The Challenge of Implementing Sustainable Development: Integrating Socio-Economic Values in Interdisciplinary Approaches

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ICRE8 International Centre for Research on the Environment & the Economy

SDSN GREECE

LSE THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

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Sustainable development: organizing principle for meeting human development goals while at the same time sustaining the ability of natural systems to provide the natural resources and ecosystem services upon which the economy and society depend.

Desired result: state of society where living conditions and resource use continue to meet human needs without undermining the integrity and stability of the natural system.

Sustainable development can be classified as development that meet the needs of the present without compromising the ability of future generations to do the same.

SUSTAINABLE DEVELOPMENT SOLUTIONS NETWORK

A GLOBAL INITIATIVE FOR THE UNITED NATIONS

A global network of universities, research and innovation centres, civil society organizations, businesses, policymaking and political institutions, to support the science driven implementation of the Sustainable Development Goals (SDGs)

What is the United Nations Sustainable Development Solutions Network – UN SDSN?

- SDSN was launched in 2012 by UN Secretary General Ban-Ki Moon
- In order to mobilize global scientific and technological expertise
- To promote practical problem solving for sustainable development

SDSN-Global, Earth Institute, Columbia University
SDSN-Global Director, Prof. Jeffrey Sachs

SDSN Global

- SDSN Climate Change Work: The Paris Agreement on CC, Deep Decarbonization Pathways, Low Carbon Technology Partnership Initiative

- SDG Academy: platform high-quality mass online education in the field of sustainable development, 1 million students enrolled.

- SDSN Thematic Networks: The World in 2050; Forests, Oceans, Biodiversity, and Ecosystem Services; Redefining the Role of Business for Sustainable Development

- Solution Initiatives promote new technologies, business models, institutional mechanisms, policies and combinations thereof that can dramatically accelerate progress towards sustainable development.

International Centre for Research on the Environment and the Economy (ICRE8)
www.icre8.eu

University of Athens Political Economy of Sustainable Development Lab (PESD)
http://pesd.econ.uoa.gr

Website: www.unsdsn.gr

SDSN GREECE

Co-Chairs
Prof. Phoebe Koundouri
Prof. Andreas Papandreou

Leadership Council
Business, Politicians, NGOs, Policy Making

Youth Section

SDSN Greece Cross-Cutting Themes & Thematic Priorities

CROSS-CUTTING THEMES

Natural Capital Valuation: Sustainable Investment Allocation

Climate Change: Mitigation and Adaptation Policies

Sustainable Development in Times of Crisis

THEMATIC PRIORITIES

Sustainable Shipping and Marine Resources

Sustainable Energy and Energy Security

Sustainable Water-Food-Energy Nexus

Sustainable Tourism and Biodiversity

Education and Training Courses in Sustainable Development

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Is "Sustainable Development" something new?

Physiocrats (18th century), Malthus (19th century), etc...

The Tragedy of the Commons, Garrett Hardin

Science 13 Dec 1968: Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons.

70's Sustainability on Political Agenda

1972: United Nations Environmental Program (UNEP)

1980: World Conservation Strategy

1983: World Commission on Environment and Development (WCED)

1987: Our Common Future

Etc...

2000: Millennium Development Goals

2015: Sustainable Development Goals, Agenda 2030

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***Cluster** of research entities:*

*- **ICRE8**, private not for profit Research Center*

*- **ReSEES/AUEB**: Athens University of Economics and Business, Research on Socio-Economic and Environmental Sustainability (ReSEES) Laboratory*

*- **PESD/NKUA:** National and Kapodistrian University of Athens, Political Economy of Sustainable Development Laboratory*

*- **SDSN-Greece:** United Nations Sustainable Development Solutions Network*

*- **ATHENA**, government Research Center,*

with a strong commitment to research related to Economics, Environment, Energy, (Eco-)Innovation and Sustainability, with an exceptional record in attracting research funding, achieving successful completion of influential projects with explicit policy interventions, and producing numerous academic and popular publications.

SDSN Map of Finished & Ongoing Projects

- **€100+ million of research funding from:** European Commission: DG RTD (FP4,5,6,7, H2020), DG MARE, DG ENV, DG ENER, International Organizations: World Bank, OECD, EBRD, WHO, FAO, UN, Governments in all **5** continents
- **1000+ peer-reviewed research papers & books**

Central Concept:

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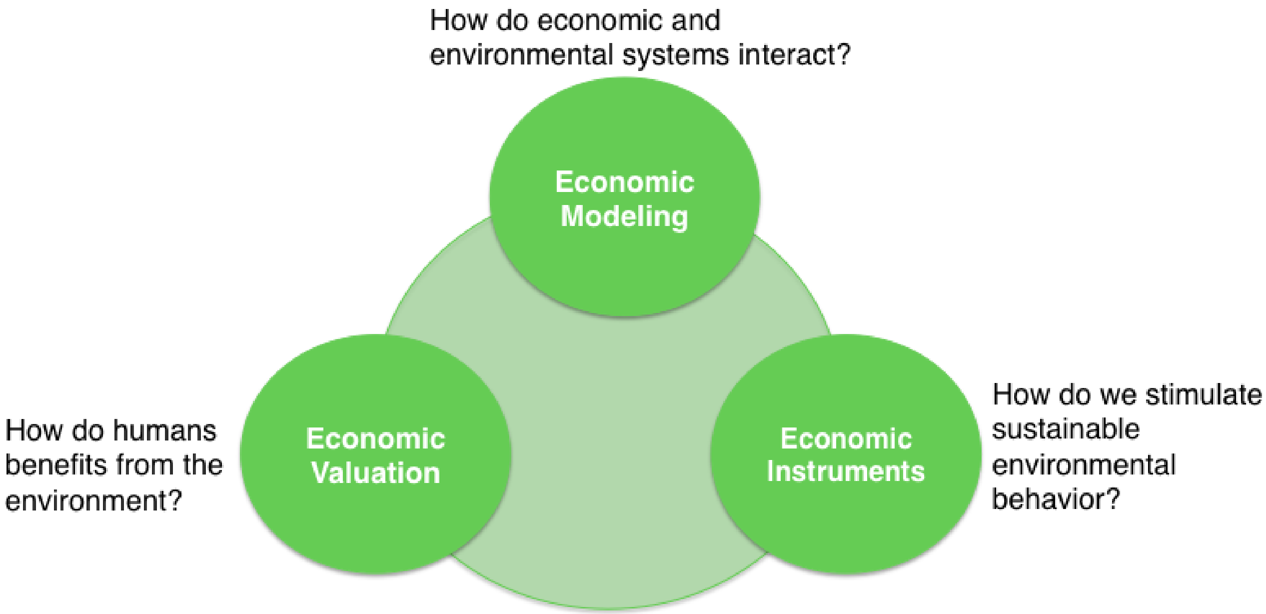
*Achieving **Natural Resources, Economic, Social Sustainability** by developing **scientific and methodologically sound approaches** to recognizing, demonstrating and capturing the **Total Economic Value** of natural resources and other public goods important for social welfare, integrating them in sustainable **management instruments and policy making**, while recognizing the **interdisciplinary** nature of the challenge.*

AN INTRODUCTION TO THE NON-EXPERT

Economics?

Allocation of scarce resources across people, over time & space in a way that social welfare is maximized.

Natural Resources, Environmental and Energy Economics?



Research Lab on Socio-Economic and Environmental Sustainability (ReSEES)

Athens University of Economics and Business

ICRE8 www.icre8.eu

Stages of Interdisciplinary Analysis

CHARACTERIZATION

- Natural Resources,
- Socio-Economic
- Institutional
- Stakeholders

MODELS ON INTERACTION

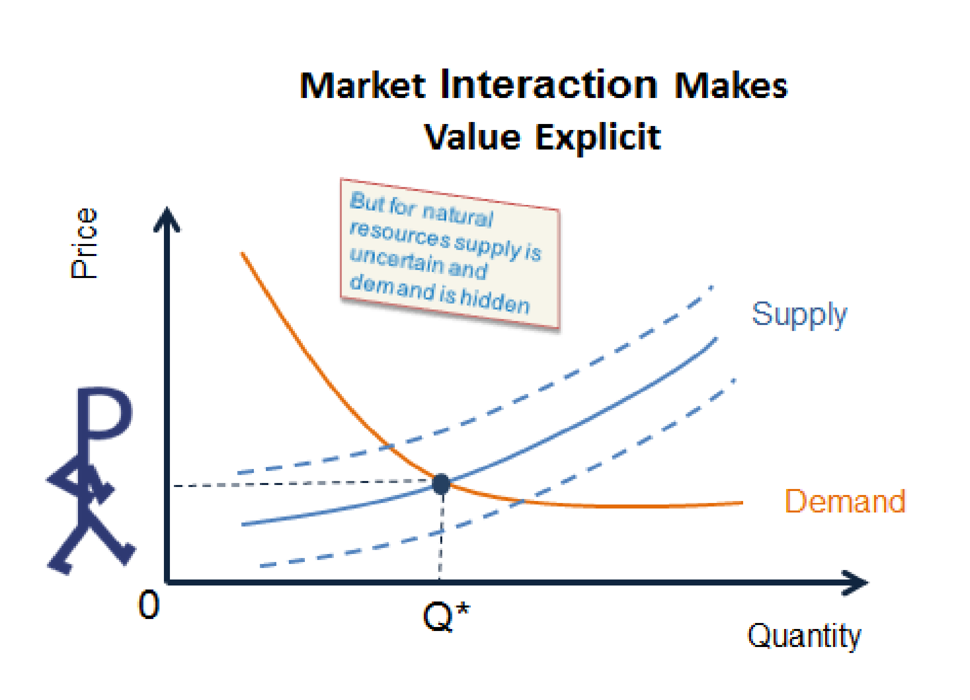
- Nature
- Society
- Economy
- Including CC & SE scenarios

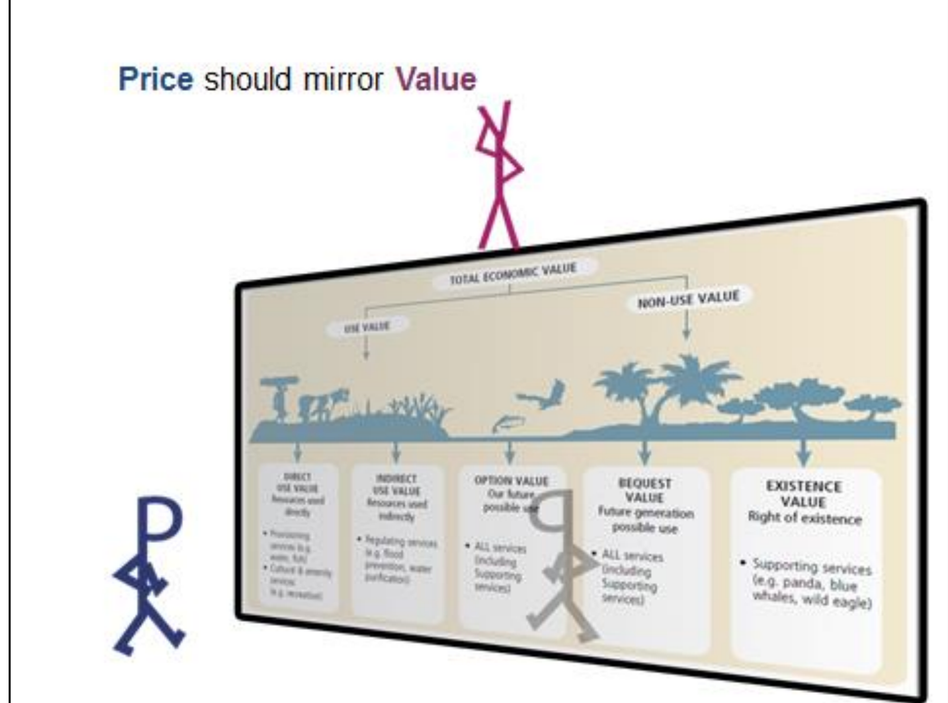
EMPIRICAL APPLICATION of MODELS, FUTURE SIMULATION

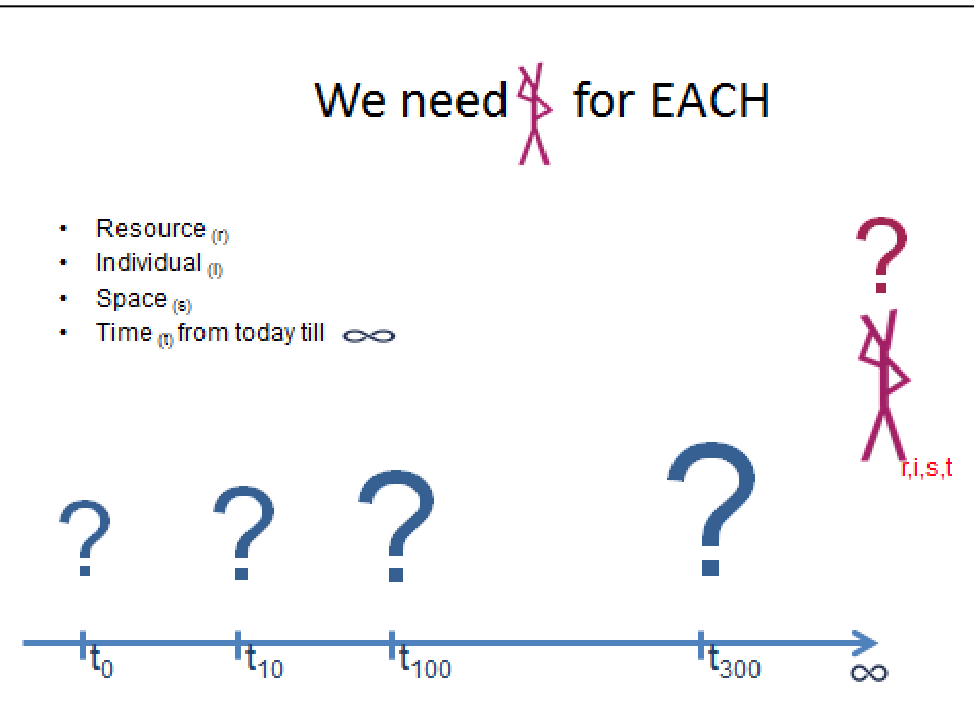
- Quantitative & Qualitative Results
- Decision Criteria (CBA)
- Management and Policy Recommendations

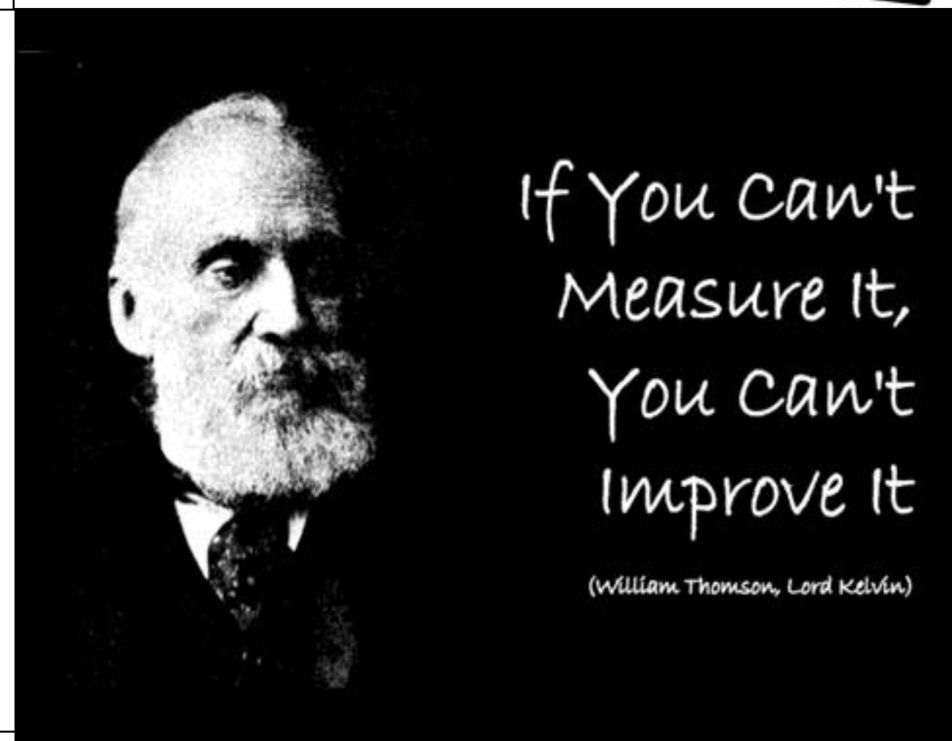
SOLUTIONS & INNOVATION / Stakeholders Adoption and Diffusion

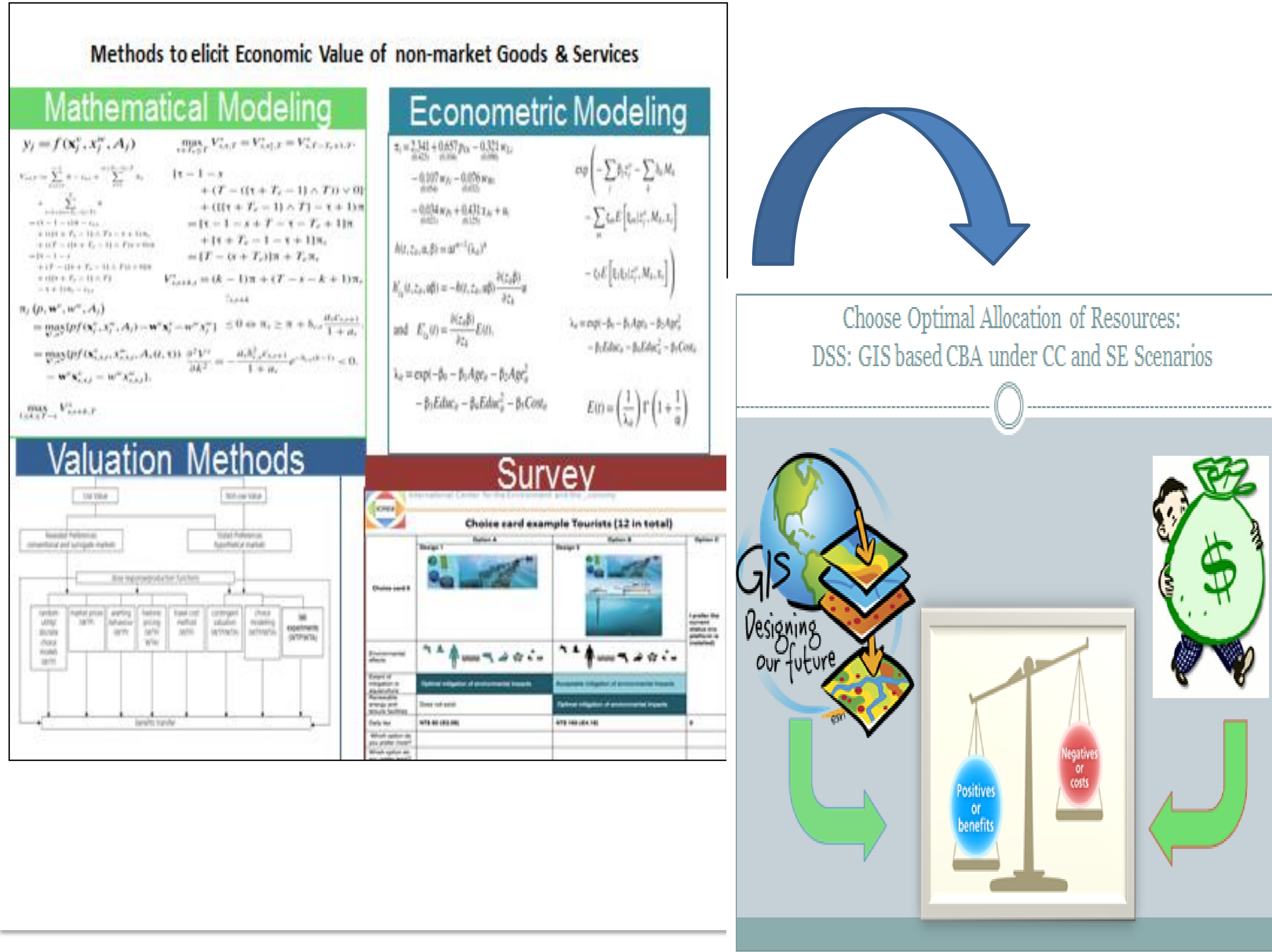
- Socio-Economic Instruments
- Infrastructural Investments
- Nature-Based Solutions
- Technological Innovation
- Social Innovation


Market Interaction Makes Value Explicit
But for natural resources supply is uncertain and demand is hidden
Price
Supply
Demand
0
Q*
Quantity


Price should mirror Value
TOTAL ECONOMIC VALUE
USE VALUE
NON-USE VALUE
OPTION VALUE
BEQUEST VALUE
Future generation possible use
EXISTENCE VALUE
Right of existence
Supporting services (e.g. panda, blue whales, wild eagle)

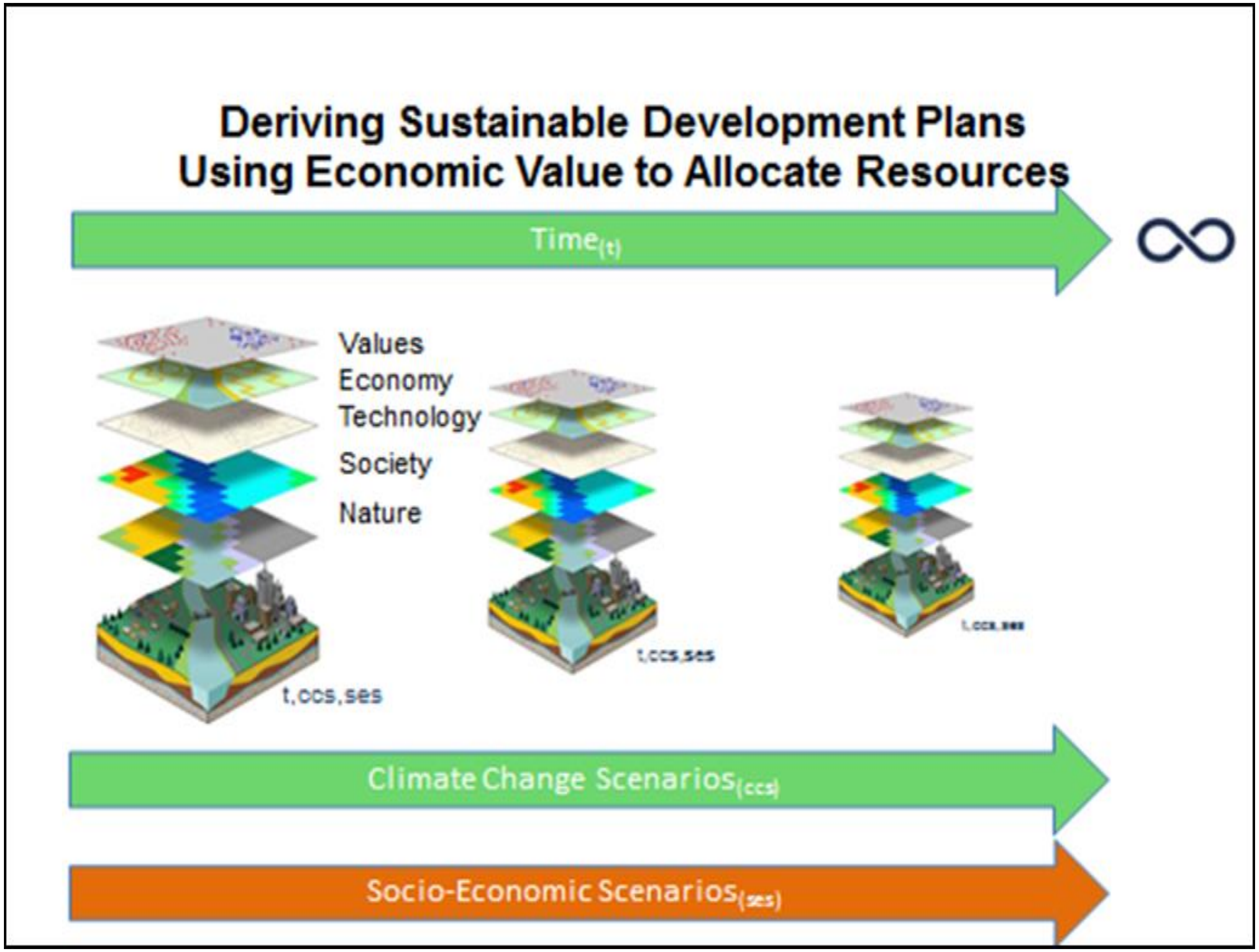

We need for EACH
Resource (r)
Individual (i)
Space (s)
Time (t) from today till ∞
?
r,i,s,t
t0
t10
t100
t300
∞


If You Can't Measure It, You Can't Improve It
(William Thomson, Lord Kelvin)



Methods to elicit Economic Value of non-market Goods & Services
Mathematical Modeling
Econometric Modeling
Valuation Methods
Survey
Choice card example Tourists (12 in total)
Choose Optimal Allocation of Resources:
DSS: GIS based CBA under CC and SE Scenarios
GIS
Designing our future
Positives or benefits
Negatives or costs
$

Implementing Social Welfare Increasing Sustainable Solutions



Nature Based Solutions

Infrastructural Solutions

Socio-Economic Tools

Pricing
Tradable permits
Quotas
Taxes/subsidies
Charges
Direct Controls
Educational/Awareness
Campaigns
Voluntary Agreements
Legal Instruments
Investments

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Our Books

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The Importance of Information in Shaping Values and Sustainable Development

Does relevant information exist?
Who owns it?
Who understands it?
How is it diffused over time/over space?
Is information uncertain?
How people react to information uncertainty?
How we deal with information uncertainty in the Long Run?

Do we face uncertainty or ambiguity?

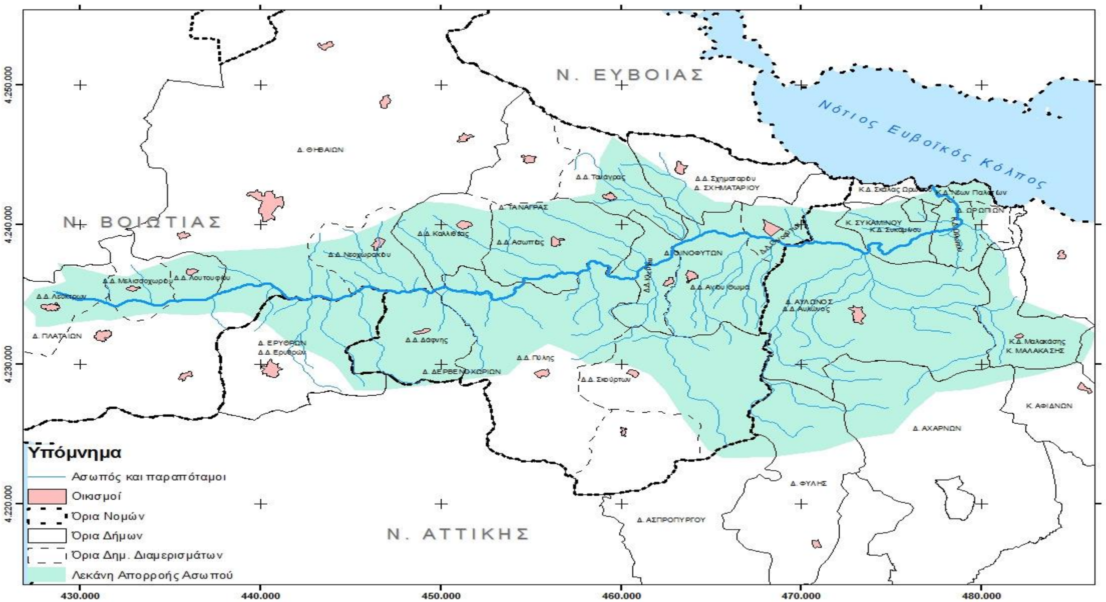
It is important to explicitly incorporate the level, quality & dynamics of information in the theoretical and empirical attempts to measure values.

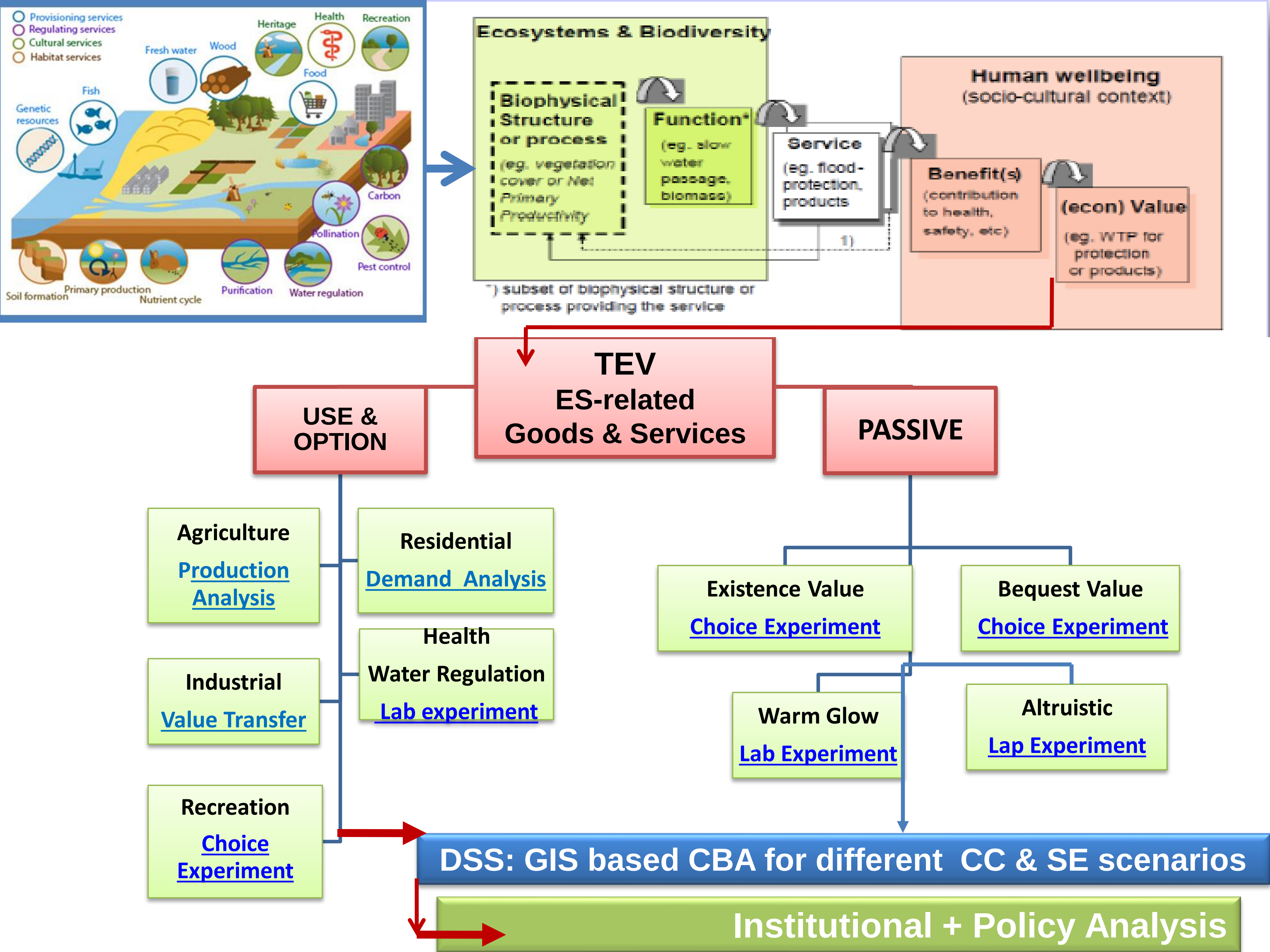
Information is Interdisciplinary!

DERIVING & MANAGING VALUES IN A RIVER BASIN

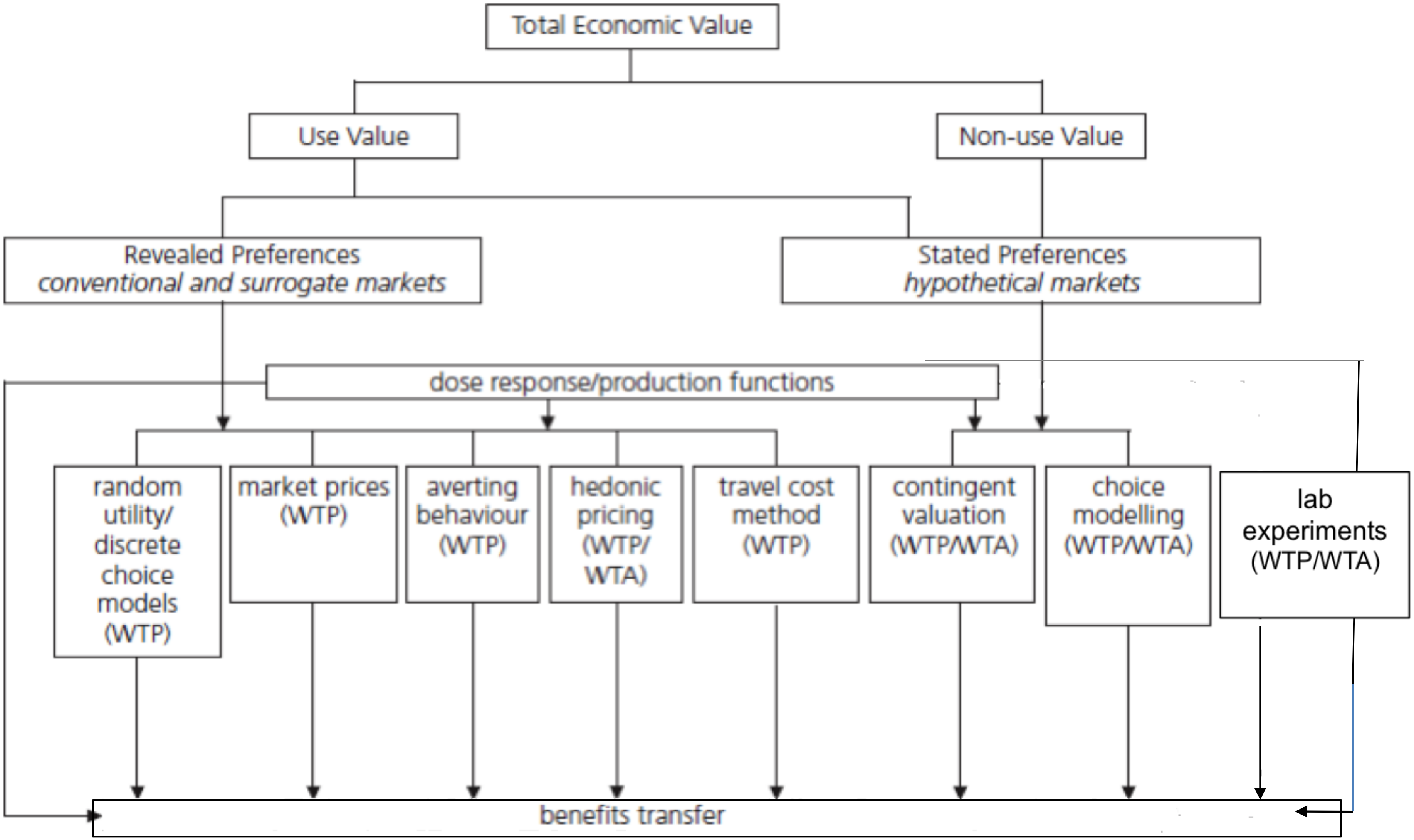
Asopos River Basin

Area 724 km^2 , flows into Evoikos Gulf
Habitat of 140 bird species: Natura 2000
Coastal zone: recreational activities
Largest industrial area & pollution
Agricultural activity & pollution
200,000 citizens (including second houses)



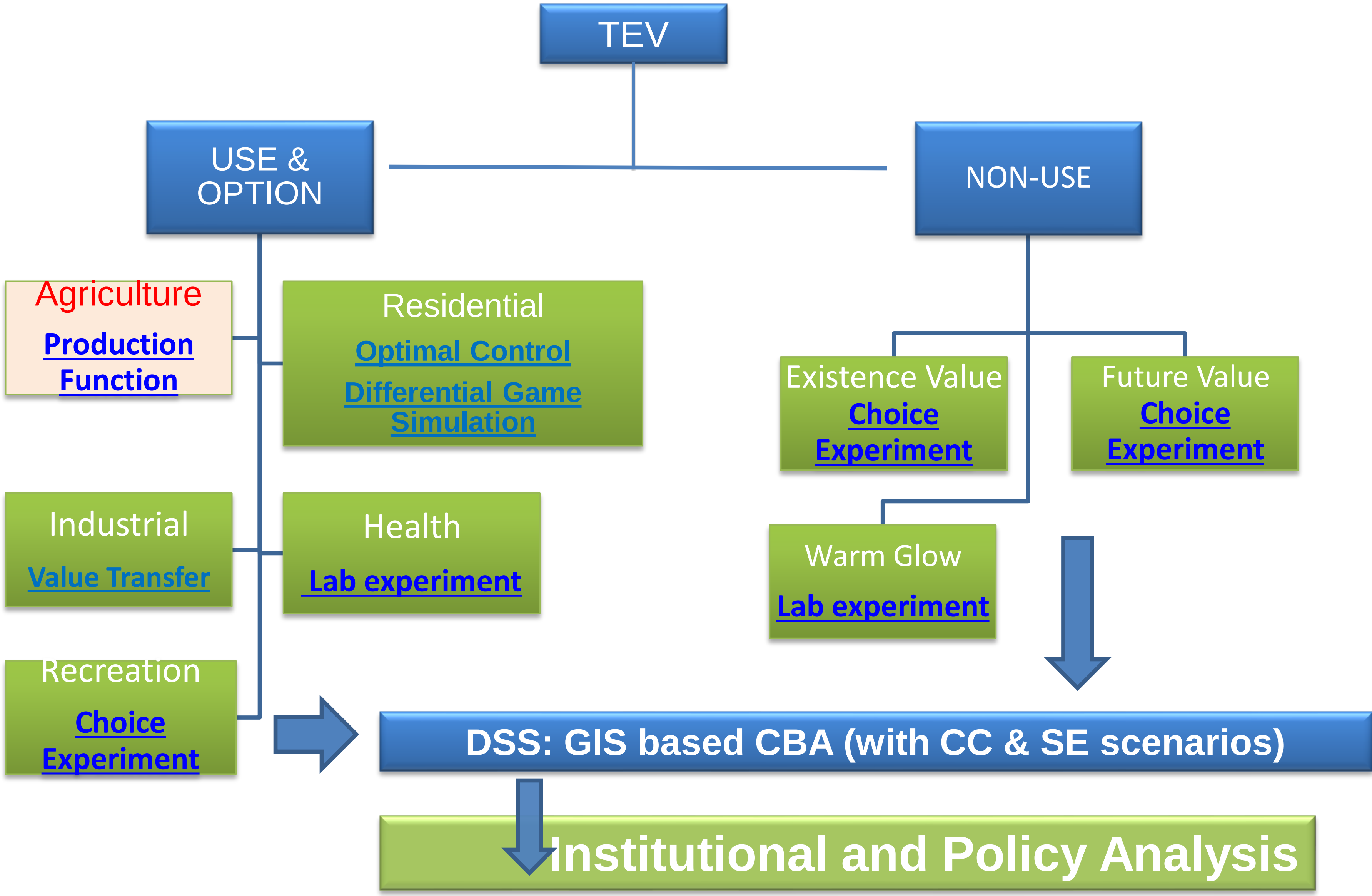


Provisioning services
Regulating services
Cultural services
Habitat services
Heritage
Health
Recreation
Fresh water
Wood
Food
Fish
Genetic resources
Carbon
Pollination
Pest control
Soil formation
Primary production
Nutrient cycle
Purification
Water regulation
Ecosystems & Biodiversity
Biophysical Structure or process
(eg. vegetation cover or Net Primary Productivity
Function*
(eg. slow water passage, biomass)
Service
(eg. flood-protection, products
Human wellbeing
(socio-cultural context)
Benefit(s)
(contribution to health, safety, etc)
(econ) Value
(eg. WTP for protection or products)
1)
*) subset of biophysical structure or process providing the service
TEV
ES-related
Goods & Services
USE & OPTION
PASSIVE
Agriculture
Production Analysis
Residential
Demand Analysis
Health
Water Regulation
Lab experiment
Industrial
Value Transfer
Recreation
Choice Experiment
Existence Value
Choice Experiment
Bequest Value
Choice Experiment
Warm Glow
Lab Experiment
Altruistic
Lap Experiment
DSS: GIS based CBA for different CC & SE scenarios
Institutional + Policy Analysis



- TEV: systematic tool for considering full range of impacts on human welfare.
- TEV: reflects the preferences of individuals.
- Preferences can be studied and estimated by stated & revealed preference methods .
- TEV: essential for resource allocation and policy making.

Total Economic Value of RB



SOCIO-ECONOMIC VALUE OF WATER IN AGRICULTURE, TECHNOLOGY ADOPTION AND DIFFUSION

CONTRIBUTION:

First Model that combines theoretically & empirically :

- Dynamic technology adoption and diffusion under uncertainty
- Different learning processes: social networks, extension, learning by doing
- Identification of peers in social networks
- Risk Preferences estimation
- Socio-economic, environmental and spatial characteristics

Theoretical and Empirical Models are Generic

Policy Recommendations:

- incentivizing welfare increasing technology adoption & diffusion
- water value, pricing and allocation
- CAP, WFD, Food Secutiry, etc.

BACKGROUND LITERATURE

Empirical studies, developed & developing countries, TAD patterns: e.g. Dinar et al. AJAE 1992; Dridi & Khanna AJAE 2005; Koundouri et al. AJAE 2006, Koundouri et. Al. 2013, etc.:

Evidence that:

- economic factors: e.g. water , input prices, cost of irrigation equipment, crop prices
- farm organizational & demographic characteristics: e.g. size of farm operation, educational level, experience
- environmental conditions: e.g. soil quality, precipitation, temperature
- risk preferences with regards to production risk

…matter in explaining TAD.

TAD patterns are conditional on knowledge about new technology: Besley & Case AER 1993; Foster & Rosenzweig JPE 1995; Conley & Udry AER 2010, etc.

Sources of Information/Knowledge:

-Extension Services (private or public): Rivera & Alex 2003; World Bank 2006; Birkhaeuser et al. 1991: ES target specific farmers who are recognized as peers.

-Social Learning: Rogers 1995: via peers (homophilic or heterophilic neighbors)….

PEERS: farmers exerting direct or indirect influence on the whole population of farmers

Homophilic

- Social ties
- Common professional & personal characteristics (education, age, religious beliefs, farming activities etc.)

Heterophilic

- Perceived successful in their farming operation
- Share different characteristics

Measuring the extent of information transmission is **challenging**:

1. **Maertens & Barrett AJAE 2013:** Difficult to define set of Peers, beyond simplistic definition of physical neighbors.

2. **Manski RES 1993:** Difficult to distinguishing learning from other phenomena (interdependent preferences & technologies; related unobserved shocks) that result in similar observed outcomes.

OUR APPROACH:

Theoretical Model: Expected utitlity:

Dynamic ptofit maximization under uncertainty

Empirical Model: econometric duration analysis merged with:

- factor analysis: identification info transmission paths (peers)
- flexible method of moments: for risk attitudes estimation

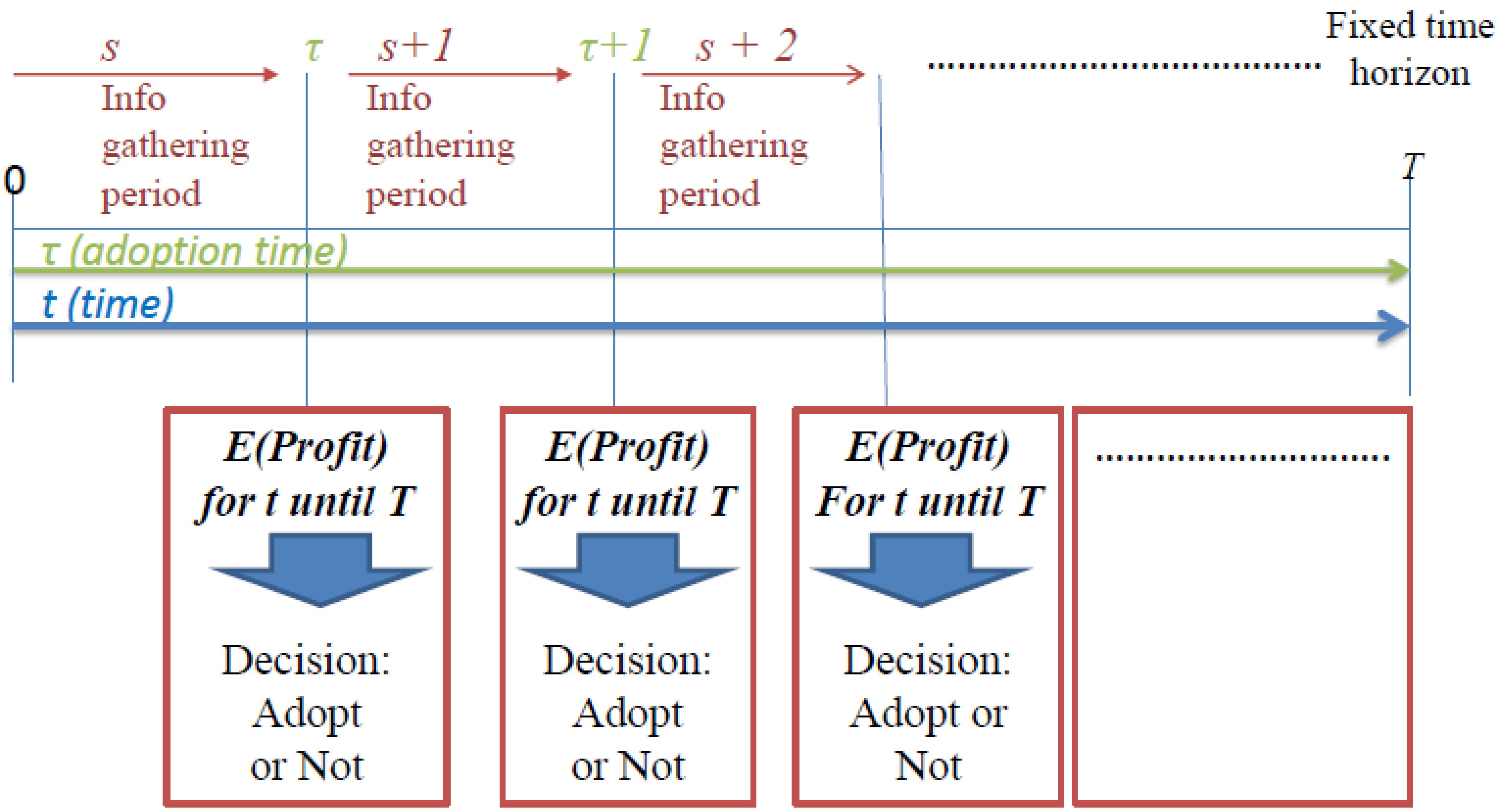
Applied model: micro-dataset olive farms

Analysis of Results & Policy Recommendation

THEORETICAL MODEL

Modeling the timing of Adoption

$$s \in \{0, 1, 2, \ldots, T-1\}, \tau \in \{s+1, \ldots, T\}, t \in \{\tau, \tau+1, \tau+2, \ldots, T\}$$



Farm's j technology, continuous twice-differentiable concave production function:

$$y_j = f(\mathbf{x}_j^v, x_j^w, A_j)$$

y_j: crop production
$\mathbf{x}_j^v$: vector of variable inputs (labor, pesticides, fertilizers, etc.)
x_j^w: irrigation water

$x_j^w < x_{min}^w$, risk of low (or negative) profit in case of water shortage.
Adoption allows hedging against the risk of drought and consequent profit loss.

A_j : technology index: irrigation effectiveness index:
(water used by crop)/(total water applied in field)

Expected Discounted Profit Functions:

- $p, w^w, \mathbf{w}^v$: expected discounted prices (assumed dynamically constant by farmer)

No Adoption

$$\pi_j(p, \mathbf{w}^v, w^w, A_j) = \max_{\mathbf{x}^v, x^w} \{pf(\mathbf{x}_j^v, x_j^w, A_j) - \mathbf{w}^v \mathbf{x}_j^v - w^w x_j^w\}$$

Already Adopted

$$\pi_{s,\tau,t}(p, \mathbf{w}^v, w^w, A_s(t,\tau)) = \max_{\mathbf{x}^v, x^w} \{pf(\mathbf{x}_{s,\tau,t}^v, x_{s,\tau,t}^w, A_s(t,\tau)) - \mathbf{w}^v \mathbf{x}_{s,\tau,t}^v - w^w x_{s,\tau,t}^w\}.$$

$A_j{}^{o}$ with conventional technology

$A_j{}^*$ with new technology farmer produces same y using same $\boldsymbol{x}^v$ and lower x^w

$A_j = A_j{}^*$: max irrigation effectiveness is reached

$A_j{}^* > A_j{}^{o}$: max irrigation effectiveness cannot be reached with $A_j{}^{o}$

May require time before the new technology is operated at A*.

$A_{j,s}(t,\tau)$: the expected, at time s, efficiency index for t, under the assumption the new technology is adopted at time τ.

c , $\partial c_{j,t}/\partial t < 0$: fixed cost of NIT known at period t.

Expected Discounted Equipment Cost:

- At any point in time, s, farmer j assumes a rate of decrease for the discounted equipment cost:

$$c_{s,s+k} = (1 + a_s e^{-\delta_{c,s}(k-1)})c_s^*$$

- $a_s, \delta_{c,s} > 0$

- $c_{s,s+k}$ is a decreasing value of k, and converges to c_s^* , the asymptotic discounted equipment cost for farmer j at time s, as $k \to \infty$.

<u>Note</u>: Farmer considers that technology efficiency index will remain constant after adoption because she does not have enough information to predict the evolution of the technology efficiency after adoption (which is a complex function of learning from others and learning-by-doing).

The model could be extended to allow for the farmers anticipating learning after adoption. Such an extension would need to incorporate assumptions about farmer-specific learning curves, which will differ between adopters based on initial adoption time and farmer-specific socio-economic characteristics.

Such an extension does not alter the learning processes of our model, neither before, nor after adoption, but it does make the first order conditions less clear.

Farmer max over τ her temporal aggregate discounted profit:

$$V_{s,\tau,T} \coloneqq \underbrace{\left[\sum_{t=s+1}^{\tau-1} \pi\right]}_{\text{Discounted profit before adoption}} + \underbrace{\left[\sum_{t=\tau}^{\{\tau+T_e-1\}\wedge T} \pi_s\right]}_{\text{Discounted profit after adoption (technology lifetime)}} \underbrace{- c_{s,\tau}}_{\text{Cost}} + \underbrace{\left[\sum_{t=1+(\{\tau+T_e-1\}\wedge T)}^{T} \pi\right]}_{\text{Discounted profit beyond technology lifetime}}$$

Farmer's Trade-off:

Benefit: Delaying investment by one year allows the farmer to purchase the modern irrigation technology at a reduced cost.

Cost: Delaying adoption by one year results in producing with the conventional, less efficient, technology and bearing a higher risk of water shortage (thus a loss in expected profit).

Adoption Equation: $$\pi_s - \delta_{c,s}(c_{s,s+1} - c_s^*) \geq \pi.$$

The quantity $c_{s,s+1} - c_s^*$ represents approximately the expected excess discounted cost, between choosing to adopt the new technology at time $s+1$, namely, as soon as possible, and postponing the adoption for a very long period, namely, for a period where the rate of decrease of the equipment cost is practically zero.

Heterogeneity in Adoption Decision Deriving from Heterogeneity in E(π) :

- **Farm-specific expected Cost for Technology & Water Efficiency Index**
  - **3 channel of Information Accumulation :**
  - extension services before and after adoption
  - social learning before and after adoption
  - learning by doing after adoption

- **Farm-specific information accumulation depends on:**
  - socioeconomic characteristics (age, education, experience)
  - spatial location
  - behavior of influential peers
  - risk preferences

- **Farm-specific characteristics:**
  - input & output prices
  - environmental conditions (defining min water crop requirements)
  - also risk preferences…

Empirical Measurement of Risk Attitudes
Integrating work from Koundouri et al. series of papers

Methodology:

- Technology adoption under production risk
  - Risk Averse Agents
- Flexible Method of Moments
- Estimate Risk Preference
- Discrete Choice Model of Adoption

Results:

- Risk preferences affect the prob. of adoption: evidence that farmers invest in new technologies to hedge against input related production risk.

- The **option value** (value of waiting to gather better information) of adoption, approximated by education, access to information & extension visits, affects the prob. of adoption.

Technology Choice Depends:

input & output prices

agent's characteristics

fixed cost of the new technology

utility function : $U(.)$

production function : $f(.)$

distribution of risk : $G(.)$

} Deriving an analytical solution is problematic!

Antle (1983, 1987): max E[U(π)] is equivalent to max a function of moments of the distribution of ε (=exogenous production risk), those moments having X as arguments. Agent's program becomes:

$$\max_X E[U(\pi)] = F[\mu_1(X), \mu_2(X), \ldots, \mu_m(X)]$$

$$where\ \mu_j,\ j = 1, 2, \ldots, m\ is\ the\ m^{th}\ moment\ of\ profit$$

Taking a Taylor approximation of $E(U(\pi))$, the FOC of the max problem:

$$\frac{\partial \mu_1(X)}{\partial X_k} = (-1/2!)\frac{\partial \mu_2(X)}{\partial X_k} \cdot \frac{\partial F(X)/\partial \mu_2(X)}{\partial F(X)/\partial \mu_1(X)} + (-1/3!)\frac{\partial \mu_3(X)}{\partial X_k} \cdot \frac{\partial F(X)/\partial \mu_3(X)}{\partial F(X)/\partial \mu_1(X)} + \ldots + (-1/m!)\frac{\partial \mu_m(X)}{\partial X_k} \cdot \frac{\partial F(X)/\partial \mu_m(X)}{\partial F(X)/\partial \mu_1(X)}$$

$$k = 1, \ldots, K \text{ (inputs)}$$

The following model is estimated for each k:

$$\frac{\partial \mu_1(X)}{\partial X_k} = \theta_{1k} + \theta_{2k}\frac{\partial \mu_2(X)}{\partial X_k} + \theta_{3k}\frac{\partial \mu_3(X)}{\partial X_k} + \ldots + \theta_{mk}\frac{\partial \mu_m(X)}{\partial X_k} + u_k$$

$$\text{where} \; : \; \theta_{2k} = -a_{2k}/(2!),\; \theta_{3k} = -a_{3k}/(3!), \ldots, \theta_{mk} = -a_{mk}/(m!)$$

$$: \; a_{jk} = (\partial F(X)/\partial \mu_j(X))/(\partial F(X)/\partial \mu_1(X))$$

$\frac{\partial \mu_1(X)}{\partial X_k}$: marginal contribution of input k to expected profit

$\frac{\partial \mu_2(X)}{\partial X_k}$: marginal contribution of input k to varaince

$\frac{\partial \mu_3(X)}{\partial X_k}$: marginal contribution of input k to skewness

a_{mk} : weight attributed by farmer to the mth moment of profit

Linking Estimated Parameters with Risk Theory:

1. Arrow-Pratt (AP) Absolute Risk Aversion:

+ve if risk averse agent (agent's welfare is negatively affected by higher variance of returns)

$$AP_k = -\frac{E(U''(\pi))}{E(U'(\pi))} \cong -\frac{\partial F(X)/\partial \mu_2(X)}{\partial F(X)/\partial \mu_1(X)} = 2\theta_{2k}$$

2. Down-side (DS) Risk Aversion:

+ve if agent is averse to DS risk (agent's welfare is negatively affected by situations, which offer the potential for substantial gains, but which also leave him slightly vulnerable to losses below some critical level)

$$DS_k = \frac{E(U'''(\pi))}{E(U'(\pi))} \cong \frac{\partial F(X)/\partial \mu_3(X)}{\partial F(X)/\partial \mu_1(X)} = -6\theta_{3k}$$

3. θ_{1k} captures systematic deviations from profit maximization or specification error.

4. k– specific Risk Premium (RP):

The larger amount of money the agent is willing to pay to replace the random vaiable π by its expected value $E(\pi)$, which is a monetary measure of the implicit cost of private risk bearing.

+ve if risk averse agent (concave utility function)

Generalizing Pratt (1964)

$$RP_k = \mu_2 \frac{AP_k}{2} - \mu_3 \frac{DS_k}{6}$$

: where μ_2, μ_3 are measures of 2nd & 3rd moments, respectively.

Estimation Procedure:

1) Estimate conditional expectation of profit using a quadratic functional form: total observed profit is regressed on all levels, squared and cross-products of input expenditures.

2) Use residuals to compute conditional higher moments, which are regressed on all levels, squared and cross-products of input expenditures.

3) Compute analytical expressions for derivatives of these moments with respect to each input.

4) Fit 2SLS of the estimated derivative of the expected profit on derivatives for higher moments.

SURVEY DESIGN
DATA COLLECTION
DESCRIPTIVE STATISTICS

Survey carried out: 2005-06 cropping period.

Greek Agricultural Census used to select a random sample of 265 olive-growers

A pilot survey: none of the surveyed farmers had adopted before 1994.

Farmers were asked to recall data for the years 1994-2004 :

- time of adoption (drip or sprinklers)
- variables related to their farming operation on the same year:

  production patterns

  gross revenues

  input use, water use, cost, structural

  & demographic characteristics.

All information was gathered using questionnaire-based interviews undertaken by the extension personnel from Regional Agricultural Directorate.

Figure 1: Diffusion of Drip Irrigation

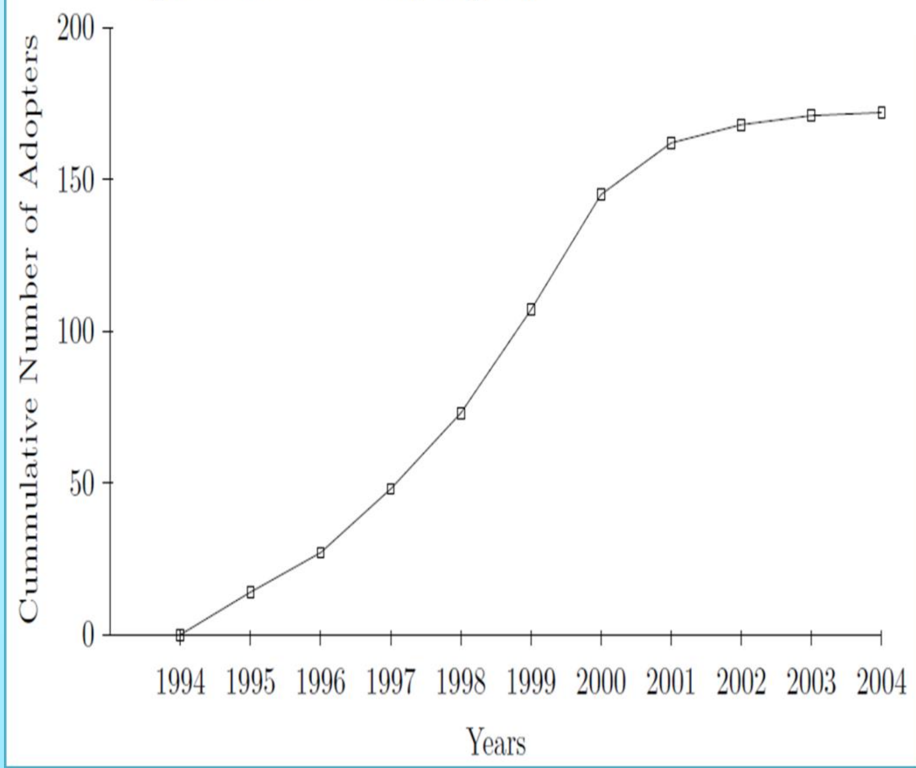


Table 1: Definitions and Summary of the Variables

Variable	All Farms	Adopters	Non Adopters
Number of Farms	265	172	93
Duration length (in years)	–	4.68	–
<u>Farm Characteristics</u>			
Farmer's age (in years)	53.9	49.9	61.3
Farmer's education (in years of schooling)	6.3	8.1	2.9
Farm size (in stremmas)	21.8	22.6	20.2
Tree density (in trees per stremma)	13.6	14.7	11.5
Installation cost (in euros per stremma)	129.3	125.8	135.8
Irrigation water price (in cents per m^3)	20.6	25.7	11.2
Olive-oil price (in euros per kg)	2.80	2.38	3.56
Profit moments:			
1st moment	1.132	1.422	0.596
2nd moment	0.569	0.702	0.323
3rd moment	0.582	0.738	0.293
4th moment	3.566	4.073	2.629
Aridity index	0.982	1.152	0.668
Altitude (in meters)	341.8	167.6	664.1
Soil type (in % of farm land):			
Sandy and Limestone	56.6	62.8	55.2
Marls and Dolomites	43.4	37.2	54.8
<u>Information Variables</u>			
Stock of adopters	31.3	35.4	23.6
Stock of *homophilic* adopters	12.6	15.0	8.1
Stock of farmers' indicated *homophilic* adopters	4.6	5.4	3.2
Distance from the adopters	49.4	44.3	58.7
Distance from *homophilic* adopters	17.4	15.2	21.6
Distance from farmers' indicated *homophilic* adopters	10.1	8.9	12.5
No of extension visits in the area	6.4	8.7	2.2
No of extension visits in *homophilic* farms	3.3	4.8	0.6
No of visits in farmers' indicated *homophilic* farms	2.0	2.9	0.2
Distance of extension outlets:			
from farms in the area	111.2	87.6	154.9
from *homophilic* farms	52.3	34.9	84.3
from farmers' indicated *homophilic* farms	23.6	17.0	35.6

All data refer to the year of adoption as those have been recalled by individual farmers. Monetary values have been deflated prior to econometric estimations.

EMPIRICAL MODEL:

DURATION ANALYSIS

FACTOR ANALYSIS

FLEXIBLE METHOD OF MOMENTS

Duration Model of Adoption and Diffusion

Duration model : conditional probability of adoption at a particular period, given:

- adoption has not occurred before
- farmer-specific information channels
- socioeconomic (& risk attitudes) characteristics
- environmental & spatial characteristics

T : duration, +ve RV with $f(t)$ continuous prob. density function

$F(t) = \int_0^t f(s)\,ds = P(T \leq t)$: cumulative distribution function

$S(t) = 1 - F(t) = 1 - \int_0^t f(s)\,ds = \int_t^\infty f(s)\,ds$: survival function

Prob. of survival (of old technology) beyond t

$1 - S(t)$: prob. farmer adopts by t

$1 - S(t)$: $E(\textit{Innovation Diffusion}) =$ share of adopting farmers

$h(t)$: hazard function (rate), rate at which individuals will adopt the technology in period t, conditional on not having adopted before t:

$$h(t) = \lim_{\Delta \to 0}\left(\frac{F(t+\Delta) - F(t)}{\Delta S(t)}\right) = \frac{f(t)}{S(t)}$$

empirical counterpart of adoption equation from theoretical model.

Empirical Hazard Function: estimated by Maximum Likelihood techniques

Assume T follows a Weibull distribution the hazard function is:

$$h(t, z_{it}, \alpha, \beta) = \alpha t^{\alpha-1} (\lambda_{it})^{\alpha}$$

α : scale parameter

α > 1: hazard rate increases monotonically with time

α < 1: hazard rate decreases monotonically with time

α = 1: hazard rate is constant

$$\lambda_{it} = \exp(-z_{it}\beta)$$

vector z_{it} : variables that determine farmers' optimal choice

β : corresponding unknown parameters

Before estimating the HF we need to estimate the <u>risk attitudes</u> & <u>information variables</u>, in order to include them in the empirical HF.

Production Risk & Moments of Profit Distribution

Koundouri et al. utilizing moments of the profit distribution as determinants of adoption.

Using recall data on:

- olive-oil revenues
- variable inputs (labor, fertilizers, irrigation water, pesticides)
- fixed (land) input

Estimated profit function:

$$\pi_i = \underset{(0.423)}{2.341} + \underset{(0.104)}{0.657}\, p_{Oi} - \underset{(0.098)}{0.321}\, w_{Li} - \underset{(0.054)}{0.107}\, w_{Fi} - \underset{(0.032)}{0.076}\, w_{Wi} - \underset{(0.021)}{0.034}\, w_{Pi} + \underset{(0.125)}{0.431}\, x_{Ai} + u_i$$

The residuals have been used to estimate the *kth* central moments *(k=1,…,4)* of farm profit conditional on variable and fixed input use.

PEERS: farmers exerting direct or indirect influence on the whole population of farmers

Homophilic

- Social ties
- Common professional & personal characteristics (education, age, religious beliefs, farming activities etc.)

Heterophilic

- Perceived successful in their farming operation
- Share different characteristics

Measuring the extent of information transmission is challenging:

1. **Maertens & Barrett AJAE 2013:** Difficult to define set of Peers, beyond simplistic definition of physical neighbors.

2. **Manski RES 1993:** Difficult to distinguishing learning from other phenomena (interdependent preferences & technologies; related unobserved shocks) that result in similar observed outcomes.

Measurement of Information Transmission

Table 2: Correlation Matrix of the Twelve Information Indicators

Variable	*Stock*	*HStock*	*RStock*	*Dista*	*HDista*	*RDista*	*Ext*	*HExt*	*RExt*	*Distx*	*HDistx*	*RDistx*
Stock	1.000											
HStock	**0.673**	1.000										
RStock	**0.579**	**0.772**	1.000									
Dista	-0.439	-0.526	-0.572	1.000								
HDista	-0.326	-0.450	-0.478	**0.732**	1.000							
RDista	-0.254	-0.410	-0.429	**0.692**	**0.919**	1.000						
Ext	0.521	0.624	0.767	-0.585	-0.521	-0.453	1.000					
HExt	0.519	0.599	0.735	-0.573	-0.510	-0.445	**0.918**	1.000				
RExt	0.520	0.595	0.719	-0.600	-0.503	-0.451	**0.882**	**0.934**	1.000			
Distx	-0.453	-0.539	-0.534	0.521	0.472	0.428	-0.556	-0.570	-0.565	1.000		
HDistx	-0.529	-0.535	-0.489	0.448	0.447	0.373	-0.496	-0.534	-0.507	**0.791**	1.000	
RDistx	-0.459	-0.455	-0.416	0.422	0.428	0.386	-0.424	-0.430	-0.417	**0.648**	**0.842**	1.000

where *Stock* is the stock of adopters, *HStock* is the stock of *homophilic* adopters, *RStock* is the stock of farmers' indicated *homophilic* adopters, *Dista* is the distance from the stock of adopters, *HDista* is the distance from the stock of *homophilic* adopters, *RDista* is the distance from the

SOCIAL NETWORK CHANNEL I:
Total no. of adopters in farmer's reference group

Stock: stock of adopters on the year the farmer adopted

HStock: stock of homophilic adopters (same age -6 year range- and education -2 year range-)

RStock: stock of farmer-perceived homophilic adopters

SOCIAL NETWORK CHANNEL II:
Distance of farmer to adopters in her reference group

- **Dista :** average distance to adopters
- **HDista:** average distance to homophilic adopters
- **RDista :** average distance to farmer-perceived homophilic adopters

EXTENSION SERVICES CHANNEL I:
Overall exposure of farmer to Extension Services

- **Ext :** no. on-farm extension visits until the year of adoption
- **Hext:** no. on-farm extension visits to homophilic farmers
- **RExt :** no. on-farm extension visits to farmer-perceived homophilic adopters

EXTENSION SERVICES CHANNEL II:
Distance of farmer to Extension Agencies

- **Distx :** distance of the respondent to the nearest EA
- **HDistx :** average distance of homophilic farmers to the nearest EA
- **RDistx :** average distance of farmer-perceived homophilic adopters to the nearest EA

Factor Analysis:
Information Transmission Paths & Peers

To describe variability among observed (correlated) variables, in terms of lower number of unobserved variables (factors).

The observed variables modeled as linear combinations of unobserved factors, plus error terms.

Factor analytic model estimated using principal components method with varimax rotation: $E(\xi_{mi}|x_{is})$

Table 3: Estimation Results of the Factor Analytic Model for Informational Variables *Factor analytic model estimated using principal components method with varimax rotation*

Variable	Stock of Adopters (ξ_1)	Distance between Adopters (ξ_2)	Exposure to Extension (ξ_3)	Distance from Extension Outlets (ξ_4)
Stock	0.8188	-0.0873	0.2280	-0.2955
HStock	0.7729	-0.2465	0.3509	-0.2454
RStock	0.6801	-0.2574	0.6080	-0.1772
Dista	-0.2850	0.7143	-0.3478	0.2061
HDista	-0.1290	0.9022	-0.2288	0.2234
RDista	-0.0858	0.9270	-0.1767	0.1758
Ext	0.2762	-0.2554	0.8562	-0.2160
HExt	0.2311	-0.2324	0.8818	-0.2537
RExt	0.2359	-0.2489	0.8667	-0.2343
Distx	-0.1854	0.2420	-0.3565	0.7465
HDistx	-0.2519	0.1683	-0.2311	0.8847
RDistx	-0.2032	0.2051	-0.1216	0.8687

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RExt	0.2359	-0.2489	0.8667	-0.2343
Distx	-0.1854	0.2420	-0.3565	0.7465
HDistx	-0.2519	0.1683	-0.2311	0.8847
RDistx	-0.2032	0.2051	-0.1216	0.8687

Estimation of Hazard Model

$$\lambda_{it} = \exp\Big(-\beta_0 - \beta_1 Age_{it} - \beta_2 Age_{it}^2 - \beta_3 Educ_{it} - \beta_4 Educ_{it}^2 - \beta_5 Cost_{it} - \beta_6 Fsize_{it} - \beta_7 Dens_{it}$$

$$-\beta_8 w_{Wit} - \beta_9 p_{Oit} - \beta_{10} Ard_{it} - \beta_{11} Alt_i - \beta_{12} Soil_{sl,i} - \sum_{k=1}^{4} \delta_k M_{kit} \sum_{m=1}^{4} \zeta_m \hat{\xi}_{mit} - \zeta_5 \hat{\xi}_{1it} \hat{\xi}_{3it}\Big) \quad (22)$$

Using regression calibration we approximate :

$$E\left[\exp\left(-\sum_j \gamma_j z_j^o - \sum_k \delta_k M_k - \sum_m \zeta_m \xi_m - \zeta_5 \xi_1 \xi_3\right)\right]$$

By: $$\exp\left(-\sum_j \gamma_j z_j^o - \sum_k \delta_k M_k - \sum_m \zeta_m E\left[\xi_m | z_j^o, M_k, x_s\right] - \zeta_5 E\left[\xi_1 \xi_3 | z_j^o, M_k, x_s\right]\right)$$

Assume the 4 latent variables, conditional on 12 InfoVar are uncorrelated with the explanatory variables, $E(\xi_m | z_j^o, M_k, x_s) = E(\xi_m | x_s)$, the estimated factor scores can be used in the hazard function.

EMPIRICAL RESULTS & POLICY IMPLICATIONS

A Reminder of the Empirical Method

Sample of 265 randomly selected olive-growing farms in Crete, Greece.

Estimate higher moments of profit (Flexible Method of Moments).

Estimate factor scores (PCA & varimax rotation).

Merge profit moments & factor scores in hazard function and estimate a duration model (right censored ML)

Consistent standard errors via stationary bootstrapping (Politis & Romano 1994)

Estimation Robustness Checks:

Estimation of hazard function including & excluding 4 latent variables.

All key explanatory variables in both models are found statistically significant.

Signs of estimated parameters remarkably stable between models.

Akaike and the Bayesian information criteria: full model is more adequate

Predicted mean adoption times are not statistically different: 5.76 and 5.74 in the full and reduced model, respectively.

Table 4: Maximum Likelihood Parameter Estimates of Alternative Specifications of the Hazard Function for the Adoption of Drip Irrigation Technology by Cretan Olive Farms

Variable	Model A.1		Model A.2	
	Estimate	t-ratio	Estimate	t-ratio
Constant	1.5617	1.8077	1.4303	1.5633
Farmer's age	-0.0168	-2.4766	-0.0106	-1.3404
Farmer's age-squared	0.0001	2.1568	0.0001	1.1931
Farmer's education	0.0182	1.1456	0.0347	2.2150
Farmer's education-squared	-0.0010	-1.5354	-0.0021	-3.0807
Installation cost	0.0089	1.0786	0.0099	1.1629
Farm size	-0.0048	-0.3848	-0.0117	-0.8617
Tree density	-0.0127	-3.7991	-0.0109	-2.9231
Water price	-0.0164	-10.892	-0.0205	-13.694
Crop price	0.0596	1.8796	0.0658	1.8465
1^{st} profit moment	-0.0943	-2.5987	-0.1132	-2.7071
2^{nd} profit moment	-0.1752	-2.4884	-0.1611	-1.8807
3^{rd} profit moment	0.0292	0.9414	0.0770	1.6685
4^{th} profit moment	-0.0024	-0.3167	-0.0125	-1.0554
Aridity index	-0.0389	-1.1718	-0.0412	-1.3601
Farm altitude	0.0006	3.3071	0.0005	2.9544
Sandy and limestone soils	-0.0002	-0.0075	0.0265	0.7475
Stock of adopters	-0.0509	-1.9745	-	-
Distance between adopters	0.0299	1.6498	-	-
Exposure to extension	-0.0531	-2.7988	-	-
Distance from extension outlets	-0.0238	-1.6691	-	-
(Stock of adopters)X(Exposure to extension)	-0.0554	-3.5119	-	-
Scale parameter (α)	9.1085	15.075	8.0932	16.420
Log-Likelihood	107.709		86.834	
Akaike Information Criterion	-0.639		-0.520	
Bayesian Information Criterion	-0.329		-0.276	
Mean Adoption Time	5.76		5.74	

-ve coefficient implies faster adoption

Table 5: Marginal Effects of the Explanatory Variables on the Hazard Rate and Mean Adoption Time of Drip Irrigation Technology Adoption

Variable	Model A.1		Model A.2	
	Hazard Rate	Adoption Time	Hazard Rate	Adoption Time
Farmer's age	0.015	-0.010	0.007	-0.006
Farmer's education	-0.047	0.031	-0.058	0.047
Installation Cost	-0.079	0.051	-0.070	0.057
Farm size	0.043	-0.028	0.082	-0.067
Tree Density	0.112	-0.073	0.077	-0.063
Water Price	0.145	-0.095	0.145	-0.118
Crop Price	-0.525	0.343	-0.464	0.378
1^{st} profit moment	0.831	-0.543	0.798	-0.650
2^{nd} profit moment	1.544	-1.009	1.136	-0.925
3^{rd} profit moment	-0.258	0.168	-0.543	0.442
4^{th} profit moment	0.021	-0.014	0.088	-0.072
Aridity Index	0.343	-0.224	0.291	-0.237
Altitude	-0.005	0.003	-0.004	0.003
Sandy-Limestone soils	0.002	-0.001	-0.190	0.152
Stock of adopters	0.449	-0.293	–	–
Distance between adopters	-0.264	0.172	–	–
Extension services	0.468	-0.306	–	–
Distance from extension outlets	0.210	-0.137	–	–

Marginal effects are computed at the means values of explanatory variables. For the case of dummy variables, they are computed as the difference between the quantity of interest when the dummy takes the value 1 and when it takes a 0 value.

Discussion of Results I : Epidemic Effects

Scale parameter (Weibull hazard function) significant $\alpha > 1$:

Endogenous learning due to reductions in uncertainty resulting from extensive use of the new technology: **learning-by-doing effects.**

Empirical Result II: Complementarity of Information Channels

- Interaction term between the two channels of information transmission is significant and -ve: complementarity.
- The passage of information is improved when utilizing BOTH rules of thumb (manuals and blueprints) mainly utilized by extension personnel AND strong social networks between olive-growers exist.

Empirical Results III: Extension & Social Learning

EXTENSION SERVICES

- Exposure to extension services induces faster adoption
- The bigger the distance from extension outlets the shorter the time before adoption. Extension agents primarily targeting farmers in remote areas

SOCIAL LEARNING

- Larger stock of adopters in the farmer's reference group induces faster adoption
- Greater distance between adopters increases time before adoption

The impact of social learning is comparable to the impact of information provision by extension personnel, mean marginal effects on adoption times:

- 0.293 for the stock of adopters
- 0.306 for exposure to extension services

Policy Recommendations from I, II, III

PR1: ES more effective in areas where there is already a **critical mass of adopters**.

PR2: Spatial dispersion of extension outlets should be designed away from market centers in a way that allows minimization of the average **distance between outlets and peer farms** in remote areas.

PR3: Nature of extension provision should be designed taking into account its **complementarity** with farmers' social networks.

Empirical Result IV: Human Capital Variables
Significant Impact of AGE & EDUCATION

Marginal Effect Farmer's Age on adoption time: -0.010 years

- up to 60: time before adoption decreases (experience effect)
- after 60: follows an increasing trend (planning horizon effect)

Marginal Effect of Education:

- E < 9 years (elementary schooling): time until adoption increases
- E > 9 years: faster adoption rates

Empirical Result V: Risk Attitudes Important Determinants of Adoption Behavior

- Higher expected profit & higher variance of profit induce faster adoption: Risk adversely affected by a high variability in returns.
- Adoption reduce production risk in periods of water shortage (confirms Koundouri et al. 2006 & Groom et al. 2008).
- 3rd & 4th moments of profit insignificant: farmers are not taking downside yield uncertainty into account when deciding whether to adopt.

Empirical Result VI: Environmental Variables, Input & Output Prices, Important Determinants of Adoption Behavior

- Adverse weather conditions induce faster irrigation technology adoption (magnitude of the effect is small).
- Olive farms with high tree density adopt faster.
- Marginal value of irrigation water in agr. production: 0.076 euro
- Water Price significant effect speeding up diffusion (0.145 and -0.95, respectively): Efficient water pricing important
- Higher crop price delays adoption rates (marginal effect is 0.343 years): reduced incentives to change irrigation practices.

Policy Recommendations from IV, V, VI

PR4: **Efficient pricing** of agricultural inputs and outputs should become an explicit target of the reformed agricultural policy as it crucial affect adoption.

PR5: **Farmer's characteristics** (education, age) and **environmental variables** (aridity, altitude) are important drivers and should be integrated in relevant policies.

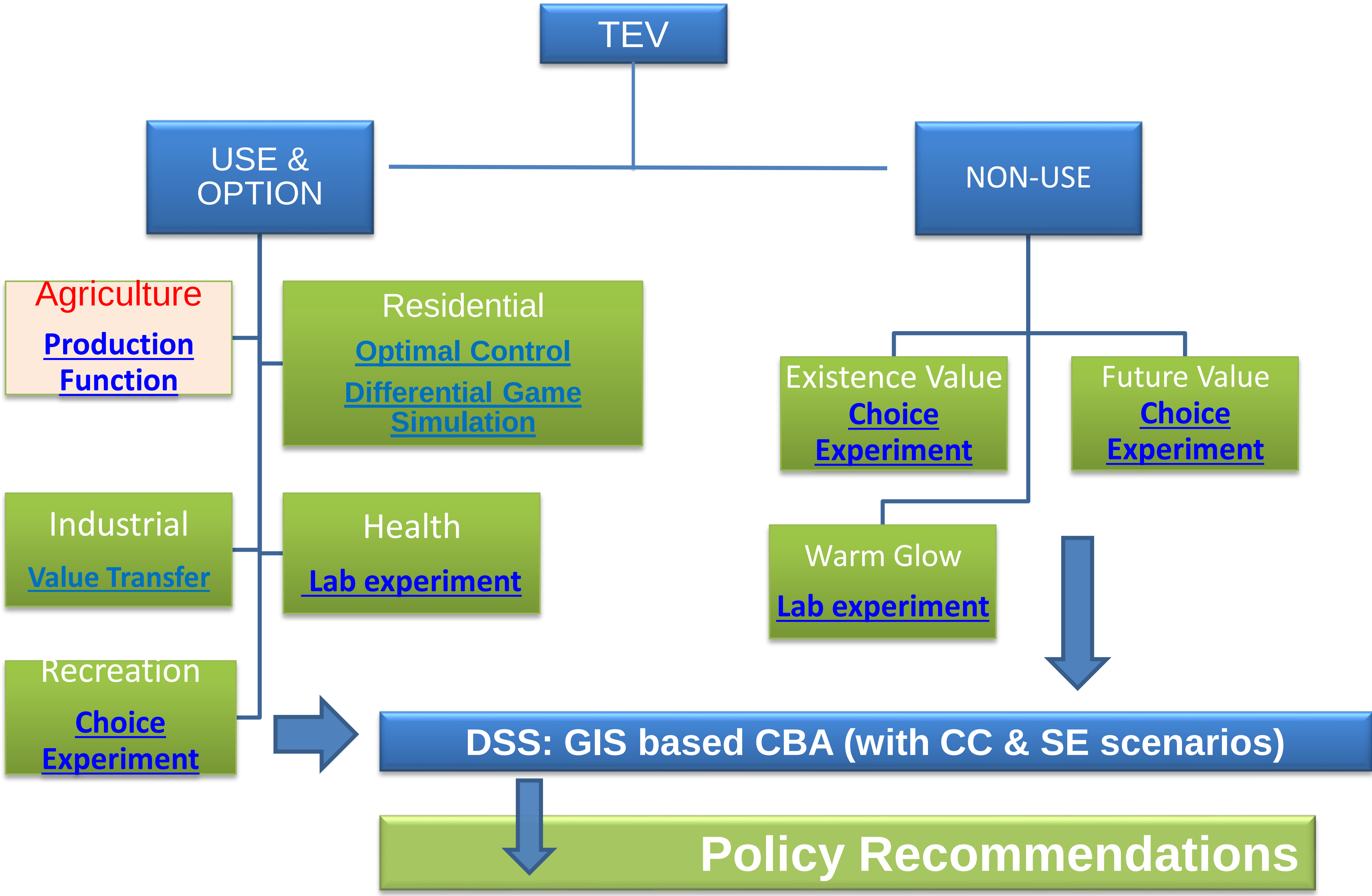
PR6: Policy makers should take into account the level of **farmers' risk-aversion**, in order to correctly predict the technology adoption and diffusion effects, as well as the magnitude and direction of input responses.

Relevant Existing Policies:

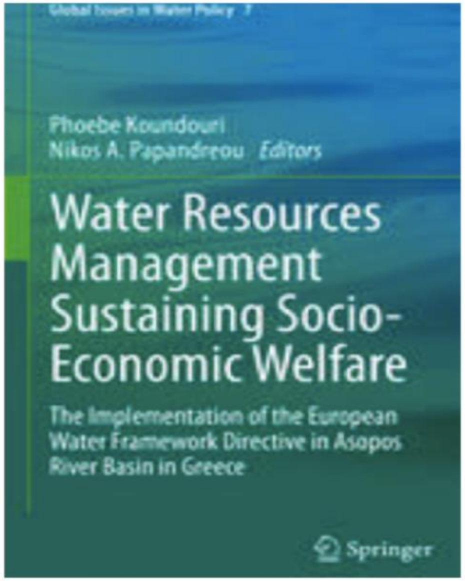
EU CAP reform; EU Environmental Directives (WFD, MSFD, EIA, et.)

Europe 2020 vision: Stimulating Sustainable (eco & env) Inclusive Growth.

Total Economic Value of RB



ASOPOS Project Deliverables



1. A Birds Eye View of the Greek Water Situation: The Potential for the Implementation of the EU WFD

2. Introducing the Case Study, the Asopos River Basin in Greece
The Economic Characterization of Asopos River Basin

3. Simulating Residential Water Demand and Water Pricing Issues

4. An Econometric Analysis of Agricultural Production: the Shadow Price of Groundwater

5. A Choice Experiment for the Estimation of the Economic Value of the River Ecosystem: Management Policies for Sustaining NATURA (2000) species and the Coastal Environment

6. A Value Transfer Approach for the Economic Estimation of Industrial Pollution: Policy Recommendations

7. A Laboratory Experiment for the Estimation of Health Risks: Policy Recommendations

8. An Economically Efficient, Environmentally Sustainable and Socially Equitable Decision Support System for Asopos River Basin: A Manual of Measures

9. Creating the Institutional Background to Support the Implementation of the Policy Manual

1) Natural Capital Valuation: Sustainable Investment Allocation

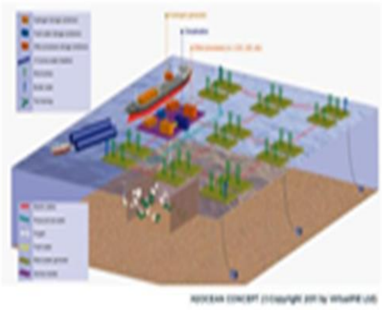
2 ZERO HUNGER
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
17 PARTNERSHIPS FOR THE GOALS

Indicative Projects

MERMAID
AQUASTRESS
BlueBRIDGE
REFRESH
GENESIS groundwater and dependent ecosystems
The ARID Cluster
TROPOS

Sustainable Energy and Resource Management

OCEANS of TOMORROW, EC-DG Research-FP6; Budget: 20,000,000



Development of a wind- wave power open-sea platform equipped for hydrogen generation with support for multiple users of energy

http://www.h2ocean-project.eu/

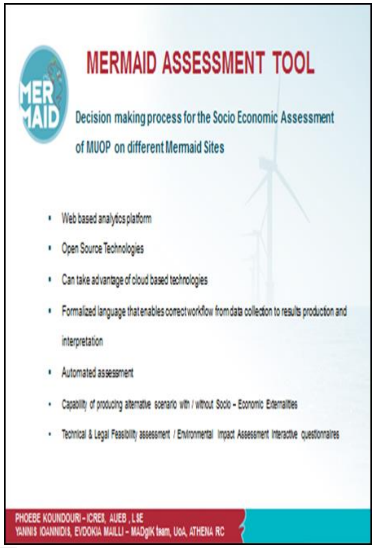
Innovative multi-purpose offshore platforms: planning, design and operation

http://www.mermaidproject.eu/

Modular multi-use deep water offshore platform harnessing and servicing Mediterranean, subtropical and tropical marine resources

http://www.tropospla tform.eu/

Innovative Multi-purpose offshore platforms: planning, design & operation

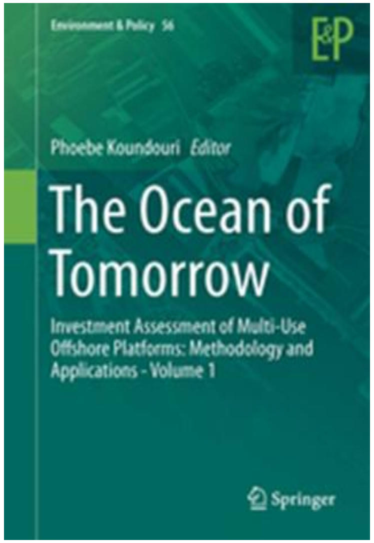


MERMAID ASSESSMENT TOOL

Decision making process for the Socio Economic Assessment of MUOP on different Mermaid Sites

- Web based analytics platform
- Open Source Technologies
- Can take advantage of cloud based technologies
- Formalized language that enables correct workflow from data collection to results production and interpretation
- Automated assessment
- Capability of producing alternative scenario with / without Socio – Economic Externalities
- Technical & Legal Feasibility assessment / Environmental Impact Assessment Interactive questionnaires

PHOEBE KOUNDOURI - ICRE8, AUEB, LSE
YANNIS IOANNIDIS, EVOOKIA MAILLI - MADgIK team, UoA, ATHENA RC

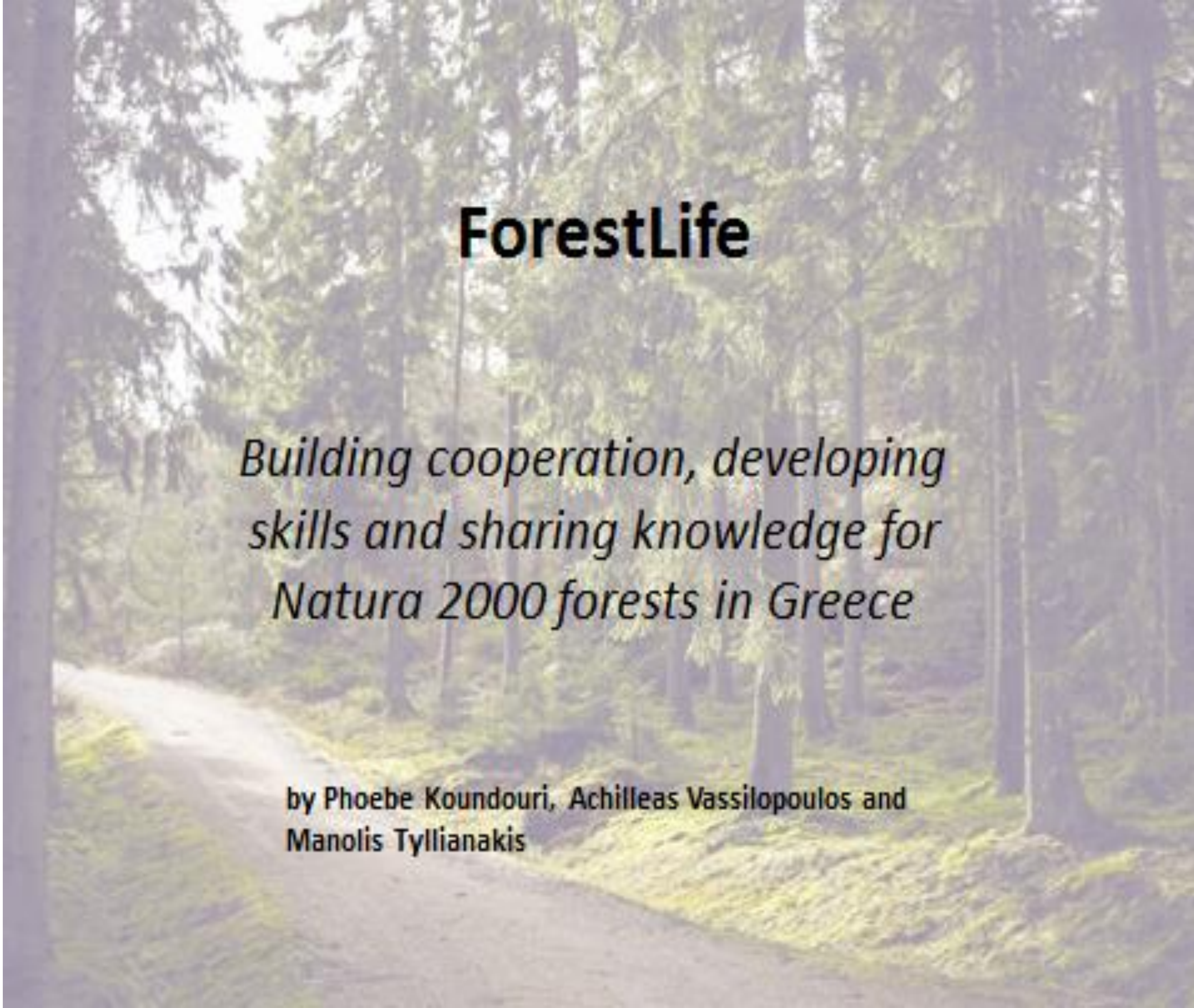


Sustainable Energy and Resource Management

The BlueBRIDGE Project –

Addressing the Blue Societal Challenge
H2020. Budget: 10,000,000 euro

Building Research environments fostering Innovation, Decision Making, Governance and Education to support Blue Growth



ForestLife

Building cooperation, developing skills and sharing knowledge for Natura 2000 forests in Greece

by Phoebe Koundouri, Achilleas Vassilopoulos and Manolis Tyllianakis

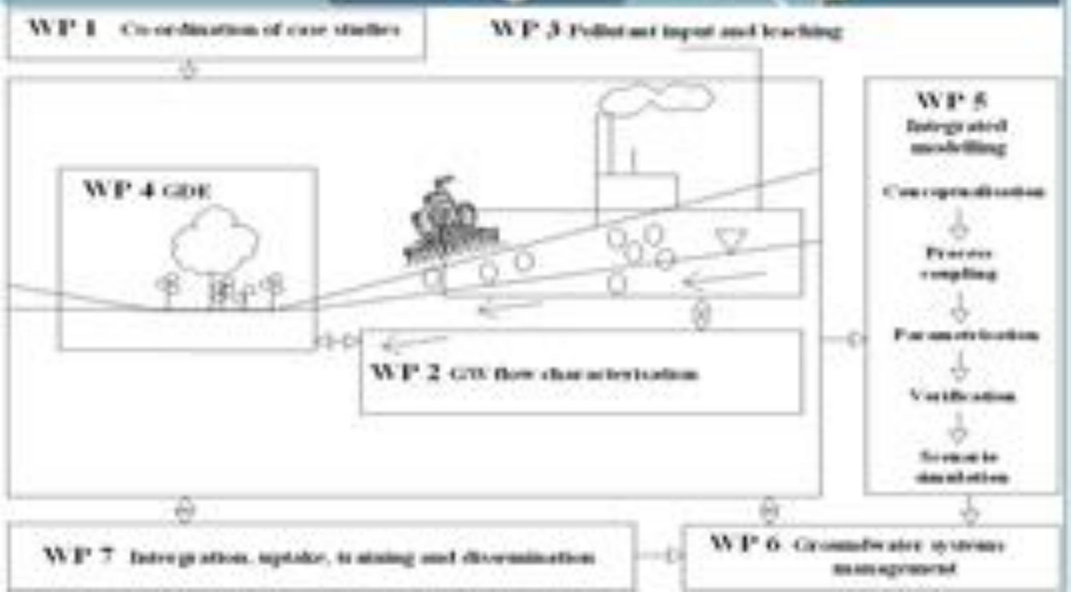
Aims

1. **Identify** the **relevant pressures** to be addressed through the project's tools (Best practice diffusion, development of skills of forest managers and other personnel) in order to improve the status of forests.
2. **Estimate** the **impact** of these interventions on **ecosystem services** and **employment.**
3. **Estimate the marginal values** associated with changes in these services, using **econometric analysis** of data from non-market valuation surveys to different stakeholders and members of the general public.
4. **Collect data** on indicators **before** and **after** the project's interventions take place and
5. **Develop** a **Decision Support** tool that values the impact of the project by converting the "**before and after**" difference in the indicators **in monetary terms**

GENESIS

groundwater and dependent ecosystems

EC, FP7, Budget: 9.170.600 €



Science for Environment Policy

The public value of including scientific information in groundwater protection policies

23 January 2014
Issue 358

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2) Climate Change: Mitigation and Adaptation Policies

7 AFFORDABLE AND CLEAN ENERGY

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

11 SUSTAINABLE CITIES AND COMMUNITIES

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

13 CLIMATE ACTION

14 LIFE BELOW WATER

15 LIFE ON LAND

17 PARTNERSHIPS FOR THE GOALS

Indicative Projects

DECISION MAKING UNDER UNCERTAINTY:

ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

ΕΙΔΙΚΟΣ ΛΟΓΑΡΙΑΣΜΟΣ ΚΟΝΔΥΛΙΩΝ ΕΡΕΥΝΑΣ

THE EXAMPLE OF CLIMATE CHANGE

THESEUS

MSP Cyprus

GLOBAL IQ

IMPACT QUANTIFICATION OF GLOBAL CHANGES

GLOBAQUA

BRIGAID

Innovations and Management for Sustainable Development

BRIGAID: BRIdging the **GA**p for **I**nnovations in **D**isaster resilience
http://brigaid.eu/

3 GOOD HEALTH AND WELL-BEING

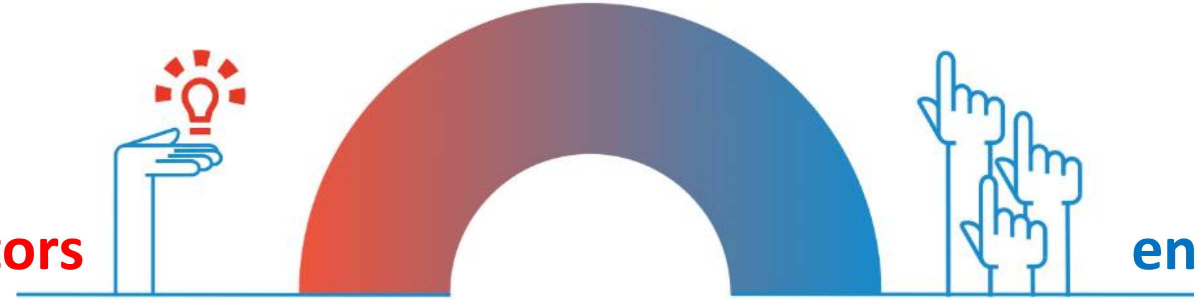
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

13 CLIMATE ACTION

Innovations and Management for Sustainable Development

Aim: To effectively bridge the gap between innovators and end-users in resilience to floods, droughts and extreme weather

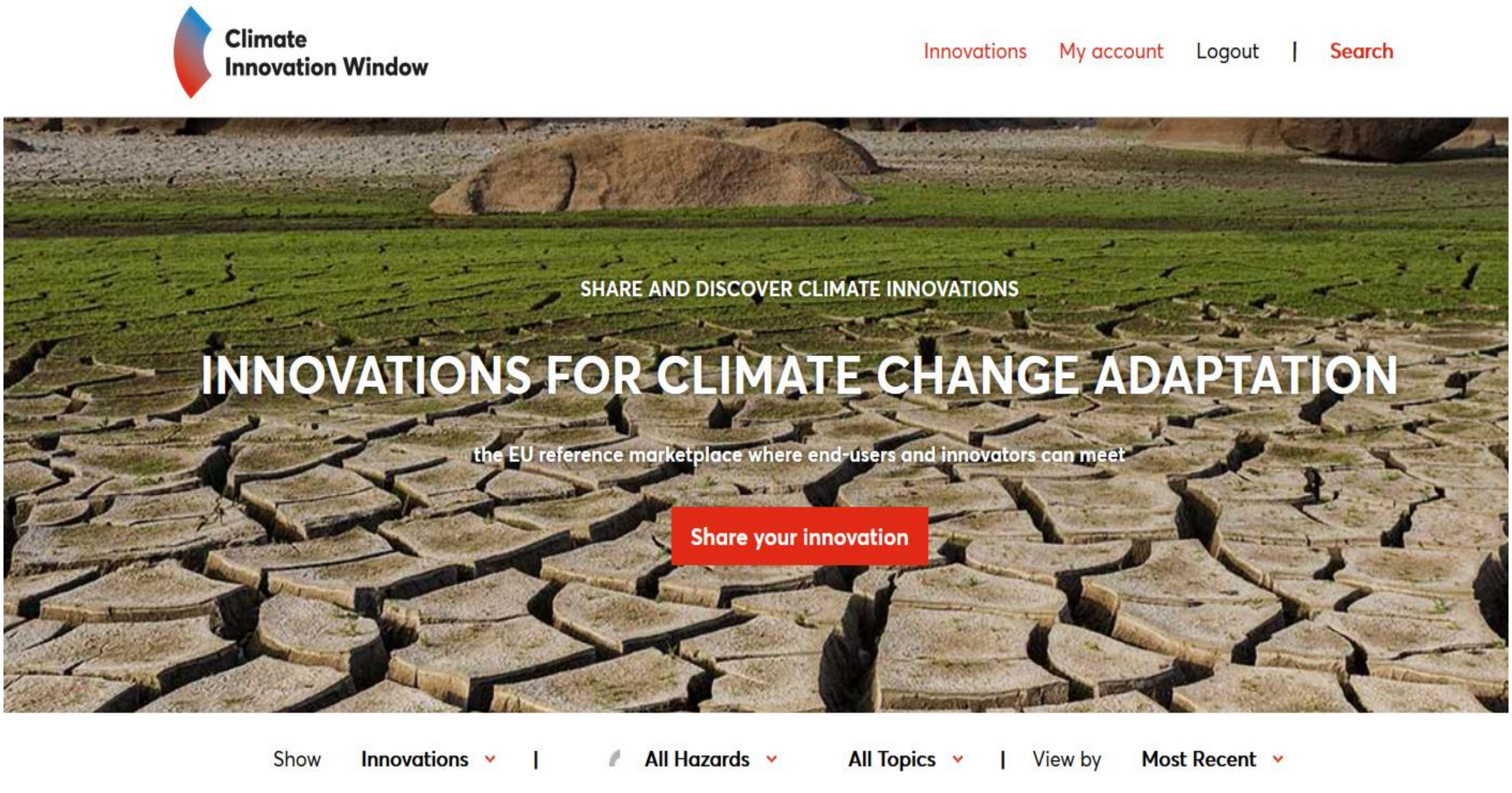
innovators



end-users

Climate Innovation Window : Interactive Platform

Interactive medium between innovators and stakeholders



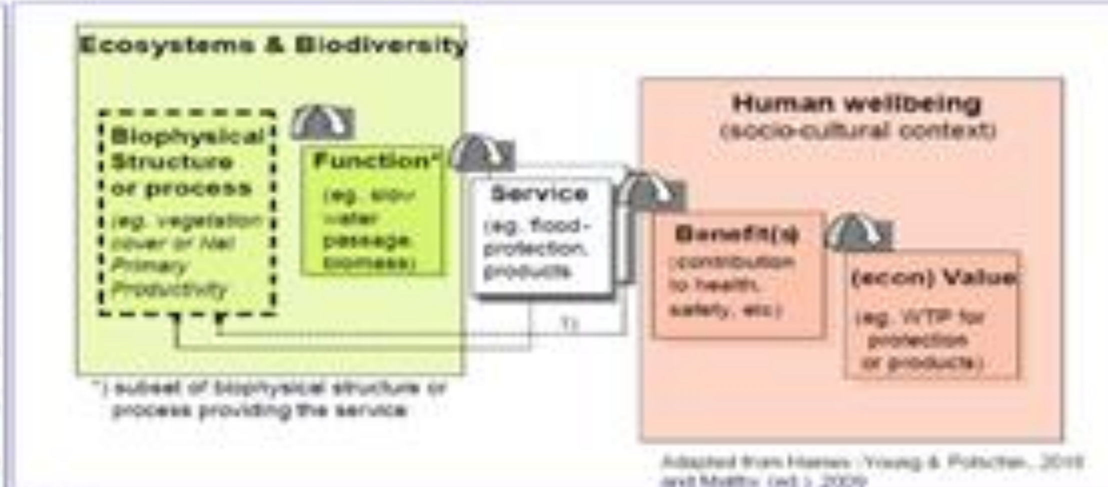
GLOBAQUA: Managing the effects of multiple stressors on aquatic ecosystems with water scarcity.
http://www.globaqua-project.eu/

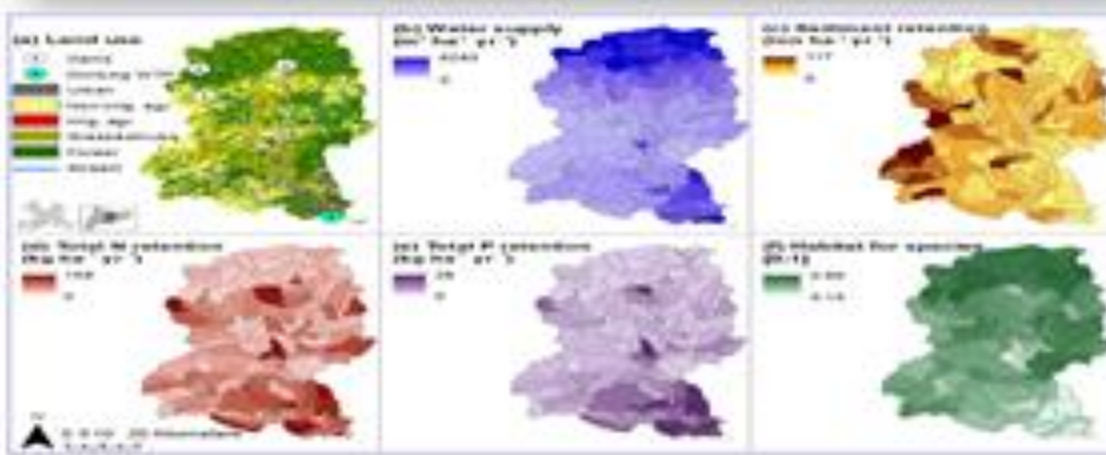
GLOBAQUA

Budget: 9.990.594 €
Funding: European Commission, 7th Framework Program

Managing the effects of multiple stressors on biodiversity and functioning of aquatic ecosystems

http://www.globaqua-project.eu, Budget: 10,000,000 euro





http://www.theseusproject.eu/

THESEUS

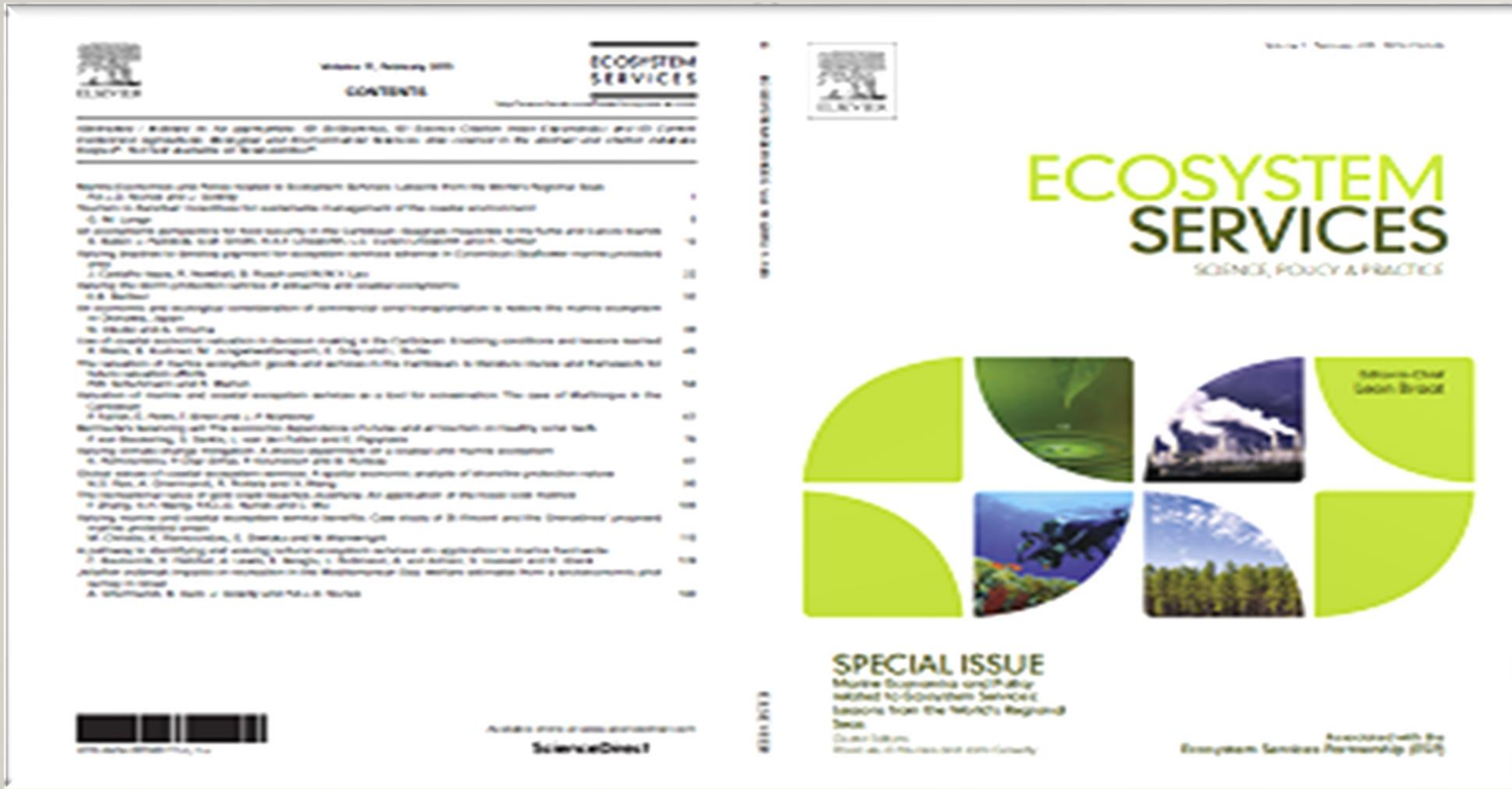
Innovative technologies for safer European coasts in a changing climate

European Commission

FP7, THEME 6 - Environment, including climate

Budget: (6,530,000 €)

The Economic Valuation of Climate Change Effects on Coastal Ecosystems: A Choice Experiment



3) Sustainable Development in Times of Crisis

1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

Indicative Projects

SESAME

simra
Social Innovation in Marginalised Rural Areas

DAFNE

المملكة الأردنية الهاشمية
بنك تنمية المدن والقرى
CITIES & VILLAGES DEVELOPMENT BANK

RECONNECT
Interreg
Balkan-Mediterranean

SMIRES
Science and Management of Intermittent Rivers and Ephemeral Streams

aqua librium

CIGESMED
Seas-era

simra
Social Innovation in Marginalised Rural Areas

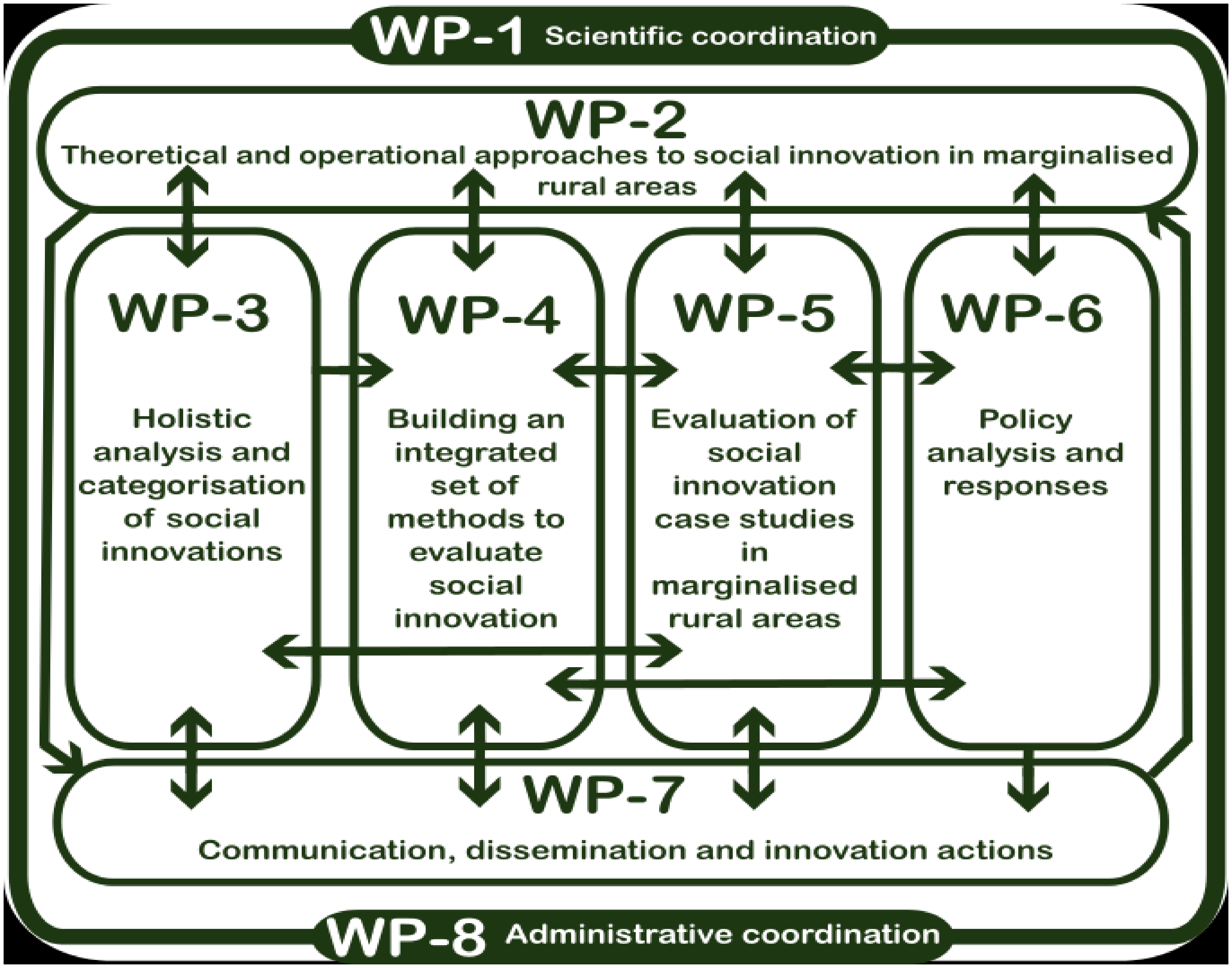
Horizon 2020

http://www.simra-h2020.eu/

- 4-year project (2016-20)
- 26 partners
- Funded by the European Union (Horizon 2020)
- € 5,9m

- Advance understanding of social innovation and innovative governance in:
  - Agriculture
  - Forestry
  - Rural Development

- Boost them in marginalized rural areas across Europe and around the Mediterranean, including non-EU countries


WP-1 Scientific coordination
WP-2
Theoretical and operational approaches to social innovation in marginalised rural areas
WP-3
Holistic analysis and categorisation of social innovations
WP-4
Building an integrated set of methods to evaluate social innovation
WP-5
Evaluation of social innovation case studies in marginalised rural areas
WP-6
Policy analysis and responses
WP-7
Communication, dissemination and innovation actions
WP-8 Administrative coordination

Sustainable Governance and Decision Support Systems

DAFNE – A Decision-Analytic Framework to explore the water-energy food NExus in complex and transboundary water resources systems of fast growing developing countries

Tools to facilitate social understanding of the impact and support comparative analysis of the alternative through negotiations

(Negotiation Simulation Lab)

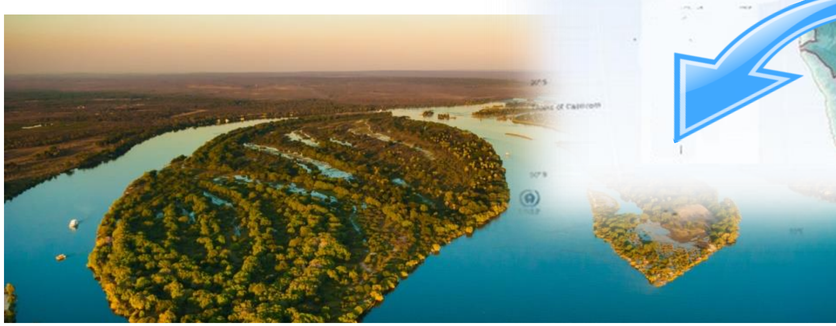
Sustainable Governance and Decision Support Systems

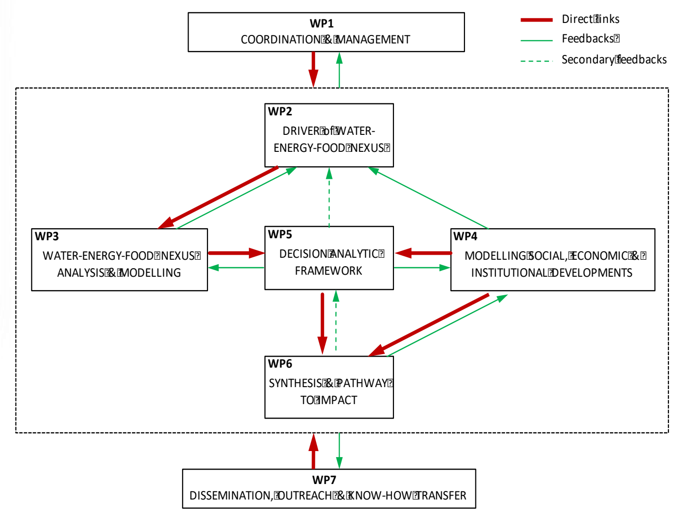
Aim: To establish a Decision-Analytic Framework for Participatory and Integrated Planning

Omo River Basin

2 Case Studies

Zambezi River Basin





Innovations and Management for Sustainable Development

The Value of Distant Benefits

&

Long-Term Discount Rates

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

13 CLIMATE ACTION

- *Humanity has the ability to make development sustainable: to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. WCED, 1987*

- *There is something awkward about discounting benefits that arise a century hence. For even at a modest discount rate, no investment will look worthwhile.*

The Economist, 1991

FUNDED BY VARIOUS GOVERNMENTS: UK, FRANCE, USA, NORWAY, SWEDEN, HOLLAND

FUNDED BY THE WORLD BANK FOR CYPRUS, MOLDOVA, UKRAINE

Innovations and Management for Sustainable Development

CBA - Ramsey Formula extended for Risk & Uncertainty

(papers by Dasgupta, Gollier, Koundouri, Weitzman and others)

In an Uncertain Environment persistent shocks on:

- ✓ the growth rate of consumption
- ✓ short-term interest rates

→ DDR

Estimate Theory Consistent DDR trajectory

- *Using Historical Data*
- *Without Structural Model*
- *Using univariate time series regime switching models*

DDR for higher PV of Long-Run effects!

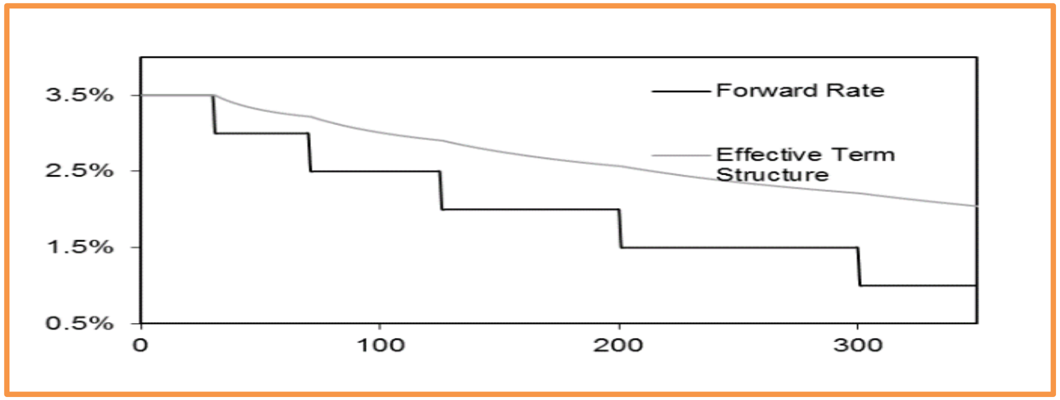
Example: *Climate Change Mitigation*

DDR implies double social cost of $CO2$ emissions

Innovations and Management for Sustainable Development

RECOMMENDED SCHEDULE OF DISCOUNT RATES PROVIDED

Adopted in:
UK, USA, France, Norway, Etc.



Country	Method	SDR%	LR (T>40) SDR Declining?	Risk & Uncertainty
EU Area	SRTP	3	Declining	sensitivity scenario analysis monte carlo simulations
Sweden	SRTP	3.28- 3.5	Mentioned Not adopted	
Moldova	SRTP/SOC	4,63+9 (RP)	Declining	
Norway	SRTP/SOC	2.5+ 1.5(RP)	Declining	
Cyprus	SRTP/SOC	2.5+ 1.5(RP)	Declining	Sensitivity Analysis
Ukraine	SRTP/SOC	5+ 7(RP)	Declining	Sensitivity Analysis

Education and Training

International, Regional, National Conferences, Workshops, Training Seminars & Research, Policy, Business Events www.eaere-conferences.org/2017

EAERE23

2017 Athens Greece

ICRE8

International Centre for Research on the Environment & the Economy

www.icre8.eu | Local Organiser

Scientific and Policy Events

European Association of Environmental and Resource Economists

EAERE

EAERE 23 in Numbers

- ✓ **1200** members from 80 countries
- ✓ **2000** submissions
- ✓ **700** peer-reviewed papers presented
- ✓ **10** Policy Sessions
- ✓ **9** Thematic Sessions
- ✓ **38** posters
- ✓ **800** registered participants
- ✓ **274** referees

- ✓ **9** sponsors
- ✓ **10** exhibitors
- ✓ More than **60.000 euros** attracted from sponsorships and exhibitors
- ✓ More than **30** volunteers

RDA FISHERIES & ACQUACULTURE Datathon

ICRE8 Workshop
19 June 2017
Athens, Greece

BlueBRIDGE receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 675680

RDA/BB FISHERIES & ACQUACULTURE Datathon

To fuel new thinking in the holistic analysis of satellite, environmental, biological and socio economic data and the interactions between fisheries, aquaculture and the marine spatial planning.

Copernicus, EMODnet, BlueBRIDGE, FAO, Eurostat, Natura2000 are among the relevant datasets that will be made available

ADVANCED POLICY WORKSHOP IN SUSTAINABILITY AND RESOURCE VALUATION

28 June 2017
Athens, Greece

Under the auspices of

SDSN GREECE

ORGANIZERS

Political Economy of Sustainable Development Lab (PESD),
Department of Economics, National and Kapodistrian University of Athens
in collaboration with
Athens University of Economics and Business and
International Centre for Research on the Environment and the Economy (ICRE8)

National and Kapodistrian University of Athens PESD

Athens University of Economics and Business

ICRE8

5th GLOBAQUA Training Course

Economics of Sustainable Water Management in accordance to the Water Framework Directive, the Millennium Ecosystems Assess-ment & Sustainable Development Goals of the UN Agenda 2030

19-20 February 2018
Athens, Greece

Under the auspices of

SDSN GREECE

GLOBAQUA

Coordinator

The course is coordinated by Phoebe Koundouri, Professor of Economics and Econometrics, Athens University of Economics and Business (School of Economics) and London School of Economics (CCCEP), Scientific Director of ICRE8, SDSN-Greece chair.

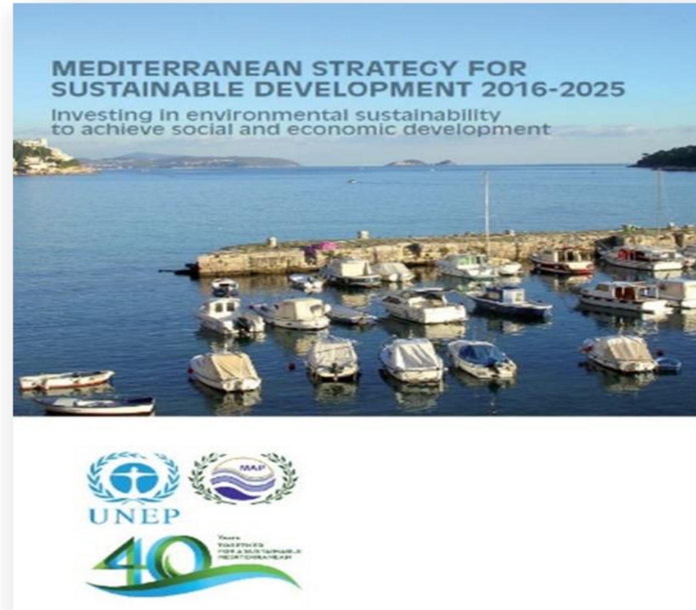
National and Kapodistrian University of Athens PESD

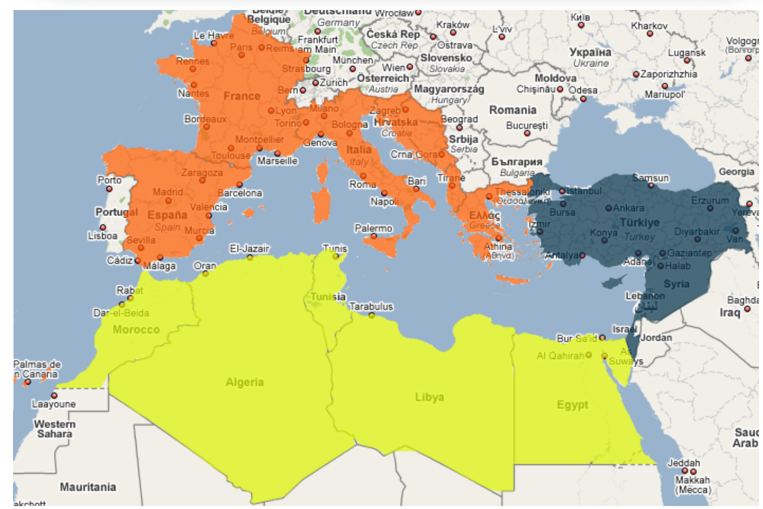
ICRE8

Contextualizing the SDGs for the Mediterranean Region:

Regional priorities for the Mediterranean: How do they translate to SDGs?

1. Ensuring sustainable development in marine and coastal areas
2. Promoting resource management, food production and food security through sustainable forms of rural development
3. Planning and managing sustainable Mediterranean cities
4. Addressing climate change as a priority issue for the Mediterranean
5. Transition towards a green and blue economy
6. Improving governance in support of sustainable development



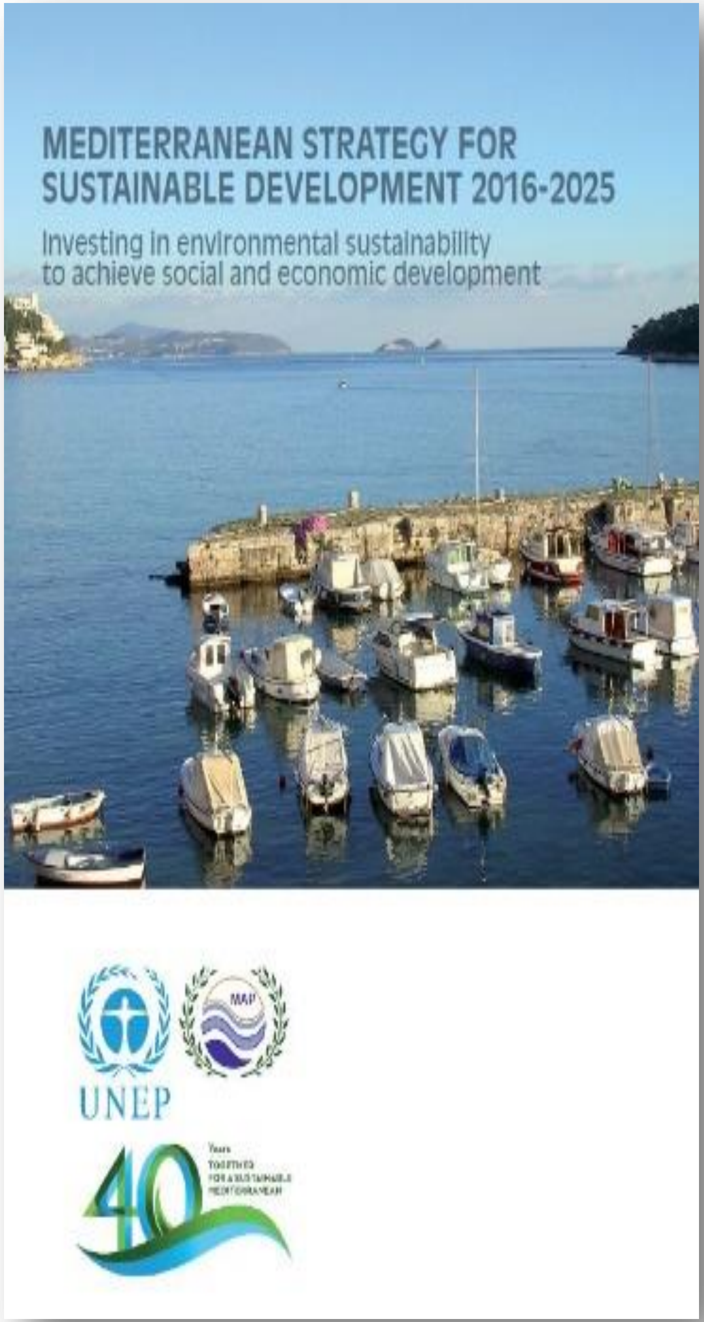


Regional strategies for sustainable development

Strategic Plans for the Region

Mediterranean Strategy for Sustainable Development (MSSD)

- Under the auspices of UNEP-MAP.
- A strategic guiding document for all stakeholders and partners to translate the 2030 Agenda at the regional, sub-regional and national levels.
- An adaptation of international commitments to regional conditions, in the context of the 2030 Agenda and its SDGs.



Where do the Mediterranean countries stand relative to the SDGs?

- 2017 SDG Indicator Dashboard and report.

- The report generates "rough grading" for all countries to draw attention to the most urgent SDG related challenges facing each country for each SDG.

Where do the Mediterranean countries stand relative to the SDGs?

Country	2017 Global SDG Index Score	Country	2017 Global SDG Index Score
Czech Republic	81.9	Cyprus	70.6
Slovenia	80.5	Israel	70.1
France	80.3	Albania	68.9
Hungary	78.0	Russia	68.9
Belarus	77.1	Algeria	68.8
Croatia	76.9	Tunisia	68.7
Slovakia	76.9	Turkey	68.5
Spain	76.8	Montenegro	67.3
Poland	75.8	Morocco	66.7
Italy	75.5	Jordan	66.0
Moldova	74.2	Bosnia & Herzegovina	65.5
Romania	74.1	Lebanon	64.9
Greece	**72.9**	Egypt	64.9
Ukraine	72.7	Syria	58.1
Bulgaria	72.5	Iraq	56.6

European – Mediterranean Countries 2017 SDG Index Score

European Mediterranean Countries

Country	Global Index Score	1 No Poverty	2 Zero Hunger	3 Good Health and Well-Being	4 Quality Education	5 Gender Equality	6 Clean Water and Sanitation	7 Affordable and Clean Energy	8 Decent Work and Economic Growth	9 Industry, Innovation and Infrastructure	10 Reduced Inequalities	11 Sustainable Cities and Communities	12 Responsible Consumption and Production	13 Climate Action	14 Life Below Water	15 Life on Land	16 Peace and Justice Strong Institutions	17 Partnerships for the Goals
Slovenia	80.5																	
France	80.3																	
Croatia	76.9																	
Spain	76.8																	
Italy	75.5																	
Greece	72.9																	
Cyprus	70.6																	
Albania	68.9																	
Turkey	68.5																	
Montenegro	67.3																	

AVERAGE Global Index Score for European Mediterranean Countries: 73.1

Source: Sachs, J., Schmidt-Traub, G., Kroll, C., Durand-Delacre, D. and Teksoz, K. (2017): SDG Index and Dashboards Report 2017. New York: Bertelsmann Stiftung and Sustainable Development Solutions Network (SDSN)

Open-Access to Scientific Information

www.openaire.eu

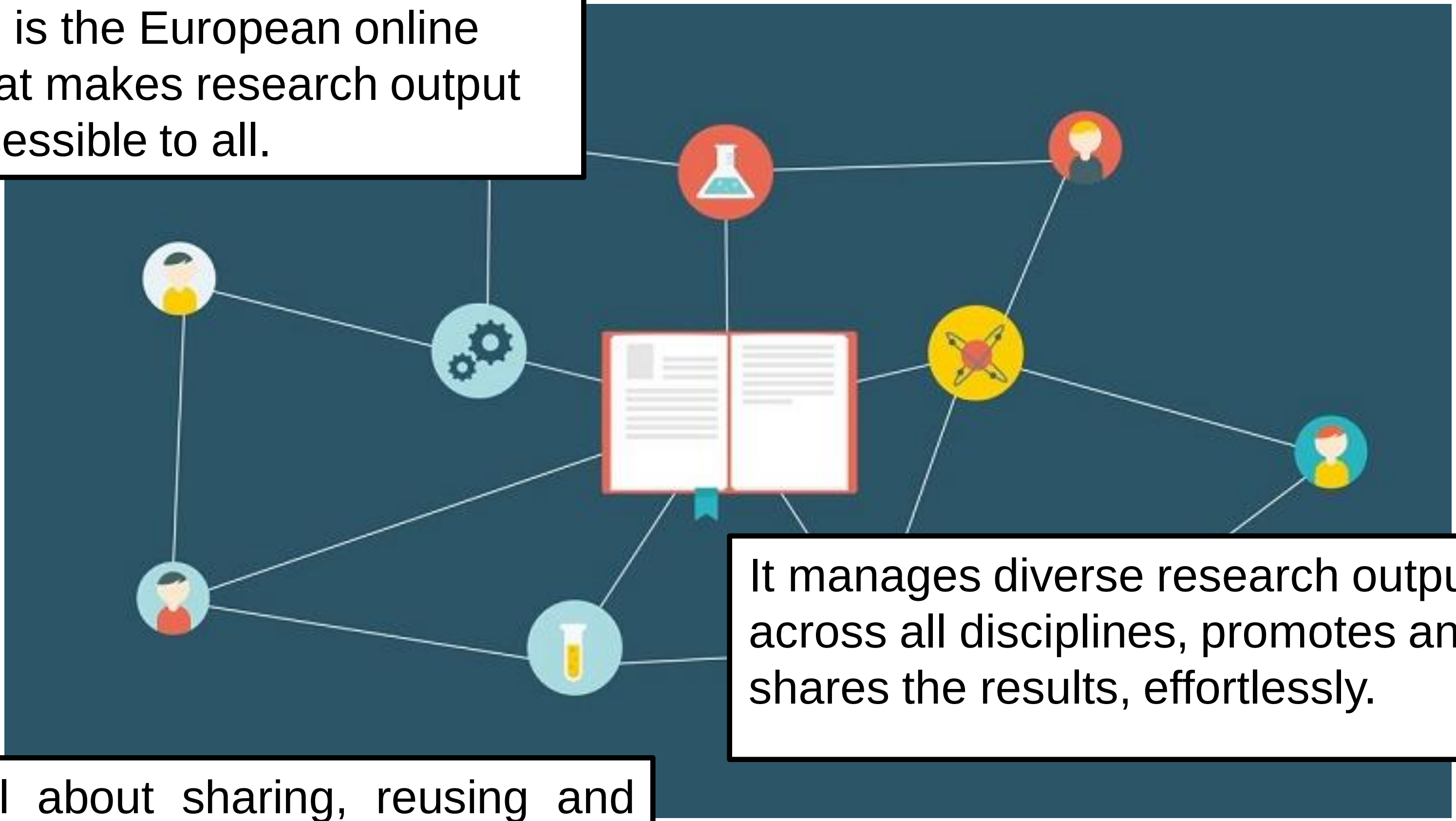
EC-DG Research-FP6

Budget: 12,000,000

Open Access evolution in Europe

http://vimeo.com/openaire/2014

OpenAIRE is the European online network that makes research output openly accessible to all.



It manages diverse research outputs across all disciplines, promotes and shares the results, effortlessly.

It is all about sharing, reusing and linking research information.

Coordination OpenAIRE Connect

- Funded by the European Union (Horizon 2020)
- ~ € 2m
- Provide technological and social bridges
- Deliver services enabling uniform exchange of research artefacts
  - Literature
  - Data
  - Methods
  - with semantic links between them and
  - across research communities and content providers in scientific communication
- Introduce and implement the concept of Open Science as a Service (OSaaS)

Horizon 2020

CASE STUDY: SDSN Greece

- Official website: www.unsdsn.gr

- Mapping of Greek universities and research centers
  - ✓ >50 public and private universities
  - ✓ 18 research centers
  - ✓ NGO’s

- Collaboration with critical strategic partners:
  - ✓ Ministry of the Environment
  - ✓ Greek Universities and Research Centers
  - ✓ Athens Resilient Office, Municipality of Athens
  - ✓ WWF, Greece
  - ✓ Foundation for Economic and Industrial Research
  - ✓ Hellenic Federation of Enterprices
  - ✓ Etc.

SDSN GREECE e-library

Our Vision

An SDG E-library for Greece

An Open Science directory of all past **20 years** completed and ongoing research publications, data and related models relevant to the 17 SDGs

A data source towards the implementation of the SDGs

immediate & long-term benefits to:

research communities research

organizations

funders, industry and… society

Literature

- ✓ Journal articles (OA and non-OA)
- ✓ White papers
- ✓ Pre-prints

Datasets

- ✓ Databases (SDG Indices, economic data, geophysical data, GIS data)
- ✓ Files

Projects

- ✓ Greek coordinators
- ✓ Greek partners
- ✓ Greek area as a case study

SDSN GREECE e-library

We're growing…

- ✓ SDG Open Science directory for Greece
- ✓ SDG Open Science directory for SDSN-Mediterrenean
- ✓ **SDG Open Science directory for the global SDSN**

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Personal Webpage: http://www.icre8.eu/professor-phoebe-koundouri