Trans-Disciplinary Learning: A Case Study Linking Science to Budgets

SETAC – Sydney, Australia

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What is Trans-disciplinary Learning?

- Creation of new knowledge from existing disciplines.
- Why does this matter?
  - Systems approach
- Why is this hard?
  - Specialty training
  - Fields of specialties
  - Organizational structures
  - Complexity of problem
  - Complexity of solutions

Case Study

- U.S. Mid-Atlantic Region
- Nearly 200 indicators
  - Health, Welfare, Future Vulnerability
  - Air, water, waste, landscape (forest, waters, wetlands, oceans)
  - Condition and stressors
- Geographic analytical unit = 12 digit Hydrologic Unit Code (HUC12)*; nearly 3700 in this region.

*U.S. Geological Survey classification scheme based on water drainage areas.

Analysis using MIRA

- Multi-criteria Integrated Resource Assessment
- MIRA approach:
  - Transparent
  - Data-driven
  - Stakeholder inclusive
  - Iterative
- Ideas/methods from a variety of disciplines: risk management, adaptive management, decision analysis, consensus building, sustainability.
  - A *Trans-disciplinary* approach to environmental analysis.

MIRA Steps

- **Decide** on the decision question. **CONTEXT is key.**
- **Decide** on decision criteria (indicator construct and data).
- **Index** data (expert judgment of significance) – relative to this decision context.
- **Preference** decision criteria (value sets using pairwise comparisons) – relative to this decision context.
- **Iterate** – LEARN.

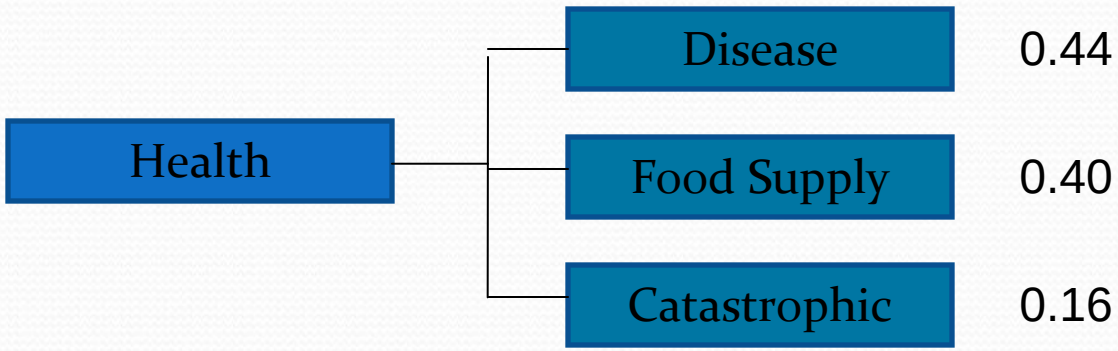
- MIRA Products: ranked list (by area, by option,…); maps of ranked areas.

Example of MIRA Indexing and Preferencing

- Index all indicator data

Criteria	Good (1)		Bad	Worst (8)
Waste	12	30	50	80
Forest	10000	8000	2000	100

- Preference decision criteria



Two Areas of Trans-disciplinary Learning

- Indexing
  - Experts from different disciplines/fields of expertise representing decision criteria data determine the relative significance of that data within the context of the analysis.
- Preferencing
  - Decision makers/stakeholders with different perspectives/different expertise experiment with different value sets – what's more important and by how much?
- Both areas are transparent.

Trans-Disciplinary Learning through Indexing: Fine Particulate Matter (PM2.5, ug/m³)

Same PM2.5 data used three different ways: Disease (D), Exercise (E), Vistas (V)

Indicator	Index						
	1.0 – 2.0	2.0 - 3.0	3.0 – 4.0	4.0 – 5.0	5.0 – 6.0	6.0 – 7.0	7.0 – 8.0
PM2.5D	3.0	8.0	12.50	15.75	16.5	17.25	18.0
PM2.5E	10.0	14.0	16.0	17.0	18.0	19.0	20.0
PM2.5V	12.0	15.0	20.0	23.0	25.0	30.0	35.0

PM2.5 Max = 30.7; PM2.5 Min = 5.8

Trans-Disciplinary Learning through Indexing: Fine Particulate Matter (PM2.5, ug/m³) with Bee Crops (hectares, ha) and Nitrogen Deposition (kg/ha)

Using multiple criteria with disparate units in the same analysis.

Indicator	Index 1.0- 2.0	2.0- 3.0	3.0- 4.0	4.0- 5.0	5.0- 6.0	6.0- 7.0	7.0- 8.0
PM25DV-D	3.00	8.00	12.50	15.75	16.50	17.25	18.00
PM25DV-E	10.00	14.00	16.00	17.00	18.00	19.00	20.00
PM25DV-V	12.00	15.00	20.00	23.00	25.00	30.00	35.00
BEECROP	1,000	10,000	50,000	80,000	120,000	180,000	350,000
NITRODEP	5.00	9.17	13.33	17.50	21.67	25.83	30.00

Trans-Disciplinary Learning through Preferencing

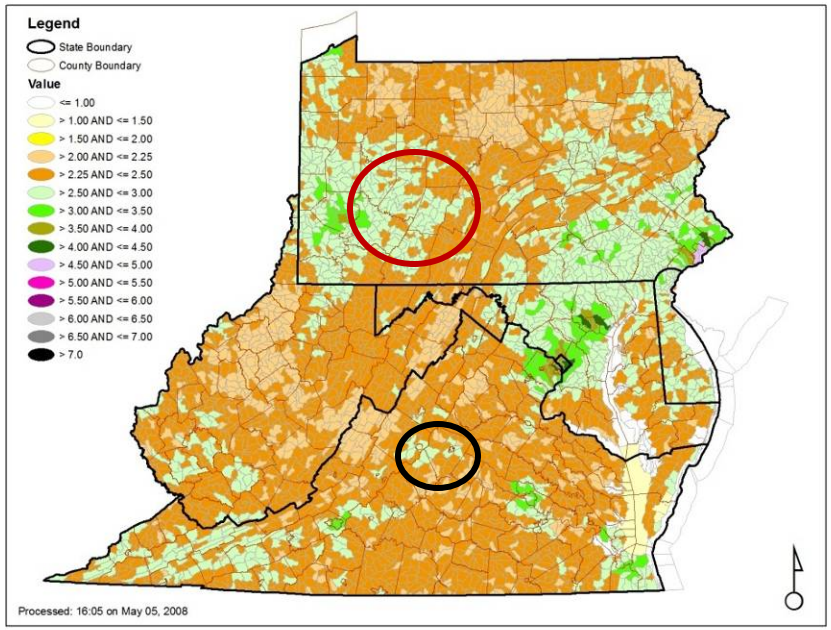
- Test the impact of different value sets on ranked watersheds.
- Learn what indicators/science drives which watersheds to rank high/low.
- Learn through the collective use of all indicators.

Relative Ranks of Watersheds Change for Different Value Sets

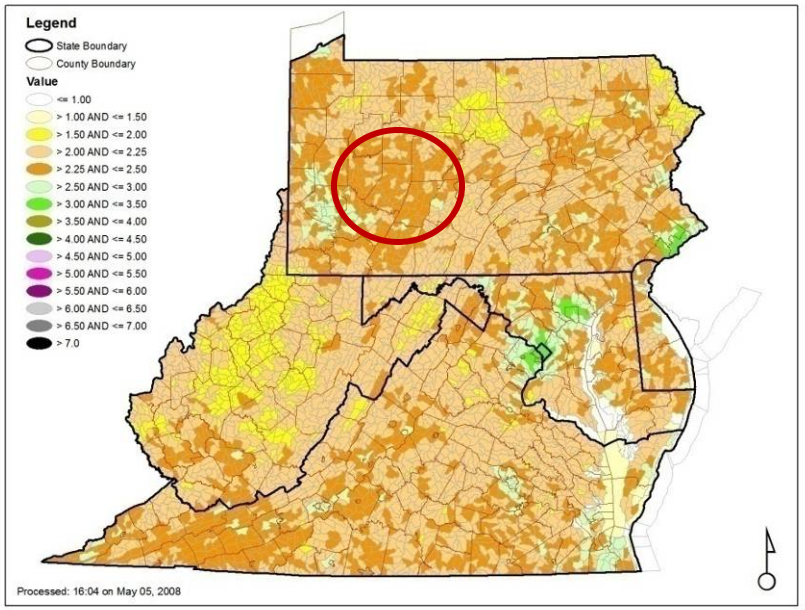
Value Set 1: Consolidated senior manager agreement (Cons)
Value Set 2: Equal preferences (all criteria equally important) (Equal)
Value Set 3: Health focused (Health)
Value Set 4: Welfare focused (Welfare)

Name of HUC	Cons	Equal	Health	Welfare
Goose Creek	1001	472	1129	887
Bald Eagle Creek	1002	616	1454	70
Grave Creek	1003	3072	1361	1934
Tunkhannock Creek	1004	583	1483	750

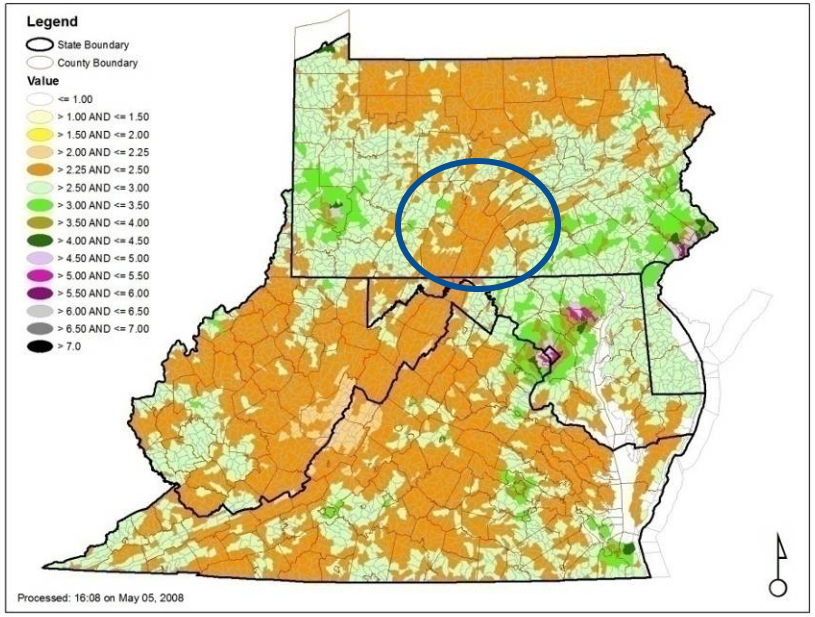
Consolidated Run



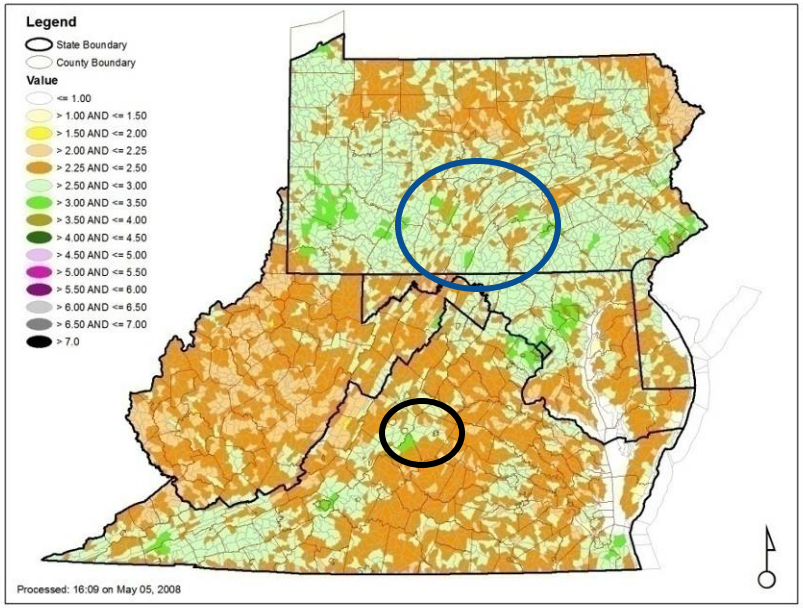
Equal Pref Run



Health Focused Run

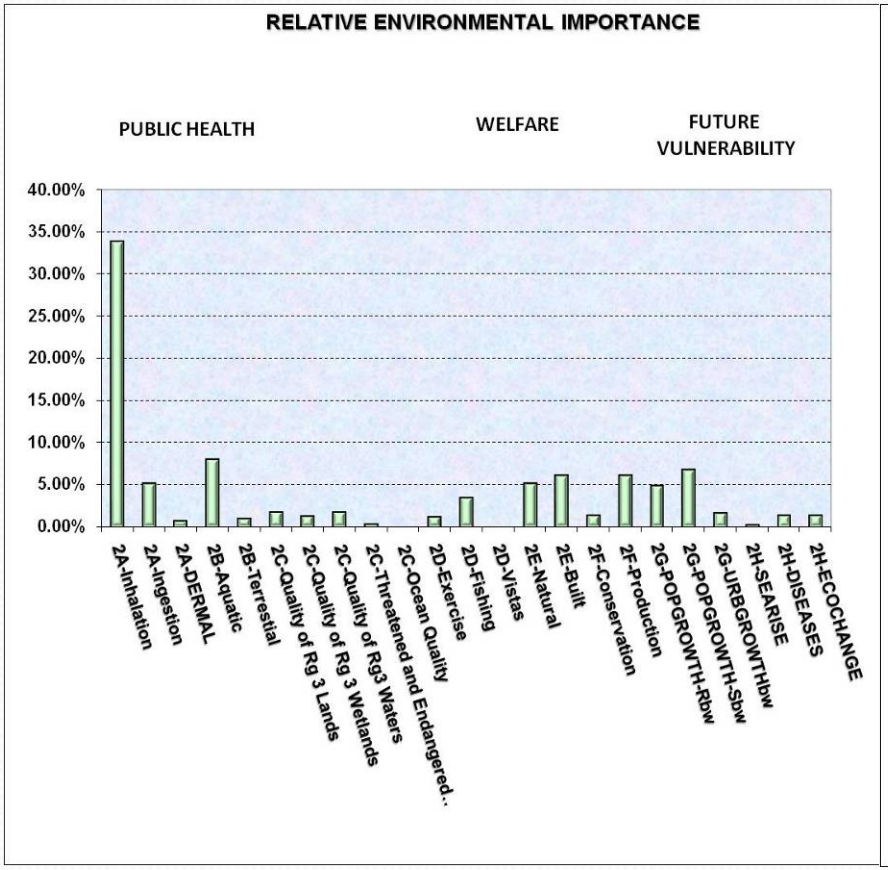


Welfare Focused Run

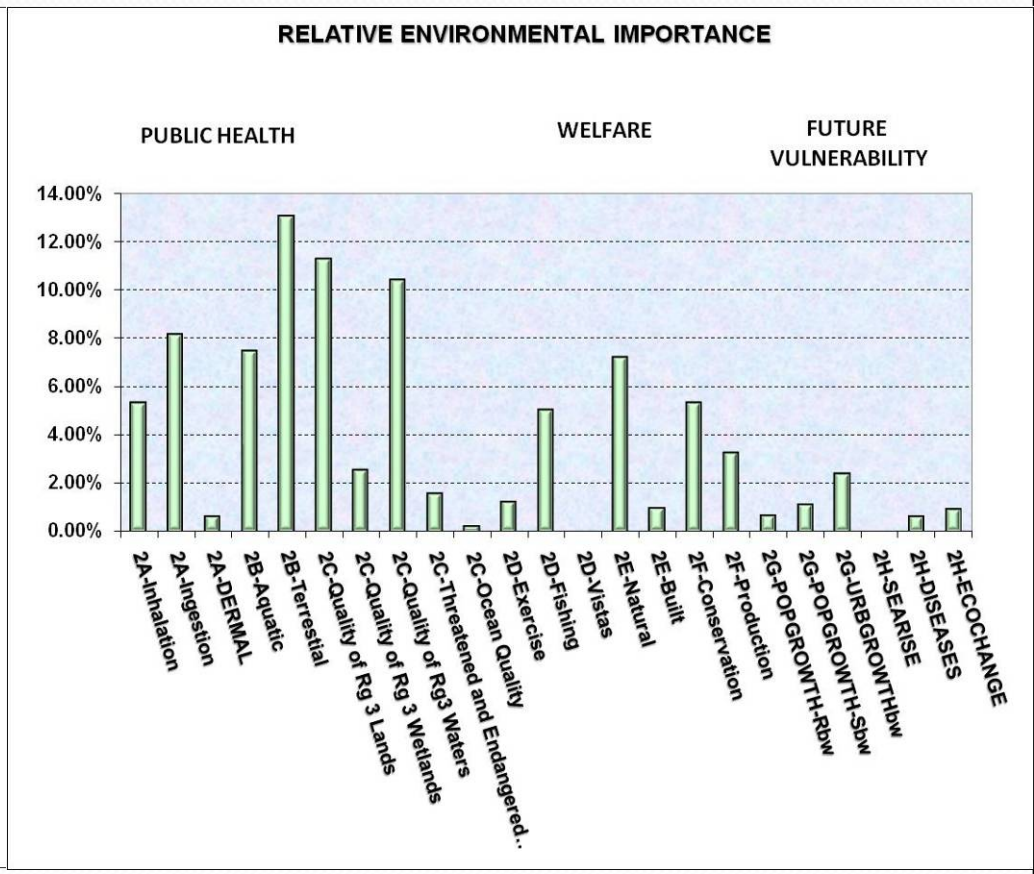


Science Drivers Differ Depending on Value Set

Extreme Health Value set*



Extreme Welfare Value set*

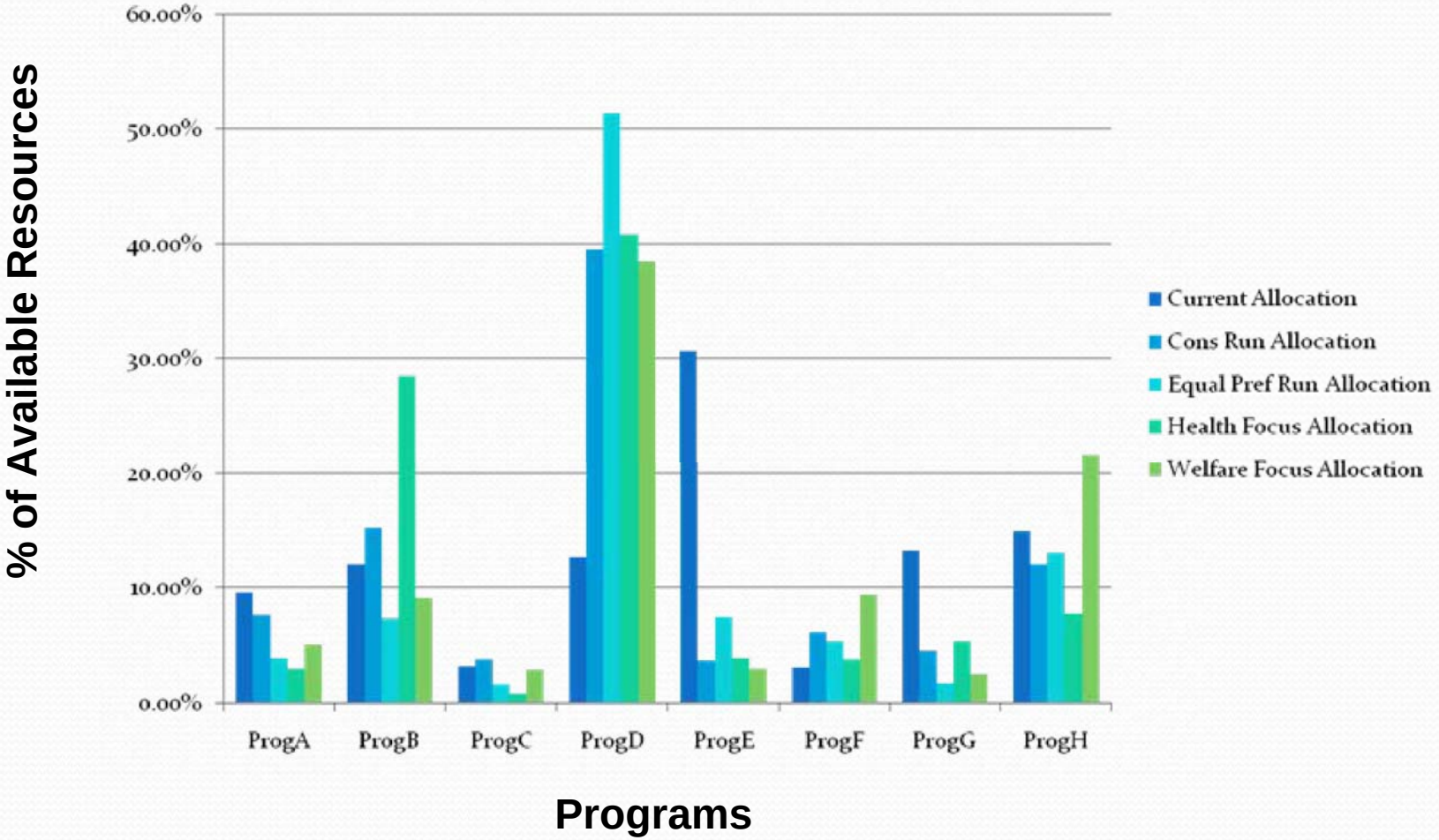


***Data is Identical.**

MIRA informs:

- What science is important?
- Where is that science important?
- BUT: How do we use this information to budget our resources?

Hypothetical Current and Potential Resource Allocation Schemes Based on 4 Different Value Sets (compared with the current allocation scheme)



Linking Science to Budgets

- Use data and values to inform resource allocation.
- Compare/Evaluate current allocation with other allocation possibilities.

Lessons Learned

- Trans-disciplinary learning isn't just a concept.
- Using science to inform budget allocations is possible.
- The MIRA process facilitates communication and learning within the organization.
- We can use the MIRA process to identify gaps: data, knowledge, communication,…
- We can do better – and we will!

Contact Information

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