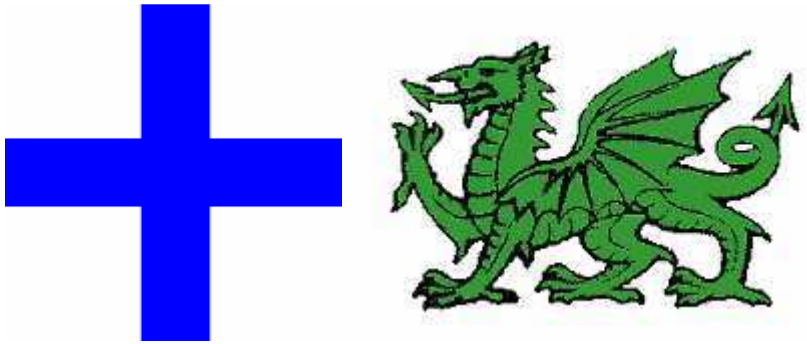

The Fourth Inter-Celtic Colloquium on Hydrology and Management of Water Resources

Application of RIAM to the Environmental Impact Assessment of Hydroelectric Installations

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Introduction

- Water
  - Crucial to life and sustainability
  - Use of hydraulic structure to control water
    - Irrigation, water supply, energy, flood control, etc.
    - > 3000 years ago in places like Egypt, the Mesopotamian, China, the Persia and in India
  - Dams (big) were started to be built
    - Aswan (Egypt), Yangtze (China – in construction), Alqueva (Portugal), …

- Environment
  - 1968, a proposed Dam in Indiana by the US Army Corps of Engineers was probably the last straw
  - 1969, environment started to become part of the decision making processes
    - US NEPA (National Environmental Policy Act)
      - impact assessment
  - 1972, UN Conference on Environment in Stockholm
  - 1992, Earth Summit in Rio
  - …

Environmental Impact Assessment (EIA): An Overview

- USA, 1969
- Canada, 1973
- In the European Union:
  - France, 1976
  - European Union Council Directive, 1985
  - Portugal, 1987
  - UK, 1988
- Now extensively used all over the world

- Is EIA a panacea to environmental problems?

NO!

- So what it is?
  - Anticipatory, participatory, integrative management tool
  - Decision makers get an indication of the likely environmental consequences of their actions
  - It is ONE of the elements of the environmental protection policy
  - Many decisions within the EIA process itself are NOT based upon the rational principles of value free objectivity

- The information generated by the EIA process occurs within a political decision-making setting (a specific cultural and administrative background), and is therefore influenced by its norms and values, as well as by its procedures.

- Any changes to the decision-making process that result from EIA will be changes made as a consequence of the evolution of the values and perspectives held by the elected decision-makers and by their advisors and/or as a result of successful public intervention.

- Subjective conclusions can provide a suitable basis for EIA, but the problem lies in recording the transparency of the assessment.

- EIA evaluations need to be re-assessed with the passage of time, and the data contained therein should be open to scrutiny and revision, as new data become available. Wholly subjective and descriptive systems are not capable of such revision, dependent as they are on the expertise and experience of the original assessors and on the quality of the descriptive record left behind.

RIAM

Recording subjective judgements by defining the criteria and scales against which these judgements are to be made.

The process of selecting components for an EIA which are then assessed against criteria is known as ‘scoping’.

Components are defined in 4 categories:

- Physical / Chemical (PC);
- Biological / Ecological (BE);
- Sociological / Cultural (SC);
- Economic / Operational (EO).

The important assessment criteria fall into two groups:

- (A) Criteria that are of importance to the condition, and which can individually change the score obtained;
- (B) Criteria that are of value to the situation, but individually should not be capable of changing the score obtained.

Group (A) Criteria

Importance of condition (A1) - spatial boundaries or human interests:

4 important to national/international interests
3 important to regional/national interests
2 important to areas immediately outside the local condition
1 important only to the local condition
0 no importance.

Magnitude of change/effect (A2) - measure of the scale of benefit/dis-benefit of an impact or a condition:

3 major positive benefit
2 significant improvement in status quo
1 improvement in status quo
0 no change/status quo
1 negative change to status quo
2 significant negative dis-benefit or change
3 major dis-benefit or change.

Group (B) Criteria

Permanence (B1) - a measure of the temporal status of the condition:

1 no change/not applicable

2 temporary

3 permanent.

Reversibility (B2) - a measure of the control over the effect of the condition:

1 no change/not applicable

2 reversible

3 irreversible.

Cumulative (B3) - a measure of whether the effect will have a single direct impact or whether there will be a cumulative effect over time, or a synergistic effect with other conditions:

1 no change/not applicable

2 non-cumulative/single

3 cumulative/synergistic.

(A1) x (A2) = AT

(B1) + (B2) + (B3) = BT

(AT) x (BT) = ES

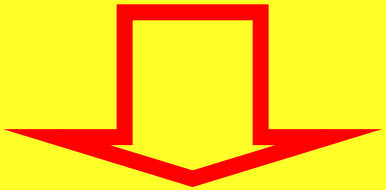
Where:

(A1) and (A2) are the individual criteria scores for group (A)

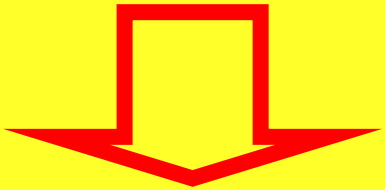
(B1) to (B3) are the individual criteria scores for group (B)

ES is the assessment score for the condition.

Ranges: To use the evaluation system described, a matrix is produced for each project option. The matrix comprises of cells showing the criteria used, set against each defined component



Calculate ES from the above equation



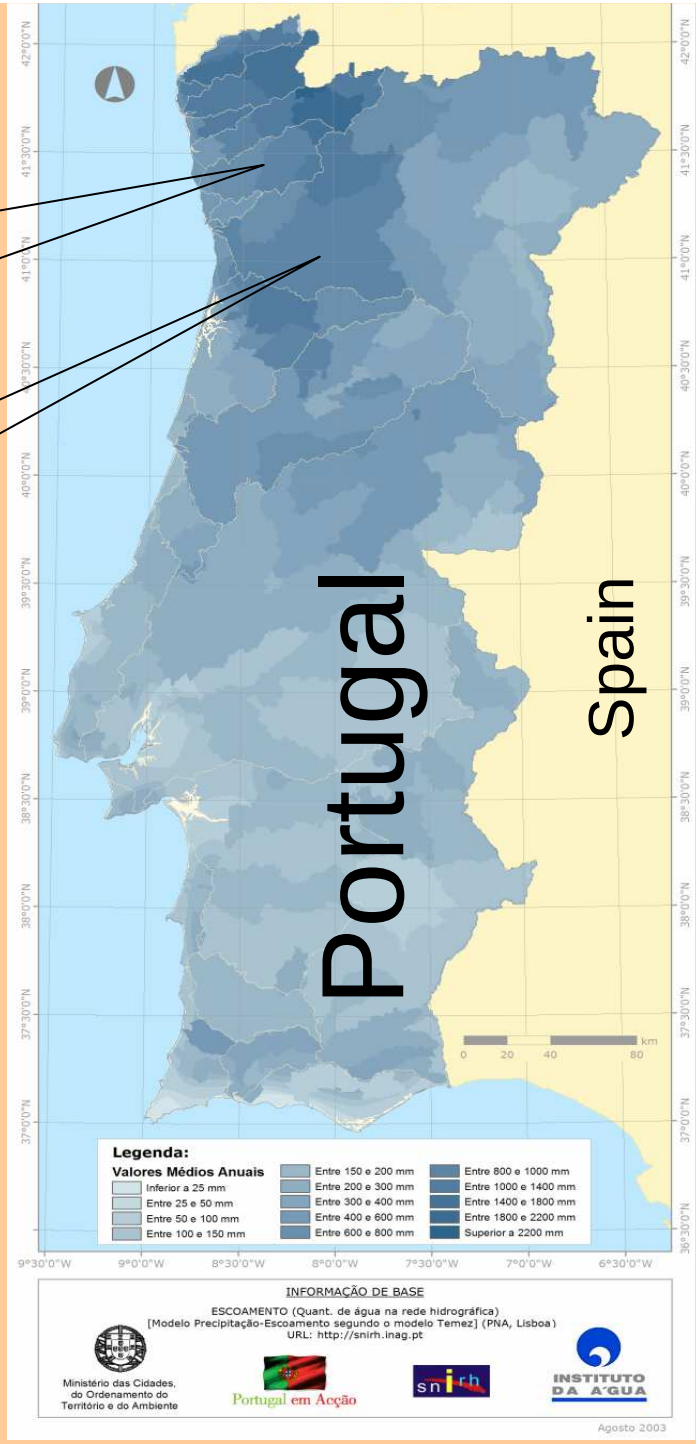
The individual ES scores are banded together into ranges (Range values: RV) where they can be compared.

Range Bands

RIAM Environmental Score (ES)	Range value (RV) (Alphabetic)	Range value (RV) (Numeric)	Description of range band
108 to 72	E	5	Major positive change/impact
71 to 36	D	4	Significant positive change/impact
35 to 19	C	3	Moderate positive change/impact
10 to 18	B	2	Positive change/impact
1 to 9	A	1	Slight positive change/impact
0	N	0	No change/status quo/not applicable
-1 to -9	-A	-1	Slight negative change/impact
-10 to -18	-B	-2	Negative change/impact
-19 to -35	-C	-3	Moderate negative change/impact
-36 to -71	-D	-4	Significant negative change/impact
-72 to -108	-E	-5	Major negative change/impact

Application

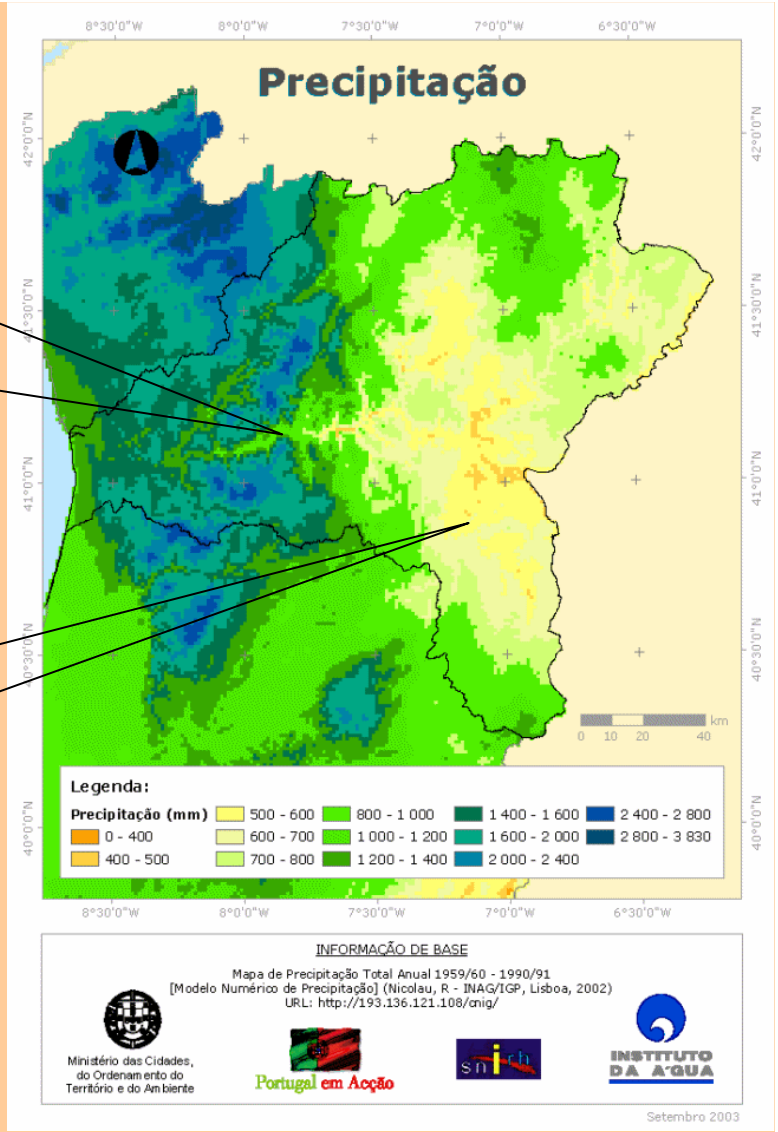
- Vale de Madeira Hydroelectric System
  - Situated on River Côa of the Douro river Basin



- Between the Municipalities of Pinhel and Figueira de Castelo Rodrigo
- Only for energy production, average annual production of 2,58 GWH
- PPT < 550 mm/y

Douro River Basin

River Côa

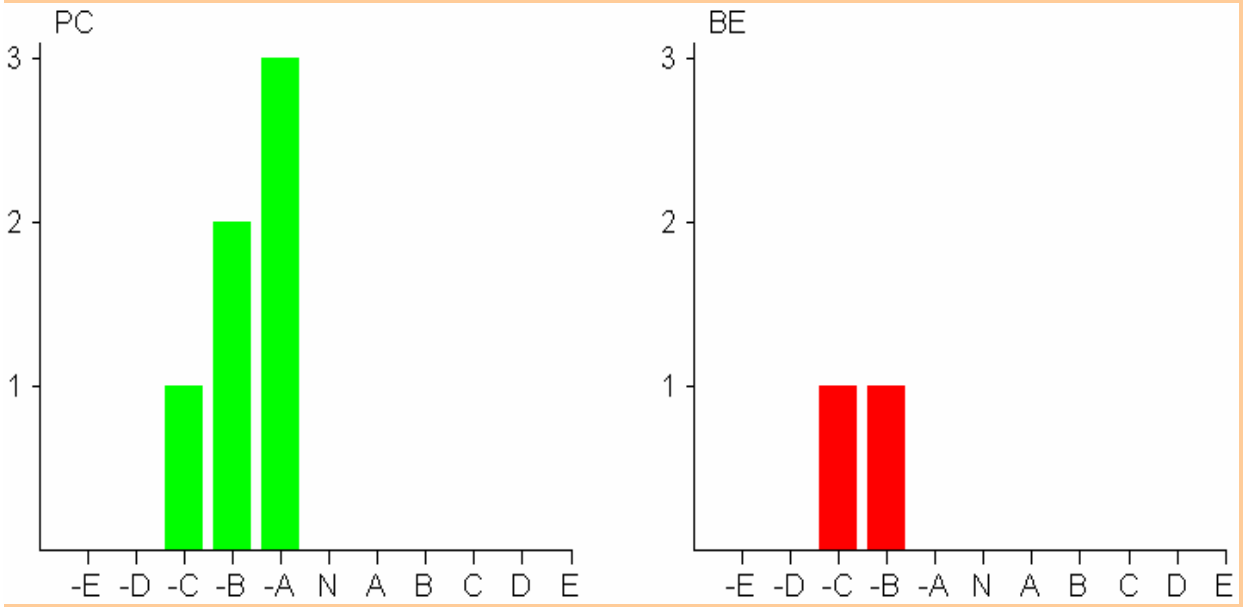


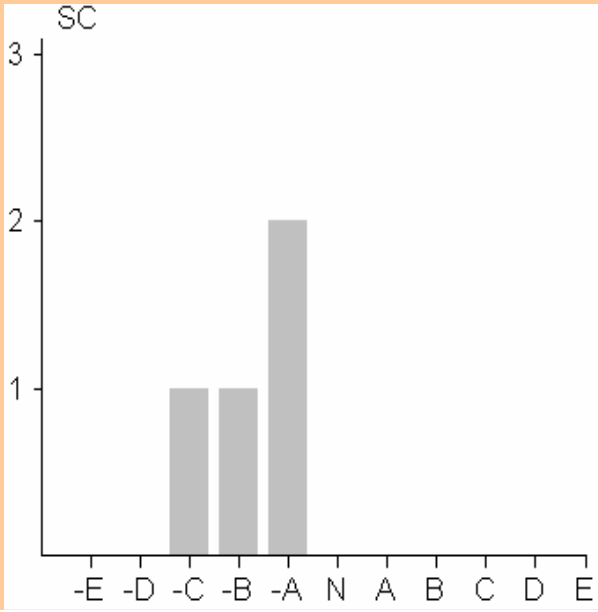
After developing the component sets, they were introduced into the program with their possible condition.

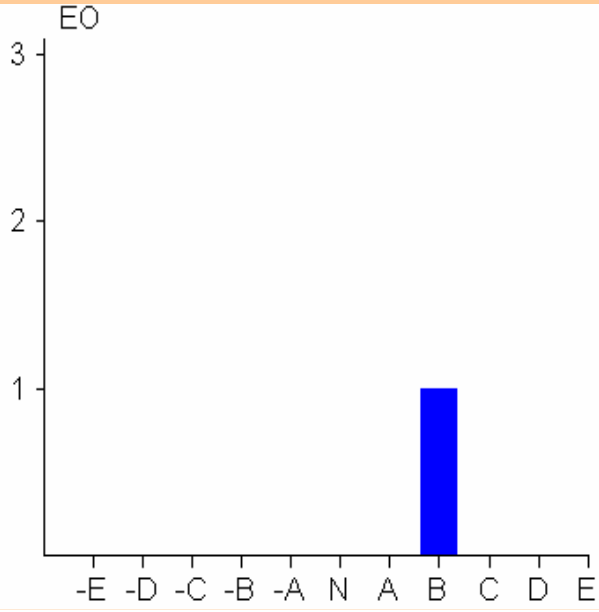
Following is a sample data of the physical/chemical category for the exploration phase:

Component	A1	A2	B1	B2	B3
PC1: Geophysics	2	-1	3	2	1
PC2: Soil	2	-2	3	2	3
PC3: Water quality and water resources	2	-1	3	2	1
PC4: Climate	1	1	3	2	1
PC5: Air quality	1	0	1	1	1
PC6: Environmental noise	1	-1	3	2	1

Construction Phase







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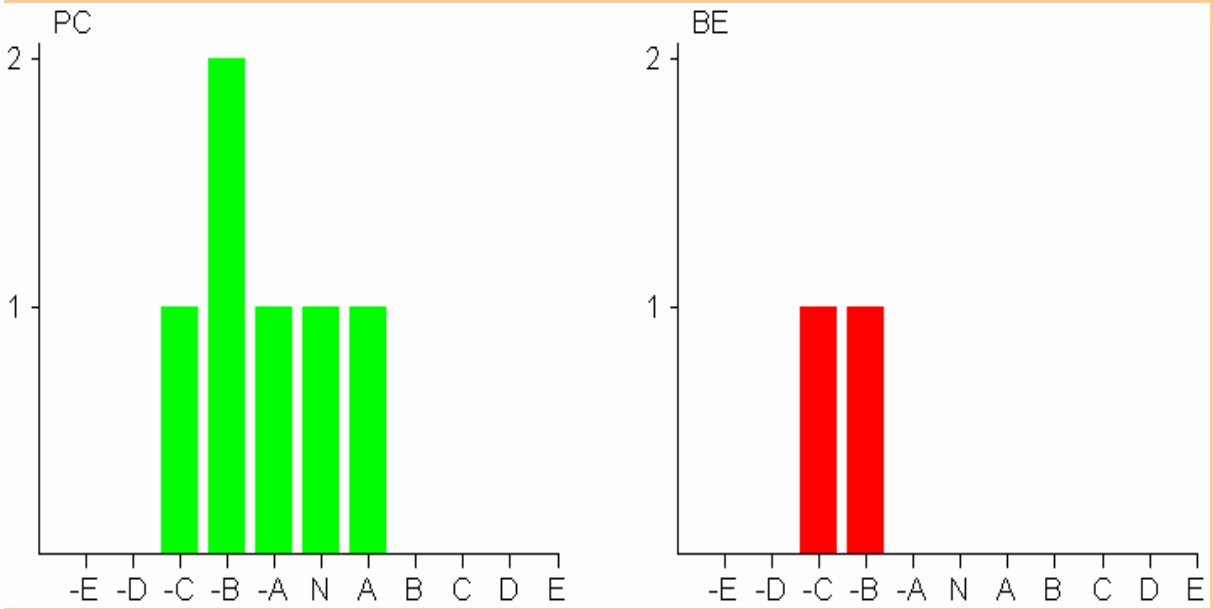
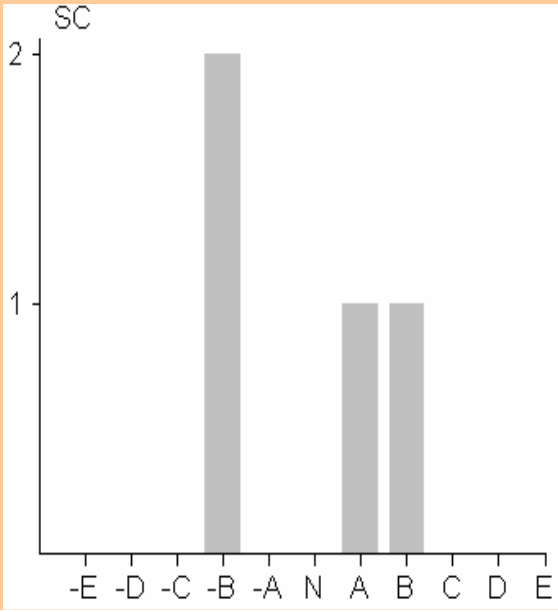
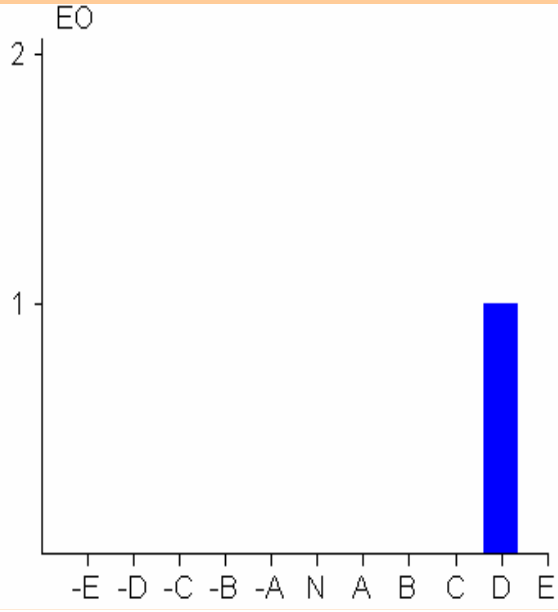
Exploration Phase







Conclusions

- RIAM enabled the fulfilment of the immediate aim of EIA as to facilitate sound, integrated decision making in which environmental considerations are explicitly included;

  → Particularly important for researchers (academics) who would like to give scenarios.
- It allowed for a permanent record of the arguments in the judgement process;
- It lets to compare phases and alternatives (including the no-action).

Thank you!