Valuing Environmental Damage: an integrated economic framework

Forest fire damage case

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Environmental damage compensation: Main issues

1) Theoretical background
2) Multi-dimensional operating procedure to identify damage elements
3) Valuation methods
4) Multi-dimensional scale of damage: profile across time
5) Concluding remarks

1) Environmental damage

- Measurable adverse change in a natural resource or measurable impairment of a natural resource service
- Measure injured Resource TEV change in terms of **Compensating surplus**

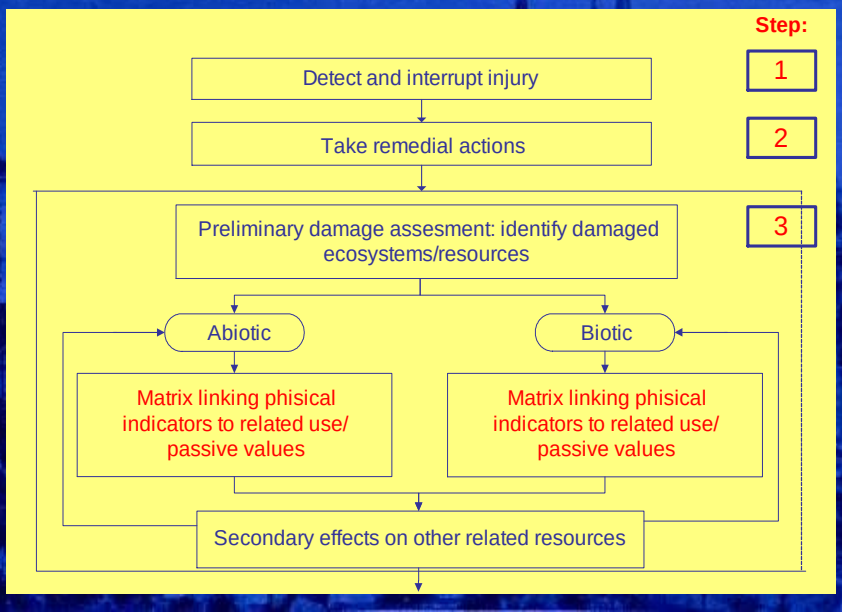
Multi-dimensional approach: Scale of injury:

- **Geographical distribution of the injury**
- **Different resources involved**
- **Different individuals suffering welfare losses**
- **Time length to re-establish the baseline**

Multi-dimensional approach: Assessing environmental damage:

- Multi-dimensional scale of the effects (in-site vs. off-site)
- Different evaluation methods
- Risk of double-counting errors
- Time length and choice of a ‘proper’ discount rate

2) Five steps multi-dimensional operating procedure



Matrix approach linking indicators to public services loss or impairment: a 'Forest'

VALUE	USE													USE/PASSIVE							PASSIVE			
FUNCTIONS	Production							Demand						Ecosystem Services										
SERVICES	*Primary Sector*		*Industrial sector*		*Services sector*				Recreation and landscape															
INDICATORS	*Wood production*	*Non-wood production*	*Goods production*	*Energy production*	*Transport*	*Tourism*	Other…	Civil Uses	Hunting	Non-wood products picking	Fuel-wood	Recreational uses	Other…	Hydrogeological protection (soil erosion)	Hydrogeological protection (runoff)	Protection agains ckimate change (CO_2 uptake)	Conservation for genetic inheritance	Biodiversity conservation	Habitat conservation	Other…	Conservation for genetic inheritance for future generations	Conservation for rare ecosystems for future generations	Historical-cultural values	Other…
Indicator 1																								
Indicator 2																								
Indicator 3																								

Matrix approach linking indicators to public services loss or impairment: a 'River'

VALUE	USE															USE/PASSIVE								PASSIVE				
	Production									Demand						Ecosystem services												
FUNCTION/ SERVICES	*Primary sector*				*Manufactory Sector*		*Services sector*				Recreation and landscape																	
INDICATORS	*Irrigation*	*Livestock*	*Aquaculture*	*Fishing*	*Goods production*	*Energy production*	*Transport*	*Tourism*	Others…	Civil uses	Swimming	Boating	Recreational fishing	Other recreational uses	Others…	Floodwater storage and conveyance	Groundwater recharge and discharge	Shoreline stabilization	Pollution assimilation	Biodiversity storehouse	Nutrient cycling	Habitat for species	Others…	Preservation for future generations	Preservation of genetic resources	Preservation for others	Cultural-Historical	Others..
Indicator 1																												
Indicator 2																												
Indicator 3																												

Damage:

Reversible, the injured resource can be naturally recovered

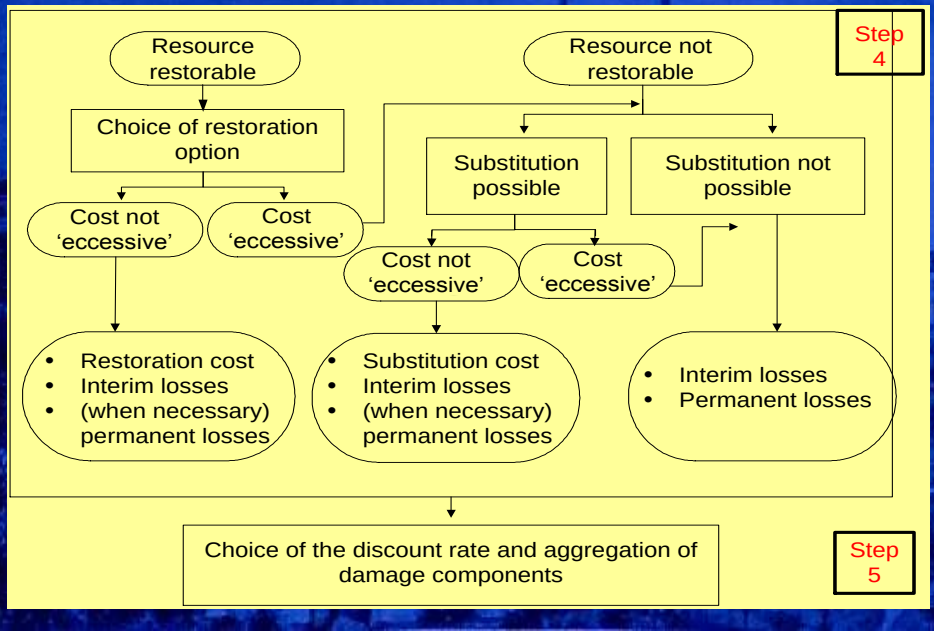
Irreversible, the injured resource can not be naturally recovered

Resource:

Restorable, human intervention may activate and/or accelerate natural resource recovery, at a 'reasonable' cost

Not Restorable, human intervention may not activate and/or accelerate natural resource recovery, at a 'reasonable' cost

IDENTIFICATION OF DAMAGE PROFILE OVER TIME AND CHOICE OF VALUATION METHODS



Compensation for environmental damage (con't)

Damage	Resource: Restorable	Resource: Not restorable
Reversible	(1) Defensive expenditures Substitution Costs Restoration costs Temporary welfare losses	(2) Defensive expenditures Substitution Costs Temporary welfare losses
Irreversible	(3) Defensive expenditures Substitution Costs Restoration costs Temporary welfare losses	(4) Defensive expenditures Substitution Costs Temporary and permanent welfare losses

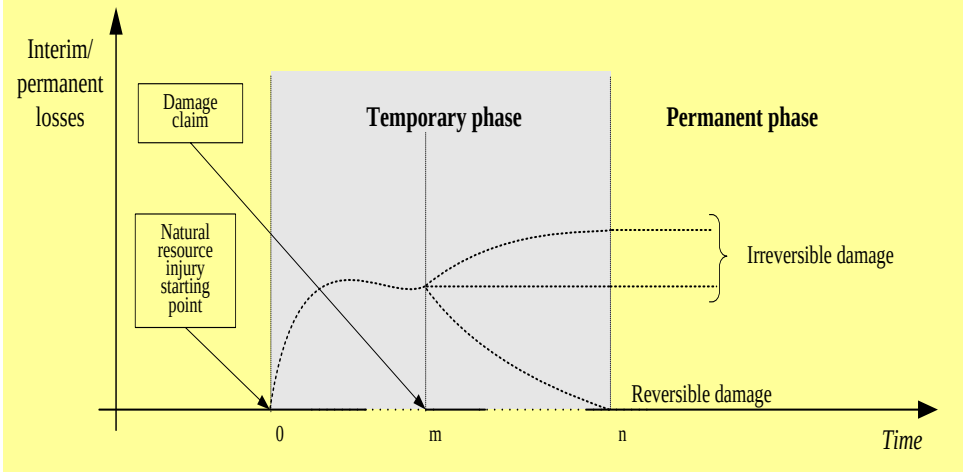
2) Approaches in valuing compensation for environmental resource damage

Approach	Method	Type of Study
Imputed preferences	Defensive cost Restoration cost Substitution cost	Primary study: *ad hoc* field survey Secondary study: benefit transfer
Revealed preferences	Market price Travel cost Hedonic pricing	
Stated preferences	Contingent valuation Conjoin analysis	

Valuation Methods for public services losses

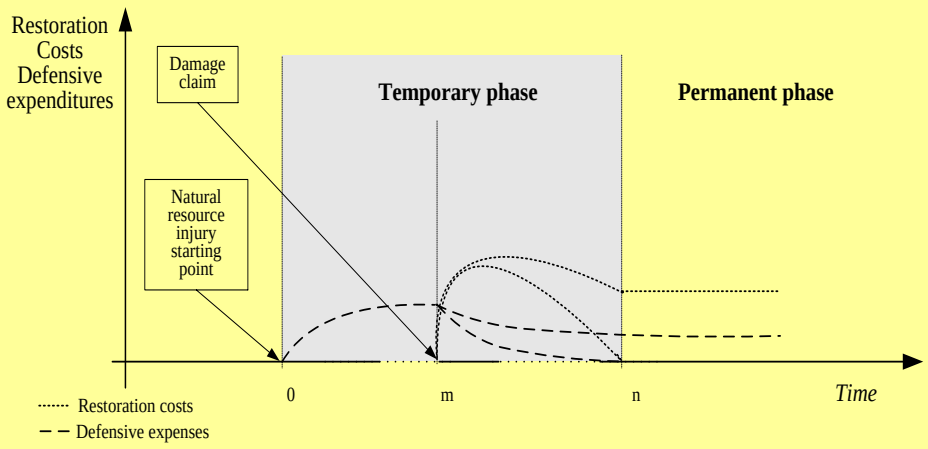
ECONOMIC VALUATION METHODS	FUNCTIONS/SERVICES													
	Production			Demand		Ecosystem services								
	Primary sector	Manufactory sector	Services sector	Civil use	Recreational and landscape	Species habitat	Pollution assimilation	Biodiversity storehouse	Others…	Preservation for future generations	Preservation of genetic resources	Preservation for others	Cultural-Historical	Others..
Defensive expenditure cost	X	x	x	x	x	x	x	x						
Restoration cost						x	x	x						
Substitution cost	x	x	x	x	x	x	x	x						
Market prices	x	x	x	x/X	x									
Hedonic price	x	x	x	x/X	X									
Travel cost					X									
Contingent valuation				x	x	X	X	X		X	X	X	X	
Conjoint Choice analysis				x	x	X	X	X		X	X	X	X	

Damage valuation and time
1) Welfare losses profiles across time



Damage valuation and time (con't)

2) Restoration/substitution costs and averting expenses profiles across time



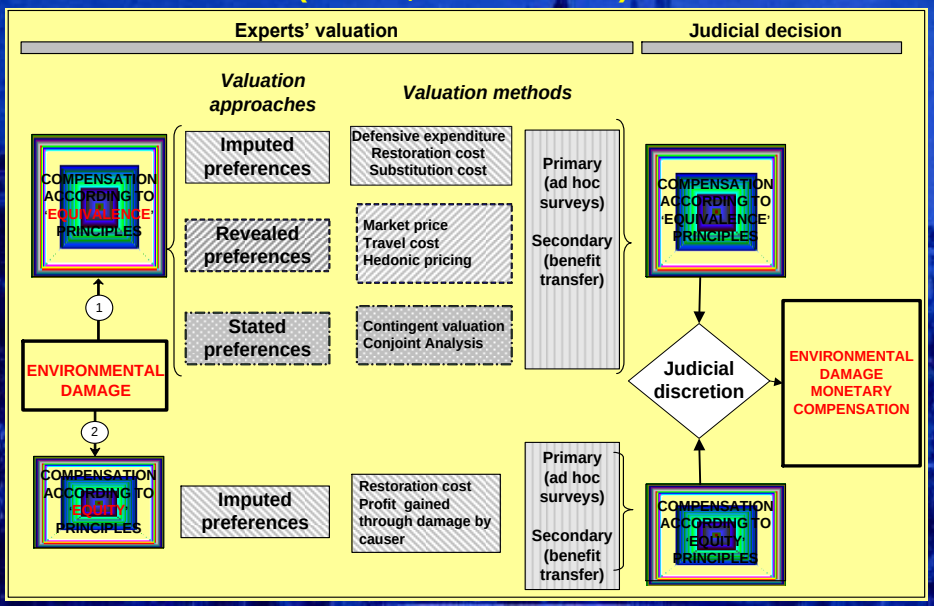
Compensation for environmental damage

$$D_m = \sum_{i=0}^{m} (B_i + C_i)(1+r)^{m-i} + \sum_{j=m}^{n} (B_j + C_j) \frac{1}{(1+r)^{j-m}} + \frac{(B_k + C_k)}{r} \frac{1}{(1+r)^{n-m}}$$

Declining long term social discount rate

Period of years	0-30	31-75	76-125	126-200	201-300	> 300
Discount rate	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%

Concluding remarks:
Environmental damage compensation under Italian law (Art. 18, law 349/1986)



Conclusions: environmental damage evaluation in a court

ISSUE	CONCLUSION
Conflictual environment	'Robust' estimations are needed
Monetary evaluations	TEV but 'parsimony' principle
Many injury's effects	Different estimation methods
Direct and indirect effects	Double-counting risk
'With-without' principle not 'ante-post'	