitigation, biodiversity and sustainable development goals^{1,30}. Restoration of an estimated 500,000 km² of drained peatlands worldwide is needed by mid-century to align with the temperature targets of the Paris Agreement³¹. Multiple lines of evidence from peatland types and locations globally show that raising water levels reverse some of the impacts of drainage, including reducing subsidence and carbon emissions, reducing fire incidence and enabling ecosystem recovery³²⁻³⁵. However, the intricacies of rewetting can be crucial management variables that are not yet well understood for different peatland types, landscape settings

and timescales^{36,37}. Similarly, there remain questions surrounding the long term (multi-decadal) trajectories and outcomes from restoration, with some studies highlighting that restored vegetation communities differ significantly from the original³⁸ and certain aspects of the peatland system (including biodiversity) are not fully restored even after a decade^{8,34,39}. Creating an additional layer of complexity is the wide variety of peatland types, the inter-relations between restoration efforts, continued peatland activities (either alongside or in opposition to restoration, see Theme 5), climate change and the wider landscape or political context⁴⁰. This theme includes questions on approaches to peatland management and restoration, including socio-economic considerations, trajectories and timings, and the interconnectedness between restoration efforts and climate change. Several questions refer to identifying the most effective designs, techniques or outcomes, but we do not envisage a single globally optimal solution in most cases: restoration effectiveness is site- and context-dependent. The priority is therefore to build comparative evidence and decision-support frameworks that clarify which approaches work best under which conditions, so that restoration guidance can be tailored to specific places. The theme garnered the largest number of submitted questions to the community survey, reflecting a need for evidence-based guidance to improve restoration outcomes.

17. **How can peatland conservation and management be most effectively designed to maximise carbon sequestration while safeguarding ecosystem functions, biodiversity, and sustainable development goals at a catchment level?*
18. **What are the most effective techniques for restoring the hydrological function of peatlands, and how do subsequent management practices affect hydrological functioning, water quantity and quality?*
19. *Which restoration approaches yield the most effective outcomes to restore ecosystem function in degraded peatlands (e.g., from drainage, agriculture, mining)?*
20. *What are the long-term (multi-decadal) responses and recovery trajectories of peatlands (including water quality, carbon, biodiversity) to restoration interventions and how do these trajectories vary across different landscapes and climate scenarios?*
21. **How do management practices during peatland restoration affect carbon fluxes?*
22. *Can the increase in methane after peatland restoration be mitigated, and if so, what are the most effective approaches to do this?*
23. *How can the restoration of peatlands be achieved cost-effectively and efficiently at scale, considering factors like community participation, funding mechanisms, and trade-offs among land use demands (e.g., food production, conservation, carbon sequestration, biodiversity)?*
24. *What are the most effective approaches to integrate traditional ecological knowledge or knowledge from Indigenous peoples into sustainable peatland management and restoration, and can this approach enhance the success of restoration efforts?*
25. *How long does it take for a degraded peatland to recover in terms of carbon sequestration, greenhouse gas balance, biodiversity and ecosystem stability, and what factors influence the timeline of restoration efforts in achieving functions similar to undisturbed peatlands?*
26. *Is there an accelerated rate of carbon sequestration following effective peatland restoration compared with an intact functioning peatland? If so, how long does this effect last?*
27. *How will the effectiveness and long-term viability of peatland restoration projects be affected by climate change (including extreme weather and fire events)?*
28. *What are the impacts of peatland management trajectories on local communities, and how can different trajectories be prioritised whilst ensuring local community livelihoods are supported?*
29. **What are the most effective strategies for preventing and managing peatland fires to minimise environmental and societal impacts?*
30. **Which indicators provide the most reliable and efficient means of evaluating the success of peatland restoration efforts?*

31. *How does resource extraction and associated infrastructure (e.g., roads, oil well pads, stockpiles, acid and nutrient deposition) affect peatland structure and function, particularly carbon storage?*
32. *How does the loss of peatlands impact the surrounding environment, and how can we improve our understanding of the relationships between peatlands and their surroundings?*

Theme 4: Technological advances for peatland science and monitoring

Emerging technologies are opening new frontiers in peatland research, including low-cost sensors, aerial technologies, modelling approaches and artificial intelligence. For example, early inventory-based peatland mapping efforts^{2,41} have often been superseded by advanced satellite sensors, data fusion, and machine-learning approaches that improve peatland extent mapping¹⁵ and move beyond location mapping to assessing condition, ecosystem function and behaviour¹², enable repeat monitoring to detect peatland expansion/contraction⁴³, and gas flux measurements⁴⁴. Despite these advances, gaps remain where ground-truth data are sparse, and integrating satellite, aerial technologies, and in situ observations continue to be essential for reliable, repeatable monitoring and robust greenhouse gas accounting. Modelling advances, from site-scale models (e.g., DigiBog⁴⁵ HPM⁴⁶) to land surface models (LSMs), Earth system models (ESMs), integrated assessment models (IAMs), and digital twins of the environment (DTEs), enable synthesis of field data, exploration of system dynamics, and testing of management or climate scenarios. Yet peatland modules are largely absent or limited (mostly to northern regions) in LSMs, and peatlands remain unrepresented in most ESMs, IAMs and DTEs, leaving a major gap in global environmental modelling. This theme focuses on leveraging technology to fill data gaps and improve predictive understanding. The questions submitted here reflect the community's perception that embracing these new and emerging technologies could advance the field and enable us to better answer some of the most pressing remaining questions in peatland science.

33. **How can remote sensing be used to identify and map peatland areas (including underlying forest), estimate peat depth, carbon storage and fluxes?*
34. *How can remote sensing and other existing and emerging technologies (including AI) be used to improve our understanding of peatland dynamics, support peatland monitoring and management, and address the challenges of peatland research?*
35. *What are the most effective and economically viable techniques for monitoring peatland health and functionality over time and at the landscape scale?*
36. **How do we best include peatland net carbon budgets and carbon-climate feedbacks in Earth system models?*
37. *How do we accurately and rapidly quantify the carbon stocks of peatlands and which approaches would be suitable for peatlands where fieldwork and ground validation are particularly difficult (e.g., high-altitude mountain peatlands)?*
38. *Which standardised methods are most suitable to cost-effectively and reliably estimate greenhouse gas fluxes from peatlands?*

Theme 5: Communities, policies and economic frameworks

Peatland conservation and restoration ultimately depend on good governance inclusive of the empowerment of local communities, combined with appropriate policy and economic conditions. With peatland policy cutting across sectors (climate, agriculture, forestry, water, rural development) and often regional and national boundaries, policy fragmentation and incoherence can occur. For example, EU subsidies for farming drained peat soils contradict environmental policies advocating for peat restoration⁴⁷. Added complexity arises with community land rights, overlapping authorities and other interests^{48,49}. In recent years, awareness of the importance of peatlands has grown, leading to new national peatland strategies⁵⁰, international initiatives and inclusion of peatlands in climate agreements⁵¹, carbon markets⁵², and payment for ecosystem

service schemes⁵³. Nonetheless, significant policy challenges remain: coordinating across sectors and scales (international conventions down to local land rights), ensuring that economic incentives like carbon credits or payments for ecosystem services are effective and equitable, developing approaches such as paludiculture (i.e., wet agriculture and forestry) that reconcile peatland use with climate and environmental goals, and giving voice to the communities living around peatlands. The questions in this theme focus on how we can better integrate peatlands into policy and economic systems in ways that provide multiple cross-cutting benefits and are socially viable, equitable and just.

39. *What are the economic values of peatland ecosystem services and do these values support conservation efforts against conversion to alternative land uses? If so, how?*
40. *How can peatlands be used to generate sustainable economic value (e.g., agriculture, resource use, local climate finance, carbon markets, ecotourism) without degrading them?*
41. *How can the added value of paludiculture commodities from peatland restoration activities be increased while minimising greenhouse gas emissions from a life cycle perspective?*
42. *How can sustainable agriculture on peatlands be practiced in a way that minimises greenhouse gas emissions whilst meeting societal needs and supporting food production?*
43. *What effective, sustainable alternatives can be developed to replace peat used in supply chains (e.g., in horticulture) in different geographies (e.g., UK vs. Rwanda)?*
44. **What policy frameworks and improvements at international and national levels are needed to effectively protect, conserve, and sustainably manage peatlands long-term?*
45. *How can global environmental initiatives incentivise peatland management in equitable and just ways that benefit and empower local communities and organisations as agents of change, whilst optimising climate, biodiversity, and ecosystem services?*
46. *What are the most effective approaches to integrate peatlands across different conditions (e.g., pristine, degraded, restored) in national greenhouse gas inventories, particularly within the Nationally Determined Contributions of countries required under the Paris Agreement?*
47. *How do peatland carbon credits translate to stored peatland carbon and under what conditions (ecological, governance, financial, cultural) is there a positive (causal) relationship and how can the benefits be equitably shared?*
48. *Which factors affect community acceptance and landscape-level uptake of peatland socio-ecosystemic issues, and how can these be better integrated into water-management policies?*
49. *How effective are payment-for-ecosystem-services schemes in peatlands? What can we learn from effective and ineffective schemes?*
50. *What strategies are most effective for conserving undisturbed peatlands and should protection of these intact systems be prioritised and increased beyond current efforts?*

Discussion

Through a community-driven process, we have compiled a list of 50 priority questions that, if answered, would substantially advance peatland science and inform conservation, restoration and sustainable management over the coming decade. These questions cover five major themes ranging from fundamental science of carbon dynamics to practical considerations of policy and technology, and reflect the multifaceted importance of peatlands (Fig. 3). The questions are wide-ranging and designed to be answerable through research projects and programmes. We hope that the questions will guide researchers looking to inform and prioritise their own efforts and programmes of work, guide policy makers and funders involved in directing future peatland research and evidence, and encourage collaborative dialogues between peatland groups across research, policy and practice. Ultimately, progress on these questions should improve evidence-based decision-making for peatland management, strengthening the science-policy-practice interface in this field.

The list of questions is, by its very nature, a product of the community who participated in the community survey and the prioritisation. The demographic survey data suggest our results are weighted toward the perspectives of scientific researchers, while certain perspectives (e.g., Indigenous community knowledge) are under-represented. Similarly, despite efforts to solicit input globally through multiple language translations and use of key contacts on the ground for major peatland regions (See Supplementary Methods), certain peatland-rich regions (e.g., Amazonia, Nile Basin) are under-represented and our respondent distribution does not directly mirror peatland area (Fig. 2). This underrepresentation could be attributed to a number of factors including fewer peatland specialists and institutions in these regions (constrains both awareness of the survey and the time available to participate), the structure of policy and practice frameworks where peatlands are incorporated into broader wetland, grassland or forest categories rather than specific peatland policies, and peatlands in some regions not being widely recognised (partly linked to a lack of data on location and extent)^{1,54}.

During processing of the questions, balancing specificity with breadth was a key challenge: questions had to be researchable yet broadly applicable across scales, echoing other collaborative prioritisation efforts^{55,56}. Multiple entries that were local in scope but of broad interest were merged and generalised (e.g., questions on the distribution of peatlands in the Democratic Republic of Congo were combined with broader questions on the distribution of tropical peatlands). Condensing and merging questions for clarity inevitably masks complexity and restricts questions of local interest; however, the chosen methodology allows for narrow questions to resonate more broadly. Although the 50 questions are framed at a global level, their relative importance is likely to vary among regions and governance contexts (e.g., temperate, tropical and boreal peatlands). Similarly, the questions span a continuum from topics that are relatively well-studied to areas where evidence remains sparse. For some questions, major syntheses and assessments now exist (e.g., global peatland carbon stocks¹), yet these still highlight substantial uncertainties, regional data gaps and implementation challenges. In such cases, the priority lies in refining estimates, increasing spatial and temporal resolution, and/or improving the translation of existing knowledge into management and policy. Other questions remain fundamentally unresolved. We therefore envisage this list as a global framework that can be adapted and re-prioritised in regional or national exercises using locally framed variants retained in the complete list of questions⁵⁷, and remain as a living research agenda against which progress can be assessed and updated through future exercises.

Answering these questions will require a range of approaches, new collaborations and coordinated cross-disciplinary effort. It will require peatland researchers to effectively synthesise existing evidence and unify data across research groups, facilitating discovery, exchange and aggregation of data and findings, through agreed standards for collecting and reporting. Many questions straddle disciplines: for example, addressing equitable incentives for peatland restoration (Q45) demands input from social scientists, economists, and local communities in addition to ecologists and climate scientists. Likewise, integrating peatlands into Earth system models (Q36) will demand close collaboration between peatland scientists and modellers. One encouraging aspect of this prioritisation is that it was itself a highly collaborative global effort; sustaining such collaboration will be vital. We urge the peatland community to use this list as a framework for building a shared research agenda, developing coordinated projects and international peatland challenge programs, forming regional working groups and conducting comparative studies across regions. Bottom-up action must be matched by top-down support: funders, agencies and philanthropies can accelerate progress by targeting calls to these questions, investing in synthesis centres and data infrastructure, supporting long-term observatories, and resourcing co-production with practitioners. Educators and professional training programmes also have a key role through embedding integrative, quantitative and social science skills and supporting training networks, placements and fellowships that prepare the next generation of peatland scientists to work across sectors.

From a policy perspective, these priority questions can also guide evidence-based policy development. Notably, 9% of survey respondents were from government organisations and the invited experts for prioritisation included representatives from policy organisations and government officials, ensuring the questions reflect real-world policy concerns. For example, questions on economic valuation and sustainable use (Q39–42) align with the needs of agencies trying to balance development and conservation. A clear message from Theme 1 (Q1–9) is that robust data on peatland extents and emissions are urgently needed, which will require not only new data collection but also better synthesis, harmonisation and packaging of existing datasets at the spatial and temporal scales relevant to decision makers (e.g., catchment planning as well as national inventories and climate reporting). As researchers work on these questions, engaging with policymakers early will ensure the findings are translated into action.

In conclusion, the 50 priority questions for peatland science presented here provide a community-developed research agenda. They highlight a collective intent to safeguard peatlands as nature-based climate solutions and vital ecosystems, by improving our knowledge of how peatlands function, how they are changing, and how we can best use, protect or restore them. We hope this agenda will foster new research initiatives, encourage interdisciplinary and international cooperation, and attract attention to peatlands from the broader scientific community. By addressing these questions, peatland research can provide the foundations for better peatland stewardship in the face of global change.

Methods

Community-driven approaches to research prioritisation offer a transparent and democratic way to identify the most pressing questions across regions and disciplines, making them especially suited to complex, cross-cutting topics like peatland science. We conducted a collaborative research prioritisation following a two-stage process: (1) an open online, globally-available survey to collect candidate research questions from the peatland community, and (2) a voting process by a panel of experts to prioritise those questions. This approach was adapted from established research prioritisation frameworks¹¹ with additional focus on maximising representation across the global peatland community, which has been a criticism of previous prioritisation studies⁵⁸. See also Supplementary Methods.

Global online survey for question solicitation

We distributed an anonymous online survey to invite researchers, policymakers, practitioners or anyone connected with peatlands worldwide to submit their top research questions for peatland science. The survey consisted of a single open-ended question asking respondents to propose one or more priority questions for peatland research, alongside a small set of demographic questions (e.g., their country of residence, peatland region of interest, sector of work, and years of experience with peatlands). To reduce language barriers, the survey was translated into 20 languages besides English, with native speakers verifying translation accuracy. We used a chain-referral and broad advertising strategy to ensure global reach: the survey was shared via peatland research networks, email listservs, conference announcements and social media. Key contacts were designated for major peatland regions and tasked with direct outreach to distribute the survey through appropriate means and networks for that region. Under-represented regions were identified while the survey was still open and additional efforts were focused on those regions to increase representation. See also Supplementary Methods.

Question processing

After the survey closed, a core group of six peatland scientists processed the questions. We compiled responses from the 467 respondents, noting that some respondents submitted multiple questions, comments and keywords. We translated non-English submissions to English, removed personalised information and responses that could not be worded into questions (e.g., some respondents submitted keywords only). For all remaining questions,

we standardised the wording of questions for clarity (e.g., rephrasing statements as questions, correcting grammar) while keeping the original meaning. We applied inclusion criteria with questions retained if they were related to peatlands (relevance), the meaning was clear (clarity), answerable through realistic research design (answerability), were not already answered with the answer well-established (novelty). Questions not fitting these criteria were set aside (see Supplementary Methods for details and examples). We used cluster analysis to identify and merge duplicate or similar questions. Multiple questions from the same respondent were treated as independent submissions and were consolidated with similar questions from other respondents, where necessary. This vetting yielded a refined list of 212 questions that was used for prioritisation.

Prioritisation

We used a selection of peatland experts to prioritise the questions. The experts were selected by the Global Peatland Initiative (independent of the lead authors/core team) and specifically selected for diverse representation across geographical regions, demographics and sectors (e.g., including policymakers, non-governmental organisations, researchers and youth communities). We invited 75 experts and 41 submitted their scores. We used a cumulative voting system: each expert was allocated 25 votes across the question list (with the freedom to put multiple votes on questions they felt strongly about). The voting was done remotely and anonymously with each participant seeing a randomised list of 212 questions (Supplementary Methods, Supplementary Dataset⁵⁷). After voting, we summed the points for each question and ranked questions by total score. We identified a set of highest-scoring questions and, where closely related questions overlapped in content, merged them and made minor wording edits for clarity. The questions were organised into themes to allow topics of interest to be identified, related questions to be compared side-by-side and clusters of research needs to be identified relevant to particular landscape, policy, or management contexts.

Analysis

We performed analyses on the survey responses to understand the respondent demographics and submission patterns in order to contextualise results and assess the breadth of our outreach and potential biases (see also Supplementary Discussion). The 50 priority questions were grouped post hoc into five thematic categories based on content affinity; this grouping was discussed and agreed upon by the core author team after reviewing the top 50 questions. The themes emerged organically, with many submitted questions naturally clustered around certain topics such as carbon/climate, restoration, etc. There is overlap between some questions across different themes; some questions that could align with multiple themes; and some questions that are similar. Wherever possible, we aimed to preserve the prioritisation decisions. We emphasise that within each theme, the numbering of questions is for reference and does not relate to perceived importance.

Reporting summary

Further information on research design is available in the Nature Portfolio Reporting Summary linked to this article.

Data availability

The full set of questions generated in this project and the prioritised list of questions are available in Figshare with the identifier <https://doi.org/10.17637/rh.30752888> [ref⁵⁷].

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Competing interests

The authors declare the following competing interests: some of the authors are employed in paid roles in non-academic organisations, including government agencies, intergovernmental organisations, non-governmental organisations and environmental consultancies, whose mandates include peatland research, management, conservation or policy advice. These roles are disclosed in the list of affiliations. There are no other competing interests.

Additional information

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