A Framework for Making Qualities of Indicators Transparent

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Why Transparency is Important

- Transparency is a basic requirement in science to allow for testing and validation of a scientific results.
- Transparency makes it easier for people with different background to participate in discussions concerning scientific knowledge and advice. However, this transparency is of another kind. A list of data and equations may be sufficient to make results transparent for a researcher within that specific field. Non-experts, on the other hand, need other means for transparency; like information about the underlying assumptions, how these assumptions affect the indicator and its associated threshold level, or how well founded the underlying knowledge is.
- In policy questions with conflicting interests, uncertain knowledge can result in lack of trust in scientific advice. Transparency concerning uncertainties, how it affects advice and how it affects management may increase credibility.
- Transparency and a proper uncertainty assessment will increase the relevance of advice based on indicators.
- Sufficient transparency may help understanding scientific disputes.
- Lack of transparency may make complex issues look simple and managers and stakeholders may have false expectations of the indicator

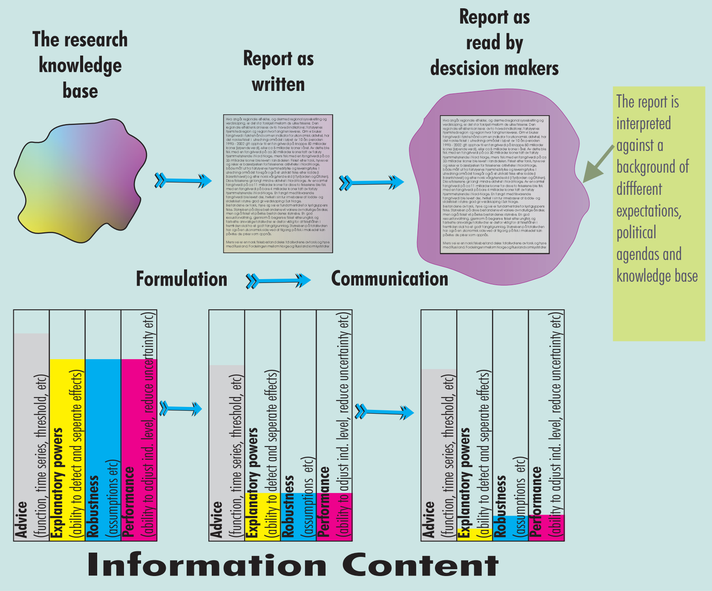

Figure 1:
How knowledge of underlying scientific assumptions and uncertainties can be lost or misinterpreted through ordinary scientific advisory reports.

Traditional representation of scientific advice based on an indicator.

Is the indicator scientifically well founded?

Advice Statement

Indicator Time Series

The intention of this part is to show the historic development.

- Present the indicator time series

Function of Indicator

Some indicators are for management purposes while others are not. Some indicators reflect the concern directly while others are proxies. To be clear on this the intention of the indicator should be states, both what the indicator is meant to reflect and also whether management is associated to the indicator.

- Explain what the indicator reflects.
- State whether the indicator is used for management purposes.

Threshold(s)

A threshold may reflect a danger or a target. Some indicators, like spawning stock biomass, are associated with more than one threshold. How a threshold is defined technically will explain these matters.

- State the value(s) of the threshold(s).
- Explain how they are technically defined.

Supporting Information

When an indicator is a proxy for a state or a situation there may exist other relevant information. This could be related time series or more qualitative knowledge.

- Present relevant time series.
- Present relevant knowledge (quantitative or qualitative).

Conclusion/Advice

A conclusion or an advice may be formulated as a statement or/and presented by predictions or scenarios.

- Present conclusion.
- If relevant, present advice.

Power of Explanation

Cause-effect in Indicator

An indicator is meant to reflect the state or the condition of a system. Knowledge on what causes the indicator value to fluctuate may be helpful for management purposes. In some cases we know the causes, either qualitative or quantitative, while in other cases we do not.

- State what causes changes in the indicator value.
- State whether there is a quantified relationship between cause and effect.
- State whether an indicator value is predictable or not.

Cause-effect in Threshold

A threshold is meant to reflect a danger or a target. How well defined a danger is will vary. In many cases there is no abrupt danger at a certain limit, but the danger will gradually increase. In some cases a danger may not be static but will depend on many factors. A single threshold will not be able to reflect this, but will rather be statistical considerations based on averages. Where knowledge is scarce a threshold may be borrowed from a related field.

- Explain how well defined the threshold is.

Ability to detect change

Some indicators are direct measurements, which means that changes are accurately observed. Other indicators are based on aggregated information in a way that it will take some time before a change can be confirmed. In other words, it will take time to settle the indicator value.

- State to what degree it is possible to detect changes in the indicator level.

Ability to seperate effects

An indicator value may change due to more than one cause. If management can regulate only one of the causes, it may be valuable to separate the effects of the different causes. The ability to separate the causes will decide what kind of management is possible and what kind of scientific advice is relevant.

- State to what degree it is possible to quantify what effect the different causes.

Robustness

Underlying Assumptions in Indicator

All scientific knowledge is built on assumptions, like generalizations, simplifications and extrapolations. People outside a certain research field may not understand the equations, theories or the quality of data, but may have an idea of how relevant an assumption is related to the policy question. In any case, the underlying assumptions may illustrate an uncertainty perspective concerning the indicators.

- List the underlying assumptions to the indicator level.

Underlying Assumptions in Threshold

The decision on the threshold value is also built on assumptions.

- List the underlying assumptions of the decision of the threshold value.

Sensitivity Analysis Indicator

If an indicator value is sensitive to an underlying assumption, and it is not known how valid the assumption is, it may decrease the indicator's relevance. A sensitivity analysis will give an idea of how sensitive the indicator is to the different assumptions. It thus reflects part of the uncertainty due to the assumptions.

- Present a sensitivity analysis. If it is not carried out, explain why.

Sensitivity Analysis Threshold

- Present a sensitivity analysis.

Management Perspectives

Ability to Adjust Indicator Level

In some cases it is possible to adjust an indicator level, either qualitative or quantitative, by regulating human activity that affects the level. In other cases it may not be possible to adjust or it is unknown whether it is possible.

- Describe to what extent it is possible to adjust the indicator level.

Reversebility of Danger

This is partly related to the last box.

- State whether the potential dangers are reversible or not , or whether knowledge on this is uncertain.

Possibility of Reducing Uncertainty

Scientific research may reduce uncertainties associated to the indicator and its use. Control of human activity may also reduce uncertainty. In many cases there will remain uncertainty that is not reducible.

- Explain whether the uncertainty is reducible, and what kind of scheme will/may reduce it.

Are the communicated quantities and conclusions sensitive to the underlying assumptions, simplifications or generalizations?

Will managing human activity help?

The Uses of the Framework

- ***Selecting indicators***. The framework may serve as a method for systematically comparing qualities in the suggested indicators. To find a suitable set of indicators to measure the state of the Barents Sea ecosystem, the descision makers have numerous time series from many fields of science to choose from. A non-specialist may have limited insight in how well the indicator reflects the issue, how well founded the knowledge in this field is and the like. This framework provides a transparency that may be helpful when discussing the possible indicators.

- ***Increasing awareness among scientists***. The framework will call attention to different uncertainty perspectives that a scientist may not be used (or trained) to communicate or reflect on. The framework may clarify whether advice can be made more relevant, like expressing it in a different manner or by carrying out a sensitivity analysis. Scientists may have a tendency to speak about their science in a rather confident way. The ACFM report (Advisory Committee on Fishery Management) is an example of this. Annual advice on quotas is expressed as if the precision level in the knowledge basis is higher than it actually is.

- ***Communicating to users***. In ecosystem based management a manager has to relate to indicators with very differing qualities. Scientific advice is often presented as resulting from a black box. This framework opens up this black box helping to clarify uncertainty characteristics associated with an indicator. A user may more easily judge the relevance of the indicator, the uncertainties, its limits and its strengths.

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