

Institution: The University of Edinburgh
Unit of Assessment: B7 – Earth Systems and Environmental Sciences
Title of case study: FINANCING GLOBAL FORESTS THROUGH MONITORING, CERTIFICATION SCHEMES AND USER-NETWORKS
<p>1. Summary of the impact</p> <p>Impacts: I) Development of carbon credit certification schemes, including the expansion by the Gold Standard Foundation into land-use and forestry and the creation of the Natural Forest Standard by Ecometrica Ltd (both in 2012). II) Enhanced cross-sector collaboration for the quantification of forest-loss risks and implications for financing risks, through the 2011 creation of a Forest Finance Risk Network (FFRN).</p> <p>Significance and reach: The Gold Standard Foundation represents nine forestry projects worldwide (benefiting >8,500 people) and over 1.8million ha. of Brazilian land is managed through two Natural Forest Standard projects. The FFRN connects 80 member organizations globally.</p> <p>Underpinned by: Research into carbon emissions associated with forest-loss, undertaken at the University of Edinburgh (2005 onwards).</p>
<p>2. Underpinning research Numbered references relate to research outputs in Section 3.</p> <p>Key researchers The start and end dates of continuous employment in the School of GeoSciences, University of Edinburgh, are shown along with the most recent / current position of each researcher.</p> <p>Patenaude, Lecturer in Forests and Carbon Management (2005 onwards) Woodhouse, Professor of Applied Earth Observation (1999 onwards) Nichol, Senior Lecturer (2002 onwards) Malthus, Senior Lecturer in Remote Sensing (1994 - 2009)</p> <p>Research overview and context Carbon gains and losses in woodland represent, in many parts of the world, a significant fraction of carbon market requirements as laid down by the Kyoto Protocol. Research at the University of Edinburgh led by Patenaude since 2005 has investigated two aspects of such processes. Firstly, examining and understanding the techniques available (the combination of financial and technical instruments) to meet carbon market requirements. This work has led to the development of new ways of monitoring and modelling carbon gains and losses in woodlands. Secondly, investigating the engagement of business leaders in addressing climate change and in responding to carbon markets. This work demonstrated the generally low-level awareness of business leaders to: I) the financial consequences of climate change, and II) recognising the responsibilities attendant upon managing forests as one major risk element in the financial and ecosystems services markets.</p> <p>Key research findings that underpin the subsequent impact In the 2003 IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry protocols, Patenaude summarised the potential of remote sensing, especially LiDAR, to quantify carbon gains and losses in woodlands. Pre 2005 research by Patenaude investigated the potential of such techniques to meet the carbon market requirements set by the Kyoto Protocol and demonstrated that LiDAR offered the best approach for 3-D accounting of carbon, which constituted a significant advance towards the inclusion of forest carbon in a global carbon market. Building upon these findings, the Edinburgh teams led by Patenaude and Woodhouse have gone on to develop new remote-sensing data analysis techniques, as published in 2008 [1] and a new multi-spectral canopy LiDAR designed to monitor carbon stocks in forests, for which an international patent application was published in 2009 [2] and demonstration project results were</p>

Impact case study (REF3b)

published in 2011 [3]. These research findings have emphasised the innovative potential of LiDAR in forest monitoring applications, such as are those required for the UN-led Reducing Emissions from Deforestation and Forest Degradation (REDD) programme.

Research by Patenaude has also investigated the climate change and carbon market education available to corporate leaders. A study published in 2011 demonstrated that meeting the managerial challenges that climate change brings requires knowledge which is, currently, poorly addressed in business education and in managerial scholarship [4]. The issues of deficient education, limited communication, and poor take-up within individual sectors were identified – in a commissioned piece published in *Nature* in 2010 – as of pressing concern [5]. A second commissioned piece, published in 2011, also addressed the risks of forest loss for the financial sector, such as those associated with fire, wind, pests and diseases, anthropogenic interference and regulation [6].

3. References to the research

Comments in bold on individual outputs give information on the quality of the underpinning research and may include the number of citations (Scopus, up to September 2013) and/or the 2012 Thomson Reuters Journal Impact Factor (JIF). The starred outputs best indicate this quality.

[1]* Peer-reviewed journal article describing underlying methodologies, >10 citations

Patenaude, G., Milne, R., Van Oijen, M., Rowland, C. S. and Hill, R. A. (2008) 'Integrating remote sensing datasets into ecological modelling: a Bayesian approach', *International Journal of Applied Remote Sensing* 29, 1295–1315, DOI: 10.1080/01431160701736414

[2] International patent application for new multispectral canopy LiDAR technology

The key researchers are co-inventors of World Intellectual Property Organization application PCT/GB2009/050490, "Remote Sensing System" (2009). The application document is available at <http://tinyurl.com/B7-3-S3-2C>. Instrument development was funded by NERC/DTI award (2007).

[3]* Peer-reviewed journal article on multispectral canopy LiDAR demonstration project

Woodhouse, I. H., Nichol, C., Sinclair, P., Jack, J., Morsdorf, F., Malthus, T. J. and Patenaude, G. (2011) 'A Multispectral Canopy LiDAR Demonstrator Project', *IEEE Geoscience and Remote Sensing Letters* 8, 839–843, DOI: 10.1109/LGRS.2011.2113312

[4]* Peer-reviewed journal article, JIF: 5.2

Patenaude, G. (2011) 'Climate change diffusion: While the world tips, business schools lag', *Global Environmental Change* 21, 259–271, DOI: 10.1016/j.gloenvcha.2010.07.010,

[5] Commissioned journal commentary article, JIF: 38.6

Patenaude, G. (2010) 'Climate class for business schools', *Nature* 466, 30, DOI: 10.1038/466030a

[6] Commissioned journal commentary article

Davies, S. and Patenaude, G. (2011) 'Addressing the forest science versus investment nexus: can a more holistic understanding of risks bridge the gap?', *Carbon Management* 2, 613–616, DOI: 10.4155/cmt.11.65

A further metric of research quality is given by the peer-reviewed grants that have contributed to the preceding outputs, which include:

- *Case Studies for the development of a forest-specific toolbox for investment (2012 - 2013)*, sponsor: NERC (NE/J019720/1), value: £125k + £105k from partners, awarded to Patenaude.
- *Forest Finance Risk Network: Towards Stable Investment Environments for Forestry (2011 - 2012)*, sponsor: NERC (NE/I022183/1), value: £124k + £98k contribution from partners, awarded to Patenaude.
- *Mission Concept Support: a Spaceborne Multispectral Lidar Mission Concept (2010 - 2011)*, sponsor: NERC-NCEO, value: £220k, awarded to Astronomy Technology Centre, Strathclyde University with Patenaude as Co-I.

4. Details of the impact

Lettered references relate to corroboration sources in Section 5.

Development of carbon credit certification schemes

Pathway: The research-led advice of Patenaude on societal and commercial aspects of forestry carbon emissions has been regularly solicited by think-tanks, NGOs and certification bodies. Patenaude was asked by the Gold Standard Foundation (GSF) to provide advice on the potential extension of the GSF certification scheme into forest, agriculture and land-use carbon, which occurred in September 2012 through acquisition of the CarbonFix standard. The underpinning role of Patenaude's research-led advice in this decision is corroborated in a letter from the CEO of the GSF [A]. Patenaude also led the technical panel of the Natural Forest Standard (NFS), developed by Ecometrica Ltd (May 2012) as a voluntary carbon standard integrating social, biodiversity and carbon values for REDD Natural Forest projects [B].

Significance and reach:

- The GSF manages a premium quality carbon offset certification programme and is the largest international certification standard for carbon mitigation projects (mobilizing c. €500million). The forest, agriculture and land-use certification scheme now includes 9 validated / pre-validated projects worldwide, benefiting 8,695 people and representing 20,042 ha of project land [C].
- The NFS standard is used by two projects in Brazil (Trocano Araretama, area 1,346,541 ha. and Madeirinhas, area 493,953 ha.) to avoid deforestation and forest degradation [D].

Enhanced cross-sector collaboration on financial risks from forest-loss

Pathway: Patenaude has been invited on three occasions to contribute to the Z/YEN Ltd commercial think-tank events 2010 - 2011. These invitations were underpinned by the research work and are corroborated in a letter from the Director of Z/YEN [E]. Building on these networking activities. In 2011 Patenaude established the cross-sector Forest Finance Risk Network (FFRN, <http://tinyurl.com/B7-3-S4-1>, funded by the NERC award listed in Section 3), aimed at providing knowledge exchange between researchers and end-users, to generate a stable investment environment for forestry. In 2012, a research-led spin-out company providing consultancy and project/data management services related to remote sensing of forest resources, Carbomap Ltd. (<http://www.carbomap.com>) was founded with Woodhouse as CEO and Patenaude as Director.

Significance and reach:

- The three Z/YEN events at which Patenaude presented were: "Finance, Water & Forestry: Where's The Data? Symposium" (July 2010); "Finance and Forestry Roundtable on Finance And Forestry: Where's The Data?" (September 2010); and as key speaker at the "Finance, Biodiversity and Managed Ecosystems: Where's The Data?" (Spring 2011). In each case the audience was 200+ participants, drawn from representatives of financial institutions, carbon market consultancies, investors, NGOs, and emission traders [F].
- In the year from August 2011 membership of the FFRN grew from 8 to over 80 global carbon-related organisations, including NGOs, insurers and investors (e.g., WWF, WillisRE, VCS, ForestRe, Acclimatise). The following members can corroborate specific benefits derived from the network (all of which occurred 2011 – June 2013). The Director of EnviroMarket Ltd can corroborate the development of "Two forest bonds and an early stage development of data service for investors are products that emerged as a result of the Network led by Patenaude" [G]. The Director of ForestRe Ltd stated: "Really excellent work. Extremely useful for us as a risk modelling unit for insurance sector – we have to price risk in a few hours for most forest clients. The network has helped us develop growth models, wind damage functions and the planning and design of baseline situations" [H]. The Head of Economics and Climate Change at the Forestry Commission Scotland stated: "The knowledge exchange improves our knowledge of how risks will be estimated for the woodland carbon code [...], and how our buffer estimates will be therefore amended" [I].
- Carbomap Ltd is a rapidly developing business that has already been identified as

'important' in a February 2012 article by NGO *Responding to Climate Change* and been the recipient of a SMART Feasibility Award (January 2013) from Scottish Enterprise [J].

5. Sources to corroborate the impact

Where two web-links are given, the first is the primary source and the second an archived version.

[A] Factual Statement from the Chief Executive Officer of The Gold Standard Foundation

Corroborates the input of Patenaude's research-led advice into the 2012 GSF consultation process on extending its certification scheme into forest, agriculture and land-use carbon and the overall support provided by this advice in the September 2012 decision to acquire CarbonFix.

[B] Website for the Technical Panel of the Natural Forest Standard

<http://tinyurl.com/B7-3-S5-XB> or <http://tinyurl.com/B7-3-S5-B> Provides evidence of Patenaude's research-based expertise contributing to the development of certification standards.

[C] CarbonFix Project Index List, now managed by the GSF

<http://tinyurl.com/B7-3-S5-XC1A> or <http://tinyurl.com/B7-3-S5-C1> Provides evidence of the global projects now managed by the GSF following its procurement of CarbonFix. The total people benefiting and area of land managed represents the sums of the 9 projects listed as validated or pre-validated. Evidence of the acquisition of CarbonFix by GFS (September 2012) is given by the following press-release: <http://tinyurl.com/B7-3-S5-XC2A> or <http://tinyurl.com/B7-3-S5-C2>

[D] NFS Project Index, Validation statement and Project Details.

<http://tinyurl.com/B7-3-S5-XD> or <http://tinyurl.com/B7-3-S5-D> Provides evidence of the Trocano Araretama (validated March 2013, Page 2) and Madeirinhas (originated June 2012, Pages 3-10) projects in Brazil that now engage with the NFS to avoid deforestation and forest degradation.

[E] Factual Statement from the Director of Z/Yen Group Limited

Provides corroboration of Patenaude's invitation to, and valued contributions at, the three listed Z/Yen Group events.

[F] Meeting websites for cross-sector events

<http://tinyurl.com/B7-3-S5-XF1> or <http://tinyurl.com/B7-3-S5-F1> Finance and Forestry: Where's The Data? (September 2010) Provides evidence of the role of Patenaude as one of 5 panellists.
<http://tinyurl.com/B7-3-S5-XF2> or <http://tinyurl.com/B7-3-S5-F2> Long Finance-London Accord Spring Conference (March 2011) Provides evidence of Patenaude's key speech "Finance, Biodiversity and Managed Ecosystems".

[G] Director of EnviroMarket Ltd

Can corroborate the quoted statement in Section 4, in particular that the research work by Patenaude has underpinned the development of two forest bonds and data services for investors.

[H] Managing Director of ForestRe Ltd

Can corroborate the quoted statement in Section 4, in particular the development of new models for understanding forestry risk in the insurance sector.

[I] Head of Economics and Climate Change at the Forestry Commission

Can corroborate the quoted statement in Section 4, in particular the commissioning of work (value £36,000) on the calculation of buffer sizes for Woodland Carbon Code projects. Further corroboration of the interaction between the Forestry Commission and the FFRN is given in a February 2012 press release: <http://tinyurl.com/B7-3-S5-XIA> or <http://tinyurl.com/B7-3-S5-I>.

[J] Responding to Climate Change article and list of SMART Scottish Enterprise Awards

I) February 2013 RTCC article: <http://tinyurl.com/B7-3-S5-XJ1> or <http://tinyurl.com/B7-3-S5-J1> Provides corroboration of the utility of Carbomap services. II) List of SMART: Scotland Grants accepted April 2012 - March 2013 <http://tinyurl.com/B7-3-S5-XJ3> or <http://tinyurl.com/B7-3-S5-J3A> Provides corroboration that Carbomap received a 'Feasibility Award' (row 69 of spreadsheet).