

Forestry Carbon: Valuation, Discounting & Risk Management

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- Overview
 - 1) Background (designing C policy instruments)
 - 2) Approaches to valuing carbon
 - a) social value
 - b) market value
 - 3) Valuing future carbon savings
 - a) social value
 - b) market value
 - 4) Allowing for non-permanence & other risks
 - a) discounting
 - b) other approaches to risk management
 - 5) Concluding remarks
 - Valuing forestry's contribution to climate change mitigation

1) Background (Carbon policy instruments):

- Valuing carbon is important in:
 - establishing a framework of incentives that values climate change mitigation activities (e.g. ‘carbon price’)
 - Stern Review (2006, p.xviii) on establishing a carbon price (through tax, trading, or regulation):
 - “an essential foundation for climate-change policy”
 - DECC/DEFRA (2009, p.iii) Making the right choices for our future:
 - “A comprehensive policy framework should seek to establish a carbon price – usually best achieved through an intervention upstream in the supply chain.”
 - comparing climate change mitigation benefits over time.

Background (Carbon policy instruments):

- government roles include:
 - establishing a framework of incentives
 - Overcoming market failures due to climate externalities
 - International (e.g. via UNFCCC process)
 - National level
 - providing clarity concerning the social value of carbon
- Mechanisms that provide incentives to sustain & enhance forest carbon stocks are currently weak both nationally & at international level:
 - Kyoto Protocol excludes REDD (~20% of emissions)
 - EU emissions trading scheme excludes forestry
 - Few explicit incentives in UK for increasing forestry carbon

Context

- **(i) Govt guidance on valuing carbon for policy appraisal**
 - currently under review
 - underlying perspectives/assumptions remain controversial
- **(ii) Govt Quality Assurance Scheme for Offset Providers**
 - Potential extension to forestry credits more generally?
- **(iii) Carbon budgets**
 - Dept of Energy & Climate Change Consultation on Carbon Units, the net UK carbon account & carbon accounting
 - Potential extension to forestry credits more generally?
- **(iv) Carbon Impact Assessment methodologies linked to the Marginal Abatement Cost (MAC) of Carbon under UK and Scottish Climate Change Bills**

Govt's Quality Assurance Scheme for C Offsetting

- **launched by DECC in January 2009**
 - replaces draft DEFRA code published in 2008
- **covers:**
 - **Kyoto-compliant credits**
 - CERs (Clean Development Mechanism)
 - ERUs (Joint Implementation)
 - **EU Emissions Trading Scheme phase II credits (EUAs)**
- **most forestry credits excluded**
 - **Only 2 forestry projects approved under CDM to date**
 - No tCERs or ICERs yet issued?
- **Q: How might the Govt's Quality Assurance Scheme be extended to cover forestry credits more generally?**

Aims of the current study:

- **(i) review of methods (including discounting) used to:**
 - Value carbon
 - Compare carbon benefits in different time periods
 - Manage risks and uncertainties
- **(ii) consider approaches appropriate to extending standards to forestry carbon more generally in UK markets**

Perspectives on Forestry Carbon

(links to 2008 Payments for Ecosystem Services study available at:

<http://www.forestresearch.gov.uk/fr/INFD-5XNKRC>):

- **Inclusion of forestry carbon:**
 - allows higher emission reduction targets to be reached
 - reduces cost of meeting given emissions reduction target
- **Quality & measurement issues**
 - **Standards & verification** (wide range of quality of carbon credits)
 - **Cost-effectiveness vs measurement precision trade-off**
 - E.g. soil carbon measurement not cost-effective?
 - **Scientific uncertainties**
 - E.g. material substitution benefits generally excluded (range of uses)

Types of Carbon Credits

- **(i) ‘Compliance’ credits:**
 - **Kyoto Protocol**
 - **Certified Emissions Reductions (CERs)**
 - forestry projects a special case for which temporary five-year (tCERs) or longer-term (ICERs) credits issued
 - **Emission Reduction Units (ERUs)**
 - **Assigned Amount Units (AAUs)**
 - **Removal Units (RMUs)**
 - **EU Allowances (EUAs) issued under EU ETS**
 - **National schemes**
 - E.g. tradable abatement certificates (NGACs) under the New South Wales Greenhouse Gas Abatement scheme
- **(ii) ‘Voluntary’ credits:**
 - **Carbon Financial Instruments (CFIs)** - Chicago Climate Exchange
 - **Voluntary Emissions Reductions (VERs): Verified/ Unverified**
 - Range of standards (CarbonFix, CCB, Gold Standard, VER+, VCS)

UK Carbon Offsets providers (for forestry projects in the UK)

Organisation	Website	Type of Organisation	Type(s) of project	Primary market(s)	Types of Credit
Carbon Footprint	www.carbonfootprint.com	Company	R, LPT	Firms, Households	VERs
Carbon Forestry	www.carbonforestry.co.uk	Company	T	Firms, Households	Unverified
Carbon Leaf	www.carbonleaf.co.uk	Company	T	Households	Unverified
Carbon Offset Scotland	www.carbon-offset-scotland.com	Company	T	Households	Unverified
Carbon Responsible	www.carbonresponsible.com	Company	T	Firms, Households	VERs & CERs
Co2balance	www.co2balance.uk.com	Company	A, HN	Firms, Households	VERs (max 90% sold)
Erase my Footprint	www.erasemyfootprint.com	Company	A	Households	Unverified
Forest Carbon	www.forest-carbon.co.uk	Company	A	Firms	Unverified
Future Forests	www.futureforests.co.uk	Company	T, R	Households	Unverified
Grow a Forest	www.growaforest.com	Non-profit Company	A	Households	Unverified
Moor Trees	www.moortrees.org	Charity	A	Households	Unverified
Project Climate	http://projectclimate.org	Company	A	Firms	VERs
The CarbonNeutral Company	www.carbonneutral.com	Company	T, F	Firms, Households	VERs & CERs
The C-Change Trust	www.thec-change.com	Charity	A, CF, HN	Firms, Households	VERs
Treeflights	www.treeflights.com	Company	A, R	Households	Unverified
Trees for Cities	www.treesforcities.org	Charity	U, CF	Households	Unverified

Sources: Ewing (2008), and offset providers' websites.

Notes: A: Afforestation (planting trees where none previously); CF: Community Forestry; F: Forestry (unspecified); HN: development of habitat networks; LPT: 'Low profile' tree planting (hedgerows, school grounds, etc); R: Reforestation/Restoration (planting trees in previously forested areas); T: Tree planting (unspecified); U: Urban tree planting

UK Carbon Offset providers (overseas forestry projects)

Organisation	Website	Cat	Types of project	Overseas Location(s) of projects	Primary market(s)	Types of Credit
C level	www.Clevel.co.uk	Company	RR	Uganda	Firms, Households	VERs
Carbon Footprint	www.carbonfootprint.com	Company	R, LPT	Kenya	Firms, Households	VERs
Carbon Me	www.carbonme.org	Company	CF, R	LDCs incl. Ethiopia	Households	Unverified
Carbon Positive	www.carbonpositive.net	Company	R	LDCs incl Brazil & Indonesia	Firms, Households	VERs (+ CERs in the future)
Climate Stewards	www.climatestewards.net	Charity	T	Ghana & other LDCs	Households	VERs
Climate Warehouse	www.climatewarehouse.com	Company	F	Worldwide	Firms	VERs & CERs
Co2balance	www.co2balance.uk.com	Company	A, HN	France	Firms, Households	VERs (max 90% sold)
Cool Earth	www.coolearth.org	Charity	D	Brazil, Peru & Ecuador	Firms, Households, Schools	VERs
Correct Carbon	www.correctcarbon.co.uk	Company	R	Panama	Households	VERs
Envirotrade	www.envirotrade.co.uk	Company	R, Ag	Mozambique, Bhutan & other LDCs	Firms, Households	VERs
Flying Forest	www.FlyingForest.org	Company	T	Namibia, S. Africa, Zambia	Households	Unverified
Greenstone Carbon Management	www.greenstonecarbon.com	Company	A, R	Worldwide	Firms	VERs & CERs
GroPower	www.GroPower.net	Company	J	Philippines	Households	VERs
Mycarbondebt	www.mycarbondebt.com	Company	T	India, Tanzania	Households	VERs
Plan Vivo	www.planvivo.org	Non-profit Foundation	CF/Ag	Mexico, Uganda, Mozambique	Firms	VERs
Ripple Africa	www.rippleafrica.org	Charity	T, R	Malawi	Households	VERs
The CarbonNeutral Company	www.carbonneutral.com	Company	T, F	Worldwide	Firms, Households	VERs & CERs
Treeflights	www.treeflights.com	Company	A, R	Peru	Households	Unverified
Trees for Cities	www.treesforcities.org	Charity	U, CF	Peru, Ethiopia, Kenya,	Households	Unverified
World Land Trust – Carbon Balanced	www.carbonbalanced.org	Charity	D, R, RR, HN	Ecuador, Paraguay, Brazil	Firms, Households	VERs & CERs

Sources: Ewing (2008), and offset providers' websites.

Notes: A: Afforestation; Ag: Agroforestry; CF: Community Forestry; D: Avoided deforestation; F: Forestry (unspecified); HN: development of Habitat Networks; J: Jatropha tree planting to use seeds for biofuel (fossil fuel substitution); LPT: 'Low profile' tree planting (hedgerows, school grounds, etc); R: Reforestation/Restoration; RR: Rainforest reforestation; T: Tree planting; U: Urban tree planting. LDCs: 'Less Developed Countries'

2) Approaches to carbon valuation (Social Value):

- (i) **Social cost of carbon (SCC)**
 - Based upon estimated global damage cost of emissions
- (ii) **Marginal abatement cost of carbon (MAC)**
- (iii) **Carbon price / pollution tax** to meet a climate stabilisation goal
- (iv) **Shadow Price of Carbon (SPC)**: e.g. tax that equates SCC & MAC
 - Wide range of estimates:**
 - SCC estimates** span over three orders of magnitude from zero to over £1000/tC (Downing *et al.*, 2005)
 - Depend upon approach / model / assumptions (incl stabilisation)**
 - E.g. estimates for stabilisation around 550 ppm CO₂e:**

Source:	US Climate Change Science Program (Clarke et al, 2007)			UK Government (DEFRA) (Price et al, 2007, Table 2)		
Basis:	Carbon price/tax (based upon £=\$1.309 from Stern Review)			Shadow Price of Carbon (2007 prices)		
Model/estimate:	MERGE	MiniCAM	IGSM	Low	Central	High
Year:				(-10%)		(+20%)
2020	£6/tC	£11/tC	£57/tC	£109/tC	£121/tC	£145/tC

Market Value of carbon

- **Wide range of prices**
 - prices in voluntary markets worldwide (excl CCX) ranged from \$1.8/tCO₂e - \$300/tCO₂e in 2007 (Hamilton et al, 2008)
- **Value depends upon:**
 - **Type of activity & credit**
 - Afforestation, reforestation, reduced deforestation, ...
 - **Quality of credit**
 - Duration (e.g. 5-yr tCERs vs longer-term ICERs)
 - timing of benefits & certification (e.g. ex-ante vs ex-post)
 - levels of risk
 - **Demand factors** (incl confidence in offset quality)
 - **Supply factors** (incl certification & other transactions costs)
 - **Regulatory factors** (incl fungibility of credits)
 - E.g. price of EUAs fell from €30 (April 2006) to under €1 (early 2007) once supply implications of initial allocations under the EU ETS (phase I) became clear
 - **Related markets** (e.g. oil prices)
 - **Market expectations** (cf 'animal spirits' of investors? - Keynes)

3 Comparing benefits over time:

Discounting for:

- **(i) Time**
 - **Time preference:**
 - Preference for benefits sooner rather than later
 - often considered an accurate description of behaviour
- **(ii) Changing circumstances**
 - Diminishing 'marginal utility'
 - If individuals/society expect to become more wealthy over time
 - Risk/uncertainty aversion
 - Future benefits more risky / less certain
 - (Damage - e.g. negative discounting for **increasing damage caused by carbon emissions at higher atmospheric concentration**)

3a) Social Discount rates:

- **Rate of Social Time Preference (elements):**
 - rate at which future consumption is discounted compared to current consumption if no change in level expected
 - expected rate of growth of per capita consumption
 - elasticity of the marginal utility of consumption
- **Rates applied vary (no international standard)**
 - declining ('hyperbolic') rates in some cases
 - E.g. Treasury Green Book (Table 6.1, p.99) declining rate
 - 3.5% (yrs 0-30); 3.0% (yrs 31-75); 2.5% (yrs 76-125)...1%
 - rates used can depend upon the purpose
 - E.g. marginal vs non-marginal (avoid all impacts) decisions
 - Stern Review (2006) used lower rates than Green Book

DEFRA Shadow Price of Carbon

DEFRA Shadow Price of Carbon, discounted, and implicit discount factor

Year	SPC in £/tCO ₂ (2008 prices)	Discounted SPC in £/tCO ₂ (2008 prices)	Discount factor
2008	26.5	26.5	1.000
2020	33.6	22.2	0.839
2030	40.9	19.2	0.725
2040	49.9	16.8	0.633
2050	60.8	15.2	0.574
2100	164	10.1	0.383
2150	440	8.6	0.326
2200	1185	8.6	0.326
2250	3193	10.6	0.400

Sources: SPC up to 2050 taken from DEFRA guidance (Price et al, 2007, Table 3);
Discounted and post-2050 estimates based upon Green Book discount rates;
Social Value assumed to increase at 2% pa due to increasing damage cost

3b) Market Discount rates:

- dependent upon factors including:
 - Expected future market conditions for carbon credits
 - expected future market prices
 - Preferences and perceptions of buyers
 - expectations about levels of risk & uncertainty
 - attitudes to risk (risk-averse, risk neutral, etc)
 - extent of willingness to delay carbon benefits
 - Regulatory factors
 - e.g. fungibility and opportunities to bank credits

4) Valuation & non-permanence (e.g. fire) risk management:

- **(i) Discounting**

- E.g. future carbon benefits with a risk of $x\%$ that they fail to materialise may be valued at $(100-x)\%$ of a benefit that is certain by a risk-neutral decision-maker
 - cf 'certainty equivalent'
- partly reflected in market prices for ex-ante credits (future carbon benefits)

Valuation & non-permanence risks:

- **(ii) Maintaining a Buffer**
 - Credit issuers withhold proportion of credits to cover risks
 - akin to discounting but increases rather than decreases value of a credit
 - **several voluntary standards use this approach, including:**
 - **CarbonFix Standard: 30%**
 - **Voluntary Carbon Standard: 5%-60%**
 - Dependent upon 'low', medium' or 'high' risk category (and project type)
 - **Carbon Forestry Standard (UK): >50%**

Valuation & non-permanence risks:

- **(iii) Temporary crediting (limiting duration of credits)**
 - Excludes entirely benefits accruing beyond specified time
 - eliminates need to consider more distant risks
 - Used for Kyoto credits (under CDM):
 - 5 years (tCERs) or remaining project duration (ICERs)
 - Used by some voluntary market standards:
 - VER+ (max 50 years)
 - Effect on value of credits also depends upon replacement requirements
 - E.g. Kyoto credits ICERs & tCERs have to be replaced on expiry

4b) Other risk management approaches

(not directly involving carbon valuation) include:

- **(d) Ex-post (rather than ex-ante) crediting**
 - Reduces/eliminates need to consider future risks
 - E.g. Kyoto credits (CERs, tCERs, ICERs...)
 - but risks still remain for some ex-post credits
 - E.g. forward delivery of Kyoto credits (gCERs)
- **(e) Insurance**
- **(f) Portfolio management**

4) Concluding Remarks (Social Value):

- current DEFRA guidance:
 - Estimates of the social value of carbon are sensitive to assumptions about future levels of atmospheric GHGs.
 - Current estimates based upon assuming stabilisation of atmospheric GHGs within the 450-550ppm CO₂e range
 - Were accelerating global emissions expected to result in these levels being exceeded, the Government's estimates of the social value of carbon would need to be revised upwards.
 - The magnitude of the social value of carbon influences whether carbon mitigation actions are cost effective.
 - A low value makes relatively costly mitigation unviable.
 - High discount rates can have a similar effect (resulting in future carbon savings being valued less).

Risks of undervaluing potential contributions of forestry carbon to climate change mitigation

- **i) Internationally:**
 - **Avoided deforestation:**
 - UNFCCC process (post-Bali)
 - **developing markets for forestry C of central importance to tackling climate change (Eliasch Review, 2008)**
 - EU emissions trading scheme
- **ii) Nationally:**
 - a) quality assurance (carbon offsets)
 - FC currently developing a forest carbon quality assurance scheme
 - b) carbon accounting frameworks
 - c) if relatively modest social value & relatively high discount rate adopted

Carbon valuation & risk management approaches for forestry carbon QA:

- Temporary crediting:
 - need for consistent approach to valuing benefit streams for different lengths of time
- Discounting:
 - Public (social) discounting rather than market approach may be preferable (given potential for manipulation by participants)
- Buffer:
 - Useful but requires impartial risk assessments
 - Role for central designated body?

Concluding Remarks (general):

- incentives to conserve existing forests and to plant new ones are important for the potential of forests for climate mitigation to be realised.
- Several methods are available to cover risk management (e.g. non-permanence), and comparisons of time profiles of carbon benefits in developing a **forestry carbon QA scheme**
- Without incentives to value forestry carbon significant climate mitigation opportunities are likely to be missed

Further research:

- **1) Additionality: Review of concept/usage**
 - a) Types (statutory, investment/financial, environmental)
 - b) Tests & evidence required
 - i) regulatory
 - ii) voluntary market standards
 - Quantifying net benefits from climate mitigation activities
 -
- **2) Comparative analysis of silvicultural options for climate change mitigation**
 - valuing carbon sequestration & substitution profiles

Further information:

- Discussion Paper (forthcoming): **Forestry Carbon: Valuation, Discounting and Risk Management**
- **Will be available at:**
 - <http://www.forestresearch.gov.uk/fr/INFD-5XNKRC>

Thanks for listening!