# Global Water Ecosystem – Past, Present, Future?

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## Abstract

Water resources at the globe are among the critical elements of life conditions not only for biological processes but for industry as well. It is not only the water consumption for different kind of purposes but also the destroying of water reserves by many ways. This paper is based on the research project Circle, financed by European Regional Development Fund. The project will focus on opportunities for energy recycling, nutrients re-use, water reserves recycling and reducing of water use as well as opportunities for technology development. The geographical focus is on the global issues although the web survey results are based on the Finnish perspectives. In this paper we will present trends affecting the future of water service business in the long run, actors forming the water ecosystem as well as preliminary scenarios and visionary concepts concerning the future in water business. The data for this paper has been collected by a web-survey sent to actors in water ecosystem, but also from student work in Laurea UAS in spring 2017. Circle is an ongoing project until end November 2018.

## Introduction and Background

Water resources at the globe are among the critical elements of life conditions for all biological processes. Three tensions will impact on the global future: *East –west –tension* has its background in the times of the cold war, when the weapon competition between US and former Soviet Union created the roots for the continuous economic growth. Today, this tension is a bit weak and the world is still looking for the new poles strong enough to generate growth again. During the last decades e.g. USA and China have been in the so called non-military war from the first position as an economic leader in the world or today perhaps USA and North Korea are even more in a traditional debate concerning war and nuclear weapons, too. *North-south –tension* has been defined as a polarization between rich and pure parts of the world. In the history, the rich north has used (and is still using) the resources of the poor south, e.g. in the form of cheap labor but also by exploiting the natural resources under the market prices. Also, during last two three years the increasing volume of immigrated people from south to north Europe is a sign of this tension. *Human –nature –tension* means the relationship of human beings and the globe as an ecosystem. Human beings have been used natural resources on the planet Tellus more than the nature can renew them. If all people in the world would live like north-Americans, we would need five globes. Even if people would live like we Finns, we would need four globes (Meristö 2013).

Water reserves on the globe are limited. It is not only the water consumption for different kind of purposes but also the destroying of water reserves by many even illegal ways is essential for the future development of whole mankind and the globe as a whole. Water reserves on the globe are 90% in the

seas, but also other reserves like polar ice, ground water or water in the air. Water reserves are distributed unequally between the countries in the world. North part of the globe has the best reserves. Still, water is needed everywhere and almost for every action both in natural and in manmade work. Quality requirements for drinking water are very high in order to avoid health problems and diseases. Ten percent (10%) from the world population is without safety water, and 30 % without basic sanitation. Waste water in the global context will be purified only in 20% of the cases, and 80% remain as it is (Katko 2017). Water services are a big business. Investment needs in the global context in 2017 are all together 150 billion dollars, but in the reality investments will reach only 45 billion dollars. Because of the poor infrastructure 30% of drinking water will be lost before reaching a consumer, in developing countries the share is even bigger, approximately 40-50% (Hukka 2017).

Water is the new oil! This is a sentence the futurists have repeated during the last decades since 1980´s. This means that the war of the clean water is as possible as the wars and conflicts because of oil have been since the first oil crisis in 1973. On energy side the renewables are coming, i.e. windmills, bioenergy from waste or solar energy. On water side, the recycling is still in the very beginning. In Singapore they do have the concept of *new water,* based on recycling through the process not only for other purposes but also for drinking water, which is unusual in the case of recycling water. In industry side recycling of all materials and alternative stuff is more familiar, even water recycling e.g. in the form of closed circulation in pulp and paper industry, the concept developed decades ago in Finland.

## Material and Methods

In this paper we will focus on global water ecosystem, especially on how to exploit the nutrients and energy from the water on agricultural side, how to avoid pollution to the water in all sectors in the future and how to decrease the water consumption not only at institutional level including business, government and other institutes but also at consumer or citizen level especially concerning the everyday living in different type of residential areas. This paper is based on our ongoing research project CIRCLE, financed by ERDF, i.e. European Regional Development Fund. Häme University of Applied Sciences acts as a coordinator and the other partners are Laurea University of Applied Sciences (UAS) with its FuturesLab CoFi, the Association for Water and Environment of Western Uusimaa (LUVY), Aalto University and Sykli Environmental School of Finland. The web survey results consist of the Finnish perspectives but they are relevant also in the global context.

The Circle project focuses on opportunities for energy recycling, nutrients re-use, water reserves recycling and reducing of water use as well as opportunities for technology development. In this context also financial mechanisms, legislation, educational needs and ecosystem actors with the best practices will be analyzed. Laurea's research group has got support and contribution in data collection and analysis from two student groups from Laurea UAS, namely business students from Hyvinkää campus and MBA students in futures research field from Tikkurila campus, both in spring 2017.

Data collection for the study includes futures workshops with ecosystem actors to produce visionary knowledge, web-surveys to actors and experts to collect trends and impacts on this field and complementary interviews among key actors from water business and from water research side. The web-survey sent in winter/spring 2017 to the actors of the water ecosystem will form the main data for this paper. Also, alternative scenarios for the water related businesses were created in spring 2017 by six groups of students in Laurea MBA program (Student reports 2017). Examples of these students´ work will be presented at the end of this paper in the conclusion part.

This Circle project started in September 2016 and it will continue until August 2018. Theoretical background lies on one hand on the futures research paradigm and its methodology, including megatrends, PESTE analysis, scenario approach as well as visionary concept design. Visionary concept design (Kokkonen et al. 2005) is a methodology developed by FuturesLab CoFi in co-operation with the former University of Arts and the former University of Technology, both today better known as a part of Aalto University in Finland. Visionary concept design starts from the future and its alternative development paths and focuses on needs and opportunities risen from alternative scenarios. Scenarios will serve as wind tunnels to test ideas and concepts, but also as and ideation source to design visionary concepts, i.e. future-oriented concepts that are based on the future needs identified in different scenarios (Leppimäki et al. 2008; Laitinen & Meristö 2016).

On the other hand, cluster analysis and ecosystem theory are a part of the methodological concept in which actors and factors will be combined and described into a systemic view to the water ecosystem and its sustainable future alternatives. (Meristö & Laitinen 2017). Analysis and synthesis of the knowledge collected and created will be processed with the help of scenario methodology tool kit.

## Web Survey Results: Actors and Factors Shaping the Future in Water Business

The main aim of our web-survey was to identify actors and factors influencing on the future of the water service business sector in the long run. Also, the estimates for the state of the art were asked, too. The surveys consisted of six parts including (1) background information of the recipient, (2) estimating the change factors affecting to the future, (3) estimating the key actors in the field, (4) key indicators to follow, (5) vision for the water sector and (6) opportunity for the open feedback. The survey was sent to the different actors in the water business and related actors from public and private sectors as well as from NGOs. The survey was open from March 8$^{th}$ to the end of April 2017. All together 54 replies were got broadly from various categories in business, government, education, and so on. According to the web-survey results, the recipients considered the future with the time frame variating from the less than one year up to 20 years. The most common horizon among the recipients was 20 years to the future, which is very easy to understand in the field of water service business with heavy investments to the infrastructure.

The change factors to the future were estimated by scale almost/fully agreed or disagreed with the statements presented in the survey (Figure 1). Altogether 15 statements from different perspectives

were presented: three of them were political by nature, three economic, three social, three technological and three ecological according to PESTE analysis (Meristö 1983). Time frame to the future reached the next 20 years, i.e. one generation ahead until 2037.

The most disagreed statements were number 2 and 8, which were not believed among the replies:

- (2) Reform of the Regional Administration in Finland will break the monopoly of municipalities.
- (8) Water Crisis will cause a collapse in trust index of citizens concerning municipalities´ Water Services.

The most agreed trends on the other hand were statements number 4, 5, 6, 11, 12 ja 14:

- (4) Weak economic situation in municipalities will bring totally new fees and taxes on the water services (e.g. rainwater fee)
- (5) Citizens´ willingness to pay extra for clean water with good quality.
- (6) Public-Private Partnership models will provide new business opportunities for agile actors.
- (11) Digital follow up services and products will enable real-time pricing of water (analogy from energy sector, stock exchange electricity)
- (12) Technologies enabling Recycling of energy and nutrients will come to water service branch slowly.
- (14) Extreme weather phenomena will make more difficult the control of floodwater significantly in Finland, too.

The actors answering the survey would be surprised, if the reform of regional administration would break the monopoly of municipalities, and also the trust of consumers to the water services will be strong in the future, too. Changes were expected to the action models in the field and also to the pricing policy. Consumers will be willing to pay for the high-quality water, but also the municipalities will probably need to develop new type of fees for their services to fulfill the financial gap in their economy. Climate change will cause extreme weather phenomena more often, which will complicate the control of floodwater in Finland, too. The water service sector is conservative. This means, that the new technologies will be slowly adopted in this field. Digital advices and services will become more general among consumers, and this will enable e.g. real-time pricing even in the near future.

| | Totally agree (value: 4) | Agree (value: 3) | Disagree (value: 2) | Totally disagree (value: 1) |
|---|---|---|---|---|
| 1. Difference of the legislation in foreign countries will form limitations for the Finnish companies and their business opportunities (avg: 2,32) | | | | |
| 2. Reform of the Regional Administration in Finland will break the monopoly of municipalities (avg: 2,09) | | | | |
| 3. EU directives and harmonization will obstruct regional development. (avg: 2,25) | | | | |
| 4. Weak economic situation in municipalities will bring totally new fees and taxes on the water services (e.g. rainwater fee) (avg: 3,02) | | | | |
| 5. Citizens´ willingness to pay extra for clean water with good quality (avg: 2,89) | | | | |
| 6. Public-Private Partnership models will provide new business opportunities for agile actors. (avg: 3,15) | | | | |
| 7. The loading of Water Services in Rural residential areas will significantly decrease because of the Urbanization development (avg: 2,45) | | | | |
| 8. Water Crisis will cause a collapse in trust index of citizens concerning municipalities´ Water Services. (avg: 2,07) | | | | |
| 9. Urbanization will put speed to the automatization of agriculture and its water services (avg: 2,40) | | | | |
| 10. Growing demand for energy-efficiency will move water services towards local solutions (e.g. logistics) (avg: 2,53) | | | | |
| 11. Digital follow up services and products will enable real-time pricing of water (avg: 2,96) | | | | |
| 12. Technologies enabling Recycling of energy and nutrients will come to water service branch slowly (avg: 2,96) | | | | |
| 13 Lack of (clean) water is a fact in international context and that will rise the water prices (avg: 2,89) | | | | |
| 14. Extreme weather phenomena will make more difficult the control of floodwater significantly in Finland, too (avg: 2,96) | | | | |
| 15. The growing awareness of people can be recognized in everyday life concerning water consumption. (avg: 2,76) | | | | |

*Figure 1.Estimations (N=54) concerning the future statements in the water business service sector.*

According to the web-survey the key actors in the water service field come from water treatment plants, but also from the group of decision-makers at national level (Figure 2). Private companies as well as by authorities controlling and regulating the sector have an important role in the field, too. The lowest position of the actors was given to the residential associations, agricultural actors as well as active citizens. Nor did education or lobbying organizations play any important role in this field.

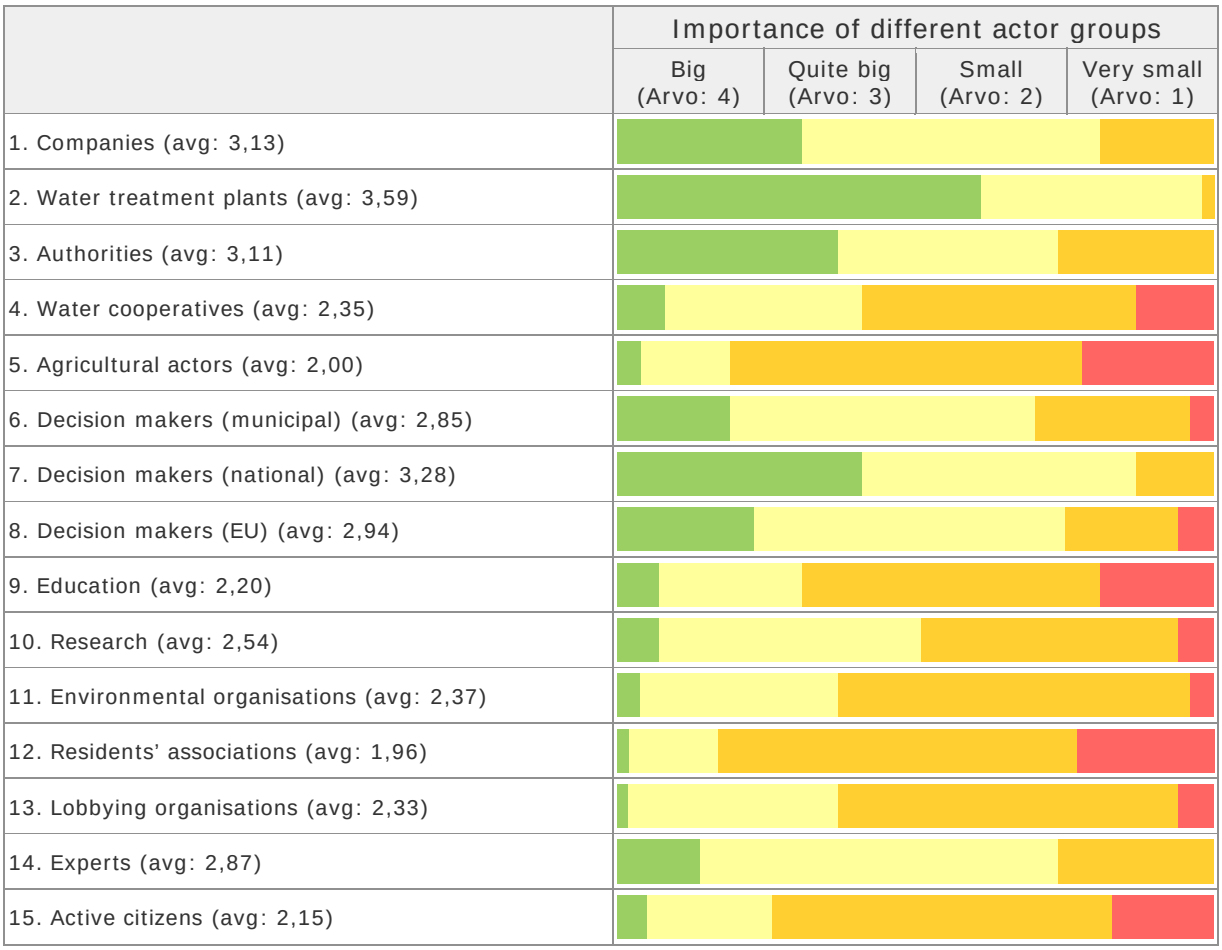


*Figure 2.Estimations (N=54) concerning the role of different actors in the water ecosystem field.*

The actors in the water ecosystem face critical phenomena and factors in the future, as our survey results show. The water ecosystem consists of many different actors with different roles. Theoretically, in the ecosystem there are first the actors in the middle, playing the main role in the field and then there are related and supporting actors, forming the multidisciplinary service and industry network around the key actors. Furthermore, the main actors in the water ecosystem context need also so called enablers, which usually are actors from public sector, but also from the third sector like different associations and other NGOs as well as from the financing sector. Each actor has its specific role in the ecosystem dynamics and their significance can vary from time to time in the "save the water" project, depending on the conditions in the real world.

In our web-survey, we also asked what kind of innovation water business cluster would need in the future. Most of the respondents saw that the technological innovations are the most needed ones. More specifically, technological innovations could be related e.g. to IoT-based solutions, real-time monitoring systems and automation. However, quite many of the respondents saw that also business and social innovations are needed. Business innovations could relate e.g. to financing models, co-operation models and procurement processes whereas social innovations could relate to financial solutions on poor countries.

## Results: New Service and Product Concepts for Water Sector Companies

As an example scenarios and visionary concepts in each scenario will be presented for an illustrative state owned airline company diversifying its business to the water business sector (Student report Anttila et al 2017). First, PESTE factors were identified and their significance was estimated. The most significant factors are as follows:

- (P) Rainwater belongs to the state, End of state owned companies
- (E) For mid-class consumers air ticket prices too high, Increasing costs of air plane vehicles
- (S) Clean water a priviledge only for a few people, Tourism – an unethical activity
- (T) Copying water for household use a new opportunity, Water zipping possible
- (E) Clean water the most valuable asset for marketing in tourism, unexpected natural phenomena more common in future.

*Copying water is a revolutionary concept*, where copying is analogically compared to copying data files, i.e. from water it can be produced more water without more resources. *Water zipping is also a radical concept*, which comes from file zipping meaning that the requirements for the space are less than in normal case.

Second, four alternative scenarios were built from different assumptions, where scenario axes consist of two dimensions, i.e. drivers for the future, which are Water technology (innovations in this field or not) and Water reserves (lack or enough). In scenario alternatives there is on one hand enough water or not and on the other hand technology is advanced or not. Based on these assumptions scenario alternatives are the next four:

Scenario 1. ZIP-water and a flying water bottle. This scenario assumes that the technology develops so radically that the packing and copying of water is possible. As a consequence, transporting water by airplanes is efficient and the global water resources will be distributed more evenly.

Scenario 2. Water mine. In this scenario there is serious lack of pure water because of contamination. Technological development enables airplanes to collect water from the clouds and the airline companies become remarkable players in water business.

Scenario 3. Water war. This scenario assumes that remarkable share of water resources are contaminated and there is not much technological development in water supply field. The ownership of the water resources is fragmented which weakens global water supply. The scarce water resources lead water wars and water becomes a luxury product with a high price.

Scenario 4. Social water –common good with water. In this scenario it is assumed that there are very dry areas in the globe and the technology has not managed to solve the problem. The difficult situation in the dry area in leads to the increased amount of refuses. Also, social corporate responsibility and end social entrepreneurship becomes more general.

Each of these scenarios will include a wide range of opportunities for new products and services as well as for new business models. Scenario 1 will rise up innovations for water transportation with removable zip-water and water-express opportunities. Scenario 2 includes the revolutionary concept for

the future with a flying water mine in the sky. Scenario 3 will focus on army flights and red-cross hospital flights but also on water business as usual, if possible in uncertain environment. Scenario 4 will grow with network-based business model and with a daughter company as a social entrepreneurial firm.

As a conclusion we will present a summary of the work prepared by all our student groups in spring 2017, focusing on different themes concerning global water reserves (Table 1).

*Table 1. Visionary concepts and innovations (based on Student reports 2017).*

| Theme | Visionary concepts (examples) |
|---|---|
| Local water from business perspective | Business unit for humanitarian aid<br>Cleaning pill<br>Utilizing water received from snow<br>Filtered water for new markets |
| Water business in airline company | Zip water<br>Cloud catcher / Water hoover<br>Speculative trading with water resources<br>Cooperation with charities |
| Rain management | Weather manipulation<br>Cooperation with insurance companies<br>Transferring rains<br>Brand: "More sun" |
| Recreational use of water | Water park at home<br>Spiritual water retreats<br>Natural water parks<br>Branded organic water |
| Water purification in traveling | Utilizing nanotechnology in packaging<br>Possibility to manipulate the taste of water<br>Purifying packages |
| Ecological tourism | Virtual lake tourism<br>Importing water from space<br>Green card lotteries to Finland to find pure water experiences |

The themes of student groups and the visionary concepts developed were related to the opportunities concerning local water, water business in airline company, rain management, recreational use of water, water purification in traveling and ecological tourism.

## Discussion and Conclusions

Ecosystem, including all the actors from core actors to enablers is similar in other countries, although our survey results consider only Finnish actors. Especially research community co-operation in Circle project shows that Finnish practices are appreciated e.g. in Brazil and Kenya. Changing factors are partly country related (e.g. issues concerning legislation, administration and regional development) but many of them are universal like the growing awareness of people concerning water consumption.

Scenarios developed for an illustrative airline company can be generalized almost everywhere. Market in this case is global, covering especially the areas with scarce water resources. Visionary concepts

themselves are "useful" in every company working in this field, regardless of the home country. Some of the visionary concepts mentioned in this paper are quite radical ones. According to Rush & Marshall (2015), in the water related businesses there is a tendency for the system to encourage incremental rather than more radical innovations. However, the future-orientation and the long timeframe explains the radical features of some concepts introduced in this paper.

In theory, this paper relies on the methods proved in practice, and the results and their significance are fruitful mostly for practioners or practice-oriented researchers. The Circle project is an ongoing project. These results are preliminary ones. The research work will continue together with the whole project team in order to clarify and complete the ecosystem with real water business actors with their roles and positions in it, but also to co-create generic scenarios for the water business sector in cooperation with the real actors in joint futures workshop facilitated by the futures researchers of our team. Water business sector is a challenging field, where the traditional attitudes will meet the future challenges. The changes in the mindset are necessary at all levels in the ecosystem. We wish our joint effort in the Circle project will bring the actors more close to the shared vision of the desirable future.

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