Tables and Figures Chapter 9

Table 9.1. Forest area by region in 2000 and changes in area in 1990s, million hectares per year (FAO 2001)

Region	Land area	Total forest (natural forests and forest plantations)				Natural forest	Forest plantation
	million ha	*Million ha*	% of land area	% of all forests	Net change 1990-2000 *million ha/year*	*million ha*	*million ha*
Africa	2 978	650	22	17	-5.3	642	8
Asia	3 085	548	18	14	-0.4	432	116
Europe	2 260	1 039	46	27	0.9	1 007	32
North and Central America	2 137	549	26	14	-0.6	532	18
Oceania	849	198	23	5	-0.4	194	3
South America	1 755	886	51	23	-3.7	875	10
WORLD TOTAL	**13 064**	**3 869**	**30**	**100**	**-9.4**	**3 682**	**187**

Note: Changes are the sums of reported changes by country.

Domain	Natural forest					Forest plantations			Total forest
	Losses			Gains	Net change	Gains		Net change	Net change
	Deforestation (to other land use)	Conversion to forest plantations	Total loss	Natural expansion		Conversion from natural forest (reforestation)	Afforestation		
Tropical	-14.2	-1.0	-15.2	+1	-14.2	+1	+0.9	+1.9	-12.3
Non-tropical	-0.4	-0.5	-0.9	+2.6	+1.7	+0.5	+0.7	+1.2	+2.9
Global	**-14.6**	**-1.5**	**-16.1**	**+3.6**	**-12.5**	**+1.5**	**+1.6**	**+3.1**	**-9.4**

Table 9.2. Wood volume and above-ground biomass by region (FAO 2001)

Region	Forest area	Volume		Biomass	
		by area	total	by area	total
	million ha	*m^3/ha*	*Gm^3*	*t/ha*	*Gt*
Africa	650	72	46	109	71
Asia	548	63	35	82	45
Oceania	198	55	11	64	13
Europe	1 039	112	116	59	61
North and Central America	549	123	67	95	52
South America	886	125	111	203	180
Total	**3 869**	**100**	**386**	**109**	**422**

Table 9.3. Production, major consumers and producers of forest products in 2003 (FAO 2005)

World production in 2003		
roundwood total	3342	mill. m3
industrial roundwood	1588	mill. m3
wood fuel	1755	mill. m3
sawnwood	402	mill. m3
wood-based panels	214	mill. m3
wood pulp	170	mill. tons
recovered paper	15	mill. tons
paper and paperboard	328	mill. tons

	Major consumers of forest products, % of global consumption
Industrial roundwood	USA (25%); Canada (12%); China (8%); Brazil (6%); Russian Federation (5%)
Sawnwood	USA (30%); Japan (6%); Canada (5%); Brazil (5%); China (5%)
Wood-based panel	USA (26%); China (21%); Germany (5%); Japan (5%); Republic of Korea (3%)
Pulp for paper	USA (29%); China (13%); Canada (8%); Japan (7%); Finland (5%)
Paper and paperboarc	USA (27%); China (13%); Japan (10%); Germany (6%); UK (4%)

	Major producers of forest products, % of global production
Wood fuel	India (17%); China (11%); Brazil (8%); Ethiopia (5%); Indonesia (5%)
Industrial roundwood	USA (26%); Canada (12%); Russian Federation (8%); Brazil (6%); China (6%)
Sawnwood	USA (22%); Canada (14%); Brazil (5%); Russian Federation (5%); Germany (4%)
Wood-based panel	China (20%); USA (19%); Canada (8%); Germany (6%); Indonesia (3%)
Pulp for paper	USA (28%); Canada (14%); China (10%); Sweden (6%); Finland (6%)
Paper and paperboarc	USA (25%); China (12%); Japan (9%); Canada (6%); Germany (6%)

Table 9.4. Selected regional and global estimates of change in forest area and the role of forests and other terrestrial vegetation in carbon exchange with the atmosphere. Negative is sink

Regions	FAO, 2001		Rate of change in C store of woody biomass				Estimates of annual C flux during 1990's (TgC/yr) based on ← inversion of atmospheric transport models land observations → combined
	Forest area, million ha	Net area change 80's-90's, million ha/yr	UN-ECE, 2000		UNFCC, 2002 (1996-2002 average)		
			TgC/yr	MgC/ha/yr	TgC/yr	MgC/ha/yr	
OECD North America	525.8	-0.2					0 to -300[5] -500±600[9]
1 Separately: Canada	244.6	0	-92.7	-0.22	-21.8	-0.09	-80 ± 200[1] -570 ± 910[2]
USA	226.0	0.4	-166.5	-0.58	-176.3	-0.78	
Mexico	55.2	-0.6					
OECD Pacific	192.6	-0.3	-61.1	-0.1	-12.4[b]	-0.08 [b]	0±200[1]
Europe	149.7	0.7	-86.1	-0.67	-56.7[a]	-0.38 [a]	0 ± 200[1] -1,030 ±940[2] (Europe and boreal Asia) -135 to -205[6] -300±800[9] -140[11]
Countries in Transition	923.6	0.5	-470.7	-0.51			
Russia separately	851.4	0.1	-428.8	-0.48			-322 to -433[7] -520±128[8] -1,300±800[9] (Siberia only)
Northern Africa	67.3	-1.0					-170 ± 980[2] (Northern Africa) (Tropical Africa) 157 ± 64[3] (Tropical Africa) 120 ± 30[4] 350 ± 200[1]
Sub-Saharan Africa	582.6	-4.2					
Caribbean, Central and South America	909.1	-4.1					(Tropical America) 441 ± 265[3] (Tropical America) 430 ± 200[4] 750 ± 300[1] 630 ± 1,060[2]
2 Brazil separately	543.9	-2.3					0±200 [12]
Developing Countries of South and East Asia and Middle East	518.9	-0.7					1,090 ± 500[1] (Tropical Asia) 680 ± 740[2] (Tropical Asia) 473 ± 150[3] 350 ± 150[4]

3 China separately	163.5	1.8				30 ± 200[1] -157[13] -68[15] -620 ± 660[2] (Temperate Asia)
4 Global total	3869.5	-9.4				2,180 ± 800[1] -1,340[2] 900 ± 2,100[5] -1,300±1,500[9] -700±800[10]

NOTES: Positive = sink
[a] European Community only
[b]Australia and New Zealand only
[1] Houghton 2003a (flux from changes in land use and land management based on land inventories).
[2] Gurney et al. 2002 (inversion of atmospheric transport models)
[3] Achard et al. 2004 (estimates based on remote sensing for tropical regions only)
[4] De Fries et al. 2002 (estimates based on remote sensing for tropical regions only)
[5] Potter et al. 2003 (NEP estimates based on remote sensing for 1982-1998 and ecosystem modelling, the range reflects interannual variability)
[6] Jansssens et al. 2003 (includes forest, agricultural lands and peatlands between Atlantic Ocean and Ural Mountains, excludes Turkey and Mediterranean isles).
[7] Shvidenko and Nilson, 2003 (forests only, range represents difference in calculation methods)
[8]Nilsson et al. 2003 (includes all vegetation)
[9] Cias et al. 2000 (inversion of atmospheric transport models)
[10] Plattner et al. 2002 (revised estimate for 1980's is 400±700)
[11]Nabuurs et al. 2003 (forests only)
[12] Houghton et al. 2000 (Brazilian Amazon only, losses from deforestation are offset by regrowth and C sink in undisturbed forests).
[13] Fang et al. 2001
[14] Pan et al. 2004

Regional Breakdowns
1- OECD North America: Canada, Mexico and the United States
2- OECD Pacific: Australia, Japan, Korea and New Zealand
3- Europe: Austria, Belgium, Czech Republic, Denmark, France, Finland, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom
4- Countries in Transition: Albania, Armenia, Azerbaijan, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, Estonia, Georgia, Gibraltar, Former Yugoslav Republic of Macedonia (FYROM), Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Malta, Moldova, Romania, Russia, Slovenia and Serbia/Montenegro, Tajikistan, Turkmenistan, Ukraine, Uzbekistan
5- Sub-Saharan Africa: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Congo, Cape Verde, Central African Republic, Chad, Democratic Republic of Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Swaziland, United Republic of Tanzania, Togo, Uganda, Zambia, Zimbabwe
6- Northern Africa: Algeria, Egypt, Libya, Morocco, Sudan, Tunisia

7- Middle East: Bahrain, Islamic Republic of Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates and Yemen.
8- Caribbean, Central and South America: Anguilla, Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, French Guiana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, St. Kitts and Nevis, Saint Lucia, St. Vincent and Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela
9- Developing Countries of South and East Asia: Brunei, China (including Hong Kong), Chinese Taipei, Indonesia, DPR of Korea, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam Bangladesh, India, Nepal, Pakistan, Sri Lanka, Afghanistan, Bhutan, Fiji, French Polynesia, Kiribati, Maldives, New Caledonia, Papua New Guinea, Samoa, Solomon Islands, Vanuatu

Table 9.5. Cumulative land area (in Mha) for forestation and avoiding deforestation in different tropical regions and global total for the carbon price scenario $10+5% increment/year (Sathaye et al. 2005)

	Maximum area suitable for forestation	2050 forestation	2050 deforestation	2100 forestation	2100 deforestation
Africa	200	11.6	108.6	42.4	108.6
China	63	63.0	0.0	63.0	0.0
India	22	21.8	0.0	21.8	0.0
Rest of Asia	200	84.5	82.8	200.0	104.4
Central America	21	4.4	30.7	11.9	33.3
South America	200	18.0	142.3	57.9	157.5
Total tropics	706	203.3	364.4	397.1	403.8
Global total	1045	392.1	364.4	709.7	403.8

Table 9.6. Feasible area for implementing reforestation/afforestation project, and its cumulative potential mitigation (several sources)

Country	Feasible Area (Mha)	Cumulative potential Mitigation (Gt C)
Indonesia	32.5[1]	-5.5[1]
Philippines	4.4[2]	-1.18[3]
Vietnam	5.5[3]	-0.42[3]
Cambodia	3.5[4]	-0.37[4]
Myanmar	~ 25.0[5]	~ -3[5]
Thailand		
Malaysia		
Lao		
India	63.5[6]	

[1] Rosalina et al. (2003), [2]Sathaye (2001), [3]Kohn et al. (2003), [4]MOE (2002), [5]Estimation, [6]Ravindranath et al.(2001)

Table 9.7. Summary of results for forestation simulations for the three budget periods (Waterloo et al. 2003, Table 3 exe summary)

Region	Forestation area	Cumulative Sequestration 2000-2050	Costs 2000-2050	Cumulative Sequestration 2000-2100	Costs 2000-2100
	(x 1000 ha y-1))	(Gt C)	(x 10^6 $)	(Gt C)	(x 10^6 $)
C.America/Caribbean	100	-0.015	152	-0.042	419
Africa	70	-0.014	204	-0.042	609
Asia	4437	-0.328	1702	-0.664	3636
Oceania	6	0	2	-0.001	7
South America	679	-0.170	2190	-0.449	5867
Total	5291	-0.527	4250	-1.19	10539

Table 9.7A Mitigation potential per hectare for forest mitigation options in selected countries

Mitigation options	Mitigation potential *tC/ha*		Mitigation potential *tC/ha/year*
	India	Mexico	Seven tropical country average
	Ravindranath et al, 2001	*Masera et al., 2001*	*Sathaye et al, 2001*
Short rotation	25	61	3.8 to 19.2
Long rotation	80	98	1.6 to 11.1
Afforestation		67	
Forest Regeneration	162		
Forest protection or Avoided deforestation	182	141-188	

Notes: The tropical countries are: India, Indonesia, Thailand, Tanzania, Brazil, China and Mexico

Table 9.7B. Cost estimates for carbon sequestration projects (From Cacho et al., 2003)

Projects	**Cost range ($/tC)**	**Source**
Farmers to conserve forests on their farm	7-24	Smith and Mourata (in press)
Adopt multi-strata agro-forestry, Peruvian Amazon	8-31	Smith and Mourata (in press)
Profafor, Ecuador	16	Various sources, Smith et al. (2000)
Scolel Te, Mexico	10-12	De jong et al. (2000)
Forestry projects in developing countries	2-25	De jong et al. (2000)
Forestry projects in industrialized countries	5-82	De jong et al. (2000)
Reforestation with short rotation species in land with low opportunity cost	<5	Various sources reviewed by Smith and Scherr (2002)
Industrial plantations in China, Thailand, India and Brazil	<5	Hardner et al (2000) and Austin et al (1999) cited by Smith (2002)

Table 9.8. Incremental mitigation potential for selected tropical countries and for the tropics (Sathaye et al. 2001)

	2000-2012		2000-2030	
	Cumulative (Gt C)	Annual (Gt C/year)	Cumulative (GtC)	Annual (Gt C/year)
Seven Tropical countries	-1.851	-0.140	-6.199	-0.200
All Tropics	-2.730	-0.210	-9.028	-0.290

Note: Seven countries include Brazil, China, India, Mexico, Indonesia, Philippines and Tanzania

Table 9.9. Land area and cumulative carbon benefits gained across scenarios, relative to reference case (Sathaye et al. 2005).

Scenario [b]	Carbon Price ($/t C)		Land Area Gained (Mha)		Carbon Benefits Gained (Gt C)	
2010 C Price + Annual Increase	2050	2100	2050	2100	2050	2100
$10 + 3%	33	143	212	555	-15	-50.9
Forestation			52	77	-4.9	-16.3
Avoided defor-estation			160	478	-10.7	-34.5
$20 + 3%	65	286	363	819	-28.6	-79.5
Forestation			75	135	-8.9	-28.5
Avoided defor-estation			288	684	-19,6	-50.9

Table 9.10. LULUCF Potential of considered Non- Annex B Countries – for the period 2008-2012 (in Mt C per year) – (from Jung, 2005)

Project type	Plantations		Avoided deforestation		Agroforestry		Regeneration	
Uptake factors	Low	High	Low	High	Low	High	Low	High
Asia	-3.18	-5.17	-13.63	-24.05	-0.26	-0.61	-0.76	-2.15
Africa	-0.12	-0.21	-19.6	-35.88	-0.04	-0.11	-0.37	-1.10
Latin America	-0.71	-1.09	-89.93	-151.43	-0.07	-0.18	-2.45	-5.09
Indonesia	-0.49	-0.74	-8.99	-16.19	-0	-0	-0.01	-0.02
Venezuela	-0.03	-0.05	-4.49	-5.19	-0	-0	-0.04	-0.09
China	-2.53	-4.18	-0.58	-0.88	-0.25	-0.59	-10.50	-31.50
India	-0.01	-0.02	-24.75	-41.25	-0.02	-0.05	-0.04	-0.09
Brazil	-0.49	-0.74	-25.31	-42.18	-0	-0	-0.74	-1.49

Table 9.11. The technical potential of primary biomass from forestry sector at a regional level for the year in EJ/y[1] 2020 – 2050 based on: (Hall, 1993; Fischer and Schrattenholzer, 2001; Dessus 1999; Yamamoto, 2001; Williams, 1995; Walsh et al, 1999; Smeets et al, 2005)

Regions	EJ/y		GtC/y ($GtC_{avoided}$)			
	LOW	HIGH	LOW		HIGH	
North America	3	11	0.10	(-0.055)	0.36	(-0.203)
OECD Europe	1	4	0.03	(-0.018)	0.13	(-0.074)
F USSR + Eastern Europe	2	10	0.07	(-0.037)	0.33	(-0.184)
Japan + Australia + NZ	0	3	0.00	(0)	0.10	(-0.055)
Latin America	1	21	0.03	(-0.018)	0.69	(-0.387)
Africa	1	10	0.03	(-0.018)	0.33	(-0.184)
Centrally planned Asia	1	5	0.03	(-0.018)	0.16	(-0.092)
Other Asia	1	8	0.03	(-0.018)	0.26	(-0.147)
Middle East	1	2	0.03	(-0.018)	0.07	(-0.037)
World lowest and highest estimate[#]	11	74	0.36	(-0.203)	2.42	(-1.364)
World based on global studies	14	65	0.46	(-0.258)	2.12	(-1.198)

[#] This is the sum of the total list of Lowest and Highest estimates, however in theory this may not be possible as the categories are different and the geological aggregation is slightly different. Furthermore, differences between trade patterns may exists. Therefore we also included the range of global studies results.

[1] When converted from m3 or ton, we have used the assumptions of 0.58 ton/m^3 and a HHV of 19 GJ/ton

Table 9.12. Summation of regional results as presented in section 9.4.3 and 9.4.4. Note that these figures are surrounded by large uncertainty. Differences in studies, assumptions, and price scenarios make a simple summation almost impossible. These are best estimates for the medium long term period where these values may be reached around 2040 in the medium price scenario of around 20US$/tonne CO_2. If measures are effective, then the higher ranges apply beyond 2050.

	Annual Sequestration and or avoidance of emissions (Gt C /y)	Bioenergy avoided emissions (Gt C /y)
OECD North America	-0.05 to -0.08	-0.104
Europe	-0.02 to -0.04	-0.037
Countries in transition	-0.02 to -0.04	-0.086
Africa	-0.05 to -0.15	-0.073
OECD Pacific	-0.01 to -0.02	-0.018
Middle East	-0.005 to -0.01	-0.024
Caribbean, Central and south America	-0.1 to -0.3	-0.141
East Asia	-0.05 to -0.1	-0.043
Developing countries of South Asia	-0.1 to -0.2	-0.061
South East Asia	-0.1 to -0.2	
Japan	-0.01 to -0.02	Included in East asia
Total	-0.5 to -1.2	-0.59

Table 9.13. Summary of results for af-/reforestation simulations for the three budget periods (banking from 2002 onwards) without adoption of criteria (except for additionality), but taking 'project success rates' into account. Certification precision level set at 20% (affecting costs), 25% increase in current planting rate due to CDM and a 35-year rotation period. (Waterloo et al. 2003).

Region	Af-/reforestation area	Cumulated sequestration 2000-2050	Cumulated Costs 2000-2050
	(x 1000 ha y-[1])	(Gt C)	(x 10^6 $)
C.America/Caribbean	100	-0.015	152
Africa	70	-0.014	204
Asia	4437	-0.328	1702
Oceania	6	0	2
South America	679	-0.170	2190
Total	5291	-0.527	4250

Table 9.14. Technical, economic and economic potential forestry mitigation estimation, by biome

Geographic Region, and Mitigation Option (reference)	Technical potential (Option potential with current practices, all available land) (Gt C/yr)	Economic potential (Single option, or multiple forest-agriculture sector options in competition) (Gt C/yr average)	Economic Potential as % of Technical Potential (%)	Reference and notes
		Temperate and Boreal Regions		
A/R, Annex I	-0.007 to -0.046 [a] (26 midpoint)	-0.009 [b] in 2010, at $10/tC	35%	a. Noble and Scholes, 2001, and Kolshus, 2001, both from Sampson and Scholes, 2000 b. Sathaye et al., 2005; Sathaye et al., 2005a. Values are average/yr of cumulative C flux to given date. Scenario 2 mitigation results used, where C price is $10 in 2010 and rises at 5%/yr to reach $70/tC by 2050.
A, U.S., 15 year program	-0.091 to -0.203 [c] (-0.147 midpoint)	-0.003 [d] at $18.3/tC	2%	c. Lewandrowski et al., 2004, using Birdsey, 1996 and cropland and pasture land available defined by Moulton and Richards, 1990
		-0.022 [c] at $25/tC	15%	
		-0.086 [c]	58%	d. USEPA, 2005. Values are annualized over

		at $100/tC -0.220 [d] at $110/tC	150%	2010-2100.
FM U.S.A.	-0.190 [f] biological opportunities on private timberland	-0.029 [d] in 2010, at $18.35/tC -0.105 in 2010, at $183/tC [d] -0.110 [g] (C price NA)	15% 58%	f) Vasievich and Alig, 1996, in Birdsey et al. 2000 g) Richards and Stokes, 2004. Values are annual, for various time periods that vary by model results reported.
Tropical Regions (including China)				
A/R, non-Annex I	-0.614 [a]	-0.096 [b] in 2040, at $10/tC rising at 5%/yr	16%	
D, non-Annex I	-1.7 [a] in 2010	-0.104 [b] in 2010, at $10/tC -0.177 [b] in 2040, at $10/tC rising at 5%/yr	6% NA	
FM, non-Annex I	-0.200 [h] in 2040	-0.090 [b] in 2040, at $10/tC rising at 5%/yr	4%	h) Sampson and Scholes, 2000
Global Estimates				
A/R Global	-0.399 [a] In 2010	-0.042 [b] in 2010, at $10/tC -0.184 [b] in 2040, at $10/tC rising at 5%/yr	10% NA	
D Global	-176 [a] in 2010	-0.104 [b] in 2010, at $10/tC -0.177 [b] in 2040, at $10/tC rising at 5%/yr	6% NA	
Global A/FM/D	-2.3 [a] in 2010	-0.146 [b] in 2010, at $10/ -0.361 [b] in 2040, at $10/tC rising at 5%/yr	6% NA	

Notes:
D: avoided deforestation
FM: forest management
A: afforestation
R: reforestation
NA: not available

Table 9.15. Synergy or tradeoff between climate mitigation activities and adaptation potential

Activities, practices and management systems	*Carbon sequestration or emission reduction potential*	*Biodiversity conservation*	*Adaptation potential*
Carbon conservation			
Deforestation reduction through policy changes	+++	+++	+++
Formation of protected areas	+++	+++	++
Sustainable Forest Management	+++	++	?
Fire protection practices	++	++	+++
Carbon sequestration			
Afforestation	+++	++	?
Reforestation	+++	++	?
Industrial plantations	++	- -	--
Agro-forestry	++	++	+++
Urban forestry	++	++	+++
Carbon offsets (substitution for fossil fuels and unsustainably harvested wood)			
Short rotation forestry for biofuels	+++	- -	--
Bioenergy (Bioelectricity through gasification or combustion of biomass)	+++	- -	--
Fuel efficient stoves	+	+	+
Efficient charcoal kilns	++	++	+

Notes: + Low Positive Impact; ++ Medium Positive Impact; +++ High Positive Impact; - Low negative impact, -- Medium negative impact, ? positive or negative adaptation impact

Table 9.16 Characteristics of lCER's and tÇER's.

	tCER	***lCER***
Discount for project emissions and negative leakage	***Only for emissions since the last verification***	***During the whole (remaining) crediting period***
Duration of validity	***Five years after last verification during the crediting period***	***Only until the end of the last entire commitment period during the crediting period***
Validity for compliance	***Renewed tCER can be used during the commitment period it was certified***	***As lCERs are not renewed. they can only be used for compliance in one commitment period***

Table 9.17: *Typology of CDM transaction costs*

	Administration costs	***Control costs***
Upfront	***Search costs*** ***Negotiation costs*** ***Approval costs*** ***Registration fee***	***PDD costs*** ***Validation costs***
During project lifetime	***CER issuance fee*** ***Adaptation levy*** ***Project governance***	***Monitoring*** ***Verification & certification***

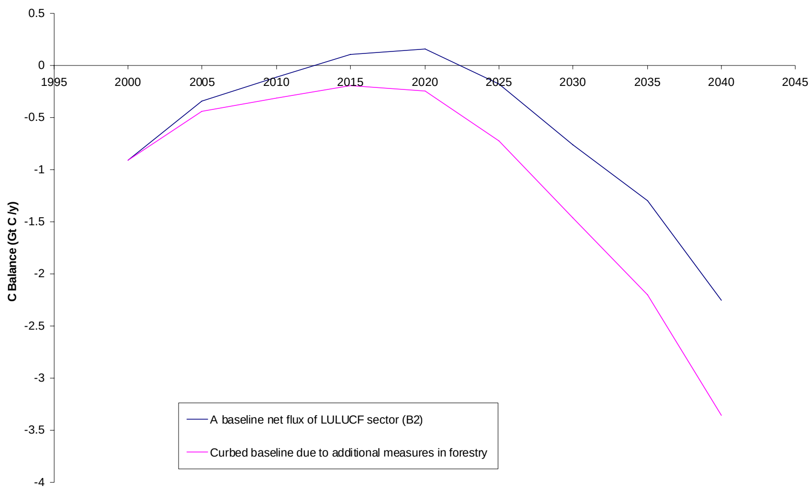

Figure Exe sum 1. The wedge: A possible projection of the baseline of the global LULUCF sector (B2) and the economic potential of curbing of this baseline by additional measures in the forestry sector alone at a carbon price of around 20US$/ton CO_2. Note that large uncertainty surrounds both the baseline, as well as the effect of the measures. Naturally, choosing another baseline would have an impact on the size of the curbing as well, however, literature does not allow such a dynamic approach.

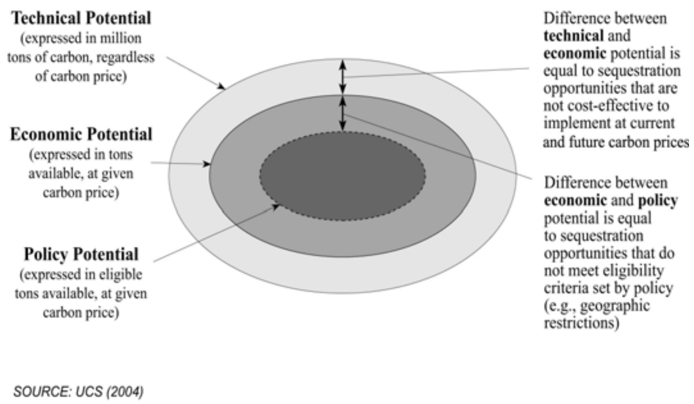

Figure 9.1. Distinguishing technical, economic and policy potential of mitigation. In this chapter we consider the additional economic potential against a baseline, taking into consideration the interlinkages (incl. trade-offs) between adaptation, mitigation and sustainable development (UCS 2004).

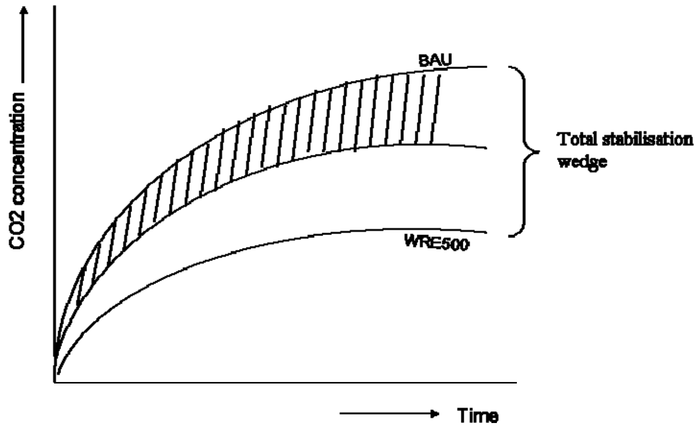

Figure 9.2. The total stabilisation wedge to reach the 550ppmv stabilisation scenario (following Pacala et al.) and the hypothetical contribution of forestry (shaded). This chapter quantifies the forestry wedge which is then summed up with and compared to other sectors in chapter 11.

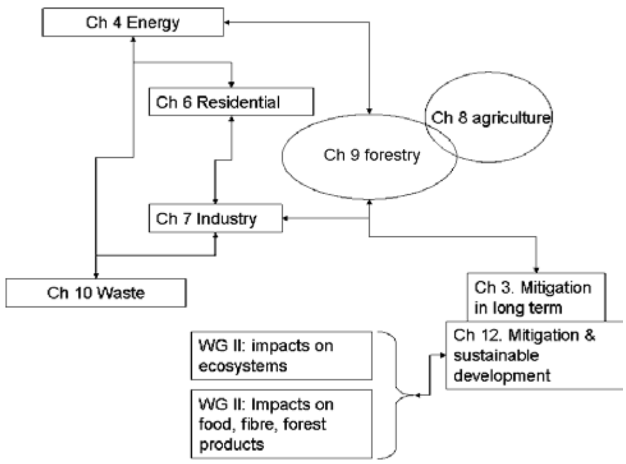

Figure 9.3. Relations between this chapter and the other chapters of WG III and relevant chapters of WG II.

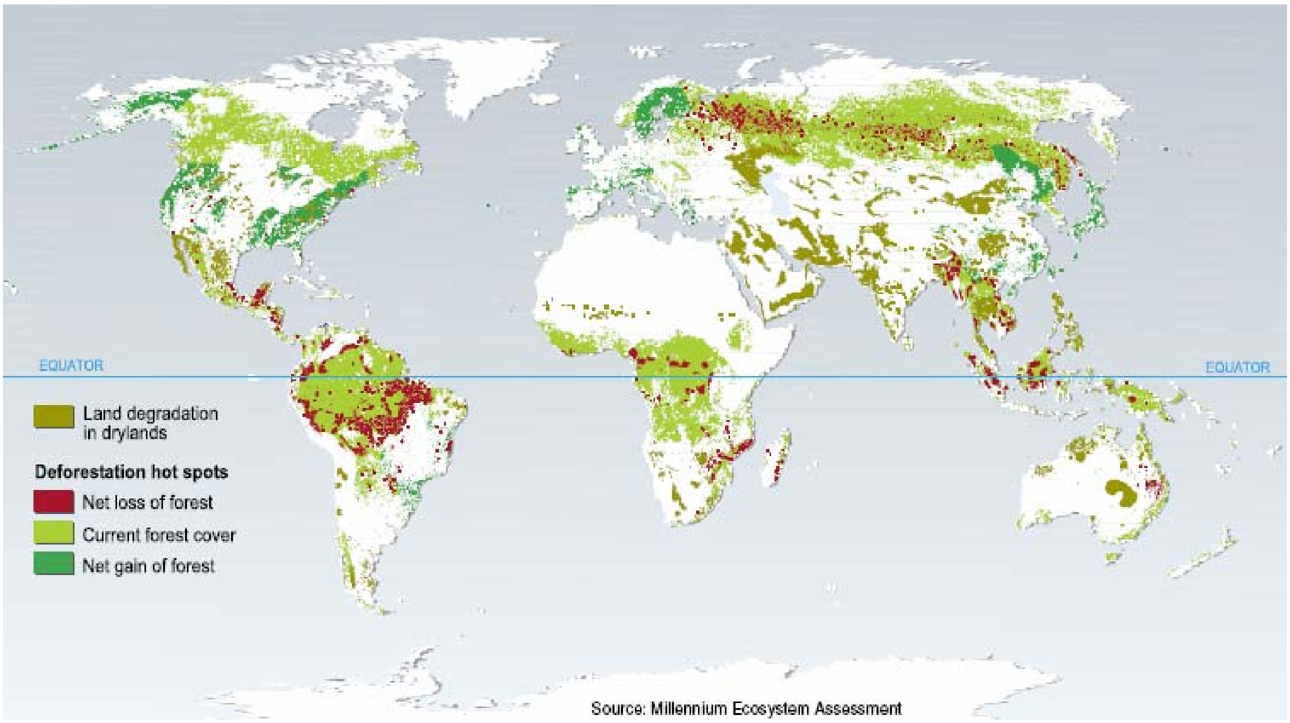

Figure 9.4. Areas undergoing high rates of land cover change between 1980 and 2000 (Millenium Ecosystem Assessment, 2005)

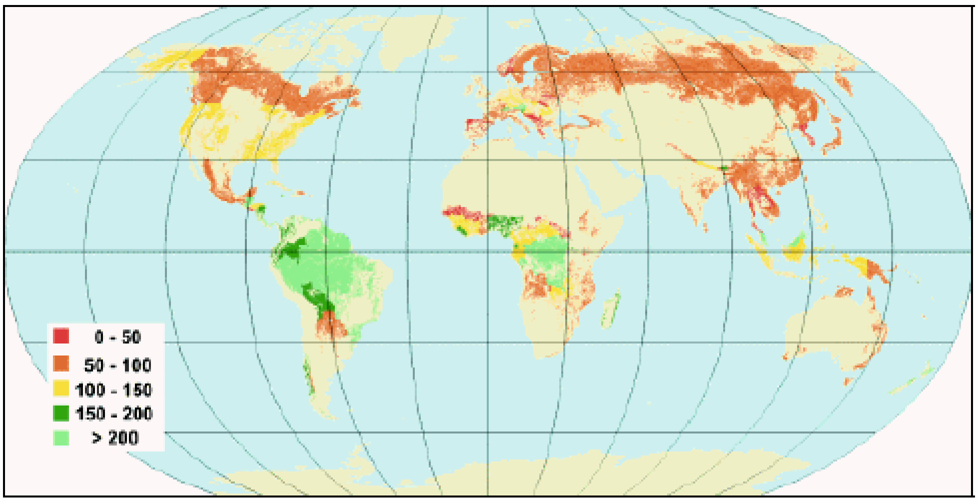

Figure 9.5. Aboveground woody biomass by country, tonnes per hectare (FAO 2001)

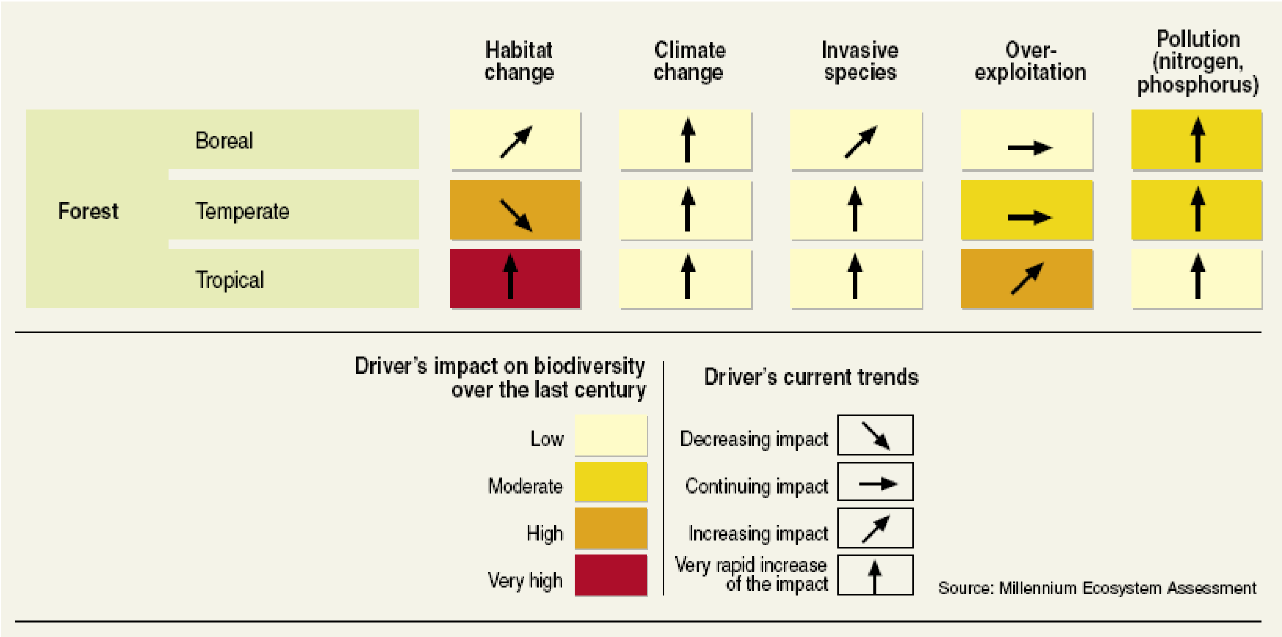

Figure 9.6. Main direct drivers of change in biodiversity of forests (Millenium Ecosystem Assessment, 2005).

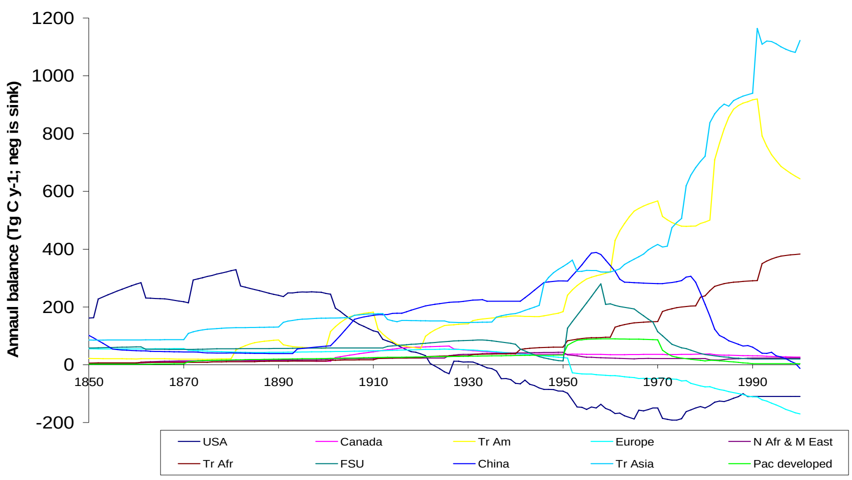

Figure 9.7. Carbon balance of the LULUCF sector (often forests alone) per continent, historically. Pos = source. Houghton Tellus inpress (data from CDIAC)

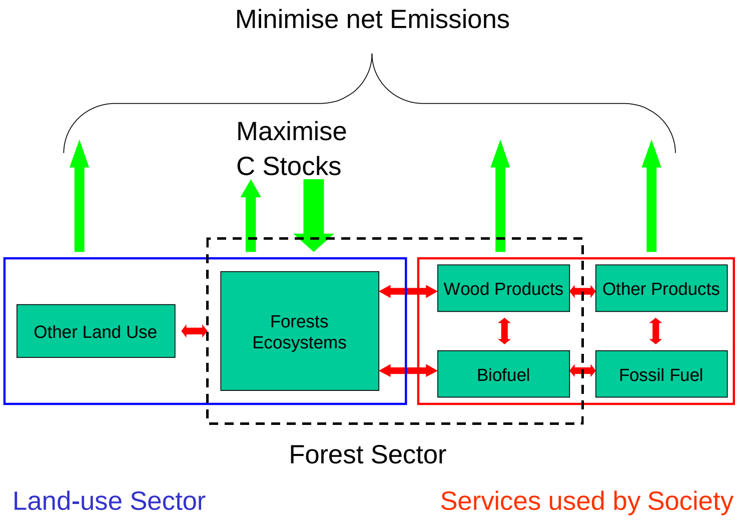

Figure 9.8. Mitigation strategies aimed at maximizing carbon storage in forest ecosystems need to be assessed with regard to their impacts on net GHG emissions across all sectors. The optimum strategy may change as the system boundaries are expanded from forest ecosystems, to the entire forest sector, to all services provided by the forest sector, and ultimately to all land-use decisions.

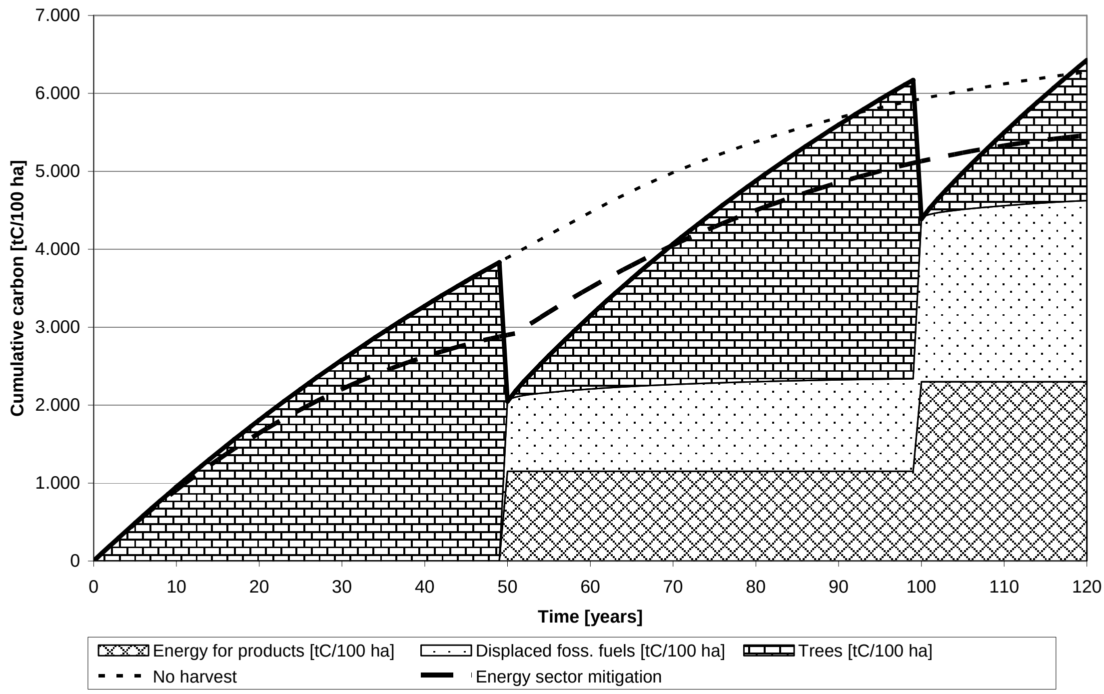

Figure 9.9. (Box 9.1) Comparison of long-term emission reduction through reductions of fossil fuel use in the energy sector with carbon sequestration on land (a conceptual diagram)

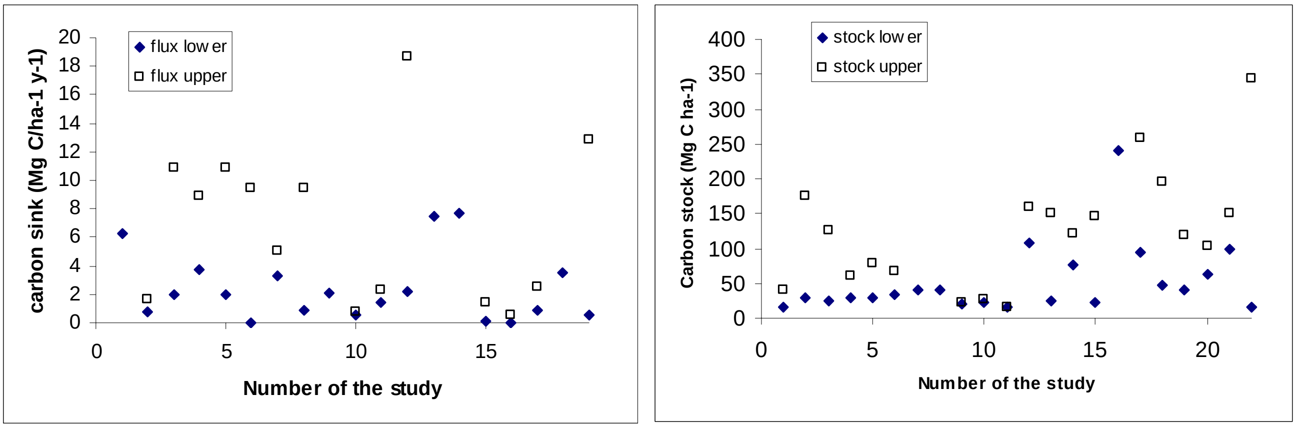

Figure 9.10. Upper and lower bounds for annual biomass carbon sink (left) and carbon stock in plantations as reported in literature for sites around the world (many refs). Usually the higher fluxes are found in the shorter term studies.

References for the left panel: Sedjo and Solomon 1989, Nordhaus 1991, Moulton and Richards 1990, Dudek and Leblanc 1990, Adams et al. 1993, Richards et al. 1994, Parks and Hardie 1995, Richards 1997, New York State 1991, Van Kooten et al. 1992, Slangen and Van Kooten 1996, Bowonwiwat 1995, Barson and Gifford 1990, Tasman Institute 1994, Nabuurs en Schelhaas 2002, Groen et al. 2005, Kraxner et al 203, Laclau 2003, Garcia-Quijano et al. 2005

References for the right panel: Dixon et al. 1991 (3x), Houghton et al. 1993 (3x), Stavins 1999, Newel and Stavins 1991, Plantinga 1991 (2x), VanKooten et al. 2000, Masera et al. 1995, Ravindranath and Somashekhar 1995, Xu 1995, Sedjo 1999, Kerr et al. 2001, Nabuurs en Schelhaas 2002, Groen et al. 2005, Masera et al. 2003, Cannell 2003, Garcia-Quijano et al. 2005.

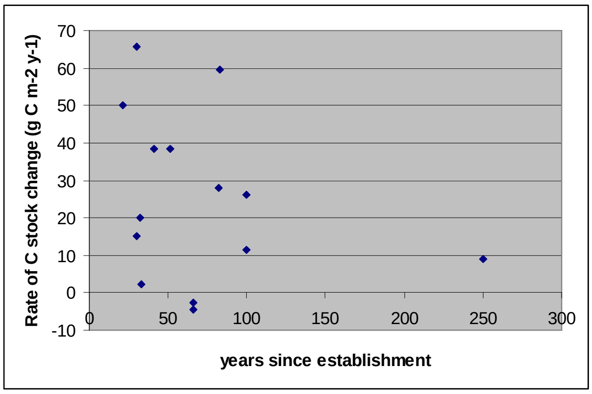

Figure 9.11. A Average rates of soil carbon accumulation since forest establishment after agricultural use (From Post and Kwon 2000).

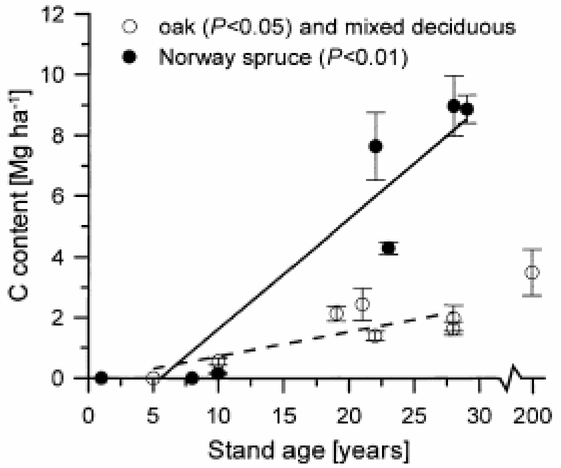

Figure 9.11. B Forest floor C contents in afforestation chronosequences of oak and norway spruce and of an adjacent ~200 years old mixed forest. Vesterdal et al. 2002.

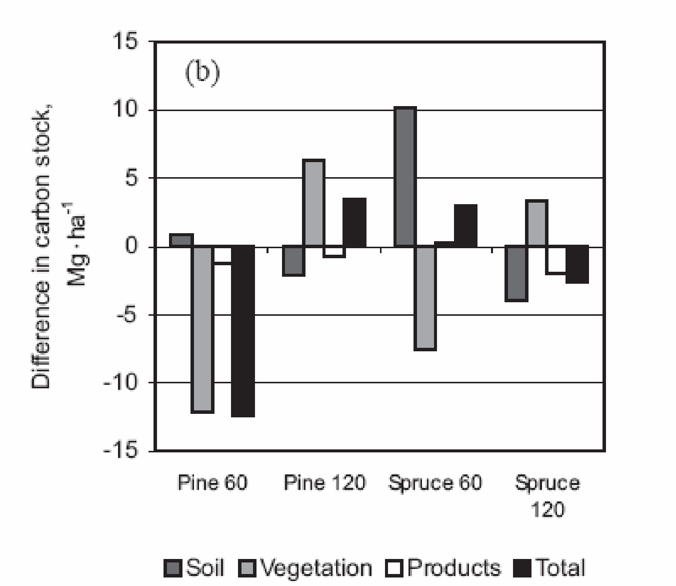

Figure 9.12. Difference in carbon stocks in soil, vegetation, and products compared to a 90 year rotation of the same species (Liski et al. 2001) .

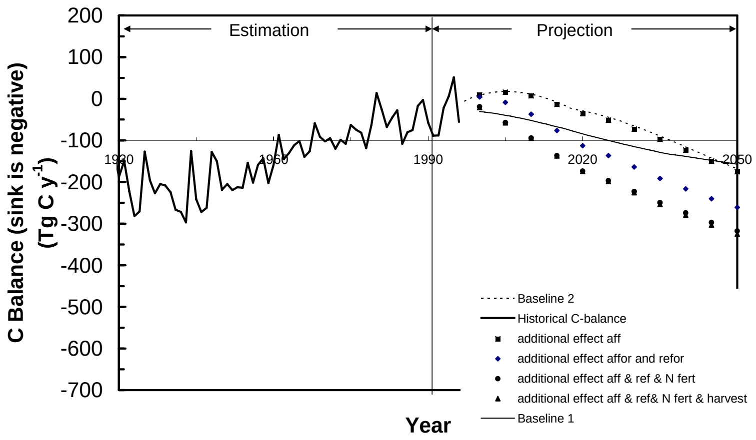

Figure 9.13. Historical carbon balance of Canadian forests, two projected baselines under no-climate change assumptions and four assessments of <u>theoretical biological potential</u> of the degree to which the baseline-2 could be curbed (Adapted after Chen et al. 2000). Options are depicted here in a cumulative way while in practice such cumulation cannot simply be expected. Large uncertainty surrounds both the historical balance as well ass all projections.

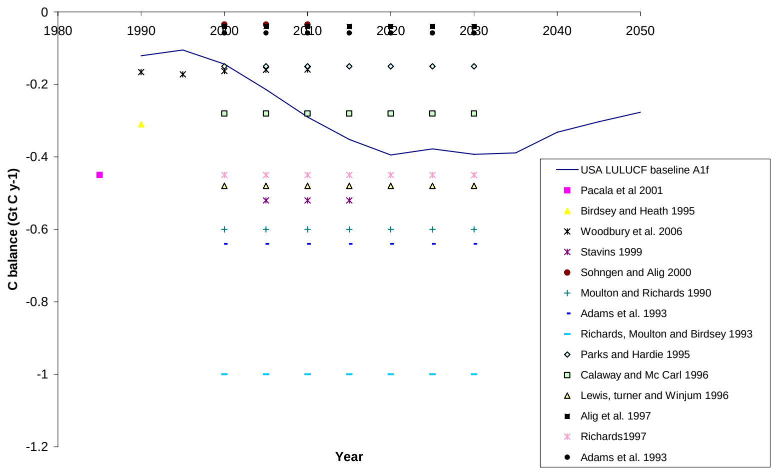

Figure 9.14 Projected baseline for the whole LULUCF sector as derived from IMAGE under A1f scenario, and assessments from literature for the USA.

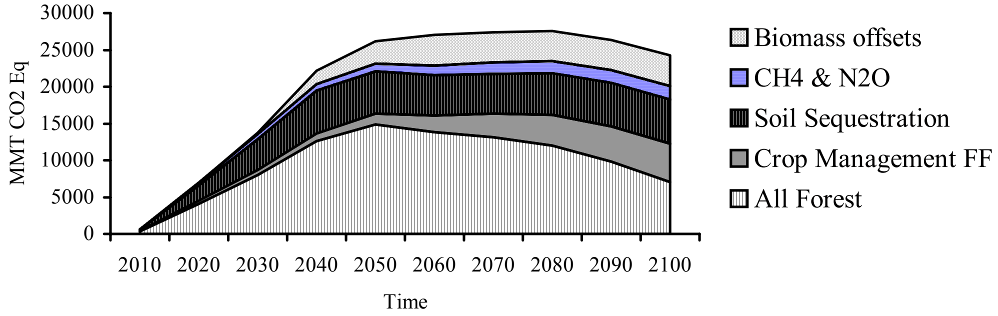

Figure 9.15. Cumulative mitigation contributions from major strategies at a \$15 CO_2 Equivalent Price in the whole LULUCF sector in the USA (Lee at al.)

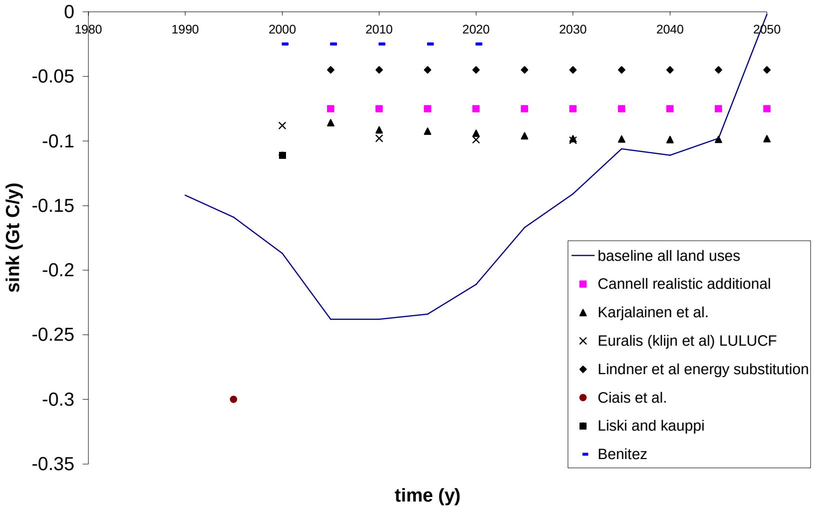

Figure 9.16. Projected baseline for the whole LULUCF sector as derived from IMAGE under A1f scenario, and assessments from literature for the Europe

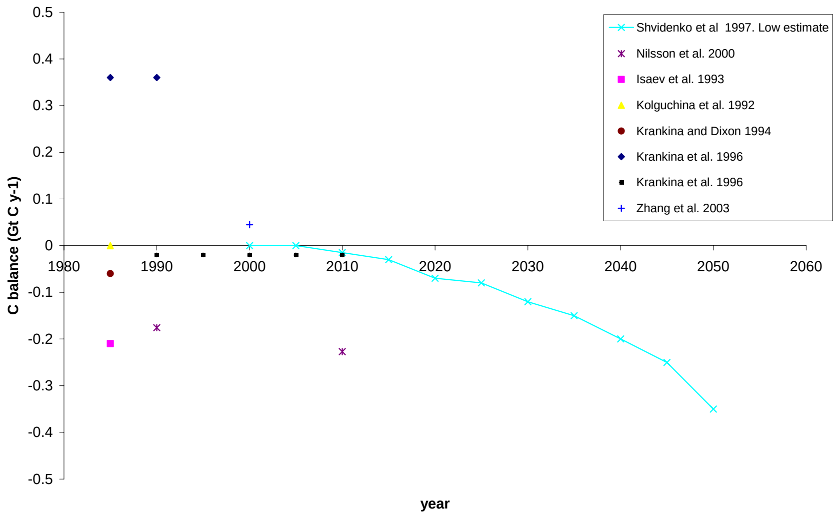

Figure 9.17. Carbon balance studies and options for additional sequestration from literature for Russia

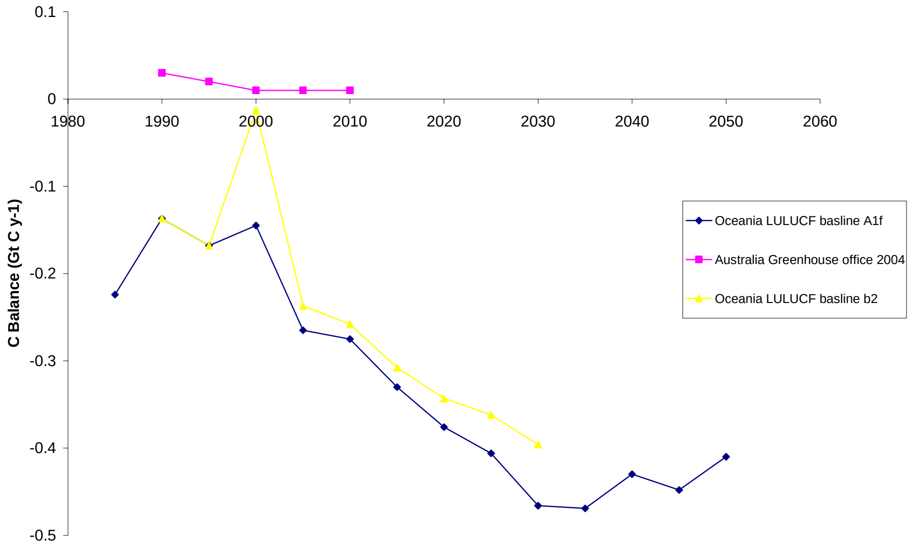

Figure 9.18. Projected baselines for the whole LULUCF sector as derived from IMAGE under A1f and B2 scenario for Oceania

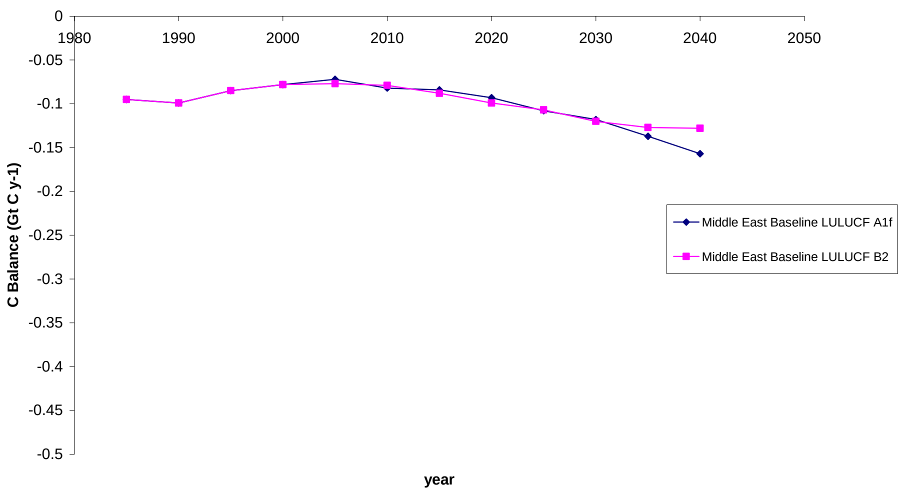

Figure 9. 19. Projected baselines for the whole LULUCF sector as derived from IMAGE under A1f and B2 scenario for the Middle East

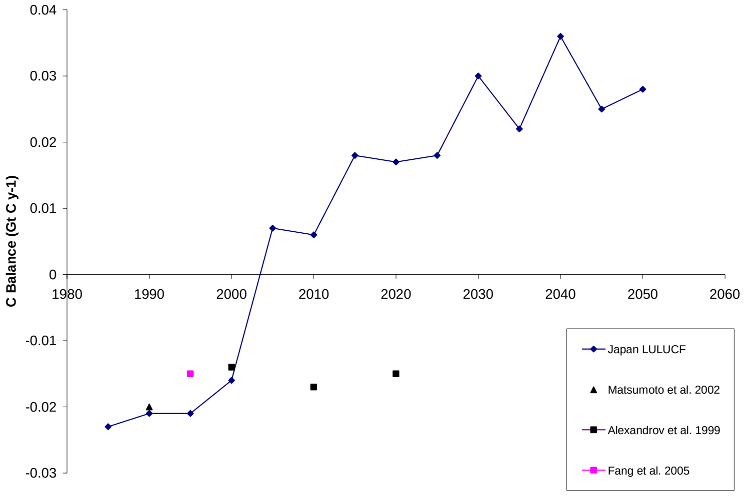

Figure 9.20: Projected baseline for the whole LULUCF sector as derived from IMAGE under A1f scenario for Japan and assessments

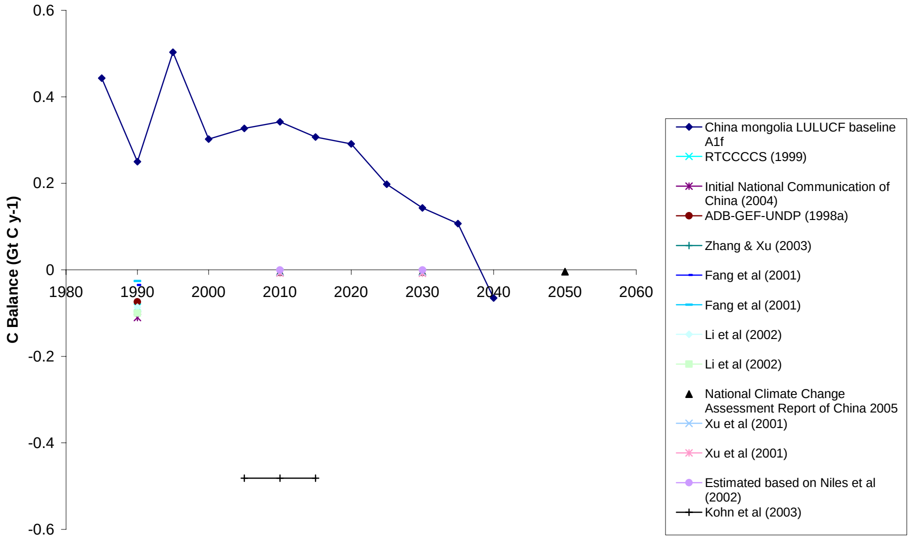

Figure 9.21. Projected baseline for the whole LULUCF sector as derived from IMAGE under A1f scenario for East Asia and assessments

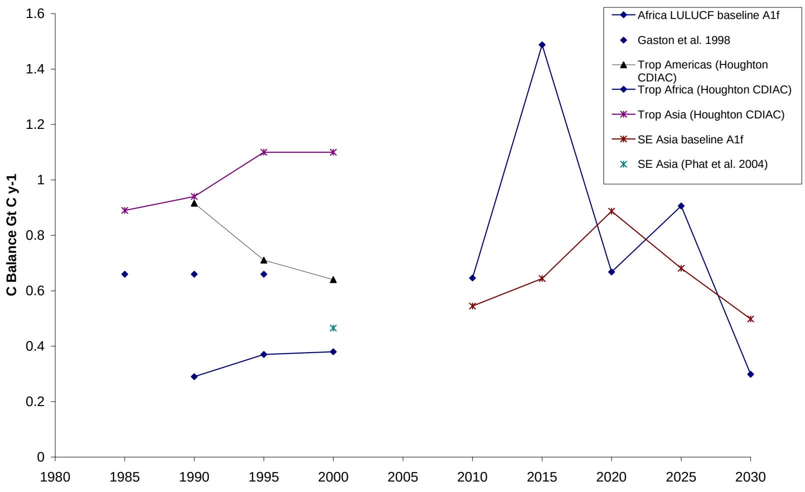

Figure 9.22. Historical LULUCF balance and some baseline projections for some tropical regions.

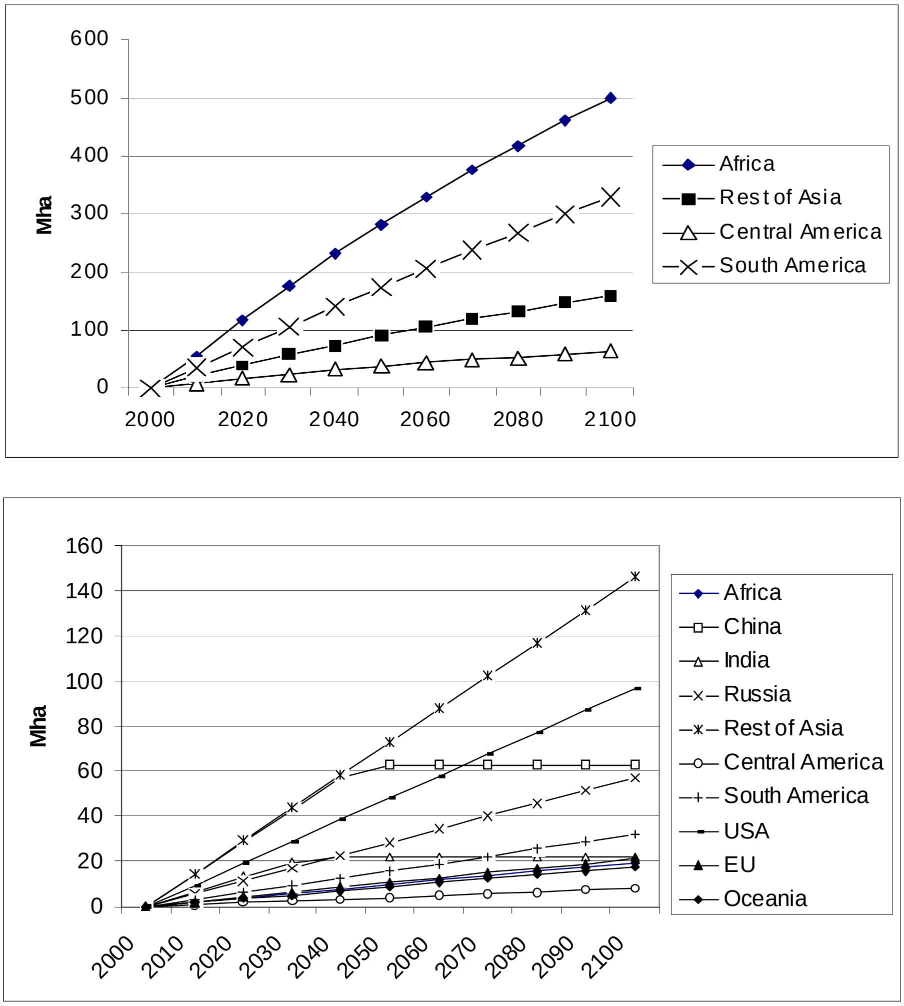

Figure 9.23. Cumulative land area deforested by region as projected by Sathaye et al. (2005) (top) and cumulative area afforested (bottom)

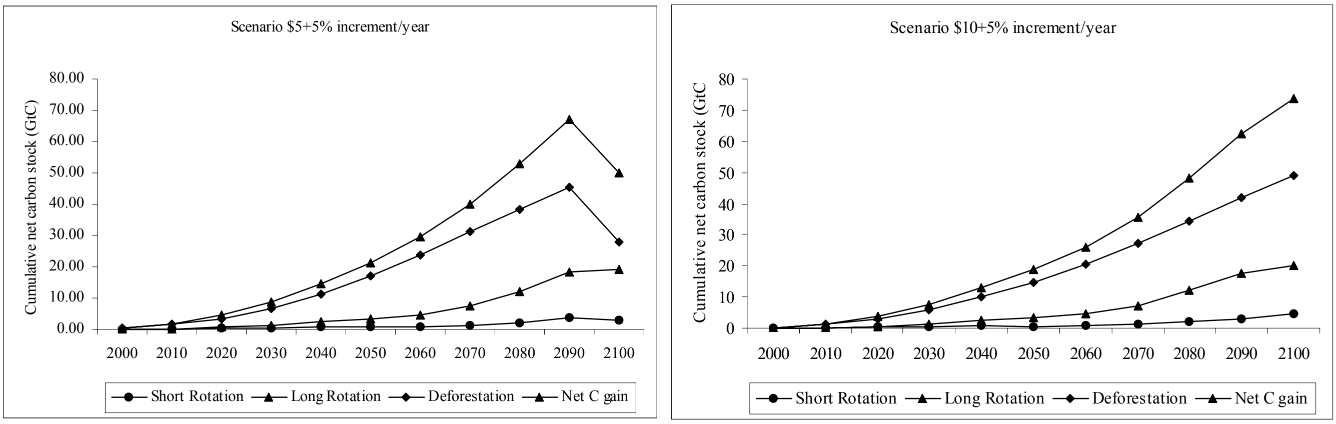

Figure 9.24. Mitigation potential under the carbon price scenarios of US$5 and US$10 in 2000 with an annual price increment of 5%.

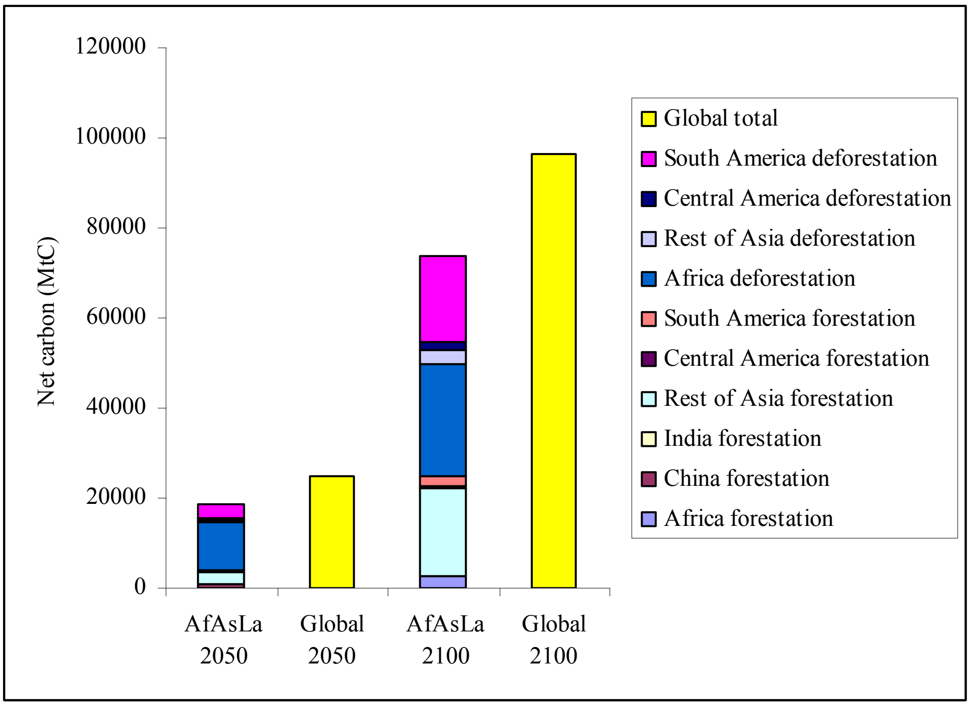

Figure 9.25. Cumulative mitigation potential (2000-2050 and 2000-2100) in different regions according to mitigation options under the Scenario US$10 + 5% price increase (Sathaye, et al, 2005). AfAsLa; Africa, Asia and Latin America.

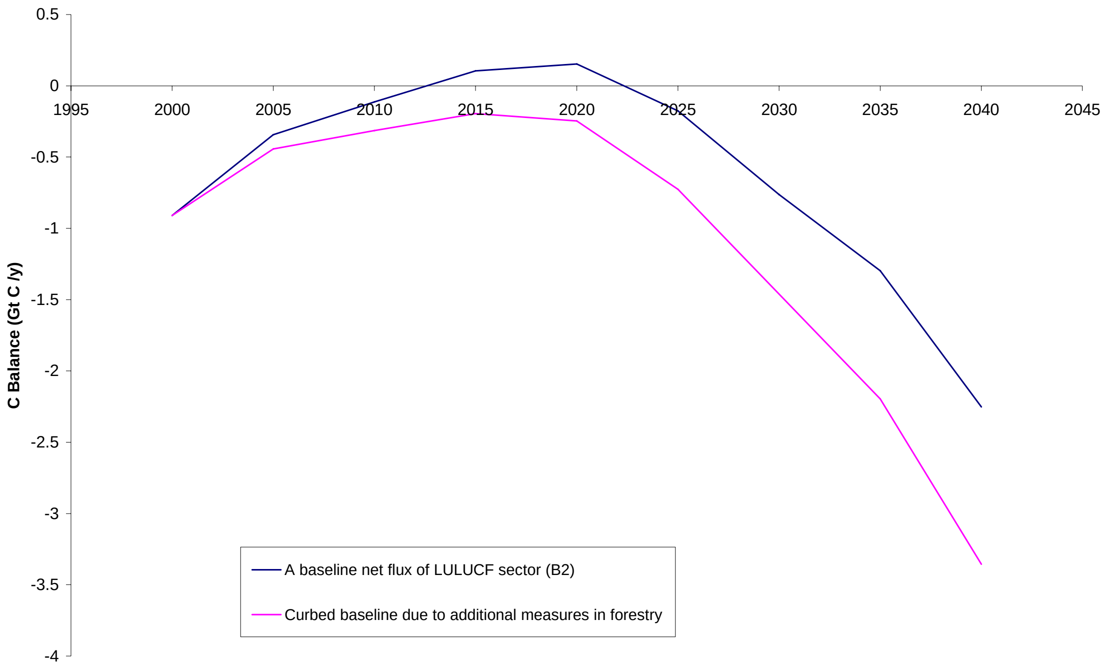

Figure 9.26. The wedge: A hypothetical projection of the baseline of the global LULUCF sector (B2) and the economic potential of curbing of this baseline by additional measures in the forestry sector alone at a carbon price of around 20US$/ton CO_2. Note that large uncertainty surrounds both the baseline, as well as the effect of the measures. Naturally, choosing another baseline would have an impact on the size of the curbing as well, however, literature does not allow such a dynamic approach.

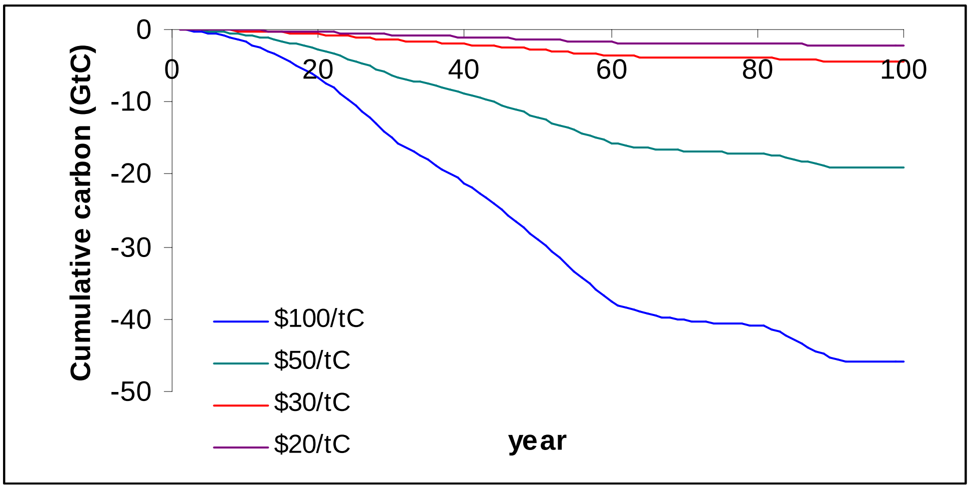

Figure 9.27. Cumulative carbon sequestration globally from afforestation and reforestation of degraded lands (Benitez et al. 2005). E.g. at a price of 50$/t C (13.6 $/t CO_2) the annual sequestration for the first 20 years amounts on average to -0.14 Gt C/y. For the first 40 years, the average e annual amounts to -0.22 Gt C /y.

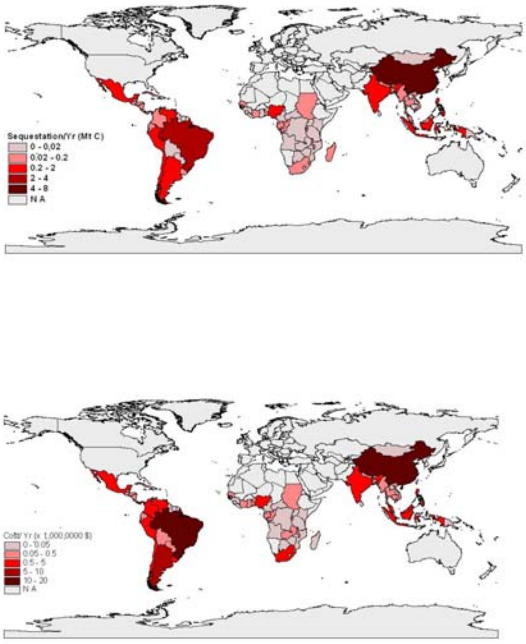

Figure 9.28. Maps of the Waterloo et al (2003) study for af/reforestation. Top: carbon sequestration rate per year and country. Bottom: costs per year and country (note: legend is x1000,000 US$/y)

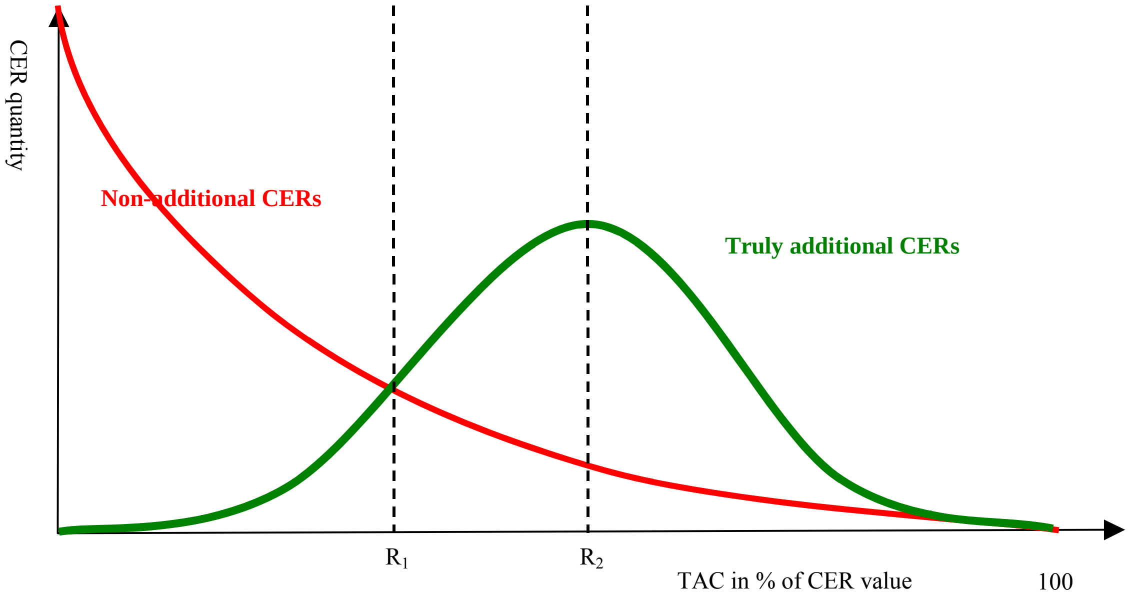

Figure 9.29. ***Trade-off between control-related Transaction costs (TAC) and Certified emission reduction (CER) output***