



Understanding sustainable development in Finnish water supply and sanitation services

Citation

Takala, A. (2017). Understanding sustainable development in Finnish water supply and sanitation services. *International Journal of Sustainable Built Environment*, 6(2), 501-512. <https://doi.org/10.1016/j.ijbsbe.2017.10.002>

Year

2017

Version

Publisher's PDF (version of record)

Link to publication

[TUTCRIS Portal \(http://www.tut.fi/tutcris\)](http://www.tut.fi/tutcris)

Published in

International Journal of Sustainable Built Environment

DOI

[10.1016/j.ijbsbe.2017.10.002](https://doi.org/10.1016/j.ijbsbe.2017.10.002)

License

CC BY-NC-ND

Take down policy

If you believe that this document breaches copyright, please contact cris.tau@tuni.fi, and we will remove access to the work immediately and investigate your claim.

HOSTED BY



ELSEVIER

Gulf Organisation for Research and Development

International Journal of Sustainable Built Environment

ScienceDirect
www.sciencedirect.com

Original Article/Research

Understanding sustainable development in Finnish water supply and sanitation services

Annina Takala

The Faculty of Business and Built Environment, Tampere University of Technology, PO Box 541, FI-33101 Tampere, Finland

Received 25 March 2017; received in revised form 25 June 2017; accepted 20 October 2017

Abstract

Water supply and sanitation services are essential to human and environmental well-being. Globally one of the biggest challenges to sustainable development is lack of access to improved water supply and sanitation services. Yet it is less obvious what sustainable development means in countries with high coverage of these services. In this article sustainable development is explored from the perspective of Finnish water supply and sanitation services. The study consists of eight semi-structured interviews with water sector experts and their views are analysed in relation to literature. In this article sustainable development is understood as a learning process and dialogue of values.

The interviewed water sector experts primarily perceive sustainable development from an environmental point of view, and treat it in a rationalistic and mechanistic manner. Challenges are tackled by technological fixes, such as improving energy and material efficiency. It is argued in this paper that this kind of approach undermines the complexity and dynamicity of sustainable development and can suppress learning. Sustainable development is mostly explored only from the perspective of water services, although some of the interviewees recognise their role for wider societal development. Interaction and dialogue between water sector experts and the community regarding sustainable development is lacking or skills to accomplish this interaction are inadequate.

© 2017 The Gulf Organisation for Research and Development. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Keywords: Sustainable development; Water supply services; Sanitation services; Finland

1. Introduction

Water supply and sanitation services¹ are one of the cornerstones of functioning societies. The provision of safe drinking water is essential to human health and well-being, and sanitation services play a central role not only in secur-

ing human health but also in enabling conglomerations of human settlement thrive without compromising the state of the environment. These services can be seen to be at the heart of sustainable development, as the basic idea of sustainable development is the advancement of human well-being within the planetary boundaries (WCED, 1987; Steffen et al., 2015).

In 2015, the United Nations General Assembly adopted the Sustainable Development Goals, the sixth goal focussing on clean water and sanitation. In addition, water is a crosscutting theme for all the goals (Bhaduri et al., 2016;

E-mail address: annina.takala@tut.fi

Peer review under responsibility of The Gulf Organisation for Research and Development.

¹ The term ‘water services’ is used from here onwards to cover both water supply and sanitation services.

<https://doi.org/10.1016/j.ijsbe.2017.10.002>

2212-6090/© 2017 The Gulf Organisation for Research and Development. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

UN-Water, 2016). Globally, the challenges related to the sustainable development and water services are blatantly obvious as 663 million people still lack access to improved water sources and 2.4 billion people to improved sanitation (UNICEF and WHO, 2015). It is less obvious what sustainable development entails in countries with high coverage of water services. In Finland, which is the setting for this article, 98% of the population have access to improved sanitation and 100% to improved water sources (Ibid). Can we argue that in countries like Finland water services have already achieved sustainability and the questions related to sustainability are of limited interest? This is possible, if we understand sustainability from a very narrow perspective. However, the starting point in this paper is that sustainable development should rather be viewed as an on-going process than a goal (Newman, 2005; Voß and Kemp, 2006), and therefore it requires constant re-evaluation of practices and approaches. In addition, the water sector in countries with a high coverage of water services are facing a multitude of challenges potentially compromising their sustainability (e.g. Bos and Brown, 2013; Mann and Runge, 2007). Wilderer (2004, 10) questions the sustainability of water services altogether as “[w]ater is unwisely used, and valuable materials are not returned to the material cycle but destroyed”.

The aim of this study is to explore how Finnish water sector experts understand sustainable development in water services, and discuss the implications of this dominant understanding. The focus is not only on the sustainability of water services themselves, but the role these services can play in wider society. After all, the way water services are organised affects the well-being of people, society's use of resources, and the state of our environment (Malmqvist et al., 2016). The study is not limited to the sustainability of water and wastewater utilities, but analyses sustainable development in the wider context of water services.

2. Sustainable development

Sustainable development has been widely discussed and debated since the 1980 s. The purpose of this section is not to provide an overview of this vast discussion nor to give an operational definition of sustainable development. Rather, it introduces the conceptual discourses on sustainable development that guide this study.

2.1. Sustainable development as learning

Sustainable development aims to address simultaneously the various concerns related to both environmental and social systems. However, these systems are complex and dynamic; problems cannot be solved independently of a large number of complicating factors (Blewitt, 2008; Norgaard, 1994). According to systemic understanding of sustainable development, the environment (natural systems) and human systems (society, economy, culture) form a nesting system (see Ainger and Fenner, 2014). The natu-

ral system forms the basis and, thus, it provides the context and boundaries in which societal development and well-being can be pursued (see Steffen et al., 2015 for a contemporary presentation on the planetary boundaries).

Due to the inherent complexities and uncertainties, even the most extensive research on planetary boundaries do not tell us which human actions are allowable and which forbidden (Haila and Levins, 1992). Sustainable development is a socially constructed and reconstructed concept (Hajer and Versteeg, 2005). It is about what we value and what we consider worth striving for. Values change as the world changes, i.e. as our skills, knowledge and capabilities change (see also Beck, 2011). It can be said that sustainable development both requires a dialogue and is a dialogue of values (Blewitt, 2008; Ratner, 2004).

Thus, sustainable development is not something to be defined or measured in absolute terms, but is open to constant change and adaptation (Arias-Maldonado, 2013). It must be discussed and negotiated depending on the context (Robinson and Cole, 2015). It is not a goal, but rather an on-going process, that requires continuous re-evaluation, learning and re-learning (Voß and Kemp, 2006).

It is widely recognized that in the face of sustainable development, the mechanistic and reductionist ways of thinking are not adequate, but systemic, holistic, contextual, subjective and pluralist premises are needed (Norgaard, 1994; Sterling, 2001; Halbe et al., 2015; Voß and Kemp, 2006). This is a profound change, or even a paradigm shift (Gough and Scott, 2007) that necessitates collective learning throughout society (Norgaard, 2004). Furthermore, according to Gough and Scott (2007), sustainable development should be viewed as a challenging framework for thinking about everything we are and we do. In this line of thinking, the ambiguity of the concept should be embraced as it can act as a powerful tool of thinking, and help understand the uncertain and complex world we live in. Thus, sustainable development may productively function as a learning process (Blewitt, 2008).

2.2. Sustainable development in water services research

Klostermann and Cramer (2006) and Palme (2010) have a similar starting point to this study as they start with the idea of sustainable development as a social construction. They examine a variety of understandings of sustainable development in the water services sector. The difference is that in this study the focus is not so much on the detailed analysis of how sustainable development has been conceptualised in specific organizations, but more of an overarching view of sustainable development in the Finnish water services sector.

Palme (2010) examines concepts that researchers and practitioners foster about sustainable urban water systems. According to her, researchers tend to look at water services as a part of a larger picture, analysing linkages to agriculture, energy and waste. Furthermore, researchers highlight flexibility as means to increase resiliency of water systems.

When discussing technical approaches, researchers seem to favour decentralised options and separation of wastewater fractions. The practitioners, representing three Swedish water utilities, on the other hand, perceive that the current design of water services system accords with their view on sustainable development, especially if sewage sludge is recycled. Even more than that, they see that water services operation in itself is sustainable development. What practitioners identify as critical issues for the sustainability of water systems seem to be the problems they face in everyday practice, for example, the quality of raw water.

Klostermann and Cramer (2006) analyse how concepts of sustainable development have been translated into practices in two Dutch drinking water companies. Long-term view and reduction of environmental harm are recurring themes among the two water companies. The understandings of sustainable development evolve in complicated ways inside the companies, within a rich context of existing meanings, practices and relationships.

In addition to these empirical studies, a growing body of research focuses on analysing the premises of sustainable urban water management (e.g. Pahl-Wostl, 2002; van de Meene and Brown, 2009; Malmqvist et al., 2006; Marlow et al. 2013), sustainable infrastructures and utilities (e.g. Ainger and Fenner, 2014; van Vliet et al. 2005; Voß et al., 2006; Byrne and Taminiau, 2016), and sustainable development of the water sector in general (e.g. Herrick and Pratt 2012; Beck, 2011). The current water services systems are seen to be unable to respond to the sustainability challenges, such as, growing population, climate change, infrastructure renovation debt, changing social values and growing demands, use of chemicals and energy in treatment processes, and loss of nutrients (e.g. Krantz 2012; Malmqvist et al. 2006; Bos et al. 2013).

The current water services systems are furthermore criticised for being hierarchical and centralized, technocratic, focused on large-scale infrastructures, and having minimal stakeholder and inter-organizational involvement (Werbelloff and Brown, 2011; van de Meene and Brown, 2009; Castro 2013; Voß et al.; 2006; Halbe et al., 2015). In contrast, sustainable systems are expected to be flexible, adaptable, transparent, and based on broad engagement, collaboration and partnerships (van de Meene and Brown, 2009).

According to Marlow et al. (2013), favoured approaches in SUWM literature are decentralised solutions and local source diversification. They warn of advocating specific technical solutions based on the researchers' idea of sustainability. Much of the literature on sustainable water management, as a matter of fact, focuses more on the facilitation of socio-technical transitions than assessing technical options (Bos et al., 2013; Herrick and Pratt, 2012).

One key aspect explored in relation to sustainability transitions is governance. In general, a shift to more interactive, participatory, collaborative and adaptive network-based governance approaches is advocated (van de Meene and Brown, 2009; Kuzdas et al. 2016; Pahl-Wostl

et al. 2007; Van de Meene et al., 2011). Learning and experimentation are highlighted as crucial components for sustainability transitions (Farrelly and Brown, 2011; van de Meene et al., 2010; Pahl-Wostl, 2002).

Traditionally, the water services sector has been a rather closed community, focusing on technology and supply-side solutions (Barraqué, 2009; Castro 2013; Heino and Takala, 2015). It has relied heavily on engineering expertise that can be said to be based on prediction and control, and risk-averse management style (Halbe et al., 2015). Sustainable water services systems, then again, require the acceptance of and active dealing with ongoing uncertainty rather than “engineering away” uncertainties. (Herrick and Pratt, 2012; Voß and Kemp, 2006; Ainger and Fenner 2014).

The point is not that engineering approach to water services would be obsolete but that the water services sector needs to become more open cognitively. As Herrick and Pratt (2012) remind, sustainability problems are rarely “owned” by the utility, but require collaboration with external stakeholders. One way to do this could be to change from product to service orientation (Heino and Takala, 2015; van Vliet et al. 2005; see also Byrne and Taminiau, 2016 for discussion on energy sector). The role of consumers (Chappels and Medd, 2008), households (Krantz, 2012) or even more broadly that of citizens (Castro, 2013) are stressed in literature.

Marlow et al. (2013) criticise advocates of sustainable urban water management of ignoring and even overriding the values held by the broader community. As has been stated, sustainable development in this study is understood as something that is to be negotiated in collaboration. Furthermore, focusing only on the sustainability of water systems as a separate entity is inadequate, but it needs to be considered as part of larger systems (see also Palme, 2010). It is suggested that sustainable development of water systems needs to be examined as part of the public services and public good. Public good is not defined by the experts alone, but necessitates dialogue and community involvement.

3. Methodology and context

3.1. Qualitative research approach

As the starting point of this study is that sustainable development is a socially constructed concept that draws its meaning in a societal dialogue, the research approach chosen is qualitative (Sharp et al., 2011). Semi-structured face-to-face in-depth interviews were conducted with eight Finnish water services professionals. The semi-structured interview technique was preferred as it provides structure, yet allows flexibility in exploring themes also outside the original list of questions. This was important in order to ensure that the research material would include a rich variety of perspectives instead of a strong focus on the preconceived ideas of the interviewer.

The relatively small number of interviewees is explained by the aim to have a detailed analysis of the research

material. The research design was dictated by trying to find balance between the versatility in the research material and the depth of the analysis of the material. Thus, the eight interviewees were selected according to purposeful sampling. Careful attention was paid to the backgrounds of the interviewees. To ensure that the research material would represent a diversity of perspectives to sustainable development in water services, and not just that of utilities, experts representing different organizations in the Finnish water services sector were interviewed. The interviewees represent municipal water and wastewater utilities (Interviewees 3, 4, 7), a co-operatively run water utility (Interviewee 1), state administration (Interviewee 2), regional administration (Interviewee 6), a water protection association (Interviewee 5), and a national association representing water and wastewater utilities (Interviewee 8). All interviewees work as water sector experts. Some are in their early careers whereas others have gained more experience.

The interviews were recorded and transcribed. Transcribed materials were read carefully and comments by the interviewees were categorised according to central themes. This kind of analysis can be characterised as a data-bound or abductive content analysis. Themes or categories are not pre-determined, but earlier research still impacts their formation (Forman and Damschroder, 2008). Interpretations emerge through an iterative process between reading data and theory (Moisander and Valtonen, 2006). It is common that results of qualitative studies are introduced simultaneously with discussion. However, in this case as the topic of sustainable development is ambiguous and contested, the results are presented separately to enable the reader to assess the reliability and credibility of the interpretations. The results are presented utilising direct quotations from the research material that have been translated by the author (interviews were held in Finnish).

3.2. Finnish context

Before moving on to results, the Finnish approach to sustainable development and the organisation of water services sector are briefly described. This is done to give background information on the institutional structures in Finland, and help the reader to contextualise the interpretations and evaluate their transferability to other contexts (see Borrego et al., 2009)

3.2.1. Approach to sustainable development

Finland is committed to international agendas and declarations on sustainable development, the latest being the 2030 Agenda for sustainable development. Instead of a traditional strategy for sustainable development, the Finnish government decided in 2013 to try something different: Society's Commitment to Sustainable Development, *The Finland we want by 2050* (Prime Minister's Office, 2016). The idea is to engage all societal actors – companies, municipalities, NGOs, and educational institutions – to

make their own operational commitments to promote sustainable development.

Thus, the Finnish approach to sustainable development can be characterized as collaborative rather than top-down. According to Rouhinen (2014), Finnish politics on sustainable development is based on shared expertise and collaborative learning of government together with administration, business life, scientific community, and civil society. Finnish strengths are considered to be strong educational provision, competencies and societal stability (Lyytimäki et al., 2016).

Finland generally performs well in international sustainability comparisons and benchmarking (see Lyytimäki et al., 2016 for an overview). For example, in the Environmental Performance Index (EPI) 2016, Finland was ranked at the top, because of “its societal commitment to achieve a carbon-neutral society that does not exceed nature's carrying capacity by 2050, a vision replete with actionable goals and measurable indicators of sustainable development” (Hsu et al., 2016, 111). However, development related to social issues has been less positive and more attention has been called for issues such as social inequalities and unemployment (Lyytimäki et al., 2016).

3.2.2. Water services

Finland has an abundance of fresh water resources with a long-term average of about 20 000³ per inhabitant (Eurostat, 2017). Because of improved industrial and communal wastewater treatment, nutrient discharges have decreased significantly since the 1980 s. All in all, surface waters are assessed to be in a good or high status in 85% of Finnish lakes and 65% of rivers (Putkuri et al., 2014).

As mentioned earlier, the coverage of water services in Finland is high. According to the Finnish Ministry of Agriculture and Forestry (2016b), the centralized water supply services cover more than 90% and wastewater services about 85% of Finnish households. Legally, municipalities are responsible for developing water services, however, they are not directly responsible for the production of these services. The majority of the population is served by municipality-owned utilities. In addition, user-owned organizations, such as water cooperatives, play an important role especially in the less urban environments. In the most sparsely populated areas the access to water is often based on private wells and on-site sanitation solutions.

Finnish success, for example, in EPI can be partly attributed to the high coverage of water services. Reliable and high quality water services form the basis of a stable society. But what about water sector's uptake of the Society's Commitment to Sustainable Development? After all, the idea is that everyone would participate. The water services sector has been rather passive in making their own Commitment. As of March 2017 only Helsinki Region Environmental Services Authority HSY had published their Commitment: to reduce nitrogen emissions per capita by 20% and phosphorus emissions by 50%, both in

comparison with 2015 levels and to be achieved by 2030 (Commitment, 2017b).

To be fair, the passivity of the water services sector can be understood by the Finnish emphases on sustainable development. For example, the national sustainability indicators take water services only indirectly into account (Lyytimäki et al., 2016). Furthermore, the overall number of commitments made has been relatively moderate.² In addition, several municipalities have made commitments and as water services utilities are in most cases owned by municipalities, these commitments apply to the utilities as well. For example, the City of Tampere has agreed to “promote sustainable economic and innovation policy, resource-wise economy and responsible procurement in its own operations” (Commitment, 2017a). So, at least in principle, Tampere Water, the municipal water and wastewater utility, should adhere to this commitment.

All in all, water services in Finland are not in any acute crisis; everything is functioning relatively well. Furthermore, there is enthusiasm about exporting Finnish water expertise and making it a successful international business. For example, one of the Finnish Government’s key projects is blue bioeconomy, the main idea being that water will be Finland’s next big export asset and this will be based on the high level of Finnish water expertise and technology (Finnish Ministry of Agriculture and Forestry, 2016a). There ought to be leeway to assess issues related to the long-term sustainable development of water services sector and also expertise needed for it. Thus, we will next give the floor to the sector experts and their understanding of sustainable development in the water services.

4. Experts’ views on sustainable development of water services

4.1. Protection of water sources

Practically all the interviewed experts initially perceive sustainable development from the point of view of environmental issues. First and foremost they discuss protection of water source from pollution and prevention of its overuse. For example, according to Interviewee 3,

“In practice, from the point of view of a water utility, sustainable development is that you don’t exhaust your fresh water resources, and that in any case you don’t ruin them. You should not discharge treated wastewater so that it causes damage to the receiving waters. This is self-evident, but these are the starting points [of sustainable development].”

According to this view, sustainable development would seem to be inherent in water services. After all, water protection and making sure there is enough water can be said

to be the core purpose of water services. But let us look at the environmental aspects in more detail.

4.2. Consumption of energy and materials

When the environmental side is elaborated more, the consumption of energy and materials, particularly chemicals, is emphasized. Interviewee 1 argues that sustainable development is “Of course, all things related to energy consumption”. When describing sustainable development in general, Interviewee 6 links it strongly with energy production and consumption:

“Well, isn’t sustainable development, or the way I understand it is that in energy production we should try to use as much as possible energy that is not polluting. Of course it depends what one considers to be polluting, but to at least get rid of oil and coal based energy production. And through sustainable development the consumption of energy should be curbed or reduced. [--] All activity should be such that we could curb the amount of waste, and to recycle. So, no landfill.”

The same interviewee continues discussing water services and arguing that the situation in Finland is quite sustainable. For this person, water protection makes sense as then you need to use as little energy and chemicals as possible:

“I think water services, at least in Finland. . . It’s different if we talk about some place where they spend a lot of expensive energy to make water from salt water, well I don’t know if that is sustainable, but I think in Finland we are on sustainable basis. We use quite little water and our appliances are such that they don’t waste water. We can, after all, use relatively clean groundwater, so the production of water doesn’t need so much energy. Of course, from the point of view of sustainable development, you need to be able to protect water sources in the future as well. That would be sustainable development as there’s no need for chemicals or energy in the treatment process.” (Interviewee 6).

In addition to energy, use of materials and especially chemicals is emphasized. For example, Interviewee 5 interprets sustainable development from the point of view of the use of chemicals and their life cycle:

“First thing that comes to my mind is of course all questions related to materials. And chemicals. Like, what kind of materials and chemicals are used? And how will they be disposed of, where will they end up, what is their biological permanence if they end up in some water body? What is the renewal rate, and what are the costs of getting rid of. Or what’s the footprint? I think [sustainable development] revolves around these [kind of issues].”

None of the interviewees question the conservation of energy, but one shortly mentions the problems related to

² The current situation and the commitments made can be viewed online: www.commitment2050.fi

choosing a sustainable source of energy as it is a political question and might not necessarily be in the interest of the water utility's customers:

“When we talk about energy, we have to remember that we need to serve our customers. If we start to buy eco-electricity, well, I don't know if we are serving our customers in the best possible way. This is a bit of a political question, what belongs to the duty of utilities and what not.” (Interviewee 3).

The interviewees perceive conservation of energy as a key question in relation to sustainable development. Conservation of water, then again, is not really seen that relevant in Finland. There is plenty of water and as Interviewee 6 argues, the situation in Finland is on a sustainable basis as *“We use quite little water and our appliances are such that they don't waste water.”* Conservation of water is also seen to be bad for business, as in Finland water services are to be financed with user fees. As Interviewee 1 describes:

“I don't know. I mean, there's a lot of talk about water consumption and amounts used, but it's not really any problem for us here in Finland. We can't help it if in Ethiopia or elsewhere, they don't have water. We have it but we can't get it there. So, it doesn't help no matter how much we conserve water here. It doesn't make things any better elsewhere. . . It's not a problem for us. Besides, it's better for us water utilities the more water we sell, haha.”

So, sustainable development is seen to be about trying to limit the consumption of energy and materials and to control their environmental effects.

4.3. Durability and long lifespans

Another dominating issue is related to materials, but not so much to material consumption as to the characteristics of the chosen materials. This is linked to the long lifespan of water services systems.

“When choosing materials, sustainable development is of course about using the best possible materials, so that you don't have to renew everything next year. If you build a water treatment plant, and you need to renovate it in two years and then again in four years, it is not sustainable development. You should do it properly and with high quality.” (Interviewee 3).

“When building water supply pipes and wastewater sewers, we are building them for long time periods, decades or even hundreds of years. So, we should try to remember at that point to try to make them as good as possible and not just stare at the price. . . We should use materials and methods that will last.” (Interviewee 1).

“Well, first thing that comes to my mind is the choice of materials, that you don't bury underground anything that you are not totally happy with or convinced about. . . we need to change thinking from fifty years to hundreds of years.” (Interviewee 7).

In the Finnish language, the words sustainable and durable are both translated as the same term *kestävä*. So, in some cases sustainable development in Finland can be understood more concretely (as durability) than perhaps in other languages.

4.4. Quality of operation

The mentality of making things to last is not linked only to materials but basically to all activities: *“All that we do, we do well.” (Interviewee 1).* It is therefore not just a material concern but more of an operating principle and it is applied also to the maintenance of networks and utilities.

“If networks are in good shape, and there's not a lot of water losses, that is surely one guarantee of sustainable development. It decreases the need of water and wastewater treatment. . . Keeping utilities in good shape is according to sustainable development.” (Interviewee 6).

Furthermore, it is not just about fulfilling minimum requirements, but doing the best one can:

“Of course, priority is that obligations are taken care of and samples are taken, but then the other side is that I try to encourage [staff] to pursue the best possible results for the water bodies.” (Interviewee 5).

Although high quality was generally seen as a positive thing in relation to sustainable development, continuous improvement of, i.e. quality of water, can be seen to contradict sustainable development. There is a tendency that the requirements for both quality of tap water and treated wastewater are made more stringent and this is seen to be against the idea of trying to use as little chemicals and energy as possible:

“Of course, one [question] is how well should wastewaters be treated. It is not anymore according to sustainable development if we treat it to 100%. It consumes so much energy and chemicals and such. So, one should think about it and not make too clean water. After all, the environment can tolerate some kind of loading.” (Interviewee 6).

Also, Interviewee 5 questions the sensibility of *“improving water quality just by 0,01. . . you should think about what the actual value is”*, urging that this should be analyzed especially in relation to the use of chemicals and energy.

4.5. Economics

In the interviews, economic issues were discussed at many points. Balancing the economy of the utilities in the long-term and water services experts lacking economic competences were among the key challenges. One interviewee linked sustainable development explicitly to economic viability. When asked what the biggest challenges related to sustainable development are at their water utility, *Interviewee 1* responded:

“What could it be? Economically we are in a quite good state and there are no bogeys in sight that could stop sustainable development from happening.”

Economic aspects were also seen to be along the same lines as the discussed environmental issues. For example, saving energy benefits both the environment and economy:

“I want to do these [energy saving] exercises because, in addition to decreasing carbon footprint, it is also sheer money. And surely, part of the electricity goes to absolute [waste].” (Interviewee 4)

“But I think that water acquisition is on a rather sustainable basis, even though water is transferred somewhat long distances it is usually from the inland to the coast, so it is quite cheap as you don’t need that much pumping.” (Interviewee 6).

However, the choice of high quality materials can be problematic if the focus is on the prices as Interviewee 1 argues: “So, we should try to remember at that point to try to make them as good as possible and not just stare at the price...” This is a problem especially when times are economically challenging.

None of the interviewees experienced water services tariffs problematic, “*Our tariffs are about right*” (Interviewee 7). According to Finnish legislation, water utilities should cover their costs with user fees, and full cost recovery seems to be an important principle also for the interviewees.

We have long distances and few consumers, so that mathematics for us is such that this is unavoidably costly. Other municipalities of similar size have similar situation. But all costs are rarely covered by user fees, water fees, but instead municipalities subsidize [water services]. Here we are not subsidized with tax money. [Constructed wetland that is in planning] might be such, there have been promises that it will be paid with tax payers’ money as with also be hiking area, a kind of recreational space.” (Interviewee 3).

On general level, the assumption is that especially in small municipalities, utility managers do not have the guts to have high enough prices to cover all costs (Interviewee 6).

4.6. Scale and structure

Most of the interviewees maintain that the Finnish water sector is too dispersed and small in scale. However, one interviewee questioned the sensibility of increasing the scale on the grounds of environmental concerns and power being transferred from the local communities:

“Then it’s the authorities... I’m wondering if they are guilty of partial optimization by giving terribly stringent orders on the purification plants’ emission levels. And this then leads to the fact that to obey stringent regulations, you need to have big purification plants, meaning that we have to get rid of local small plants, build long transfer lines. Does that make any sense either? We are just finishing a 40 m long transfer line. [...] This centralization, it seems to be the starting point of [regional authorities]. They don’t ask from municipalities. They just guide. [...] There is a lot of talk on these material flows that centralization is causing. That we are transporting precipitation chemicals from far away... Transfer lines are also linked to centralization as they use energy and require maintenance.” (Interviewee 4).

The dominant view is that development into bigger units would mean more resources and better capabilities to respond to challenges. Merging water utilities together to form larger utilities is seen to minimize overlaps and thus make activities more efficient. More resources would provide better possibilities to develop services systematically. The current system with more than 1000 utilities is seen as a challenge:

“There are lot of small utilities and the whole water supply and sanitation sector is fragmentary. So, it should be centralized, made stronger. To have strong utilities that would have competence and necessary resources and ability to take care of water services in a high quality way.” (Interviewee 8).

“And then bigger size would give the possibility to every now and then focus on something else. Here, at the moment the municipality is growing at a terrible pace, and we, I mean the staff at the water utility, are just running. So, professionally this is not very challenging as all resources go to everyday operation. [--] Normally, as I said, we have hands totally full with daily routines. There’s no time to think, no time to develop.” (Interviewee 7).

Centralization and larger scales are seen to help in the long-term development. Then again, one interviewee sees that staff in larger utilities is more specialized and they have insufficient understanding of “the big picture”, and thus limited competence to develop water services. *Interviewee 3* argues:

“They have been specializing for so long. All the time, from the beginning. Someone from [a bigger water utility], well, they don’t understand enough about the general development needs of water services. They don’t understand the perspective of the municipality or the inhabitants. They are specialized in their [own thing]”.

The discussion seems to revolve around finding an appropriate scale for water services. Bigger is not automatically better, but can be a more resilient system. Then again, decision-making in a smaller water utility can be more flexible and that way enhance resiliency. Appropriate size and scale varies according to context.

“I’d say that this is a sufficient scale. This is suitably small. When we are deciding something and need something, there’s not too many people involved. And everyone needs to understand broadly. So, we can, with a rather small group of people, make decisions flexibly. If you think about [a bigger water utility] where they have a lot of people, well they have very narrow... they only know their own thing. [--] But where do you draw the line that you can still function properly? What is the scale? In our neighbouring municipality it is the municipality who runs the water utility and they have two people there who are responsible for water services. And even they are working only part-time. That’s too little. You can see that they don’t develop and they can’t even do everything that is be mandatory. And it’s like that. They can manage as long as something bad doesn’t happen. But there’s no resilience. If there’s even a small crisis, oh boy, they’re in trouble.” (Interviewee 1).

“Mindset should be gradually shifted from fifty years to hundred years regarding things and solutions. And then other thing is, on the development side, that in networks and utilities you should always take into account possibilities for extension. In every solution you should have thought that the system is expandable and adaptable. Then again, there are many things that are easier to just demolish and build new. Again, it is about competence. Understanding what should be done.” (Interviewee 7).

All in all, it would be important that both the physical and organizational structures are flexible and adaptable. This would also necessitate a change of thinking. For Interviewee 7, issue is about having an understanding or vision of long-term development and then acting accordingly.

4.7. Societal development

Appropriate scale is clearly connected to the development of water utilities, but development is discussed also more generally. For example, Interviewee 5 discusses the relation of sustainable development to development. Again, long-term view is highlighted:

“What comes to my mind about sustainable development... something, for example, development cooperation. That you take development forward so that you think that you can continue on that path. It is not trying to get maximal, quick development to some specific point. Development should happen with the condition of having future in sight, that you are able to continue it in a sustainable manner. And I guess the use of natural resources is associated with this.” (Interviewee 5).

Some interviewees also discuss whether water services can guide societal structure and development. For example, the sustainability of extending centralized networks to remote areas is questioned as in more densely designed and built communities the need to commute is smaller and this way greenhouse gas emissions of traffic decrease.

“Of course, you should think about how far it makes sense to draw pipes. Sustainability at some point... It doesn’t make sense to extend networks everywhere, even though that is what we are doing. One thing is, of course, how community structure, particularly in Finland, develops. If the structure is densified, as the goals stipulate, well then that would mean that you should not spread networks too widely. Instead, one could consider on-site solutions.” (Interviewee 6).

Some of the interviewed experts perceive that they as managers and experts of water services have a significant role in guiding societal development:

“It has exceeded all my expectations how big influence I can concretely have. To guide and develop things, help citizens in our municipality.” (Interviewee 3).

“I feel perhaps kind of social responsibility. Am I taking society into the right direction?” (Interviewee 4).

“Of course this sector is such that is it even possible to come up with anything big and radical? After all, you should not develop just for the sake of developing, but it should take things forward. You shouldn’t change things if they don’t get any better.” (Interviewee 1).

Again, the long-term perspective and continuation are highlighted. According to the interviewees, things at the moment with water services are rather well, but there is always room to develop. All in all, development in the water services sector seems to be about finding the balance between stability and change.

4.8. Leadership

In the development efforts, the role of competent staff is highlighted. As a matter of fact, one interviewee directly links staff to sustainable development. After discussing

durability and material choices, *Interviewee 7* ponders about an alternative perspective to sustainable development:

“But those are the basic things. What I think would be interesting, to what I don’t really have answers is sustainable development regarding people. Regarding staff. Like, when we get a new person straight from the school, from our point of view sustainable development would be that this person would develop, learn, be motivated and would stay with us. But then again, the old rule is that the staff renewal rate should be from five to ten percent annually. This is also true, this is to keep things dynamic. New blood, new thinking. So, combination of these issues, I mean, how to get small change and to get people motivated and believe in the meaning of their work. [--] How to get so that all plumbers would have some kind of urge to learn and think if things could be done in a better way, and then of course taking also into account the environmental values.”

Again, there’s the issue of balancing between change and stability. The role of competent and motivated staff is discussed in other interviews also. It is not directly linked to sustainable development but nevertheless seen as a crucial issue for the continuous provision of high-quality water services. *Interviewee 1* highlights leadership for staff motivation:

“Professional pride, everyone at our work knows it. And I try to remind them that we are daily doing an important job. To appreciate what you’re doing and do it so that others also appreciate. It is, we have this responsibility. If there’s like a big leakage or something else that all of a sudden you need people to come to work in the middle of the night, then they will all come. I’ve heard that at some places they just say that I’m not coming. I think there’s a leadership problem if you haven’t been able to feed them a sense of responsibility and professional pride; that we are doing important work, we are like firemen. If there’s an emergency, then we are ready. And I really can thank our own team that there’s never any problems in this regard.”

So, the role of staff and visionary leadership is crucial for water services. What about people outside the utilities? As we have seen, the role of authorities is being questioned especially in relation to centralization and the ever more stringent quality demands, but citizens and customers are rarely mentioned. The perspective of citizens and municipality is mentioned in relation to developmental efforts. In addition, one interviewee ponders that use of green energy might be against customers’ interests.

One reason for this might be that when sustainable development is seen as limiting energy and chemical consumption, it is something quite straightforward and relatively easy to control. When it comes to people, control

is more difficult. One interviewee contrasts sustainable development with engineering. When asked what sustainable development is, *Interviewee 3* responds:

“It comes very close to the emotional thing that is around. When we talk about the development of water services [in our area], there has been a lot of opposition on the emotional level. One key to this is that there’s more talk about sustainable development. [--] Everyone is thinking about sustainable development and you can easily get a lot of opponents if you make a wrong decision. Or if people think that this can be a threat to a lake or other water bodies, so this does bring up the problems somehow.”

And continues:

“My challenge has been that as an engineer I speak like an engineer, I can’t help it. An engineer talks about results, about economics, about technology. But then when it feels bad that wastewater discharge point is at this place]. It feels bad! How does an engineer respond? How does an engineer handle that kind of situation? Or a manager? Or an economist? When it goes to emotions. [--] It is so easy to teach and learn through numbers. In engineering world they work well, and you can argue for things by showing that these are more expensive or that purification results are percentually this much higher or lower. [--] But when you have to think about the general acceptability and reliability of services, and when you have to interact with the staff, citizens, customers and the political world, well, then this is quite a complex entity, where everything needs to be taken into consideration.”

For this interviewee, sustainable development is about emotions, not rationality. The legitimacy of these emotional concerns is not questioned, but the inadequate competences to address these concerns.

5. Discussion

The interviewed water services experts mainly and most explicitly discuss sustainable development through environmental issues. Due to this focus, and particularly the emphasis on water protection, most of the interviewees seem to feel that sustainable development is already under control and that it is even inherent to water services. This can implicitly be seen in the way environmental issues are discussed in comparison to economic issues. Balancing the economy is seen as a more pressing challenge whereas environmental issues are something quite easy to control. These are similar to observations in the Netherlands (Klostermann and Cramer, 2006) and Sweden (Palme, 2010).

The fact that sustainable development is seen to be already in order and under control in water services is problematic as it may suppress the aspiration for continuous development and learning. The interviewees perceive

sustainable development more as a goal than a process, undermining its dynamicity. Despite the impressive track record of water services in improving environmental health, it is debatable if environmental issues are adequately acknowledged in the water sector. [Palme \(2010\)](#), for example, calls for critically examining the existing water services systems from the point of view of recycling nutrients and responding to the challenges of climate change.

The obvious point to make is that it is debatable whether solving environmental problems suffices as sustainable development. Even the environmental issues are seen in quite a quite simplistic and rationalistic manner (e.g. wasting energy is uneconomic). According to [El-Zein and Hedemann \(2016\)](#) it is typical for engineers to focus on technological fixes and overlook social and political dimensions. Among the interviewees, only *Interviewee 3* problematizes environmental issues, pondering that it might be environmentally rational to acquire eco-electricity but that such a decision is political and does not really belong to the water utility. Mostly, the complexities and uncertainties involved with environmental sustainability are brushed off.

In addition to environmental issues, the interviewees also highlight long-term thinking. It is associated with the long lifespans of water services systems and the durability of materials. From the perspective of sustainable development, this is a somewhat contradictory issue. On one hand, sustainable development requires long-term thinking and especially acknowledging inter-generational equity. For example, [Beck \(2011\)](#) analyses sustainability in the water sector and argues that long-term view must be central in our thinking. On the other hand, there is danger that excessive emphasis on the long lifespans and huge investment costs of the infrastructure makes water services rigid, providing little freedom to opt for changes ([Krantz 2012](#); [Voß et al., 2006](#)). This is problematic if we understand sustainable development as adapting flexibly to uncertainty and constant change ([Voß and Kemp, 2006](#)).

Especially when sustainable development is not directly discussed, the interviewees highlight development. Mostly they refer to the development of water services utilities, but some also discuss wider societal development. Development seems to be a battle between long-term stability and change. [Malmqvist et al. \(2006\)](#) argue that in water services development is usually understood in rather conservative terms, e.g. as the connection of newly built or *peri-urban* areas to existing networks, or minor improvements to water treatment processes. In the interviews, development of utilities is seen to be closely linked to economic and scale questions. Bigger and more centralized water services are expected to ensure more resources to develop operations systematically. [Ainger and Fenner \(2014\)](#) maintain that this is typical for engineering; economies of scale and optimisation are highlighted overlooking the possibilities of smaller decentralised options. Then again, some interviewees express concerns because they feel that in larger water utilities the perspective of the municipality and citizens can be

lost. In other words, the purpose or public good of water services is at risk of becoming obscured (see [Castro, 2013](#)).

[El-Zein and Hedemann \(2016\)](#) argue that public good is absent or at least poorly defined in much of engineering practice. Based on this study, this seems to apply to Finnish water services. Two interviewees mention their possibility as water services managers and experts to have an impact on the municipal development or even the society at large. However, they do not elaborate this perspective further. Absent is also the interaction and dialogue of water services experts with others in defining societal development or public good that is to be promoted by water services. Only *Interviewee 3* discusses the difficulty that he as an engineer has experienced trying to participate in dialogue as he is used to talk about hard facts such as technology and economics, using the language of numbers. He contrasts this with sustainable development which is more about emotions. This is in line with observations from the literature: water engineers have traditionally applied an expert approach based upon prediction and control, and feel awkward and insecure when losing this control ([Barraqué, 2009](#); [Halbe et al., 2015](#)).

As public good is rarely brought up in the interviews, also the role of citizens remains minor. The interviewees discuss their leadership efforts in relation to their staff, but no one discusses the possibility of water services in general or themselves as water sector experts motivating people to change their practices (see e.g. [Herrick and Pratt, 2012](#)). For example, the role of water utilities in encouraging or guiding people to save water or not to release unwanted materials into sewers, is not mentioned. This again seems to suit the technocratic culture of water services, as the focus is on technology and supply-side solutions ([Barraqué, 2009](#); [Heino and Takala, 2015](#); [Werbelloff and Brown, 2011](#)). It seems that the role of citizens is just to reproduce already embedded arrangements ([Chappells and Medd, 2008](#)).

6. Conclusions and reflections

The interviewed Finnish water services experts primarily perceive sustainable development from the environmental point of view. Furthermore, they feel that sustainable development is inherent to water services. If we understand sustainable development as a learning process, it can be seen a promising premise that it is not perceived as an add-on. Another promising aspect is that the interviewed experts highlight the importance of development and long term thinking. However, less encouraging is the fact that environmental and developmental issues are mainly approached in a rationalistic and mechanistic manner. Sustainable development is taken care of by technological fixes, such as improving energy and material efficiency of water utilities. This undermines the complexity and dynamicity of sustainable development.

When discussing sustainable development, the interviewees mainly focus on the perspective of water services

utilities. Learning and the role of leadership regarding own staff are highlighted. Customers and citizens are mostly described as something causing uncertainty and making control more difficult. In general, there is a tendency for water services experts to aim for depoliticising water services and seeking greater autonomy from public oversight (see also Bakker, 2003). This is understandable as public involvement and politics bring more uncertainty and make it hard to focus solely on water services issues. However, if we understand sustainable development as a dialogue of values and an encompassing learning project that is to answer simultaneously to the combined environmental and developmental concerns then extensive focus on water services is problematic. As has been argued, sustainable development receives meaning in water services if water services are examined as part of the community or municipality they are serving. Thus, it is insufficient to analyse sustainable development of water services as a closed and isolated entity.

It is suggested that one concrete way for the Finnish water services sector to take part in dialogue on sustainable development would be to make their own Commitment to Sustainable Development. This would help to communicate their point of view on sustainable development. In addition, the process of crafting a Commitment and monitoring progress related to it could, in best case, act as a catalyst for reflecting current ways of thinking and operating, and provide an opportunity for learning.

Acknowledgements

First and foremost I want to express my sincerest gratitude to the interviewees for giving their valuable time and willingness to share their thoughts so openly. Furthermore, I want to thank the three anonymous reviewers for significantly improving this paper. This work was supported by the Maa- ja vesitekniikan tuki ry grant number 34500.

References

- Ainger, C., Fenner, R., 2014. *Sustainable Infrastructure: Principles into Practice*. ICE Publishing, London.
- Arias-Maldonado, M., 2013. Rethinking Sustainability in the Anthropocene. *Environ. Polit.* 22 (3), 428–446. <https://doi.org/10.1080/09644016.2013.765161>.
- Bakker, K., 2003. *An Uncooperative Commodity. Privatizing Water in England and Wales*. Oxford University Press, Oxford.
- Barraqué, B., 2009. The development of water services in Europe: from diversity to convergence. In: Castro, J.E., Heller, L. (Eds.), *Water and Sanitation Services. Public Policy and Management*, Earthscan, London, pp. 234–248.
- Beck, M.B., 2011. *Cities as Forces for Good in the Environment: Sustainability in the Water Sector*. Warnell School of Forestry and Natural Resources. University of Georgia.
- Bhaduri, A., Bogardi, J., Siddiqi, A., Voigt, H., Vörösmarty, C., Pahl-Wostl, C., Bunn, S.E., Shrivastava, P., Lawford, R., Foster, S., Kremer, H., Renaud, F.G., Bruns, A., Osuna, V.R., 2016. Achieving Sustainable Development Goals from a Water Perspective. *Front. Environ. Sci.* 4, 64. <https://doi.org/10.3389/fenvs.2016.00064>.
- Blewitt, J., 2008. *Understanding Sustainable Development*. Earthscan, London.
- Borrego, M., Douglas, E.P., Amelink, C., 2009. Quantitative, qualitative, and mixed research methods in engineering education. *J. Eng. Educ.* 98 (1), 53–66.
- Bos, J.J., Brown, R.R., 2013. Realising sustainable urban water management: Can social theory help? *Water Sci. Technol.* 67 (1), 109–116. <https://doi.org/10.2166/wst.2012.538>.
- Bos, J.J., Brown, R.R., de Farrelly, M.A., Haan, F.J., 2013. Enabling sustainable urban water management through governance experimentation. *Water Sci. Technol.* 67 (8), 1708–1717. <https://doi.org/10.2166/wst.2013.031>.
- Byrne, J., Taminiau, J., 2016. A review of sustainable energy utility and energy service utility concepts and applications: realizing ecological and social sustainability with a community utility. *WIREs Energy Environ.* 5 (2), 136–154. <https://doi.org/10.1002/wene.171>.
- Castro, J.E., 2013. Issues of governance and citizenship in water services: a reflection on Latin American experiences. In: Katko, T.S., Juuti, P.S., Schwartz, K. (Eds.), *Water services Management and Governance. Lessons for a Sustainable Future*. IWA Publishing, London, pp. 133–145.
- Chappells, H., Medd, W., 2008. From big solutions to small practices: bringing back the active consumer. *Soc. Alternat.* 27 (3), 44–49.
- Commitment, Sustainable economic and innovation policy and responsible procurement in Tampere <https://commitment2050.fi/commitment/sustainable-economic-and-innovation-policy-and-responsible-procurement-in-tampere>. 2017 accessed (17.03.17).
- Commitment, 2017b. Vähennämme pääkaupunkiseudun asukkaiden typpi- ja fosforipäästöjä vesistöön <https://sitoumus2050.fi/commitment/vaehennaemme-paaekaupunkiseudun-asukkaiden-typpi-ja-fosforipaaestoejae-vesistoeen> (accessed 17.03.17).
- El-Zein, A.H., Hedemann, C., 2016. Beyond problem solving: engineering and the public good in the 21st century. *J. Clean. Prod.* 137, 692–700. <https://doi.org/10.1016/j.jclepro.2016.07.129>.
- Eurostat, 2017. Water statistics http://ec.europa.eu/eurostat/statistics-explained/index.php/Water_statistics (accessed 17.03.17, updated 31.01.17.).
- Farrelly, M., Brown, R., 2011. Rethinking urban water management: Experimentation as a way forward? *Global Environm. Change* 21 (2), 721–732. <https://doi.org/10.1016/j.gloenvcha.2011.01.007>.
- Finnish Ministry of Agriculture and Forestry Clean water and fisheries resources and water resources expertise to boost Finnish exports http://mmm.fi/en/article/-/asset_publisher/clean-water-and-fisheries-resources-and-water-resources-expertise-to-boost-finnish-exports 2016 (accessed 26.01.17, updated 30.11.16.).
- Finnish Ministry of Agriculture and Forestry Water services and groundwater <http://mmm.fi/en/water/water-services-and-groundwater> 2016 (accessed 20.11.16.).
- Forman, J., Damschroder, L., 2008. Qualitative content analysis. In: Jacoby, L., Siminoff, L.A. (Eds.), *Empirical Methods for Bioethics: A Primer*. Elsevier, Oxford, UK, pp. 39–62.
- Gough, S., Scott, W., 2007. *Higher Education and Sustainable Development: Paradox and Possibility*. Routledge, Abingdon, Oxon.
- Haila, Y., Levins, R., 1992. *Humanity & Nature*. Pluto Press, London.
- Hajer, M., Versteeg, W., 2005. A decade of discourse analysis of environmental politics: achievements, challenges, perspectives. *J. Environ. Policy Plan.* 7, 175–184. <https://doi.org/10.1080/15239080500339646>.
- Halbe, J., Adamowski, J., Pahl-Wostl, C., 2015. The role of paradigms in engineering practice and education for sustainable development. *J. Clean. Prod.* 106, 272–282. <https://doi.org/10.1016/j.jclepro.2015.01.093>.
- Herrick, C., Pratt, J., 2012. Sustainability in the water sector: enabling lasting change through leadership and cultural transformation. *Nat. Cult.* 7 (3), 285–313. <https://doi.org/10.3167/nc.2012.070303>.
- Heino, O., Takala, A., 2015. Viewpoint – paradigm shift of water services in Finland: from production mentality to service mindset. *Water Altern.* 8, 433–446.

- Hsu, A. et al., 2016. *Environmental Performance Index*. Yale University, New Haven, CT.
- Klostermann, J.E.M., Cramer, J., 2006. Social construction of sustainability in water companies in the Dutch coastal zone. *J. Clean. Prod.* 15 (16), 1573–1584. <https://doi.org/10.1016/j.jclepro.2006.07.031>.
- Krantz, H., 2012. Water systems meeting everyday life: a conceptual model of household use of urban water and sanitation systems. *Public Work Manage. Policy* 17, 103–119. <https://doi.org/10.1177/1087724X11415285>.
- Kuzdas, C., Warner, B., Wiek, A., Vignola, R., Yglesias, M., Childers, D. L., 2016. Sustainability assessment of water governance alternatives: the case of Guanacaste Costa Rica. *Sustain. Sci.* 11 (2), 231–247. <https://doi.org/10.1007/s11625-015-0324-6>.
- Lyytimäki, J., Lähteenoja, S., Sokero, M., Korhonen, S., Furman, E., 2016. *Agenda 2030 in Finland: Key questions and indicators of sustainable development*. Prime Minister's Office, Helsinki.
- Malmqvist, P.-A., Heinicke, G., Kärrman, E., Stenström, T.-A., Svensson, G., 2006. *Urban Water in Context*. In: Malmqvist, (Ed.), *Strategic Planning of Sustainable Urban Water Management*. IWA Publishing, London, pp. 1–21.
- Mann, J., Runge, J., 2007. Setting the course for a brighter future. *J. AWWA* 99 (10), 58–68.
- Marlow, D.R., Moglia, M., Cook, S., Beale, D.J., 2013. Towards sustainable urban water management: a critical reassessment. *Water Res.* 47 (20), 7150–7161. <https://doi.org/10.1016/j.watres.2013.07.046>.
- Moisander, J., Valtonen, A., 2006. *Qualitative Marketing Research*. SAGE, London.
- Newman, L., 2005. Uncertainty, innovation, and dynamic sustainable development. *Sustainability: Science, Practice, & Policy*, 1(2), 25–31.
- Norgaard, R.B., 1994. *Development Betrayed. The end of progress and coevolutionary revisioning of the future* Reprint 1995. Routledge, London.
- Norgaard, R.B., 2004. Learning and knowing collectively. *Ecol. Econ.* 49, 231–241. <https://doi.org/10.1016/j.ecolecon.2004.03.021>.
- Pahl-Wostl, C., 2002. Towards sustainability in the water sector – the importance of human actors and processes of social learning. *Aquat. Sci.* 64 (4), 394–411.
- Pahl-Wostl, C., Craps, M., Dewulf, A., Mostert, E., Tabara, D., Taillieu, T., 2007. Social learning and water resources management. *Ecol. Soc.* 12 (2), 5 <http://www.ecologyandsociety.org/vol12/iss2/art5/>.
- Palme, U., 2010. Multiple conceptions of sustainable urban water systems: problem or asset. *Water Policy* 12 (3), 425–443.
- Prime Minister's Office Society's Commitment to Sustainable Development <<http://kestavakehitys.fi/en/commitment2050>> 2016 (accessed 23.11.16.)
- Putkuri, E., Lindholm, M., Peltonen, A., 2014. *The State of the Environment in Finland 2013*. SYKE Publications.
- Ratner, B.D., 2004. "Sustainability" as a dialogue of values: challenges to the sociology of development. *Sociol. Inq* 74 (1), 50–69. <https://doi.org/10.1111/j.1475-682X.2004.00079.x>.
- Robinson, J., Cole, R.J., 2015. Theoretical underpinnings of regenerative sustainability. *Built. Res. Inform.* 43 (2), 133–143. <https://doi.org/10.1080/09613218.2014.979082>.
- Rouhinen, S., 2014. *Matkalla mallimaaksi? Kestävän kehityksen juurtuminen Suomessa (On the Path Towards a Model Country? How Sustainable Development Took Root in Finland)*. Doctoral dissertation, University of Eastern Finland, Kuopio, <http://urn.fi/URN:ISBN:978-952-61-1596-2>.
- Sharp, L., McDonald, A., Sim, P., Knamiller, C., Sefton, C., Wong, S., 2011. Positivism, post-positivism and domestic water demand: interrelating science across the paradigmatic divide. *Trans. Ins. Br. Geograph.* 36 (4), 501–515.
- Steffen, W., Richardson, K., Rockström, J., Cornell, S.E., Fetzer, I., Bennett, E.M., Biggs, R., Carpenter, S.R., de Vries, W., de Wit, C.A., Folke, C., Gerten, D., Heinke, J., Mace, G.M., Persson, L.M., Ramanathan, V., Reyers, B., Sörlin, S., 2015. Planetary boundaries: Guiding human development on a changing planet. *Science* 347, 1259855 [10.1126/science.1259855](https://doi.org/10.1126/science.1259855).
- Sterling, S., 2001. *Sustainable Education. Re-visioning Learning and Change*. Schumacher Briefing No. 6. Green Books for the Schumacher Society.
- UN-Water, 2016. *Water and Sanitation Interlinkages across the 2030 Agenda for Sustainable Development*. http://www.unwater.org/fileadmin/user_upload/unwater_new/docs/UN-Water_Analytical_Brief_Water%20and%20sanitation%20interlinkages%20across%20the%202030%20Agenda%20for%20Sustainable%20Development.pdf
- UNICEF, WHO, 2015. *Progress on sanitation and drinking water – 2015 update and MDG assessment*. http://www.wssinfo.org/fileadmin/user_upload/resources/JMP-Update-report-2015_English.pdf
- van de Meene, S.J., Brown, R.R., 2009. Delving into the 'Institutional Black Box': revealing the attributes of future sustainable urban water management regimes. *J. Am. Water Resour. Associat.* 45 (6), 1448–1464.
- van de Meene, S.J., Brown, R.R., Farrelly, M.A., 2010. Capacity attributes of future urban water management regimes: projections from Australian sustainability practitioners. *Water Sci. Technol.* 61 (9), 2241–2250. <https://doi.org/10.2166/wst.2010.154>.
- van de Meene, S.J., Brown, R.R., Farrelly, M.A., 2011. Towards understanding governance for sustainable urban water management. *Global Environ. Change* 21 (3), 1117–1127. <https://doi.org/10.1016/j.gloenvcha.2011.04.003>.
- van Vliet, B., Chappells, H., Shove, E., 2005. *Infrastructures of Consumption. Environmental Innovation in the Utility Industries*, Earthscan, London.
- Voß, J.-P., Kemp, R., 2006. Sustainability and reflexive governance: introduction. In: Voß, J.-P., Bauknecht, D., Kemp, R. (Eds.), *Reflexive governance for sustainable development*. Edward Elgar, Cheltenham, UK, pp. 3–28.
- Voß, J.-P., Truffer, B., Konrad, K., 2006. Sustainability foresight: reflexive governance in the transformation of utility systems. In: Voß, J.-P., Bauknecht, D., Kemp, R. (Eds.), *Reflexive governance for sustainable development*. Edward Elgar, Cheltenham, UK, pp. 162–188.
- WCED (The World Commission on Environment and Development), 1987. *Our Common Future*. <http://www.un-documents.net/wced-ocf.htm>.
- Werbelloff, L., Brown, R., 2011. Security through diversity: moving from rhetoric to practice. *Water Sci. Technol.* 64 (4), 781–1188. <https://doi.org/10.2166/wst.2011.495>.
- Wilderer, P.A., 2004. *Applying sustainable water management concepts in rural and urban areas: some thoughts about reasons, means and needs*. *Water Sci. Technol.* 49 (7), 8–16.