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Assessing the most Sustainable Alternative for Production of Drinking Water – ASTA a decision support system Alternatives fulfilling the EU-Water Framework Directive

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To keep business running and improving decisions are needed in all aspects of management. Decisions can be made relying on a wide variety of criteria ranging from a personal intuition to scientifically based research. This study is dedicated the development of a decision support system integrating quantitative sustainability into the decision making process of water utilities.

Sustainability is in this context defined as aspects of Economic, Environmental (including resource consumptions and foot prints) and Social matters. The term “sustainable development” is often quoted from the Brundtland Commission (WCED, 1987) as: “*development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs*”. In 1992 this definition of sustainable development was concretized a step further as a balance of three dimensions: Environmental protection, Economic growth, and Social development (UNEP, 1992).

These three aspects are called Key Criteria and are subdivided into Criteria and furthermore into Indicators which are quantified when different alternatives are evaluated.

The purpose of this study was to develop a decision support system incorporating sustainability in terms of Environmental, Economical and Social aspects which can be used for evaluating alternatives for handling of water. This three-dimensional character of sustainability has settled the architecture of the decision support system to Assess the most SusTainable Alternative - ASTA.

The sustainability assessment is carried out by integrating different tools for evaluating the three Key Criteria:

- Environmental aspects: Evaluated by carrying out a Life-Cycle Assessment (LCA) in combination with environmental impact assessments,
- Economic aspects: Evaluated by use of Cost-Benefit Analysis (CBA) where a benefit-cost-ratio is calculated,
- Social aspects: Evaluated by a Multi-Criteria Assessment (MCA) called Analytical Hierarchy Process which is excellent for comparing alternatives on indicators of qualitative nature

The three types of assessments are integrated by a Multi-Criteria Assessment frame which ties the evaluations together to obtain a joint decision support result.

To evaluate ASTA we assessed four alternatives (A1-A4) of technologies for water supply by different resources which all aim at fulfilling the regulations on the freshwater scarcity (Water Framework Directive) being challenged by the intensive water abstraction near Copenhagen, in Copenhagen Energy (KE) in Denmark.

- A1. Substitution of 20% of all households' water supply by non-potable water (rain water and well water)
- A2. Preventing non-acceptable low water flow in streams by adding supplementary water in the habitat
- A3. Moving well sites further away in order to distribute the pressure on the freshwater scarcity (+ 20 km)
- A4. Extracting and treating surface water from a lake (ultra- and nano-filtration, UV radiation)

Preliminary results showed that it is possible to develop a decision support system integrating sustainability into a holistic decision support system tailored for the water sector. The promising results are presented as Total Value-score with the strength of keeping all values on a local scale (only considering the alternatives in focus) allowing for easy and quantitative comparison of the result of the alternatives. Comparing the evaluation of alternatives A1 – A4 for water supply showed that the alternative Preventing non-acceptable low water flow (A2) is preferable from a sustainability point of view, see **Figure 1.1**.

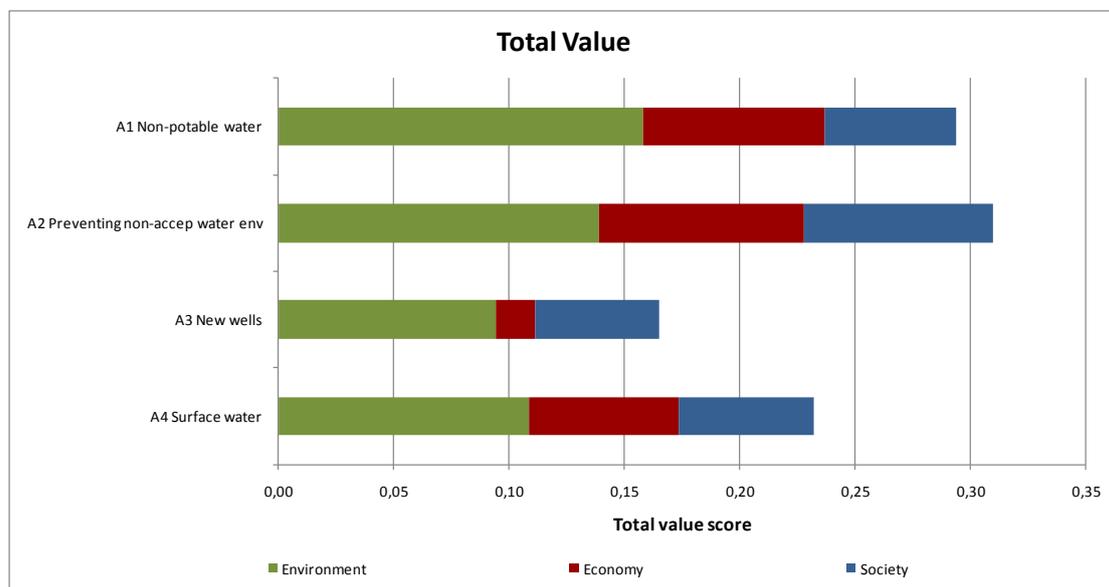


Figure 1.1 Assessment of the four alternatives A1 – A4 for drinking water supply assessed by the decision support system ASTA integrating sustainability into the decisions. The bars represent the sum of the contributions to sustainability (from left) from Environmental, Economical and Social aspects.

The next step in the project will be to quantify and integrate impacts on resources (water and ecosystems) and resource consumption into the decision support system.

The decision support system, ASTA, assessed the optimal alternative which in this case study included e.g. non-potable water (A1) and advanced treatment of surface water (A4). Finally, ASTA will also add value to the water utilities decision-process by making decisions transparent and well-argued and in accordance with the principles of sustainability as defined by this study.

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