Πανεπιστήμιο Αιγαίου

Τμήμα Επιστημών της Θάλασσας-Σχολή Περιβάλλοντος

Ανοικτό ακαδημαϊκό μάθημα

Διαχείριση Παρακτίων Περιοχών

Διδάσκοντες:
Ο.Τζωράκη, Μ.Κωστοπούλου-Καραντανέλλη, Α. Βελεγράκης,
Δ.Κίτσιου, Ε.Κρασακοπούλου, Ι.Μπατζάκας, Γ.Τσιρτσής,
Π. Τουρλιώτη

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Χρηματοδότηση

- Το παρόν εκπαιδευτικό υλικό έχει αναπτυχθεί στα πλαίσια του εκπαιδευτικού έργου του διδάσκοντα.

- Το έργο «**Ανοικτά Ακαδημαϊκά Μαθήματα στο Πανεπιστήμιο Αιγαίου**» έχει χρηματοδοτήσει μόνο τη αναδιαμόρφωση του εκπαιδευτικού υλικού.

- Το έργο υλοποιείται στο πλαίσιο του Επιχειρησιακού Προγράμματος «Εκπαίδευση και Δια Βίου Μάθηση» και συγχρηματοδοτείται από την Ευρωπαϊκή Ένωση (Ευρωπαϊκό Κοινωνικό Ταμείο) και από εθνικούς πόρους.

Integrated Management of Islands and Development

George Tsirtsis

School of the Environment, Dept of Marine Sciences, University of the Aegean
e-mail: gtsir@aegean.gr

'Islands and Sustainability: Attractiveness, Accessibility, Environmental Management and Development'
University of the Aegean, Mytilini Greece, 18-19 May 2015

Introduction

Run through quickly…

- The complexity of insular areas due to interactions of social and economic factors with environmental processes (terrestrial and marine)
- Isolation
- Considerable differences between islands due to their specific environmental or socioeconomic characteristics
- Often controversial policies implemented at local, regional or national level
- Vulnerability to climate changes
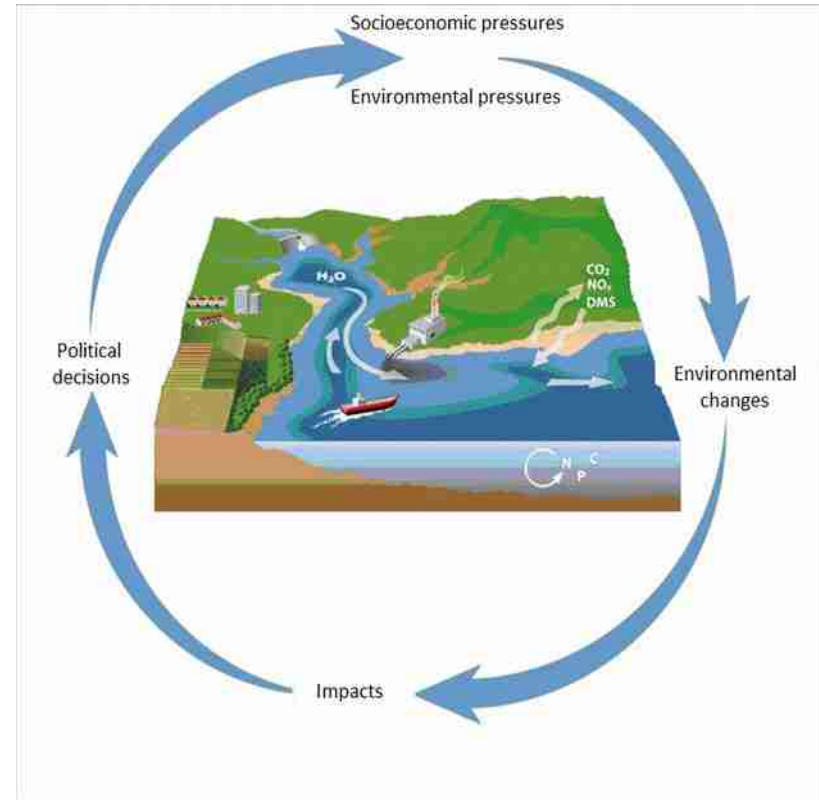
Need for development of quantitative integrated tools (DSS) to support politicians and decision makers characterized by:
- Flexibility
- Transferability
- Easiness of application
- Possibility to include political priorities and social views

Introduction

Main purposes of a DSS (Janssen 1992)

- to support individuals or groups in their decision processes
- to support rather than replace judgment of these individuals
- to improve effectiveness of decision-making rather than its efficiency

- ICZM Challenges and DSS Functionalities (Van Kouwen et al. 2008)

- *Knowledge-Related Challenges and Functionalities*
- to be based on interdisciplinary approaches
- to deal with uncertainty in available data or future changes
- to include Spatial and Temporal Patterns and Behavioral Dynamics
- able to forecast and backcast

- *Process-Related Challenges and Functionalities*
- to integrate science and management
- to ensure stakeholder participation
- to make Complex Information Understandable
- able to deal with different phases

All of the above functionalities are not included in the existing DSS and they are not specially designed for the Mediterranean islands

A proposed modelling framework (DSS) for ICZM or Sustainable Development of Islands:
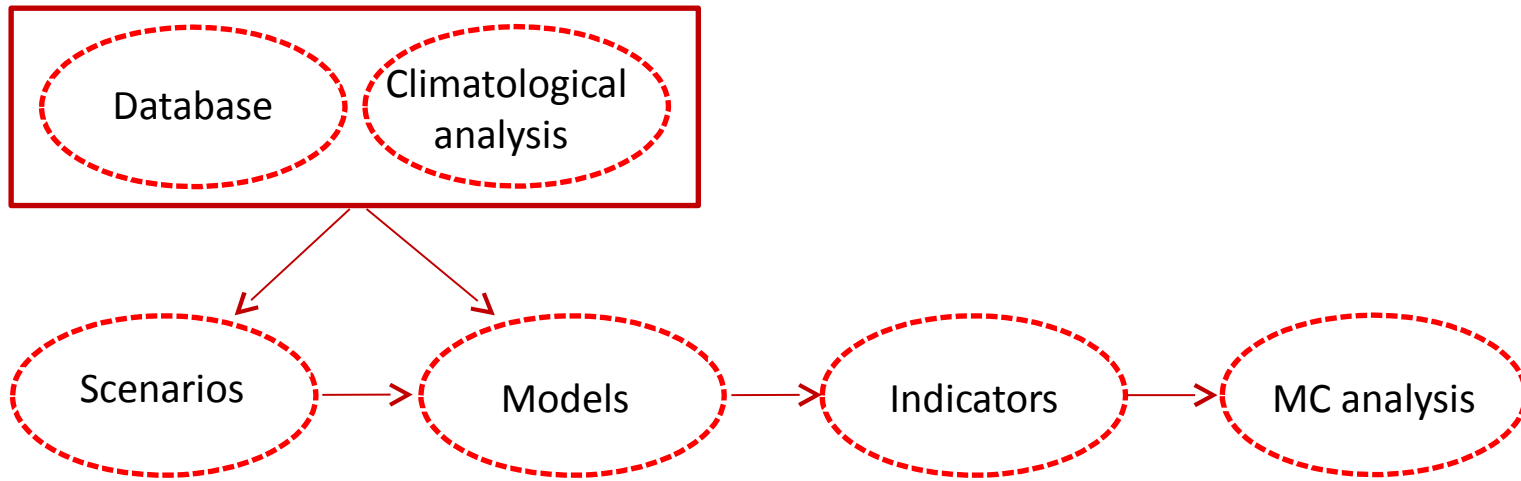
The modelling framework comprises of:

- A complete database including environmental, social and economic information, preferably under a GIS, where needed
- A thorough analysis of climatological data to reveal possible climatological trends
- Models linking economic and social activities and processes to environmental, economic and social indicators
- Scenarios describing the future evolution of the area under consideration
- A Multicriteria Choice (MC) methodology to rank scenarios according to priorities set by politicians or stakeholders
- A user-friendly interface to be used by scientists or specially trained members of the scientific staff of local or regional authorities

A conceptual diagram of the modeling approach
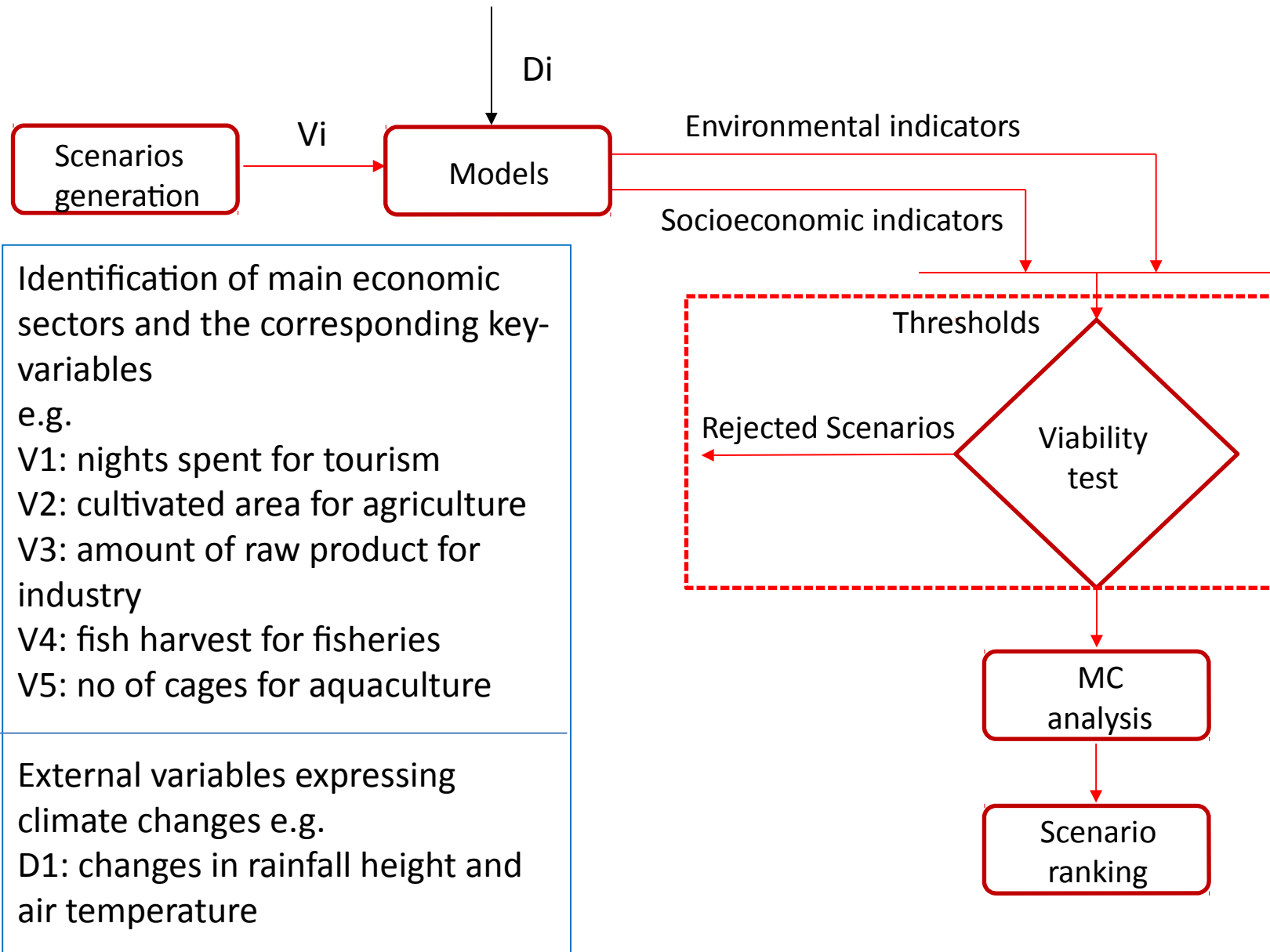
The models

Simple models

Simple linear relations connecting key-variables (corresponding to main economic sectors) to environmental and socioeconomic indicators, e.g.:

<u>For tourism:</u>
Income=beds**(nights spent/bed)*(money spent/night)

Jobs=beds*employment/bed, where employment/bed=0.6

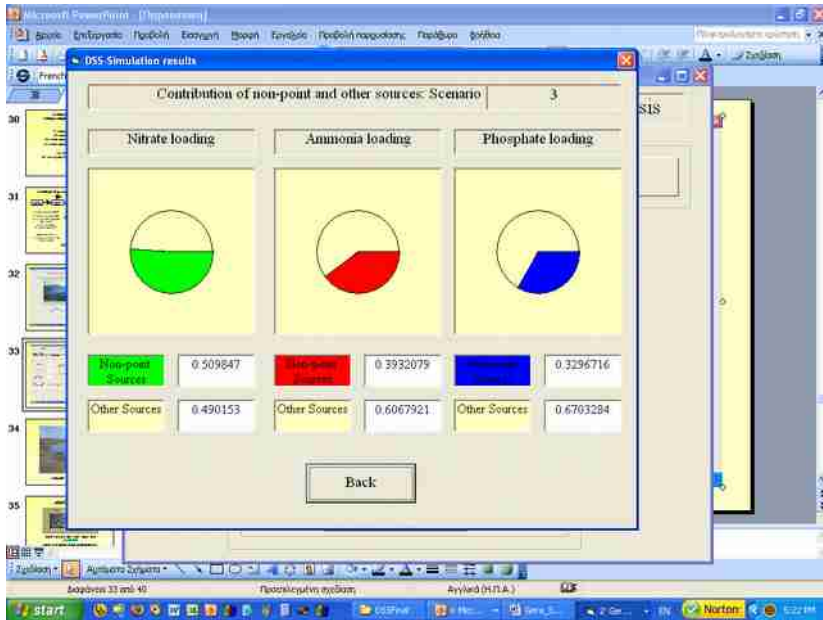Water consumption=beds*(nights spent/bed)*(water consumption/night spent), where water consumption/night spent=350 liters

<u>For aquaculture:</u>
Income=(no cages*fish produced/cage)*value
Jobs=no cages*employees/cage

The models

More complex models

For instance a watershed model estimating runoff and concentrations of pollutants (e.g. nitrate) flowing into the receiving water bodies after rainfalls...

...taking into account both environmental (e.g. geomorphology, meteorology) and socioeconomic data (population, tourism, industrial activities)

...or models of hydrodynamic circulation estimating important variables as the water renewal time in coastal areas, the fate of pollutants or the risk of formation of eutrophic or HAB episodes

...or water budget models incorporating climate changes

Runoff (Mm3)

$f(x) = -0.66x + 105.57$
$R^2 = 0.06$

Year

AVERAGE VELOCITY, mixing conditions, Apr 18   AVERAGE VELOCITY, mixing conditions, Apr 18

Indicators

Environmental

- Terrestrial nutrient loading
- Energy consumption
- Water consumption
- Loss of biodiversity
- Deforestation/Loss of wetlands
- Risk of eutrophication
- Risk of HAB formation

Socioeconomic
GDP, employment, unemployment, social well-being etc

…desirable to combine the various environmental, economic and social indices into three synthetic criteria by applying the appropriate weights to the individual indicators

Questionnaires to stakeholders, decision makers and inhabitants may support the above process

Scenario development

By defining trends (% annual changes) for the next few years in:
- Vi variables, each one expressing a main economic sector
- Di variables expressing climate changes and
- Coefficients (e.g. water consumption/hectare, per capita energy consumption in households)

Feedback mechanisms can be also incorporated (e.g. population change is influenced by the economic growth and social well-being)

Examples of scenarios:
1. BAU: Current trends/Business As Usual (monoculture of olive trees, Untreated wastewater, Expansion of urban areas without planning)
2. PT: Economic Growth (Agricultural intensification/Tourism development)
3. DG: Deep Green (Organic farming/Ecotourism/Conservation plans for natural environment)
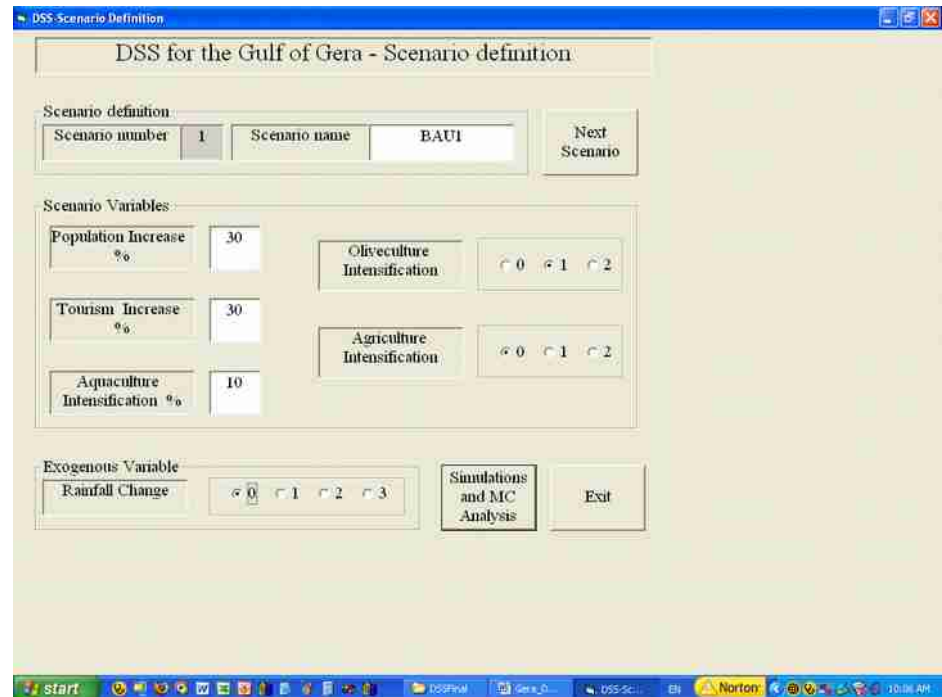
Multicriteria (MC) analysis

Application of the Analytic Hierarchy Process (a semi-quantitative MC method) offering the possibility to include prioritization according to policies or stakeholder views
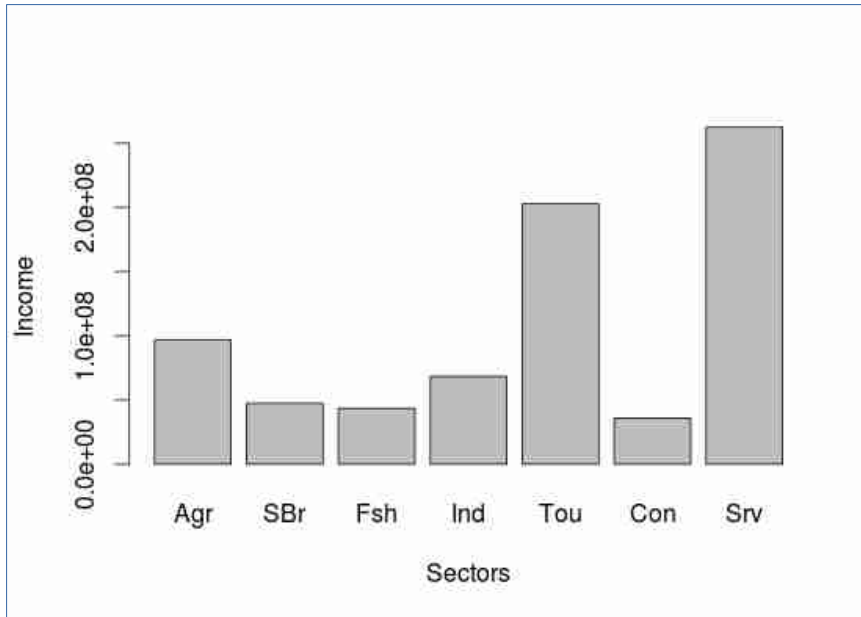
A case-study: Island of Lesvos

A case-study: Island of Lesvos
Current state of Lesvos - Environmental indices
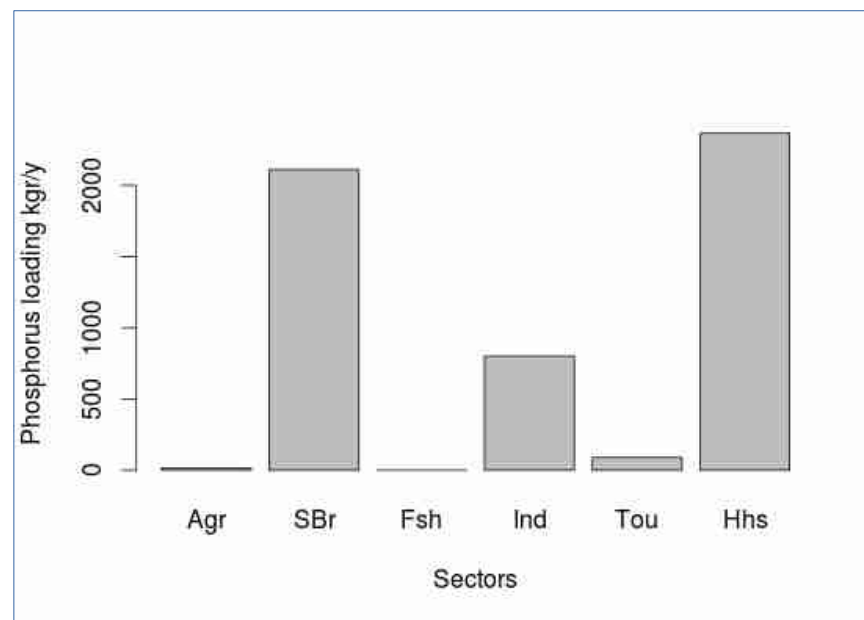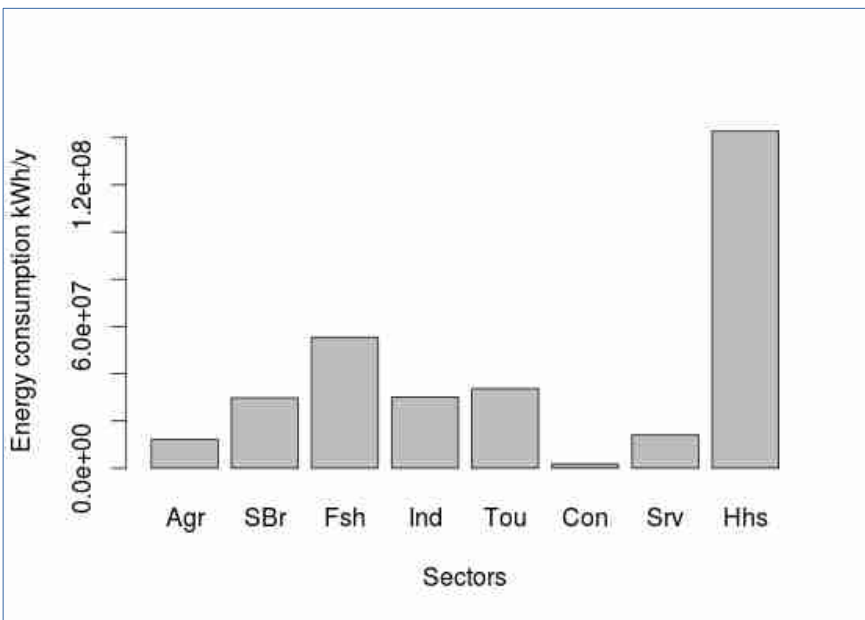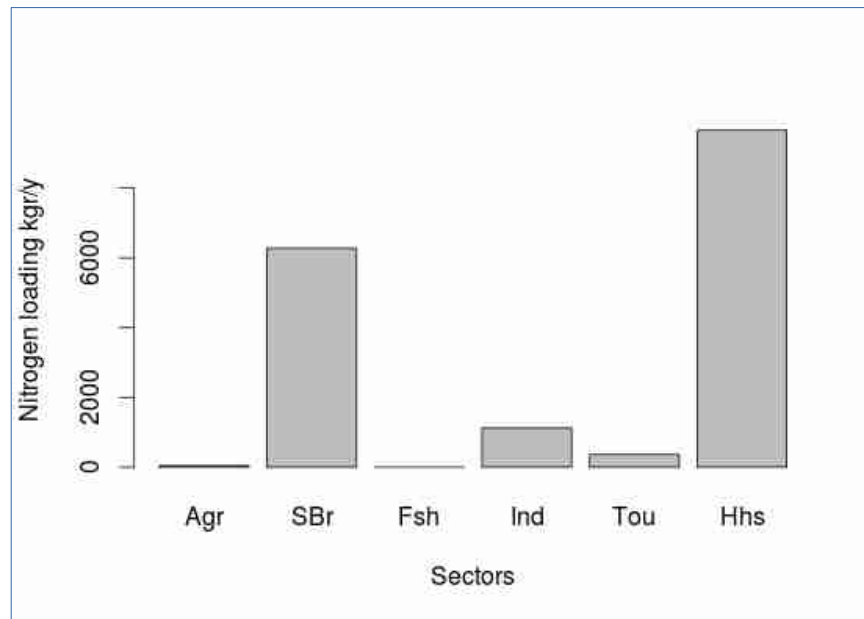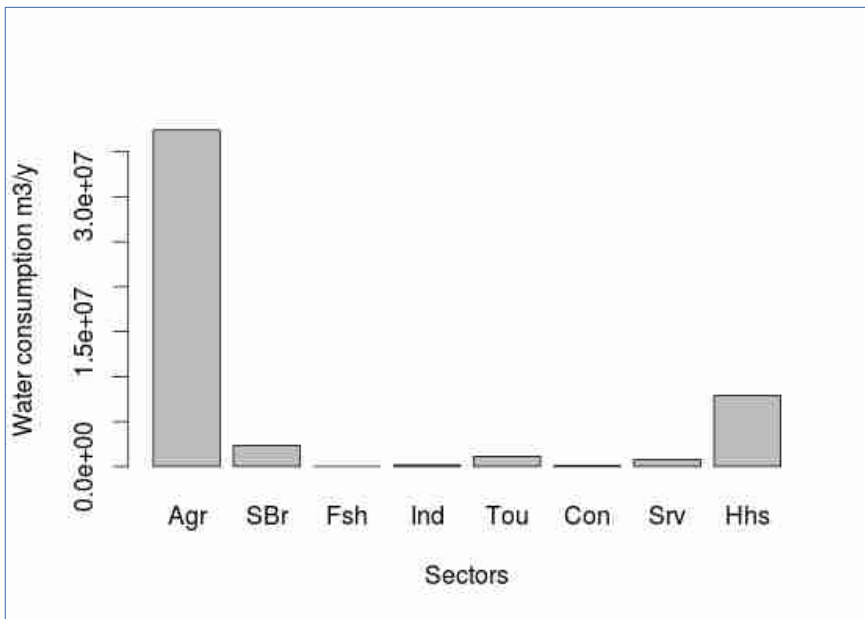
A case-study: Island of Lesvos
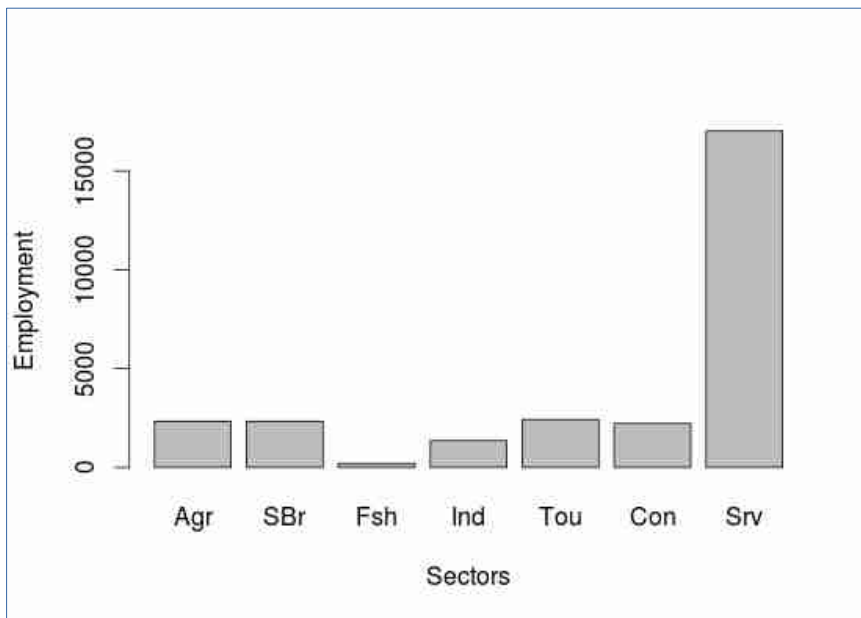## Current state of Lesvos – Economic and Social indices

Poverty index: 0.067

Access to education: 0.073

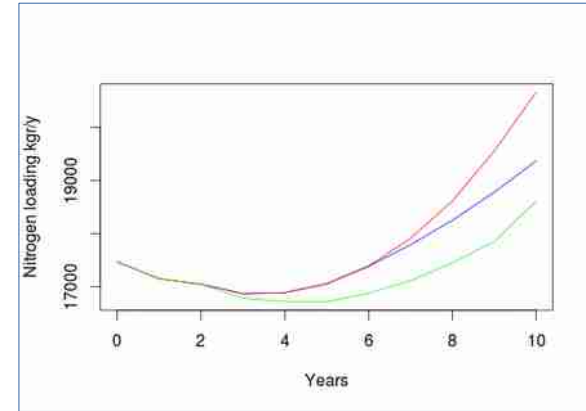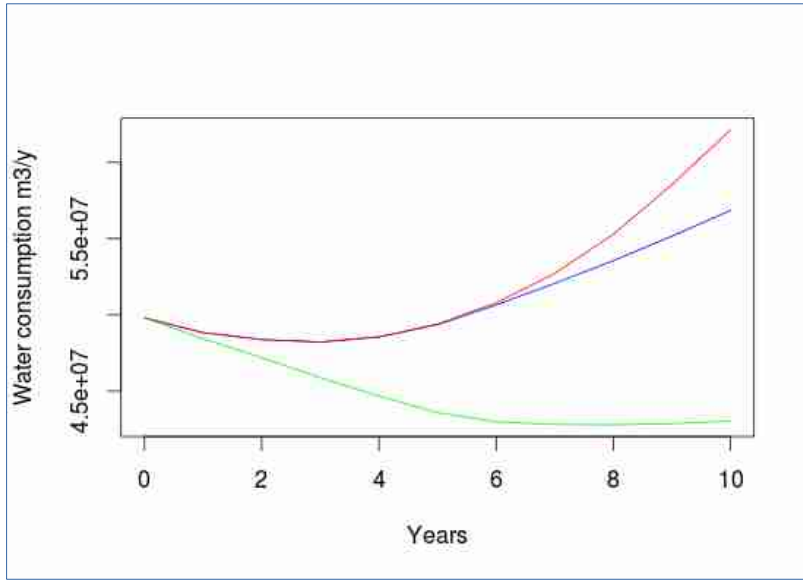Life Expectancy: 0.454

Human Development Index (HDI): 0.787

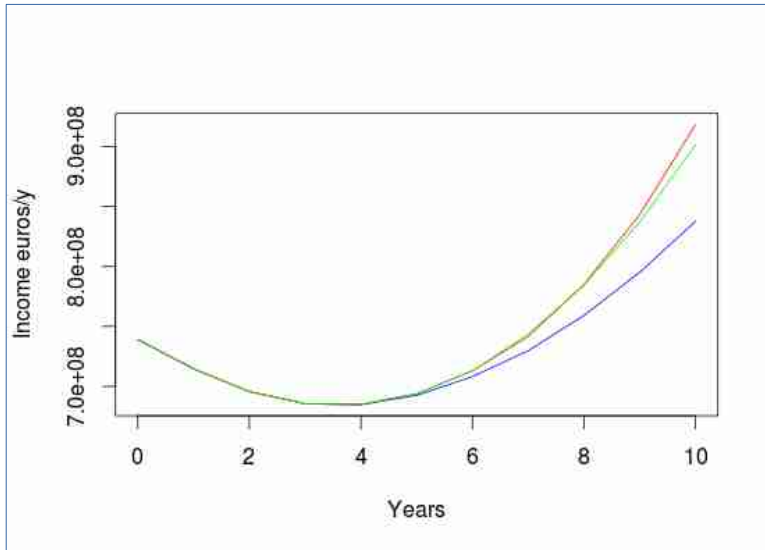Water consumed is 65% of infiltrated

A case-study: Island of Lesvos
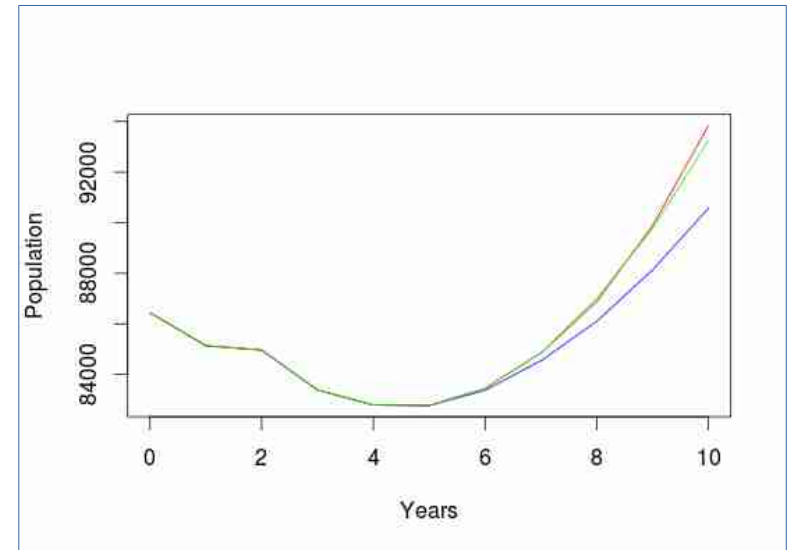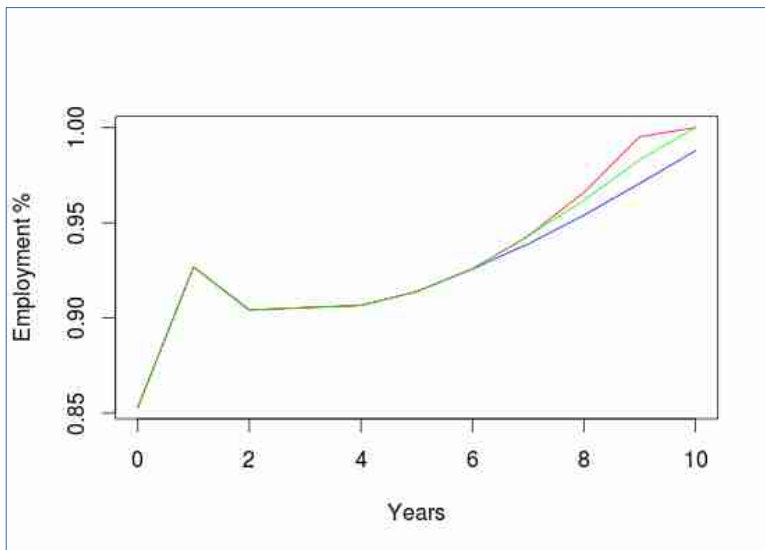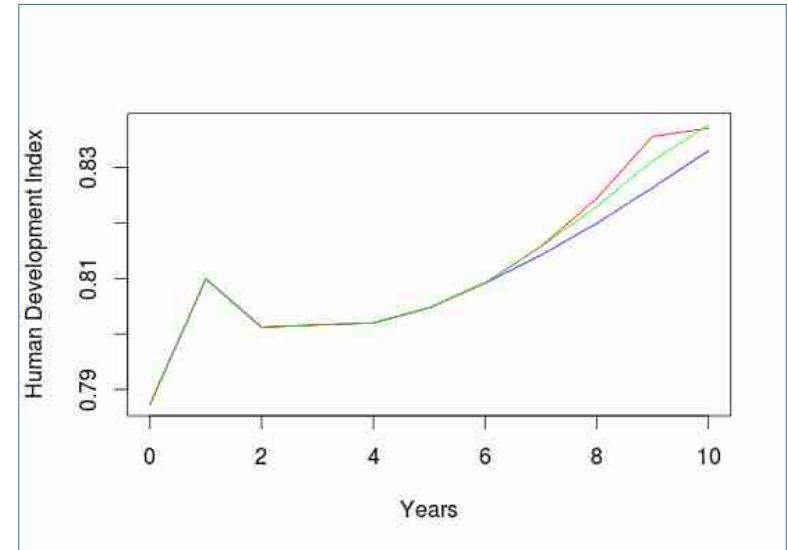## Results of scenarios – Environmental Indices
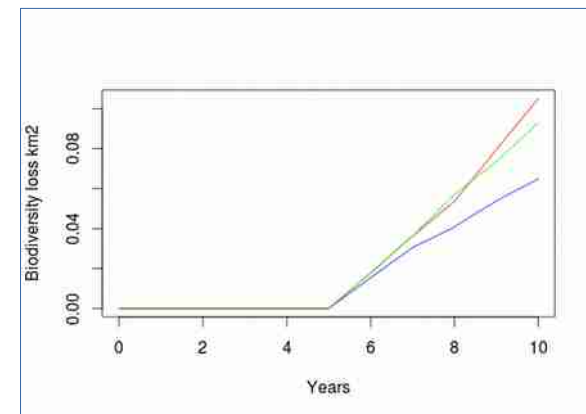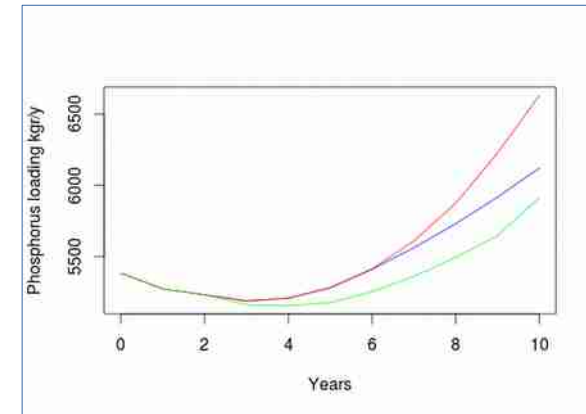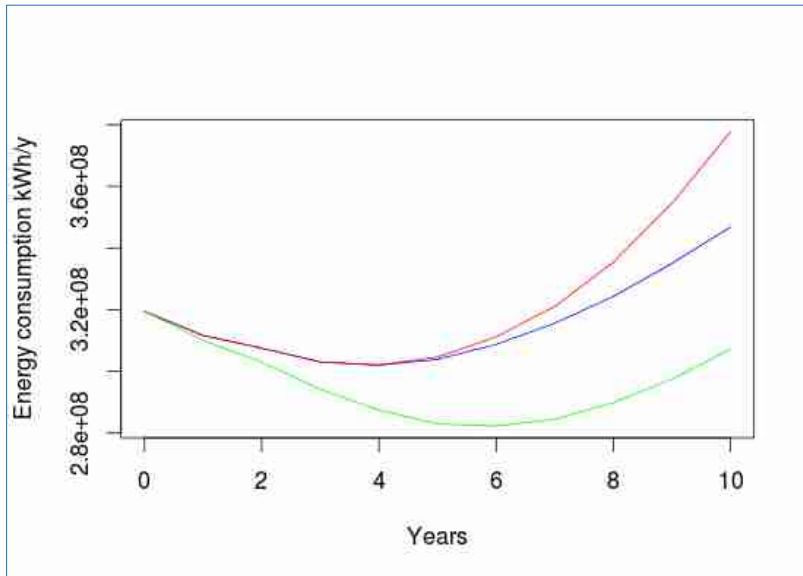
A case-study: Island of Lesvos
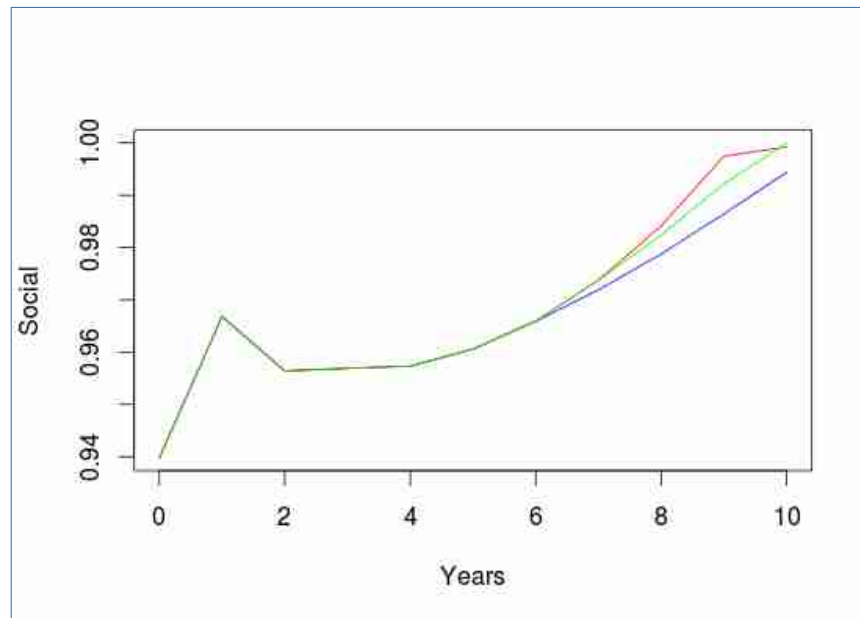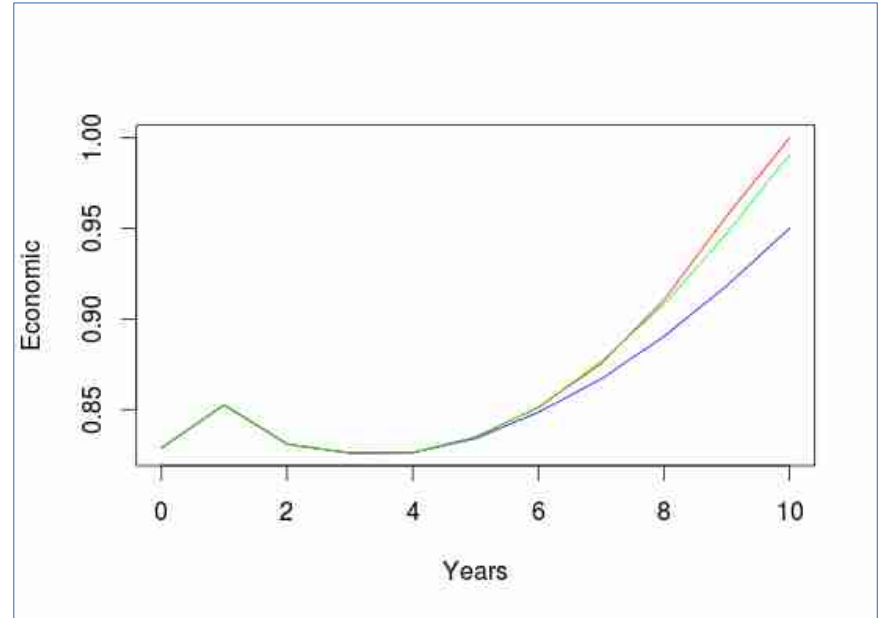## Results of scenarios
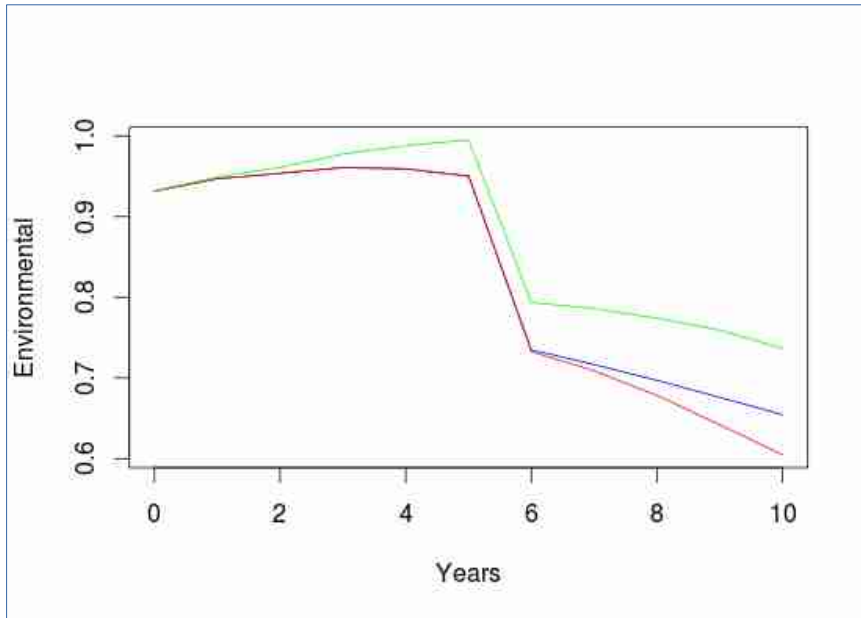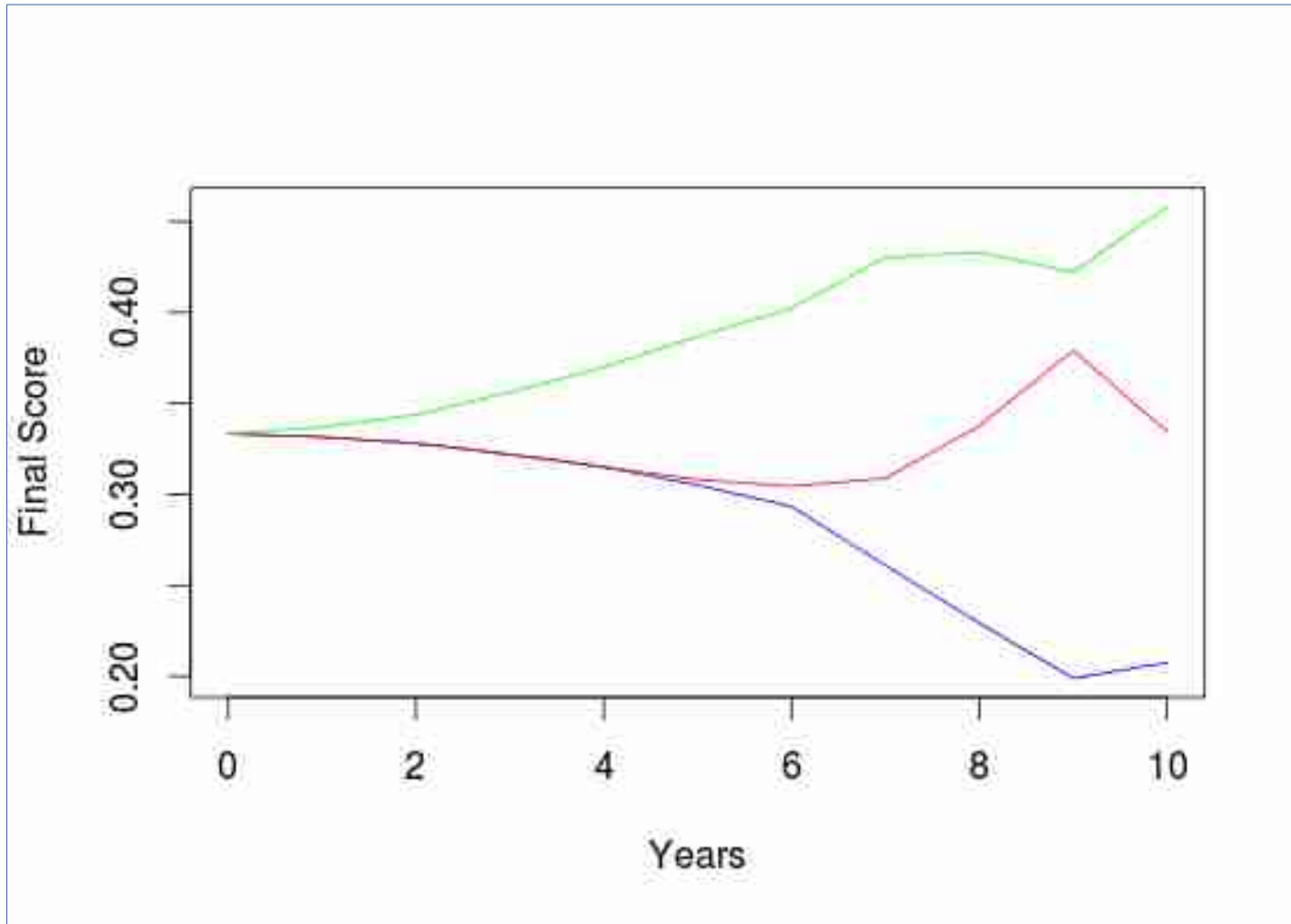
Economic Indices

Social Indices

A case-study: Island of Lesvos
Trends of Environmental, Economic and Social Criteria (equal weights on indices)

A case-study: Island of Lesvos
Final Score (Ranking) of scenarios (equal weights on three criteria)

Conclusions – Future Improvements

- **Such DSS platforms provide a framework for the (better) communication between scientists from different disciplines**

  - The proposed DSS is currently being applied to Hellenic Coastal Zones and Islands (islands of Lesvos, Chios, Samos)

  - Information from Questionnaires is being processed for Samos island to support scenario development and Multicriteria Analysis

  - The existing models are being elaborated and the possibility to include results from more complex models running off-line is being discussed and investigated

  - A validation procedure is being investigated

  - The uncertainty of the model has to be quantified in some way

  - The possibility to include spatial or more pseudo-spatial components to increase resolution is also investigated

  - The development of a friendly-user interface is also essential offering the opportunity to be used directly by the end-users or as an educational tool

Models DO NOT always work and make trustful predictions...

...but they ALWAYS support the organization of our thinking...

Thanks a lot!