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# Catalysing policy for the conservation of Amazonian peatlands in Peru

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## Key messages

- Peatlands are major carbon reservoirs that release massive amounts of greenhouse gas into the atmosphere when disturbed. However, their importance is far from being adequately reflected in global and national climate change mitigation policies.
- Peru acknowledges the importance of conserving its vast tropical peatlands but needs to enhance internal capacity, establish a regulatory framework, and generate scientific data to protect them effectively.
- Scientists working in CIFOR-ICRAF's<sup>3</sup> Global Comparative Study on REDD+ played a key role in fostering political recognition of peatlands in Peru, by providing new Monitoring, Reporting, and Verification (MRV) data on peatland areas, improving local MRV capabilities, and facilitating the formation of a Peruvian peatland community to safeguard this ecosystem.
- With assistance from CIFOR-ICRAF scientists, the Government of Peru has established a national definition and regulatory framework for the conservation and sustainable management of peatlands.
- Sustained political backing is essential for implementing and sustaining the regulatory frameworks for peatlands, along with strategies concerning climate change, water regulation, biodiversity conservation, and local livelihood enhancement.

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<sup>3</sup> The Center for International Forestry Research (CIFOR) and World Agroforestry (ICRAF) merged in 2019. The research was initiated by CIFOR prior to the merger, but for the sake of consistency this brief refers to the organization's current name (CIFOR-ICRAF) throughout.

## Importance of Peruvian peatlands

Peatlands are major carbon reservoirs that release massive amounts of greenhouse gas into the atmosphere when disturbed. However, peatlands are often overlooked in both global and national climate change mitigation policies. For instance, Peruvian Amazonian lowland peatlands cover an area of 62,700 km<sup>2</sup> (Hastie et al. 2022) out of a total of 1,700,000 km<sup>2</sup> of peatlands in the whole of the tropics (Gumbricht et al. 2017); i.e. 3.7%. They are mostly concentrated in the northeast Pastaza-Marañón River basin (43,600 km<sup>2</sup>) in Peru. This peatland hotspot was estimated to store 4.1 gigatonnes (GtC) of carbon in peat deposits up to 7.5 m deep (Hastie et al. 2022; Lähteenoja et al. 2012), which represents 46% more than the global ocean carbon uptake in 2022 (2.8 GtC) (Friedlingstein et al. 2022).

The protection of peatlands in Peru faces challenges such as a lack of national peatland data, a lack of maps and greenhouse gas (GHG) emission factors, a lack of political coordination among institutions for defining and enforcing regulations, and inadequate financing for their preservation, sustainable management, and restoration. In Peru, carbon sequestration potential and vulnerabilities of peatlands, such as infrastructure development, climate change, and land-use change, were previously overlooked in national policies, including in the National Wetlands Strategy.

## The GCS REDD+ project in Peru

Since 2009, the The Global Comparative Study on REDD+ (GCS REDD+) project, supported mainly by the Norwegian Agency for International Cooperation, has been implemented through multiple phases, culminating in its fourth phase (2021–2024). It involved comprehensive research to determine what has worked and what hasn't with REDD+ (reducing emissions from deforestation and forest degradation, and enhancement of forest carbon stocks) across 22 countries. Over the years, this research has required constant engagement with government institutions, non-governmental organizations (NGOs), Indigenous Peoples' organizations, research institutions, and the private sector.

In Peru, in addition to supporting national REDD+ efforts, the GCS REDD+ project has researched peatlands extensively for several reasons. First, Peru hosts the world's fifth-largest repository of tropical peatlands (UNEP 2022). Its larger area of peatlands remains in pristine condition compared to peatlands in other regions worldwide (Lilleskov et al. 2018). Yet mounting development pressure and the absence of dedicated conservation policies pose significant threats to Peru's

peatlands and their invaluable carbon reserves. Second, Peru participates in the Sustainable Wetlands Adaptation and Mitigation Program (SWAMP), a collaborative effort by CIFOR-ICRAF and the United States Department of Agriculture Forest Service (USFS) with support from the US Agency for International Development (USAID). As a SWAMP network member, Peru benefits from the programme's capacity-building initiatives. These help countries with carbon-rich tropical wetlands make informed decisions to mitigate GHG emissions and promote resilient ecosystems. Finally, the GCS REDD+ project aimed to support commitments outlined in the Joint Declaration of Intent on climate and forests involving Peru, Norway, Germany, the United Kingdom, and USAID. The declaration strives to diminish GHG emissions from deforestation and forest degradation while fostering sustainable development in Peru. Overall, there has been political interest in better protecting and managing peatlands in Peru and an acknowledgement of the critical challenges that need to be addressed.

Over the years, through its involvement in both GCS REDD+ project and SWAMP, CIFOR-ICRAF has solidified its reputation as a leader in the field of peatland ecology, thanks to its persistent global research and engagement efforts that provided valuable insights.

Key partners in Peru for the GCS REDD+ project comprise the Ministry of Environment (MINAM), the Research Institute of the Peruvian Amazon (IIAP), and USFS. IIAP was both a partner and a beneficiary of project activities. Under GCS REDD+, the focus on peatlands follows three strategies: (1) a pluri-disciplinary state-of-the-art review on Peruvian peatlands, highlighting opportunities and challenges in collaboration with national partners; (2) generation of scientific Monitoring, Reporting and Verification (MRV) data on Peruvian peatlands and publishing peer-reviewed articles; (3) promotion of the development of the Peruvian peatland community.

## Purpose and methodology of the story of change

Coordinated by CIFOR-ICRAF's Quality for Impact (Q4I) team, this 'story of change' assesses the influence of the GCS REDD+ project in Peru, with a focus on how CIFOR-ICRAF's research and engagement have supported the Government of Peru in establishing and enforcing a policy framework for the conservation and sustainable management of peatlands. This self-assessment is based on a Theory of Change<sup>4</sup> (Figure 2) that articulates GCS REDD+ research and engagement

<sup>4</sup> The narrative in this Infobrief describes the Theory of Change. Figure 2 provides a graphical depiction at the end of this report.

activities in its fourth phase and previous phases. It assesses whether interventions achieved their goals and reached intended groups, as well as potential long-term impacts. It also extracts lessons on effective stakeholder engagement. This work compiles a review of secondary data including reports, government policies, media stories, insights from lead researchers in the country, evidence collected by an independent consultant through interviews with nine key stakeholders, and a sense-making workshop to discuss findings from these interviews.

## Laying the foundations of CIFOR-ICRAF's research in Peru (baseline)

When CIFOR-ICRAF initiated its project in Peru, it brought a wealth of experience from extensive research on REDD+ and peatlands. It was able to draw on significant milestones achieved in REDD+ policy advice and peatland science, both locally

and internationally. CIFOR-ICRAF's earlier work in Indonesia, addressing the systematic deforestation caused by draining peatlands, served as a foundation for its work in Peru.

Among CIFOR-ICRAF's notable achievements was the development of methodologies for quantifying emission fluxes, recognized by the Intergovernmental Panel on Climate Change (IPCC) in October 2013 as part of the IPCC Wetlands Supplement. These guidelines mandated governments to enhance their reporting of GHG emissions from wetlands, thereby increasing pressure on countries to address agricultural emissions in peatlands and mangroves. To fulfil this purpose, CIFOR-ICRAF implemented appropriate methodologies and acquired additional technical infrastructure and equipment to determine emission factors for peat (IPCC 2018).

However, this journey was not without its challenges. CIFOR-ICRAF researchers encountered significant logistical hurdles, including the remote locations



**Figure 1. Measuring peat degradation**  
Photo by Kristell Hergoualc'h/CIFOR-ICRAF

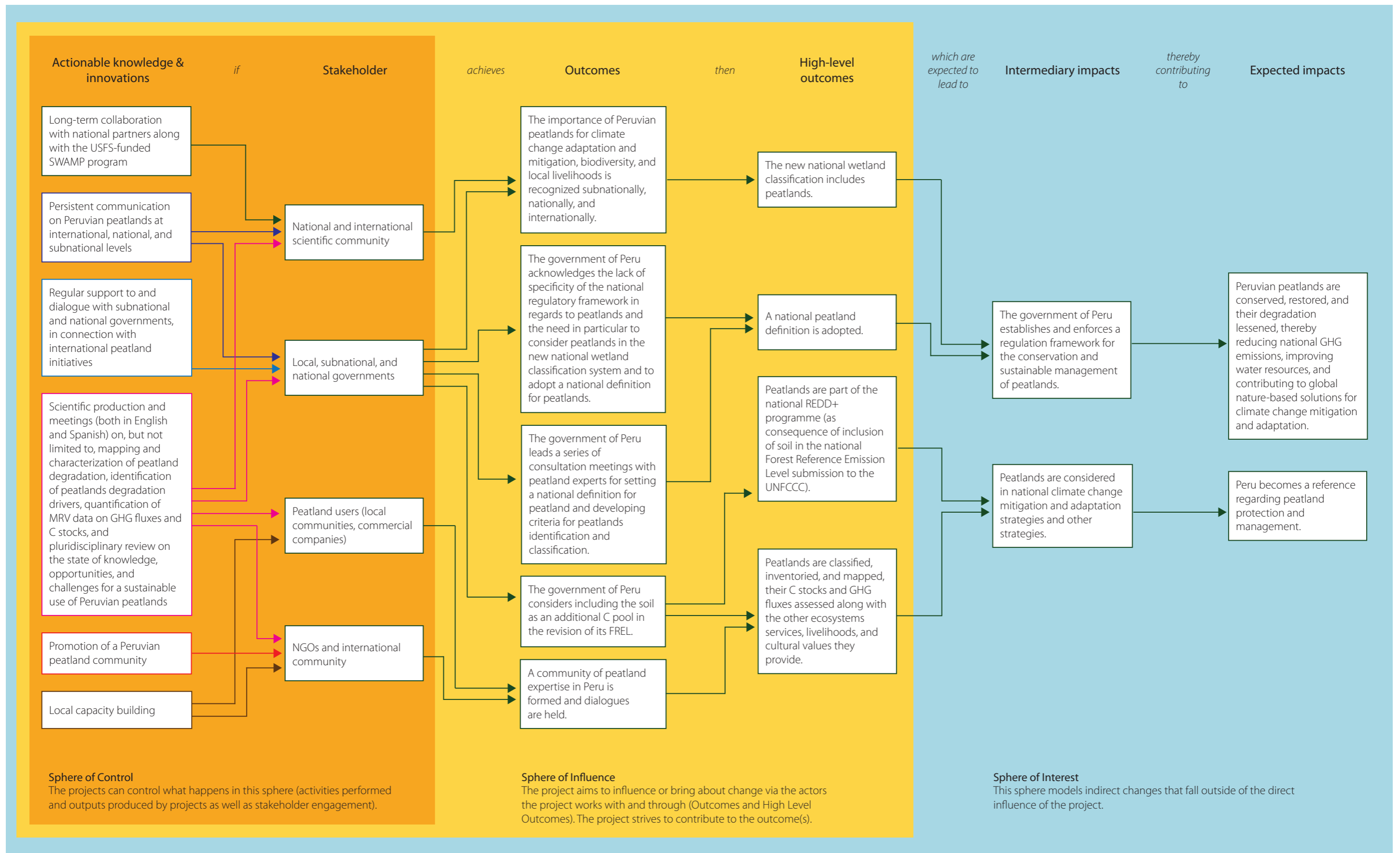


Figure 2. Theory of Change

Source: Authors' illustration

of peatlands; high costs associated with specialized laboratory equipment; and risks from wildlife. Obtaining permits and navigating collaborations with the private sector posed additional obstacles. Initial scepticism within the scientific community about CIFOR-ICRAF's methodologies for studying carbon flux in peatlands also presented challenges and criticism.

### CIFOR-ICRAF's collaborative research and engagement initiatives in Peru

CIFOR's research, despite those challenges, laid the foundation for political acknowledgement of Peru's contribution to tropical peatlands. As a long-term

aspiration, Peru seeks to establish itself as a benchmark in safeguarding and responsibly managing peatlands. The primary objective of the GCS REDD+ project in Peru is to play a significant role in preserving, restoring, and reducing degradation of national peatlands. This effort aims to ultimately reduce national GHG emissions, improve water resources, and contribute to global nature-based climate change mitigation and adaptation actions, fostering more sustainable local livelihoods.

Through collaboration and regular dialogues with the government, national partners, and key stakeholders, CIFOR-ICRAF has expanded and solidified this knowledge base over the years.

Scientists delivered a series of actionable knowledge and innovations outputs (see the left side of the Theory of Change diagram, Figure 2), providing new MRV data that illustrated the extent of Peru's peatlands, enhancing national MRV capacities, and supporting the establishment of a Peruvian peatland community dedicated to protecting this vital ecosystem. These efforts significantly bolstered peatland conservation in Peru. This subsequently led to the development of a proposal to include peatlands in the country's Nationally Determined Contributions (NDCs) for mitigating climate change under the Paris Agreement.

CIFOR-ICRAF has forged long-term collaborations with national and international partners to advance peatland conservation. Beginning with initial meetings and field visits with IIAP and SWAMP in 2012, CIFOR-ICRAF has continued to engage in collaborative workshops and events. Notably, a South America workshop on wetlands was held in collaboration with SWAMP in 2013. CIFOR-ICRAF has also actively participated in events such as the 2014 UNFCCC Climate COP in Lima, with close interactions with Manuel Pulgar-Vidal, then Minister of Environment and COP 20 President; the 2016 National Forestry Congress in Lima; and the 2019 MINAM workshop, presenting various research initiatives focused on Peruvian peatlands. Research priorities for CIFOR-ICRAF have included mapping and characterization of peatland degradation, identification of drivers behind peatland degradation, quantification of MRV data related to GHG fluxes and carbon stocks, and multidisciplinary reviews concerning the state of knowledge on sustainable use of Peruvian peatlands. A series of research studies published by CIFOR-ICRAF between 2017 and 2023 has delved into these topics, providing valuable insights and informing conservation efforts. In 2017, CIFOR-ICRAF published an exploratory study about the Peruvian Amazon (Hergoualc'h 2017) (translated into Spanish). In 2019, three additional research studies were published. One addressed the loss of peatlands in Indonesia as a case for prevention in Peru (Lilleskov et al. 2018), another analysed the effect of soil and root degradation in Peruvian peatlands and GHG emissions (van Lentet al. 2019), and a third identified the impacts of *Mauritia flexuosa* degradation on carbon stocks in Peruvian Amazon freshwater peatlands (Bhomia et al. 2019). In all, CIFOR-ICRAF published 14 research papers on Peruvian peatlands between 2017 and 2013. For example, several delved deeper into the factors influencing GHG exchange in peatlands (Griffis et al. 2020; Hergoualc'h et al. 2020). Another determined carbon loss due to peatland degradation in the Peruvian Amazon (Hergoualc'h et al. 2023).

CIFOR-ICRAF's engagement with national and subnational governments, as well as international platforms, has been instrumental in advancing peatland

conservation policy. CIFOR-ICRAF has actively participated in the development of national strategies such as the Forest Reference Emission Level (FREL). It has also organized events like the National Symposium on "Sustainable Management of Peruvian Peatlands" (CIFOR 2023) in 2019. CIFOR also convened events at international platforms (Bustamante et al. 2019) where scientists advocated for the importance of peatlands. CIFOR-ICRAF continued its efforts even during the global Covid-19 pandemic: virtual science-to-policy dialogue events were used to present to research findings to the Government of Peru related to mapping degradation and deforestation in palm swamp peatlands in the Peruvian Amazon (Marcus 2021). In 2023, CIFOR-ICRAF organized the fifth session of the Platform for Science and Public Policies, where scientists and policymakers discussed research and public policies to reduce GHG emissions from the degradation of peatlands in the Peruvian Amazon.

In addition to policy advocacy, CIFOR-ICRAF has played a crucial role in promoting a Peruvian peatland expert community and local capacity building. Initiatives such as seminars and student supervision have contributed to knowledge dissemination and skills development, further supporting peatland conservation efforts in Peru. For example, CIFOR-ICRAF organized a seminar with SilvaCarbon at La Molina University in 2018 on carbon dynamics in Amazon peatlands. The next year, a Peruvian student supervised by CIFOR-ICRAF graduated from the National University of the Peruvian Amazon. The student focused on root dynamics in palm swamp peatlands and contributed to a research paper published in 2018 (Bhomia et al. 2019).

### The change

Advancing national peatland ecosystem conservation efforts in Peru required a clear peatland definition and a related legislative framework, as well as institutionalized protection mechanisms to prevent further peatland degradation and ensure ongoing monitoring. CIFOR-ICRAF's interventions have significantly contributed to progress in both these areas of peatland protection.

### Consolidating the relevance of peatlands in Peru

Delivering targeted, actionable knowledge, and innovations outputs as described above contributed to generating five Outcomes (central part of the Theory of Change, Figure 2), further consolidating the relevance of peatlands in Peru. In 2018, the

#### Box 1. Science-to-Policy



In Peru, GCS REDD+ hosted six science-policy dialogues during 2021–2023 (shifting to online and hybrid formats during the Covid-19 pandemic) to engage scientists, policymakers, and practitioners, and address their concerns. Discussions focused on safeguards, land use, models and reference levels, policy impact, peatlands conservation and management, and deforestation mitigation. Each dialogue built on the momentum of the previous one.

CIFOR-ICRAF's Q4I team systematically conducted feedback surveys to assess whether these dialogues provided a valuable platform for scientists, policymakers, and other stakeholders to exchange knowledge and insights. For the most part, participants' learning expectations were met and new knowledge was gained. There is a clear acknowledgement that decision-making processes are better informed by sharing the latest scientific evidence on these topics, fostering collaborative efforts and connecting people from diverse backgrounds, including science, policy, practice, and civil society. Overall, this series of dialogues addressing various topics related to peatlands played a critical role in advancing the legal recognition of peatlands in Peru. It built understanding, identified policy needs, engaged stakeholders, generated policy recommendations, and advocated for change.

Government of Peru made significant progress by acknowledging the insufficiency of its national regulatory framework concerning peatlands. This recognition was discussed during a meeting convened by MINAM that deliberated on a proposal for a wetland classification system within the country. The intrinsic uniqueness of the peatlands became evident, prompting further discussion. The importance of peatlands in Peru began to crystalize. CIFOR-ICRAF, the Peruvian National Biodiversity Research Center, and San Marcos University played a key role in shaping the outcome of this meeting. Their recommendations resonated strongly with the authorities. Consequently, the meeting concluded with a consensus that peatlands must become an integral part of the new wetland classification system.

This moment initiated a series of developments driven by the government. It embarked on a journey of consultation with experts in the field of peatlands with two crucial objectives. First, it sought to establish a comprehensive national definition for peatlands that encapsulated their distinctive characteristics and significance. Second, it aimed to develop precise criteria for identifying and classifying these unique ecosystems. CIFOR-ICRAF was committed to contributing expertise and knowledge to these processes. One of the IAP experts involved in these consultations remarked, *“There are quite a few international definitions for peatlands, and the idea behind these expert meetings, where CIFOR-ICRAF participated, is to homogenize everything. Having a common criterion to define peatlands for the country is important for decision making.”*



**Figure 3. Field visit to peatlands area in Loreto during training on peatlands' emissions accounting**

Photo by Junior Raborg/CIFOR-ICRAF

Moreover, the government demonstrated awareness of the profound impact of peatlands on local livelihoods. This recognition extended to both subnational and national levels. A representative from the Ministry of Environment emphasized, *“There are many peasant communities and native communities that are linked to the use of peatlands, so it is crucial that they understand their value.”* This insight highlights the interconnectedness of peatlands with the lives and well-being of numerous communities across Peru. Additionally, concerns emerged regarding the exploitation of peatlands by businesses, especially in the high Andean zone. The representative added, *“Often, it’s not the communities that engage in predatory or over exploitative practices, but rather numerous businesses are emerging around peat, particularly in the high Andean zone. We observe how these businesses exploit the land, which is concerning.”* This acknowledges the need for responsible and sustainable management of these vital ecosystems, recognizing their economic and ecological value.

Recognizing the importance of peatlands for biodiversity was another milestone. This recognition was not confined to the national level alone. At the subnational level, particularly in regions like Loreto, a Regional Wetlands Strategy already incorporated peatlands. One of the local researchers attested to this, stating, *“Even at the regional level, here in Loreto, there is a Regional Wetlands Strategy that already includes peatlands. This is also due to CIFOR-ICRAF’s role in bridging academia with policymakers, using information from other institutions as well.”*

These developments culminated in 2021 with a historic achievement by the government. A national definition for peatlands was officially adopted through the Supreme Decree N° 006-2021-MINAM: *“Disposiciones generales para la gestión multisectorial y descentralizada de los humedales”* (MINAM 2021). This marked a significant moment, providing the much-needed regulatory framework for the conservation and sustainable management of peatlands across the country.

Peru’s journey to recognize and protect its peatlands exemplifies the power of collaboration between government entities, academic institutions, and research organizations like CIFOR-ICRAF. This collaborative spirit, combined with a commitment to safeguarding ecosystems vital to local communities and biodiversity, is a testament to the enthusiasm and dedication that continue to drive progress in Peru’s environmental landscape.

### Institutionalization and capacity building

The Outcomes described above ultimately contribute to four High-Level Outcomes (central part of the Theory of Change), fostering the institutionalization of peatlands conservation and strengthening capacity building among national institutions. Peatland protection can be institutionalized by incorporating ecosystem attributes into concrete protection mechanisms. However, at the time of writing, the politically turbulent context that Peru has experienced in recent years (2016–present) challenges this institutionalization. The government is primarily preoccupied with addressing crises deriving from the political instability, leading to frequent turnover among decision makers. This turnover weakens the continuity of conservation efforts, causing delays in achieving results.

Although the government did not include soils as an additional carbon pool in revising its FREL, it nonetheless cited CIFOR-ICRAF’s technical report that accounts for soil emissions. In an interview, a MINAM representative stated, *“The potential (of peatlands) is undeniable. [...] The peatlands’ organic carbon content is more evident than the above-ground biomass in the trees. That is very evident, and the importance precisely lies in this storage. I think that what is really lacking is to take another step, perhaps to make that importance known because I reiterate that many of us know that they are important, but many of us do not know at what level.”* This expected result required further local research to obtain adequate country-specific data. According to the interview with the Directorate of Climate Change representative at MINAM, *“We are awaiting the completion of several documents. [...] The idea is to see how we include peatlands within the current reference level that we are doing but in a preliminary way.”*

The growing recognition of the mitigation potential of peatlands is important for their inclusion in the FREL and, consequently, into the national REDD+ programme, which is expected to emerge. Donors are willing to provide funding for mapping peatlands, inventorying their carbon stocks, and monitoring their GHG fluxes, conditional on the government officially recognizing peatlands in the REDD+ programme. In addition, studies on peatland classification, inventory, and mapping, as well as the analysis of carbon fluxes and stocks, such as those published by CIFOR-ICRAF researchers until 2023 (Hergoualc’h et al. 2023), are expected to continue. They will contribute to a deeper understanding of the various ecosystem services, and of the cultural and economic benefits generated by these ecosystems.

Furthermore, the Peruvian government has considered peatlands in its national commitment to climate change adaptation, and it is expected that peatlands will be officially included in the mitigation plans. As the MINAM stated, “We already have a proposal to include peatlands in the NDC of mitigation that needs approval, [...] We expect to receive the approval or feedback in the short-term.” The successful implementation of these strategies will depend on effective coordination between the different sectors and levels of government.

Through CIFOR-ICRAF’s long-term interventions, a community of peatland expertise has begun to form and engages in dialogue in Peru. The various meetings organized by CIFOR-ICRAF to bring together specialists and build local capacities on peatlands have contributed to an emerging expert community, and facilitated collaboration between researchers and the government. A MINAM representative stated during an interview, “This link between the institutions, led by the Directorate of Biological Diversity, had a major focus on peatlands, (...) all of this comes in an articulated effort, and I believe that CIFOR-ICRAF is fundamental at this stage.” Involving national and regional governments with scientists to develop a publication that synthesizes current information on Peruvian peatlands was successful and demonstrated CIFOR-ICRAF’s role as a facilitator between academia and government. However, political will is key to sustaining the community’s growth and momentum. This community is not yet self-sustaining, so CIFOR-ICRAF’s role as a facilitator remains vital for its consolidation.

## Conclusion and lessons learned

This story of change highlights CIFOR-ICRAF and its partners’ dedication to support the conservation and restoration of Peruvian peatlands, as well as reduction of their degradation, as a crucial nature-based solution for climate change mitigation and adaptation. Three key elements have driven CIFOR-ICRAF’s contribution to change:

**CIFOR-ICRAF’s widespread credibility in recommending policy measures is driven by its ability to use science-based research and promote evidence-based decisions.** Prior to its engagement in Peru, CIFOR-ICRAF’s experience in addressing peatland degradation in Indonesia provided invaluable lessons based on comprehensive research that addressed logistical complexities, security risks, and scepticism from the scientific community. The research, providing a solid technical basis, was complemented by effective communication and stakeholder engagement, forming a community of experts that provided sustainability to the research. Furthermore, CIFOR-ICRAF’s success

in developing emission quantification methodologies recognized by the IPCC has significantly influenced global policies on GHG emissions from wetlands, solidifying CIFOR-ICRAF’s position as a leader in tropical peatland research.

**CIFOR-ICRAF’s well-designed communication strategy supports accessibility and applicability of its research findings.** CIFOR-ICRAF’s communication strategy uses plain, practical language for specific policy recommendations. This makes CIFOR-ICRAF’s research findings – published in various formats and shared in targeted platforms and events, e.g., science-to-policy dialogues – more accessible. They are thus more likely to be understood and applied by policymakers and stakeholders.

**Strategic engagement of researchers with a wide variety of stakeholders, including institutions, government agencies, NGOs, academia, and research centres empowers these groups, builds a sustainable community of experts, and helps scale up the results.** CIFOR-ICRAF’s collaboration with the Peruvian government has played a key role in enhancing the country’s commitment to peatland protection. Through close engagement, CIFOR-ICRAF facilitated the development and adoption of a regulatory framework. By acknowledging the importance of this ecosystem, it positioned Peru prominently on the global stage: Peru became a member of the Global Peatlands Initiative (GPI) and has been a member of the International Tropical Peatlands Center (ITPC) since 2021.

However, despite these achievements, challenges persist. Larger recent political crises have hindered progress in public policy to protect peatlands, underscoring the need for sustained political will and cross-sectoral coordination. Moreover, while CIFOR-ICRAF’s efforts have yielded substantial results, continued and expanded technical support are needed to address the growing demands of peatland conservation in Peru.

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## References

- Bhomia RK, van Lent J, Rios JMG, Hergoualc’h K, Coronado ENH, Murdiyarto D. 2019. Impacts of *Mauritia flexuosa* degradation on the carbon stocks of freshwater peatlands in the Pastaza-Marañón river basin of the Peruvian Amazon. *Mitigation and Adaptation Strategies for Global Change* 24: 645–668. <https://doi.org/10.1007/s11027-018-9809-9>
- Bustamante M, Valett A, Yu Z. 20 November 2019. Peatlands in South America: An asset in climate action efforts? *Forests News*. <https://forestsnews.cifor.org/62995/peatlands-in-south-america-an-asset-in-climate-action-efforts?fnl=entencial-de-las-turberas-peruanas-frente-al-cambio-climatico-esta-siendo-subestimado%3ffnl=es>
- CIFOR (Center for International Forestry Research). 29 March 2023. Presentations from the National Symposium on the Sustainable Management of Peruvian Peatlands. Bogor, Indonesia: CIFOR. <https://www.cifor.org/es/corporate-news/presentaciones-del-simposio-nacional-sobre-la-gestion-sostenible-de-las-turberas-peruanas-disponibles/>
- Friedlingstein P, O’Sullivan M, Jones MW, Andrew RM, Bakker DCE, Hauck J, Landschützer P, Le Quéré C, Lujikx IT, Peters GP, et al. 2023. Global Carbon Budget 2023. *Earth System Science Data* 15(12): 5301–5369. <https://essd.copernicus.org/articles/15/5301/2023/essd-15-5301-2023.pdf>
- Griffis TJ, Roman TD, Wood JD, Deventer J, Fachin L, Rengifo J, Del Castillo D, Lilleskov E, Kolka R, Chimner RA, et al. 2020. Hydrometeorological sensitivities of net ecosystem carbon dioxide and methane exchange of an Amazonian palm swamp peatland. *Agricultural and Forest Meteorology* 295: 108167. <https://www.sciencedirect.com/science/article/pii/S0168192320302690?dgcid=coauthor>
- Gumbrich T, Roman-Cuesta RM, Verchot L, Herold M, Wittmann F, Householder J, Herold N, Murdiyarto D. 2017. An expert system model for mapping tropical wetlands and peatlands reveals South America as the largest contributor. *Global Change Biology* 23. <https://doi.org/10.1111/gcb.13689>
- Hastie A, Coronado ENH, Reyna J, Mitchard E, Akesson C, Baker T, Cole L, Oroche C, Dargie G, Davila N, et al. 2022. Risks to carbon storage from land-use change revealed by peat thickness maps of Peru. *Nature Geoscience* VL – 15. [https://www.researchgate.net/publication/359965330\\_Risks\\_to\\_carbon\\_storage\\_from\\_land-use\\_change\\_revealed\\_by\\_peat\\_thickness\\_maps\\_of\\_Peru](https://www.researchgate.net/publication/359965330_Risks_to_carbon_storage_from_land-use_change_revealed_by_peat_thickness_maps_of_Peru)
- Hergoualc’h K, van Lent J, Dezzio N, Verchot LV, van Groenigen JW, Gonzales ML, Grandez-Rios J, et al. 2023. Major carbon losses from degradation of *Mauritia flexuosa* peat swamp forests in western Amazonia. *Biogeochemistry*. <https://doi.org/10.1007/s10533-023-01057-4>
- Hergoualc’h K, Dezzio N, Verchot LV, Martius C, van Lent J, del Aguila-Pasquel J, Gonzales ML. 2020. Spatial and temporal variability of soil N<sub>2</sub>O and CH<sub>4</sub> fluxes along a degradation gradient in a palm swamp peat forest in the Peruvian Amazon. *Global Change Biology* 26(12): 7198–7216. <https://onlinelibrary.wiley.com/doi/full/10.1111/gcb.15354>
- Hergoualc’h K, Gutiérrez-Vélez VH, Menton M, Verchot LV. 2017. Characterizing degradation of palm swamp peatlands from space and on the ground: An exploratory study in the Peruvian Amazon. *Forest Ecology and Management* 393: 63–73. <https://www.sciencedirect.com/science/article/pii/S0378112716307423>
- IPCC (Intergovernmental Panel on Climate Change). 2018. 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetland [https://www.ipcc.ch/site/assets/uploads/2018/03/Wetlands\\_Supplement\\_Entire\\_Report.pdf](https://www.ipcc.ch/site/assets/uploads/2018/03/Wetlands_Supplement_Entire_Report.pdf)
- Lähteenoja O, Reátegui Y, Räsänen M, Torres D, Oinonen M, Page S. 2011. The large Amazonian peatland carbon sink in the subsiding Pastaza-Marañón foreland basin, Peru. *Global Change Biology* 18(1): 164–178. <https://doi.org/10.1111/j.1365-2486.2011.02504.x>
- Lilleskov E, McCullough K, Hergoualc’h K, del Castillo Torres D, Chimner R, Murdiyarto D, Kolka R, Bourgeau-Chavez L, Hribljan J, del Aguila-Pasquel J, et al. 2019. Is Indonesian peatland loss a cautionary tale for Peru? A two-country comparison of the magnitude and causes of tropical peatland degradation. *Mitigation and Adaptation Strategies for Global Change* 24: 591–623. <https://link.springer.com/article/10.1007/s11027-018-9790-3>
- Marcus M. 18 November 2021. Characterizing and assessing palm swamp degradation in the Peruvian Amazon. Slideshare. Bogor, Indonesia: CIFOR-ICRAF. <https://www.slideshare.net/slideshow/characterizing-and-essing-palm-swamp-degradation-in-the-peruvian-amazon/250674156>
- MINAM (Ministerio del Ambiente). 2021. Disposiciones generales para la gestión multisectorial y descentralizada de los humedales. Decreto Supremo N° 006-2021-MINAM. El Peruano, jueves 6 de mayo de 2021, 14–31. [https://sinia.minam.gob.pe/sites/default/files/sinia/archivos/public/docs/ds\\_006-2021-minam.pdf](https://sinia.minam.gob.pe/sites/default/files/sinia/archivos/public/docs/ds_006-2021-minam.pdf)

UNEP (United Nations Environment Programme). 2022. Global Peatlands Assessment: The state of the world's peatlands. Evidence for action toward the conservation, restoration, and sustainable management of peatlands. Main Report. Global Peatlands Initiative. United Nations Environment Programme, Nairobi. <https://doi.org/10.59117/20.500.11822/41222>

Van Lent J, Hergoualc'h K, Verchot L, Oenema O, van Groenigen JW. 2019. Greenhouse gas emissions along a peat swamp forest degradation gradient in the Peruvian Amazon: Soil moisture and palm roots effects. *Mitigation and Adaptation Strategies for Global Change* 24(2): 625–643. <https://doi.org/10.1007/s11027-018-9796-x>



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The Center for International Forestry Research and World Agroforestry (CIFOR-ICRAF) harnesses the power of trees, forests and agroforestry landscapes to shift the trajectories of three global issues – biodiversity, climate change and food security – supported by our work on equity and value chains. CIFOR and ICRAF are CGIAR Research Centers.

