Water in the Alps. An economic reading

Danube Floodrisk workshop

Trento, October 3, 2011

Luca Cetara
Adviser to the Italian Ministry for the Environment
Eurac research
European School of Economics

PROVINCIA AUTONOMA DI TRENTO

Autorità di bacino del fiume Adige

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

MINISTERO DELL'AMBIENTE
E DELLA TUTELA DEL TERRITORIO E DEL MARE

alpenkonvention • convention alpine
convenzione delle alpi • alpska konvencija
www.alpconv.org

Economics. A working definition.

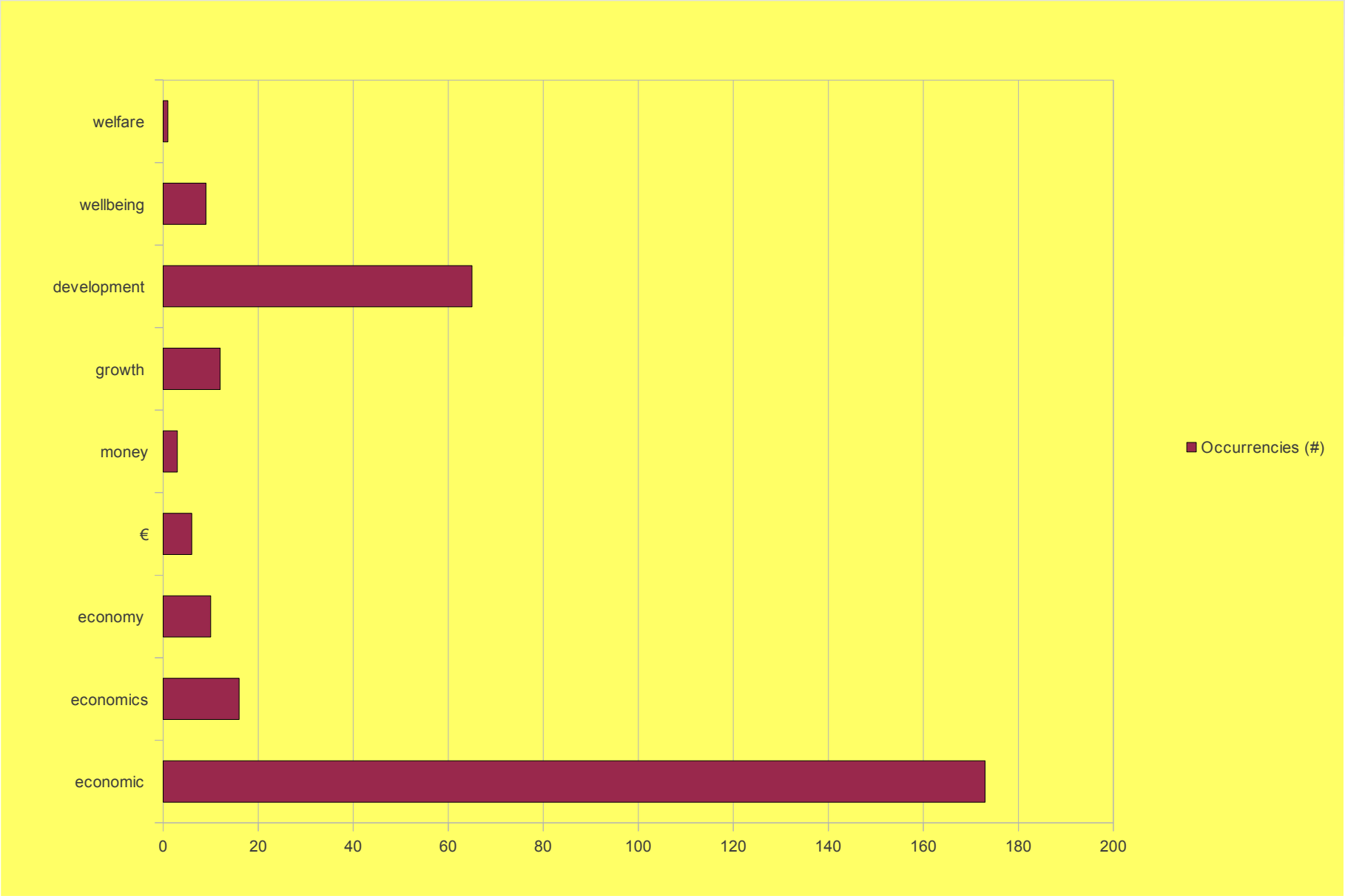
Economics is a social science that studies human behaviour as a relationship between ends and scarce means which have alternative uses. That is, economics is the study of the trade-offs involved when choosing between alternate sets of decisions

Lionel Robbins (1932, 2nd ed., 1935). An Essay on the Nature and Significance of Economic Science, London: Macmillan: pp 16.

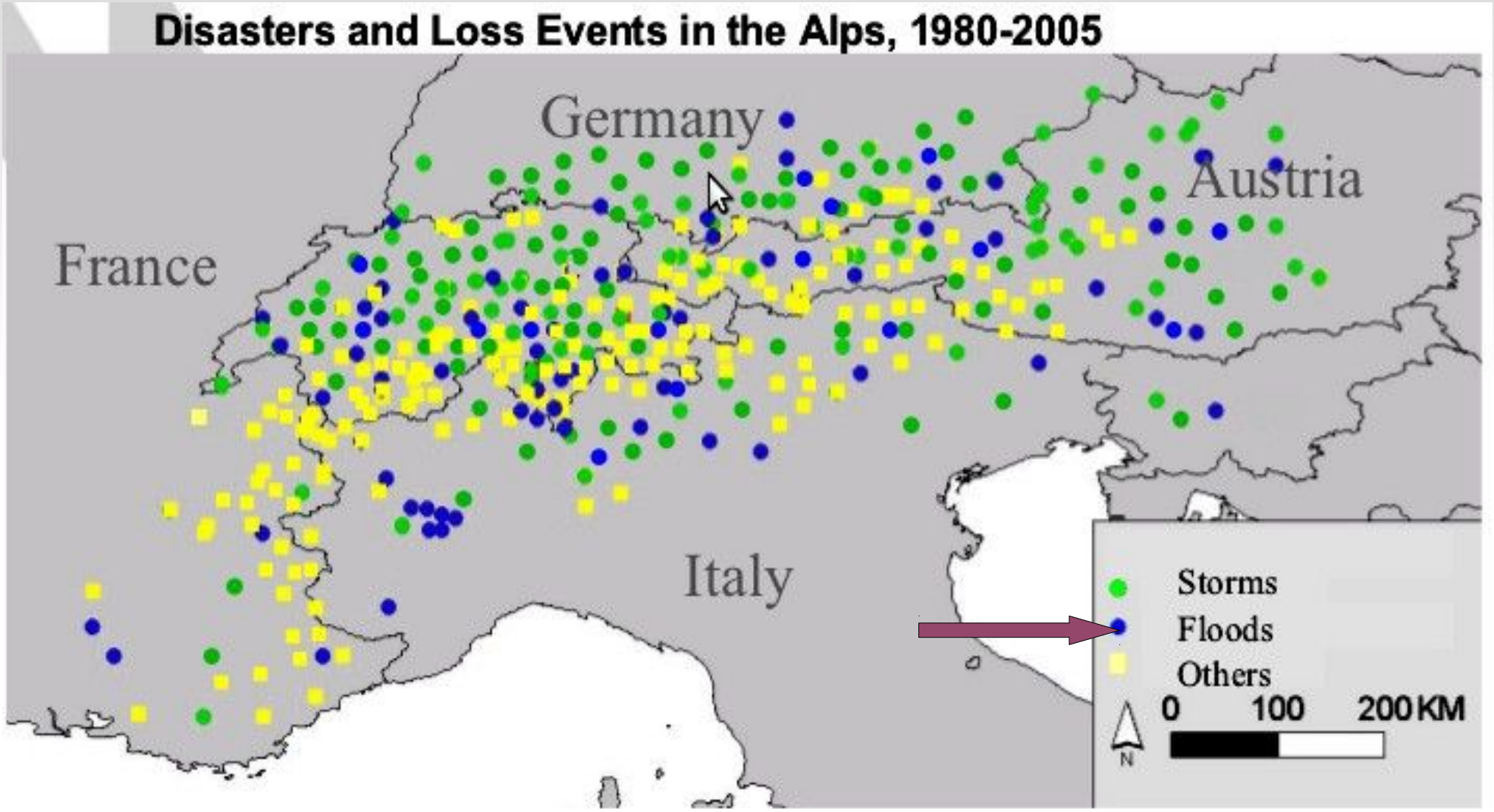
Main economic meanings of, and means of inquiry on water

Economic meaning	*Main domain of economics involved*
Threat	Welfare economics, finance, insurance theory, social choice theory, economic approach to human behaviour
Factor of production	Production theory, ecological economics
Quality of Life / Well being factor	Welfare economics, ecological economics, latest approaches in the measurement of quality of life / well being
Resource	Economics, Cost-Benefits Analysis

Incidence of economic terms in the Report
(absolute values)



Water as a threat: the economics of natural hazards



Sources: OECD (2007), MunichRe (2006)

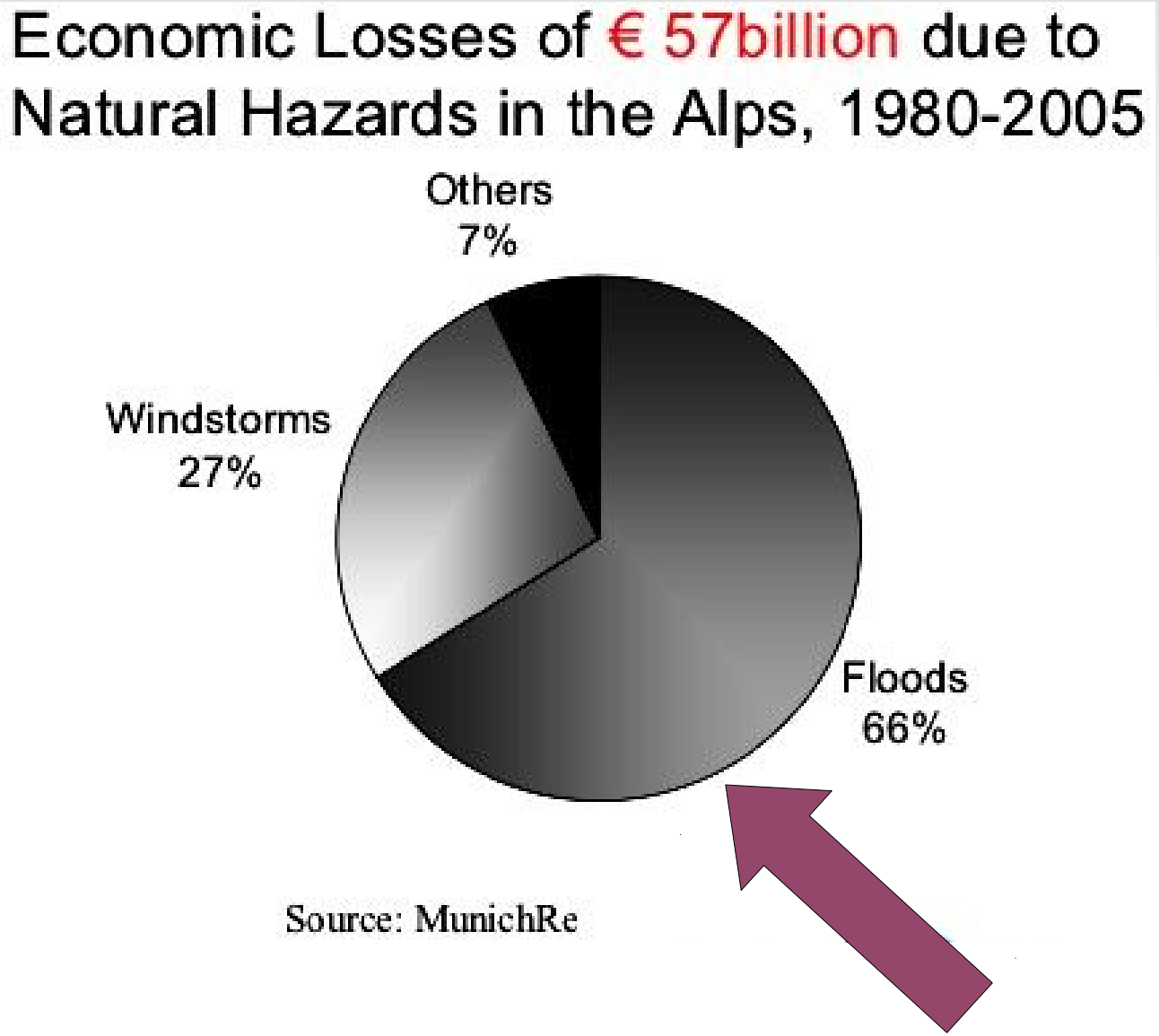
Water as a threat: the economics of natural hazards

Natural Hazards and Climate Change Impacts

Changes in Natural Hazards	Confidence in projected changes	Most affected regions	Economic importance
Winter Floods: Greater intensity and frequency	Medium	Lowlands, densely populated areas	**Very high**
Avalanches: Increasing incidence at high altitudes	Low	High mountain range, tourism areas	Medium
Mass movements: Increasing frequency/ magnitude	Medium	Northern/Western Alps	Medium
GLOFs and other related mass movements: increasing incidence	**High**	High mountain range, tourism areas	Low
Permafrost related mass movements: Increasing incidence	**High**	High mountain range, tourism areas	Low
Forest fires: Increase in number of events in Southern Alps	Medium	Lower mountain range of Southern Alps	Low
Winter Storms: Greater intensity and frequency	Medium	Alpine arc, densely populated areas	**Very high**

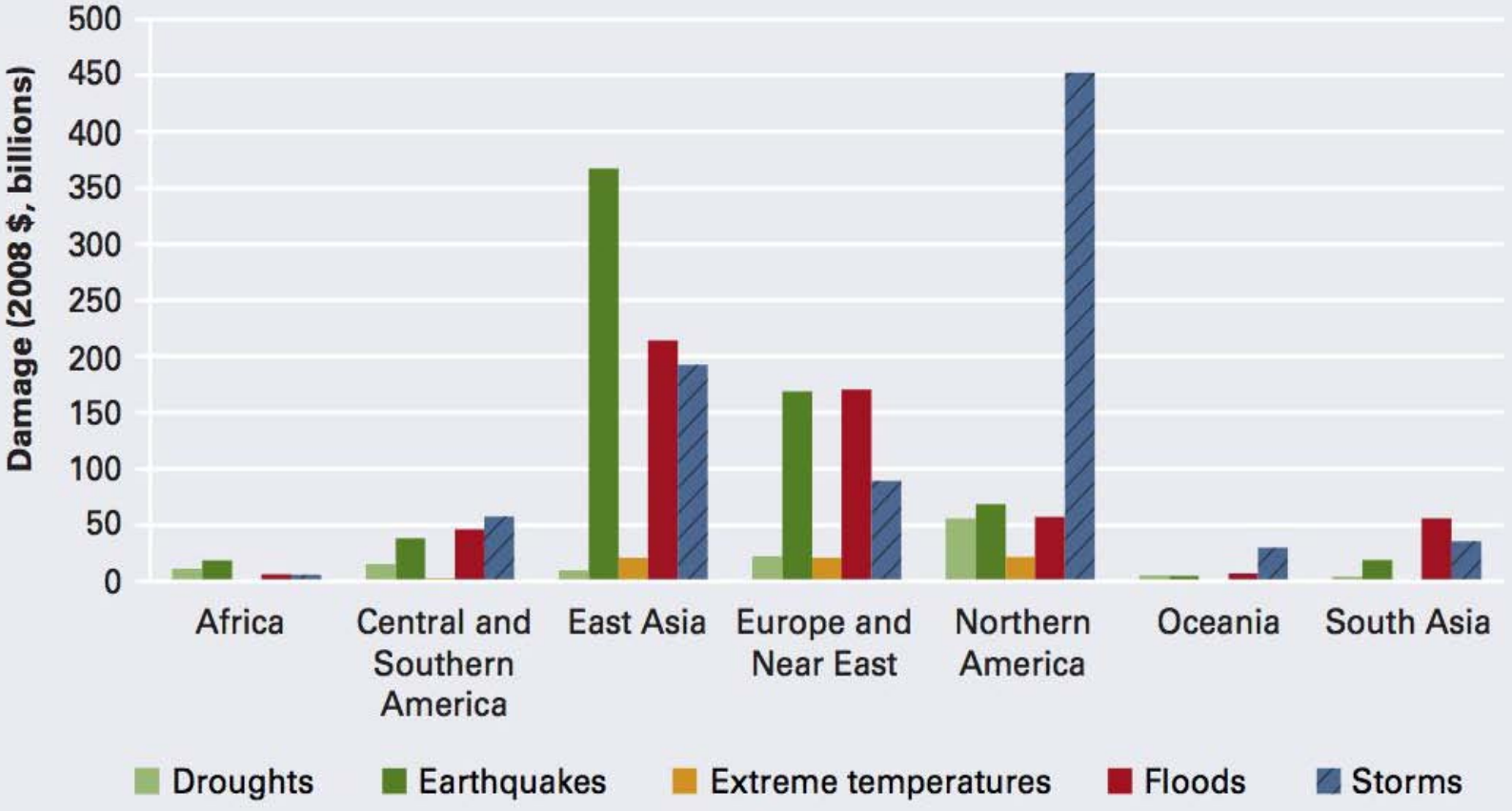
Source: OECD (2007)

Water as a threat: the economics of natural hazards



Rich countries are more affected by NHs' economic consequences

Figure 1.6 More damage in rich countries, mostly from earthquakes and storms



Note: Damages by type of event and by region, 1970–2010 (February).
Source: World Bank staff based on EM-DAT/CRED.

Water as a threat: the economics of natural hazards

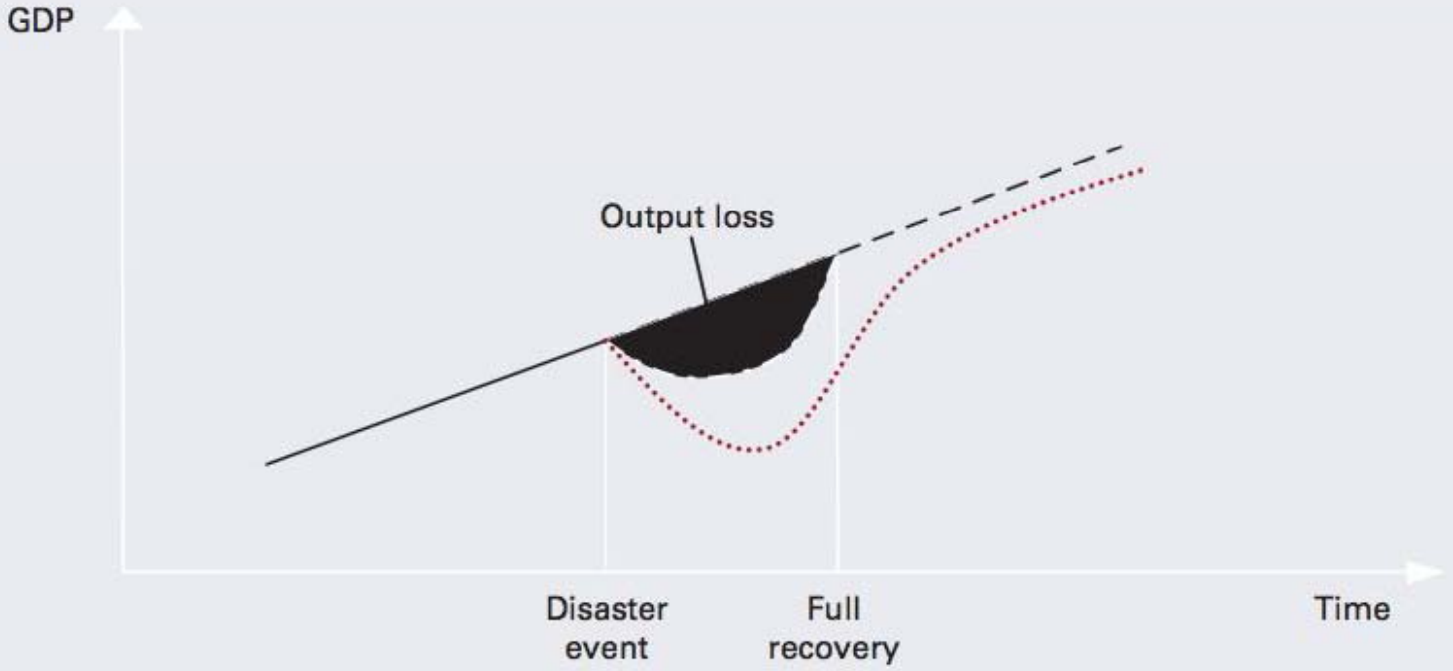
Table 2.3 Growth effect of a "typical" (median) disaster

		Effect on:			
		GDP growth	Agricultural growth	Industrial growth	Service growth
Median intensity of:	Droughts	–0.6%***	–1.1%***	–1.0%**	–0.1%
	Floods	1.0%***	0.8%***	0.9%***	0.9%***
	Earthquakes	–0.1%	0.1%	0.9%*	–0.1%
	Storms	–0.1%	–0.6%***	0.8%*	–0.2%

Note: The effects on GDP growth rates—the rate of change of output—and not on output levels. So, a typical drought could reduce overall GDP growth by 0.6 percent; agriculture growth by 1.1 percent, and so on.
*significant at 10%; **significant at 5%; ***significant at 1%.
Source: Loayza and others 2009.

Water as a threat: the economics of natural hazards

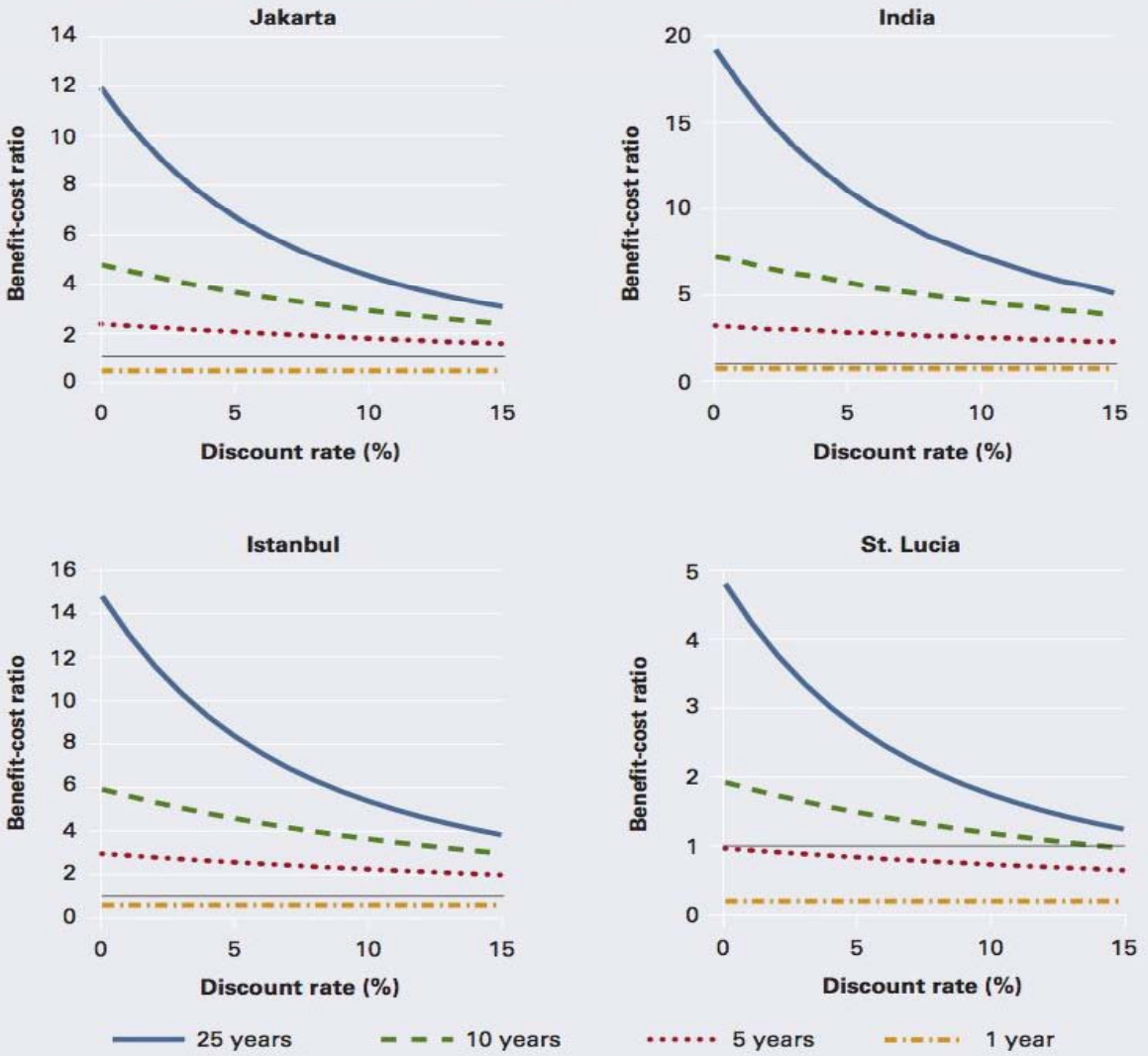
Figure 2.3 A possible post-disaster GDP path



Note: Other paths are also possible. For example, output could also rise above pre-disaster levels, but this can be an artifact of a reconstruction boom, as discussed later in the chapter.
Source: World Bank staff based on Hochrainer 2006.

The role of individual prevention in the management of damages from NH

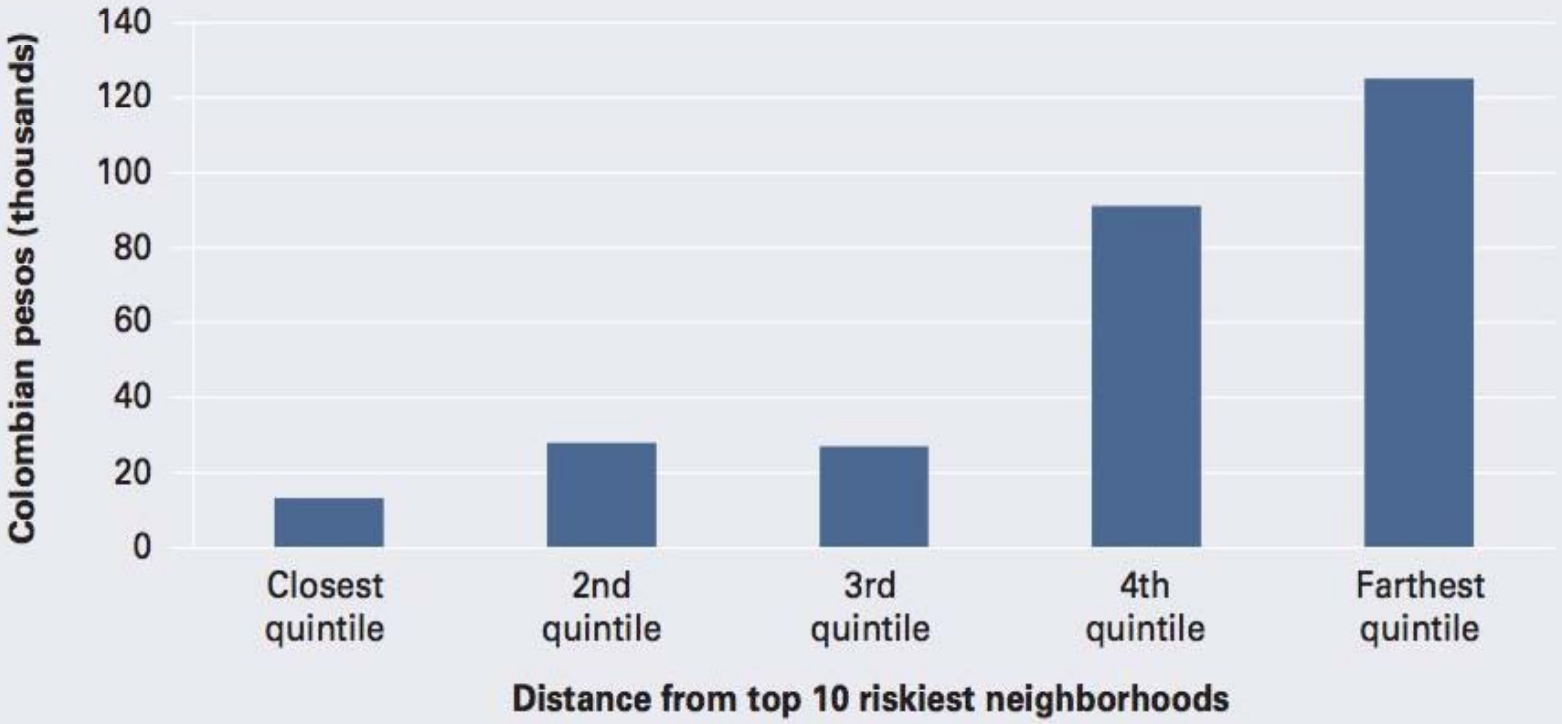
Figure 3.1 Private preventive measures pay



Note: The figure refers to the following examples: elevating a house with mixed wall, concrete floor, and asbestos roof by one meter in Jakarta; protecting windows and doors in a wood frame house in Canaries, St. Lucia; retrofitting a five-story building to increase quake resiliency in Istanbul; and flood-proofing a brick house by building with new brick on a raised plinth in India.
Source: IIASA/RMS/Wharton 2009.

Land and real estate markets should reflect the risk distribution on the territory

Figure 3.2 Property prices for comparable properties are higher in locations farther from earthquake risk in Bogota



Source: Lall and Deichman 2009.

A few lessons from the economics of natural hazards

- Absolute damage is larger in rich countries (with more assets): role of spatial planning and spatial development decisions
- In the context of disasters, measuring changes in output is an imperfect measure of changes in consumption, and it cannot fully capture the cost of pain, suffering and anxiety.
- NH affect regional output (phyisical damage + disruption in normal economic activity). Estimates of the impact on welfare and prices over time can be tried (with limits)
- Floods: 1% GDP growth after a flood of typical intensity (disruption + nutrients deposit + increase hydroelectric power, which boosts industrial growth) (Loayza et al. 2009)
- “Self insurance” + market insurance: financial merits of prevention & risks properly embedded in market prices
- Room for policy action, based on findings from economics (e.g. excess management, insurance cover in “red zones”, conditional issue of insurance contracts, involvement of the government)

Other few lessons from the economics of natural hazards

- Cost-Benefits Analysis (CBA) can help decide on / weigh between:
  - *Alternate spatial development projects (e.g. focus on critical infrastructure)*
  - *Alternate protection systems or measures (e.g. good economic returns of early warning systems)*
  - *Spatial development projects vs. conservation projects (e.g. economic role of vegetation cover in watersheds)*
- Economic instruments & behavioural economics can help citizens make appropriate location decisions and undertake prevention: e.g. well functioning land and real estate markets, governments' pre- and post-disaster spending analysis, etc.

A proper application of economic findings can help undertake efficient regional decision making

Water as (an environmental) resource: the point of view of ecological economics

- Ecological economics recognizes that **humans and their economies are parts of larger natural ecosystems** and coevolve with them. It aims at:
  - Understanding the interdependence between economic and natural systems (*tolerances* of ecosystems to human induced changes and of economies to ecosystem changes)
  - Establishing conditions for sustainability and search the proper balance among different water uses in order to keep ecosystem services
- Ecosystem services (ESS) have instrumental value to the human economy. Use-values may be reflected by the sum of private individual values. However, ecosystems also have non-use values (aesthetic, moral, cultural). All are reflected in the concept of Total Economic Value (TEV)
- The quality of an ecosystem is a necessary condition for the provision of ESS

Water as (environmental) resource: the point of view of ecological economics

- Areas covered by vegetation play a key-role in regulating the water cycle in a watershed
- Reduction of active costs to be incurred in to recover hydrogeological instabilities, landslides, loss of soil, and provide water purification etc. happens in the presence of functional ecosystems
- Current free human use of many of the ecosystem functions and in the absence of full awareness of them
- Analyses on ecosystems' functionality, current and potential use of their services and marginal value of flows & stock of Natural Capital that determines the aggregate of services, at present, are only partially available
- Results may become a tool for assessing the quality of the landscape, the ecological functionality and for guiding land management policies (which at present, for the most part, don't consider all the environmental, social and economic benefits of such services)

Water as (environmental) resource: the point of view of ecological economics (2)

- Proper management of vegetational capital assures the maintenance of functions for water purification, regulation of the water cycle (on the basis of rainfall / evapotranspiration balance), soil erosion, absorption of CO2.

- Other ESs include: landscape quality, human wellbeing activities, recreation and inputs to the production of other goods & services, also in remote areas with respect to the mountains

- In river catchment areas: estimate of the demand of ESs, through "replacement cost" and "avoided cost" techniques (cost of replacing an ecosystem or its services, as a *proxy* for the value of the service itself; cost of the actions taken to avoid damage, as a measure of the benefits ensured by the presence of the ecosystem)

- Valuation of regulatory services of the water cycle allows to build territorial scenarios highlighting the economic significance of the ecological functions performed by ecosystems

Water as (an environmental) resource: water ecosystem services identification and valuation in the Alps. Remarks.

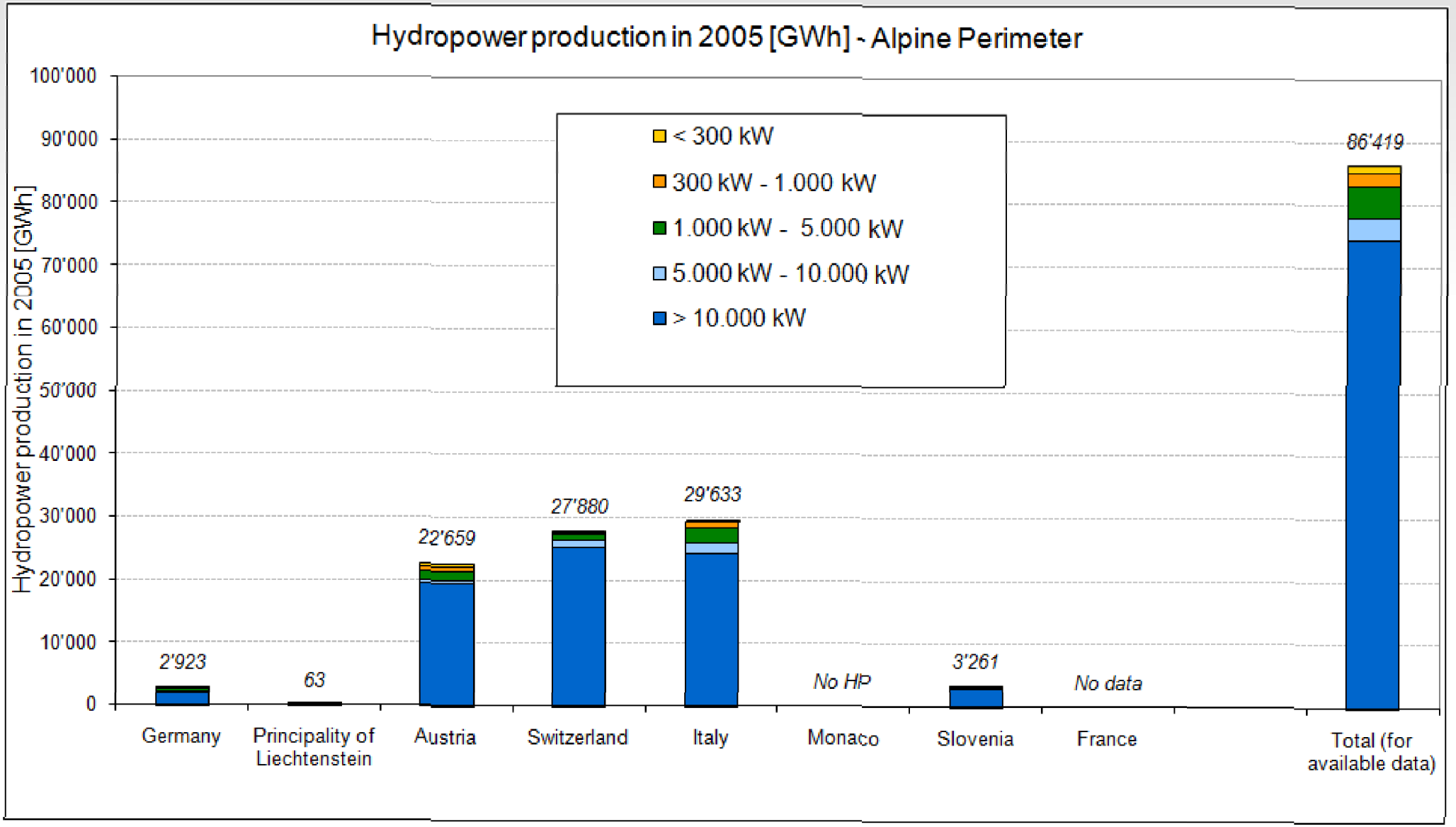
Since 1991, the city of Munich has encouraged farmers whose lands are in the catchment area that provides water for the city, to convert to organic agriculture. This improved the quality of tap water in Munich, imposing a cost on the city government (paid through PES schemes), but reducing water sanitation expenditure

Though still questionable, the application of an economic approach to biodiversity seems to be rather effective in raising the awarenes of the public, on a few, formerly undisclosed, aspects of ecosystems (*shadow values*) and the value of environmental resources

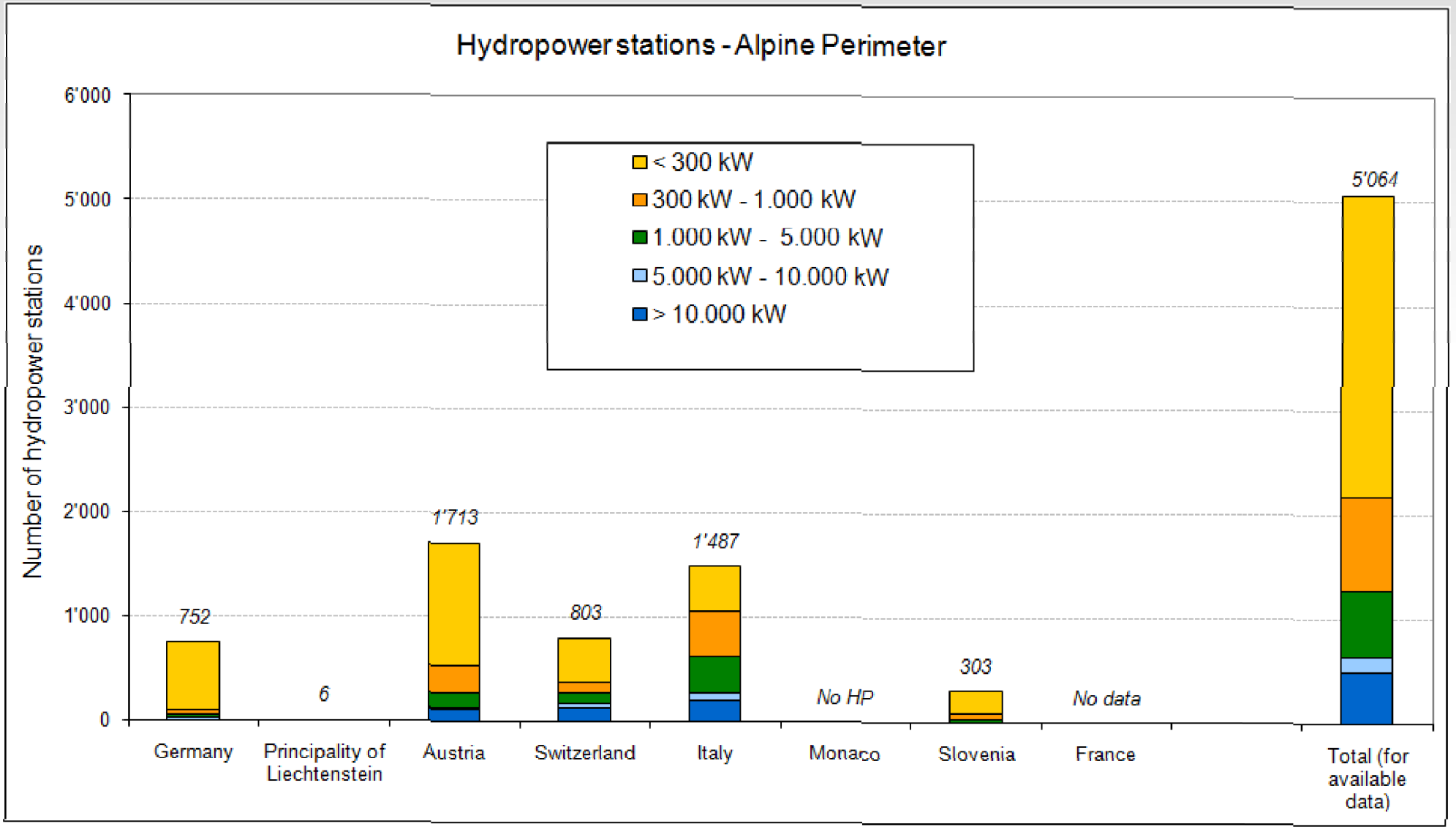
The exploitation of ecosystems with regard to their Use / Non-use values is a political decision, that can be supported by economic figures and a CBA

The conservation of a good ecological quality in the Alpine watersheds can support the production of further economic value through ecosystem services, both directly and indirectly

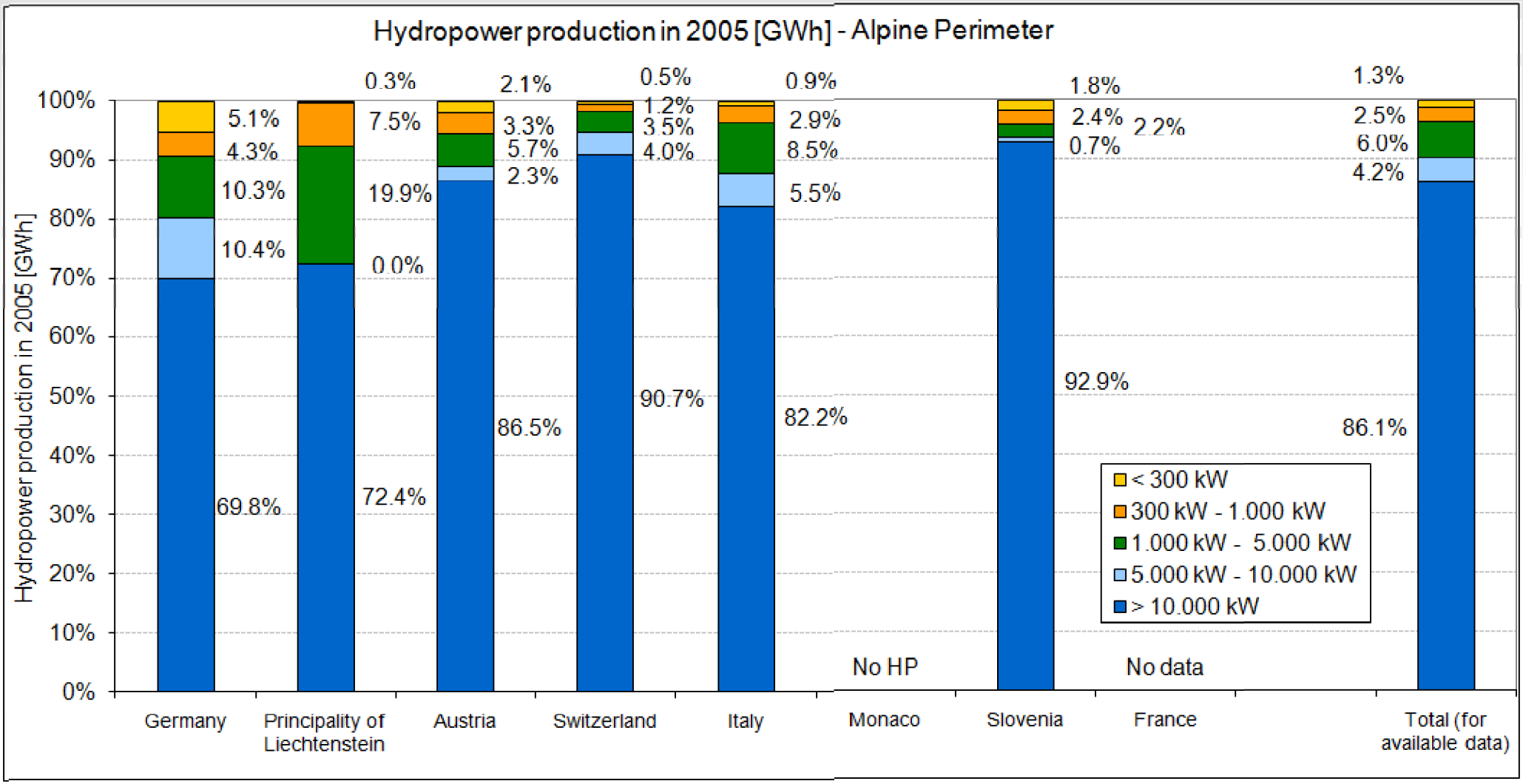
Water as a factor of production. Hydropower market in the Alps: most of energy is produced by large plants



Water as a factor of production. Hydropower market in the Alps: most of the plants < 300 kW



Water as a factor of production. Hydropower market in the Alps: plants >10.000 kW produce > 85% of energy



Water as a factor of production. Hydropower sector in the Alps

- Marginal cost of HP production (per kWh) lower than other modes of energy production. Thus, the price of energy is determined on the electric stock exchange
- The cost structure of a typical HP plant is largely composed by fixed costs (for larger and older plants already amortized)
- Incentive to increase the quantity of energy supplied
- The higher costs of other renewable energies production increase competition on hydropower
- Further incentives to the quantity of energy supplied is represented by the Green Certificate Schemes
- Plant type matters. *Diversion plants* are more flexible on the timing of energy production and allow to earn higher profits
- *Through-flow plants* have smaller outputs, on average and marginally; they have to produce energy continuously and have management costs meaningfully depending on the height of the waterfall and the productive capacity

Water as a factor of production. Hydropower market in the Alps: the economic rent

- In (micro)economics, a rent is represented by the quantity of money originating as a mathematical difference between the marginal income deriving from and the marginal cost of supplying an extra unit of product or service.
- A rent is always present in a monopoly condition, that is when a certain good or service is provided by a single subject over a relevant market.
- In the field of water services the condition of a “natural monopoly” is recognised, depending on the limited amount of a resource that is available and e.g. by the high fixed costs to construct the infrastructures to deliver water services.
- The rent deriving from hydropower production can be seen as an “extra profit” for the energy supplier
- *“Rent seeking”* tends to develop in the presence of an economic rent and public support schemes, and need to be controlled (in order to avoid losses in efficiency and damages to the consumers)
- The existence of a rent can become an important incentive for companies to compete for a concession's grant

Water as a factor of production. Hydropower market in the Alps: the economic rent

Brief analysis of the hydro power rent and its use:

- Economic sustainability of HP (depending on: energy prices, plant type, public aid schemes)
- Need to assure a cost-effective management of the service, also if a rent is extracted from the management of the monopoly
- Capture and use of the rent (through fees, concessions, earmarking decisions on environmental quality):
- *Policy options:*
  - Protection measures from NH (see above)?
  - Ecological quality of water bodies / nature conservation ?
  - Measures to support regional economic growth or economic development ?
  - Measures for the improvement of the inhabitants' quality of life, equity measures (local *vs.* general community; discounts on energy price)?

Water as a factor of production. Hydropower market in the Alps: public aids dependency

Power plant type	> 10 MW	1-10 MW	< 1 MW
Revenue	**180**	**180**	**220**
Energy National unitary price	75	75	75
certificates FER	105	105	145
Total costs	**96**	**106**	**174**
Operational costs	21	17	104
Capital costs	76	89	70
Profit	**84**	**74**	**46**
Profit without FER	**-21**	**-31**	**-99**

Water as a factor of production. Hydropower market in the Alps: limited availability

The hypothesis to set a limit to the overall exploitation of the resource by redistributing the benefits from hydropower production also to the subjects that cannot receive new concessions, need a **neutral and independent public decision maker** in order **to assure the transparency of the process.**

Clear choices are to be made and shared among the most relevant stakeholders on the affected territory, asking for both economic prosperity and environmental quality of their territory.

Participatory processes, e.g. river contracts, taking advantage of the positive attitude of different subjects (including the “utility” sector) may help improve the direct involvement of the local population both in the developing & management of new planning instruments, and in the definition of decisions about the use of economic returns.

Challenging the “Paradox of Plenty” in the Alps

“Ad rivum eundem lupus et agnus venerant,
siti compulsi. Superior stabat lupus,
longeque inferior agnus. Tunc fauce improba
latro incitatus iurgii causam intulit;
'Cur' inquit 'turbulentam fecisti mihi
aquam bibenti?' Laniger contra timens
'Qui possum, quaeso, facere quod quereris, lupe?
A te decurrit ad meos haustus liquor'. (…)”

Aesop's Fables: Phaedrus - Book I - I. Lupus et Agnus

“Wolf paradox”:

scarcely understandable claims often rely on motivations grounded on hidden ends

Conditions for the Paradox to apply not met in the Alps

- High quality of institutions and governments
- Developed political participation & political voice
- High number and quality of services to the citizens

...even though water is a scarce natural resource

Water Management in the Alps. Final remarks.

- Efficiency seeking *vs.* the “wolf paradox”
- “Rent seeking” through water management of territories can generate an “environmental – economic ends” confusion (search for funds and power?)
  - Most of hydropower potential is exploited in the Alps
  - Great derivations cover the majority of hydroelectric energy supply
  - Cost structure (fixed + variable) calls for improving big plants
  - Central role of public aids (temporary measures) in supporting the sector, especially for smaller plants: need for an “economic sustainability” assessment
  - Need of private investment to enhance the hydropower sector, in a financial crisis
  - Separate management and control/supervision can improve sector efficiency
  - Several stakeholders have to be involved in regional development decisions: diversity is an asset
  - CSR policies, corporate governance and transparency are widely present in the hydropower industry (see: GRI): there is room for agreement on the results
  - Politics should look at social wellbeing and at the final outcomes, not aiming at a direct implementation when this does not translate into higher efficiency
  - Mountain areas host important human assets and a valuable “social capital” (see: RSA 4), that increase the reliability and effectiveness of stakeholders involvement

Water Management in the Alps. Conclusions.

- Economics has been extensively applied in the field of water management
- There is room for improvement in the field of natural hazards and connected economic instruments
- There is a strong need for more accurate valuations and an appropriate metrics
- Applied ecological economics is a relevant research and policy opportunity especially in mountain areas
- Law and economics approach can help manage the delicate issue of new concessions for water derivations
- Rent seeking behaviours need to be assessed in terms of efficiency and social desirability
- Further research is needed on Quality of Life & Human well being, as linked to ecosystems' quality
- The reliability and effectiveness of stakeholders involvement need to be measured and properly supported with appropriate tools and studies

Thank you for your attention and have a good reading!

Danube Floodrisk workshop

Trento, October 3, 2011

Luca Cetara
Adviser for the Italian Ministry for the Environment, Land and Sea
EURAC research, Representing Office Rome
European School of Economics, Milan – Rome Campuses