Urgent Need for Change
Overhauling EIA/SIA training in higher education

Luis A. Bojórquez-Tapia and Tatiana Merino-Benítez

IAIA Regional Symposium
Infrastructure and the Environment:
The route of Latin America towards sustainability
Antigua, Guatemala, Nov. 6-7, 2024

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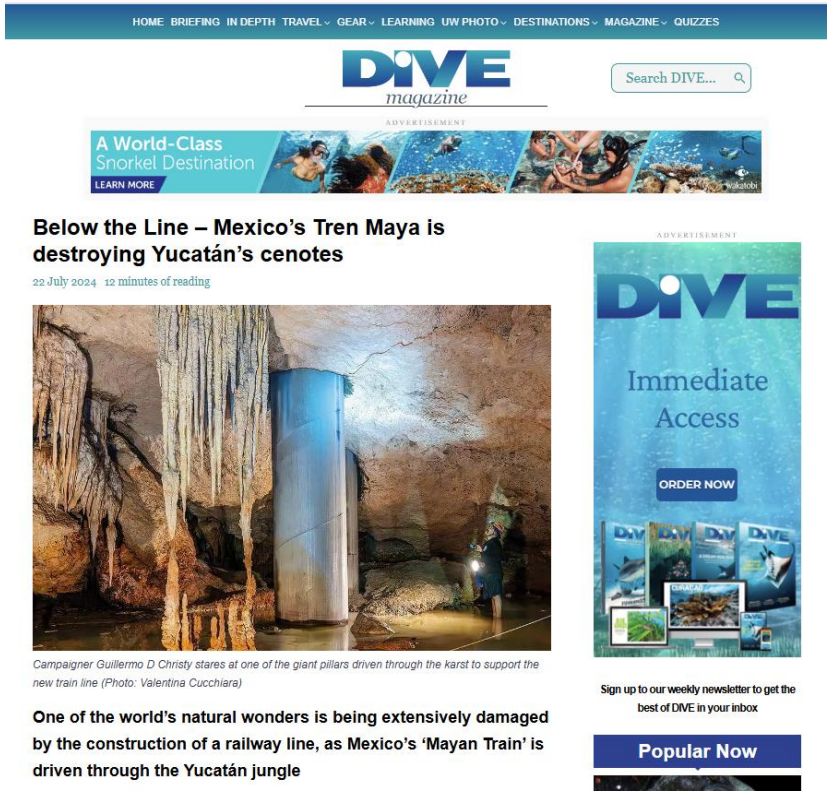
https://es.mongabay.com/2023/11/biologo-que-usa-fotografia-para-denunciar-danos-ambientales-por-construccion-del-tren-maya-entrevista/

https://divemagazine.com/print-issues/tren-maya-destroying-yucatan-cenotes



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Below the Line – Mexico's Tren Maya is destroying Yucatán's cenotes

22 July 2024 12 minutes of reading

Campaigner Guillermo D Christy stares at one of the giant pillars driven through the karst to support the new train line (Photo: Valentina Cucchiara)

One of the world's natural wonders is being extensively damaged by the construction of a railway line, as Mexico's 'Mayan Train' is driven through the Yucatán jungle

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Un paso hacia la sostenibilidad

Diferencia entre la matriz de Leopold y Conesa

- Conesa radica en su enfoque cualitativo y cuantitativo, respectivamente. Mientras que la matriz de Leopold se basa en la evaluación subjetiva de impactos, la matriz de Conesa se basa en datos numéricos y cálculos matemáticos.
- La matriz de Leopold es más flexible y puede adaptarse a proyectos con diferentes niveles de información disponible. Por otro lado, la matriz de Conesa requiere datos numéricos más específicos y detallados para realizar los cálculos necesarios
- Conesa compara la situación del medio ambiente con y sin intervención de la actividad humana; mientras leopold mide los posibles impactos ocasionados por la ejecución de una obra o proyecto.

$$S = 3In + 2Ex + Mo + Pe + Rv + Sy + Ac + Ef + Pr + Rc$$

$$S = \{Low \leq 25, 25 < Moderate \leq 50, 50 < High \leq 75, 75 < Very\ High \leq 100\}$$

$$In = \{Low = 1, Medium = 2, High = 4, Very\ high = 8, Total = 12\},$$

$$Ex = \{Isolated = 1, Partial = 2, Widespread = 4, Total = 8, Critical = 12\},$$

$$Mo = \{Long - term = 1, Medium - term = 2, Immediate = 4, Critical = 8\}.$$

$$Pe = \{Fleeting = 1, Temporary = 2, Permanent = 4\}.$$

$$Rv = \{Long - term = 1, Medium - term = 2, Irreversible = 4\}.$$

$$Sy = \{Non - synergic = 1, Synergic = 2, Very\ synergic = 4\}.$$

$$Ac = \{Simple = 1, Accumulative = 4\}.$$

$$Ef = \{Indirect = 1, Direct = 4\}.$$

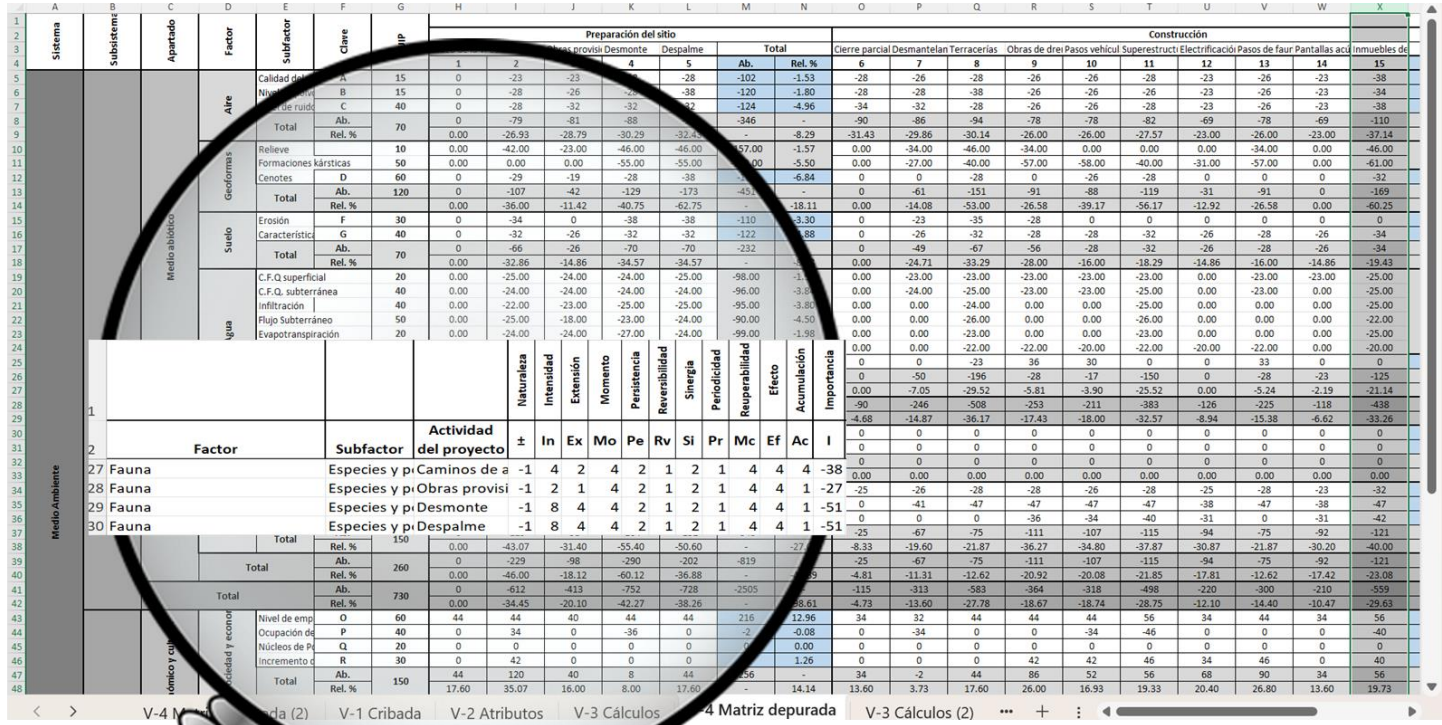
$$Pr = \{Discontinuous = 1, Periodic = 2, Continuous = 4\}.$$

$$Rc = \{Immediate = 1, Medium - term = 2, Able\ to\ mitigate = 4, Irrecoverable = 8\}$$

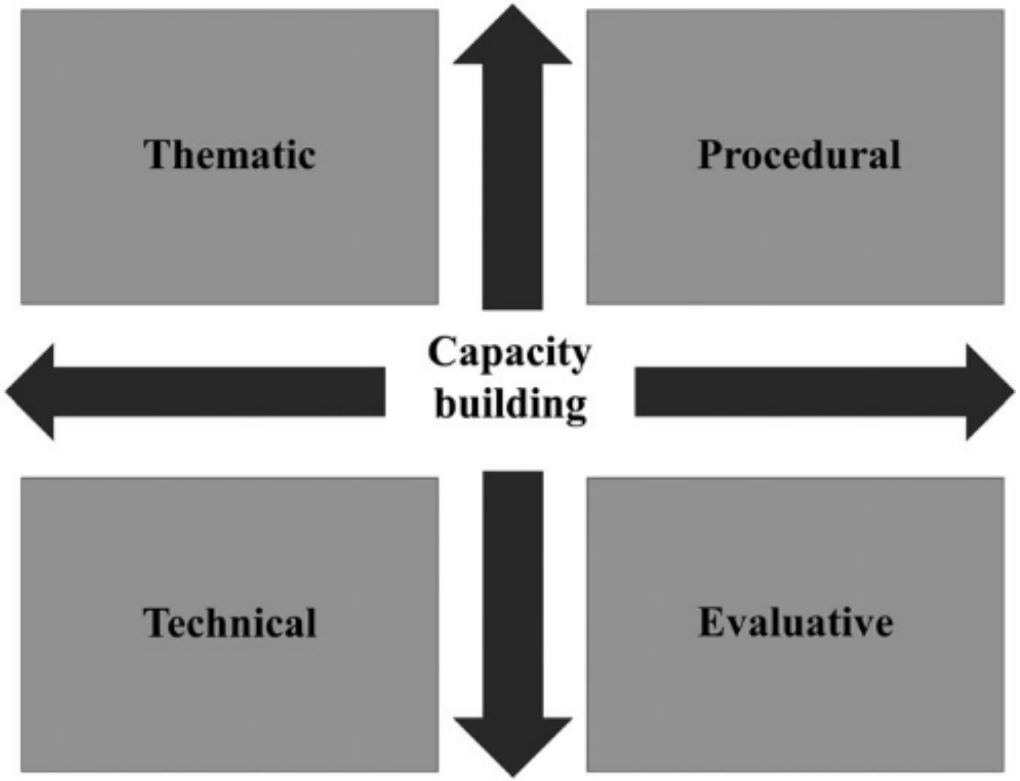
https://evaluaciondeimpactoambiental.com/metodologias-de-evaluacion-de-impacto-ambiental-una-guia-completa/

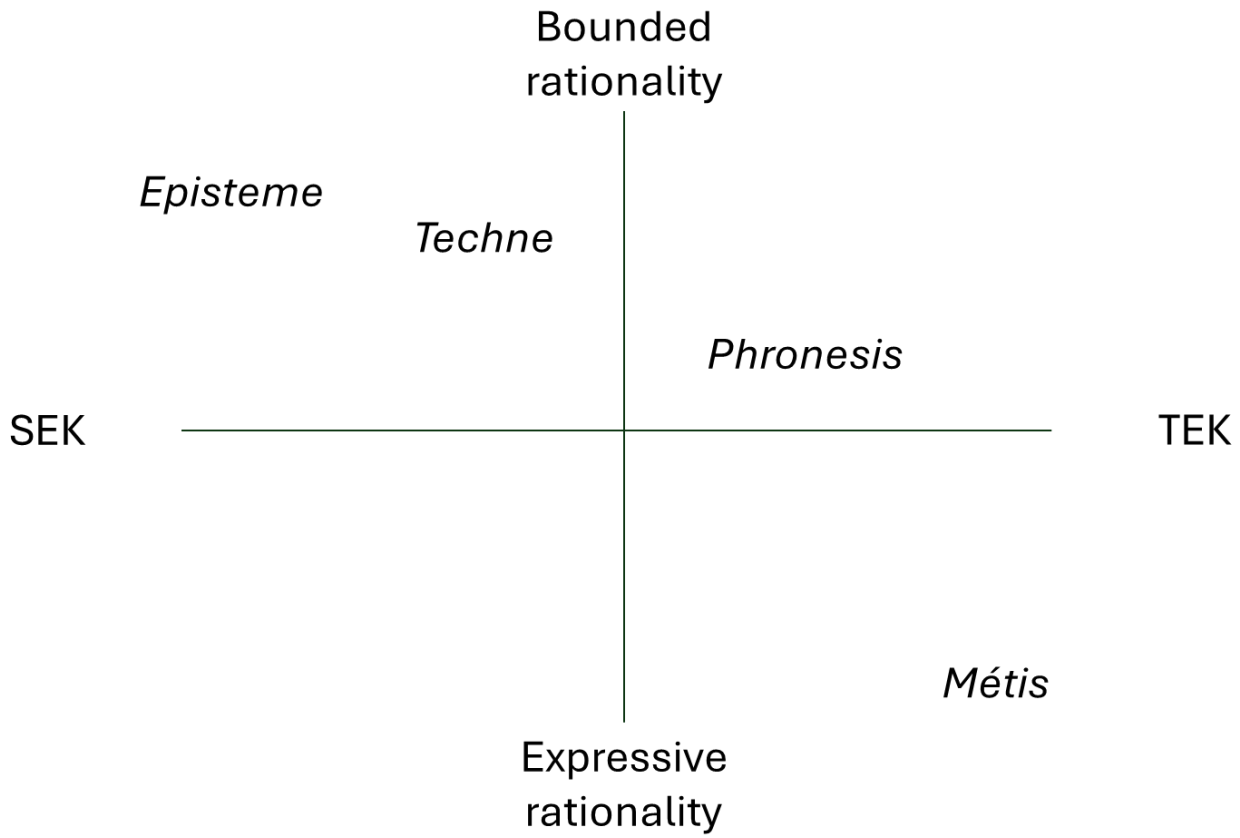
9. Número de impactos presentes por etapa del proyecto.

VALOR CUALITATIVO	INTERPRETACIÓN	CLAVE	IMPACTOS
ENTRE + 76 Y +100	IMPACTO BENÉFICO MUY ALTO	*C*	0
ENTRE +51 Y +75	IMPACTO BENÉFICO SIGNIFICATIVO	*S*	4
ENTRE +26 Y +50	IMPACTO BENÉFICO MODERADO	*M*	4
ENTRE +13 Y +25	IMPACTO BENÉFICO IRRELEVANTE	*I*	0
TOTAL, POSITIVOS			
0	NO SE ESPERA QUE OCURRA UN IMPACTO	*N*	0
ENTRE -13 Y -25	IMPACTO ADVERSO IRRELEVANTE	*I*	6
ENTRE -26 Y -50	IMPACTO ADVERSO MODERADO	*M*	11
ENTRE -51 Y -75	IMPACTO ADVERSO SEVERO	*S*	7
ENTRE – 76 Y -100	IMPACTO ADVERSO CRITICO	*C*	1
TOTAL, NEGATIVOS			
TOTAL			



Overhauling EIA/SIA training and teaching





Yosune M. et al, 2021. Challenges and opportunities for universities in building adaptive capacities for sustainability: lessons from Mexico, Central America and the Caribbean. CLIMATE POLICY https://doi.org/10.1080/14693062.2021.1985422

Large-scale infrastructure investments are being challenged in the pursuit of environmental justice

Necessary & Sufficient causation

$$P \leftrightarrow Q$$

$$\neg P \rightarrow \neg Q$$

$$\neg P \leftarrow \neg Q$$

Overdetermined causation

$$\neg P \vee Q$$

Integration

- **Pragmatic synthesis** of multiple knowledge domains of complex and uncertain problems
- **Credible, legitimate, and salient** results for sustainability transformations
- **Consensus** regarding a problem, its causes, and its sustainable pathways
- **Precautionary principle:** minimize false negative diagnosis or type II errors under uncertainty

Expert judgment Environmental harm is	**Evidence**	
	True	**False**
True	Sensitivity (TPR)	Type-I error (FPR)
False	Type-II error (FNR)	Specificity (TNR)

Measurement: A value on a ratio scale representing a specific, meaningful amount of an attribute

GIS-MCDA: integrating intangibles and tangibles; objective treatment of subjectivity

Significance: impacts are measured in a way that is both interpretable and comparable

Bayesian reasoning: Updating belief with evidence

Evaluation: Mechanisms, patterns, thresholds & trade-offs

Table 1

Types of uncertainty

Knightian uncertainty, after Knight [44], arises from the impossibility of knowing all the information needed to set accurate odds of the possible outcomes. It refers to circumstances plagued by unknown unknowns, unpredictability, and emerging systemic properties [45] that cannot be addressed in modeling [46,47].

Ontological uncertainty refers to the ignorance of the entities and relationships of the real world. It manifests itself in the hidden assumptions of the scientific representations of socio-environmental systems. It is a major obstacle for the formation of propositions about future states of the world.

Politically induced uncertainty refers to the 'deliberate ignorance' of public agencies when dealing with precarious and controversial circumstances by intentionally limiting the scope of the required assessments.

Deep uncertainty pertains the disagreement about the adequacy of the models' structure and composition, as well as the appropriateness of the parameters' probability distributions.

Epistemic uncertainty is the imperfection of knowledge about a system or different interpretations about the same body of knowledge.

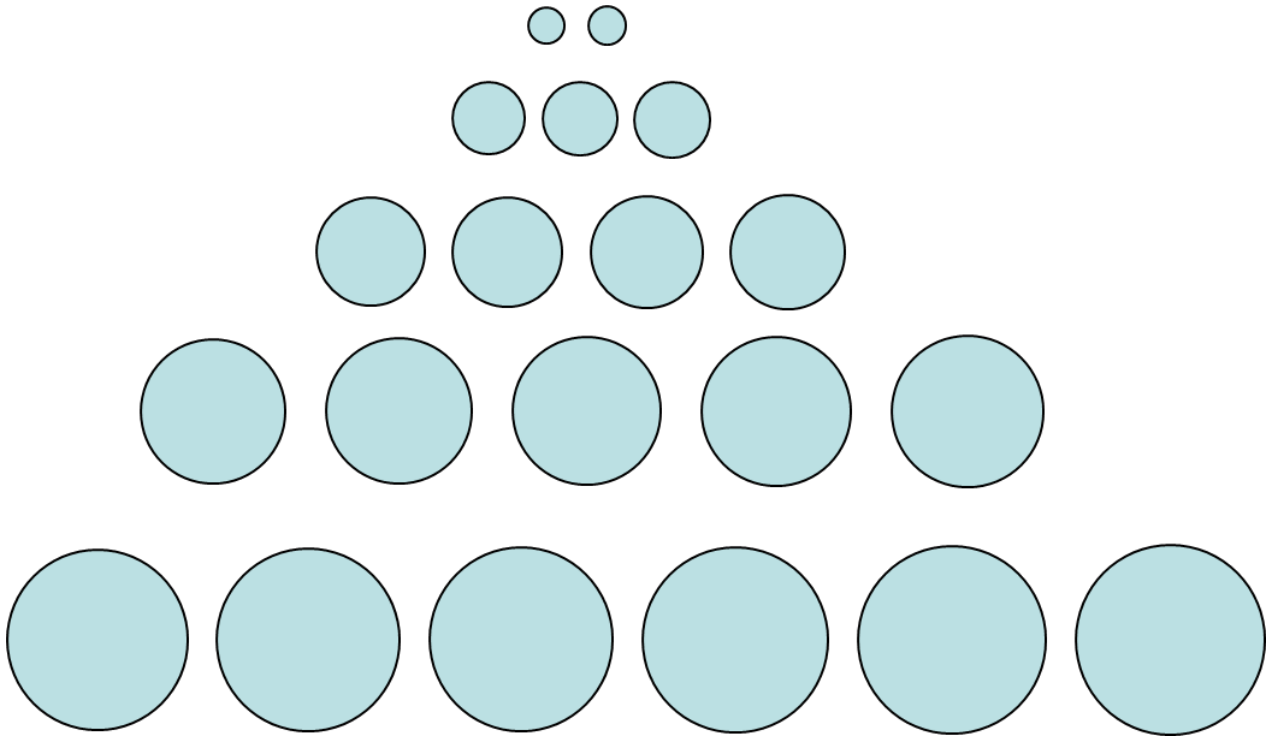
Linguistic uncertainty relates to the inexact nature of discursive interactions that involve polysemous terms (semantic uncertainty) and inaccurate expressions (predicate uncertainty) to characterize qualitative evidence.

Normative uncertainty concerns the impossibility of knowing the evolution of ethical values into the future with respect to alternative courses of action in the present.

Ambiguity refers to the simultaneous presence of multiple knowledge frames that convey a diversity of interpretations about the desirability of future states of the world.

Ley de Weber – Fechner (1889):

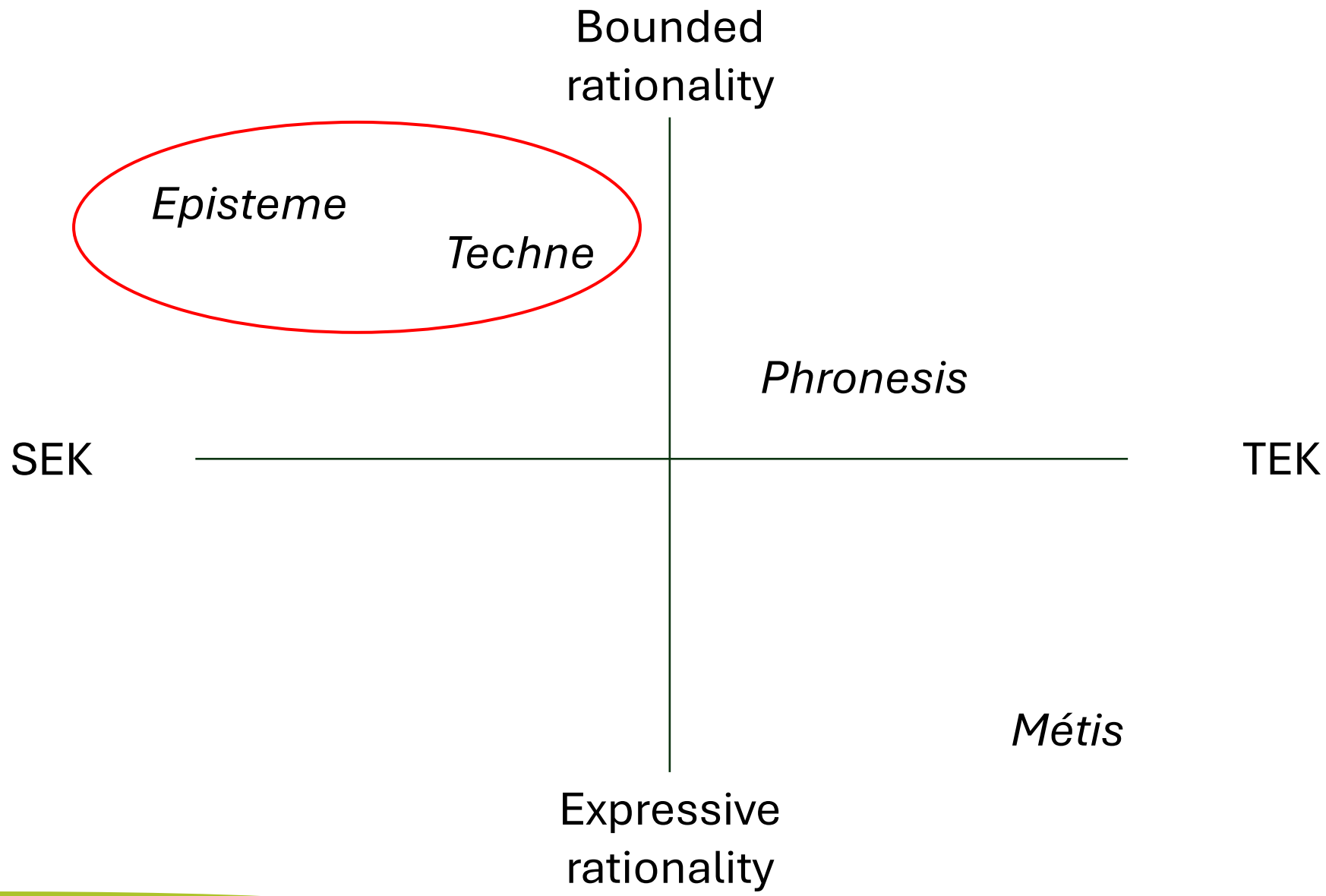
$$s_v = s_{v-1} + \frac{\Delta s_{v-1}}{s_{v-1}} s_{v-1}$$



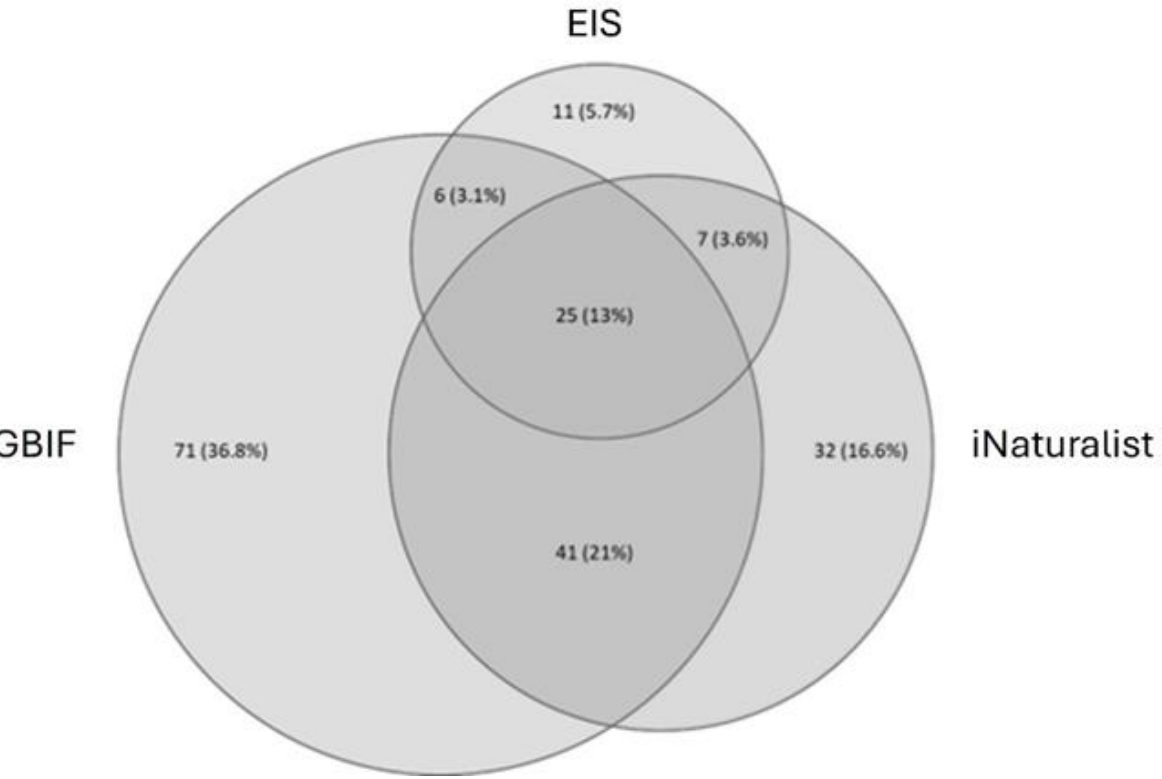
Ley de Miller (1956)

$$\Psi_n = n \log \rho$$

Linguistic variable				A	
Wallsten	**Allegation**	**Plausibility**	**Fundamental scale**	α	$P(\alpha)$
Almost impossible	Inconspicuous	Inconclusive	Extremely less	1/9	0.10
				1/8	0.11
Doubtful	Scintilla	Unfounded	Very strongly less	1/7	0.13
				1/6	0.14
Improbable	Suspicious	Speculative	Strongly less	1/5	0.17
				1/4	0.20
Unlikely	Ambiguous	Problematic	Moderately less	1/3	0.25
				1/2	0.33
Tossup	Random (accidental, by chance)		Equally	1	0.50
				2	0.67
Possible	Substantial	Conceivable	Moderately more	3	0.75
				4	0.80
Good chance	Unequivocal	Convincing	Strongly more	5	0.83
				6	0.86
Probable	Preponderant	Well-founded	Very strongly more	7	0.88
				8	0.89
Almost certain	Beyond doubt	Conclusive	Extremely more	9	0.90


Bounded rationality
Episteme
Techne
Phronesis
SEK
TEK
Métis
Expressive rationality

Biodiversity: Open data & IA vs Tren Maya EIS



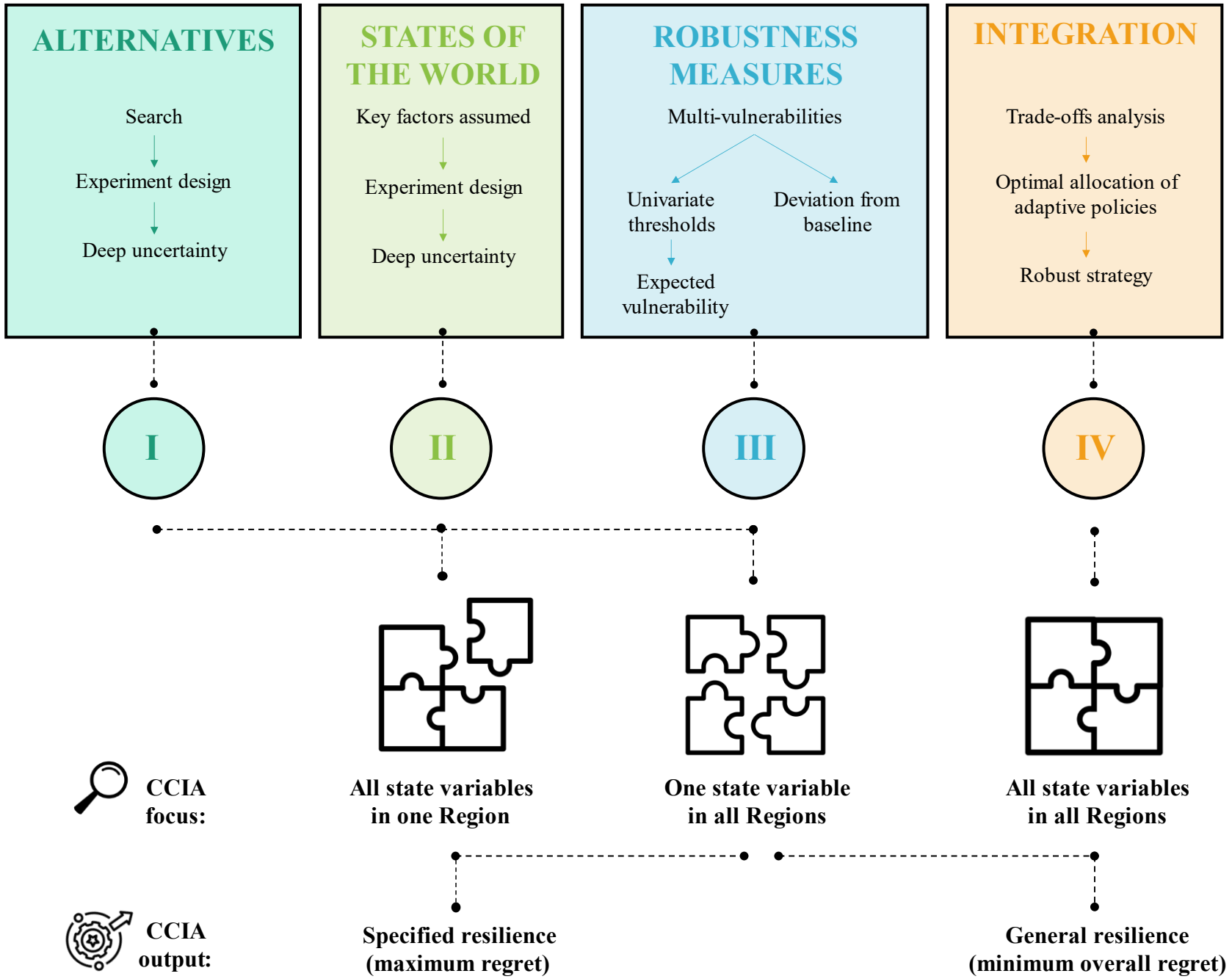
Species Name	Impact indicator								
	In	Ex	Mo	Pe	Rv	Sy	Ac	Ef	Pr
Onychorhynchus coronatus	8	4	4	7	4	4	4	4	7
Lepidochelys olivacea	4	4	4	4	4	4	4	4	7
Nephrolepis cordifolia	4	4	4	4	4	1	1	4	3
Pionopsitta haematotis	4	4	4	4	4	1	1	4	3
Amazona oratrix	8	8	4	7	7	4	4	4	7
Spizaetus tyrannus	8	4	4	7	4	4	4	4	7
Spizaetus ornatus	8	4	4	7	4	4	4	4	7
Jabiru mycteria	8	4	4	7	4	4	4	4	7
Sarcoramphus papa	8	4	4	7	4	4	4	4	7
Cairina moschata	4	4	4	4	4	4	4	4	3

Evaluation	Impact indicator										Synthesis	
	In	Ex	Mo	Pe	Rv	Sy	Ac	Ef	Pr	Rc	S	S'
Weighted linear combination												
EIS	8	4	4	2	1	2	1	4	4	1	51	H
AI-max	8	8	4	7	7	4	4	4	7	7	84	VH
Non-linear combination												
EIS	0.50	0.25	0.50	-	-	0.50	0.06	-	-	-	0.53	VH
AI-max	0.50	0.50	0.25	-	-	1.00	1.00	-	-	-	1.00	VH

Avoiding errors of omission (type-II)

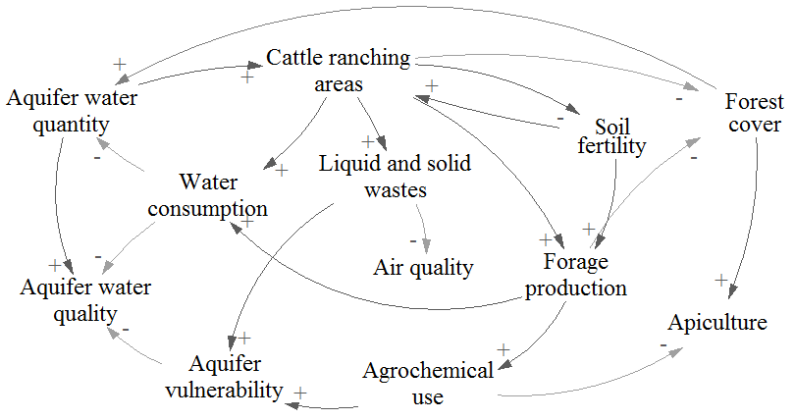
Evaluation	Impact indicator										Synthesis	
	In	Ex	Mo	Pe	Rv	Sy	Ac	Ef	Pr	Rc	S	S'
Weighted linear combination												
EIS	8	4	4	2	1	2	1	4	4	1	51	H
AI-max	8	8	4	7	7	4	4	4	7	7	84	VH
Non-linear combination												
EIS	0.50	0.25	0.50	-	-	0.50	0.06	-	-	-	0.53	VH
AI-max	0.50	0.50	0.25	-	-	1.00	1.00	-	-	-	1.00	VH

DMDU

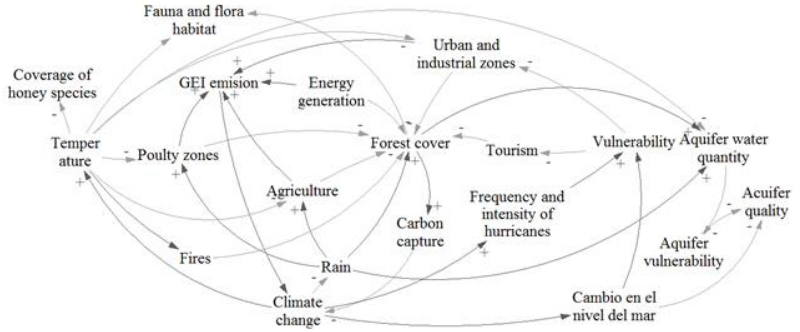

ALTERNATIVES
Search
Experiment design
Deep uncertainty
STATES OF THE WORLD
Key factors assumed
Experiment design
Deep uncertainty
ROBUSTNESS MEASURES
Multi-vulnerabilities
Univariate thresholds
Deviation from baseline
Expected vulnerability
INTEGRATION
Trade-offs analysis
Optimal allocation of adaptive policies
Robust strategy
I
II
III
IV
CCIA focus:
All state variables in one Region
One state variable in all Regions
All state variables in all Regions
CCIA output:
Specified resilience (maximum regret)
General resilience (minimum overall regret)

I

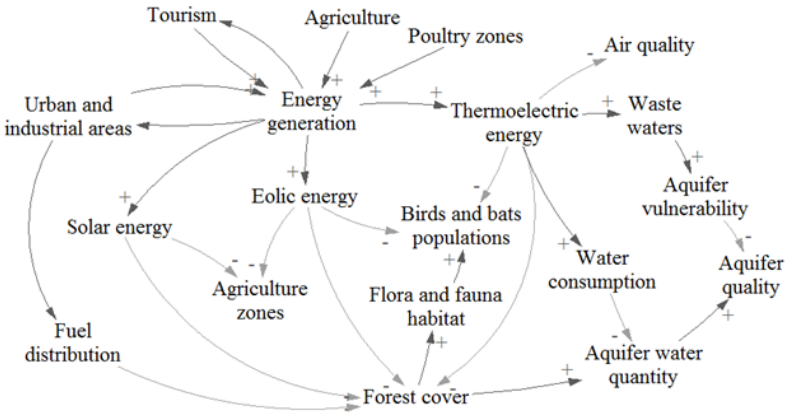
Participatory workshops



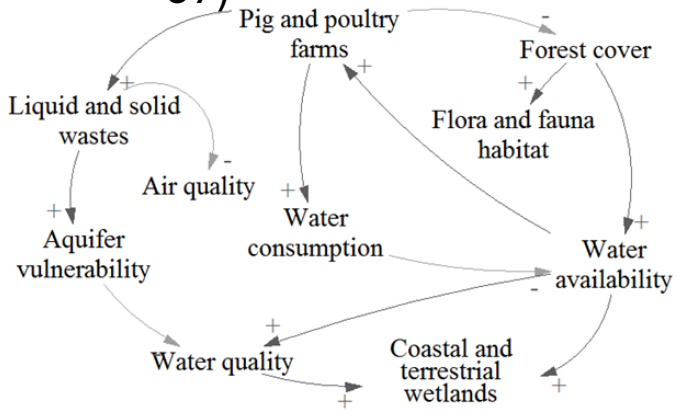
Cattle zones (n= 40)



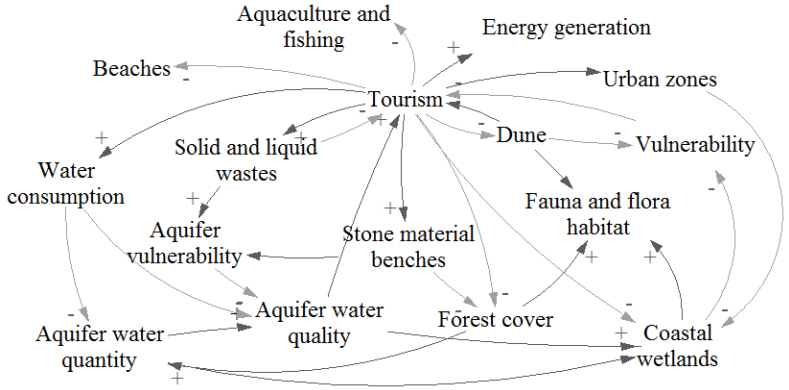
Climate change (n= 97)



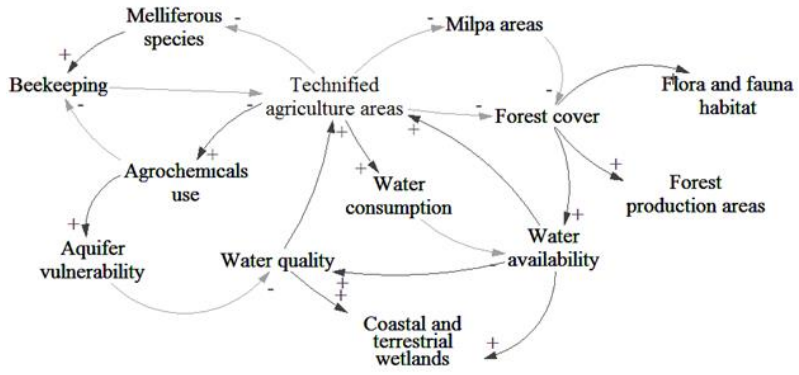
Power generation (n= 67)



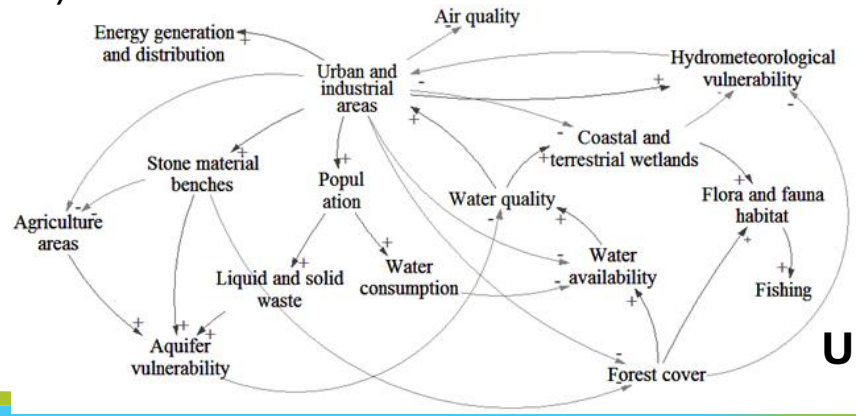
Swine and poultry plants (n= 41)



Tourism (n= 61)



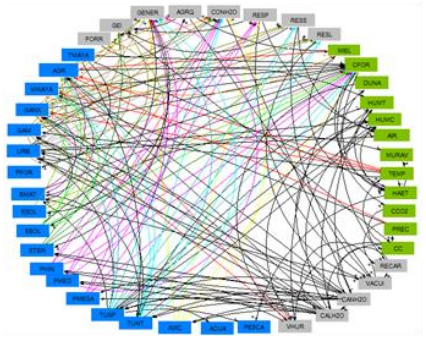
Agriculture (n= 68)

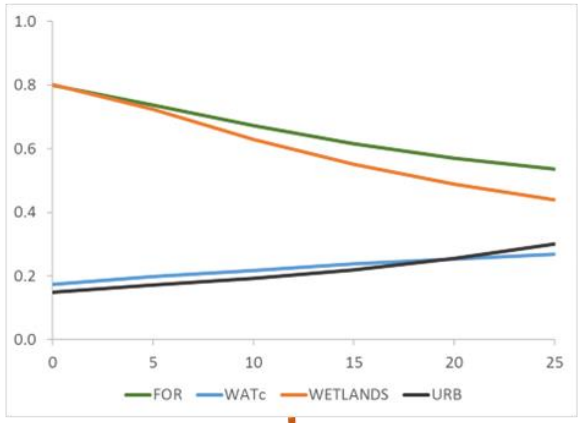


Urban sprawl (n= 84)

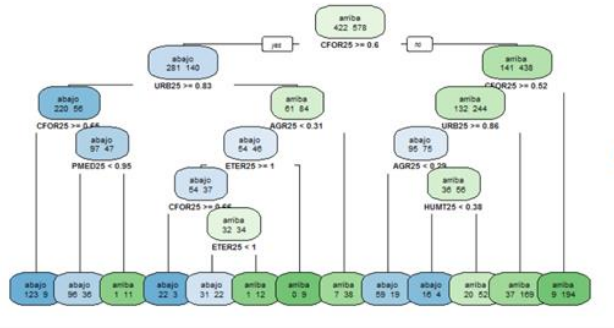
II

SOW: States of the world

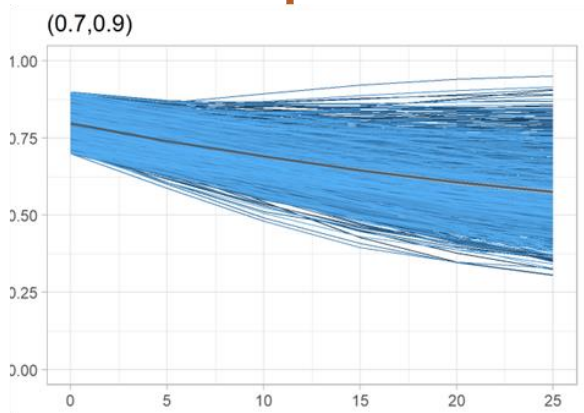


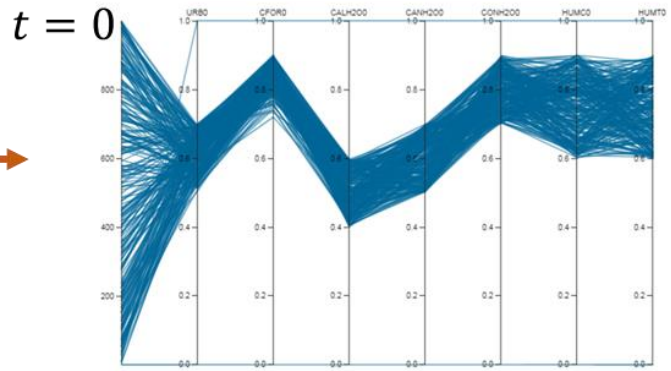


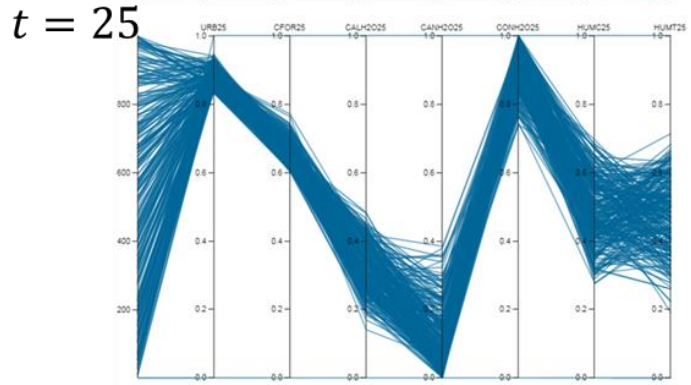
$$\frac{dx_{it}}{dt} = -x_{it}\, ln\, x_{it}\left(\sum \alpha_{ij} x_{jt} + \sum \beta_{ij} \dot{x}_{jt}\right)$$



$$Vulnerabilidad = f\left(\frac{\left|\frac{\partial W}{\partial X}\right|}{\frac{W}{W_0}}\right)$$



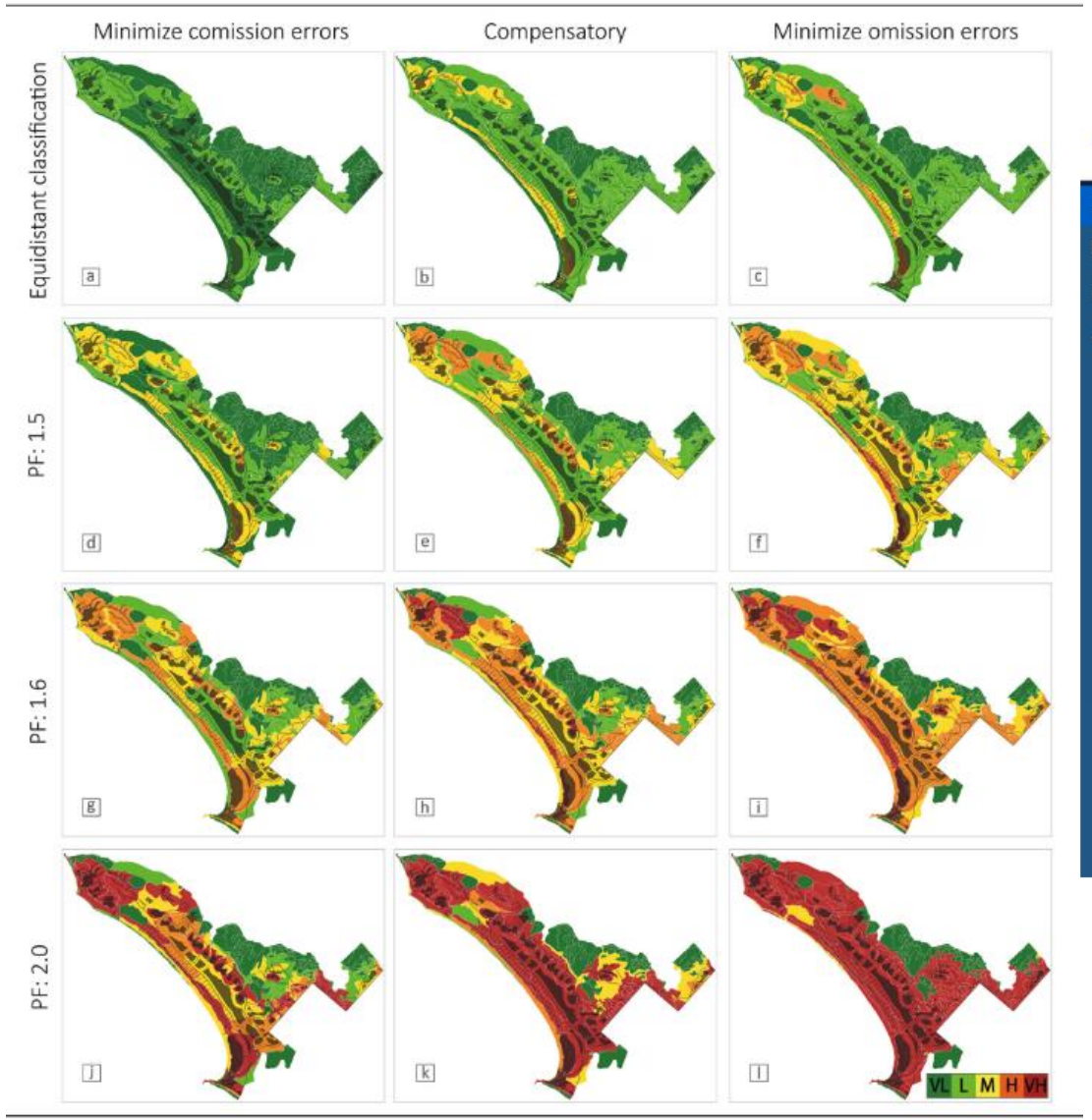




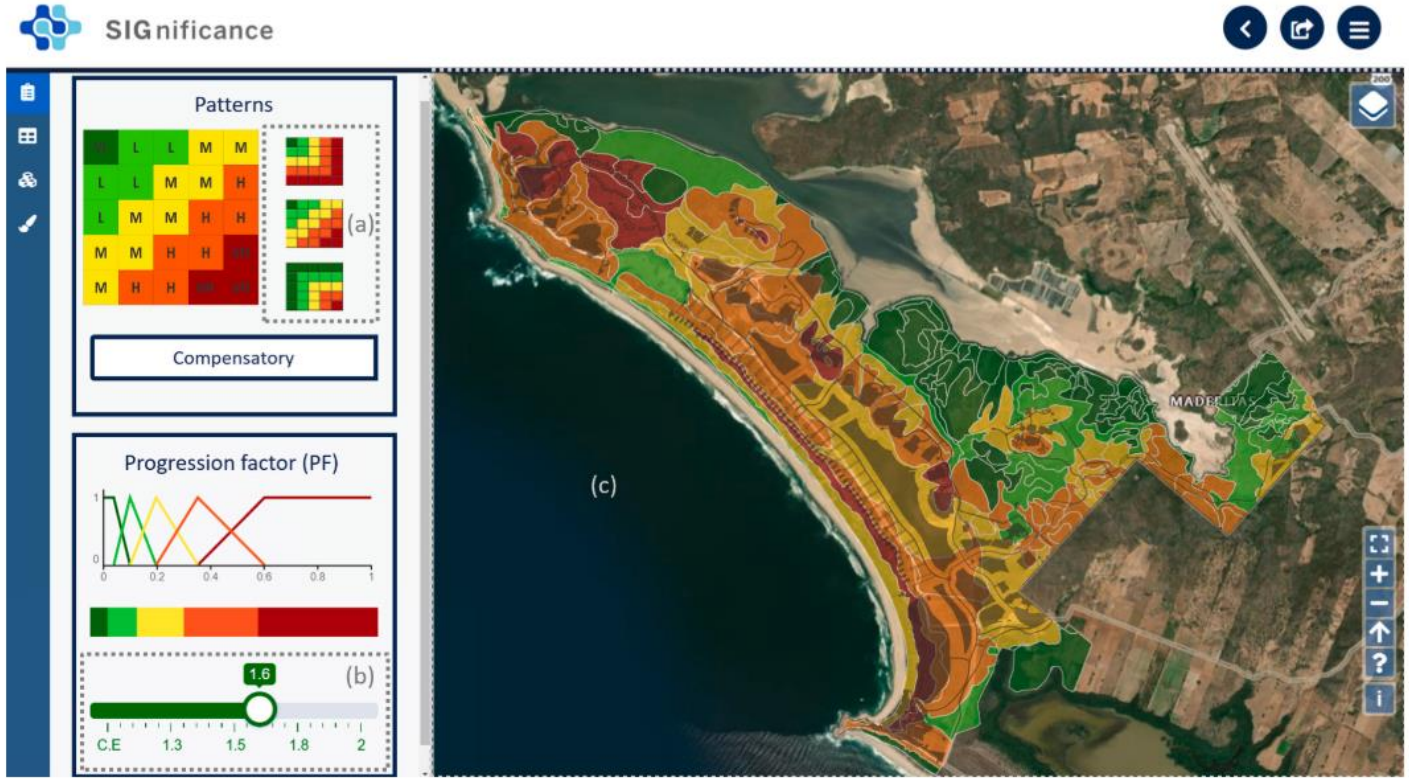
ANÁLISIS

"PROBABILIDAD DE PÉRDIDA DE 1/5 DE HUMEDALES SI SE DUPLICAN LAS ZONAS URBANAS EN 50 AÑOS"

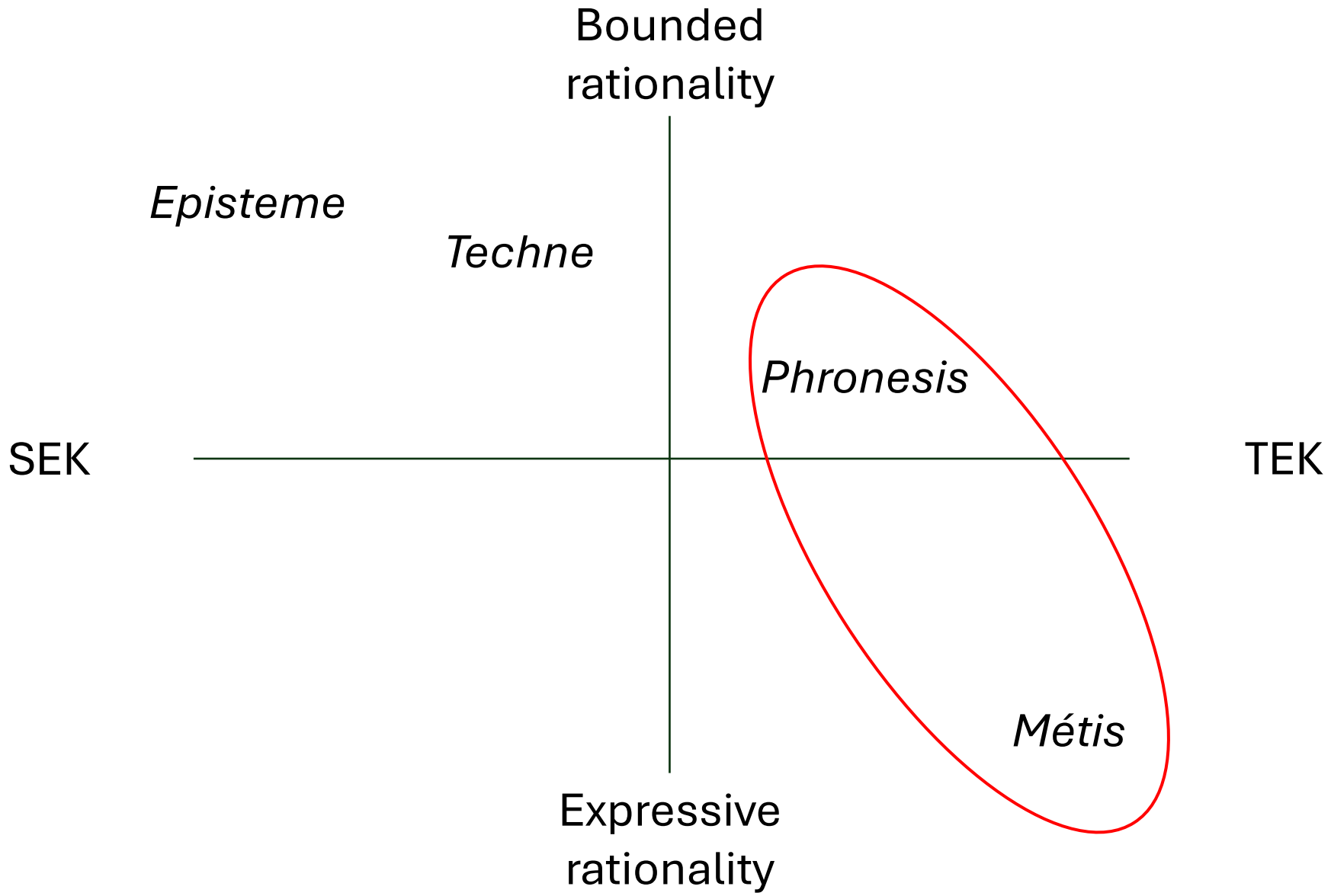
SOW and analytic deliberation



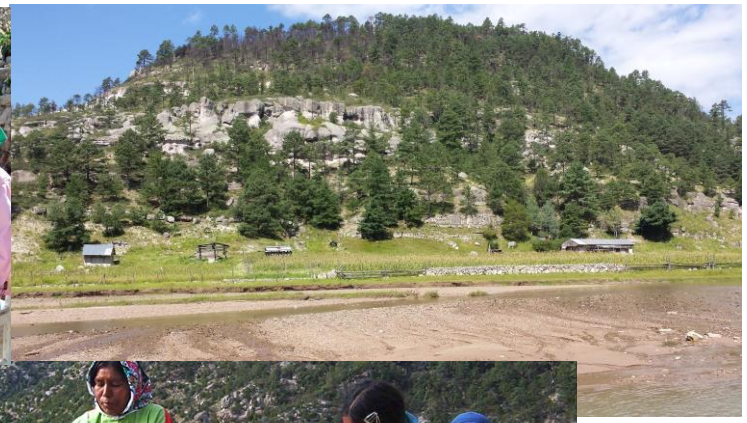
https://doi.org/10.1016/j.eiar.2023.107091

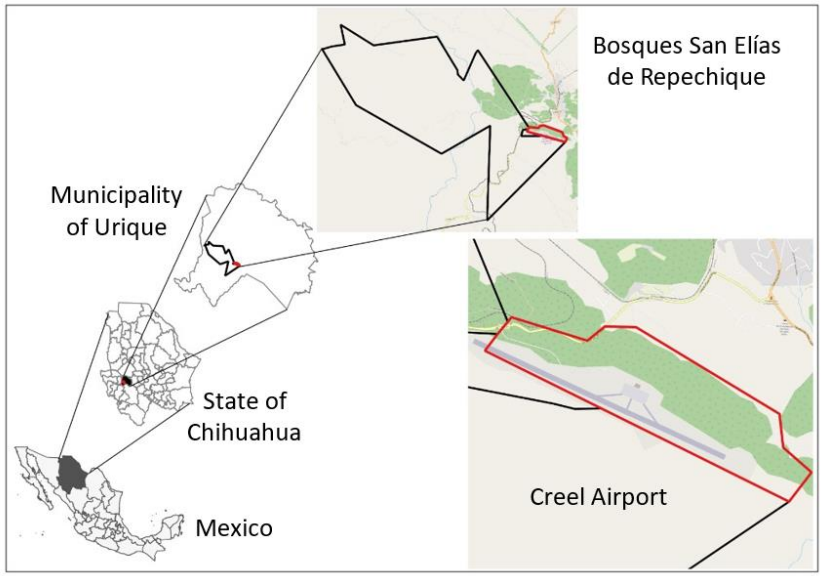


https://doi.org/10.3389/fclim.2024.1331945


Bounded rationality
Episteme
Techne
Phronesis
SEK
TEK
Métis
Expressive rationality

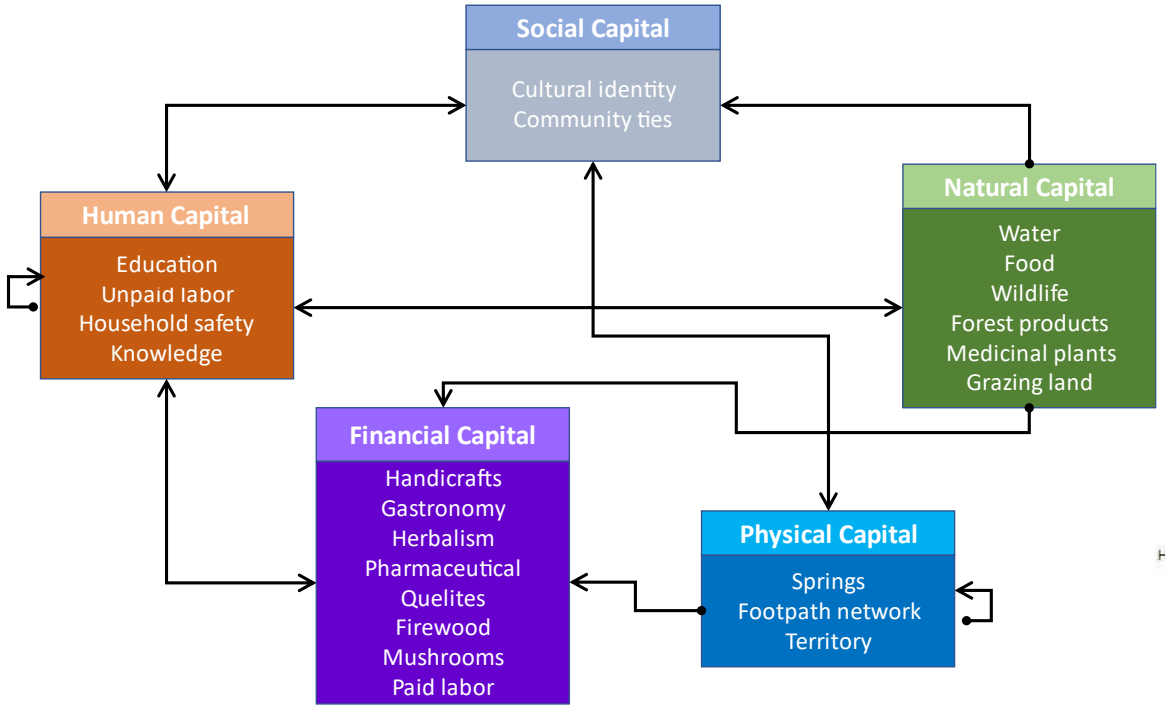
SIA: Bridging the Epistemological Divide

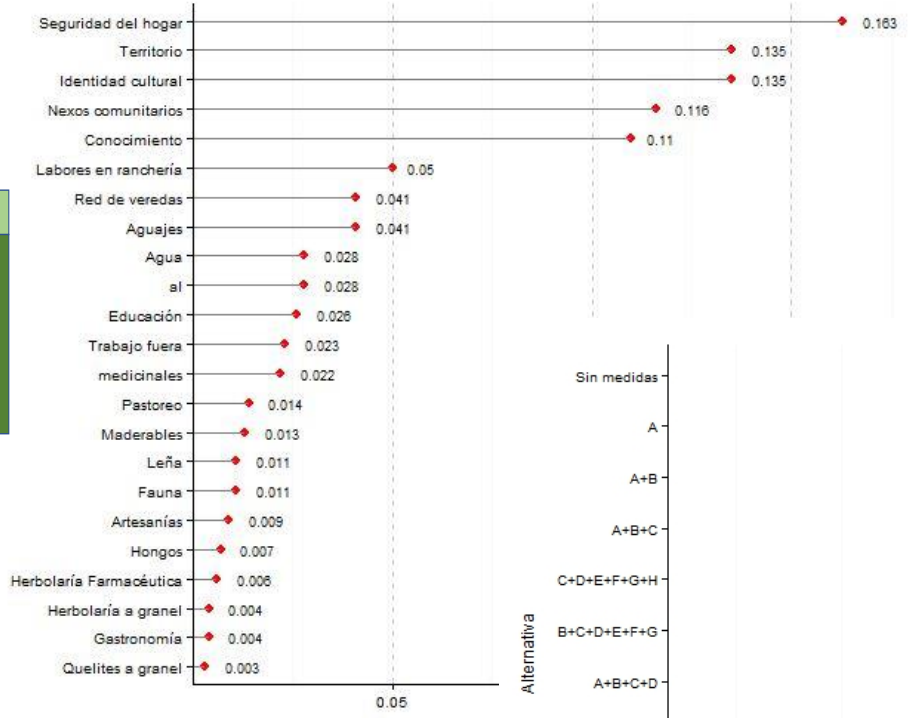


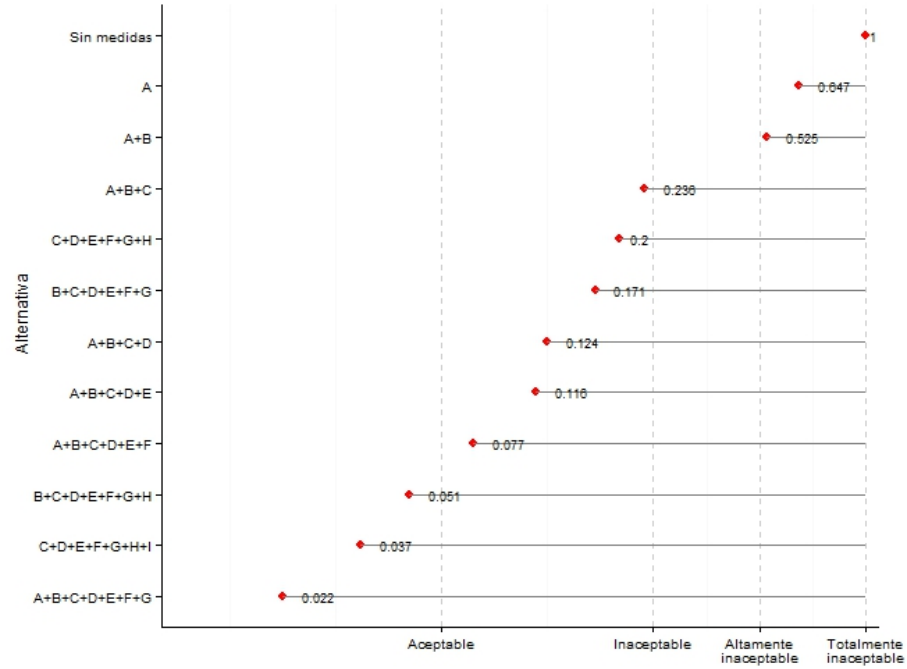


SIA: Sustainable Livelihoods Framework

ANP based Phenomenological hermeneutics







Expert judgment: Cognitive biases and conjecturing causation


begin
end


Training Highlights
Our comprehensive training program includes:
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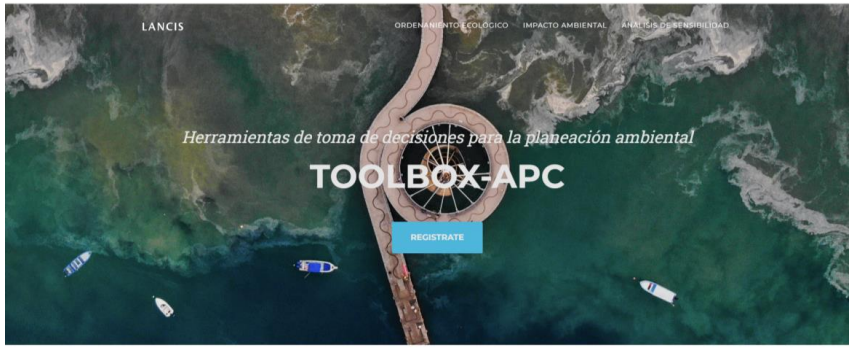
LANCIS
ORDENAMIENTO ECOLÓGICO
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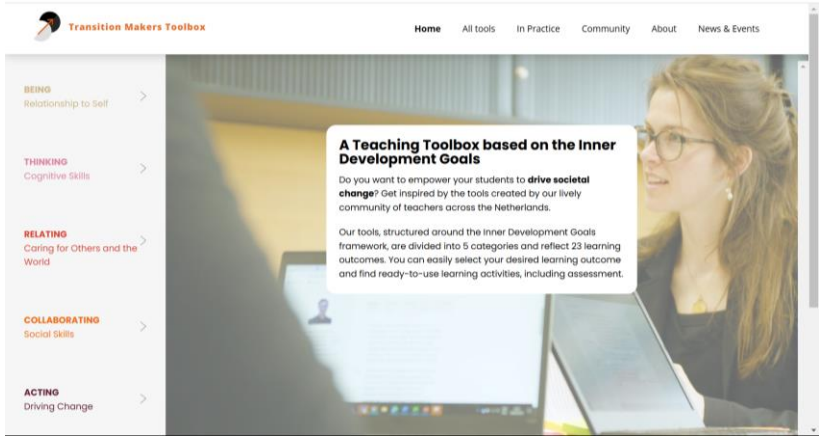
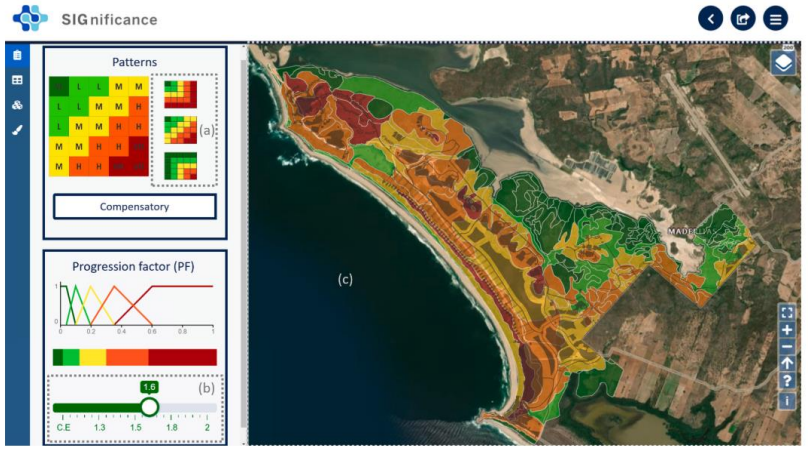
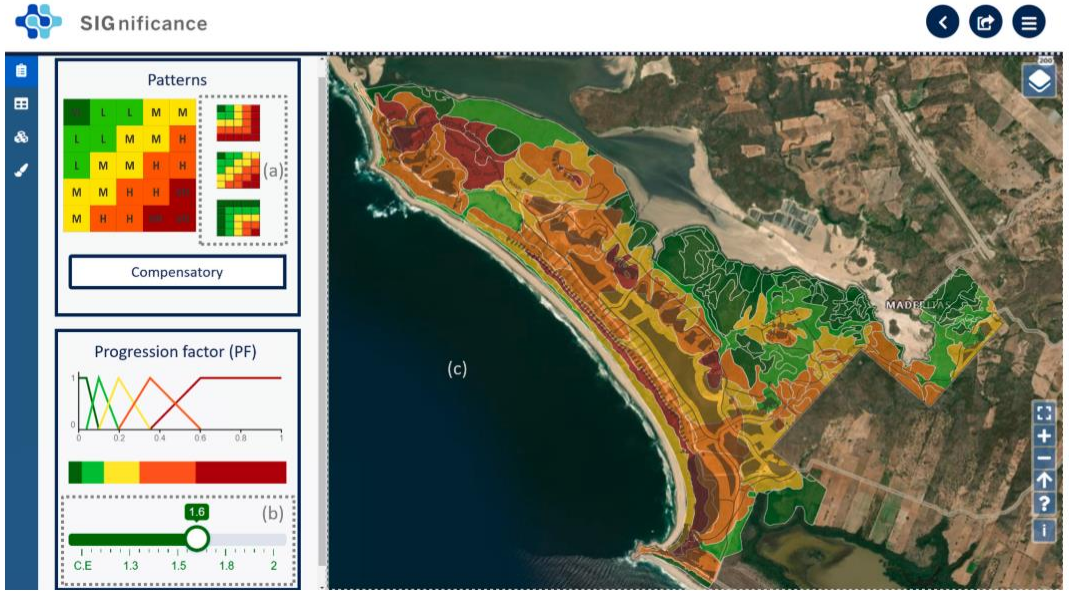
Herramientas de toma de decisiones para la planeación ambiental
TOOLBOX-APC
REGISTRATE


Transition Makers Toolbox
Home
All tools
In Practice
Community
About
News & Events
BEING
Relationship to Self
THINKING
Cognitive Skills
RELATING
Caring for Others and the World
COLLABORATING
Social Skills
ACTING
Driving Change
A Teaching Toolbox based on the Inner Development Goals
Do you want to empower your students to drive societal change? Get inspired by the tools created by our lively community of teachers across the Netherlands.
Our tools, structured around the Inner Development Goals framework, are divided into 5 categories and reflect 23 learning outcomes. You can easily select your desired learning outcome and find ready-to-use learning activities, including assessment.


SIGnificance
Patterns
(a)
Compensatory
Progression factor (PF)
(b)
1.6
C.E
1.3
1.5
1.8
2
(c)


LANCIS
ORDENAMIENTO ECOLOGICO
IMPACTO AMBIENTAL
ANALISIS DE SENSIBILIDAD
Herramientas de toma de decisiones para la planeación ambiental
TOOLBOX-APC
REGISTRATE


SIGnificance
Patterns
(a)
Compensatory
Progression factor (PF)
1.6
(b)
C.E
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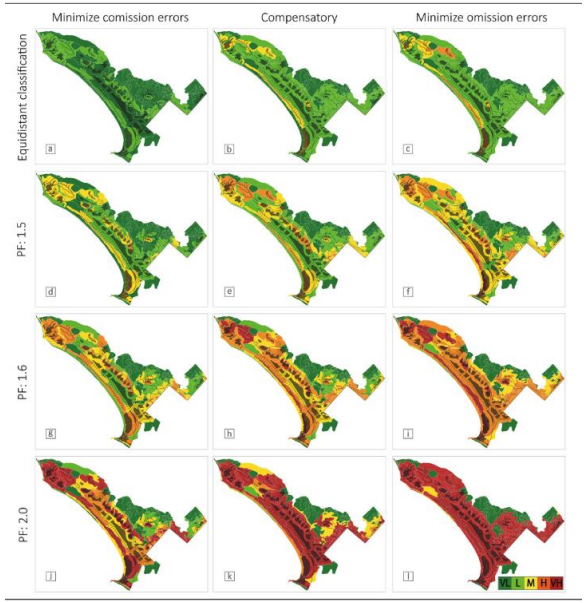
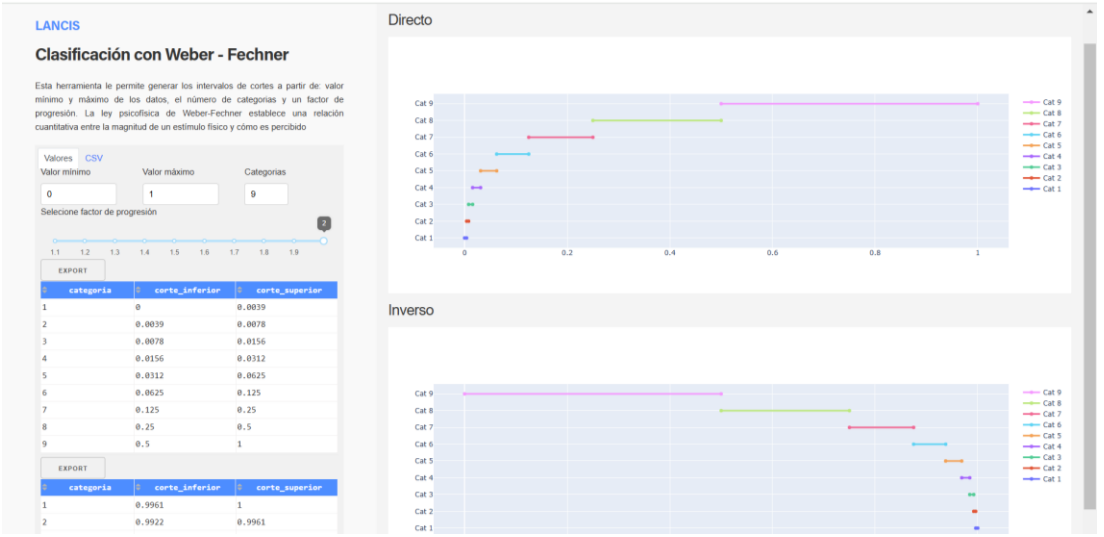

Minimize comission errors
Compensatory
Minimize omission errors
Equidistant classification
PF: 1.5
PF: 1.6
PF: 2.0
VL L M H VH


LANCIS
Clasificación con Weber - Fechner
Esta herramienta le permite generar los intervalos de cortes a partir de: valor mínimo y máximo de los datos, el número de categorías y un factor de progresión. La ley psicofísica de Weber-Fechner establece una relación cuantitativa entre la magnitud de un estímulo físico y cómo es percibido
Valores
CSV
Valor mínimo
Valor máximo
Categorías
Selecione factor de progresión
EXPORT
categoria
corte_inferior
corte_superior
Directo
Inverso