IEA Bioenergy

Task 25
Greenhouse Gas Balances of Bioenergy Systems

Summary of the joint Task 25 and COST E21 Workshop session

Land-Use, Land-Use Change and Forestry: the Road to COP6

28 September 2000
Joensuu, Finland

K.A. Robertson, and B. Schlamadinger (eds.)

October 2000

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Implications of different definitions and generic issues

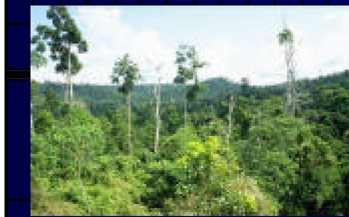
Presented by Gert-Jan Nabuurs, ALTERRA Green World Research, the Netherlands

IPCC Special Report Land Use, Land Use Change and Forestry

Chapter 2:
Implications of different definitions and generic issues

1

Issues dealt with in Chapter 2



- Core definitional issues
- Accounting issues
- Methods for monitoring and verifying
- Sustainability issues

2

Definitional issues: Forests

- Definitions for forest: 240 definitions in use, often country specific reflecting specific national circumstances.
- Three broad categories: administrative, land use, land cover

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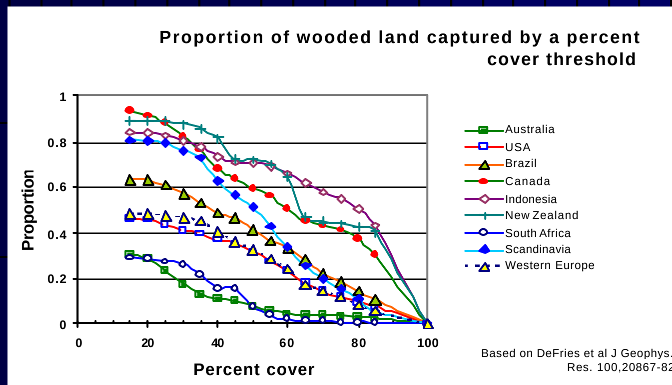
Definitional issues, defining a forest by canopy cover



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Definitional issues: delineation of current forest area

5

Definitional issues: Afforestation, Reforestation, Deforestation (ARD)

- Main issue in reforestation, if that is seen in the sense of regular forest management of harvesting and replanting, then afforestation can be regarded as establishment of forest usually agricultural land
- Deforestation always in the sense of long term or permanent removal of forest cover; issue is the canopy cover limit

6

Accounting Issues

Principles of UNFCCC reporting:

- accounting system should adhere to : transparency, consistency, comparability, completeness, accuracy, verifiability, and efficiency.

7 .

Accounting issues

- To what activities does the accounting apply ?
- Will it be based on activities or on land units?
- What carbon related to the activity will be counted?

8 .

Accounting: land versus activity

- Land based: First identify the land, then count all carbon stock changes on that land in the commitment period
- Activity based: First identify the activity, then only count the carbon stock changes directly associated with that activity

9

Accounting: other issues

- Direct human induced versus natural
- baselines & business as usual
- system boundaries (pools included)
- leakage
- timing and discounting

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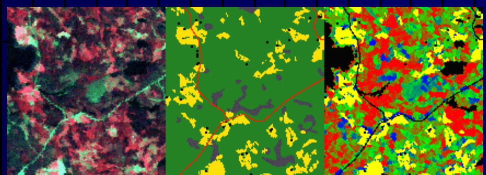
Monitoring methods

- Forest inventory
- Soil sampling and mapping
- Eddy flux
- Flask measurements
- Remote sensing
- Ecosystem modelling



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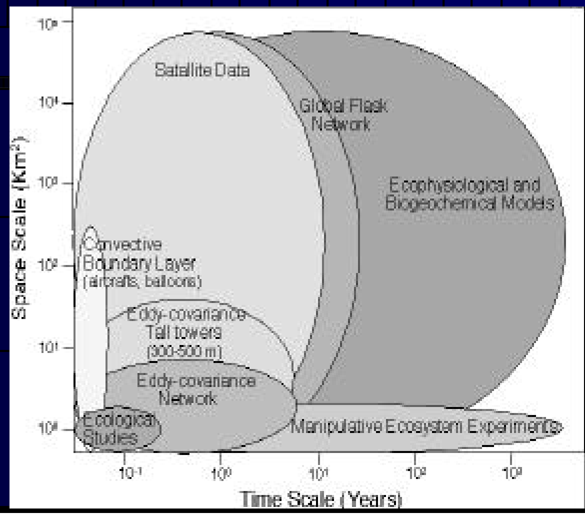
Methods: applicability



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Methods

- No one ideal method
- Depending on project size and definition to be chosen: a combination of remote sensing (area change), forest inventory/soil sampling (C stock change) will be needed
- for verification: eddy flux, modelling

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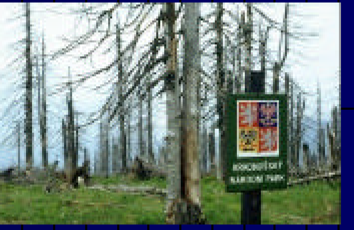
Sustainability issues

- Kyoto projects may have side impacts
- biodiversity
- employment
- water quality
- soil erosion
- wood products/forest industry



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Afforestation, reforestation and deforestation

Presented by Bernhard Schlamadinger, Joanneum Research, Austria

IPCC Special report on LULUCF: Afforestation, reforestation and deforestation

Bernhard Schlamadinger

Joensuu, 28 September 2000

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1

Contents

- Article 3.3
- Definitions
- Accounting rules
- Stand, landscape and global level analysis
- What are the key problems?

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2

Article 3.3

Net changes in GHG emissions by sources and removals by sinks

- resulting from direct human-induced land-use change and forestry activities,
- limited to afforestation, reforestation and deforestation since 1990,
- measured as verifiable changes in carbon stocks in each commitment period,

shall be used to meet the commitments of each Annex I Party.

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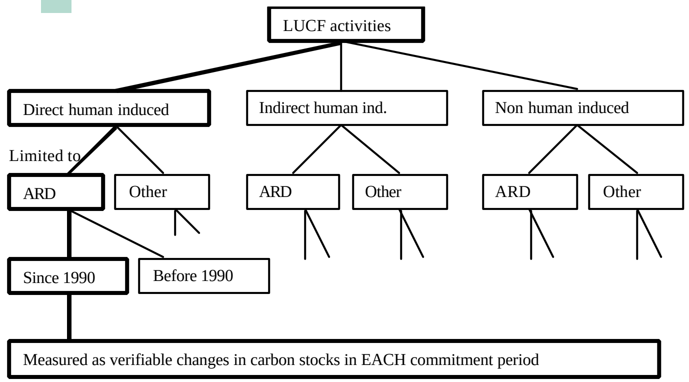
Afforestation, reforestation and defor



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Definition of „forest“

- Low threshold
- High threshold
- Biome-based threshold
- Flexible threshold

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Afforestation, reforestation and deforestation

IPCC
- Based on transitions between forest and nonforest land-uses

FAO
- Includes harvest/ regeneration cycle because regeneration is defined as reforestation

Aggradation / degradation
- Requires multiple or biome-specific thresholds

Accounting approaches
- Land-based:
  - Accounting is over full commitment period (land-based I) or starts no earlier than with the activity (land-based II)
- Activity-based:
  - As Land-based II, but only stock changes resulting from the activity are counted.

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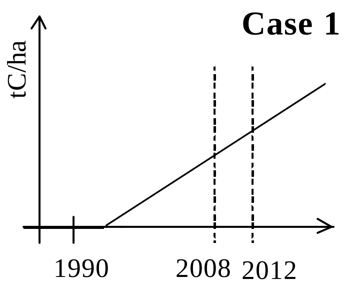
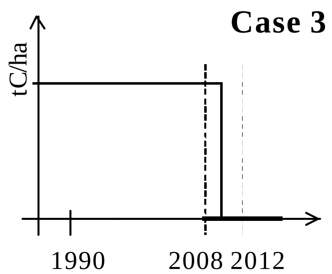
Stand level: simple afforestation and deforestation cases





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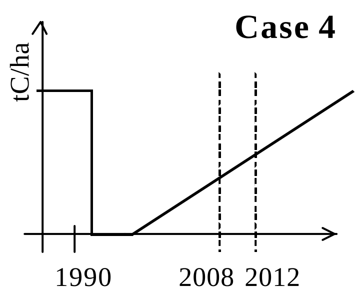
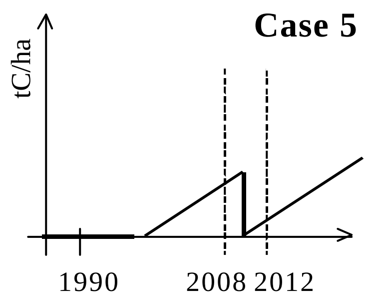
The report also discusses definitional and accounting options for the following cases:





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8 .

Forest estate managed on sustainable yield basis, FAO scenario

— Land-based approach I:
  - Could lead to net debit during first and subsequent CPs

— Land-based approach II:
  - Net credit for regrowing trees, partly offset by delayed emissions from soils and harvest residues

— Activity-based approach:
  - Net credit during first and subsequent CPs

➔ *In each case would the accounted stock change generally be different from the actual stock change in the forest estate during a commitment period.*

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IPCC Scenario

— Countries with net forest sink and a forest area increase often report carbon debits

— This is because all stands deforested are accounted, but only those stands reforested since 1990

— But deforestation is still a significant source of emissions in many countries.

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Global

Continuation of ARD at 1990 level

	Annex 1	
Mt C yr-1	AR	D
IPCC definitions	26 (7 to 46)	-90
FAO - Land-based I	-516 (-759 to -243)	-90
FAO - Land-based II	37 (-190 to 295)	-90
FAO - Activity-based	315 (87 to 573)	-90

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11.

What are the problems

— Article 3.3 was not completely understood by all during Kyoto negotiations

— The Article 3.3 anomaly could have been fixed via Article 3.7 by applying a net-net approach for all deforestation activities.

— This may have resulted in less pressure for additional activities under Article 3.4.

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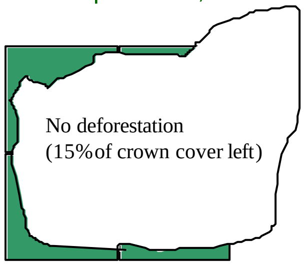
12 .

Some other issues: Assessment unit size

— A maximum assessment unit is needed:

— for example 10 ha, 8.5 ha deforested:



— Solution: smaller max assessment unit or losses greater than e.g. 1 ha must be reported as deforestation

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Simplified methodologies

— Simplified methods can reduce costs. E.g.,
- default values
- benchmarking
- statistical sampling
- modelling
- temporal and spatial averaging

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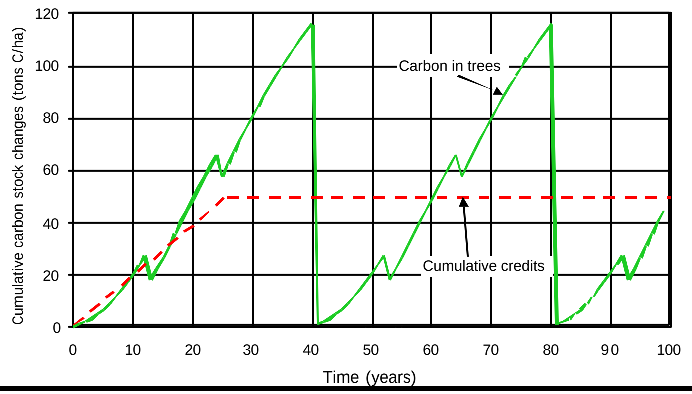
Simplified methodologies

Hypothetical Managed Forest Stand



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Some conclusions

— Consistency between reported and actual stock changes on lands undergoing ARD activities:
➔IPCC definitions

— In many regions, countries, and for total of Annex I, the IPCC scenario is likely to result in net debits.

— Pre-1990 ARD was purposefully excluded

— LULUCF rules are interrelated with commitments

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Chapter 4, Additional human-induced activities - Article 3.4

Presented by Gregg Marland, Oak Ridge National Laboratory, USA

4

Additional Human-Induced Activities—Article 3.4

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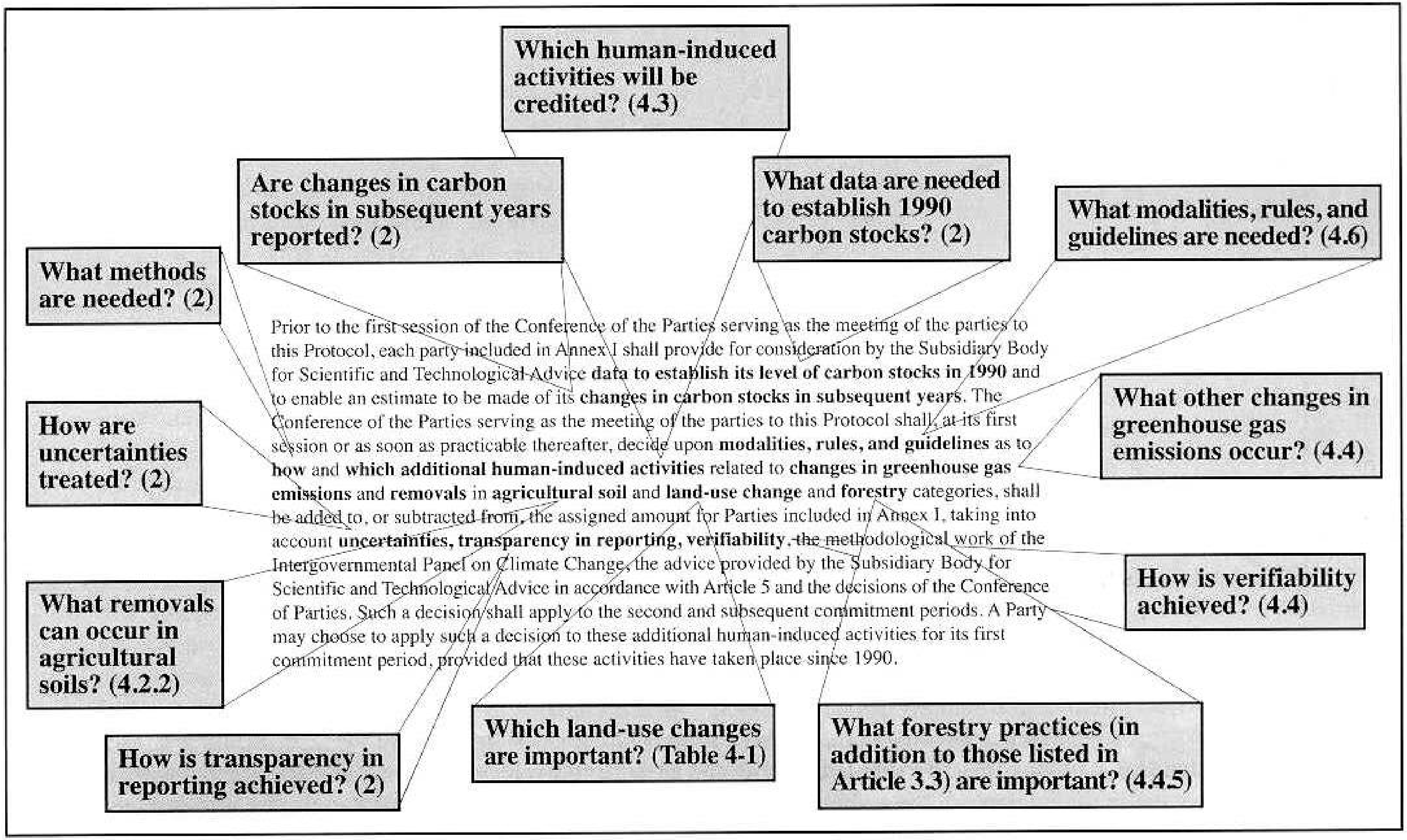


Figure 4-1: Illustration of questions that arise from text of Article 3.4 of Kyoto Protocol. Numbers in parentheses indicate sections of this Special Report where the questions are discussed.

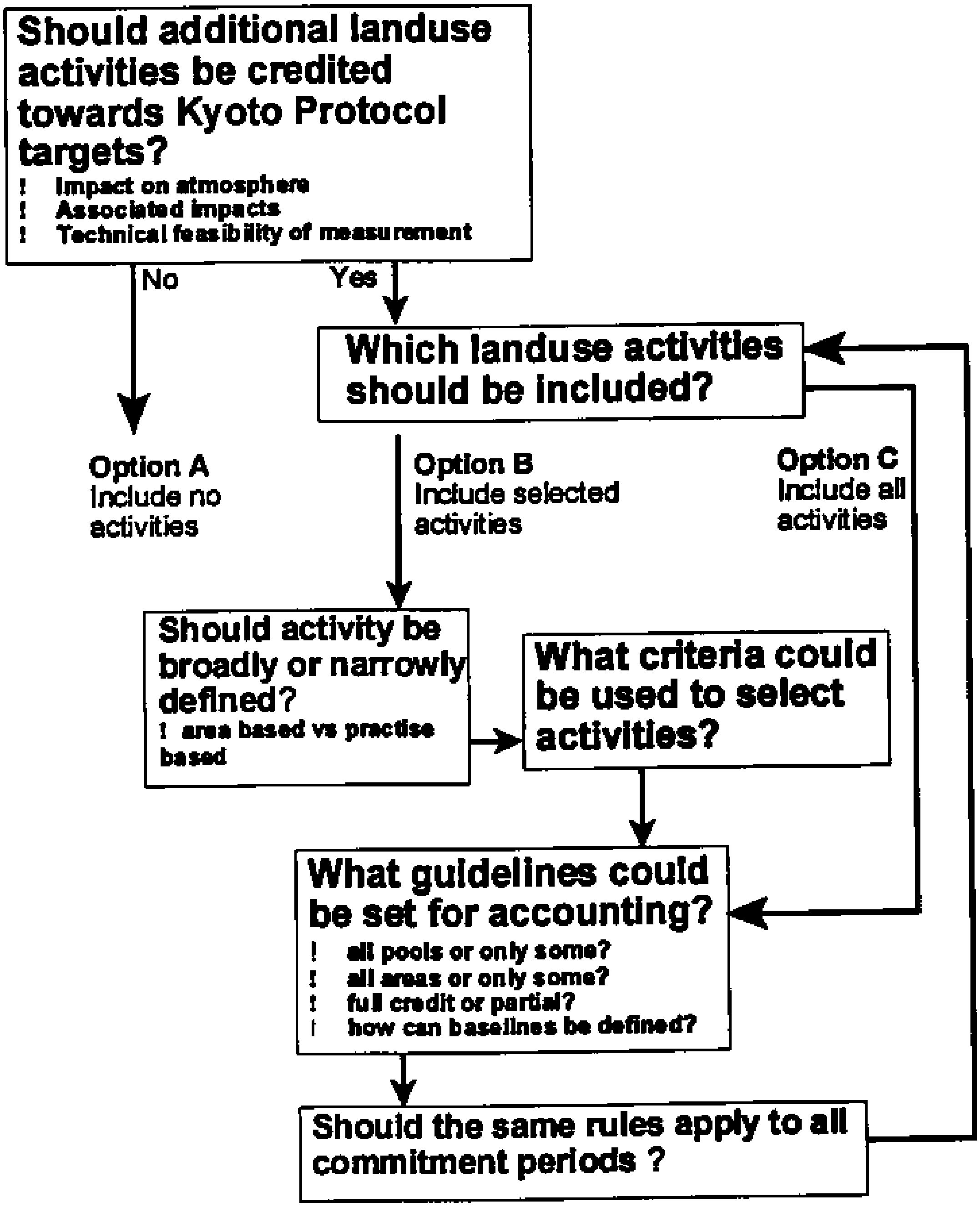


Figure 5-5. Decision Tree to assist in determining Whether and Which Additional Activities to Include under Article 3.4 of the Kyoto Protocol.

Land Cover ⇩ *from* *to* ⇨	**Cropland**	**Grassland, Desert, Savanna**	**Forest, Woodland**	**Urban, Industrial**	**Wetland, Tundra**
Cropland	Cropland management (3.4)	Cropland conversion (3.4)	Afforestation (3.3)	Development (3.4)	Wetland restoration (3.4)
Grassland	Grassland conversion (3.4)	Grassland management (3.4)	Afforestation (3.3)	Development (3.4)	Wetland restoration (3.4)
Forest	Deforestation (3.3)	Deforestation (3.3)	Forest management (3.4)	Deforestation (3.3) Land-use change w/o deforestation (3.4)	Wetland restoration (3.4)
Urban - Industrial				Urban ecosystem management (3.4) Products (3.4)	
Wetland Tundra	Drainage (3.4)	Drainage (3.4)	Drainage (3.4)	Drainage (3.4)	Peat and rice management

Figure 4-6: Suggested land-cover, land-cover/use change, and forestry matrix that illustrates how activities might be identified with different land cover areas. Numbers in parentheses indicate relevant Article in Kyoto Protocol, where apparent.

Table 4-3: *Possible repositories for additional carbon storage in terrestrial ecosystems or their products, and approximate residence times for each pool. Mean residence time is average time spent by a carbon atom in a given reservoir.*

Repository	**Fraction**	**Examples**	**Mean Residence Time**
Biomass	woody	tree boles	decades to centuries
	non-woody	crop biomass, tree leaves	months to years
Soil organic matter	litter	surface litter, crop residues	months to years
	active	partially decomposed litter; carbon in macro-aggregates	years to decades
	stable	stabilized by clay; chemically recalcitrant carbon; charcoal carbon	centuries to millennia
Products	wood	structural, furniture	decades to centuries
	paper, cloth	paper products, clothing	months to decades
	grains	food and feed grain	weeks to years
	waste	landfill contents	months to decades

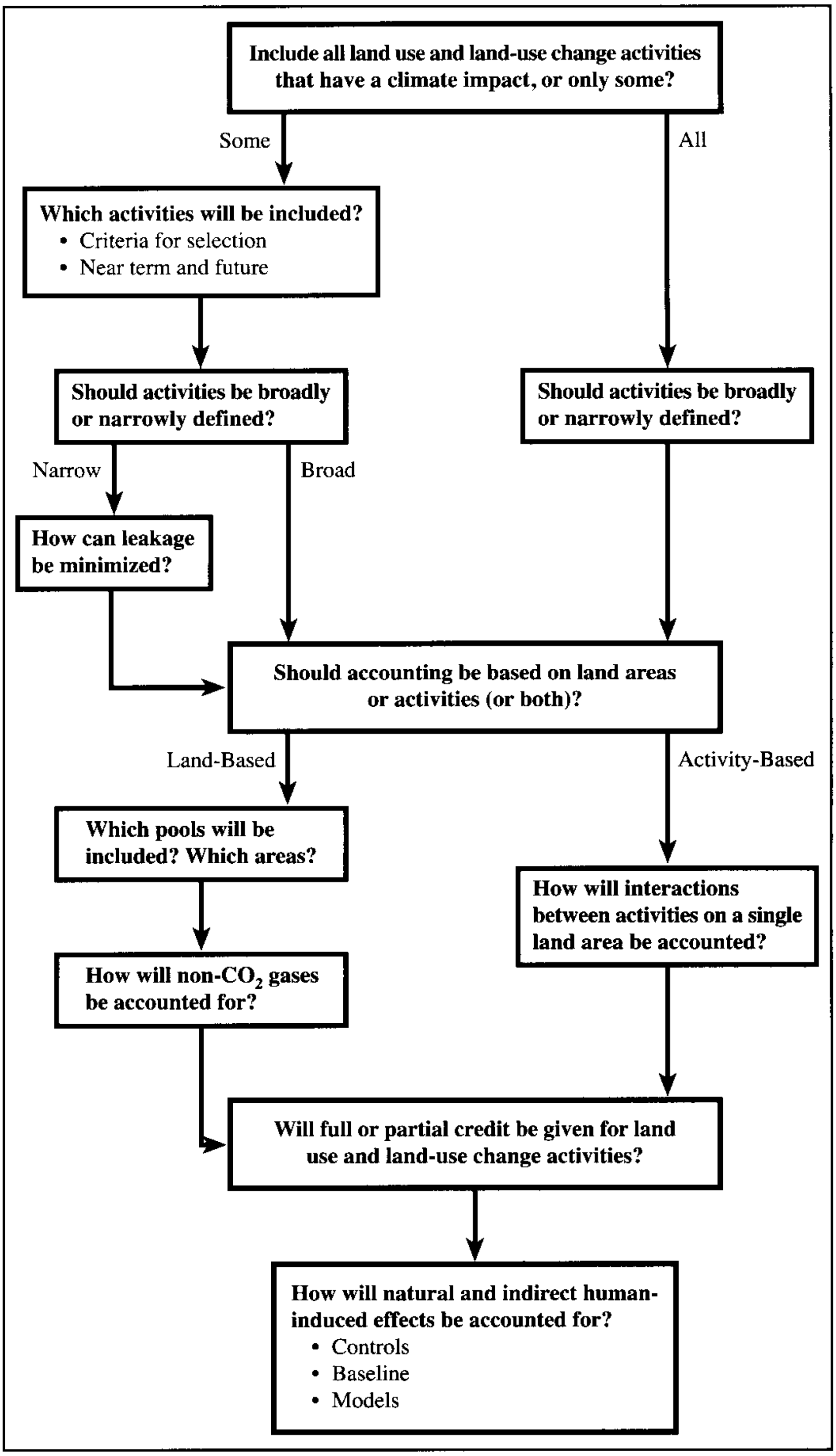


Figure 4-5: Decision tree to assist in determining which additional activities to include under Article 3.4 of Kyoto Protocol.

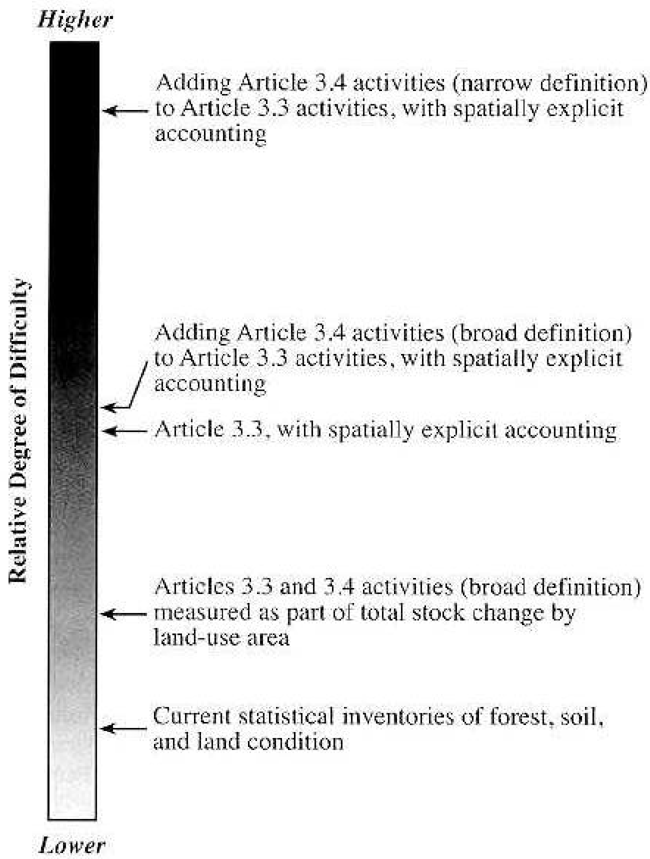


Figure 4-7: Relative costs of measuring and reporting carbon stock changes under different decisions regarding definition of "activities" and requirements for spatially explicit accounting.

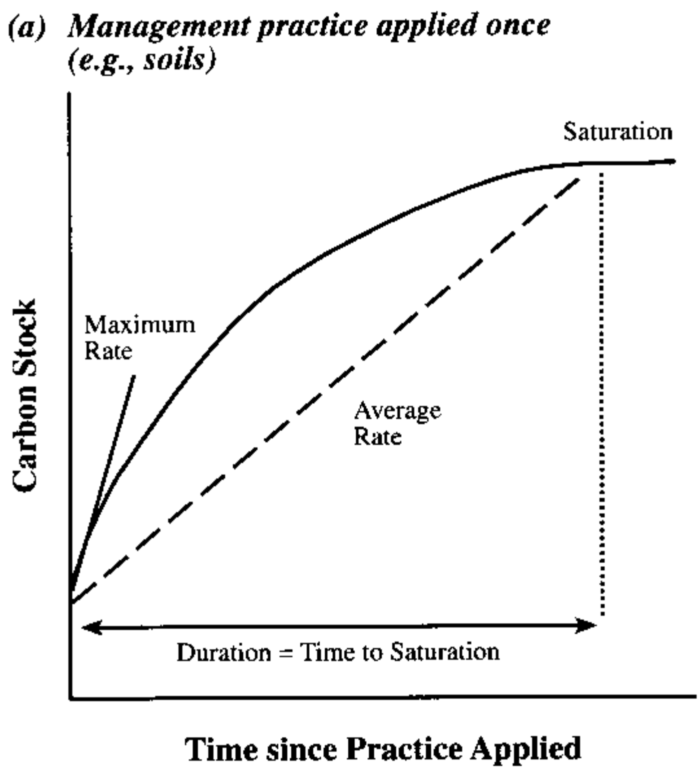


Table 4-1: Potential net carbon storage of additional activities under Article 3.4 of the Kyoto Protocol. Increases in carbon storage may occur via (a) improved management within a land use, (b) conversion of land use to one with higher carbon stocks, or (c) increased carbon storage in harvested products. For (a) and (b), rates of carbon gain will diminish with time, typically approaching zero after 20–40 years. Values shown are average rates during this period of accumulation. Estimates of potential carbon storage are approximations, based on interpretation of available data. For some estimates of potential carbon storage, the uncertainty may be as high as ±50%.

Activity (Practices)	Group[a]	Area[b] (10^6 ha)	Adoption/ Conversion (% of area) 2010	2040	Rate of Carbon Gain[b] (t C ha^{-1} yr^{-1})	Potential (Mt C yr^{-1}) 2010	2040
a) Improved management within a land use							
Cropland (reduced tillage, rotations and cover crops, fertility management, erosion control, and irrigation management)	AI	589	40	70	0.32	75	132
	NAI	700	20	50	0.36	50	126
Rice paddies[c] (irrigation, chemical and organic fertilizer, and plant residue mgmt.)	AI	4	80	100	0.10	<1	<1
	NAI	149	50	80	0.10	7	12
Agroforestry[d] (better management of trees on croplands)	AI	83	30	40	0.50	12	17
	NAI	317	20	40	0.22	14	28
Grazing land (herd, woody plant, and fire management)	AI	1297	10	20	0.53	69	137
	NAI	2104	10	20	0.80	168	337
Forest land (forest regeneration, fertilization, choice of species, reduced forest degradation)	AI	1898	10	50	0.53	101	503
	NAI	2153	10	30	0.31	69	200
Urban land (tree planting, waste management, wood product management)	AI	50	5	15	0.3	1	2
	NAI	50	5	15	0.3	1	2
b) Land-use change							
Agroforestry (conversion from unproductive cropland and grasslands)	AI	~0	~0	~0	~0	0	0
	NAI	630	20	30	3.1	391	586
Restoring severely degraded land[e] (to crop-, grass-, or forest land)	AI	12	5	15	0.25	<1	1
	NAI	265	5	10	0.25	3	7
Grassland (conversion of cropland to grassland)	AI	602	5	10	0.8	24	48
	NAI	855	2	5	0.8	14	34
Wetland restoration (conversion of drained land back to wetland)	AI	210	5	15	0.4	4	13
	NAI	20	1	10	0.4	0	1
c) Off-site carbon storage							
Forest products	AI	n/a[e]	n/a	n/a	n/a	210	210[e]
	NAI	n/a	n/a	n/a	n/a	90	90
Totals	AI					497	1063
	NAI					805	1422
	Global					*1302*	*2485*

[a] AI = Annex I countries; NAI = non-Annex I countries.
[b] Areas for cropland, grazing land, and forestland were taken from IGBP-DIS global land-cover database derived from classification of AVHRR imagery (Loveland and Belward, 1997). Each land-use/land-cover type was subdivided by the climatic regions defined in Table 4-4, using a global mean climate database (Schimel *et al.*, 1996) of temperature and precipitation, with additional calculations of potential evapotranspiration (Thornthwaite, 1948). Each climatic region was further subdivided by Annex I and non-Annex I countries. Modal rate estimates from Table 4-4 were then weighted by the relative area of each land use by climatic region for Annex I and non-Annex I countries to derive a global area-weighted mean rate for each land use.
[c] Riceland area was subtracted from cropland area.
[d] Of the 400 Mha presently in agroforestry, an estimated 300 Mha are included in the land-cover classification for cropland; the remaining 100 Mha are included in forestland cover. These areas were subtracted from the respective totals for cropland and forestland.
[e] Assumes that severely degraded land is not currently classified as cropland, forestland, or grassland.
[f] Estimates for 2040 are highly uncertain because they will be significantly affected by policy decisions; n/a = not applicable.

***Table 4-4**: Summary of potential rates of carbon gain and associated impacts for various activities.*

Activity	Ecozone[a]	Key[b] Practices	Rate[c] ($tC\,ha^{-1}yr^{-1}$)	Confi-dence[d]	Duration (yr)[e]	Other GHGs[f]	Associated Impacts
Cropland management	Boreal	Ley/perennial forage crops, organic amendments	0.3–0.6 (0.4)	M	40	$+N_2O$	Increased food production, improved soil quality
	Temperate – dry	Reduced tillage, reduced bare fallow, irrigation	0.1–0.3 (0.2)	H	30	$+N_2O$	Increased food production, improved soil quality, reduced erosion, possibly higher pesticide use
	Temperate – wet	Reduced tillage, fertilization, cover crops	0.2–0.6 (0.4)	H	25	$+N_2O$	Increased food production, improved soil quality, reduced erosion, possibly higher pesticide use
	Tropical – dry	Reduced tillage, residue retention	0.1–0.3 (0.2)	L	20	$+N_2O$	Increased food production, improved soil quality, reduced erosion, possibly higher pesticide use
	Tropical – wet	Reduced tillage, improved fallow management, fertilization	0.2–0.8 (0.5)	M	15	$+N_2O$	Increased food production, improved soil quality, reduced erosion, fertilizers often unavailable, possibly higher pesticide use
	Tropical – wet (rice)	Residue management, fertilization, drainage management	0.2–0.8 (0.5)	L	25	$++CH_4$, $+N_2O$	Increased food production
Agroforest management	Tropical	Improved management	0.5–1.8 (1.0)	M	25	$+N_2O$	
Grassland management	Temperate – dry	Grazing management, fertilization, irrigation	0–0.3 (0.1)	M	50	$\pm CH_4$, $+N_2O$	Increased energy use, salinity, higher productivity
	Temperate – wet	Grazing management, species introduction, fertilization	0.4–2.0 (1.0)	M	50	$\pm CH_4$, $++N_2O$	Higher productivity, acidification, erosion, reduced biodiversity
	Tropical – dry	Grazing management, species introduction, fire management	0.1–1.5 (0.9)	L	40	$-CH_4$, $++N_2O$	Reduced soil degradation, higher productivity, woody encroachment (reduced productivity)
	Tropical – wet	Species introduction, fertilization, grazing management	0.2–3.9 (1.2)	L	40	$-CH_4$, $++N_2O$	Increased productivity, reduced biodiversity, acidification
Forestland management	Boreal and Temperate – dry	Forest regeneration, fertilization, plant density, improved species, increased rotation length	0.1–0.8 (0.4)	L	80	$+N_2O$, $+NO_x$	Leakage (rotation length), high cost efficiency

Table 4-9: Rates of potential carbon gain under selected practices for forestland in various regions of the world.

Practice	Country/ Region	Rate of Carbon Gain ($t\ C\ ha^{-1}\ yr^{-1}$)	Time[1] (yr)	Other GHGs and Impacts	Notes[2]
Improved Natural Regeneration	India	0.55	30		a
Increased Rotation Length	Canada	0.022	80	Leakage (increased harvest elsewhere)	b
	USA	0.036	80		b
	The Netherlands	0.035	80		b
Forest Fertilization	Canada	0.03–0.19	20	$+N_2O$, $+NO_x$	b
	USA	0.08–0.48	20	Ecological changes	b
	The Netherlands	0.1–0.6	20		b
	Norway	0.44	20		c
Forest Conservation	India	0.48	30	Environmental improvements	a
Reduced Forest Degradation	Tropical/ Global	1.7–4.6	40	Environmental improvements	h
Several Practices Combined	USA	3.1	50	Ecological changes	d
	Norway	0.12–0.20	20		e
Several Practices Combined,	USA	1.2	40	Ecological changes	f
Loblolly Pine	USA	3.5	25		g
Species Change (Aspen to Red Pine)	USA	0.88	80	Ecological changes	f

[1]Time interval to which estimated rate applies. This interval may or may not be time required for ecosystem to reach new equilibrium.

[2]a. Ravindranath *et al.* (1999).
b. Nabuurs *et al.* (1999).
c. Lunnan *et al.* (1991).
d. Birdsey *et al.* (2000).
e. Hoen and Solberg (1994); assuming harvest volume is kept constant.
f. Row (1996).
g. Albaugh *et al.* (1998); refers to intensive fertilization and irrigation on an infertile drained sandy soil in North Carolina. Rate is an average estimate of 3 years of measurements starting in 8-year-old stands.
h. Based on mean biomass stock differences between non-degraded and degraded tropical forests as reported in FAO (1996). Stock differences are 182, 126, and 70 tons dry matter per hectare for tropical wet, moist, and dry zones, respectively, with carbon content as 50% of dry matter.

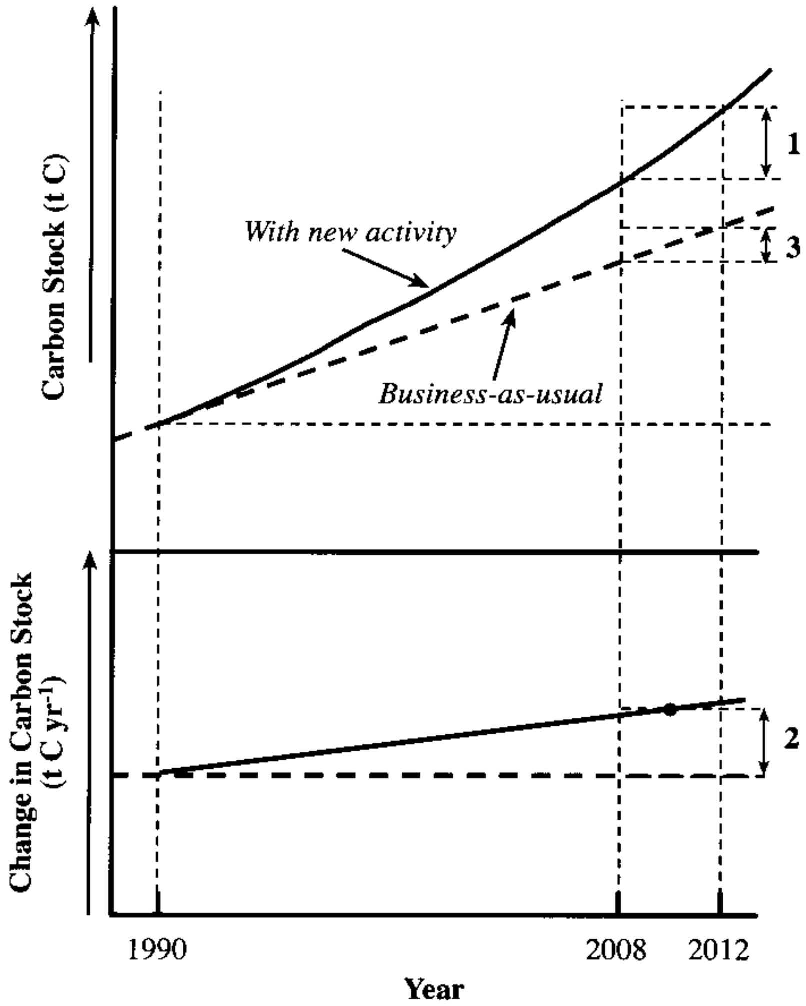


Figure 4-12: Three possibilities for evaluating change in carbon stocks attributable to Article 3.4 activities. Figure shows total carbon stock (above) and annual change (below) for an activity that causes an increase in carbon stocks and the path that would have been followed without the activity. The activity is arbitrarily assumed to have begun in 1990. The example chosen shows an increase in carbon stocks with respect to business-as-usual, but the principles are equally relevant if the activity resulted in a decrease in carbon stocks with respect to business-as-usual. If the stock in 2008 is taken as the reference (Section 4.6.3.2), the credit for the first commitment period will be as shown by arrow 1. If the change in carbon stocks in 1990 is taken as the reference (Section 4.6.3.1), the credit will be as shown by arrow 2. If the business-as-usual scenario is taken as a baseline (Section 4.6.3.3), the credit will be as shown by arrow 1 minus arrow 3.

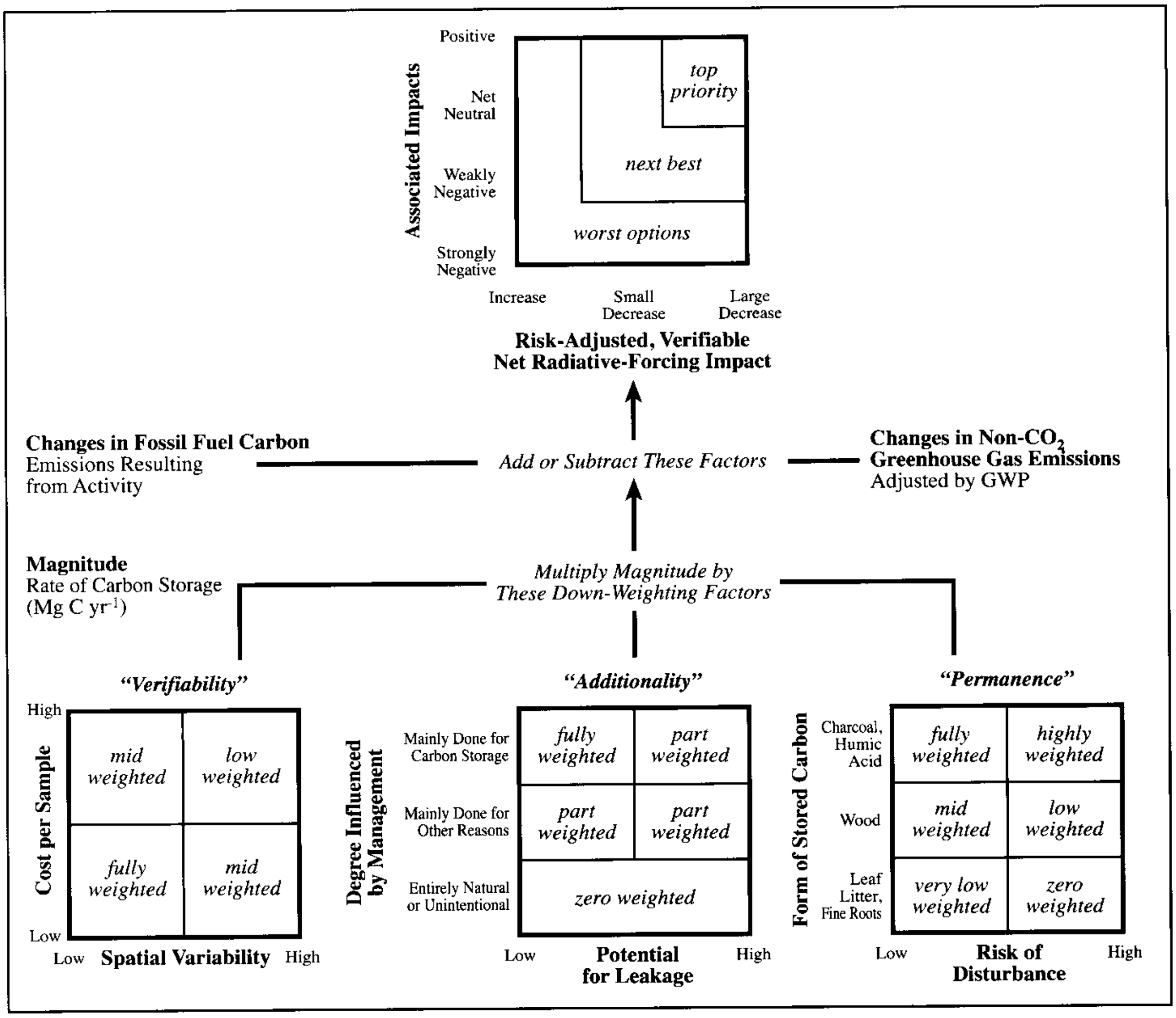


Figure 4-13: One possible framework for systematically considering a variety of factors that have a bearing on the suitability of an activity for inclusion under Article 3.4 of Kyoto Protocol. The entry point is an estimate of the magnitude of the carbon stored by the activity (lefthand side, lower middle). This estimate is then progressively down-weighted by considerations such as how easy it is to verify, the degree to which it is an intended consequence of a management action, and how likely it is to be lost through disturbance (note that this is an example list; the Parties have yet to decide which criteria will be employed). The estimate then must be adjusted for changes in non-CO_2 GHG emissions and changes in fossil fuel consumption resulting from the activity. Finally, this adjusted estimate must be weighted up in relation to the non-climate benefits or disbenefits it may cause.

Chapter 5, Project based activities

Presented by Omar Masera, University of Mexico, Mexico

IPCC Special Report on LULUCF

Project-based Activities

Omar Masera
Institute of Ecology, University of Mexico

Land-Use Land-Use Change and Forestry: The Road to COP6 Joensuu, Finland, 25- 28 June 2000

1

Road Map

- Project Experience
- Key Concerns on LULUCF projects

2

Project Experience

- **Projects -- Planned set of activities that are**
  - **confined to one or more geographic locations in the same country**
  - **belong to specified time periods and institutional frameworks, and**
  - **allow monitoring and verification of greenhouse gas (GHG) emissions or changes in carbon stock**
- **Much experience with LULUCF projects, but few specifically for GHG mitigation**

3

Project Experience

- About 3.5 million ha of area is covered in about 30 projects in 19 countries implemented during the 1990s
- For 21 projects where sufficient data are available
  - Unit mitigation 10-108 tC/ha
  - Costs range from 0.2-28 tC/ha

4 .

Project Type	Land Area (Mha)	Carbon Mitigation (Mt C)	Costs \$ t^{-1} C	Carbon Mitigation t C ha^{-1}
Emissions Avoidance via Conservation: Forest Protection (7*) Forest Management (3*)	 2.9 0.06	 40-108 5.6	 0.1– 15 0.3 – 8	 4 - 252 40 - 85
Carbon Sequestration Reforestation and Afforestation (7*) Agroforestry (2*)	 0.10 0.2	 12 10.8	 1 – 28 0.2-10	 26 - 328 56-165
Multi-Component and Community Forestry (2*)	0.53	20-49	0.2 – 15	0.2 – 165

5

Key Concerns on Climate Change Projects

- Credibility of baselines and the tests for additionality
- Controlling leakage of carbon
- Measuring and monitoring of GHG emissions and carbon stock
- Permanence (risks): Duration of carbon stocks of a LULUCF project
- Sustainability concerns about LULUCF projects

(most of these concerns apply also to energy projects)

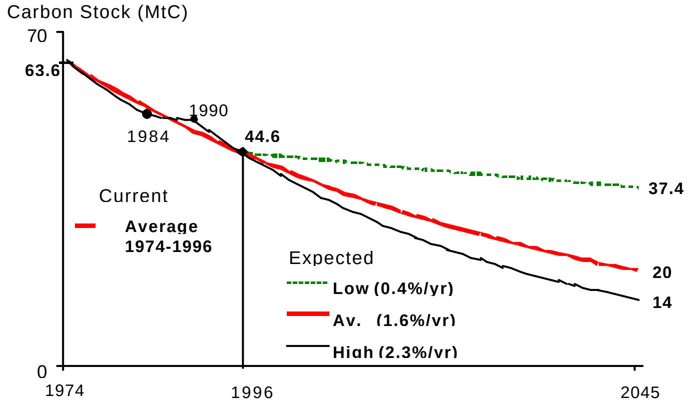
6

Baselines

- Project GHG accounting requires a without-project baseline
- No standard methods exist for setting baselines
- Approaches include:
  - project-specific vs. generic baselines (regional/benchmarks)
  - fixed or adjustable baselines
- Tests for additionality: technological, institutional, financial

7

Historical and projected carbon storage in SE Mexico
Regional Approach



8 .

Permanence

- Carbon capture in LULUCF projects is potentially reversible
  - Fundamental difference with energy
- There are methods to tackle the problem:
  - **Debit the released amount**
  - **Replace it with a new project**
  - **Claim partial credit to begin with**
  - **Create buffer zones at the start of the project**
  - **Adequately address SD concerns**

9

Permanence: Accounting Approaches

- **Project runs in perpetuity:-- Carbon stock created or emissions avoided are locked in forever**
  - **Carbon stock released for any reason may be accounted for by**
    - **Debiting the released amount**
    - **Replacing it with a new project**
    - **Claiming partial credit to begin with**
      - **Creating buffer zones at the start of the project**
- **Tonne -year approach:-- Projects should be maintained until they counteract the effect of an equivalent amount of avoided GHG emissions**

10

Leakage

- **Leakage is the displacement of emissions outside the project boundaries**
- **Originates when projects reduce access to land, food, fiber, fuel and timber resources without offering alternatives**
- **Might be difficult to estimate in some cases (exports)**
- **There is "positive leakage" → adoption of good options spread beyond project boundaries**
- **Leakage may be quantified by**
  - **Monitoring key indicators of leakage, e.g., timber or agricultural output, movement of dwellers**
  - **Standard risk coefficients developed for project type and region**

11

Alternatives to cope with Leakage

- Increase availability of displaced resources (multicomponent projects)
- Leakage may be offset through
  - Buffer zones as in the PAP project in Costa Rica
  - Reducing the estimated carbon benefits as in the Reduced Impact Logging (RIL) Project in Malaysia.

12 .

Measurability of GHG benefits

- There are several carbon pools -- live and dead biomass, soil, and wood products
  - Relative importance depends on the type of project
- Techniques and tools exist to measure carbon stocks in project areas relatively precisely depending on the carbon pool
- More experience is needed on project carbon accounting
- Qualified independent third-party verification could play an essential role in ensuring unbiased monitoring

13

Carbon Measurement Needs

Type	Trees	Roots	Dead Biomass	Soil	Products
Avoided Emissions	Red	Green	Red	Green	Yellow
Sequester Carbon	Red	Green	Yellow	Green	Red
Carbon Substitution	Red	Yellow		Red	

Red- needs to be measured; Green - recommended
Yellow- may be necessary

14

Project Risks

- There are natural and human caused risks
  - Fires, extreme weather events, and pests
  - Political and economic risks that are common to all projects
- Risk could be addressed through
  - Good practice management systems, diversification of project activities and funding sources, self-insurance reserves, involvement of local stakeholders, external auditing, and verification
  - Standard insurance services, regional carbon pools, and portfolio diversification

15

Associated Impacts and Sustainable Development

- **Site-specific experience exists on socioeconomic and environmental impacts of LULUCF projects**
- **Critical factors that affect contributions of LULUCF projects to sustainable development include:**
  - **Extent and effectiveness of local community participation**
  - **Transfer and adoption of technology**
  - **Capacity to develop and implement guidelines and procedures**
- **Above factors can alleviate concerns about project permanence**

16

Chapter 6, Implications of the Kyoto Protocol for the reporting guidelines

Presented by Justin Ford-Robertson, Forest Research, New-Zealand

Implications of the Kyoto Protocol for the Reporting Guidelines

Justin Ford-Robertson
(on behalf of Chapter 6 authors)

1

Revised 1996 IPCC Guidelines

- Guidelines written for reporting national GHG Inventories under UNFCCC
  - Chapter 5 on LUCF
- Annual emissions reporting
- 3 components:
  - Reference manual
  - Workbook
  - Reporting Instructions

2

Reference Manual

- Encourages comprehensive accounting of all pools affected by anthropogenic activities
- Covers all pools (main LUCF activities)
- Does not differentiate between *direct* and *indirect human induced*
- Feasible to estimate changes in AGB and BGB, soil, litter and wood products

3

Workbook

- Accounting methods and default data for a sub-set of pools
  - AGB, 0.3m of soil
- Does not give methods for other pools
  - BGB, wood products, deep soil C
- Assumes stock of harvested wood products is not increasing
- Soil C pool and other pools are not linked

4 .

Reporting Instructions

- Definitions of activities
- Tables to report emissions and removals of GHGs

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Guidelines for National and Project accounting

- Guidelines also for reporting National Inventories under Article 5.2 of Protocol
- Adequacy for purpose eg:
  - definitions
  - data
  - reporting tables

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Afforestation, Reforestation, Deforestation

- Definitions of ARD are in the Guidelines
- Guidelines may need modification if:
  - other definitions are adopted,
  - additional C pools (new workbook tables)
  - reporting of ARD for AGB and BGB needs to be made geographically explicit

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ARD Issues?

- Guidelines do not apply *"since 1990"* clause
  - assess changes from annual data
- Guidelines do not ensure consistency in accounting due to flexibility in definitions
  - acceptability of default data?
  - acceptability of 'levels' of complexity?

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Additional Activities

- Guidelines could capture most additional activities
- Some pools not specified by workbook
- Associating changes in pools with activities
- Baselines and additionality may be added

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9

PROJECTS

- Guidelines not intended for projects
- Similar data and reporting needs
- Additional features may include:
  - project location and boundaries
  - leakage
  - baselines/additionality
  - socio-economic impacts
  - biodiversity impacts
  - double counting

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10