

Challenges for the water, energy and food nexus in Asia

Peter Goethals et al.



OVERVIEW

1. Sustainability definition and example problems
2. Sustainability concepts and WEF-nexus
3. Tools for (trade-off) analyses
4. Challenges for the WEF-nexus
5. Conclusions

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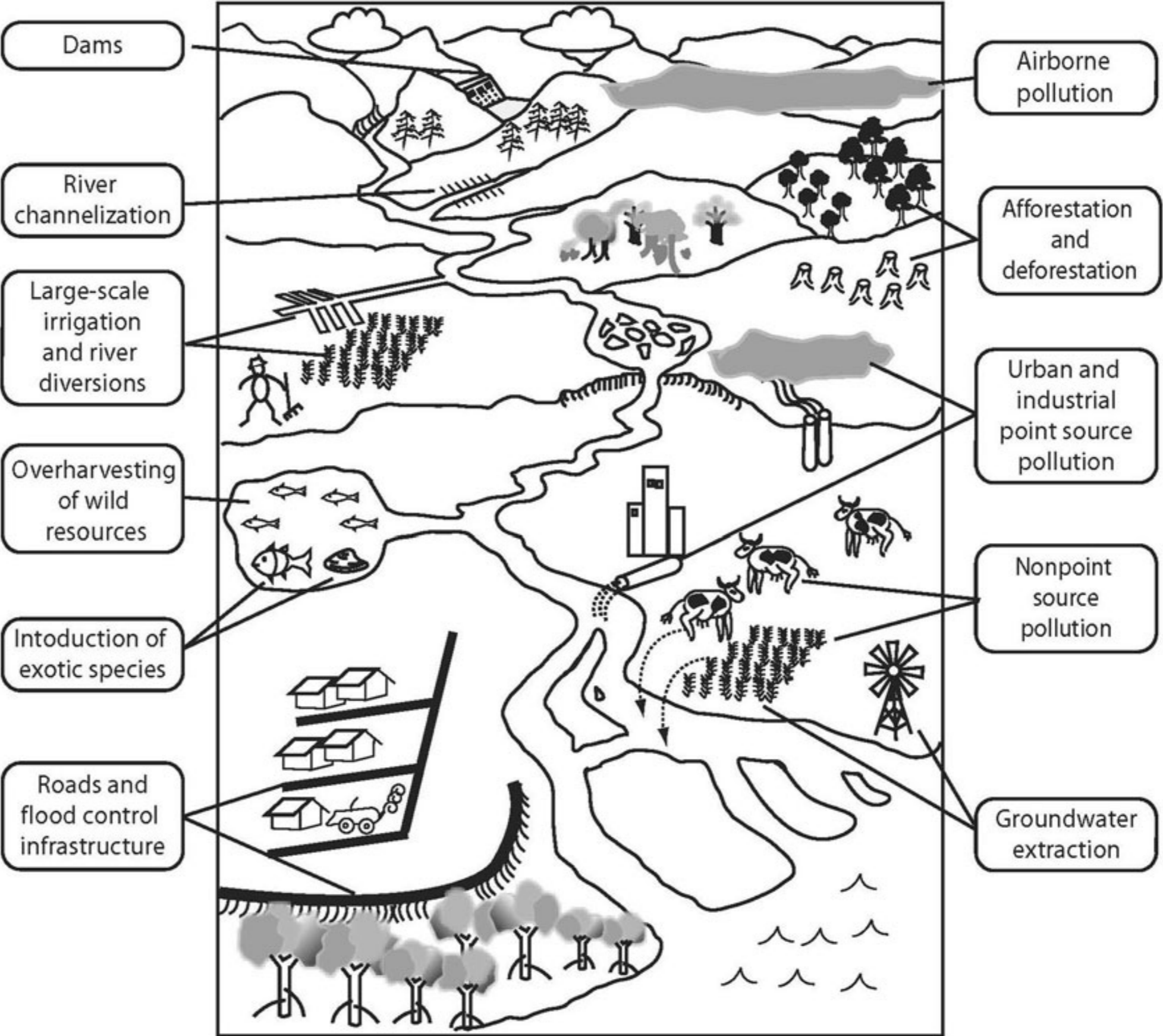
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SUSTAINABLE DEVELOPMENT

Exploit natural resources in a sustainable manner:

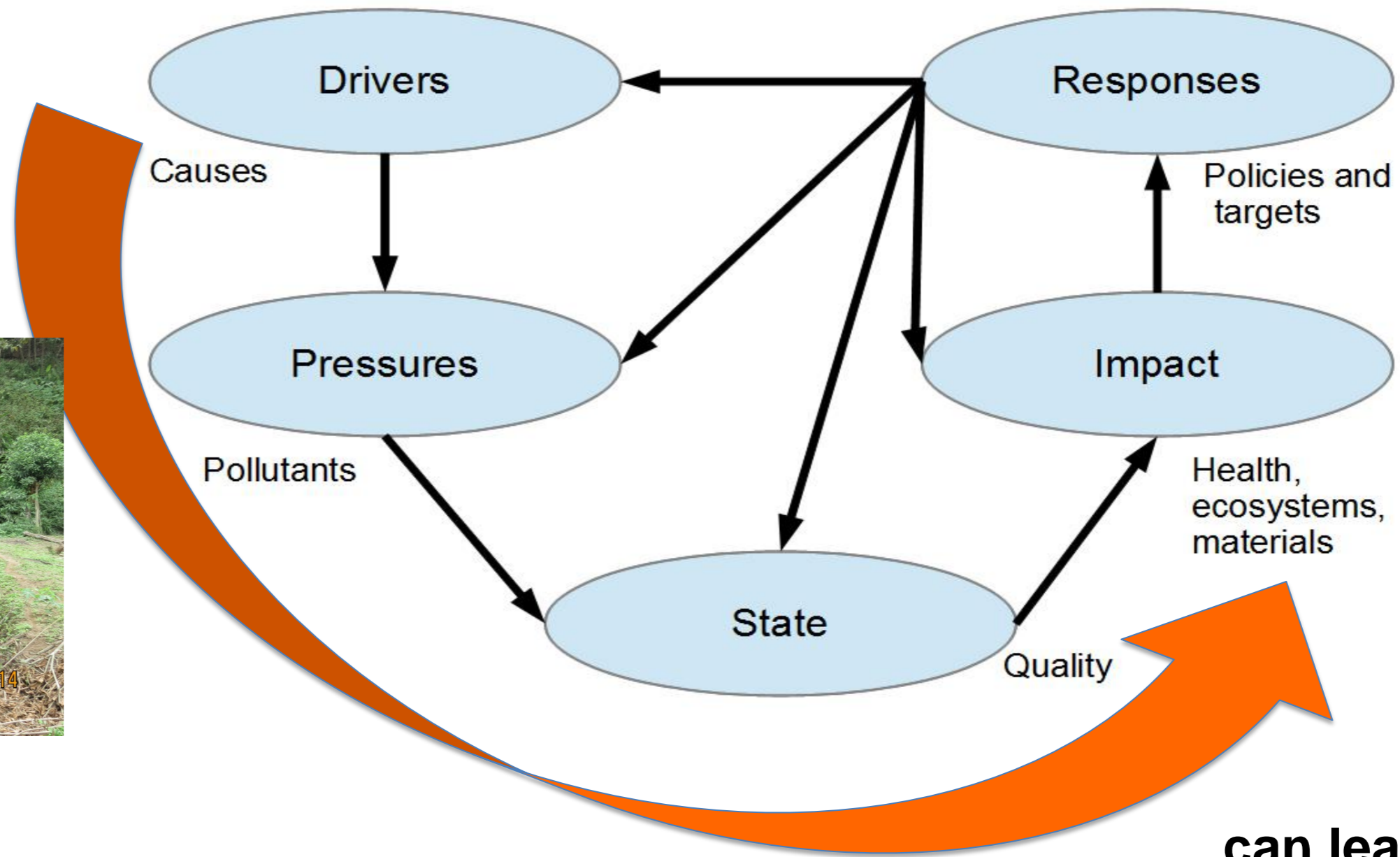
- Considering environmental, social and economic aspects
- **INCOME and WELFARE IMPROVEMENT** (increase health, income, happiness and lower risks): e.g. increased crop productivity, dealing with risks and uncertainties via insurance systems, food and energy available, ...
- **WASTE REDUCTION** (limited impacts on resources): e.g. avoid water resources spillage via waste water treatment (houses, industries), reduce water system leaks and crop losses (floods, drought), avoid pesticide contamination of water resources, electricity black outs, ...

SUSTAINABLE DEVELOPMENT ON 'A PIECE OF EARTH'?



DISTURBANCE CHAIN OR DPSIR CONCEPT: WHEN SOLUTIONS BECOME PROBLEMS

Changes in society:
technological
developments (HP dams),
intensification of
agriculture, ...



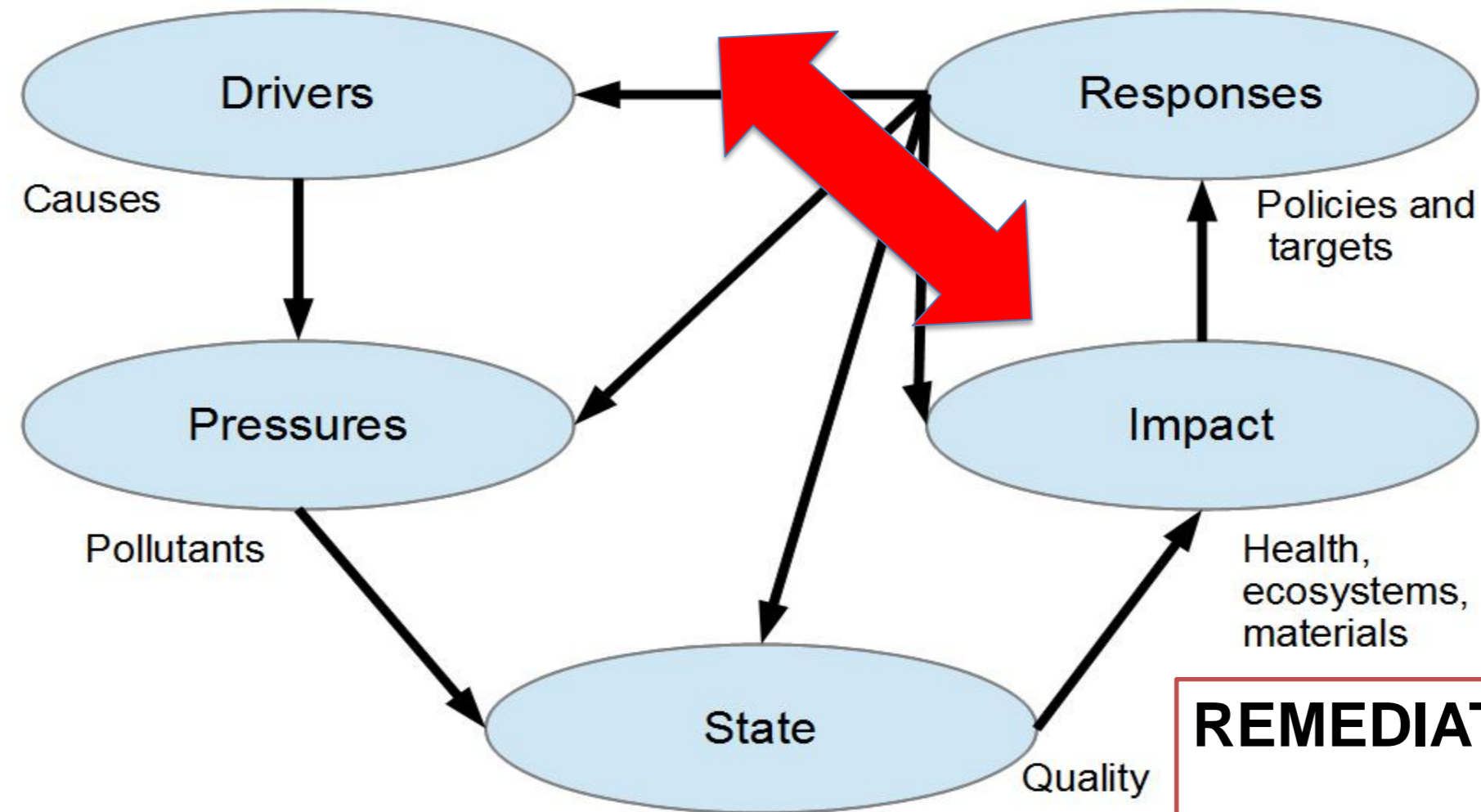
can lead to
impacts...

DISTURBANCE CHAIN OR DPSIR CONCEPT

**Intervention options
and levels**

PREVENTIVE:

- **Difficult to convince people, stakeholders, ...**
- **Most cost-effective, efficient, ...**
- **Dealing with damage prevention...**



REMEDIATIVE:

- **'Easy' to convince people, stakeholders, ...**
- **Very expensive...**
- **Dealing with damage...**

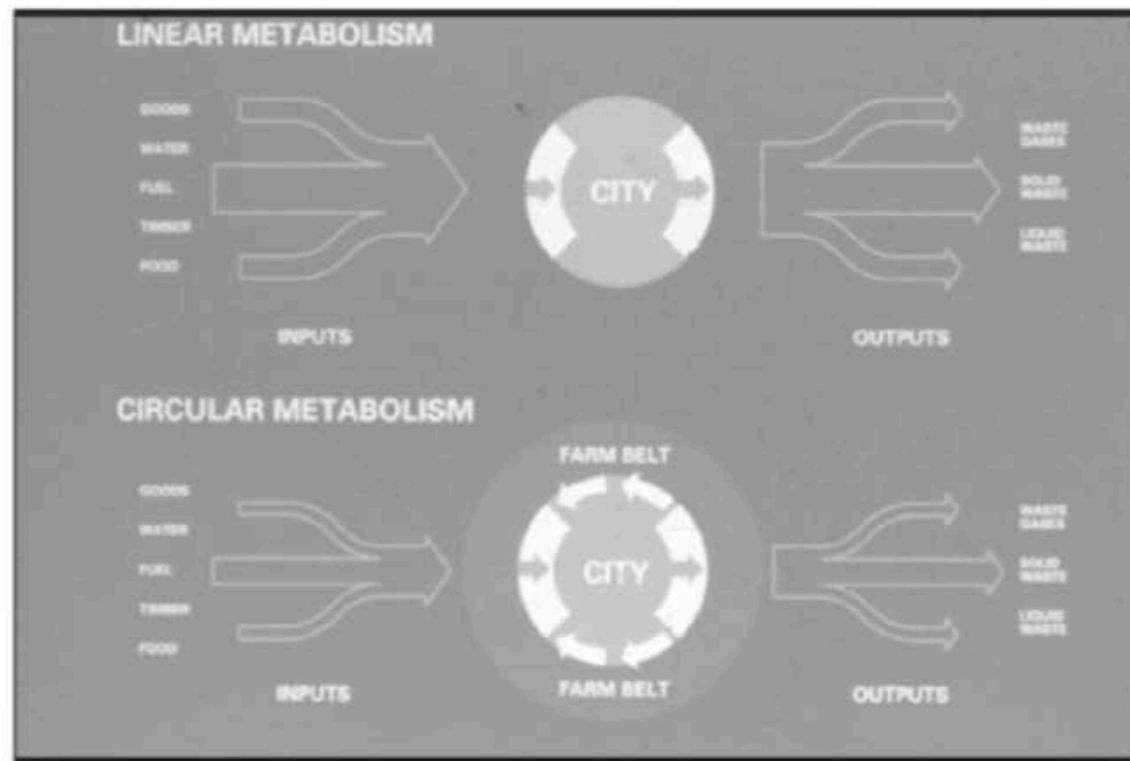
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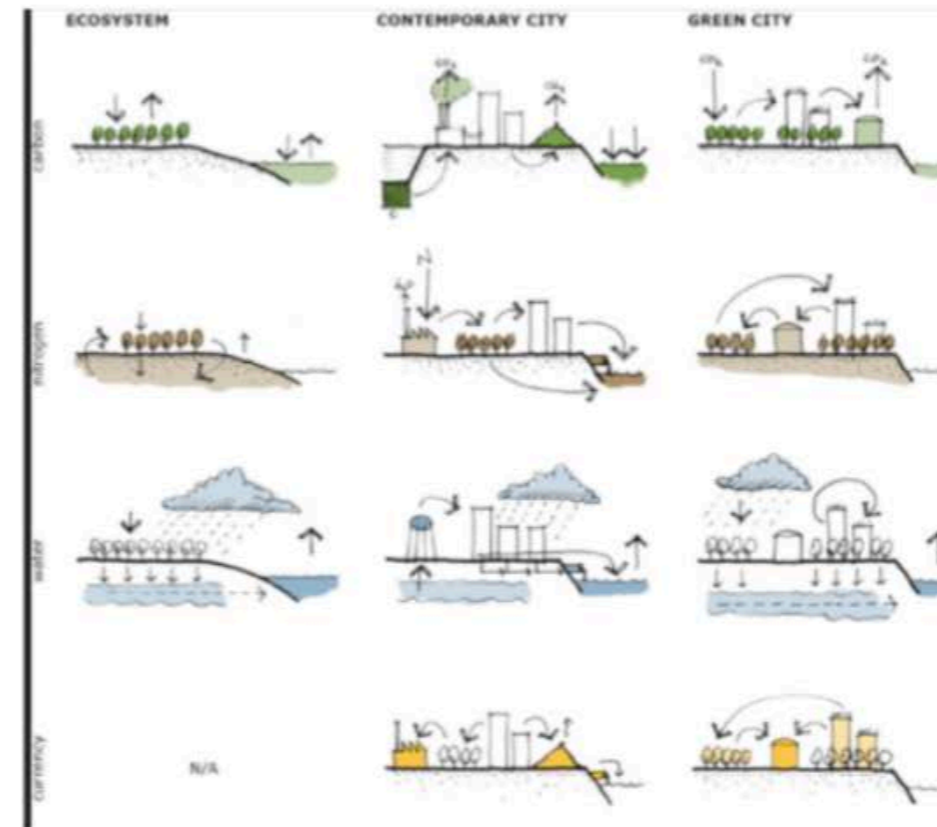
SUSTAINABILITY CONCEPTS

Sustainability assessment: 'reduce, reuse and recycle'

City, river basin metabolism

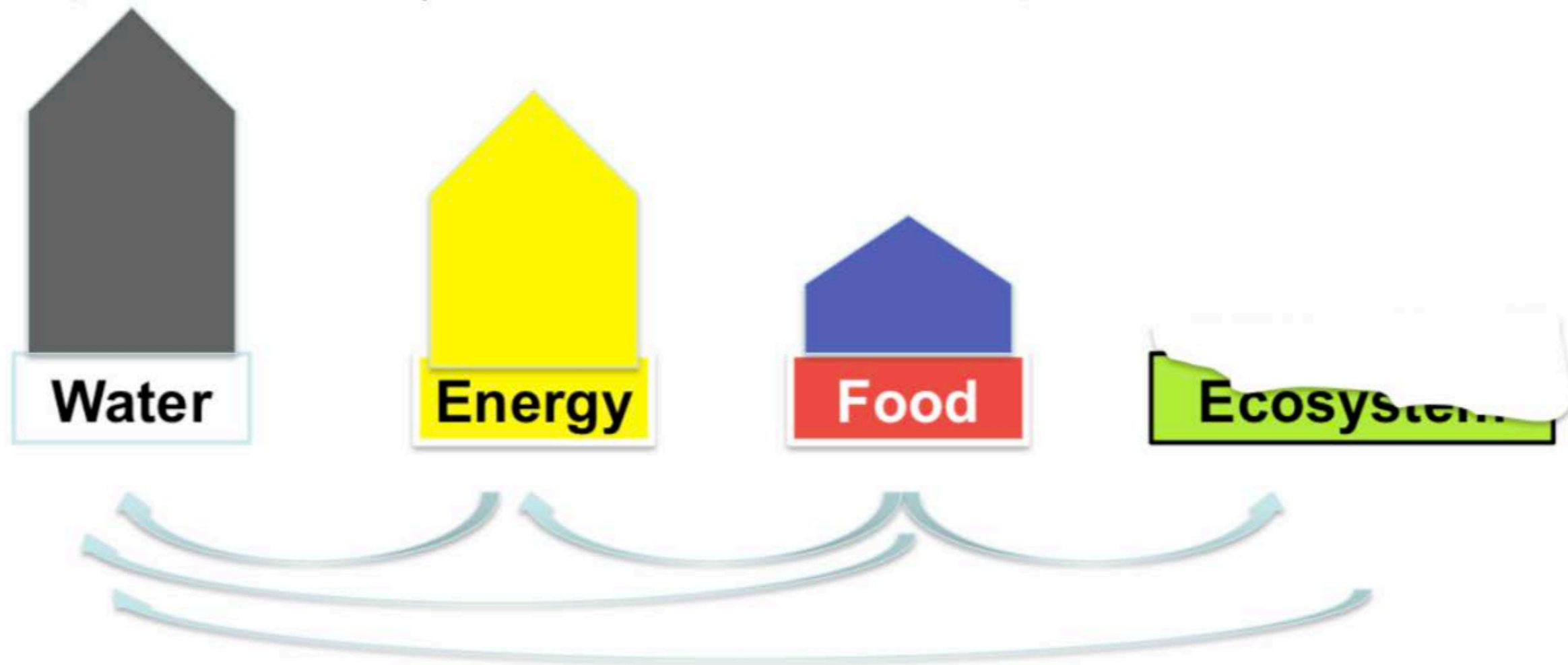


Green cities, river basins, ...



SUSTAINABILITY CONCEPTS: THE WEF-NEXUS

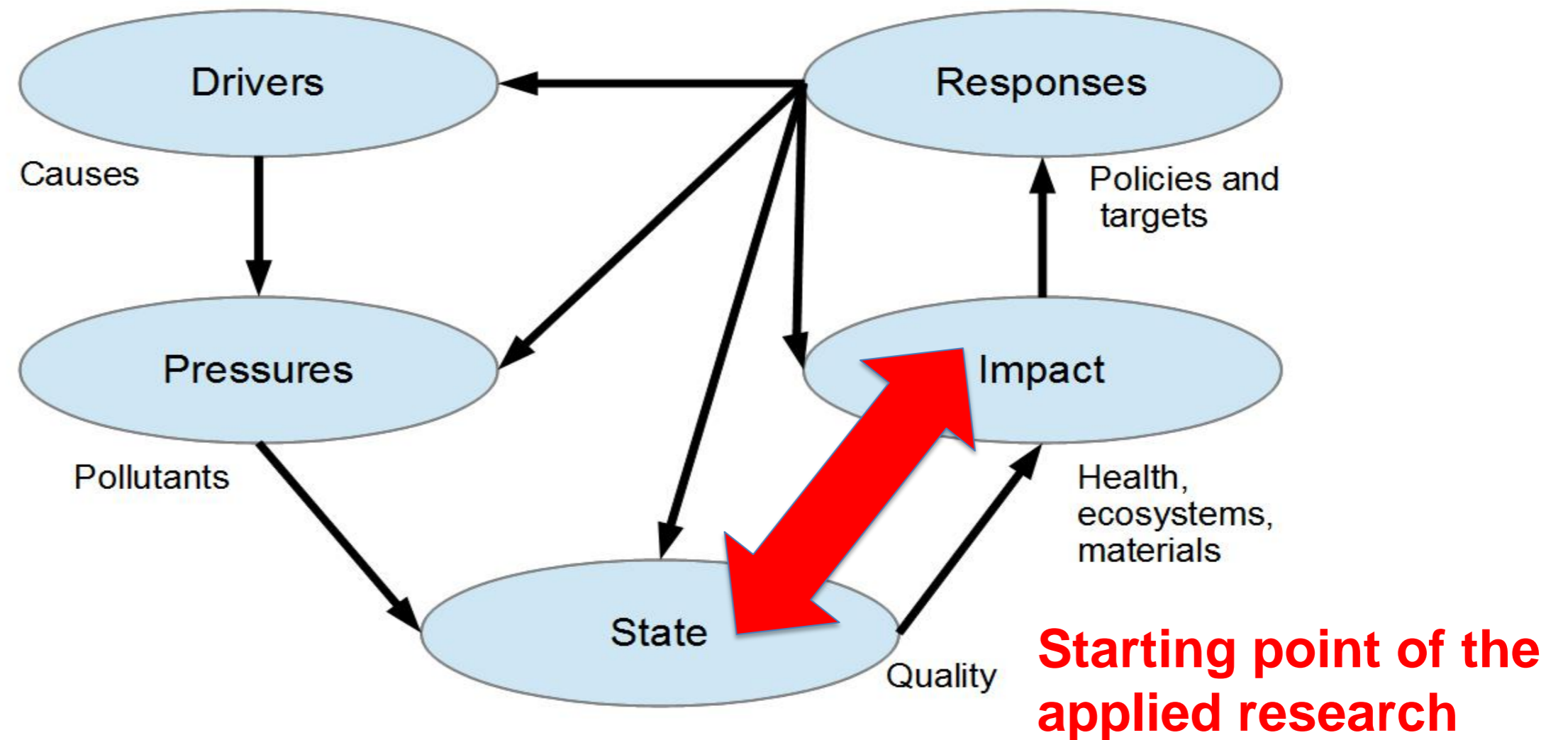
- Modifying one element, often leads to changes in the other (accumulation, extraction, destruction, pollution, ...): often combined impact on water



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EXAMPLE APPLIED WATER RESEARCH



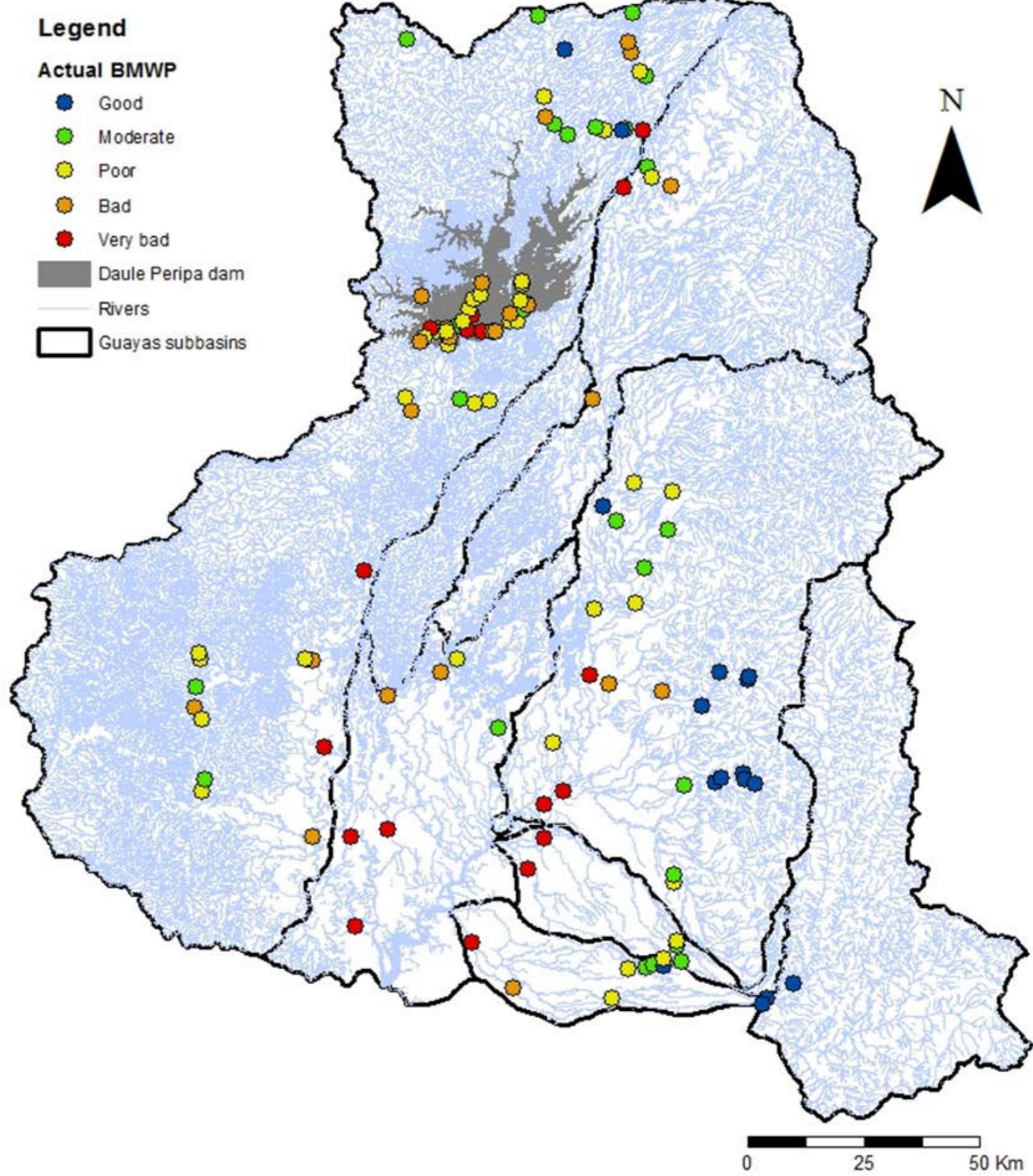
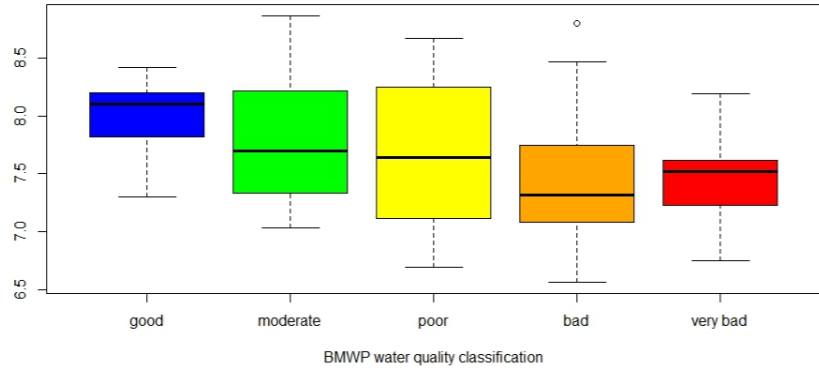
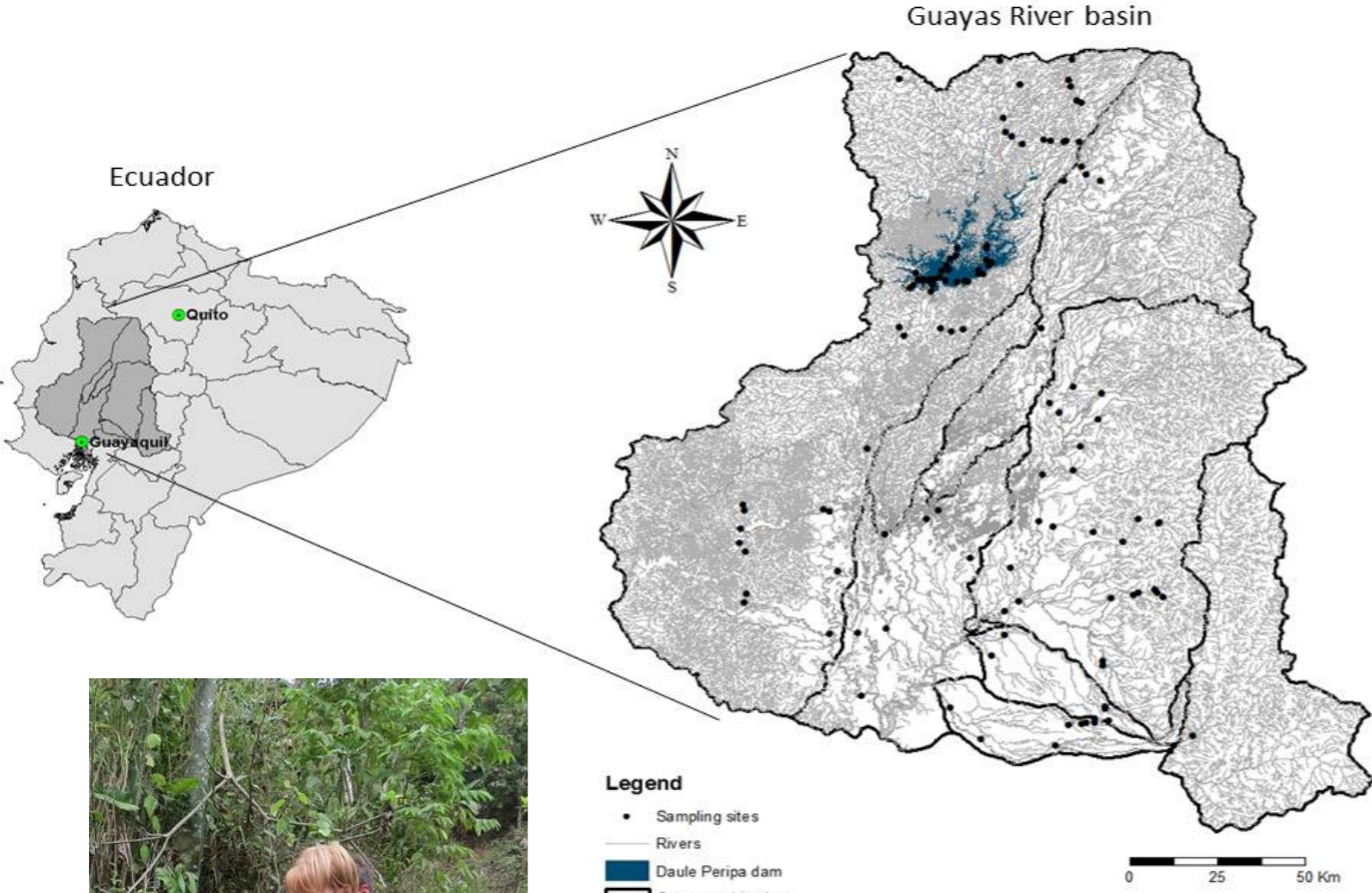
What is the current state and what are the problems of water systems?

EXAMPLE APPLIED WATER RESEARCH

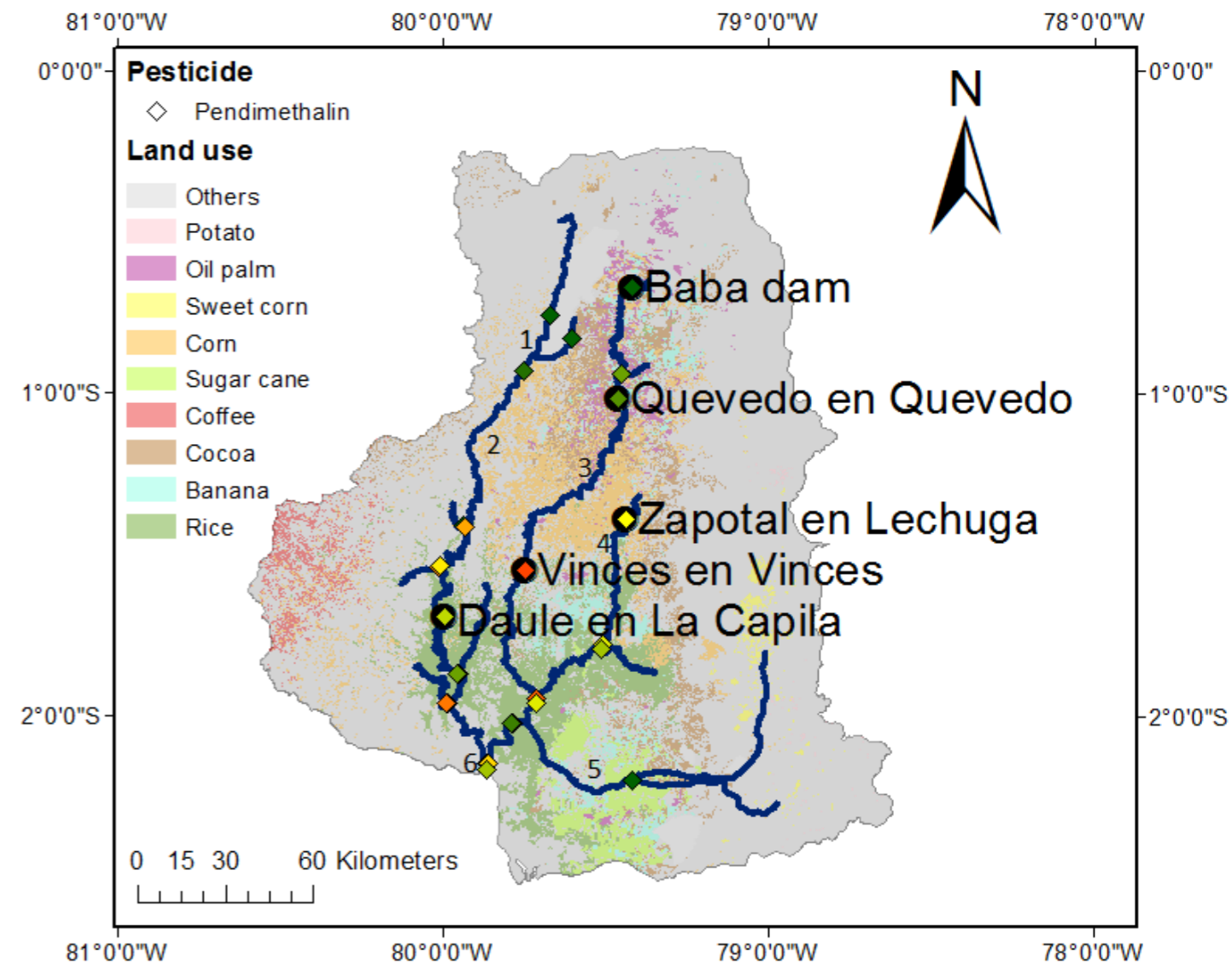
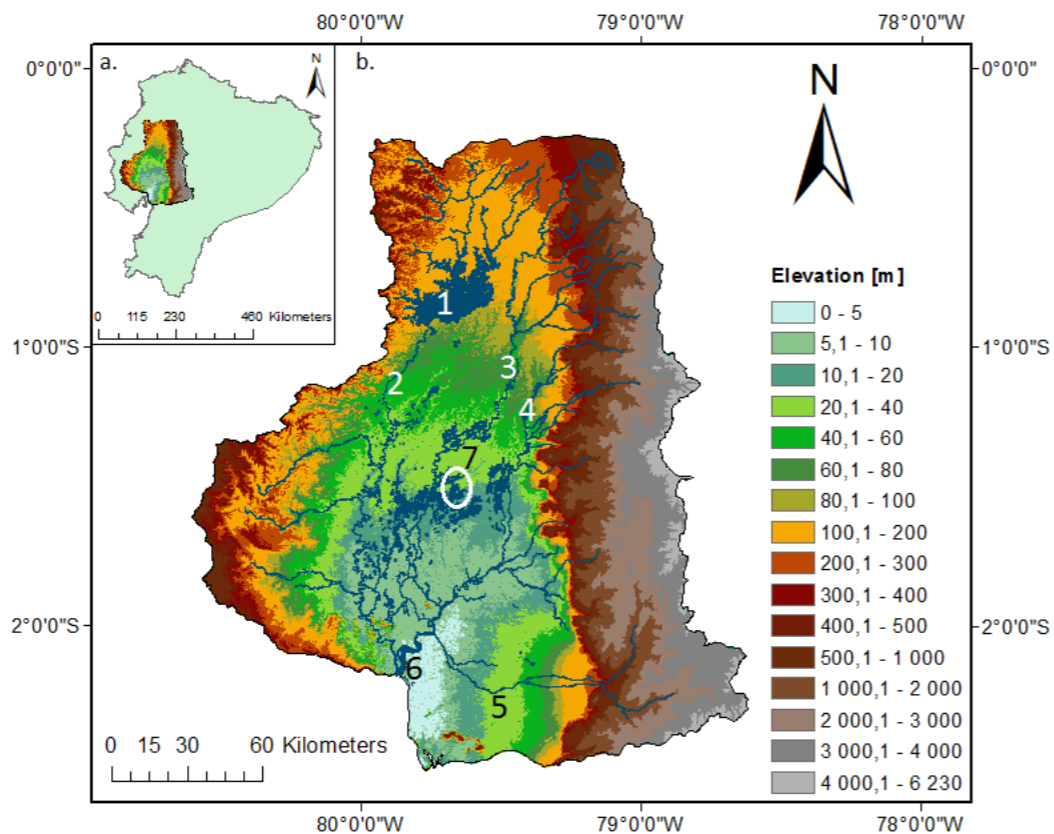
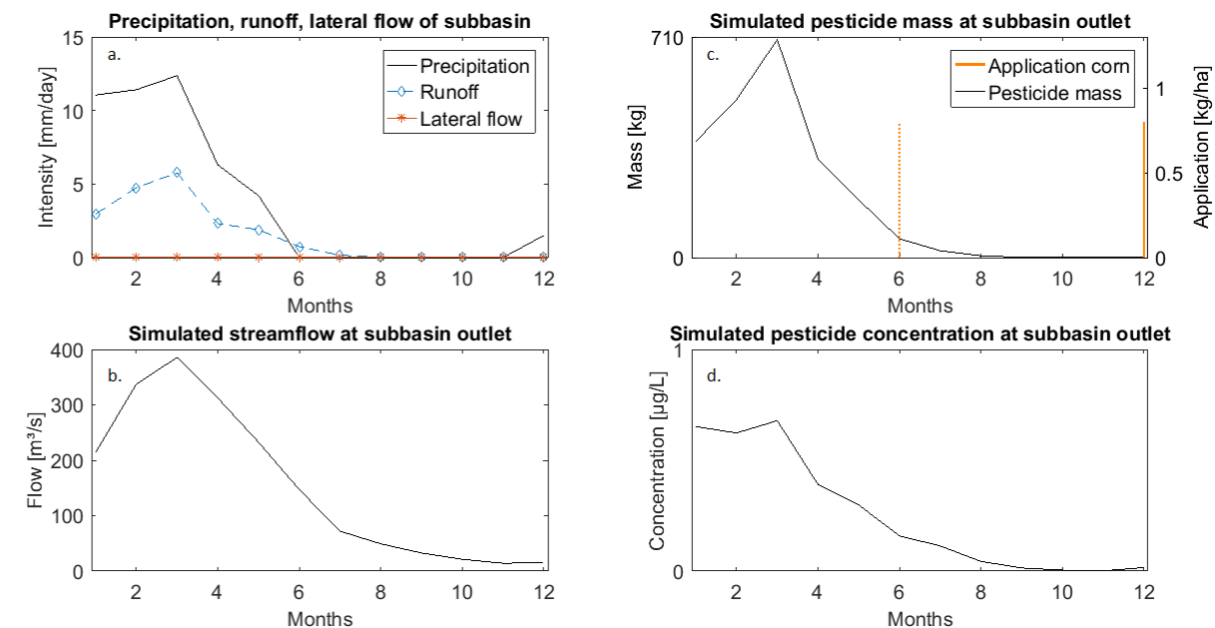
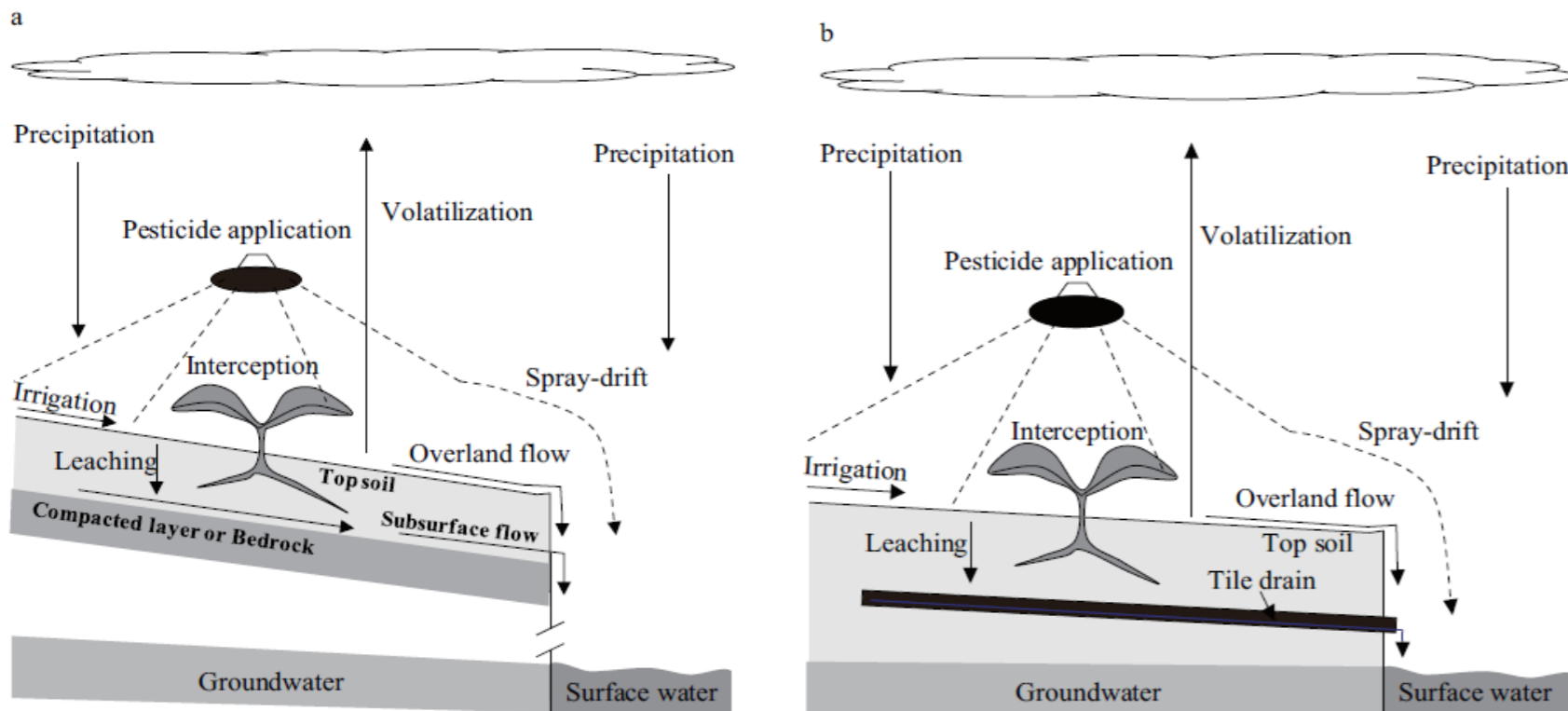
Monitoring and assessment of the hydromorphological, chemical and biological conditions:

- Method development and standardization
- Selection, buying and importing equipment
- Water system selection and analysis
- Stakeholder consultation and arrangement of permits
- Experimental design
- Detailed planning, team composition
- Data analysis and reporting (publications, reports, dissertations)

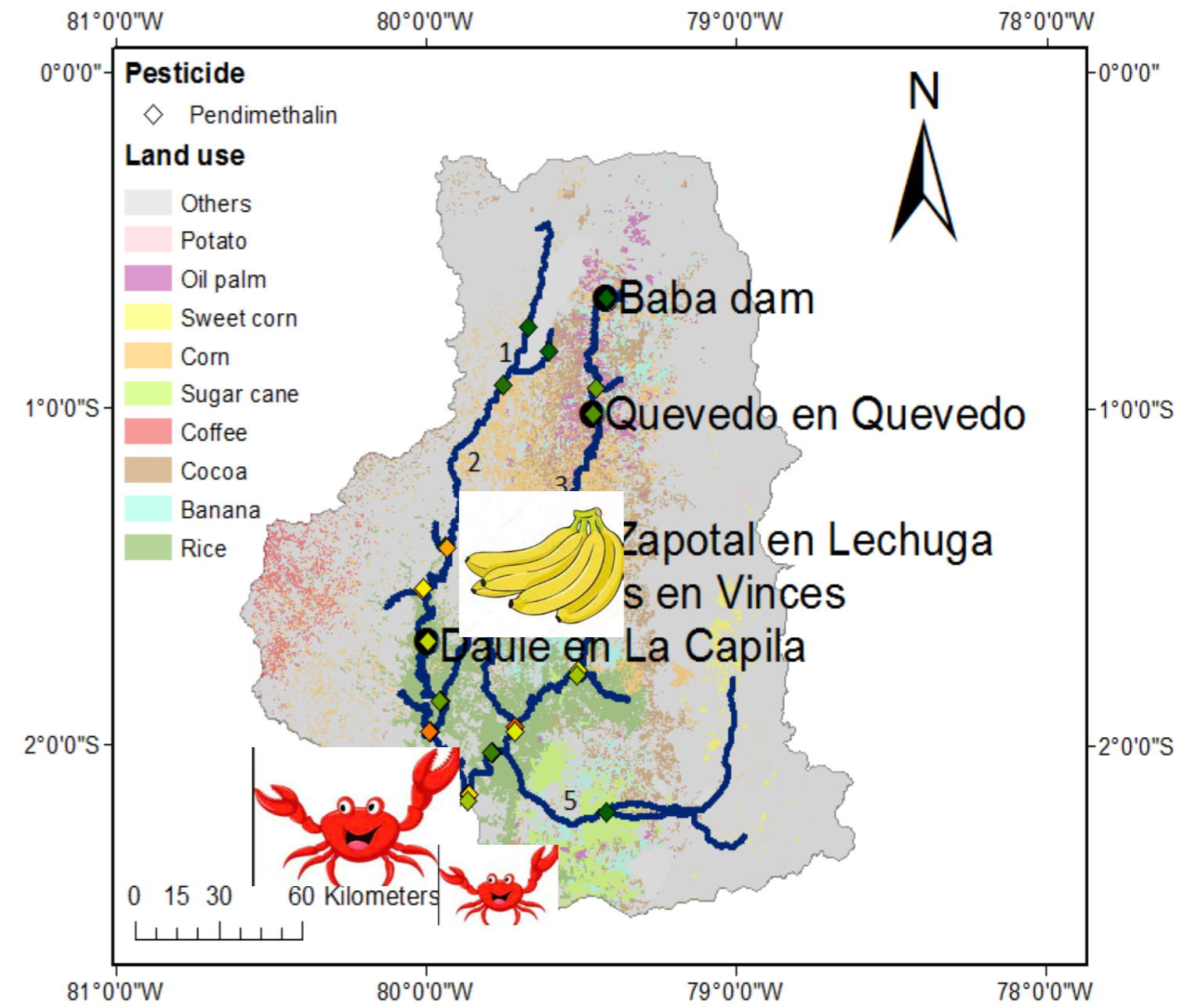
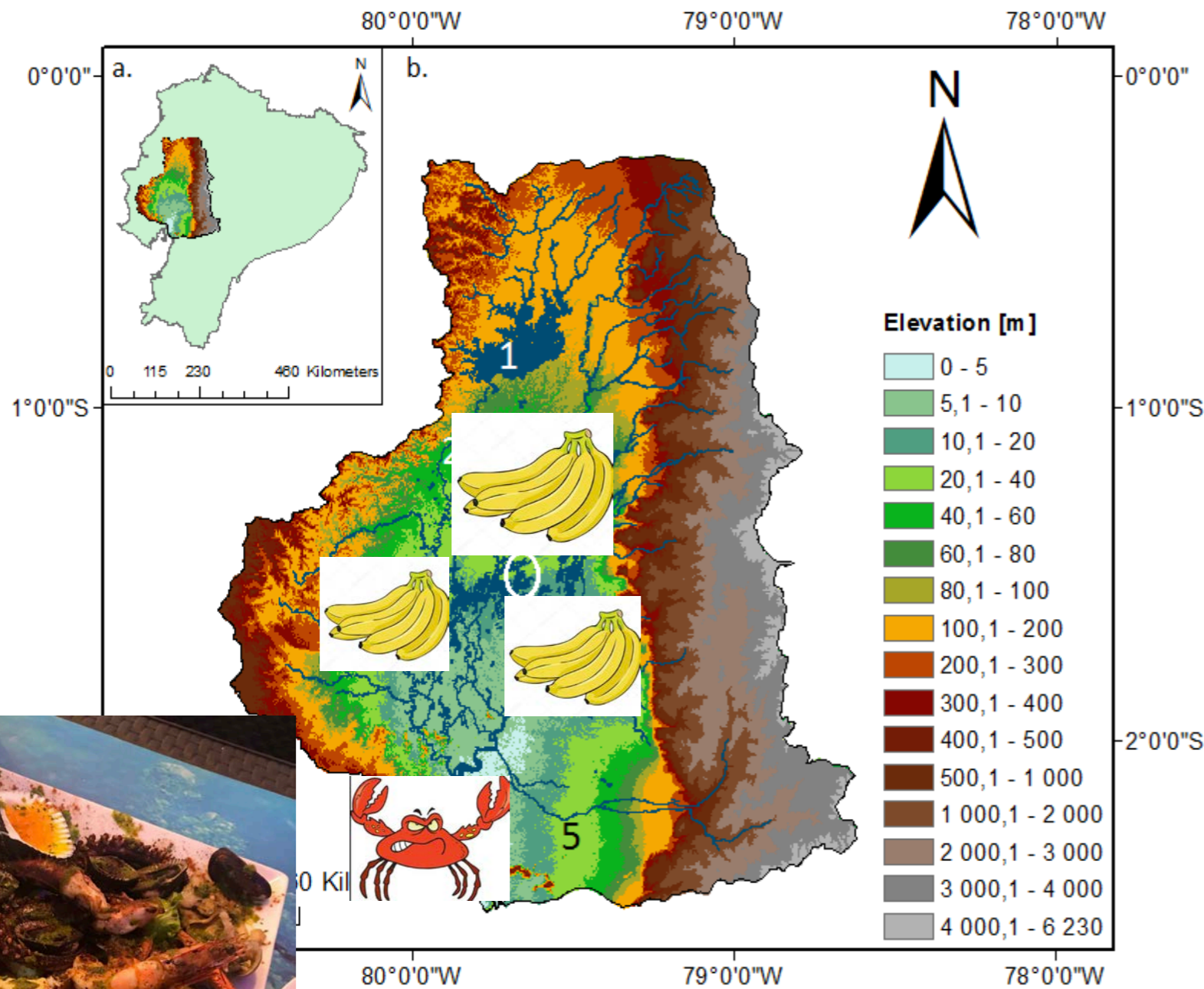
GUAYAS RIVER BASIN: STATE



GUAYAS RIVER BASIN: CAUSE ANALYSIS (VIA SWAT)

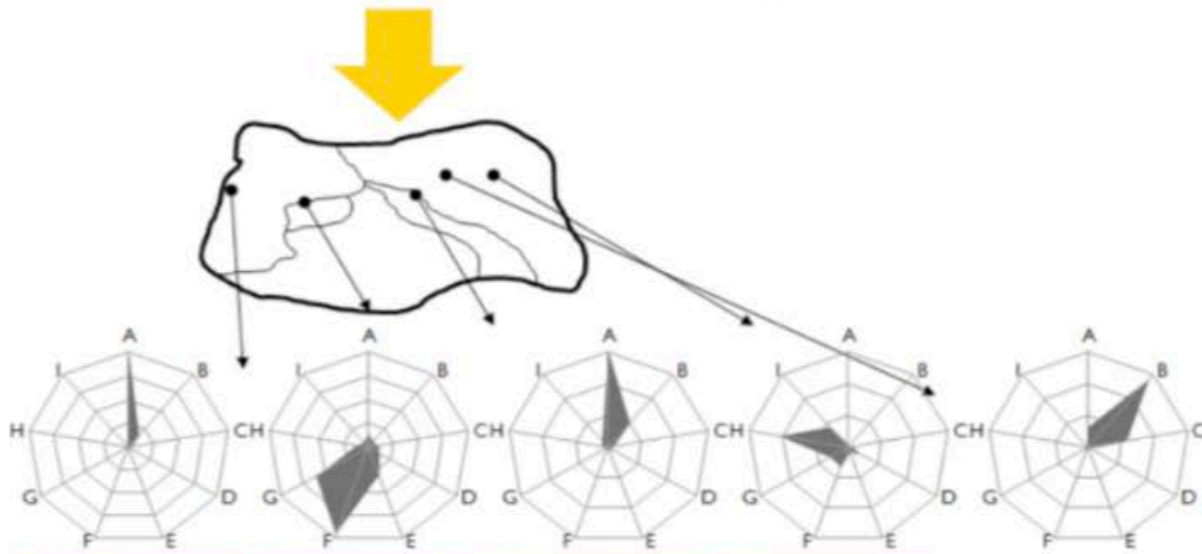
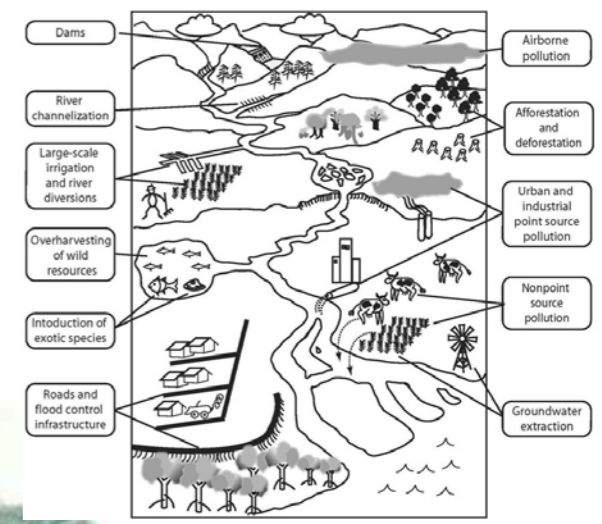


GUAYAS RIVER BASIN: CONTAMINATION CAUSE AND EFFECT ANALYSIS VIA SWAT-MODEL

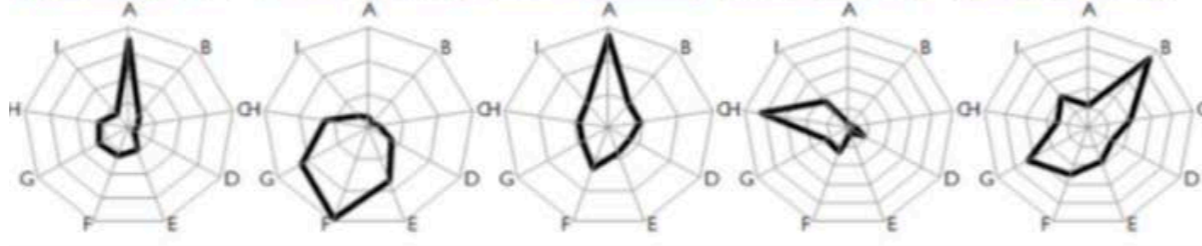
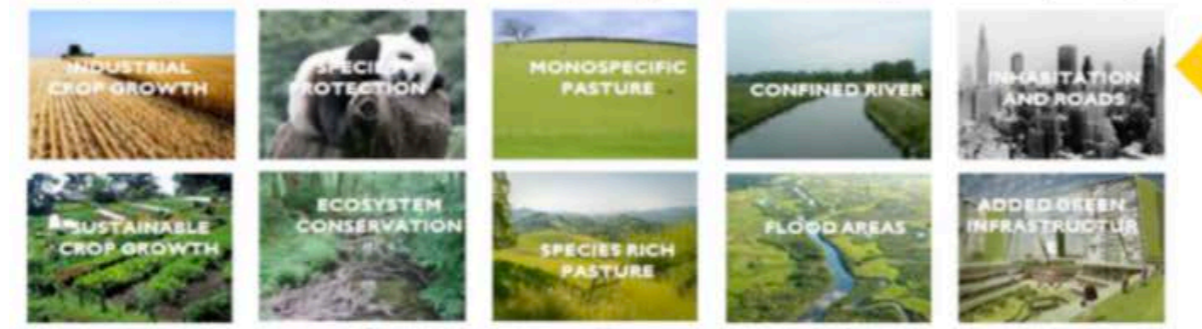


INTEGRATED TOOLS

Accurately quantify and value the potential impact of changes in land, soil and water management practices on ecosystem services

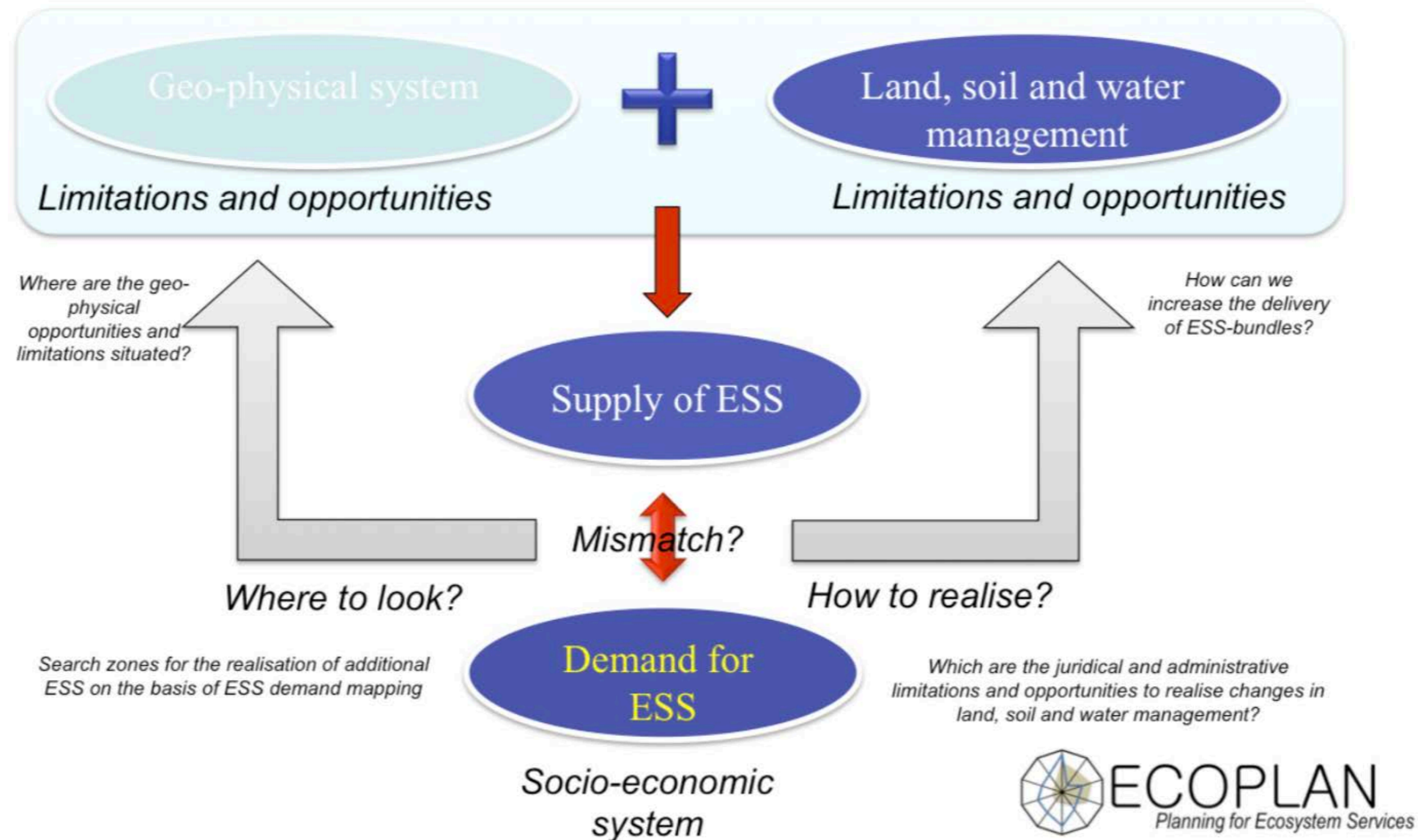


Compare the context and state of ecosystems and their services after implementation of management practices

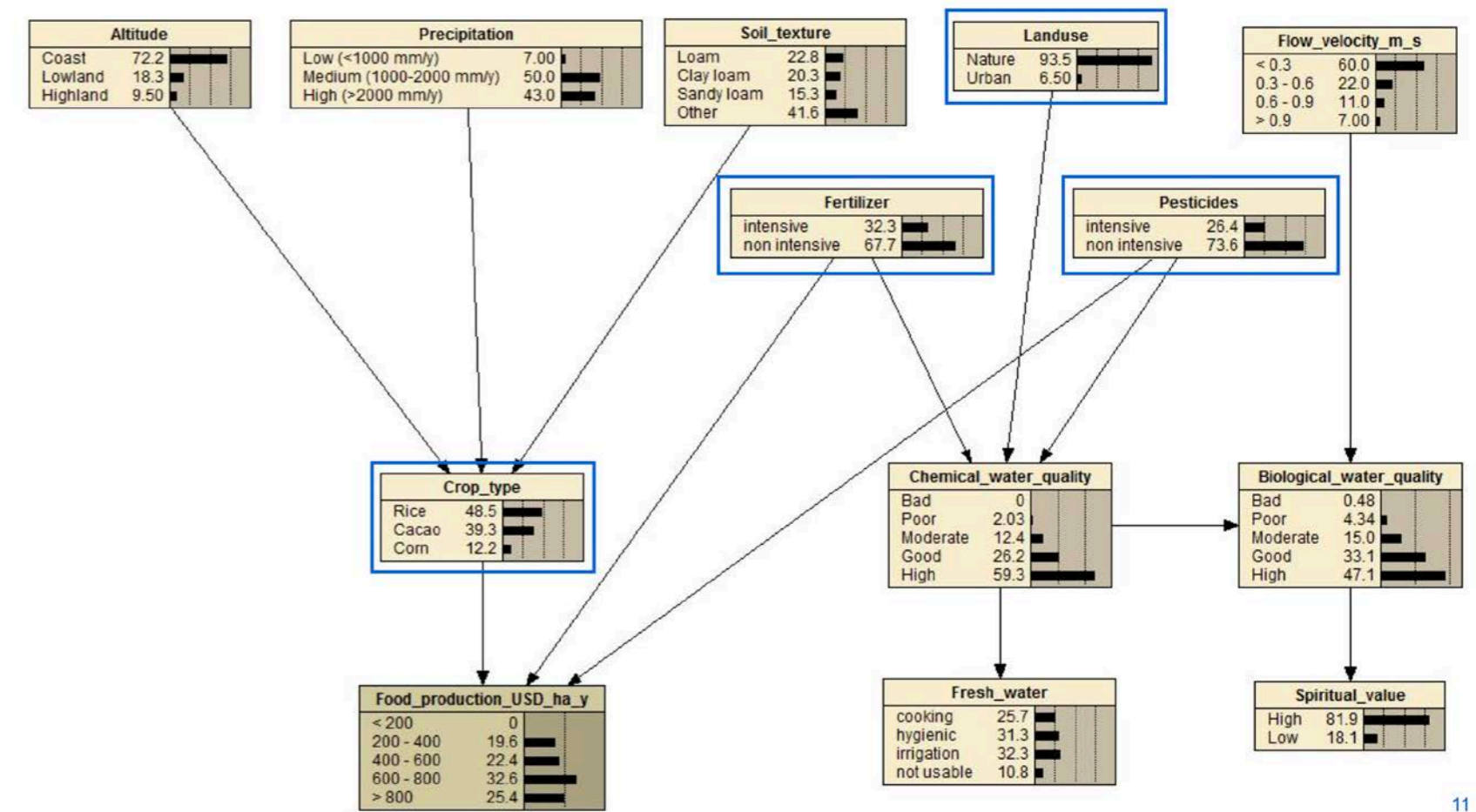
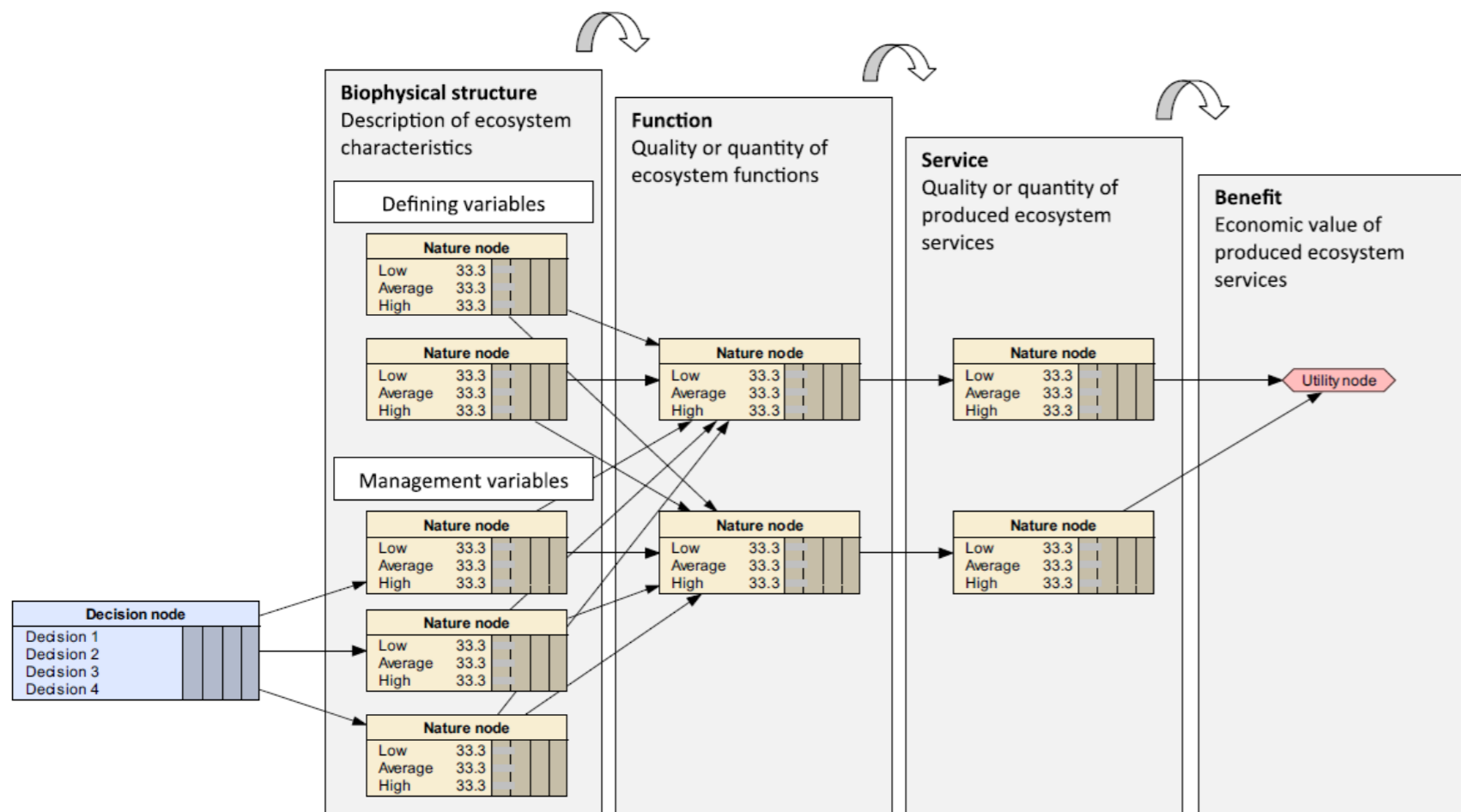
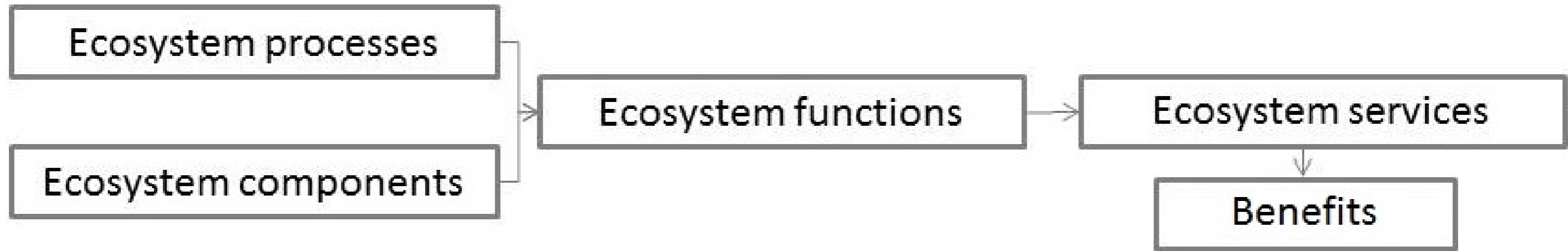


INTEGRATED TOOLS

Matching supply and demand



GUAYAS RIVER BASIN: SCENARIO ANALYSES



GUAYAS RIVER BASIN: SCENARIO ANALYSES

Social-economic income improvement from water:

- Insights in added value of water in goods and services
- Insights in needs and opportunities (supply/demand, costs/benefits): optimal balance and selection

Reduce 'social-economic' waste of water:

- Level of resources (depletion and contamination of resources)
- Level of use (inefficient use via irrelevant irrigation practices, leakages in pipes, 'running' taps, not well-tuned uses, no good storage/reuse/recycle methods)

KNOWLEDGE CREATION AND DISSEMINATION

- Provide information to all involved water, energy and food users and decision-makers (TV programmes, social media, brochures, MOOCs)
- Contribute to innovation in the WEF sectors (Triple helix approach): do research and develop a research mindset, as well as knowledge/technology transfer
- Research-based education in academia, but also at all levels (prosumer concept: everybody can be teacher and student)
- Create (Local, national and international) WEF networks

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SPHERE OF INFLUENCE/INTEREST

Knowledge availability (transfer and creation) and dissemination: education via schools, universities, ... but also other channels (professional networks, media used by citizens, ...)

Generate 'sustainable' solutions and decisions:

- From solutions to accepted decisions (involvement of stakeholders) via good and efficient governance
- Decision chain analysis: continuous improvement via installing PDCA (practical and optimal, e.g. ToRs, ...)

SUSTAINABLE AND SMART IMPLEMENTATION OF INSIGHTS AND TECHNOLOGIES

Levels of 'smartness'

- **Smart design and architecture:** what activities and infrastructure at what location: basis for effectiveness and efficiency ('activity and infrastructure habitat suitability modelling')
- **Smart implementation:** operation and management (including adaptation to changes over time, e.g. migration of people)
- **Smart use of technologies:** for short run adaptive management and also as basis for long run adaptation and adaptive implementations

PARTICULAR CHALLENGES IN ASIA

Diverse countries and development stage

Cultural and language barriers

Complex governance

High population

Diverse densities (rural/urban)

Climate (change) and other environmental challenges

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CONCLUSIONS

Food production and agriculture are only one but very crucial element of sustainable development

Crucial is to determine the status and analyze causes of problems and potential (sustainable solutions)

Education needs to be embedded in whole society and must also be initiated from different directions (prosumer concept: everybody can be student and teacher)

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