



Including environmental flows in water resources management

Karen Meijer

History

1960s

Start – disappearance of fish species in US. WQ could no longer be blamed

Focus on instream aquatic ecology (instream flows)

Minimum flows – hydrological methods (% of MAR)

Hydraulic rating methods

Habitat simulation

1990s

South Africa and Australia leading in development of 'holistic methods'.

Environmental flows

Holistic: Floodplains, wetlands, various depending species

From 'prescriptive' (BBM) to 'impacts of strategies' (DRIFT)

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Environmental flows

From ‘prescriptive’ (BBM) to ‘impacts of strategies’ (DRIFT)

Now

Many methods (over 200)

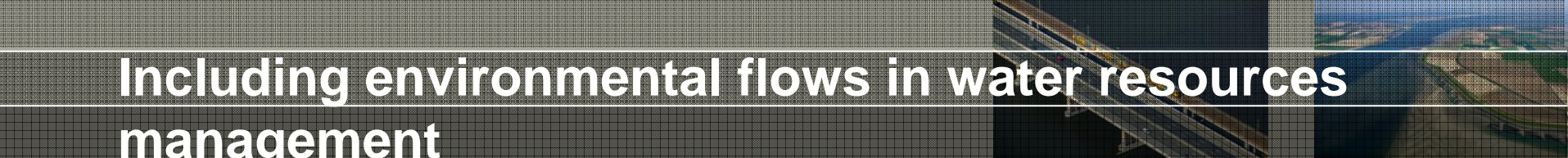
Many assessments

Little implementation

Information may still be lacking

But political will and trade-offs more important

(Renewed) attention for ‘ecosystem services’, ‘Adaptive Management’,



Including environmental flows in water resources management

*Almost in any context, **implementation presents an immeasurably greater challenge** than assessing the necessary flows*

conservationists therefore need to ensure that they do not devote a disproportionate amount of effort to discussion and debate over the appropriate environmental flow methodology, neglecting the more important effort of working for implementation

O'Keeffe, J., Le Quesne, T., 2009. Keeping Rivers Alive. A primer on environmental flows.
WWF Water Security Series 2

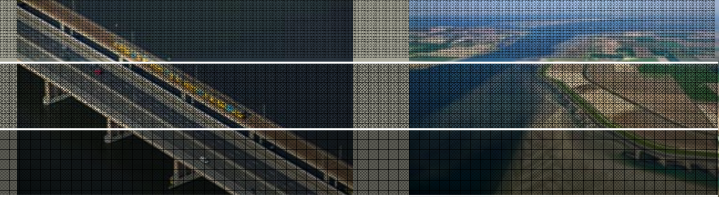
Challenges in environmental flow allocation

1. Understand what ecosystem will result and how services will change
2. Negotiate and balance interests: what level of ecosystem condition is required
3. Implement the agreed environmental flow regime

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Common misconceptions



EWA is water wasted on bugs and fish



EWA is water for “The Ecology” in competition with water for “Beneficial Uses”

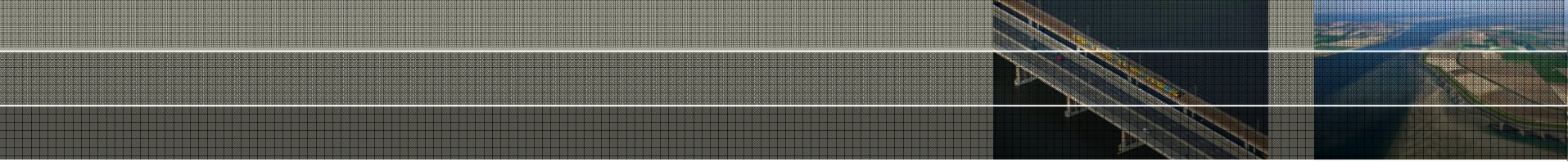
EWA costs a lot to implement

Natural flows may have higher benefits than abstractions

	Floodplain benefit	Irrigation scheme benefit
USD	37084	593
USD/ha	51	31
USD/m ³	14548	40

Hadejia-Jama'are river basin Nigeria:
floodplains have higher economic value than
irrigation areas

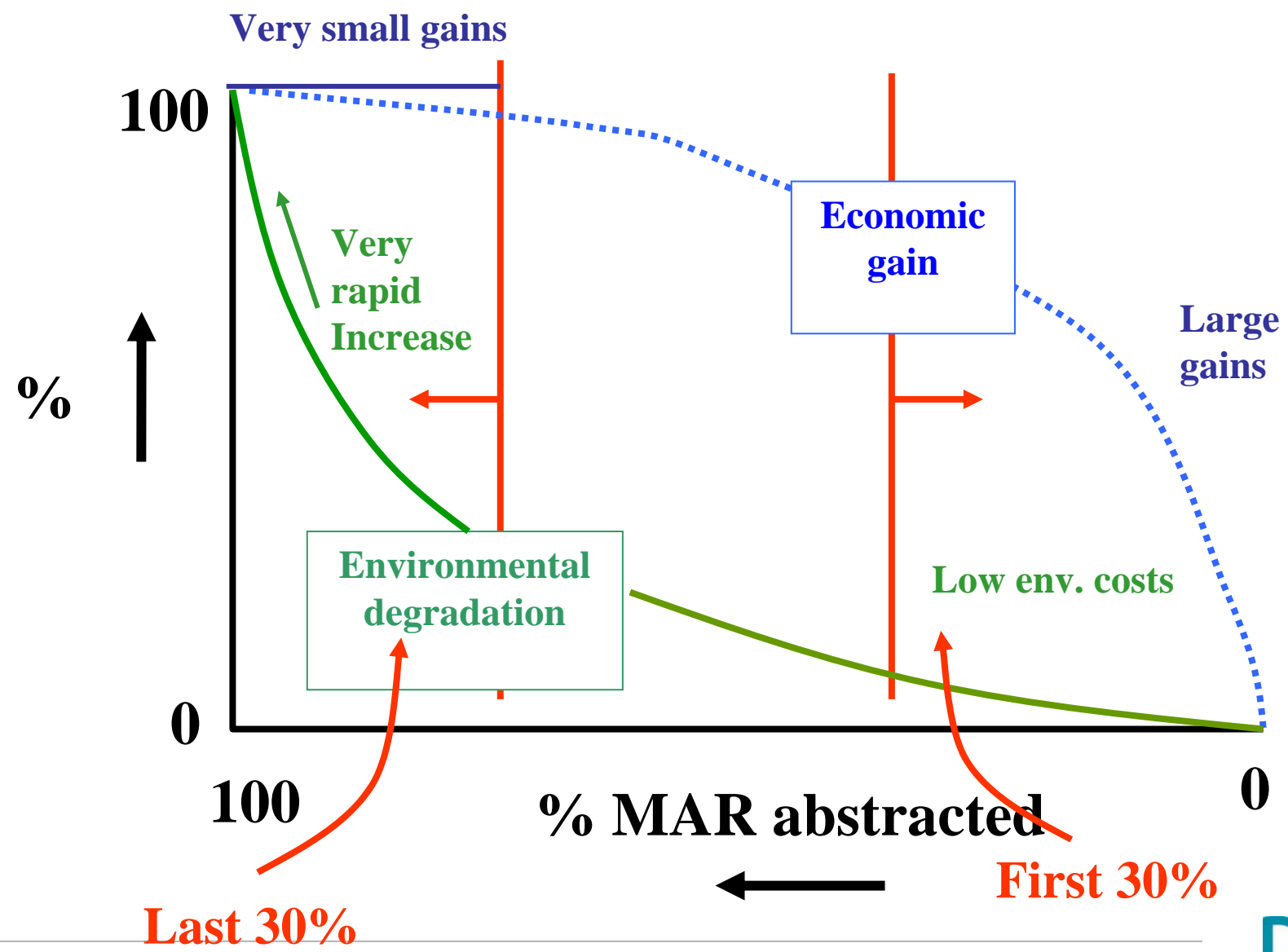
(Calculated for a 50 year period with an 8% discount rate, source: Barbier and Thompson, 1998)



King and Brown (2010) found for Zambezi that operating rules for existing infrastructure can be changed to improve downstream river conditions and the dependent social situations.

30% less HP production would lead to an improvement of 46%
downstream

3% less HP production would lead to an improvement of 15%
improvement



Two processes in assessing and implementing environmental flows

Scientific process

- Understanding ecosystem responses to flow regime changes
- Assessing the flow regime changes resulting from water management strategies
- Translating the flow regime into infrastructure operation and use regulation

*Exchange
of information*

Social process

- Setting objectives and criteria
- Negotiation & selection
- Implementation & enforcement

Objectives for environmental protection



Objectives and criteria

Determine what type of information is required to communicate impacts of flow regime changes to decision-makers

- 'ecosystem condition'
- Importance for society
- Economic value

Ecological Management Classes:

Class A - Close to natural conditions

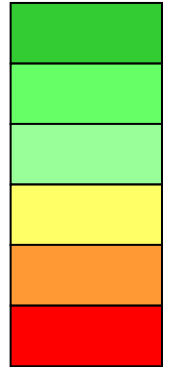
Class B - Largely natural with few modifications

Class C - Moderately modified

Class D - Largely modified

Class E - Seriously modified; no longer providing sustainable services

Class F - Critically modified; no longer providing sustainable services



The six classes can be used for describing the current state

Class A through D can be used to define the desired future state.

The Ecological Management Class is set for each section of river

In a procedure which takes account of the technical assessments of the specialist ecologists, and the wishes of the stakeholders,

but is eventually the responsibility of the Minister of Water Affairs.

(Source: O'Keeffe and Louw, 2000)

Social importance: ecosystems goods and services

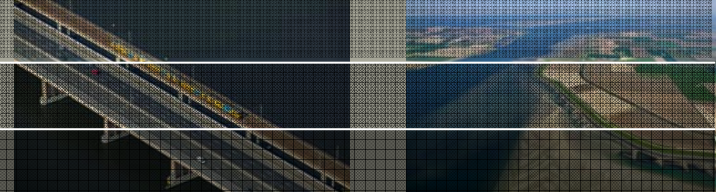
Provisioning	food (fish, animals, plants) fresh water wood and fiber fuel
Regulating	climate change flood regulation disease regulation water purification
Cultural	aesthetic spiritual cultural recreational
Supporting	nutrient cycling soil formation primary production



picture by Abbas Derahshani

Millennium Ecosystem
Assessment, 2005.

Social importance (2)



Ecosystems can be important for:

- Income generation
- Health and mental well-being

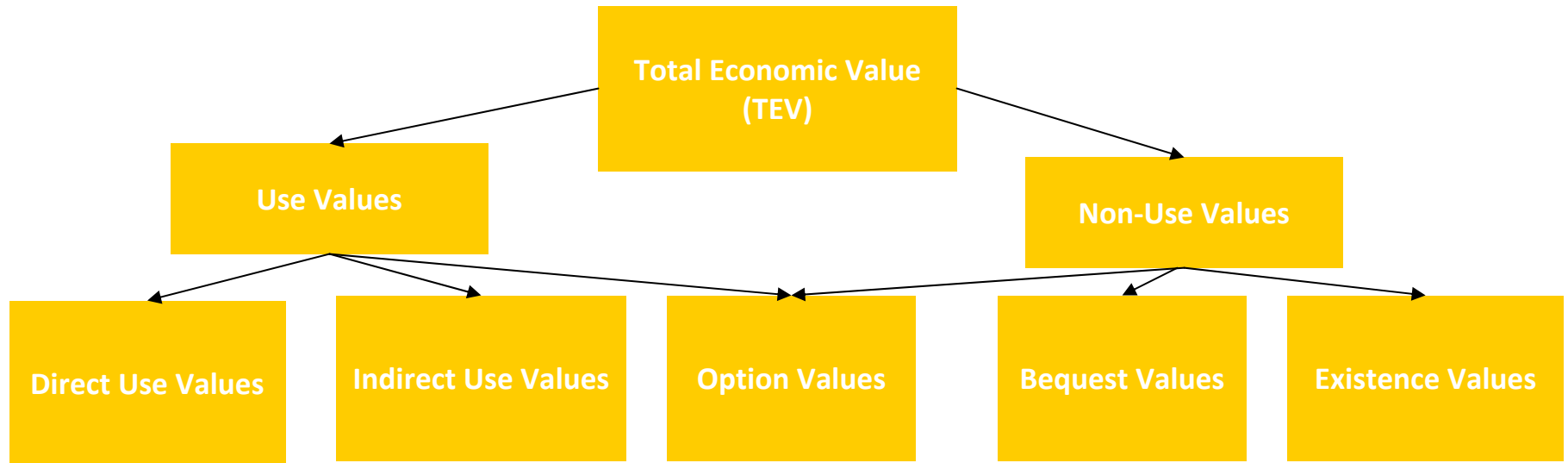
Provide to decision-makers information on:

- How many people
- Will be affected in what way

For example:

$x\%$ of people loses $y\%$ of recreation possibilities within z km from their homes

Concept of Total Economic Value



Descriptions:

Raw materials
Mainly related to
Production services

For example flood
control
(regulation services)

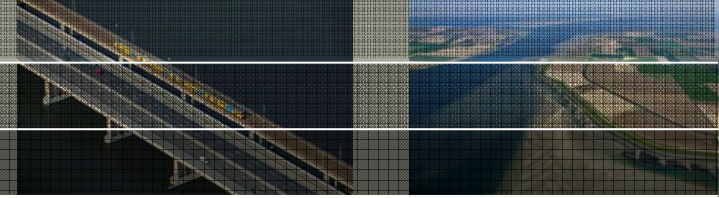
Protecting ecosystems
to safeguard
potential future use

Protection for
Future generations

For example
spiritual Values
(cultural services)

Source: Emerton & Bos, 2004

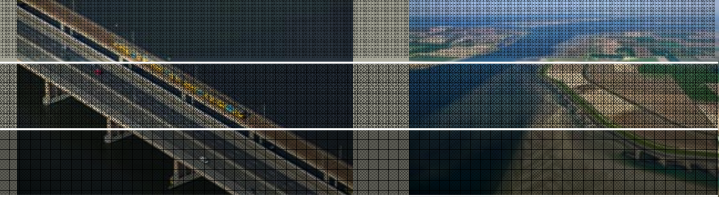
Valuation methods



Examples of valuation methods:

- **Revealed preferences** – for example based on prices people actually pay in the market for particular products from an ecosystem
- **Replacement cost approach** – what would be the cost to replace the ecosystem services? For example building a waste water treatment plant when the natural purification in a wetland is no longer present
- **Stated preferences** – direct statement of what the availability of a service would be worth. Often used in relation to recreational sites

Usefulness



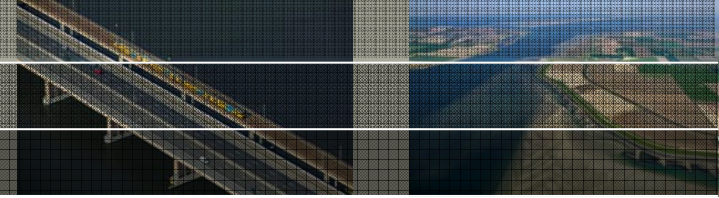
Positive

- Monetary value generally considered relevant
- Easy to understand
- With all impacts in \$ it is easy to compare alternatives
- Even if partial, useful contribution to understanding impacts of proposed changes

Drawbacks:

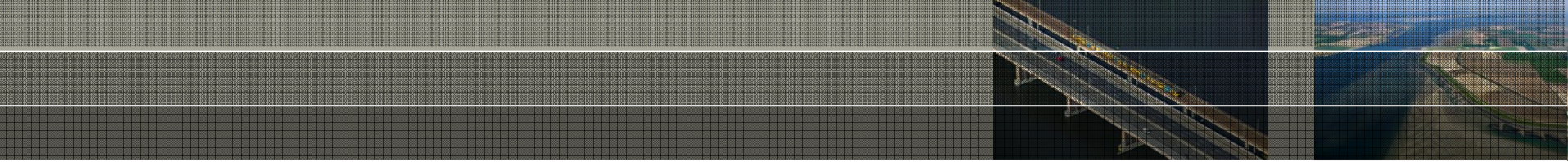
- Net present value – value in the future worth less than value now – sustainability?
- Although the concept says *total* economic value in reality only partial values are assessed

Examples of economic values



Service type	Service provided	Developed economies (US\$/ha/year)	Developing economies (US\$/ha/year)
Provisioning services	Water for people	45 – 7500	50 - 400
	Fish/shrimp/crab	200	6 – 750
	Agriculture and grazing	40 – 520	3 – 370
	Wildlife (for food)	40 – 520	0.02 – 320
	Vegetables and fruits	40 – 470	1 – 200
	Fibre/organic raw material	45	1 – 40
	Medicinal plants		6
	Inorganic raw material	15 - 160	0.1
Regulating services	Water quality control	60-6700	20-1400
	Flood mitigation	15-5500	2-1700
	Groundwater replenishment		10-90
	Erosion control		20-120
	Carbon sequestration	130-270	2-2000
	Microclimate stabilization		10
Supporting services	Biodiversity conservation		
Cultural and amenity services	Recreation and tourism	230-3000	20-260
	Cultural/religious activities	30-1800	80

The Table is from the IUCN publication 'Pay (IUCN, 2006), which had it adjusted from the PhD thesis of Louise Korsgaard (Korsgaard, 2006).

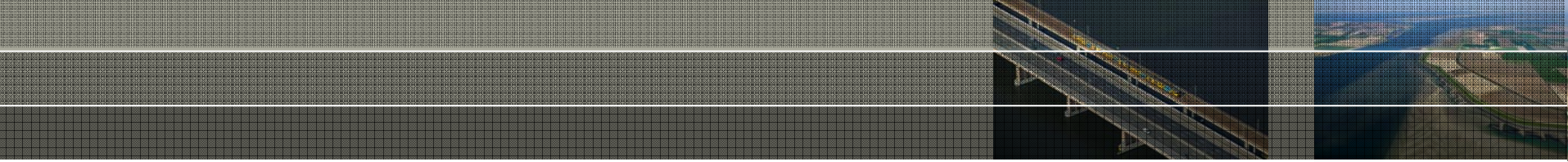


Ecosystems provide important services to society

Monetary values are useful because easy to compare, but normally not all costs are included in the valuation

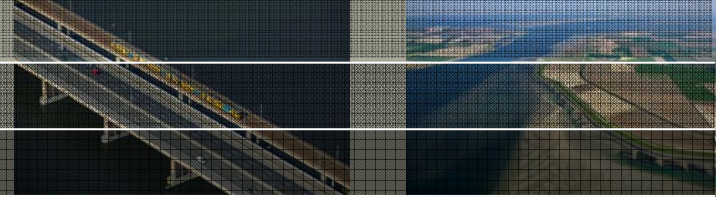
Qualitative insight in who will be affected in what way to provide a more complete picture

Only with this information can a balanced decision be made



It is important to be absolutely clear that the costs of dealing with EF issues are *legitimate project costs* that must be taken into account. Failing to deal with them *does not make them go away*, it simply distorts the ERR calculations to the extent that the true costs of the project to the community are not taken into account. This is not good economics; *nor is it good public decision-making*. (Brown and Watson, 2007)

Objectives – how to define



Start process with vision development with all actors

- Do not focus on competing interests
- But focus on common wishes
- What can be done to achieve the vision?

It is important to define objectives and criteria early in the process to guide the scientific process

But, when a better understanding of the basin is gained it may be necessary to adjust the objectives

Social process supported by scientific process

Exchange is crucial:

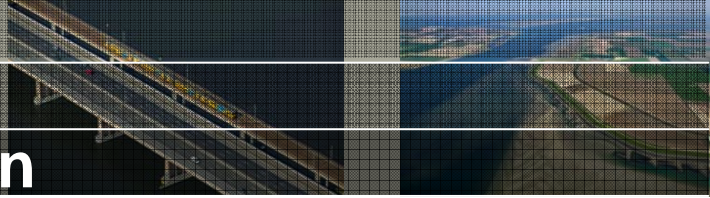
- “Agreed hydrology” (King and Brown, 2010) : how much water is available (hydrological analysis)
- Impacts of proposed interventions on all uses of the basin: requires an integrated approach (model including infrastructure and use at basin level – e.g. Ribasim)
- Including social and economic information
- Link strategies and scenarios to information that is important to decision-makers (to what extent are objectives met?)

Benefits of environmental flows are uncertain

When decision-makers are not sure that allocating water to the environment will have beneficial impacts they are not likely to be in favour of reducing other water uses for that purpose

Instead of additional study it is better to experiment and learn: adaptive management

Adaptive management (Pillar No1): Monitoring and scientific information



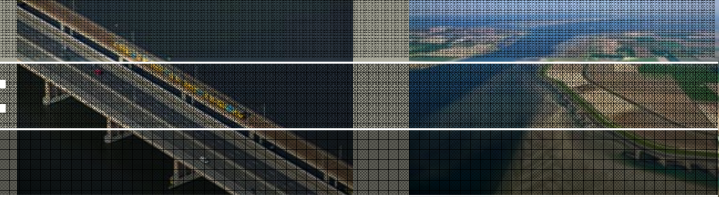
This is the core of adaptive management: learning by doing: 'see what happens'

conducting well-defined research to test for different hypotheses about system behavior

For example, on the Colorado, experimental releases have been made from the Glen Canyon dam and impacts monitored since 1991

- It was found that initial assumptions on flow-ecosystem responses were incorrect
- Experiments will continue and also impacts of non-flow changes will be considered
- See also: <http://www.gcdamp.gov/>

Adaptive management (Pillar No 2): Social learning



Social learning: a systematic process for improving management policies and practices by learning from the outcomes of implemented management strategies in a process that engages stakeholders and generates social learning

Scientific process – update system understanding

Social process – reassessment of strategies

The process takes time:

- Applied in the Everglades (Florida, USA), Kruger Park (South Africa).
- In both cases it took decades to achieve the objectives

Adaptive management (Pillar No 3): An adaptive process

Adaptive management requires that the approach can indeed be adaptable
The objective should be clearly defined, but the strategy to achieve the goal should be flexible.

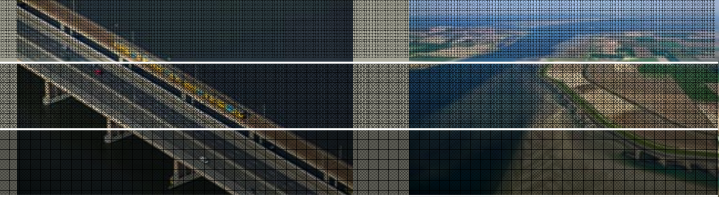
Procedures are required on how to change management based on monitoring outcomes.

Successful: mainly on small scale areas with single or limited number of objectives

Water management typically focused on river basin scale and with multiple (conflicting) objectives

Work-around: start small scale with pilot level projects

Adaptive management



‘Best available knowledge’

Regularly updated

Caution:

It is a lot easier to prevent use to increase than to reduce abstractions and regulations already allowed

So:

When impacts are uncertain it is better to define relatively conservative flow requirements

And to relax the requirements when impacts of changes in flow regime are better understood

Implementation – can be facilitated by...

- Inclusion of environmental issues in objectives
- Linking changes in ecosystem to criteria relevant to decision-makers
- Assessing impacts for scenarios and strategies identified by decision-makers
- Representation of environmental interests in decision-making process
- Including the people who will actually have to change behaviour can help prevent non-compliance with agreed flow policy
- Adaptive management procedure can prevent uncertainty with respect to assessed flow regimes

Stakeholders to be involved from the beginning

Decision-makers, interests representatives and implementers
(not everybody to the same degree in each step)

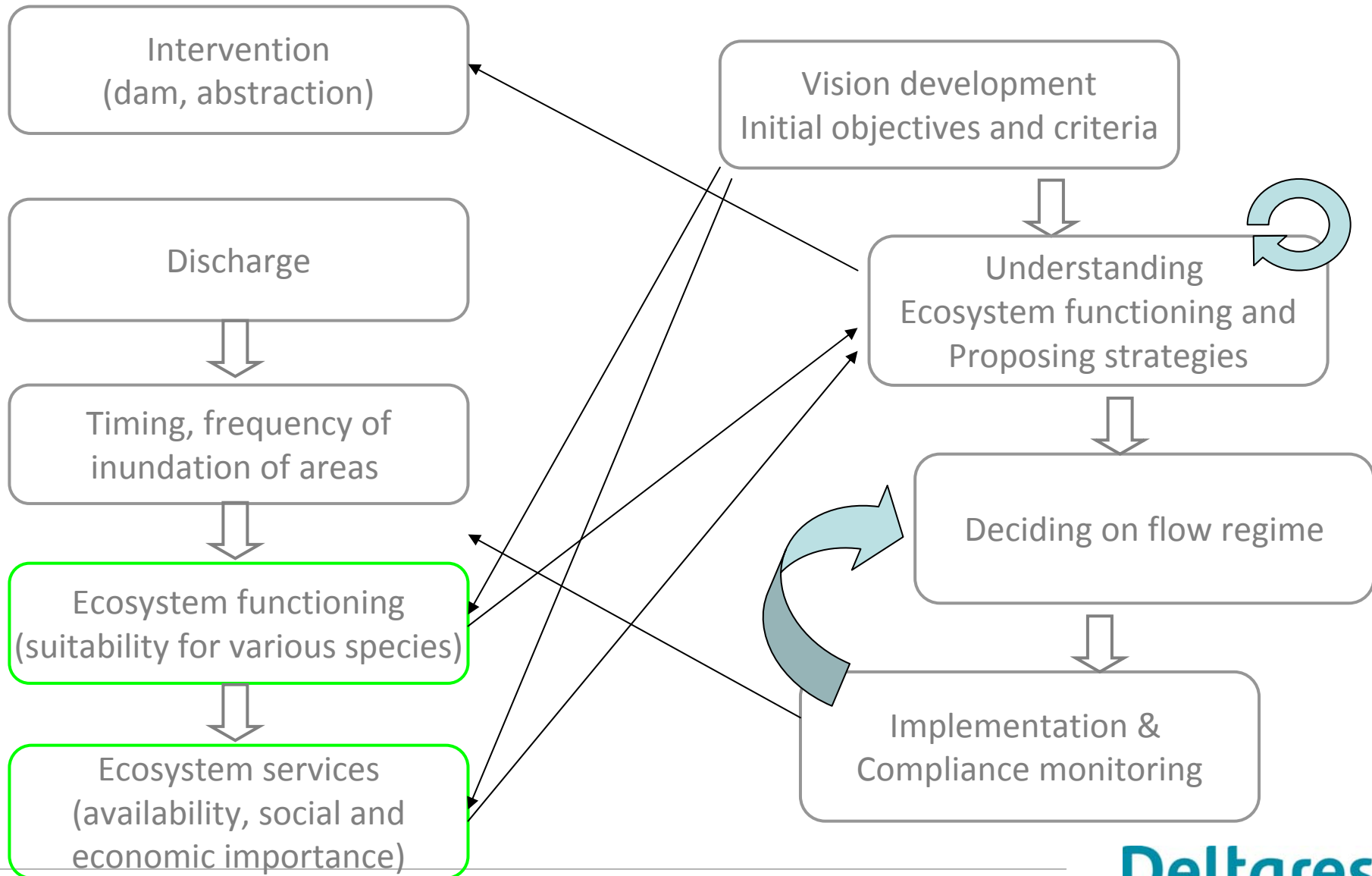
- Vision development following ecosystem approach
- Joint learning process on how the system works, not all details, but data and models used need to be supported
- Create understanding and prevent non-compliance
- Adaptive management – social learning

Complex issues, no straightforward answer → it will take time to understand impacts and possibilities

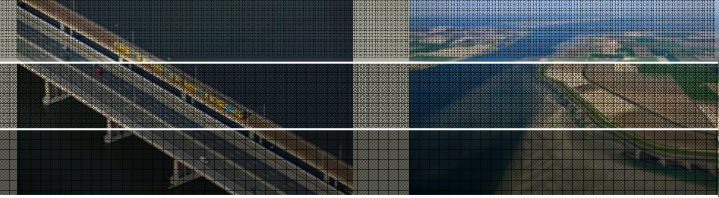
People who will be affected and who need to change behaviour → need to understand impacts and rationale

SCENARIO-BASED APPROACH

SOCIAL PROCESS



Summary



- Social process to:
 - Decide on objectives and criteria
 - Develop measures
 - Balance interests and decide on the flow regime to be implemented
- Requires a joint understanding:
 - “Agreed hydrology” and impacts of measures in terms of the identified criteria
 - To be supported by the scientific process
- Implementation of environmental flows should receive attention from the start of the process
 - Involve stakeholders from the beginning
 - Consider not only decision-makers but also people that are affected and the people that will have to do the actual implementation
 - Adaptive management and monitoring to deal with uncertainties