Institution: University of Leicester

Unit of Assessment: 17 Geography, Environmental Studies and Archaeology: Geography

Title of case study: Preserving carbon-rich tropical peatlands and forests for societal benefit

1. Summary of the impact

In the REF impact period, our research on carbon-rich tropical peat swamp forests in Indonesia has been used to:

- Shape EU, USA and Indonesian policy on land-use and biofuels
- Underpin a major peatland UN REDD rehabilitation project in Indonesia
- Provide input into UN World Meteorological Organization (WMO) publications underpinning a €75 million European Space Agency Climate Change project
- Contribute to development of robust IPCC emission factors for drained tropical peatlands
- Help a large multi-national plantation company to reduce its environmental impact
- Inform campaigns by environmental pressure groups (Greenpeace and WWF)

2. Underpinning research

In 2002, a team of academics, led by Leicester's Page, published a highly-cited state-of-the-art publication in *Nature* that, for the first time, highlighted the scale of carbon emissions associated with Indonesian peatland fires[1]. It emphasized the fact that persistent environmental change - in particular deforestation and drainage - threatens the stability of tropical peatlands, increasing susceptibility to fire. Using satellite images of a study area in Kalimantan, Borneo, from before and after the 1997 El Nino fires, and ground measurements of peat burn depth, the research estimated the amount of carbon released to the atmosphere for that area. Extrapolating to Indonesia as a whole, it was estimated that between 0.81 and 2.57 Gt of carbon were released to the atmosphere as a result of burning peat and vegetation. This was equivalent to 13–40% of the mean annual global carbon emissions from fossil fuels, contributing greatly to the largest annual increase in atmospheric CO_2 concentration detected since records began in 1957.

Recognising the critical role that fire played in the degradation of forested tropical peatlands, Leicester's Tansey, who has been conducting research into mapping of vegetation fires since 2003[2], joined forces with Page and Hoscilo (PhD student at Leicester) to derive a time series of forest loss and fire occurrence in a region of tropical peat swamp forest in Indonesia. This work, undertaken between 2007 and 2009, provided clear indications of the role of fire in peatland degradation[3].

Since 2010, Page's research further contributed to enhanced knowledge of carbon emissions from drainage and fire disturbance of tropical peatlands and quantified the CO_2 emissions resulting from drainage for large-scale plantation development, an industry which dominates the perturbation of the carbon balance in the SE Asian region[4]. This was especially critical as Page and Banks (research associate at Leicester) had reassessed information on tropical peatland area and thickness to reveal a larger carbon pool than previous estimates[5]. Therefore the task of estimating carbon emissions and their associated errors and uncertainties, arising from rapid growth and extent of industrial-scale plantations (70% of all plantations in Indonesia established since 2000) was established as a major research challenge. A major breakthrough occurred in 2012, when Page co-published research demonstrating the scale of peat surface CO_2 emissions from plantations on peat and confirmed the unit emission factor first published by Page and colleagues in 2010.

In 2013, Waldram (NERC NCEO PhD student) was awarded a PhD on the basis of his research (supervised by Page and Tansey) that established that information on peat water table depth can be extracted from satellite radar data. This cutting edge research will help to further quantify emissions as a result of lowered water tables and peat degradation in tropical peatlands as quantified in a recent Nature publication on fluvial organic carbon fluxes by Page and colleagues. This work was underpinned by both a NERC studentship and an Urgency grant to The Open University with Page as a co-supervisor/project partner.

3. References to the research

[1] Page, S.E., Siegert, F., Rieley, J.O., Boehm, H-D.V., Jaya, A. & Limin, S. (2002) The amount of carbon released from peat and forest fires in Indonesia in 1997. Nature 420, 61-65. This paper has been cited more than 800 times (Google Scholar on 4 July 2013). This output was supported by an

EU FP5 International Cooperation Development (INCO-DEV) grant Strategies for Implementing Sustainable Management of Peatlands - STRAPEAT (2001-2004) € 78,936.

[2] Tansey, K., Grégoire, J.-M., Defourny, P., Leigh, R., Pekel, J.-F., van Bogaert, E., and Bartholomé, E. (2008) A new, global, multi-annual (2000–2007) burnt area product at 1 km resolution. Geophysical Research Letters 35, L01401, doi:10.1029/2007GL031567. This output and continued research is supported through grants from: EC Joint Research Centre – Intercomparison of burned areas (2006-07) (Tansey: PI) € 21,333; European Space Agency – GlobCarbon (2006-07) (Tansey: Co-I) € 16,533; EC FP7 – Geoland2 – Burned Area product within the BioPAR portfolio (2008-12) (Tansey: Co-I) € 278,194; European Space Agency - Systematic wide area monitoring of tropical forests (2009-10) (Co-I: Tansey & Page - collaboration with Disasters Monitoring Constellation International Imaging) € 30,000; European Space Agency – ESA CCI-FIRE (2010-13) (Tansey: Co-I) € 106,000.

[3] Hoscilo, A., Page, S.E, Tansey, K., and Rieley, J.O. (2011) Effect of repeated fires on land-cover change on peatland in southern Central Kalimantan, Indonesia, from 1973 to 2005. International Journal of Wildland Fire 20, 578–588, doi: 10.1071/WF10029. This output was supported through grant EC FP6 – RESTORPEAT - Ecological restoration of tropical peatlands (2004-08) (Page: Co-I) £68,061.

[4] Hooijer, A., Page, S.E., Canadell, J.G., Silvius, M., Kwadijk, J., Wösten, H. and Jauhiainen, J. (2010) Current and future CO_2 emissions from drained peatlands in Southeast Asia. Biogeosciences 7, 1505-1514. This output was supported by grant EC FP6 – CARBOPEAT – Carbon-climate-human Interactions in tropical peatland (2007-09) (Page: PI) £102,750.

[5] Page, S., Rieley, J.O. & Banks, C.J. (2011) Global and regional importance of the tropical peatland carbon pool. Global Change Biology 17, 798-818.

4. Details of the impact

Our research has had wide ranging and significant impact in the following areas:

(A) Shaping and influencing national and international biofuel and land-use policies

- In 2010, Page was invited to an EU-JRC consultation workshop to discuss GHG emissions associated with indirect land-use change (iLUC) from biofuel production. This led to consultancy with the International Council for Clean Transportation which was seeking to lobby for more stringent biofuels policies. Page's resulting review argued that studies of palm oil plantation expansion in SE Asia had significantly underestimated peatland GHG emissions and thereby palm biofuel iLUC emissions. The EU commissioned several JRC reports citing Leicester research leading to a proposal to amend the EU Renewable Energy Directive by requiring reporting on emissions from iLUC in EU eligibility rules for biofuel feedstocks.
- In the USA, the Environmental Protection Agency found palm biodiesel offered a 17% carbon saving, based on peat emission values published by Page. Had this saving exceeded 20%, palm oil would qualify as a renewable fuel for subsidy (RFS) in the US. As a result, palm biodiesel is considered too carbon intensive to qualify under RFS.
- The World Bank and the UK Department for International Development in Indonesia commissioned an overview of the current status and policies surrounding climate change in Indonesia, drawing on Leicester research. Two years later, the Indonesian National Development Planning Agency (BAPPENAS) commissioned a study assessing the scientific basis, economic and legal aspects of reducing peatland emissions, also citing Page's research. The study recommended a moratorium on peatland conversion. Several Indonesian Presidential Instructions have also been informed by Page's research.

(B) Informing a REDD project to rehabilitate a tropical peatswamp to avoid an environmental disaster

Page's expertise led to her appointment, in 2008, as technical adviser to the Master Plan for Rehabilitation of the ex-MRP in Kalimantan. Started in 1996, the MRP aimed to open an extensive peatland for rice production, but was later acknowledged to be a socio-economic and

environmental disaster. To address this situation, the Indonesian Government announced its intention to rehabilitate the MRP; Page co-authored a technical review underpinning this Master Plan programme, which subsequently led to a REDD demonstration project launched within the framework of the Indonesia-Australia Forest Carbon Partnership (IAFCP). From 2008 onwards, Page was consulted and appointed member of the Technical Panel for this initiative. In 2012/13, Page and Tansey were further contracted by IAFCP to provide consultancy on mapping fire severity and modelling carbon emissions.

(C) Helping a multi-national company to change environmental practices
In 2009, Page and Hoscilo were commissioned to work on a science-based management support project via Deltares (Dutch hydrological consultants) for APRIL - a multi-national pulp and paper manufacturer in Indonesia. As a result, APRIL now use 'hydro-buffers' between plantations and conservation areas; raised plantation water levels, thus minimising fire and carbon emissions; monitor peat-derived emissions in order to understand the company's carbon footprint. Deltares Science Council has selected SE Asian peatland research, to which Leicester has contributed, as an area where Deltares has contributed significantly to sustainability at a globally relevant scale.

(D) Informing international programmes (UN WMO, IPCC) on climate change
Since 2009, Tansey has used his research on fire mapping, arising from research in Indonesia and at the global scale, to contribute new material to high level UN World Meteorological Organization (WMO) Global Climate/Terrestrial Observing System (GCOS/GTOS) publications, including: GTOS 68: Assessment of the Status of the Development of Standards for the Terrestrial Essential Climate Variables; GCOS-129: Progress Report on Implementation of the Global Observing System for Climate (GOSC) in Support of the UNFCCC 2004-2008; GCOS-138: Implementation Plan for the GOSC; and GCOS-107: Systematic Observation Requirements for Satellite-Based Products for Climate. The current Director of the GCOS Secretariat, based in Geneva, stated that these documents are reported to UNFCCC Parties, WMO Member States, IOC Members, Meteorological and Hydrological Services. A specific impact is the response to the GCOS requirements for the European Space Agency to set up a €75 million Climate Change Initiative (CCI) programme to generate climate-quality satellite data. Mapping fires is one of WMO's Essential Climate Variables and one of the ESA Climate Change Initiative projects.

In 2007, the UN IPCC, for the first time, included analysis of peat emissions in the Mitigation of Climate Change policy document (IPCC AR4, Working Group III, Ch.1 p.105). In 2011, Leicester's research was further cited in a policy recommendation on peatlands and REDD from Wetlands International to SBSTA (the scientific body informing UNFCCC and working closely with IPCC). In 2012, Page was invited as a Lead Author and Tansey as a Contributing Author for IPCC Wetlands Chapter 2 specifically to develop peat oxidation and fire emission factors for drained organic soils. The 2013 Supplement to the 2006 IPCC Guidelines for Ntional Greenhouse Gas Inventories, now approved and published, will impact most governments around the world.

(E) Informing campaigns by environmental pressure groups and contributing to stakeholder debate
Environmental pressure groups Greenpeace and WWF launched campaigns to highlight issues raised in Page's research. Dissemination of research findings through the media and pressure group campaigns has led to increased awareness and debate among stakeholder groups on carbon emissions from tropical peatland conversion, such as JNCC (public body advising UK Government on nature conservation) and the Roundtable on Sustainable Palm Oil (RSPO).

5. Sources to corroborate the impact

(A) Shaping and influencing national and international biofuel and land use policies

- ICCT White Paper on biofuels

http://www.theicct.org/sites/default/files/publications/ICCT_Peat-Emissions_Sept2011.pdf

- EU policy documents (Hooijer and Page, 2006 publication is cited):

http://ec.europa.eu/dgs/jrc/downloads/jrc_biofuels_report.pdf
http://ec.europa.eu/energy/renewables/consultations/doc/public_consultation_iluc/study_4_iluc_modelling_comparison.pdf

- US policy documents with the first link providing the EPA web site and the second to a pdf document downloadable from the web site containing reference to Page's work (first is at

page 8 of 19, marked 4307, footnote 30 and the second is on page 9/4308, third column continuing onto page 10/4309

http://www.epa.gov/otaq/fuels/renewablefuels/regulations.htm
http://www.gpo.gov/fdsys/pkg/FR-2012-01-27/pdf/2012-1784.pdf

- World Bank and Department for International Development Indonesia in consultation with State Ministry of Environment in Indonesia:

http://siteresources.worldbank.org/INTINDONESIA/Resources/Environment/ClimateChange_Full_EN.pdf

- Supporting statement from former deputy Minister of the Indonesian Government and Presidential Advisor, outlining influence of Page's research on Indonesian policy and Presidential decrees., including Presidential Instructions on: (i) Acceleration of Rehabilitation and Revitalisation of Peatland Area in Central Kalimantan (2007); (ii) Guidelines of Peatland Uses for Palm Oil Cultivation (2009); and also (iii) the National Action Plan on Greenhouse Gas Emissions Reduction (2011) and (iv) the Government Regulation Plan on Peatland Ecosystem Protection and Management (2011)
- Contactable source: Fuels Lead, International Council for Clean Transportation (ICCT) – contact details supplied.

(B) Informing the rehabilitation and REDD project in a tropical peatswamp to avoid an environmental disaster

- Page and Hoscilo's research is cited in 'Master Plan for the Rehabilitation and Revitalisation of the Ex-Mega Rice Project Area in Central Kalimantan: A Joint Initiative of the Governments of Indonesia and the Netherlands (Euroconsult Mott MacDonald and Deltares | Delft Hydraulics in association with DHV, Wageningen UR, Witteveen+Bos, PT MLD and PT INDEC, pp. 172) on pages 19, 83 & 86
- Research cited in policy recommendations to SBSTA

http://www.ecosystemsclimate.org/LinkClick.aspx?fileticket=T7pGPNYummI%3D&tabid=1602

- Supporting statement from Indonesia-Australia Forest Carbon Partnership / Kalimantan Forests and Climate Partnership Project Manager (former)

(C) Helping a multi-national company to change its environmental practices

- April overview of scientific project & APRIL Sustainability Report 2010 (p. 51)

http://www.aprilasia.com/index.php?option=com_content&view=article&id=57:lowland-operations&catid=66:environment&Itemid=89;http://www.aprilasia.com/images/pdfs/APRIL%20SR%202010.pdf

- Supporting statement from Project Officer, Deltares indicating the influence of Page's work on Deltares' (Dutch hydrological consultancy) financial investment in Indonesia.

(D) Informing international programmes (UN WMO and IPCC) on climate change

- Dr Tansey's contribution to the UN WMO GCOS activities

http://www.wmo.int/pages/prog/gcos/Publications/gcos-147.pdf

- Supporting statement from Director of the GCOS Secretariat, WMO, Geneva

http://www.esa-cci.org/ (navigate to About CCI -> Overview)

- IPCC Fourth Assessment Report (AR4) - Climate Change 2007: Mitigation of Climate Change features inclusion of peat emissions

http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg3_report_mitigation_of_climate_change.htm

- Chapter 2: Drained Inland Organic Soils of the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (pp. 332 of 339) http://www.ipcc-nggip.iges.or.jp/home/wetlands.html

(E) Informing campaigns by environmental pressure groups and contributing to stakeholder debate

- WWF report citing Leicester research

http://awsassets.panda.org/downloads/inodesian_climate_change_impacts_report_14nov07.pdf

- Greenpeace report citing Leicester research:

http://www.greenpeace.org.uk/media/reports/cooking-the-climate

- Examples of media dissemination and stakeholder use of the research

http://www.oilandgasonline.com/doc.mvc/New-Study-Suggests-EU-Biofuels-Are-As-Carbon-0001
http://jncc.defra.gov.uk/page-4201
http://www.rspo.org/sites/default/files/Report-GHG-October2009.pdf