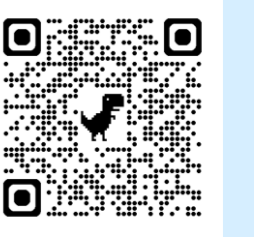


Sustainability assessment of NBS in Norwegian municipalities

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Abstract

The importance of adapting to the consequences of climate change is being increasingly recognised globally. In Norway, the expected economic impact of **water-related damage** is expected to double over the next decades. The complex nature of climate change and large spatial differences in climate vulnerability necessitates **locally tailored** and **cross-sectoral adaptation**

solutions. However, it is a challenge for often resource-strapped local authorities to determine which adaptation option is most suited to their environmental, social and economic context. In the project 'Sustainability analysis of climate change adaptation measures' (2021-2024), researchers worked together with a range of West-Norwegian local authorities and private actors in a **community of practice** to develop a **sustainability assessment framework** for evaluating and comparing climate change adaptation measures. The framework covers **five dimensions** of

sustainability: technical performance, economic performance, environmental impact, regulatory compliance, and social benefits. The indicators are flexible enough to be **adaptable** to local conditions, and decision makers can adjust the weighting of individual indicators or entire dimensions to align with local plans and sustainability goals. By documenting and combining a wide range of sustainability aspects, the framework enables meaningful and **holistic comparison** of 'grey', hybrid and nature-based adaptation measures.

Introduction

49%

Increase in days with heavy rainfall in Norway in 2100 for RCP4.5 [2].

Climate change poses a significant challenge to Norwegian authorities. The need for adaptation alongside mitigation is increasingly recognised, and the main responsibility lies with municipalities.

35bn NOK

Norwegian insurance payouts for weather and climate related damages in the last decade [1].

Damage costs are expected to increase in the coming decades if no preventive measures are taken. State guidelines emphasize nature-based solutions (NBS) as key adaptation measures, but challenges including a lack of interdisciplinary decision-making systems, uncertain finances, and insufficient political often lead to a preference for 'grey' measures.

22%

Norwegian municipalities that use NBS for stormwater management to a large extent [3].

How can municipalities make informed decisions on which climate change adaptation measure to implement, in line with their needs and sustainability goals?



Dimensions	Technical Social Economic Environmental Governance
Objectives	Key targets linked to the five dimensions
Criteria	Measuring fulfilment of the objectives
Indicators	Metrics tracking progress

Layers of the Sustainability Assessment Framework

Methods

Municipalities need a **common framework** for assessing adaptation measures, including setting sustainability targets and evaluation criteria that are **tailored to local conditions**.

Sustainability Assessment Framework

- Based on the Integrated Sustainability Assessment methodology for natural water retention measures developed in earlier projects [4-6], which contains five **sustainability dimensions**.
- For each dimension, related **objectives** were formulated based on the SDGs and local sustainability plans.
- Fulfilment **criteria** were identified to measure progress towards the objectives.
- Specific **indicators** were developed as concrete metrics of progress.
- The framework is developed for use by municipalities at the **early planning phase**.

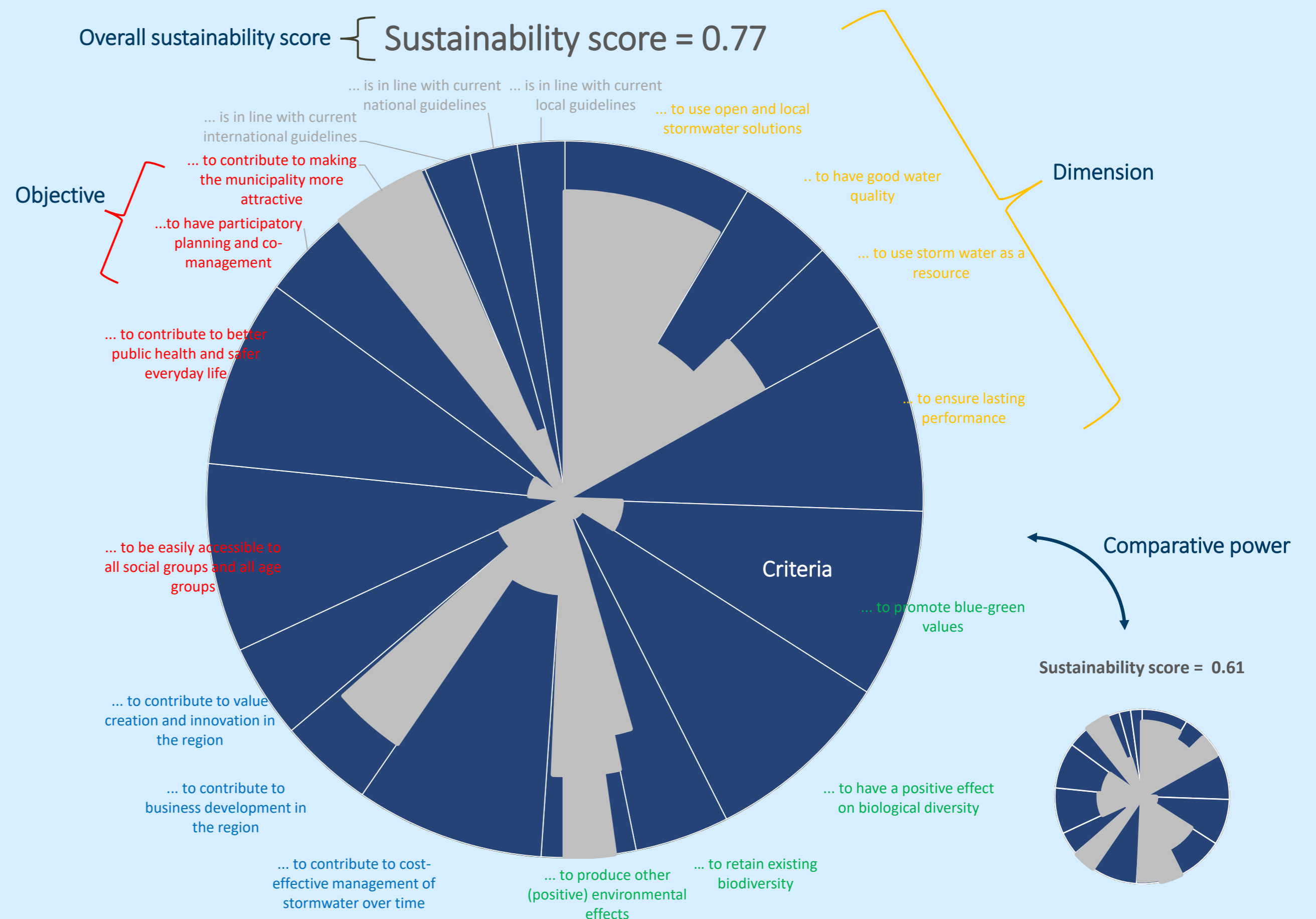
Co-creation with stakeholders

- Partners: SINTEF, Vestlandforskning (**research**); Gjesdal, Hjelmeland, Karmøy, Sandnes, Sauda, Sola (**municipalities**); Rogaland county; Skjæveland gruppen, Faber Bygg, Asplan Viak, Sweco (**industry**).
- The co-creation process addressed each step of the framework development.
- Activities included **one-on-one interviews**, independent **homework** to develop and test the framework internally, **workshops** to collectively discuss and refine the framework.
- This approach ensures that the framework is relevant to **local conditions**, and that the right data is available to quantify the indicators.

Results

- The final sustainability assessment framework consists of **5 dimensions, 18 objectives, 39 criteria, and 107 indicators**.
- The objectives and criteria are inspired by the UN Sustainable Development Goals as well as the partner municipalities' own sustainability targets.
- The indicators are based on existing literature (e.g. [7-9]) and developed co-creatively with the project partners.
- Some indicators are pre-quantified for certain NBS (e.g. based on [7]). Others are **quantified** by the user based on existing documentation or expert opinion.
- To make the framework suitable for the early planning process, the **level of detail** needed to be kept low. Most indicators are scored on a three-point scale.

- Indicators and objectives can be **weighted** to reflect local sustainability targets and priorities. This is reflected in the sustainability score and in the width of the pie sections in the results diagram (below).
- The use of a **co-creation** approach in this project both contributed to improving the framework and strengthened climate change adaptation **competence** of the municipalities and other partners.
- Cross-sectoral collaboration** is crucial for successful climate change adaptation, but also a challenge for resource-strapped municipalities.
- The combination of the five sustainability dimensions into one framework encourages the user to seek out the right expertise from multiple departments, leading to a **more just and holistic assessment** of adaptation measures.



Example of the Sustainability Assessment Framework output. All indicator values are weighted and combined to create a single sustainability score. The contributions of the different criteria, objectives and dimensions are displayed in a radar plot, which enables quick visual comparison between different proposed NBS.

Conclusions

- The indicator-based sustainability assessment framework enables **more holistic early planning** stage evaluation and comparison of NBS-based climate change adaptation interventions at the municipal level.
- While the framework has been co-created with relevant stakeholders, it needs **further testing** in the field to determine its robustness across different local contexts and NBS measures.
- There is potential to develop a **more in-depth** version to support decision-making during the **design stage** of NBS, for example to select the most beneficial vegetation types or recreational elements
- The framework could also be adapted to help **track and report** on sustainability and climate change adaptation progress, by adding indicators that measure **post-intervention changes**.

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