



**Forest Ecosystem Services:
Conceptualisation, measurement,
valuation and payments**

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ATREE

Bangalore

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A little bit about ATREE...

www.atree.res.in

Autonomous non-profit applied research institute,
recognized by MAHE for PhD in Conservation
Science & Sustainability Studies

Mandate

- Research, teaching, & outreach on conservation and sustainable development

Tenets

- Interdisciplinarity
 - Academic rigour
- Speaking to and learning from policy and practitioner audiences

Research Centres & Themes

Centre for Biodiversity Conservation

- Monitoring & Managing Biodiversity
 - Landscapes & Livelihoods
 - Ecosystem Services

Centre for Environment & Development

- Forests and Governance
- Water, Land & Society
- Climate Change Mitigation

Outline

- Forest Ecosystem Services: the concept, its precursors, contributions, and confusions
- Ecological measurement
- Economic valuation
- PES

What is forest?

It comes in many forms, and is ultimately a social construct



























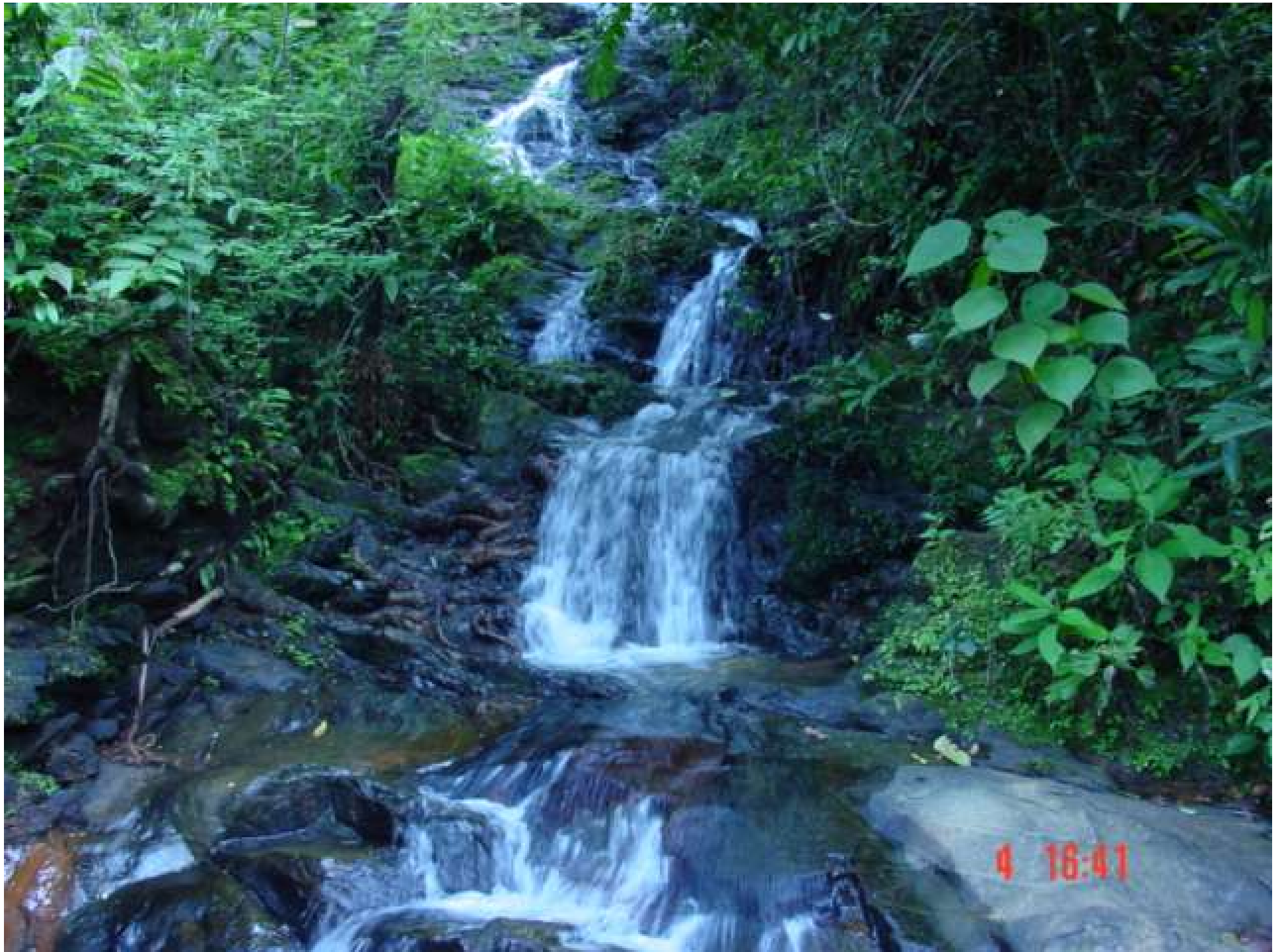
Summary

- 'Forest' refers (loosely) to a tree-dominated vegetation type
- But 'tree-dominated vegetation' covers a huge range
- Nothing sacrosanct about where one draws the line
- In that sense, 'forest' is a convention, and how we define it depends upon our interests

So what are our interests?

What are forests good
for?



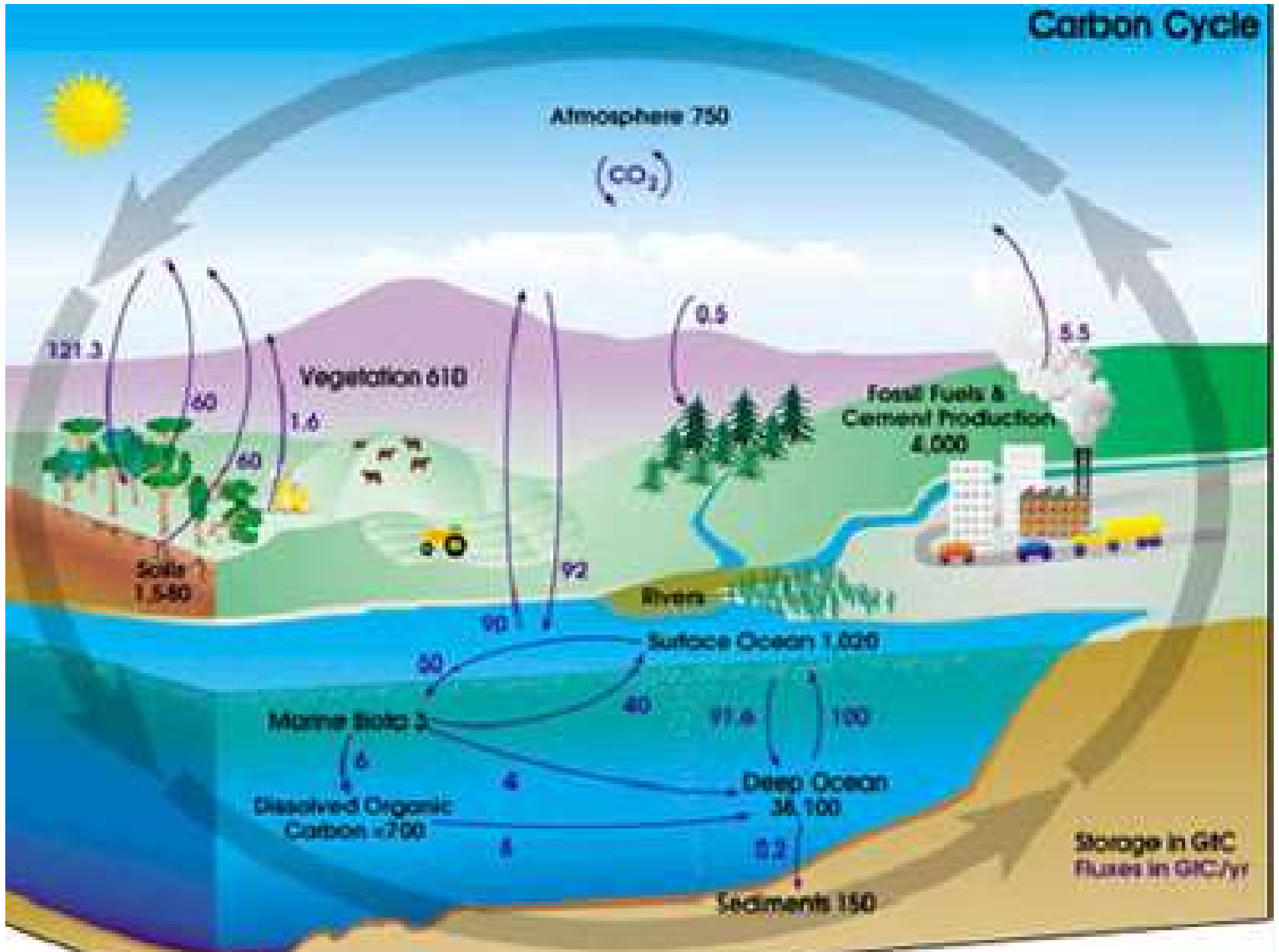




And

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Carbon Cycle

















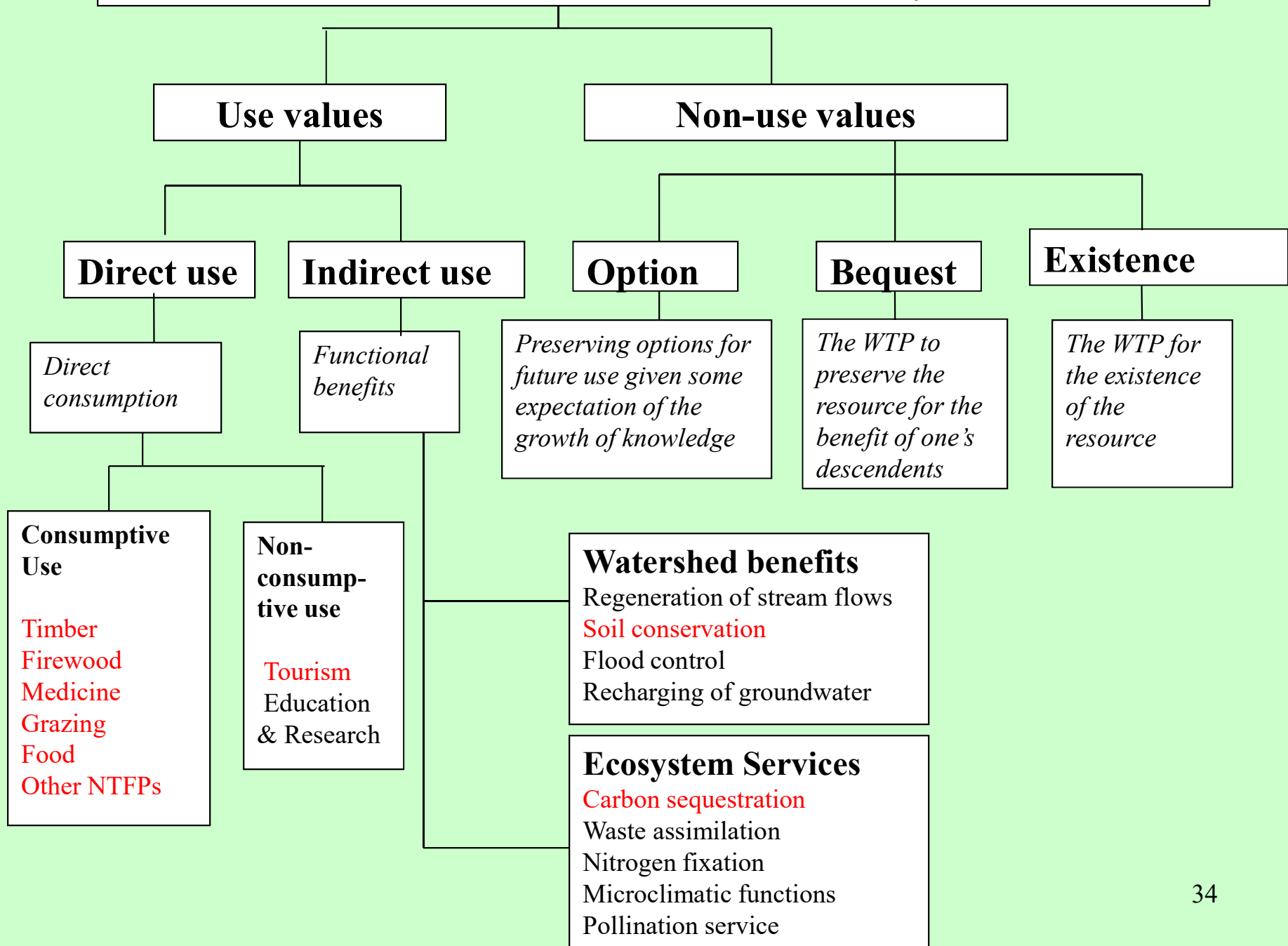


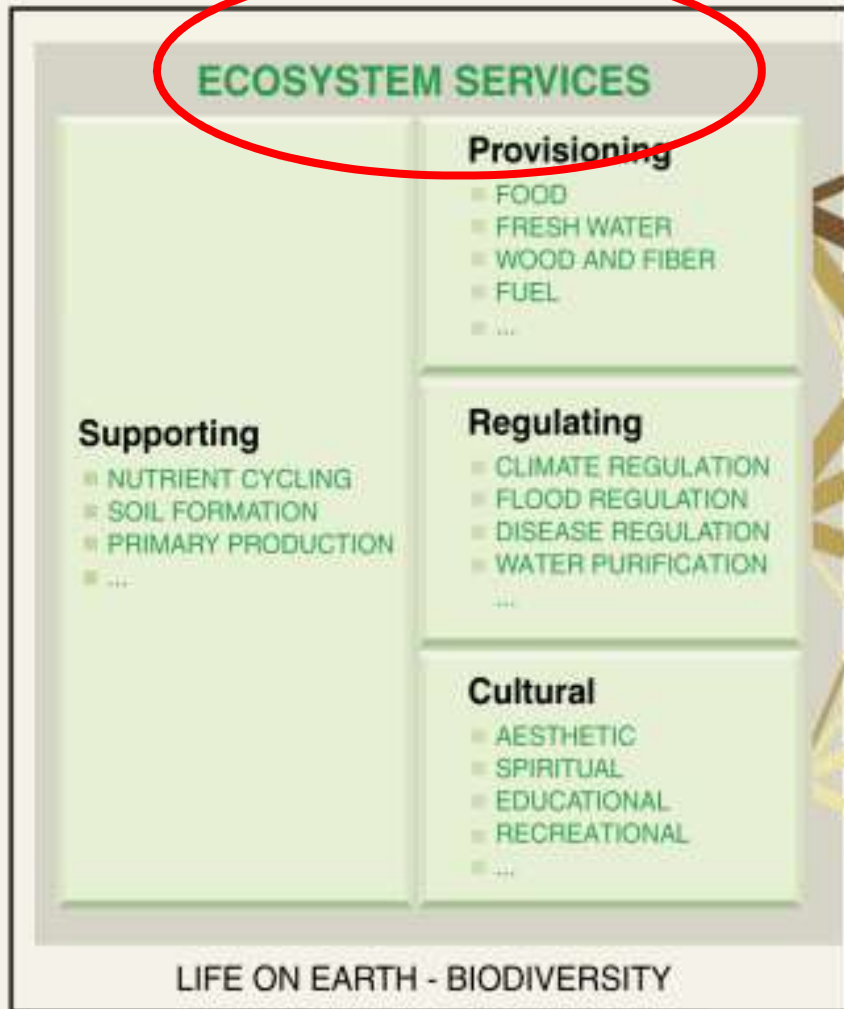
> This photo courtesy Frontline magazine

Many terms used

- Forest-based benefits

Total Economic Value of a Forest Ecosystem





CONSTITUENTS OF WELL-BEING



Source: Millennium Ecosystem Assessment

ARROW'S COLOR
Potential for mediation by socioeconomic factors

Low

Medium

High

ARROW'S WIDTH
Intensity of linkages between ecosystem services and human well-being

Weak

Medium

Strong

**MILLENNIUM
ECOSYSTEM
ASSESSMENT 2005**

Summary

- What we called forest ecosystem benefits is now being called forest ecosystem 'services'
 - Provisioning services = products = direct use values
 - Regulating services = services/indirect use values
 - Cultural services = Aesthetic or spiritual benefits = existence value
- Newer language: NCPs!
- What is really new then?

New data: Regulating Services

Regulating service	Nature of service hypothesised	Important recent empirical studies/reviews	Qualifying remarks
Pollination	Forest islands provide habitat for insects that pollinate neighbouring agricultural crops	Klein et al. 2003; De Marco and Coelho 2004; Ricketts 2004; Ricketts et al. 2004; Olschewski et al. 2006; Ricketts et al. 2008: review article; Otieno et al. 2011	<ol style="list-style-type: none"> 1. Estimating non-marginal impacts, i.e., complete disappearance of pollinators (e.g., Losey and Vaughan 2006) is unreliable 2. Risk of global pollination crisis might be exaggerated (Ghazoul 2005; but see also Kremen et al. 2008)
Pest control	Natural pest control is enhanced in complex patchy landscapes with a significant non-crop habitat	Bianchi et al. 2006: meta-analysis; Cleveland et al. 2006: insect-eating bats	<ol style="list-style-type: none"> 1. Non-crop habitat may also harbour crop pests (Zhang et al. 2007; Otieno et al. 2011) 2. Pest control service from surrounding vegetation is not the same as benefits of on-farm integrated pest management (Macfadyen et al. 2009)
Storm protection	Mangrove/coastal vegetation provides protection against cyclonic storms and tsunamis	Das 2009; Bayas et al. 2011	<ol style="list-style-type: none"> 1. Nature of vegetation may have less impact than its position and coverage (Bayas et al. 2011) 2. Vegetation may protect against storm surges, not against inundation, which requires different approaches (Feagin et al. 2010)
Nursery function	Coastal mangroves, coral reefs, and sea grass may act as nurseries for fish, thereby enhancing fish catch in the seas	Wilkinson et al. 1999; McClanahan et al. 2002; Heck et al. 2003; Manson et al. 2005	<ol style="list-style-type: none"> 1. Nursery function is much more ambiguous than earlier economic valuations assumed 2. Declines in fish catch may be more due to overharvest than coral reef loss

Source: Lele et al 2013

What is confusing?

- Supporting services



What is missing?

1. Dis-services
2. Ecological trade-offs
3. Social tradeoffs



Forests are also bad for something

1. Forest Dis-services

Dis-service	Study area	Impact (economic losses or number of people affected)	Time unit	Reference
Crop damage due to wildlife	Four southern states of India	INR 6.5 million	1981–1983	Sukumar 1989
	Sariska Tiger Reserve, Rajasthan	INR 3,300/household (average)	Annually, between 1996–1997	Sekhar 1998
Loss of livestock	Kibber Wildlife Sanctuary, Himachal Pradesh	18% of the total livestock of families around sanctuary; economic loss of 12% of income	1995	Mishra 1997
Loss of lives to elephant attacks	South India	30–50 persons	Annually	Sukumar 1991
	West Bengal, Uttar Pradesh, and Assam	115–160 persons	Annually	Sukumar 1991
	India	300 persons	Annually	Bist 2002
Loss of lives to tiger attacks	Sundarbans National Park, West Bengal	57 persons (average)	Annually, between 1975–1984	Khan 1987; Sanyal 1987
Loss of lives to snake bites	Asia	100,000 persons	Annually	Chippaux 1998; Shariff et al. 2004; Kasturiratna et al. 2008;
	India	15,000–50,000 persons	Annually	Meenatchisundaram & Michael 2009

Not to mention: mosquitoes or **viruses**!!

Source: Lele et al 2013

2. Trade-offs

- Biodiversity conservation vs timber production
- Timber harvest vs carbon sequestration
- Firewood collection vs carbon sequestration
- Grazing vs soil conservation

Ecological Trade-offs

FOREST PRODUCT, SERVICE or BENEFIT

Timber	Fuel-wood	Leaf manure	Fodder	"Minor" Produce	Hydro-logical regulation	Soil Conser-vation	Bio-diversity	Carbon seques-tered
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LAND USE TYPE

Ecological Trade-offs

		FOREST PRODUCT, SERVICE or BENEFIT								
		Timber	Fuel-wood	Leaf manure	Fodder	"Minor" Produce	Hydro-logical regulation	Soil Conser-vation	Bio-diversity	Carbon seques-tered
LAND USE TYPE	"Forest"									
	"Non-forest"									

Ecological Trade-offs

			FOREST PRODUCT, SERVICE or BENEFIT								
			Timber	Fuel-wood	Leaf manure	Fodder	"Minor" Produce	Hydro-logical regulation	Soil Conser-vation	Bio-diversity	Carbon seques-tered
LAND USE TYPE	"Forest"	Dense "natural" forest									
		Dense lopped forest									
		Open tree savanna									
		Pure grassland									
		Timber plantation									
	"Non-forest"	Coffee plantation									
		Terraced paddy									
		Slope cultivation									
		Barren land									

Ecological Trade-offs

			FOREST PRODUCT, SERVICE or BENEFIT							
			Timber	Fuel-wood	Leaf manure	Fodder	"Minor" Produce	Hydro-logical regulation	Soil Conser-vation	Bio-diversity
LAND USE TYPE	"Forest"	Dense "natural" forest	0	++	++	0	+++	+++	+++	+++
		Dense lopped forest								
		Open tree savanna								
		Pure grassland								
		Timber plantation								
	"Non-forest"	Coffee plantation								
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LAND USE TYPE	"Forest"	Dense "natural" forest	0	++	++	0	+++	+++	+++	+++	+++
		Dense lopped forest	+	+++	+++	+	++	++?	++	++	++
		Open tree savanna	0	++	++	++	+	+?	++	+	+
		Pure grassland	0	0	0	+++	0	+++?	++	+	+
		Timber plantation	+++	+	+	0	0	+/-?	+	+	+++
	"Non-forest"	Coffee plantation									
		Terraced paddy									
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			FOREST PRODUCT, SERVICE or BENEFIT								
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LAND USE TYPE	"Forest"	Dense "natural" forest	0	++	++	0	+++	+++	+++	+++	+++
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		Open tree savanna	0	++	++	++	+	+?	++	+	+
		Pure grassland	0	0	0	+++	0	+++?	++	+	+
		Timber plantation	+++	+	+	0	0	+/-?	+	+	+++
	"Non-forest"	Coffee plantation	+	+	+	0	0	++?	++?	+	++
		Terraced paddy	0	0	0	++	0	+?	+?	?	0
		Slope cultivation	0	0	0	+	0	0?	-	?	0
Barren land		0	0	0	0	0	-	-	0	0	

One could add columns for dis-services and other benefits (food)

Key Questions that follow

- What are the units for +++ and ---? Can they be added/subtracted?
 - Physical units: only commensurable within columns
 - \$\$ units: makes possible comparisons across columns<< the holy grail of economists
- Who decides? 3 different approaches
 - Valuation ('eminent domain' of state)
 - Payments ('market knows best')
 - Negotiation? ('deliberative governance')

Things to watch out for...

- Bad ecology
 - Tradeoffs forgotten=> double counting
 - **Oxygen value of trees and forests**
- Bad valuation
 - Gross value, net value, inflated value
 - Marginal value vs average value
 - Valuation in a vacuum
 - **Aggregation**
- Bad markets
 - All possible market failures: income distribution, information, property rights

SUMMARY

- “Ecosystem services” not a very new concept, can be confusing
 - Has highlighted regulatory services
 - Tends to ignore dis-services & trade-offs
- Ecology = understanding of the trade-offs /synergies in biophysical units
- Valuation = indicating the aggregate relative importance in Rupee units
- PES = allowing markets to express preferences
- Limitations: ecological errors, fake commensurability, market failures, etc

NOTES FOR THE FUTURE

- Show examples of good valuation, show examples of good PES, then talk about limitations

In short:

- Conventional valuation: fully utilitarian
- In practice, income change is equated with utility change
- Income-sensitive weights highlight the inter-group variations, while retaining intra-group aggregation across different services/benefits
- May provide valuable insights about 'net benefit' to different groups, but must resist temptation to use as 'the' tool

Part 3: The Payments approach and its critique

- Core theoretical assumptions:
 - Strong & well-understood linkages
 - Well-defined property rights (including the right to not provide the service)
 - Clearly defined recipients
 - Fairness of property rights assignments is not on the table
 - Low transaction costs
- All of these assumptions are violated!
- Politically: 'upstream poor' are being used as the justification