

Economic Valuation of Forest Ecosystem Services

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Outlines

- Definition
- Classification of services
- Conceptual framework and valuation methods
- Case studies
- Lessons learnt and Way forward

Usefulness of valuation

- estimate the relative importance of various ecosystems
- justify or evaluate particular conservation decisions in particular places,
- identify how the benefits of a particular conservation decision are distributed, and
- identify potential sources of sustainable financing.

Ecosystem services definitions

...the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life (Daily 1997).

...the benefits human populations derive, directly or indirectly, from ecosystem functions (Costanza et al 1997).

...the benefits people obtain from ecosystems (MEA 2005).

...ecological components directly consumed or enjoyed to produce human well-being (Boyd and Banzhaf 2007)

Forest Ecosystem Services

PROVISIONING SERVICES

(products obtained from ecosystem)

- Food
- Timber
- Woodfuel
- Fiber

...

CULTURAL SERVICES

(Non-material benefits obtained from ecosystems)

- Spiritual and religious
- Recreation and tourism
- Aesthetic
- Educational
- Cultural heritage

...

REGULATING SERVICES

(Benefits obtained from regulation of ecosystem processes)

- Climate regulation
- Water purification
- Disease regulation
- Water regulation
- Pollination

...

SUPPORTING SERVICES

(Services necessary for the production of all other ecosystem services)

- Soil formation
- Nutrient cycling
- Primary production

Conceptual Framework

Change in conservation policy/parameters



Change in forest cover/condition



Changes in the flow of in forest ecosystem services

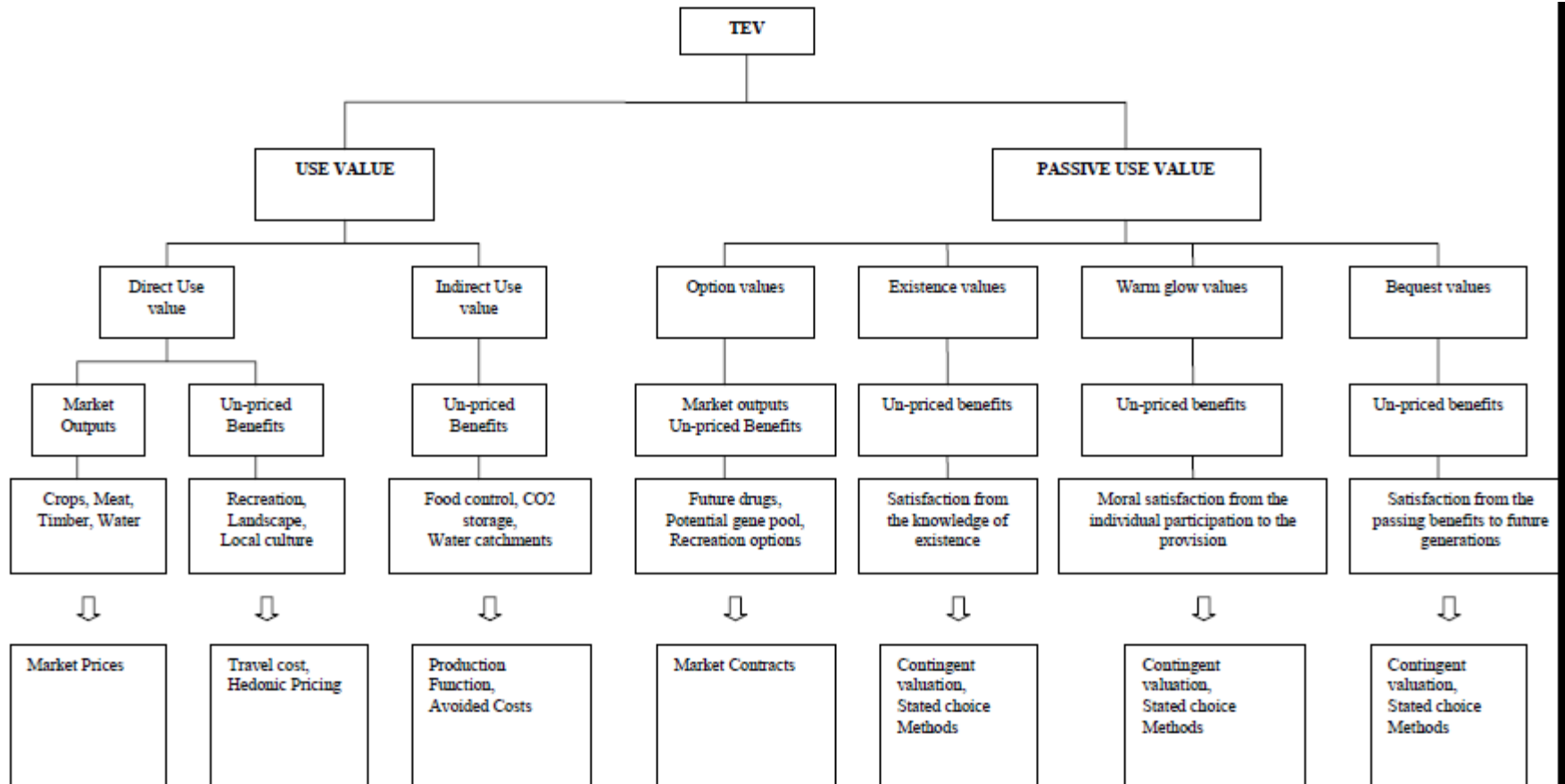


Change in economic production



Money-metric of change in utility

Total economic value of ecosystem services and potential methods



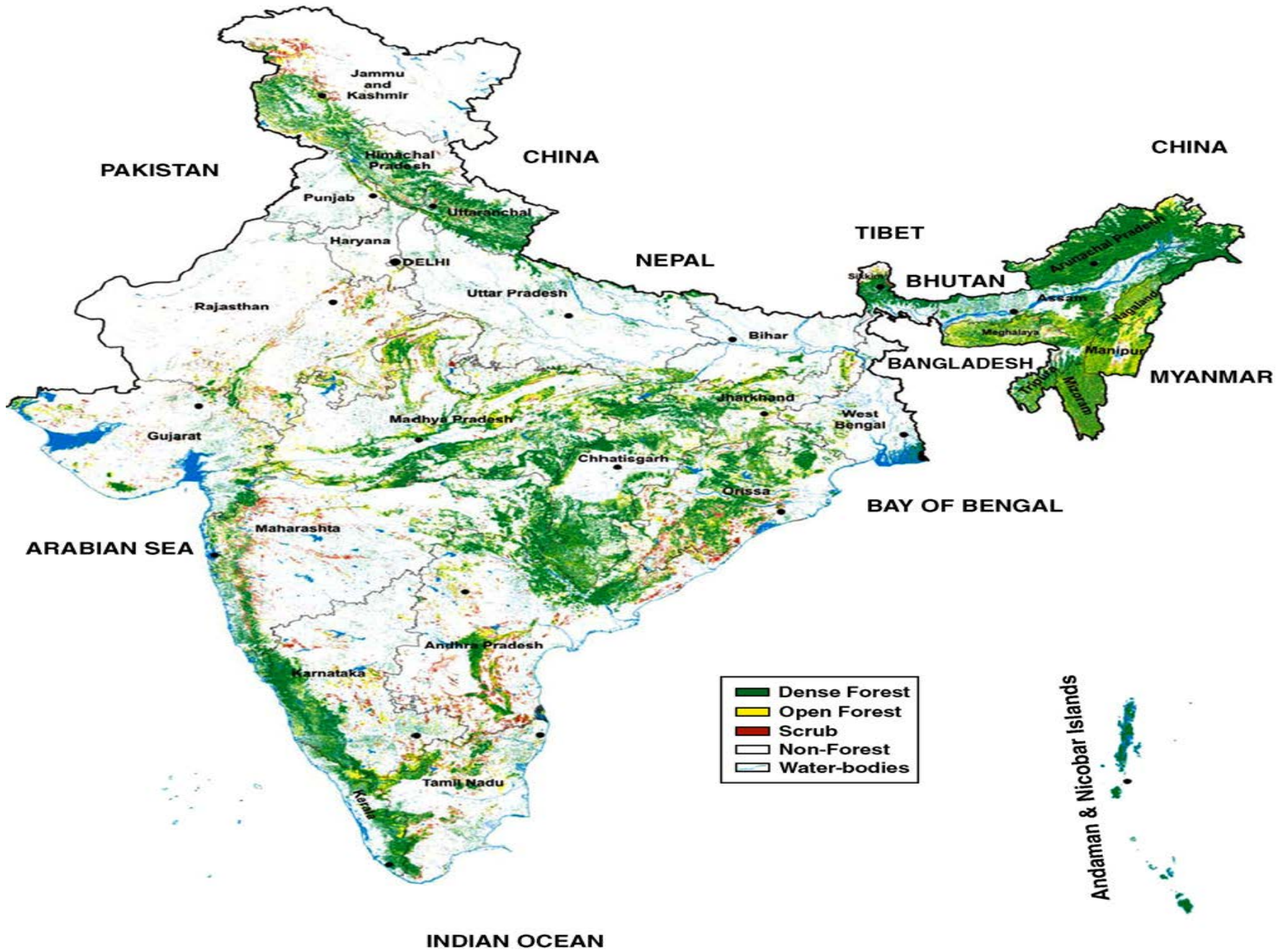
Data Requirement

- Ecological data on the specific functions, processes, and outcomes (e.g., acres of protected forests)
- production data to link the index of ecosystem flows to economic activities (e.g., the functioning of a reservoir for electricity and crop irrigation conditional on sedimentation rates);
- consumer preference (or producer technology in the case of intermediate outputs) and price data to express productivity changes in monetary terms.

Case study I- Gundimeda et al 2007

- Valuation of forest ecosystem services to adjust Indian national income accounts
- Accounts are adjusted at the state level
- Prepare physical forest accounts for area and volume
- Considers provisioning and regulating services
- Provisioning services includes: timber, NTFP, fodder and fuel-wood
- Regulating services are confined to carbon storage only
- To measure the physical change in the quantum of timber, fuel-wood and carbon storage use change in forest volume
- For NTFP and fodder use forest area accounts
- Use net price method to value all the services
- For fodder and NTFP net present values are calculated per hectare

FOREST COVER OF INDIA

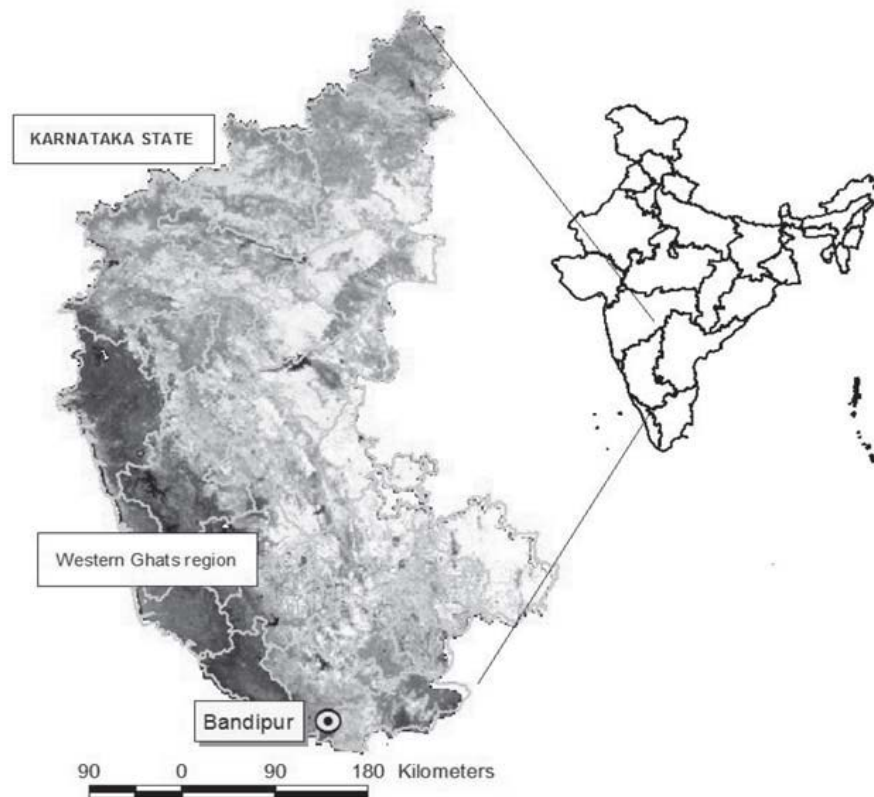


Volume and value accounts for 2001-2003

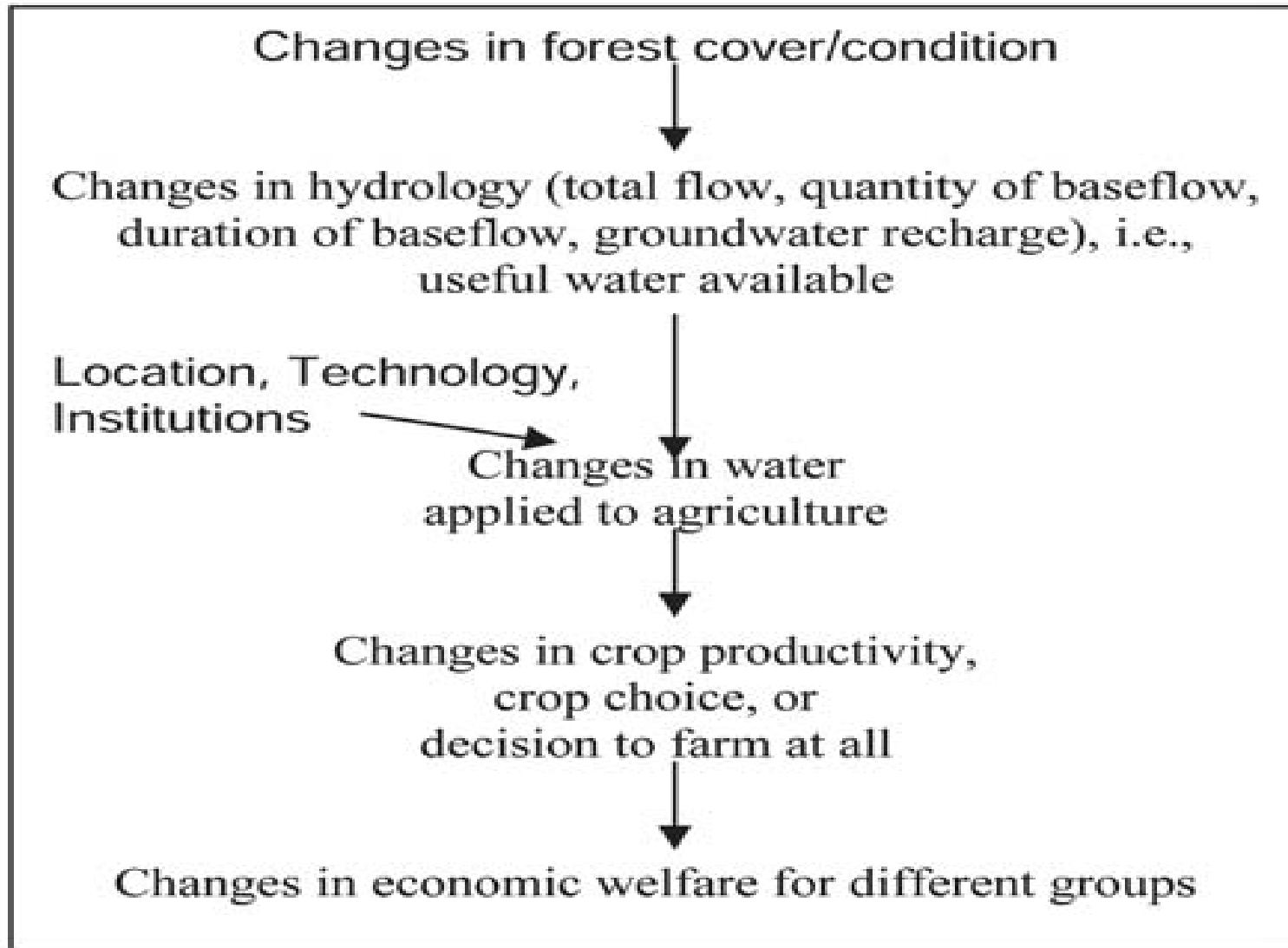
	Volume account		Value account					
	Timber	Carbon	Timber	Carbon	Ntfp	Timber ^a	Carbon ^a	Ntfp ^a
	000 cum	000 tons	Million rupees	Million rupees	Million rupees	% of GDP	% of GDP	% of GDP
Opening Stocks	5,068,313	3,558,126	10,318,016	3,202,313	825,069	55.65	17.27	4.45
Changes due to econ. activity	-409,263	-236,280	-819,963	-212,652	-	-2.21	-0.57	
Logging/harvest/logging damage	355,469	229,034	752,652	206,131	-	2.03	0.56	
Afforestation	10,786	5152	31,615	4637	-	0.09	0.01	
Shifting cultivation	14,002	6883	20,449	6194	-	0.06	0.02	
Forest encroachments	41,672	5515	59,642	4963	-	0.16	0.01	
Grazing	8905	0	18,836	0	-	0.05	0.00	
Other volume changes	843	785.0	1649	6238	-	0.004	0.02	
Forest fires	158	45	292	40	-	0.001	0.0001	
Stand mortality	685	3	1357	3	-	0.004	0.00	
Other accum	242,260	1,778,920	432,230	161,028	-	1.17	0.43	
Natural growth	182,239	130,865	355,909	117,779	-	0.96	0.32	
Regeneration	91,990	48,983	153,824	44,084	-	0.41	0.12	
Transfer of land	-31,969	-928	155,701	-835	-	0.42	-0.002	
Omissions and errors	4772	0	8489	0		0.02	0.00	
Net changes	-167,845	-58,145.4	-380,803	-115,968	4152	-1.03	-0.31	0.01
Closing Stocks	4,905,240	3,499,981	9,937,213	3,086,346	829,221	53.60	16.65	4.47

Case study II- Lele et al (2008)

Value hydrological services of forest ecosystem for irrigation purpose in the Western Ghats region in India



Conceptual framework



Relationship between rainfall, tank inflows and irrigation events

- **Rainfall and Tank Filling**
 - the tank fills more frequently in the post-monsoon (Oct-Dec) period than in the pre-monsoon or monsoon period
 - the rains during the monsoon wet the catchment and so there is likely to be higher runoff (per unit rain) in the post-monsoon period
- **Rainfall-runoff and Vegetation**

Characteristics of irrigated tank agricultural system

- the irrigation tank system is an almost 'binary' or 'threshold-based' system
- the management of the irrigation tank is a collective one
- agricultural wage labour is an important dimension of the economy

Valuation method: productivity change

- productivity might vary depending upon landholding size, soil type, as well as soil moisture
- Since direct measurements of soil moisture were not possible, they used two proxy location variables:
 - location along the reach (head-end, middle and tail-end, the assumption being that head-enders get more seepage water) and
 - elevation within the command (upland, mid-land, lowland, the observation being that lowland plots get more soil moisture from seepage).

Likely Impacts of Changes in Catchment Response on Agricultural Income and its Distribution

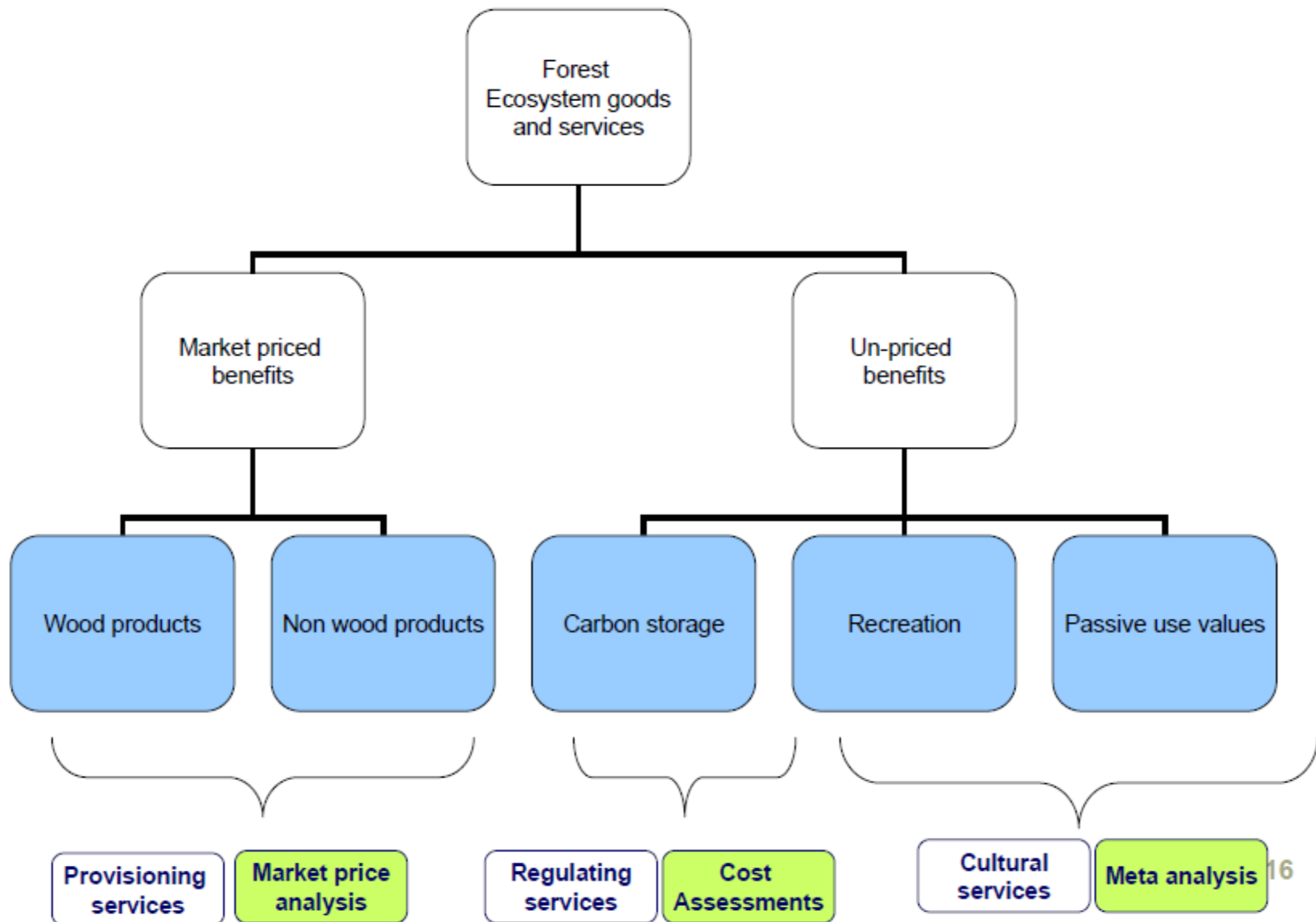
Scenario	Season	Probability of tank filling	Expected value of net income	Expected value of employment generated
Degraded forest in catchment (Current)	<i>Kharif</i>	20%	459,761	150,087
	<i>Rabi/summer</i>	57%	815,229	80,074
	Total for year		1,274,990	230,161
Degraded forest in catchment (Current)	<i>Kharif</i>	7%	403,093	128,929
	<i>Rabi/summer</i>	18%	257,441	25,287
	Total for year		660,534	154,216
DIFFERENCE in expected values	Change in total annual income/ employment		-614,456	-75,945
	Change in annual income / employment per farmer in command		-4,267	-527
	% change in annual income / employment		-48%	-33%

Case study III- Chaibai et al (2011)

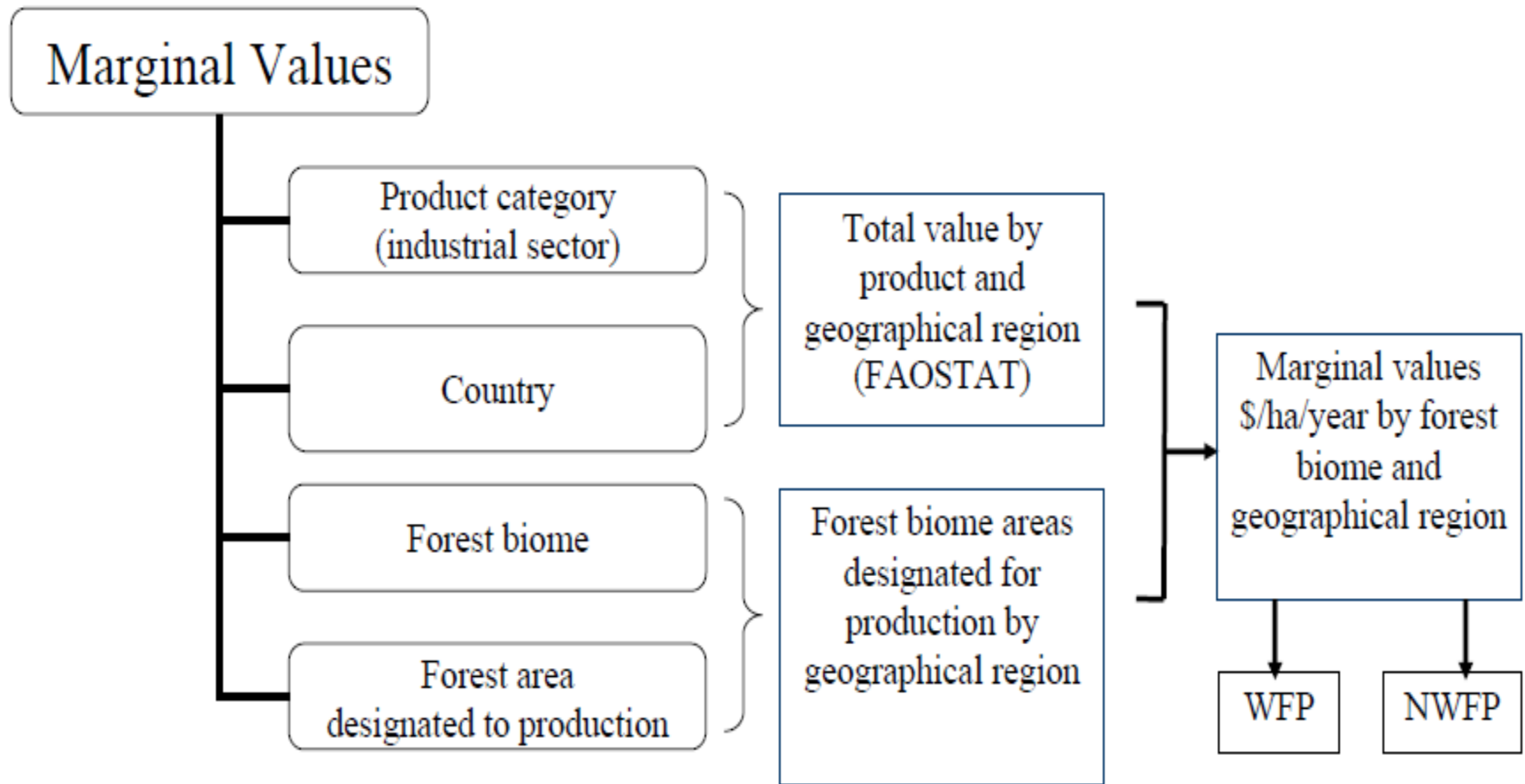
- Objective: to link global change, biodiversity, ecosystem's capacity to provide goods and services and evaluate the respective impacts in terms of human welfare changes
- Approach: 3 stages
 - Application of the **Millennium Ecosystem Assessment method: *(i) map world types of ecosystems and (ii) map ecosystem goods and services***
 - Qualitative and quantitative data assessments (physical)
 - **Develop a general economic valuation framework focusing on the identified ecosystem goods**
 - Quantitative data assessments (monetary)
 - Application of **future scenarios to a regional level to assess economic values changes (costs or benefits)**
 - Marginal analysis Objective

List of forest Ecosystem Services addressed for the monetary estimation

MEA category	Ecosystem Services
Provisioning	Food, fiber, fuel: wood and non wood products
Regulating	Climate regulation: carbon storage
Cultural	Recreation and ecotourism Passive use



Methodology: provisioning services



Methodology: carbon storage

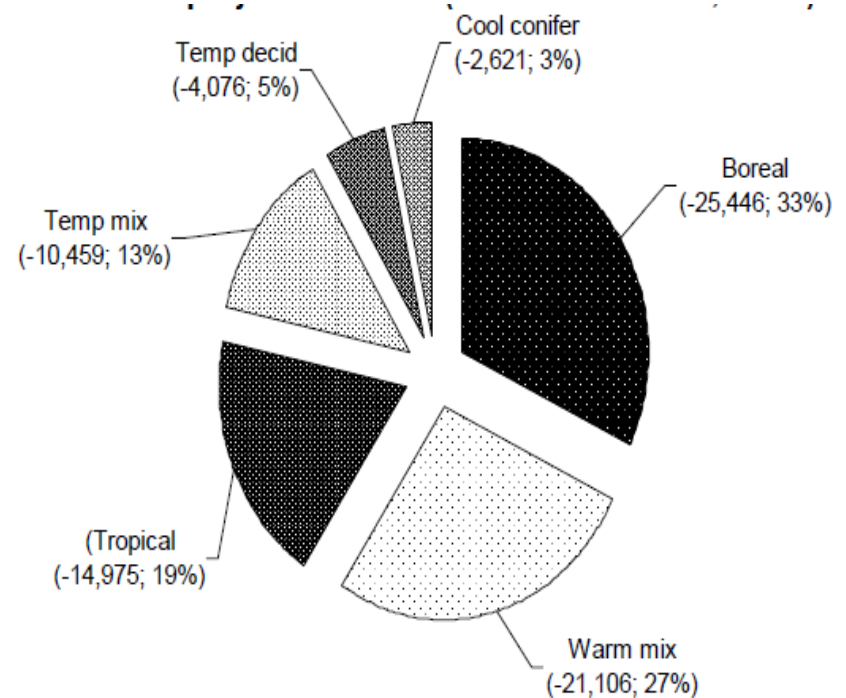
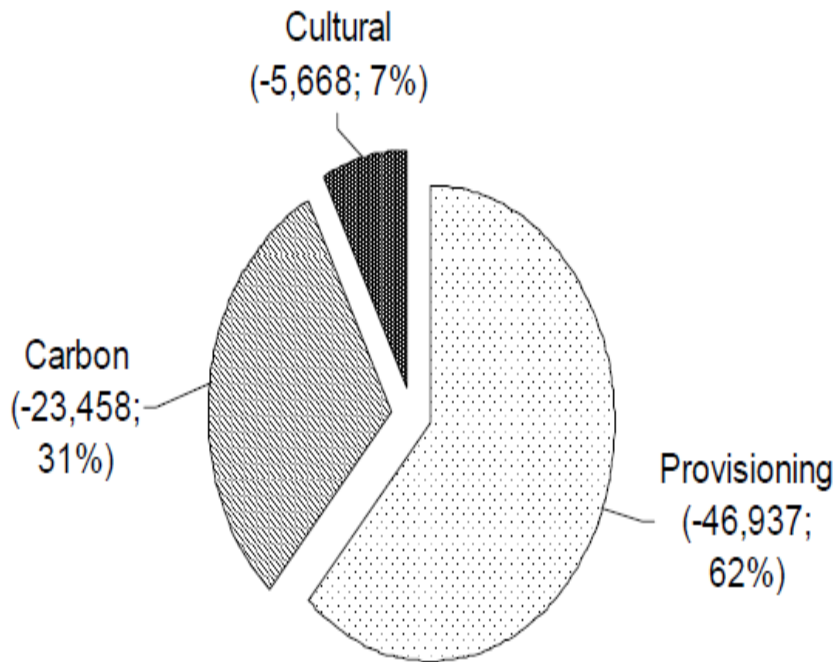
Two main valuation phases:

- (1) Assessing the biomass carbon stocks by forest type and geographical region (tC/ha)
- (2) Computing annual marginal values of carbon stocks per hectare (euro/ha/year) by forest biome and geographical region
 - Price per ton of C stocked based on Marginal Damage Cost and Marginal Avoidance Cost approaches (CASES project)

Methodology: cultural services

- Literature review about recreation and passive use valuation case studies (CVM, TC)
- Creation of an ad-hoc database (EVRI, IUCN, Econlit)
- Economic model and meta-regression function
- Selection of some representative case studies per world geographical region and forest biome
- Two-step value-transfer (using estimated coefficients)
 - Transfer from case study site to policy site
 - Inter-temporal transfer: projections in 2050

Total economic loss, worldwide projections 2050 (million Euro 2007, r=3%)



Lessons learnt and way forward

- Measurement of deforestation?
- Market prices are used for most of the provisional services, direct use methods don't reveal preferences
- Carbon market price or climate change damage function ?
- Ecotourism services, role of infrastructure, WTP of domestic vs foreign tourists (differences in income and other variables), additional attractions, benefits are not additive
- Hydrological services: interdisciplinary collaboration, individual vs full range of services, benefits are location specific (i) local geophysical and climatic conditions (ii) spatial relationship to human activities
- Health benefits: ecological epidemiological links are yet to be well understood,
- Double counting, e.g., health benefits and water quality and quantity benefits are counted separately of hydrological services

- Valuations of ecosystem services in developing countries are typically disconnected from policy options
- An underestimate of the total social cost that would result from the business-as-usual scenario.
- Compare ecosystem service benefits with costs of service delivery
- Interdisciplinary research, which is a precondition for ecosystem service measurement and valuation, continues to be exceedingly rare
- future studies combine valuation and program evaluation, so that valuation estimates are based on the observed impacts of real-world programs and policies
- Future studies must more tightly integrate policy and research by combining nonmarket valuation and program evaluation. Very challenging task for researchers

Thank you !

Welcomes feedback and comments: surender672@gmail.com