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**ГЛОБАЛЬНАЯ ВОДНАЯ ПРОБЛЕМА В РАМКАХ УСТОЙЧИВОГО ПОДХОДА К  
РАЗРАБОТКЕ**

**GLOBAL WATER CHALLENGE IN THE FRAMES OF THE SUSTAINABLE  
DEVELOPMENT APPROACH**

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**Аннотация.** В данной статье исследуется архитектура устойчивого развития в случае пресной воды. В то время как теории о войне за воду на протяжении десятилетий являются популярной чертой международной политики, реальность показывает, что даже острая межгосударственная напряженность вокруг водных ресурсов, как правило, становится источником сотрудничества, а не конфликта. Однако мощные мегатенденции нашей эпохи, такие как демографические изменения, урбанизация или изменение климата, создают новое давление на то, как страны управляют водными ресурсами внутри страны и в международных отношениях. Научный консенсус предполагает, что нынешний водный кризис является кризисом управления. Таким образом, корень проблемы не обязательно кроется в ограниченной доступности воды. Скорее в том, как законы, политические и финансовые решения, касающиеся воды, принимаются, реализуются и сопровождаются правительством и обществом. Такие проблемы проявляются с еще большей силой в межгосударственном контексте, когда действие или бездействие одной страны может привести к непропорциональному негативному воздействию на водные ресурсы, доступные другим. Следовательно, знание того, как предотвращать, управлять и разрешать водные конфликты на национальном и международном уровне, станет критически важным вкладом в процветание и стабильность любой страны в двадцать первом веке.

**Ключевые слова:** Устойчивое развитие, Глобальный, Вода, Проблемы, Инновации, Возможности

**Abstract.** This paper investigates the architecture of sustainable development in the case of freshwater. While water war theories have been a popular feature of international politics for decades, reality shows that even bitter interstate tensions surrounding water tend to become a source of cooperation rather than conflict. The potent megatrends of our era, such as demographic change, urbanisation or climate change, however, create new pressures on how countries manage water domestically and in their international relations. Scientific consensus suggests that the current water crisis is a crisis of governance. The root of the problem, therefore, lies not necessarily in the limited availability of water. Rather, how laws, policy and financial decisions on water are made, implemented and followed up by government and society. Such challenges surface with even greater force in interstate context where the action or inaction of a country may give rise to disproportionate negative impacts on the water resources available to others. Consequently, the knowledge of how to prevent, manage and resolve water conflicts at the domestic and international level will be a critical asset for the prosperity and stability of any nation in the Twenty-first century.

**Key words:** Sustainable Development, Global, Water, Challenges, Innovations, Opportunities

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## Introduction

Throughout history, great civilizations have always been concerned with how they could maintain their development and secure their resources. Sustainability played a central role in ancient civilizations as well, from Mesopotamia and Egypt, through to the River Valley of India to China. Later, however, the great geographical discoveries, colonization, and then the industrial revolution spread the pollution of the environment and the overuse of its resources to a global scale. Towards the end of the twentieth century, the effects of human activities reached a level where concerns for the environment swelled to a global scale, and it was impossible not to notice the common destiny and responsibility of mankind. Rachel Carson's book *Silent Spring*, published in 1962, is perhaps the first to influence ecological thinking and catalyze the birth of environmental movements. The most important book of the Club of Rome, *The Limits to Growth*, analyzed what would happen in the future up to 2100 of the world's population and the usage and degradation of the environment, while industrialization expands at such rate. At the international level, the United Nations Conference on the Human Environment in 1972 was the first to address the issue of the environment. The Brundtland Commission published its report *Our Common Future* in 1987. The United Nations Conference on Environment and Development was organized in 1992, with the participation of 172 countries, in Brasil, Rio de Janeiro. This conference wanted to get world leaders to agree that they are also legally committed to solving environmental problems. In recent decades, many international forums have been held to promote the implementation of sustainable development.

By the beginning of the twenty-first century, the situation had already deteriorated to such a level that the most necessary natural resource for human survival, the water is in real danger. On the global level, from America to Africa through Asia to the Far East, freshwater stress is already present or will be present. Water stress has now become a global problem. Every aspect of our life has been profoundly impacted by the worldwide water problem. The biggest reasons, why we have such a high level of water stress globally: **critical water resources are unevenly distributed on the planet, climate change, the pollution and contamination of water resources, and agriculture case to feed the growing population.**

The earth's small fresh water supply is unevenly distributed across the planet. Some regions and countries have more rivers and lakes and get regular rain, while others are mostly desert and suffer years of drought. Nowadays, there are 195 nations in the globe. But in reality,

just ten countries account for more than 60 percent of the world's freshwater supply. As a result of the uneven global distribution, 2.3 billion people live in water-stressed countries, of which 733 million live in high and critically water-stressed countries.<sup>1</sup> The growing demand for water in developing economies heightens concerns about scarcity. Freshwater consumption in developing countries has increased rapidly in recent decades. A large portion of the affected population resides in developing countries and close to two-thirds live in the BRICS countries. It will be a huge challenge for the future leading emerging BRICS economies, Brazil, Russia, India, China, and South Africa, to sustain their economic growth.

The current climate change has a significant influence on our planet's fresh water supplies, because temperature and the hydrological cycle are inextricably linked. Climate change is already posing serious challenges to water in some regions on the planet: drought, flooding, heat waves, increase in temperature. Huge sacrifices are necessary for climate change mitigation measures, which have a substantial effect on global economic processes and, indirectly, on people's daily lives. It must be questioned whether it is worthwhile to spend significant resources on countermeasures to climate change when it would be better to use them for adaptation?

In our global world, water pollution is one of the main concerns of today's world, because many contaminants endanger the water supply as rubbish and chemicals enter rivers and lakes as a result of ongoing and irresponsible human activity. Especially underdeveloped and developing countries are exposed to this danger, because of limited infrastructure and poor water control, sewage frequently finds up in clean drinking water. World Health Organization estimates that worldwide some 2.2 million people die each year from diarrhoeal disease, 3.7 percent of all deaths, and at any one time over half of the world's hospital beds are filled with people suffering from water-related diseases.

At the moment, agriculture uses the most water, making up around 70 percent of all withdrawals worldwide. Presently, agricultural water usage makes up a sizeable share of withdrawals in many developing and lower-income nations where food production makes up the majority of GDP. Many nations which are already under high water stress, because they uses their entire water resources for agriculture.

New possibilities are emerging globally as a result of the new innovation opportunities in the water industry. For instance, developing new market conditions, offering new transport

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<sup>1</sup> <https://www.unwater.org/water-facts/water-scarcity> (Date of access: 05/22/2023)

methods, and researching new marketplaces. All of these creative projects have the power to change the economic and technical landscape. Despite these limitations, there are more and more possibilities for technologies that allow improved efficacy in current water infrastructure systems and solutions that turn wastewater into a resource.

Water pipes will once again be a major factor in the twenty-first century, just as they did in past civilizations like the Sumerian. We are probably entering the most exciting era of water pipes in the twenty-first century, which will experience its renaissance. Why we all should be interested in waterpipelines? It delivers water reliably and safely, cheaply, with minimal environmental damage and a reasonable profit for consumers as well. Pipelines will be required to not only continue safely and economically into the future, but also be able to carry greater loads. A stream of investable chances to expand the blue economy in a manner that helps local economies and national economies, while safeguarding resources for future development, will be created by investing in better governance. New pipelines can help solve the water problem. This will require huge investments, huge infrastructures, and international cooperation.

Agriculture is currently the largest user of water 70 percent. In my thesis, I claim that it can emerge the virtual water trade system as a significant solution. The core of virtual water trading is that when agricultural products are traded primarily on the worldwide global market, then actually water is also exchanged. Thus, virtual water commerce refers to the covert flow of water in food or maybe other items from one nation to another. Since the preparation, production and distribution of any agricultural product requires a lot of water consumption, the trade of products can also be analyzed as the trade of water resources of one region with another region. For example, when a country imports any kind of agricultural product, such as wheat, that country is actually importing virtual water, i.e. the water needed to produce the crop. Thus, trade in agricultural products enables the transfer of water resources from water-rich nations to water-scarce regions. Virtual water trade as an international trade and resource management would reap enormous economic benefits.

A comparison of the achievements in hydraulic technology during antiquity with the contemporary practices is an excellent example and motivation for the environmental and conservation issues of our present time. Also water problems exist in many parts of the world that could be solved by using ancient or traditional methods and technologies. Actually, we should start using river management, similar to what the Sumerians and other ancient civilizations accomplished thousands of years ago. In addition, we should not adopt the radical greens view that water should be allowed to stream freely wherever it pleases because it should not be interfered with.

### *-Relevance of the study*

The world's population is growing and water consumption is increasing, but water resources are decreasing. "The world is running out of water"! The earth's small fresh water supply is unevenly distributed across the planet. Some regions and countries have more rivers and lakes and get regular rain, while others are mostly desert and suffer years of drought. Just ten countries account for more than 60 percent of the world's freshwater supply. Climate change also has a significant impact on the world's water resources: drought, flooding, heat waves. In our global world, water pollution is one of the main concerns of the world today. 3.7 percent of all deaths, and at any one time over half of the world's hospital beds are filled with people suffering from water-related diseases. At the moment, agriculture uses the most water, making up around 70 percent of all withdrawals worldwide. The agriculture case to feed the growing population is a real problem. Tensions and disputes between countries are rising due to increasing problems of water scarcity! (Israel Vs. Palestine; Egypt Vs. Ethiopia; Bangladesh Vs. India Vs. Nepal; China Vs. India; Tajikistan Vs. Kyrgyzstan; etc...)

### *-Purpose of the study*

The goal of this paper is to expand that what new possibilities, innovations can emerge globally in the water industry, and how can we address the global water crisis. For instance, developing new market conditions, offering new transport methods, and researching new marketplaces. All of these creative projects have the power to change the economic and technical landscape. It will be very significant how politicians and stakeholders will implement laws, policies, and financial decisions on water. Local government and social responses to these interventions follow suit. With such environmental stakes on the line, the responsiveness of a country may disrupt the water resources available to others. The importance and the affairs of water diplomacy and international cooperations will be very significant in the future, which will determine the trajectory of the countries in the global politics.

### *-Object and subject of the study*

The object of the study is how the global water crisis threatens the development of the sustainability of the human civilization. The subject of the study is to define what are the new innovations and possibilities that can help us solve our water problems, for our sustainability.

### *-Theoretical framework and methodology*

In the first section of my thesis, I am going to demonstrate and provide instances to illustrate each of the four causes of the current worldwide freshwater problem. In the second section of my thesis, I am going to demonstrate the options, possibilities, and innovations with examples that would solve the world's water crisis, which would reap enormous economic, social and environmental benefits for our sustainability. In both parts I use case study analysis, content analysis, comparative analysis, and data collection. Structural neoliberalism makes it possible to reveal the possible solutions for our sustainable development. In environmental governance, theories advancing neoliberal reforms have secured substantial influence in the past and secure in the present as well. Market environmentalism, liberal environmentalism, and ecological modernisation are all phrases used to describe this approach. Global water governance demonstrates how dominant neoliberal ideals have been codified in transnational water management directives and how they might be put into effect. Water supply reform trends include the incorporation of economic principles into various types of management, a greater emphasis on the environmental implications of water resource development, and a realignment of how governments, utilities, and a variety of non-state actors engage in the resource's production and consumption. Water reforms can create new opportunities for markets and the private sectors. Neoliberal ideas respond to real challenges like water management.

### *-Hypothesis of this paper*

In the first section of my thesis, I am going to provide instances to illustrate each of the four causes of the current worldwide freshwater problem. In the second section of my thesis, I am going to demonstrate the options, possibilities, and innovations that would solve the world's water crisis. I believe and scientific publications also demonstrate and prove this, that giant **water pipelines**, **virtual water trade system** and **floodplain management** would reap enormous economic, social and environmental benefits for our sustainability.



*-Review of literature and sources*

The issue of my thesis has previously been profoundly researched and reviewed by Wall Street's leading international bank: Goldman Sachs (Goldman Sachs Gr), and the thinking tank of Council on Foreign Relations. In addition, I gathered information and statistics from international organizations such as the United Nations, the World Health Organization, and the Mekong River Commission. Eventually, during my thesis, I used sources from international publications, books, and universities announcements.

## Chapter I: The History of Sustainable Development

Sustainable development is not the invention of the twenty century. Even in Bronze Age civilizations and city-states, the supply of clean drinking water and food for the growing population and getting rid of the accumulated waste, animal, and human excrement caused a serious problem. Sustainability played a central role in ancient civilizations as well, from Mesopotamia and Egypt, through to the River Valley of India to China, which was established because of the technological improvements in agriculture, allowing people to live in the same place for longer periods.

In the eighteenth century, the concern about population growth and its consequences on natural resource use emerged. The Anglican pastor and economist Thomas Robert Malthus (1766-1834) already dealt with problems threatening the future of humanity in his main book *"An Essay on the Principle of Population, „published in 1798. The constant effort towards population, which is found to act even in the most vicious societies, increases the number of people before the means of subsistence are increased. The food therefore which before supported seven millions must now be divided among seven millions and a half or eight millions.*<sup>2</sup> According to him, the population is growing faster than the amount of food that can be produced, and therefore humanity is drifting toward disaster.

According to the French philosopher Francois Fourier (1772-1837), durable consumer goods should be made that last as long as possible, production processes that produce a lot of waste should be rejected, and commercial approaches should be rejected, which is characterized by a lot of waste and changes in fashion, with the justification that this way it is possible to provide the workers with an opportunity to earn.

In the nineteenth century, the focus shifted to coal as the most important source of energy, and there were some warnings that coal deposits could be depleted. The English economist W. Stanley Jevons (1835-1882) wrote the most influential publication in this regard. In his book "The coal question" he concluded that England's coal reserves would be exhausted within a hundred years. Jevons argues that if the wasteful consumption of coal continues unchanged, England would lose its prosperity and global dominance. *Coal in truth stands not beside but entirely above all other commodities. It is the material energy of the country-the universal aid-the factor in everything we do. With coal almost any feat is possible or easy;*

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<sup>2</sup> Thomas Robert Malthus: 1798: 9.

*without it, we are thrown back into the laborious poverty of early times.*<sup>3</sup> The book of W. Stanley Jevons placed the exhaustibility of energy supplies on the public agenda for good.

The American diplomat and philologist, considered by one of the first American environmentalists, George Perkins Marsh (1801-1882), warned us that man could destroy himself and the Earth if we don't restore and sustain global resources and raise awareness about our actions. *Many circumstances conspire to invest with great present interest the questions: how far man can permanently modify and ameliorate those physical conditions of terrestrial surface and climate on which his material welfare depends; how far he can compensate, arrest, or retard the deterioration which many of his agricultural and industrial processes tend to produce; and how far he can restore fertility and salubrity to soils which his follies or his crimes have made barren or pestilential.*<sup>4</sup> His 1864 book *Man and Nature* greatly influenced many parts of the world.

As the Industrial Revolution was unfolding on the world stage from the eighteenth century, never in human history has there been a more drastic increase in production, consumption, and prosperity, transforming human societies, human progress was also linked to economic growth and material advancement. In the period between 1800 and 1970, when the world's population tripled from around 978 million to 3632 million, seemingly unslackened economic growth occurred and the quantity of manufacturing production in the world increased about 1730 times.<sup>5</sup> International annual average economic growth rates stayed between 2.9% and 3.7% from the 1780s to 1900, then rose above 4% at the start of the 20th century, dropped back to under 3% in the inter-war years, and rose to above 4% again in the 1940s and then to 5.6% between 1948 and 1971.<sup>6</sup>

During the period of unprecedented industrial and commercial expansion after the bloody Second World War, people became aware of the dangers posed by rapid population growth, environmental pollution, and resource depletion to the environment and their human survival. Environmental concerns became more topical and radical because it was feared that economic growth could threaten the survival of the human race and the planet.

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<sup>3</sup> William Stanley Jevons: 1865: 14.

<sup>4</sup>George Perkins Marsh: 1867: 27.

<sup>5</sup> Walt Rostow: 1978: 47-48.

<sup>6</sup> Walt Rostow: 1978: 49.

Rachel Carson (1907-1964) mentioned one of the first remarkable warnings about the damage caused to the natural environment by human activities. Rachel Carson's *The Silent Spring*, published in 1962, is considered the book that started the global grassroots environmental movement. It focuses on the negative effects of chemical pesticides that were, during that time, a large part of US agriculture. *For the first time in the history of the world, every human being is now subjected to contact with dangerous chemicals, from the moment of conception until death. In the less than two decades of their use, the synthetic pesticides have been so thoroughly distributed throughout the animate and inanimate world that they occur virtually everywhere. They have been recovered from most of the major river systems and even from streams of groundwater flowing unseen through the earth.*<sup>7</sup> This notable work by Rachel Carson began initiating a shift in global environmental consciousness.

Then in the middle of the twentieth century, the fear of the population explosion in the years of "baby boom years", many scholars have seen this process as a real danger in the framework of sustainable development. Among them, Dr. Paul R. Ehrlich (1932 -) predicted worldwide famine due to overpopulation and other major social problems. He recommended immediate action to limit population growth. *The battle to feed all of humanity is over. In the 1970s and 1980s hundreds of millions of people will starve to death in spite of any crash programs embarked upon now.*<sup>8</sup> *At this late date nothing can prevent a substantial increase in the world death rate, although many lives could be saved through dramatic programs to "stretch" the carrying capacity of the earth by increasing food production and providing for more equitable distribution of whatever food is available.*<sup>9</sup> At the time, the book „*The Population Bomb*” by Dr. Paul R. Ehrlich was criticized by many people for its negative and dark attitude toward the future.

Later in 1972, „*A Blueprint for Survival*” was published by Edward Goldsmith (1928-2009). This text drew attention to the urgency of environmental challenges. The work calls for radical changes, as human growth and consumption lead to the disintegration of ecosystems and the depletion of resources. The „*A Blueprint for Survival*” went on to sell more than 750,000 copies in paperback.<sup>10</sup>

A year later, in 1973, one of the most influential books "*Small Is Beautiful*" was published by Ernst Friedrich Schumacher (1911-1977). The book summarizes that the modern

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<sup>7</sup> Rachel Carson 1962: 17.

<sup>8</sup> Rachel Carson 1962: 17.

<sup>9</sup> Paul Ehrlich 1968: xi.

<sup>10</sup> <https://theecologist.org/2009/jun/12/about-ecologist> (Date of access: 05/22/2023)

economy is unsustainable, natural resources are treated as expendable income, when in fact they should be treated as capital since they are not renewed but depleted. It discusses the vast divide between the third world and the developed world. As well as the human impact of nuclear energy and technology. Furthermore, Ernst Friedrich Schumacher considers education to be the greatest human resource. *Development does not start with goods; it starts with people and their education, organisation, and discipline. Without these three, all resources remain latent, untapped potential. There are prosperous societies with but the scantiest basis of natural wealth. Every country, no matter how devastated, which had a high level of education, organisation, and discipline, produced an 'economic miracle'.*<sup>11</sup> According to Ernst Friedrich Schumacher, we need to focus on small private businesses and local needs to improve employment and sustain the economy. This system does not generate much wealth and profit, but this is exactly the point, in order to maintain our development.

### **I. 1. The Club of Rome**

The damage to the environment and the rapid growth of the Earth's population inspired the creation of the Club of Rome in 1968. The founding internationally respected scientists believed that the Earth's resources are being depleted, therefore the high standard of living cannot be maintained in the long term, and the established economic and social order may collapse. The initiators of the creation of the club were Italian industrialist Aurelio Peccei and OECD science and technology expert Alexander King. The two founders convened a meeting of the best European scientists in Rome, the capital of Italy.

Their goal: to advance three core ideas that still define the Club of Rome today: a global and a long-term perspective, and the concept of “problematique”, a cluster of intertwined global problems, be they economic, environmental, political, or social.<sup>12</sup>

The Club of Rome first entered the center of international attention in 1972, when they published their first study, entitled: "*The Limits of Growth*", which became one of the most influential texts of the twentieth century. In their publication, they warned that the Earth had a

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<sup>11</sup> Ernst Friedrich Schumacher 1973: 115.

<sup>12</sup> <https://www.clubofrome.org/history/> (Date of access: 05/22/2023)

limited supply of physical resources and that exceeding the limits of exploitation could end in catastrophe in human history, sooner than we think.

The Massachusetts Institute of Technology (MIT) group designed and ran their global computer model, World3, based on the work of Jay Forrester, to understand the causes and consequences of exponential growth in the global social and economic system. The model focused on five variables, namely population, food production, industrial production, persistent pollution, and the consumption of nonrenewable natural resources.<sup>13</sup> From these conclusions, they came to the conclusion that if fundamental changes do not take place, during the twenty-first century, the growing population will exhaust the Earth's energy and raw material reserves, and the supply of food and manufactured goods will collapse. In the meantime, environmental pollution is also increasing rapidly, the cost of medical care is increasing, like the rate of death, then the population is decreasing rapidly, and the living conditions of those remaining are tragically deteriorating.

The scientists and scholars of the Club of Rome came to these three conclusions in the book:

1. *If the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years. The most probable result will be a rather sudden and uncontrollable decline in both population and industrial capacity.*<sup>14</sup>

2. *It is possible to alter these growth trends and to establish a condition of ecological and economic stability that is sustainable far into the future. The state of global equilibrium could be designed so that the basic material needs of each person on earth are satisfied and each person has an equal opportunity to realize his individual human potential.*<sup>15</sup>

3. *If the world's people decide to strive for this second outcome rather than the first, the sooner they begin working to attain it, the greater will be their chances of success.*<sup>16</sup>

The authors of the study are Donella H. Meadows, Dennis L. Meadows, Jørgen Randers, and William W. Behrens III, who proposed a "zero-growth option" to solve the problems in the framework of sustainable development. According to their opinion, industrial production, energy consumption, and human reproduction must be curbed. Economic development based on traditional technologies cannot be sustained, since the environmental processes that develop

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<sup>13</sup> <https://www.clubofrome.org/wp-content/uploads/2022/02/CoR-LtG-ShortHistory.pdf> (Date of access: 05/22/2023)

<sup>14</sup> Donella H. Meadows, Dennis L. Meadows, Jørgen Randers, William W. Behrens III. 1972: 23.

<sup>15</sup> Donella H. Meadows, Dennis L. Meadows, Jørgen Randers, William W. Behrens III. 1972: 24.

<sup>16</sup> Donella H. Meadows, Dennis L. Meadows, Jørgen Randers, William W. Behrens III. 1972: 24.

in the process threaten the future of humanity. According to the "zero-growth" stabilized world model, it should also be possible to achieve a significant change in people's values, in which the preservation and protection of natural resources are given priority.

“*The Limits to Growth*” is the product of a study on the future of our planet, which contains six main messages:

1. The effects of human society on the environment worsened between 1900 and 1972 due to both the increase in the number of people and the number of resources consumed and the annual pollution per capita.

2. Our planet is physically limited and humanity cannot continue to use more physical resources and produce more emissions than nature can sustainably provide us. Moreover, technology alone cannot be relied upon to solve the problem, as this only delays the planet's carrying capacity by a few years.

3. The authors warned that it is possible, and even likely, that the human ecological footprint will exceed the carrying capacity of the planet, further explaining that this is likely due to significant delays in global decision-making, while growth continues, footprinting humanity into unsustainable territory.

4. Once humanity has entered this unsustainable territory, we will have to move back into sustainable territory, either through a “managed decline” of activity, or we will be forced to move back through “collapse” caused by the brutal inherent processes of nature or the market.

5. It is about hope. The authors state that: "The challenge of overshooting due to decision delay is real, but easily solved if human society decides to act," meaning that forward-thinking policies can prevent humanity's overshoot from reaching the aforementioned limits.

6. Ultimately, the authors argued for an early start to achieve a smooth transition to a sustainable world without having to go through the overshoot and contraction phases.

These messages have largely and successfully contributed to the creation of environmental movements. Furthermore, the attention of people and politicians worldwide was drawn to the dangers facing humanity, such as environmental pollution, the unlimited use of resources, and climate change. The Club's first major Report, „*The Limits to Growth*” has sold millions of copies in many languages worldwide and became a best-seller, creating media controversy and also the impetus for the global sustainability movement.<sup>17</sup>

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<sup>17</sup> <https://www.clubofrome.org/history/> (Date of access: 05/22/2023)

In the last fifty years, the Club has published many works, including one where it considered the elimination of inequalities between rich and poor countries important. Furthermore, in their other works, they emphasize that solving problems requires international institutions with powers covering the entire world. In the past period, the Club of Rome has also joined the list of organizations threatening climate catastrophe. A typical example is the statement issued by the Club in 2012, which deals with the future expected by 2052. The book warned us, for instance:

*The global average temperature will increase steadily – passing the internationally agreed danger level of plus 2 degrees Centigrade above pre-industrial time in 2050 – creating ever more frequent, ever more extreme, and ever more scary weather events, and a slowly rising sea level.*<sup>18</sup>

*The global consumption of food will grow by some 50 % to a peak in the 2040s. Mostly through increases in land yield, but also through an increase in the area of cultivated land. This will be enough to satisfy the demand from those who can pay, but not enough to adequately feed a billion people – who still will have insufficient income to pay for the food they need to survive well.*<sup>19</sup>

In 2019 The Club of Rome developed a new working program and operational structure, establishing five Impact Hubs on the following five themes: *Climate-Planetary Emergency, Reclaiming and Reframing Economics, Rethinking Finance, Emergence of New Civilizations, and Youth Leadership.*<sup>20</sup>

The *Emergence of New Civilization*'s mission is to open people's eyes and contribute to its realization in a way that is deeply respectful of the human condition and symbiosis with life at large.

The *Climate-Planetary Emergency* provides key policy tools to address the broader challenges of climate change, biodiversity loss, and human health and well-being.

The *Reframing Economics* calls for a shift away from the current system, which is based on fundamentally flawed economic theory and indicators promoting a growth-oriented philosophy.

The *Rethinking Finance* is the monetization of all transactions that must be re-examined to enhance the equitable distribution of wealth and ensure the broader prosperity of all people. This means making conscious efforts and science about finance as a value system for the benefit

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<sup>18</sup> Jorgen Randers. 2013: 8.

<sup>19</sup> Jorgen Randers. 2013: 8.

<sup>20</sup> <https://www.clubofrome.org/about-us/timeline/> (Date of access: 05/22/2023)



of the few to accelerate the shift toward real economic wealth creation for numerous amount of people.

The *Youth Leadership* is a global young leadership program built around three key targets– education, engagement, and action. This approach embraces the value of educating future leaders through education, which is inspired by the Club of Rome's core vision of a sustainable future for humanity and the planet.

Today, the Club of Rome continues to be at the forefront of challenging and controversial global affairs. They continue to advocate for policies that can practically address the many emergencies facing society and the planet today. They are currently trying to persuade governments, industrial leaders, and trade unions throughout the world to face these facts and to take appropriate action while there is yet time.

## **I.2. United Nations Conference on the Human Environment in 1972**

In exactly the same year when *The Limits of Growth* was published by the Club of Rome, the first world conference on environmental issues was held in Stockholm in 1972, which is called the United Nations Conference on the Human Environment. It contained 26 principles and placed environmental problems at the forefront of international concern. The dialogue started among developing countries about economic growth, air, water, and ocean pollution, and the well-being of people around the planet.<sup>21</sup> The conference stated common values and principles to guide the people of the world in preserving the human environment. „*A point has been reached in history when we must shape our actions throughout the world with a more prudent care for their environmental consequences. Through ignorance or indifference we can do massive and irreversible harm to the earthly environment on which our life and well-being depend. Conversely, through fuller knowledge and wiser action, we can achieve for ourselves and our posterity a better life in an environment more in keeping with human needs and hopes. There are broad vistas for the enhancement of environmental quality and the creation of a good life. What is needed is an enthusiastic but calm state of mind and intense but orderly work, For the purpose of attaining freedom in the world of nature, man must use knowledge to build, in*

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<sup>21</sup> <https://www.un.org/en/conferences/environment/stockholm1972> (Date of access: 05/22/2023)

*collaboration with nature, a better environment. To defend and improve the human environment for present and future generations has become an imperative goal for mankind—a goal to be pursued together with, and in harmony with, the established and fundamental goals of peace and of worldwide economic and social development”.*<sup>22</sup>

During the conference, it was realized that development needed to be sustainable and should focus not only on economic and social matters but also on matters related to the use of natural resources. At the summit, the *Stockholm Declaration and Action Plan* was adopted, which defines the basic principles of preserving and improving the human environment, and formulated recommendations for international environmental action. Moreover, one of the key results of the Stockholm conference was the creation of the United Nations Environment Programme (UNEP), which plays a leading role in the development of partnerships and cooperation between nations in the field of environmental protection still nowadays.

### **I.3. The Brundtland Commission**

In the 1980s a new chapter began of sustainable development. The United Nations commissioned a small group of people from developing and developed countries to develop methods with the help of which developed and developing countries can act together as efficiently as possible to achieve the common goal in the face of environmental problems, to consider the possibilities by which humanity can deal with environmental challenges more efficiently and with greater success and to proposing-term environmental protection strategies to achieve sustainable development for the next decades. This team, which was called, The World Commission on Environment and Development (WCED), is better known as the Brundtland Commission. They submitted their report in 1987, entitled *Our Common Future*.

The Brundtland report focused primarily on people's needs and interests, and to secure natural resources for future generations, and encouraging poor countries to grow economically so that all people can meet their basic needs. *Our report, Our Common Future, is not a prediction of ever increasing environmental decay, poverty, and hardship in an ever more polluted world among ever decreasing resources. We see instead the possibility for a new era of economic growth, one that must be based on policies that sustain and expand the*

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<sup>22</sup> United Nations. 1972: 3.

*environmental resource base. And we believe such growth to be absolutely essential to relieve the great poverty that is deepening in much of the developing world.*<sup>23</sup> The report expressed its conviction that social equity, economic growth, and environmental preservation are possible at the same time, thus defining the three main pillars of sustainable development: the environment, the economy, and society. The report discussed the need to apply integrated, sustainable solutions to a broad range of problems related to population, agriculture, food security, biodiversity, energy choices, and many more. Moreover, The report also illustrates that conflicts can arise from environmental degradation, and that conflict can be a major cause of unsustainable development. *Environmental stress is seldom the only cause of major conflicts within or among nations. Nevertheless, they can arise from the marginalization of sectors of the population and from ensuing violence. This occurs when political processes are unable to handle the effects of environmental stress resulting, for example, from erosion and desertification. Environmental stress can thus be an important part of the web of causality associated with any conflict and can in some cases be catalytic.*<sup>24</sup> In this case, one manifestation of the international community's concern will not only be waves of refugees from domestic political upheaval or military violence, but also environmental refugees. Those who will be forced to leave their country due to the deterioration of natural resource bases and the population's ability to support themselves.

The international impact of this report was strengthened by a series of ecological disasters at that time. For instance; the Chernobyl Nuclear Disaster when a reactor explosion at the Chernobyl Nuclear Power Plant in Soviet Ukraine in 1986 or when The Exxon Valdez oil tanker spills 10.8 million gallons of crude oil into Prince William Sound, off the Alaskan coast, after striking a reef and killing 250,000 seabirds, 3,000 sea otters, and 250 bald eagles, and destroys billions of salmon eggs.<sup>25</sup> These events highlighted the threat to the environment. Henceforth sustainable development was discussed as a major political goal and defined in a way that drew the attention of the world.

The Brundtland Commission's definition of sustainable development, still the most widely used and what is deemed the "classic" definition of sustainability in scientific literary codes: *Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*<sup>26</sup> The major critiques

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<sup>23</sup> World Commission on Environment and Development. 1987: 11.

<sup>24</sup> World Commission on Environment and Development. 1987: 198.

<sup>25</sup> <https://www.cfr.org/timeline/ecological-disasters> (Date of access: 05/22/2023)

<sup>26</sup> Brundtland Report, WCED 1987: 43.

of sustainable development were that sustainable development rests on 'shaky ground' because specific criteria of sustainability have never been formulated, thus leaving the back door open to advocates of economic growth and progressive secular materialism to hijack the concept of sustainable development for their purposes.<sup>27</sup> Another critique was that it did not question the ideology of economic growth and did not adequately challenge the consumer culture. Furthermore, developing countries suspected that sustainable development was an ideology imposed on them by the rich advanced industrialized countries under stricter conditions and rules. The danger, according to those who articulate this questions, is the sustainable development is simply meant to sustain the way of life of the West that has led to the destruction of others ways of life throughtout the world indeed to sustain the contemporary separations between developed and underdeveloped.<sup>28</sup>

#### **I.4. Earth Summit, in Rio de Janeiro, 1992**

The United Nations Conference on Environment and Development (UNCED), also known as the „Earth Summit”, was held in Rio de Janeiro, Brazil, from 3-14 June 1992.<sup>29</sup> This world summit convened each country's leaders, scientists, diplomats, and NGO representatives on the 20th anniversary of the United Nations Conference on the Human Environment held in Stockholm, Sweden, in 1972. In addition, the conference was created as a response for member states to cooperate together internationally on development issues after the Cold War.

The Rio de Janeiro conference highlighted how different social, economic, and environmental factors are interdependent from each other, and how evolve together. The primary goal of the Earth Summit was to create a broad agenda and a new blueprint for international action on development and environmental challenges, which could prepare us and help to guide international cooperation and policies in the twenty-first century. The "Earth Summit" argued positively that the concept of sustainable development is an attainable goal for all people, regardless of their international level. The conference also recognized that integrating social, economic, and environmental factors is possible and essential for maintaining human life on the planet. The conference also recognized that integrating and

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<sup>27</sup> Worster D. 1993: 142 – 155.

<sup>28</sup> Mitcham C. 1995: 323.

<sup>29</sup> <https://www.un.org/en/conferences/environment/rio1992> (Date of access: 05/22/2023)

balancing economic, social, and environmental dimensions required new perceptions of how we live and work, produce and consume, and make decisions. This concept was revolutionary for its time, and it sparked a lively debate within governments and between governments and their citizens on how to ensure sustainability for development.<sup>30</sup>

The United Nations Conference on Environment and Development or by other names the "Earth Summit" had many significant results. One of the most important results was *Agenda 21*. This huge program of action calls for new strategies to invest in the future to achieve comprehensive sustainable development in the twenty-first century. Its recommendations ranged from new methods of the education system to new ways of preserving natural resources and new ways of participating in a sustainable economy. Among other things, one plan was developed to protect the quality and supply of freshwater resources: the application of integrated approaches to developing, managing, and using water resources. It suggests that all states in the world, according to their capacity and available resources, and through bilateral or multilateral cooperation, including the United Nations and other relevant organizations as appropriate, could implement the following activities:

1. Establishment of protected areas for sources of drinking water supply.
2. Sanitary disposal of excreta and sewage, using appropriate systems to treat waste waters in urban and rural areas.
3. Expansion of urban and rural water supply and development and expansion of rainwater catchment systems, particularly on small islands, in addition to the reticulated water-supply system.
4. Strengthening the functioning of Governments in water resources.
5. management and, at the same time, giving full recognition to the role of local authorities.
6. Encouragement of water development and management based on a participatory approach, involving users, planners, and policymakers at all levels.
7. Promotion of primary health and environmental care at the local level, including training for local communities in appropriate water management techniques and primary health care.
8. Rehabilitation of defective systems, reduction of wastage, and safe reuse of water and wastewater.<sup>31</sup>

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<sup>30</sup> <https://www.un.org/en/conferences/environment/rio1992> (Date of access: 05/22/2023)

<sup>31</sup> Agenda 21. 1992: 210-212.

These are just a few examples and suggestions for a very detailed comprehensive program. These goals contain the areas of integrated water resources development and management, water resources assessment, protection of water resources, water quality and aquatic ecosystems, drinking-water supply, and sanitation, water, and sustainable urban development, water for sustainable food production and rural development, and impacts of climate change on water resources.

Moreover, one of the remarkable achievements was the Rio Declaration, and its 27 universal principles. The first principle is the central role of human beings in the aspects of sustainable development. *Human beings are at the center of concerns for sustainable development.*<sup>32</sup> *They are entitled to a healthy and productive life in harmony with nature.*<sup>33</sup> Other principles contain the importance of the environment for current and future generations and it is equal footing with development. *The right to development must be fulfilled so as to equitably meet the developmental and environmental needs of present and future generations.*<sup>34</sup> *In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.*<sup>35</sup> The number seven principle of common but differentiated responsibilities. *States shall cooperate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem.*<sup>36</sup> *In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities.*<sup>37</sup> *The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command.*<sup>38</sup> It also enshrined the two critical economic principles of polluter pays. *National authorities should endeavor to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.*<sup>39</sup> Finally, some principles were introduced relating to participation and the importance of specific groups for sustainable development, for example, the number ten. *Environmental issues are best handled with the*

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<sup>32</sup> Report of the United Nations Conference on Environment and Development. 1993: 3.

<sup>33</sup> Report of the United Nations Conference on Environment and Development. 1993: 3.

<sup>34</sup> Report of the United Nations Conference on Environment and Development. 1993: 3.

<sup>35</sup> Report of the United Nations Conference on Environment and Development. 1993: 4.

<sup>36</sup> Report of the United Nations Conference on Environment and Development. 1993: 4.

<sup>37</sup> Report of the United Nations Conference on Environment and Development. 1993: 4.

<sup>38</sup> Report of the United Nations Conference on Environment and Development. 1993: 4.

<sup>39</sup> Report of the United Nations Conference on Environment and Development. 1993: 6.

*participation of all concerned citizens, at the relevant level.<sup>40</sup> At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes.<sup>41</sup> States shall facilitate and encourage public awareness and participation by making information widely available.<sup>42</sup> Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided.<sup>43</sup>*

In general, dealing with universal principles is not easy. The notion of principle is highly appreciated by politicians and stakeholders because they believe that principles constitute a stronger and much more binding type of rule. The universal principle 27 refers to the necessity of partnership for achieving the Rio Declaration's common goals in the environment and development framework.

Ultimately, United Nations Conference on Environment and Development, Rio de Janeiro, Brazil, 3-14 June 1992 also achieved some remarkable achievements like the: United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity, and the Declaration on the principles of forest management. But on the other hand, it should be noted that most of the objectives of the Rio summit were not achieved. To the extent that the UN, civil society organizations, and other organizations strive with good intentions to prevent climate change and its harmful effects, it is now more and more difficult for them to achieve their objectives.

## **I.5. Conclusion**

Throughout history, great civilizations have always been concerned with how they could maintain their development and secure their resources. The Greeks are burdened by the deforestation of the southeastern Mediterranean basin, and the Romans by turning the Tiber into a sewer. There was hardly a nation that did not face the local environmental consequences of its actions. Later, however, the great geographical discoveries, colonization, and then the industrial revolution spread the pollution of the environment and the overuse of its resources to

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<sup>40</sup> Report of the United Nations Conference on Environment and Development. 1993: 5.

<sup>41</sup> Report of the United Nations Conference on Environment and Development. 1993: 5.

<sup>42</sup> Report of the United Nations Conference on Environment and Development. 1993: 5.

<sup>43</sup> Report of the United Nations Conference on Environment and Development. 1993: 5.

a global scale. Towards the end of the twentieth century, the effects of human activities reached a level where concerns for the environment swelled to a global scale, and it was impossible not to notice the common destiny and responsibility of mankind.

Rachel Carson's book *Silent Spring*, published in 1962, is perhaps the first to influence ecological thinking and catalyze the birth of environmental movements. The book was written in the heyday of the chemicalization of agriculture when everyone looked optimistically towards the possibilities of intensive agriculture, but Carson, in contrast to the possibilities, drew attention to the dangers lurking for human health and wildlife.

From the beginning of the seventies, reports from the Club of Rome bombarded the public and governments with threats about the future. The most important book of the Club of Rome, *The Limits to Growth*, examined what will happen in the future up to 2100 if the world's population and the use and pollution of the environment during industrialization grow at the rate of that time. They made it clear that this process could lead to a sudden and uncontrollable collapse of the population and the economy, but they also nurtured the hope that if humanity realizes that they will unite against the lurking dangers in time, then the collapse will not be lawful. Collapse can occur when the available natural or human capital becomes insufficient to remedy the effects of human-generated problems. The report provoked fierce opposition from most governments and pro-growth politicians. However, the problem could no longer be swept under the carpet.

At the international level, the United Nations Conference on the Human Environment in 1972 was the first to address the issue of the environment. The key issue of the conference was the impact of economic growth on the environment. The meeting was characterized by the difference of opinion between rich and poor countries. The developed world considered the state of the environment to be independent of socio-economic conditions, while the developing world saw poverty as the cause of the deteriorating environmental state, and therefore they also emphasized the importance of industrial development. The conference ended with the adoption of documents and the creation of the UN Environment Program (UNEP). Of course, the conference did not bring any breakthrough in alleviating environmental problems the problems swelled to a global scale and became more and more noticeable and measurable. The United Nations commissioned a small group of people from developing and developed countries to develop methods with the help of which developed and developing countries can act together as efficiently as possible to achieve the common goal in the face of environmental problems. This team was better known as the Brundtland Commission.



The Brundtland Commission published its report *Our Common Future* in 1987. They called sustainable development the way of development that satisfies the needs of the present without jeopardizing the needs of future generations. The Commission envisioned sustainable development as a three-legged stool, the three legs of which are environmental, economic, and social policy. These three supporting pillars mutually presuppose each other, which is why it is necessary to display them in a balanced way in sustainability policies. The committee believed that if the economy grows, there will be money to eradicate poverty, and more people will find work. If the poor get rich, they don't exploit their environment. If the economy grows, there will be money to solve environmental problems. They believe that the aspects of society, the economy, and the environment must be considered in a balanced way and that decisions cannot be made in favor of one or the other. Instead of separate policies, he considers an integrated policy and an institutional system that spans sectors to be good. One of the big mistakes of the report is that it did not take into account that humanity has already crossed the limit of the carrying capacity of the environmental systems, and in such circumstances, it is not possible to urge an even greater rate of growth. The report is also wrong in that it only blames poverty for the development of the bad environmental condition, and is shamefully silent about the fact that the world's few rich people cause orders of magnitude greater environmental burden by satisfying their unjustified needs. Many people are unable to satisfy their needs, while others increase their luxury needs to infinity.

The United Nations Conference on Environment and Development was held in Rio de Janeiro, Brazil, in 1992, with 172 nations participating. The conference wanted to get world leaders to agree that they are also legally committed to solving environmental problems. Neither then nor today was the world ready to accept such a document. In all cases, a document was successfully adopted which is contain universal principles. Such as the integrated nature of environmental protection and development issues, the right to development for future generations, the need for the cooperation of states in restoring the health of the environment, the importance of public environmental information and social participation, or the precautionary principle. Another document is a collection of proposals and recommendations for international organizations, governments, and civil society. Among the accepted - legally valid - conventions, the conventions on climate change and biological diversity have become well-known, and the conclusion of the conventions is followed by regular conferences of the parties to this day. The developed countries offered to use a part of their gross national product to overcome the environmental problems of the developing countries, and they also declared

the transfer of environmentally friendly technologies. This, like many other expectations, remained unfulfilled in the years after the conference.

In recent decades, many international forums have been held to promote the implementation of sustainable development, and on specific topics: international development cooperation, food and the fight against hunger, human rights, the world trade system, etc. all these forums have had little success. The real risk for humanity is that the rapidly reproducing humanity, living under the spell of continuous growth in production and consumption, is massively wasting the natural resources essential for survival while poisoning the environment with health-damaging substances.

## **Chapter II: Water Stress as a Global Problem**

Since the advent of the industrial revolution, humanity has been undergoing rapid development and modernization. The new inventions, mass production, advances in military technology, scientific and technical advances, and the rise of globalization and multinational corporations all led to the rapid exploitation of natural resources. In recent decades, humanity has officially become a mass consumer. But the real risk is that the rapidly growing population of humanity is wasting the available natural resources at an accelerating rate while emitting huge amounts of substances harmful to health and the environment into the air, soil, and water. By the beginning of the twenty-first century, the situation had already deteriorated to such a level that the most necessary natural resource for human survival, water, is in real danger.

Perhaps it is no coincidence that it is the leading bank on Wall Street and one of the largest and most influential multinational investment banks and financial services companies in the world, the Goldman Sachs announced that water is “the petroleum for the next century”.<sup>44</sup> The demand for water continues to escalate globally from population growth and industrial expansion. It means water will have huge rewards for investors who know how to play the infrastructure boom.

Furthermore, it is also noteworthy that Wáng Sùchéng, who held the position of Minister of Water Affairs for nine years until 2007, described the situation of China's freshwater resources with these ominous words: "fight for every drop of water or die, with this challenge facing China."<sup>45</sup>

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<sup>44</sup> Americas: Multi-Industry. 2008: 9.

<sup>45</sup> Brahma Chellaney 2011: 166.

The United Nations Conference on Environment and Development (UNCED), also known as the "Earth Summit," which took place in Rio de Janeiro, Brazil, from 3–14 June 1992, was the first time that the water issue was formally on the schedule. One strategy was created, among other things, to safeguard the quantity and integrity of freshwater supplies. Where it proposes that the following activities could be carried out by all states in the world, in accordance with their capabilities and resources, and through bilateral or international collaboration, including the United Nations and other pertinent groups as applicable. For instance: establishment of protected areas for sources of drinking water supply, sanitary disposal of excreta and sewage, using appropriate systems to treat waste waters in urban and rural areas, expansion of urban and rural water supply and development and expansion of rainwater catchment systems, particularly on small islands, in addition to the reticulated water-supply system, encouragement of water development and management based on a participatory approach, involving users, planners, and policymakers at all levels, strengthening the functioning of Governments in water resources, etc...

And subsequently, in accordance with the UN's Sustainable Development Goals (SDGs), which were included in the fifteen-year development plan approved by the member states in 2015, guaranteeing the accessibility and sustainable administration of freshwater and sewage for everyone became one of the SDGs. Many of the other Goals, including eradicating poverty and promoting health and well-being, depend on effective water management. Water management is referred to as a "essential component of virtually all the prevention and resilience plans" by the United Nations, despite the Paris Agreement on Climate not specifically mentioning water. The group raises concerns about the growing fragility of traditional water infrastructure and lists a number of climate-focused options, including coastal reservoirs and solar-powered water systems.

For the purpose of sustainable development, numerous national and international groups have been founded in recent decades. The Mekong River Commission, also known as the Committee for Coordination of Studies on the Lower Mekong River Basin, was established in 1957 under the authority of the United Nations with the participation of Cambodia, Lao PDR, Thailand, and Vietnam. It was the largest single development initiative the United Nations had ever taken on at the moment. No international river organization had ever tried to take on such extensive duties for funding, administration, and upkeep of water supplies. The Mekong was regarded as one of the largest uncontrolled rivers in the world, and the riparian nations were

eager to investigate the possibility of developing electricity, irrigation, and water control in order to take advantage of the river's economic potential. On 5 April 1995, Cambodia, Lao PDR, Thailand and Viet Nam signed the Agreement on Cooperation for Sustainable Development of the Mekong River Basin (the 1995 Mekong Agreement), in Chiang Rai, Thailand.<sup>46</sup> An Integrated Water Resources Management approach that shaped a shared transboundary knowledge of the development of long-term planning served as the framework for the Mekong River Commission's operations.

The group has created numerous strategies over the years that are working well for our sustainable growth. They established five key focuses to enable Mekong countries to address emerging challenges and to improve the overall state of the basin. These strategic priorities are: environment, social, economic, climate change, and cooperation.

One of the key result, is the enhancement of national plans, projects and resources from basin-wide perspectives. Where policymakers and project planners share evidence-based information with each other to establish consensus. Furthermore, for basin-wide shared benefits, national sectoral planning agencies will maximize environmental management and sustainable water resource development. Furthermore, national planning and implementation authorities communicate and apply recommendations on the development and management of water and associated projects and resources to ensure long-term basin development. Another key result must be mention, is the strengthening of regional cooperation. Where all member nations will execute the Mekong River Commission's demands efficiently and coherently, as well as guarantee effective conversation and collaboration among all the member countries. Additionally, a significant result was improved basin conditions tracking and communication. Where member states confirm and assure basin-wide monitoring, forecasting, and impact assessment, and form conclusions for better decision-making in the near future based on their the results.

In order to help the Mekong countries handle new challenges and better the general condition of the basin, the Mekong River Commission issued a new ten-year Basin Development Strategy (BDS) for the Mekong River Basin and a five-year Strategic Plan (MRC SP) in April 2021. "Basin Growth Strategy for the Mekong River Basin 2021- 2030 & MRC Strategic Plan 2021- 2025" is the name of this strategy.

The five Strategic Priorities, one for each dimension of the Mekong River Basin Indicator Framework, are as follows:

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<sup>46</sup> <https://www.mrcmekong.org/about/mrc/history/> (Date of access: 05/22/2023)

1. *Environment*: Maintain the ecological function of the Mekong River Basin.
  2. *Social*: Enable inclusive utilisation of the basin's water and water-related resources.
  3. *Economic*: Enhance optimal and sustainable development by increasing regional benefits and decreasing regional costs.
  4. *Climate change*: Ensure water security by mitigating floods and droughts.
  5. *Cooperation*: Strengthen cooperation among all basin countries and stakeholders
- The BDS Outcomes seek to describe the resulting end state that basin countries would like to see by 2030.

As a result, the Mekong River Commission expanded collaboration and partnerships for a more comprehensive administration of the river basin as a whole. The shared knowledge of possible future institutional structures for basin administration is one of the accomplishments. In addition, implemented in collaboration with nations are pertinent partnerships and cooperation methods linked to the Mekong water. Moreover, significant joint investment projects and national projects of basin-wide significance and associated measures agreed based on consideration of trade-offs, benefit sharing and risks. The Mekong River Commission collaborates with Basin Expert Groups as well. It is clearly visible, that solving the global freshwater crisis pulls regional nation governments together. These alliances can provide long-term peaceful stability in the pursuit of similar goals in the international arena.

On the global level, from America to Africa through Asia to the Far East, freshwater stress is already present or will be present. Water stress has now become a global problem. Currently, the scarcity of fresh water affects more than 40 percent of people on the Earth.<sup>47</sup> It is over half of all people on the planet. Furthermore, the rapidly growing population of humanity will only further aggravate this data. Especially considering that the majority of the population is coming from nations where there is already a severe water deficit. On average, 10 percent of the world's population lives in countries with high or critical water scarcity, which has a significant impact on access to water and meeting personal needs.<sup>48</sup> Roughly 60 percent of the incremental population experiencing severe water stress is expected to reside in the BRICs.<sup>49</sup> Nevertheless, unfortunately, one of the most dramatic facts is that the world has lost 70 percent of its natural wetlands over the century. Wetlands are one of the most biologically productive

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<sup>47</sup> <https://www.undp.org/sustainable-development-goals#clean-water-and-sanitation> (Date of access: 05/22/2023)

<sup>48</sup> Food and Agriculture Organization of the United Nations and United Nations Water. 2021: 18.

<sup>49</sup> Sustainable Growth: Taking a Deep Dive into Water. 2013: 20.

ecosystems.<sup>50</sup> They play an important role in the water cycle by receiving, storing, and releasing water, regulating flow, and supporting life. Some of these services or duties include the protection and improvement of water quality, the provision of fish and animal habitats, the storage of floods, and the maintenance of surface water flow during dry seasons. Thus healthy, functioning natural wetlands are vital for human livelihoods and sustainable development. Unfortunately, wetlands are deteriorating from pollution, climate change, and irresponsible unsustainable political and decision-making decisions. Thus, wetland plants and wild animals are therefore in crisis and many indigenous species are at risk of extinction nowadays.

The global water scarcity not just effects almost half of the world's population (especially in the third world or in the developing countries), but also the giants companies and private sectors in the developed countries also recognizes water risk. Starbucks Corporations, which is a multinational chain of coffee houses and roasteries world-wide, replaced the "water fountains" in the store with hand faucets that use 15 percent less water. In addition, the company has begun installing filtration systems that reduce wastewater by 50 percent.<sup>51</sup> The General Motors (Automobiles) implementing water conservation strategies at every plant, water use was reduced by 32 percent on a per-vehicle-produced basis between 2005 and 2010. For instance, one of the company's new assembly plants in Mexico was designed with a zero-emission system. Almost 100 percent of the waste water is treated and reused in the production process. This can reduce the amount of water used by approximately 20 million gallons per year. Moreover, Coca-Cola (one of the largest soft drink companies in the world) has promised that the company will improve water efficiency by nearly 20 percent and clean up all wastewater used in the production process. The company has undertaken to return part of the water used during the production process to nature by 2020. In 2011, an estimated quarter of the water used was replaced through community projects in places like China, India, Nicaragua, and Colombia. In the sector of healthcare, Pfizer (multinational pharmaceutical and biotechnology corporation) aims to reduce the water used in its facilities by 2 percent each year, by increasing the treatment of wastewater and the reuse of treated water in cooling towers.<sup>52</sup> Furthermore, the General Electric also reduced its freshwater consumption by 35 percent in 2011, from 2006 levels.<sup>53</sup> The multinational corporation is also attempting to create goods that reduce the amount of freshwater consumed, such as GE's "ecomagination" brand, which sells goods that are both

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<sup>50</sup> <https://www.undp.org/sustainable-development-goals#clean-water-and-sanitation>  
(Date of access: 05/22/2023)

<sup>51</sup> Sustainable Growth: Taking a Deep Dive into Water. 2013: 23.

<sup>52</sup> Sustainable Growth: Taking a Deep Dive into Water. 2013: 23.

<sup>53</sup> Sustainable Growth: Taking a Deep Dive into Water. 2013: 24.

useful and eco-friendly. In addition, one of the goal of the American chemical company DuPont is to reduce water consumption by at least 30 percent at sites in water-scarce regions. The company also develops technologies that deal with industrial wastewater treatment. However, it is quite difficult to believe the giant company DuPont. The American company knowingly continued to poison river waters, because the products manufactured with PFOA meant a profit of one billion dollars a year for the DuPont company. The chemical industry giant caused cancer to nearly a hundred thousand Americans. Lawsuits against the company are ongoing. In February 2017, DuPont settled over 3,550 PFOA lawsuits for \$671 million but denied any wrongdoing.<sup>54</sup> In 2018, the company was fined more than \$3 million for environmental violations.<sup>55</sup> According to a report by the University of Massachusetts, in 2019, DuPont was the largest water polluter in the entire United States.<sup>56</sup>

Every aspect of our life has been profoundly impacted by the worldwide freshwater problem. The biggest reasons, why we have such a high level of water stress globally: critical water resources are unevenly distributed on the planet, climate change, the pollution and contamination of water resources, and agriculture case to feed the growing population.

## **II.1. Challenge: Critical water resources are unevenly distributed on the planet**

We can simply claim that the Earth is referred to as "the water planet" or "the blue planet" since images taken from space clearly show that our planet has more water than land. But of all the water that exists on our planet, roughly 97 percent is salt water and less than 3 percent is freshwater. The majority of the freshwater on Earth is submerged in aquifers or frozen in glaciers and ice caps. Less than 1 percent of Earth's water is freshwater that is easily accessible to us to meet our needs.<sup>57</sup> So we all share 1 percent of the freshwater resources.

The earth's small fresh water supply is unevenly distributed across the planet. Some regions and countries have more rivers and lakes and get regular rain, while others are mostly desert and suffer years of drought. Sometimes the difference is huge even within a country, for

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<sup>54</sup> <https://www.business-humanrights.org/en/latest-news/dupont-lawsuits-re-pfoa-pollution-in-usa/> (Date of access: 05/22/2023)

<sup>55</sup> [https://violationtracker.goodjobsfirst.org/prog.php?parent=dupont-de-nemours&order=pen\\_year&sort=asc&page=3](https://violationtracker.goodjobsfirst.org/prog.php?parent=dupont-de-nemours&order=pen_year&sort=asc&page=3) (Date of access: 05/22/2023)

<sup>56</sup> <https://www.peri.umass.edu/toxic-100-water-polluters-index-current> (Date of access: 05/22/2023)

<sup>57</sup> <https://olc.worldbank.org/sites/default/files/sco/E7B1C4DE-C187-5EDB-3EF2-897802DEA3BF/Nasa/chapter1.html> (Date of access: 05/22/2023)

instance, in the United States, the Great Lakes region in the north is rich in freshwater, while the southern part near the Mexican border is poor in fresh water. Another example is that in China, where the world's largest population lives, the water supply is not uniform there either, since the south is very rich while the north is very poor. The Chinese government is attempting to address this uneven distribution through ambitious like the South-to-North water transfer project, which aims to divert water from the Yangtze River to drier regions in the North. The population of a region also affects the amount of water available for each person. For example, Australia has only a small portion of the world's water resources but also has a small population, so it has more water available per person than Asia, which has far more water but a much bigger population.

Nowadays, there are 195 nations in the globe. But in reality, just ten countries account for more than 60 percent of the world's freshwater supply. Notably Brazil 13 percent of global resources, the Russian Federation 10 percent, Canada 7 percent, the United States of America 7 percent, the People's Republic of China 6 percent, Colombia 5 percent, Indonesia 5 percent, Peru 4 percent, India 3 percent, Myanmar 2 percent, and rest of the world countries 38 percent.<sup>58</sup> This is already unequal freshwater distribution from the point of view of countries. Critical fact for Pakistan and Nigeria, which have one of the largest populations on earth, are not among the top 10 countries, they have to face very serious water challenges.

As a result of the uneven global distribution, 2.3 billion people live in water-stressed countries, of which 733 million live in high and critically water-stressed countries.<sup>59</sup> The growing demand for water in developing economies heightens concerns about scarcity. Freshwater consumption in developing countries has increased rapidly in recent decades. Today, China and India account for a third of global water demand. In contrast, water withdrawals in developed economies such as the United States and Japan have remained relatively unchanged.<sup>60</sup> A large portion of the affected population resides in developing countries and close to two-thirds live in the BRICS countries (Brazil, Russia, India, China, and South Africa).<sup>61</sup> It will be a huge challenge for the future leading emerging BRICS economies to sustain their economic growth, especially for China and India, because they are already the two most populated countries in the world with not enough freshwater. Canada which is not part of the BRICS countries its an abundance of freshwater resources and a relatively sparse

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<sup>58</sup> Sustainable Growth: Taking a Deep Dive into Water. 2013: 6.

<sup>59</sup> <https://www.unwater.org/water-facts/water-scarcity> (Date of access: 05/22/2023)

<sup>60</sup> Sustainable Growth: Taking a Deep Dive into Water. 2013: 7.

<sup>61</sup> Sustainable Growth: Taking a Deep Dive into Water. 2013: 5.



population means the country has close to 85,000m<sup>3</sup> of freshwater per person. In contrast, China, with 20 percent of the global population, has just roughly 2,000m<sup>3</sup> of freshwater per capita, less than 3 percent of Canada's per capita availability.<sup>62</sup> In China, some of the major cities, including Beijing, are located in drought-prone regions and they have to face serious water stress. The Chinese government tries to solve this problem with tremendous projects such as the \$60 billion South-to-North water transfer project, which aims to divert water from the Yangtze River to drier regions in the North.<sup>63</sup> The capital of China, Beijing is facing a water crisis that requires urgent solutions. One such water management strategy is the Miyún Qū water reservoir, which is located 100 kilometers north of the capital and is also the largest artificial lake in Asia. The Miyún Reservoir is the only surface water source near Beijing, the main function of which is to supply drinking water to the residents of the capital.<sup>64</sup> Another strategic step is the recycling of wastewater. In Beijing, about 20 percent of treated wastewater is used.<sup>65</sup> While in the short term, the companies responsible for the supply of drinking water manage to provide the city with an adequate water supply (the best example of this is the 2008 Beijing Olympics, where the water quality was satisfactory according to the opinion of the World Health Organization (WHO)), in the long term, the only solution is the South-North Water Conveyance Project, which will be able to feed the population of Beijing with an adequate amount of water.

Generally speaking, the western civilized world countries such as North America, Europe, and even Russia (it has one of the biggest water resources) will not face a serious threat to the water supply shortly. Because they are wealthy enough, but the biggest reason is that their population will be better aligned with available freshwater resources. Currently on Earth the third world countries and developing countries, those where there is a great drought in the summer and also a huge water shortage. Due to overpopulation, North Africa, the Sub-Saharan African area, the Middle East, South Africa, Central Asia, Northern China, and India are experiencing severe water shortages, which their own water resources simply cannot satisfy.

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<sup>62</sup> Sustainable Growth: Taking a Deep Dive into Water. 2013: 5.

<sup>63</sup> Sustainable Growth: Taking a Deep Dive into Water. 2013: 5.

<sup>64</sup> Zheng Hua, Robinson E. Brian, Liang Yi-Cheng 2013.

<sup>65</sup> Cosier Martin, Shen Dajun 2009b: 257.

## II.2. Challenge: Climate Change

From 1880, the Earth's temperature has increased on average by 0.08° Celsius every decade since the pre-industrial period. The year 2022 was the sixth-warmest year on record based.<sup>66</sup> There are numerous indicators that the Earth is indeed gradually warming and that the air's carbon dioxide concentration is rising. The United Nations and the EU's climate policies are founded on the idea that carbon dioxide emissions from people are to blame for global warming, even though it is unclear which is the cause and which is the consequence. Meanwhile, the news is filled with dire warnings about an impending climate disaster. But it is actually true, that the climate change profoundly affects every aspect of life, our economies, societies, and the environment. The current climate change has a significant influence on our planet's fresh water supplies, because temperature and the hydrological cycle are inextricably linked. Climate change is already posing serious challenges to water in some regions on the planet.

How is climate change affecting water stress? Well, first of all, the precipitation has decreased. The result is drought. The increase in precipitation and severe weather is the second factor. The result is floods. Thirdly, the temperature rises as a result. Heat waves are produced. The rise in temperature is the fourth factor, which is the thawing and melting of frozen land, snow, sea ice, and glaciers.

- *Drought*: The reduction in raw water availability for drinking water supplies reduced flow in rivers, maybe less increased concentration of pollutants in water, but there will be a challenge to the hygiene practices regularly. For example, 15 million children are now out of school in the Horn of Africa, and an additional estimated 3.3 million children are at risk of dropping out due to drought.<sup>67</sup>
- *Flooding*: The damage to infrastructure, which is one of the basic needs of our sustainability. Landslides around water resources, sedimentation, and turbidity. Moreover, the challenges of sustainability of sanitation and hygiene behavior, and waterborne disease, like the pollution of wells, and inundation of wells. Furthermore, the inaccessibility of water resources. Nowadays, flooding is a big problem not only in underdeveloped but also in developed countries as well (because of the bad river management).
- *Heatwaves*: It increases pathogens in water. Waterborne pathogens, including bacteria, viruses, and protozoa, are a direct threat to human health. Pathogens can spread easily to

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<sup>66</sup> Rebecca Lindsey – Luann Dahlman. 2023.

<sup>67</sup> Unicef 2022: 5.

humans through the ingestion of contaminated drinking water, activities like swimming, or indirectly through contaminated food. In addition, the increase of marine heatwaves endangers coral reef health.

- *The rise in temperature*: It creates the melting and thawing of glaciers, snow, sea ice, and frozen ground. The seasonality of river flows can be affected leading to a reduction in water availability in summer. In addition, it can affect ecosystems and several socio-economic sectors, including abstraction for drinking water, agriculture, industry, energy production, and navigation. Moreover, it threatens coastal cities and islands.

For instance, due to the high year-to-year variability in the Mekong region, it is challenging to find trends in the extent and intensity of floods and droughts. In particular, when coupled with ongoing urban, industrial, and farming growth, wetter climate conditions will result in much larger and highly damaging events. Flood damages are projected to be five to ten times higher by 2040.<sup>68</sup> Furthermore, it is anticipated that temperatures will continue to rise throughout the region and in all seasons. By 2060 under the worst-case projections, the average annual basin-wide temperature could be up to 3.3°C higher depending on the global emissions trajectory.<sup>69</sup> All nations have created organizational and monitoring organizations to organize actions in response to climate change, and they all have policies, strategies, or plans in place. In addition, to improving operational management and climate change adaptation planning at the national level, the Mekong River Commission focuses on assisting local communities in preparing for the effects of climate change through improved information about changing river conditions and more frequent and severe droughts. Thus, a core river monitoring network for the mainstream and remaining national river monitoring networks consolidated and the climate change adaptation, flood and drought management mainstreamed at national levels. The commission also developed a compatible decision support system based on reenergized data, modeling, predicting, and communication skills.

However, despite the fact that water is essential to problems like food security, energy production, economic growth, and poverty reduction, the term "water" is rarely used in international climate agreements. The 2020 World Water Development Report on Water and Climate Change was released by the UN as a result. The study demonstrates that water need not be an issue; rather, it can be part of the solution. The 2020 edition of the UN World Water

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<sup>68</sup> 2021–2030 Basin Development Strategy & MRC Strategic Plan 2021–2025. 2021: 48.

<sup>69</sup> 2021–2030 Basin Development Strategy & MRC Strategic Plan 2021–2025. 2021: 47.

Development Report tackles the crucial linkages between water and climate change in the framework of sustainable development. It also acts as a roadmap for effective measures to deal with these difficulties. With examples from all over the globe, it describes deeds.

The study makes the following recommendations to combat climate change:

- Safe water reuse: The issue can be resolved by irrigating with purified effluent. Since more than 50 years ago, Windhoek, Namibia, has effectively implemented drinkable reuse. Reclaimed water is increasingly considered an alternative water resource in some regions of Europe. Only 2 percent of treated wastewater is reused in Europe, but it is expected to grow in the future, with the biggest potential in Portugal and Spain.<sup>70</sup>
- Seawater and brackish water desalination: Desalination is the procedure used to purify salty or saline water into a drinkable form by eliminating salts and other elements. There are 16,000 operational desalination plants globally, producing around 95 million m<sup>3</sup>/day of desalinated water, of which around 50 percent is produced in the Middle East and North Africa region.<sup>71</sup> Other nations, including Australia, China, and the United States, have begun to increase their desalination capability amid worries about the rising demand for water and possible shortages. Only a few wealthy Arab countries, such as Qatar and Saudi Arabia, are permitted to use this method, but it should be noted, however, that it is not particularly cost effective. Despite rising cost competition, desalination is still comparatively expensive due to high energy usage. By constructing on-site power plants to supply electricity directly to the facility and implementing energy-recovery systems to repurpose energy during the process, many newer facilities minimize energy use to reduce costs. Furthermore, concerns about the related environmental effect, including greenhouse gas emissions from fossil fuels that power the facilities as well as the brine and other compounds generated during the process, have been voiced as desalination is increasingly relied upon to meet the world's water requirements.
- Atmospheric moisture harvesting: In sections of South America, the Middle East, and North America, people employ techniques like cloud seeding, which is the collection of fog water in regions with a lot of advective fog. Around the world, numerous sites with a high possibility for fog water gathering have been found. In contrast to the enormous possibility

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<sup>70</sup> The United Nations World Water Development Report. 2020: 54.

<sup>71</sup> The United Nations World Water Development Report. 2020: 54.

offered by desalination, fog water is mainly important locally because it is a low-cost and low-maintenance method. So this might be a potential solution to the water crisis, particularly in poor mountainous nations.

- Offshore aquifers: Offshore freshwater alternatives are gaining more attention. It is estimated that 0.5 million km<sup>3</sup> of fresh/brackish water exists in offshore aquifers located below shallow (<500 m) ocean water within 100 km of the shoreline.<sup>72</sup> Offshore low-salinity groundwater has been seen in numerous places across the globe.<sup>73</sup>
- Physical transportation of freshwater by the sea: These choices are currently the most "functional," but there are growing concepts and efforts to use them. Water can be transported from large rivers' deltas/estuaries, such as Amazon or Congo (the total annual discharge of both is close to 8,000 km<sup>3</sup>, some 20 times the total amount of wastewater globally) by tankers or bags to such areas as Cape Town, which almost ran out of water during the recent drought of 2017–2018.<sup>74</sup>

The United Nations firmly advises the following measures to strengthen population resistance to catastrophes, including assisting recovery from floods and droughts:

- "Sponge cities": By creating urban drainage systems that are incorporated into urban infrastructure design to provide secure flooding areas, it is possible to increase resistance to flood risks. By acting as a "sponge," the city controls swells and releases rainfall as a resource. The unexpected large quantities of rainfall, the sowing of trees and plants, as well as the construction of numerous parks, lakes, and smaller wetlands, receive and store the precipitation as a natural water reservoir. This method not only prevents flooding and safeguards the city's inhabitants and business, but it also recycles precipitation by using newly formed green spaces. The „sponge city” collects extra water during floods and strong rains so that it can be used again during dry weather. Several national authorities are currently attempting the "sponge cities". For example, the State Council of China issued a guideline on 16 October 2015, referred to as the “Directive on promoting "Sponge City Construction”, which sets out the target that 20 percent of the urban areas of Chinese cities

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<sup>72</sup> The United Nations World Water Development Report. 2020: 54.

<sup>73</sup> The United Nations World Water Development Report. 2020: 54.

<sup>74</sup> The United Nations World Water Development Report. 2020: 55.

should absorb, retain, and reuse 70 percent of the rainwater by 2020. By 2030, this percentage should increase up to 80 percent.<sup>75</sup> At the moment, places like Wuhan, Chongqing, Jinan, Beijing, Shanghai, or Shenzhen are taking part in this new green initiative as test subjects. The natural partition of China prevents the creation of "sponge cities" everywhere in the nation. If the weather is arid and frigid temperatures are typical for the majority of the year, for instance, these municipal initiatives cannot be implemented in areas with such environmental circumstances, such as those where low quality soils are present in significant quantities. The reality that these kinds of communities may encounter technological and legal difficulties, such as the restriction of street width or parking spots, further complicates the situation. The appearance of towns must be completely transformed in order to implement such expansive green projects, but Chinese municipal laws and rules frequently prefer the use of gray infrastructure components over green ones. In any case, "sponge cities" undoubtedly offer residents a healthier atmosphere, greater variety, cooler temps, and an abundance of oxygen.

The study makes the following recommendations to combat scarcity of freshwater resources:

- *Coastal reservoirs as a water supply option for coastal cities*: The development and use of coastal lakes, which offer water holding facilities at or near the mouths of rivers, is a growing answer to the water supply issues of coastal megacities. It is necessary, because today, more billion people live more hundred kilometers of a coastline. In many countries, coastal populations are expanding faster than non-coastal ones, for instance in China. A barrage across the river or containment ponds constructed along a riverbed or the shoreline are two ways to create this storage. To collect rainwater, lessen the risk of flooding, and limit saltwater incursion, these reservoirs typically have a system of gates that are run cautiously. Many coastal cities, including Hong Kong, Shanghai and Singapore are using coastal reservoirs for their water supply. For example, the Qingcaosha Coastal Reservoir in the mouth of the Yangtze River, completed in 2010, supplies water to nearly 50 percent of Shanghai city residents.<sup>76</sup>

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<sup>75</sup> Zevenbergen Chris, Fu Dafang Pathriana Assela 2018: 4.

<sup>76</sup> The United Nations World Water Development Report. 2020: 52.

- *Surface reservoirs*: Aquifers are better suited for long-term storing because they replenish and empty more gradually. Conjunctive use, which makes use of a variety of storage options, allows an area to increase its total water storage capacity by using more surface water during rainy seasons and more groundwater during arid ones. They can also be utilized for boating, fishing, and other recreational activities, and some of the dams that produce reservoirs are used to generate energy. Currently, Africa has the world's largest reservoir in terms of volume.

Despite the fact that global change is undeniable in the water sector, even in some European countries experienced as well. Mediterranean countries such as Spain and Italy struggle to maintain minimal drinking water supplies during periods of drought. Subtropical areas such as Australia, the southern United States, and countries in northern Africa are expected to experience warming and more frequent and longer droughts. Climate change impacts on water further exacerbate basic human rights to safe drinking water for all. Climate change and extreme weather events are making water management even more challenging. Between 1998-2017, floods affected more than 2 billion people worldwide.<sup>77</sup> In October 2022 Nigeria was hit by some of the worst floodings it has seen in a decade. 1.3 million people have been displaced, more than 200,000 homes have been destroyed and 600 people died.<sup>78</sup> Between 80-90 percent of all documented disasters from natural hazards during the past 10 years have resulted from floods, droughts, tropical cyclones, heat waves, and severe storms.<sup>79</sup> Furthermore, a more erratic climate like drought and flood can wipe out crops and overwhelm storage systems in agriculture and it can exacerbate the uneven distribution of the global water supply. The arid regions will likely be the most impacted as water resources become increasingly scarce. All in all, climate change and extreme weather events make water management even more challenging.

Huge sacrifices are necessary for climate change mitigation measures, which have a substantial effect on global economic processes and, indirectly, on people's daily lives. It must be questioned whether it is worthwhile to spend significant resources on countermeasures to climate change when it would be better to use them for adaptation?

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<sup>77</sup> [https://www.who.int/health-topics/floods#tab=tab\\_1](https://www.who.int/health-topics/floods#tab=tab_1) (Date of access: 05/22/2023)

<sup>78</sup> <https://www.bbc.com/news/world-africa-63280518>

(Date of access: 05/22/2023)

<sup>79</sup> [https://www.who.int/health-topics/floods#tab=tab\\_1](https://www.who.int/health-topics/floods#tab=tab_1) (Date of access: 05/22/2023)

It is necessary to recognize that the temperature changes constantly in accordance with the laws of nature and that these changes occurred even before humans arrived on Earth, as shown by historical records. Ascribing human activity to the present, continuing climate change is factually unfounded.

However, the United Nations and the EU believe that human activity's carbon dioxide releases are what is causing the rise, and based on this speculative theory, ever-more-unrealistic and ever-more-expensive goals are developing with regard to lowering carbon dioxide emissions and raising the share of green energy sources.

As a result, the IPCC (Intergovernmental Panel on Climate Change) regularly creates projections of the anticipated dire effects if carbon dioxide emissions are not reduced. These predictions, however, have thus far overstated the anticipated level of heat in an unrealistic manner.

Additionally, the problem is constantly kept front and center by state-sponsored official media misinformation, which emphasizes that everything must be done, at any cost, to stop global warming.

However, the Earth's past and the history of humanity do not support this worry, contrarily, life on Earth flourished during a warmer era than the present, and the colder periods - especially the ice ages - caused the extinction of many living species, among them the Neanderthal man.

In Africa, the warmest continent on Earth, where they resided in caverns or houses made of tree branches, bones, and animal hides without the need for heating, the proto-humans (*Homo habilis*, *Homo erectus*) are thought to be the earliest progenitors of modern humans.

In addition, the first society with a recorded past was born in Mesopotamia's southern region of Sumer, where the climate was much warmer than it is today in Europe. They had more time to reflect and pursue their interests in the arts and sciences because life was simpler, there was plenty of food, their homes didn't need to be warm, and they weren't constantly fighting to survive.

The same can be said of numerous other ancient civilizations, including the Egyptian in the Nile Valley, Indian in the Indus Valley, and Mayan cultures in Central America. These societies were the incubators of the sciences of writing, arithmetic, calendar-making, astronomy, visual arts, massive building, poems, and music.

The loss of the polar ice is one of the main concerns with climate change. But we must mention, that nowhere on Earth had a significant amount of snow and ice cover in the previous



few hundred million years, both in the winter and the summer. The ice in the arctic areas fully melted in the summer before freezing over again in the winter, like in Hungary at the Lake Balaton. Regardless of how heated it was on average, this pattern continued even during the hottest spells.

The seasons in the northern and southern regions are in phase opposites because of the tilt of the Earth's rotation axis, as is the case when it is summer in the north, winter in the south, spring in the north, fall in the south, etc. The seasonal transition is much more severe in the arctic areas, with six months of light followed by months of gloom. In addition, regardless of the normal surface temperature of the globe, during the lengthy, gloomy winter when there isn't much sunlight, the air and surface cool down to the point where the water surfaces freeze over. In actuality, the ice age is still ongoing and won't stop until all the ice melts in the summer and develops again in the winter. Regarding the predicament of many European nations, including Hungary, global warming is manifested by the possibility that most nations' climates will become Mediterranean as a result of the northward movement of climate zones. However, this provides benefits in addition to disadvantages. In my point of view, among others, Hungary might even emerge as a winner of the climate change, if the country effectively manages its water resources well.

However, in order to take advantage of this chance, our agriculture's product structure must be changed, and the watering of our farms must be resolved with sensible water management. However, this would necessitate river control similar to what the Sumerians did six thousand years ago, and the extreme greens' stance that water should run openly wherever it pleases must be abandoned because it should not be interfered with.

### **II.3. Challenge: The pollution and contamination of water resources**

In our global world, water pollution is one of the main concerns of today's world. Because many contaminants endanger the water supply as rubbish and chemicals enter rivers and lakes as a result of ongoing and irresponsible human activity. Especially underdeveloped and developing countries are exposed to this danger, because of limited infrastructure and poor water control, sewage frequently finds up in clean drinking water. In these countries sewage, sludge, garbage, and even toxic pollutants are all dumped into the water. This method of sewage

disposal is the most common in underdeveloped countries but also is prevalent in developing countries such as China, India, and Iran. Another crucial problem is the chemical waste dumped by industry and governments, which damages surface waters. Rough estimates suggest that 80-90 percent of wastewater in developing countries is discharged directly into rivers, lakes, and seas, causing water-borne diseases, and hindering tourism and economic development while severely damaging the environment.<sup>80</sup> World Health Organization estimates that worldwide some 2.2 million people die each year from diarrhoeal disease, 3.7 percent of all deaths, and at any one time over half of the world's hospital beds are filled with people suffering from water-related diseases. Of the 10.4 million deaths of children under five, 17 percent are attributed to diarrhoeal disease, i.e. an estimated 1.8 million under-fives die annually as a result of diarrhoeal diseases. For an estimated 88 percent of diarrhea cases, the underlying cause is unsafe water, inadequate sanitation, and poor hygiene.<sup>81</sup> Furthermore, the rapid urbanization of developing economies also contributes strongly to pollution, as urban population growth has far outpaced the development of urban sanitation facilities. In Jakarta, with a population of nine million people, less than three percent of the 1.3 million cubic meters (enough to fill more than 500 Olympic swimming pools) of sewage generated each day reaches a treatment plant – there is only the capacity to process 15 swimming pools' worth. Compare this to a city like Sydney, with a population of four million, where 100 percent of urban wastewater is treated to some degree. Sewage treatment plants process 1.2 million cubic meters per day (each person in Sydney produces nearly three times as much wastewater as a person in Jakarta).<sup>82</sup> Freshwater pollution is a major concern in many emerging countries due to the lack of adequate wastewater treatment facilities and the poor management of water resources. On the following pages, I am going to provide a few examples to demonstrate how dangerous water pollution caused by human activities nowadays.

Gold mining is one of the most important sources of mercury emissions in China, as about 1/3 of gold production is made using mercury mixing techniques.<sup>83</sup> Therefore, it is not at all surprising that some people suffer from mercury poisoning. A typical example of this is the mercury pollution of the Songhua Jiang River in the 1960s due to irresponsible industrial wastewater treatment. As a result, the mercury concentration in the hair of local fishermen increased to 13–58 times the RfD value (0.75ppm), in addition, many cases of methylmercury

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<sup>80</sup> <https://sustainabledevelopment.un.org/topics/water/unsgab/wastewater> (Date of access: 05/22/2023)

<sup>81</sup> Emily Corcoran. 2010: 40.

<sup>82</sup> Emily Corcoran. 2010: 26.

<sup>83</sup> Feng Xinbin 2005: 6.

poisoning have been identified.<sup>84</sup> A similar incident occurred in the Jiyùn River near the city of Tiānjīn near Beijing. When a chloralkali factory started operating in the middle course of the river in the sixties, the river began to be seriously polluted by mercury.<sup>85</sup> Mercury poisoning also appeared in northwest China in the eighties. In the province of Gānsù, the average concentration of mercury in the hair of factory workers was 45.4 mg/kg.<sup>86</sup> Southwest China can't be left out either, since according to 2003 data, mercury concentration in one of the most important rivers of Guìzhōu province ranged from 25.5 to 70.0 ng/l. The biggest problem is that this river is the water source for about 120 hectares of rice fields.<sup>87</sup> But to stay within this range, also according to 2003 data, mercury pollution in groundwater systems and total mercury concentrations in river waters in the Wànshān area ranged from 29.7 to 585.8 ng/l.<sup>88</sup> In practically all provinces of China, mercury poisoning is by the liquid route. Mercury can also enter the human body indirectly, it is enough to eat fish that has previously been swimming in mercury-containing water. It should be added that Chinese authorities have taken serious action against mercury-emitting activities in recent decades, but despite this, the problem is still not 100 percent solved. Moreover, China has enormous reserves of arsenic. Due to arsenic extraction, it is not surprising that most of the natural waters are exposed to significant arsenic risk. After the turn of the millennium, between 2001 and 2005 in 16 provinces of China, in more than 20,000 villages, 5 percent of the total number of wells contained arsenic higher than the national limit value (50µg/L).<sup>89</sup> Between 2004 and 2010, the Chinese government conducted research in suspected arsenic-affected areas. Allegedly, 12,835 villages were investigated and their total population was 1.25 billion people. The result showed that 844 villages, or 697,000 people, were exposed to drinking water with a high arsenic content.<sup>90</sup> In 2013, BBC News published an article stating that nearly 20 million people in China are exposed to arsenic-contaminated drinking water.<sup>91</sup> The question may arise, how is it possible that while nearly 1 million people were exposed to arsenic-contaminated drinking water in 2010, in 2013 this number was already nearly 20 million people, which is twenty times the data from three years ago? I don't think, and I don't think many others do either, that the number of people at risk has jumped so dramatically in three years. It is rather that the political set of the People's Republic

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<sup>84</sup> Lu Wen Qing, Xie Shao Hua, Zhou Wen Shan, Zhang Shao Hui, Liu Ai Lin 2008: 3.

<sup>85</sup> Feng Xinbin 2005: 3.

<sup>86</sup> Feng Xinbin 2005: 4.

<sup>87</sup> Feng Xinbin 2005: 3.

<sup>88</sup> Feng Xinbin 2005: 11.

<sup>89</sup> Lu Wen Qing, Xie Shao Hua, Zhou Wen Shan, Zhang Shao Hui, Liu Ai Lin 2008: 4.

<sup>90</sup> He Jing, Charlet Laurent 2013: 83.

<sup>91</sup> <https://www.bbc.com/news/science-environment-23794644> (Date of access: 05/22/2023)

of China refuses to disclose the real data or that the Western press is trying to discredit the communist government with fake news. In recent decades, doctors in the three eastern Chinese provinces of Jiangsu, Anhui, and Henan have noticed that the number of cancer patients has begun to increase. The common point between the provinces is the Huai Hé River, which connects all three regions. In the last 40 years, several food processing plants, paper factories, and other polluting factories have been built next to the river bank. According to a 2006 source, 80 percent of deaths in Anhui province were attributable to liver cancer, and in a village there, 40 people out of 280 households had esophageal cancer.<sup>92</sup> The most famous village in Henan Province is Huáng Mèng Yíng, as 105 out of 204 people died of cancer between 1990 and 2004, and the village's death rate during this period was about 60 percent higher than before 1990.<sup>93</sup> Some public health experts have confirmed that it is not surprising that various cancers have become more common due to the high level of contamination in drinking water.<sup>94</sup> Cancer cases and deaths caused by contaminated water or soil have increased significantly in recent years. According to published news, there are more than 400 cancer villages in China.<sup>95</sup> Many investigations have revealed that these settlements are located near polluted rivers. If China truly wants to be the world's leading power in the future, it must rapidly address human-caused water pollution, otherwise, its economic expansion will be unsustainable if people do not have access to safe drinking water.

India is one of the fastest-growing economies in the world. The rapid population growth and urbanization in the country in recent decades have caused many environmental problems, such as water scarcity, wastewater production, and its collection, treatment, and disposal. Many cities have grown rapidly in size, but landfills, sewage storage, etc. were not always built in the right way. Nearly 80 percent of the water supplied for domestic use passes out as wastewater. In most cases, this wastewater is left out untreated and causes large-scale pollution of the surface water.<sup>96</sup> About 80 percent of stomach diseases in India are caused by the lack of safe water with inadequate sanitation. Water pollution adversely affects the health and life of man, animals, and plants alike. Polluted water is also harmful to agriculture as it adversely affects crops and soil fertility.<sup>97</sup> Consumption of contaminated water and diseases spread by it such as

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<sup>92</sup> Bai Xuemei 2006: 28.

<sup>93</sup> Bai Xuemei 2006: 27.

<sup>94</sup> Bai Xuemei 2006: 27.

<sup>95</sup> Yu Xiaoman, Geng Yong, Heck Peter, Xue Bing 2015: 5781.

<sup>96</sup> Pukhraj Rakhecha 2020: 154.

<sup>97</sup> Pukhraj Rakhecha 2020: 155.

cholera epidemics occur regularly, typhoid, paratyphoid, dysentery, diarrhea, tuberculosis, jaundice, and amebiasis are common in India as well. Waterborne diseases are the single most important factor responsible for nearly 80% of human mortality in India.<sup>98</sup> Those living in rural areas and urban slums are the most affected. Polluted freshwater leads to high infant mortality. In some parts of the Indian state of West Bengal, drinking water with high arsenic content is widespread, leading to loss of limbs, cancer, or death.<sup>99</sup> The rapid growth of the population in India has led to several water-related problems that are relevant to public health, as well as in other emerging countries. The interesting fact is that India has had a sacred relationship with water for thousands of years. Their religious beliefs and social activities add to the pollution of our river waters from time immemorial. Dead bodies are cremated on the river banks. Partially burnt bodies were put into the river. Cattle and other animal carcasses are dumped in the waterways. All of this is carried out out of religious conviction and in accordance with age-old customs. Indian religious traditions often call for the immersion of offerings from religious prayers in rivers. Nowadays, it's typical to see people immerse offerings in plastic bags, which are extremely harmful and increase the river's pollution burden. These actions are in direct opposition to any political beliefs that seek to build a more ecologically friendly world on a global scale.

It has been for a long while that on the Black Continent, the condition of the pure water is quite terrible. In many African countries, the population is growing rapidly every year, but the lack of safe water and sanitation reduces economic growth because there is no adequate sewer system or water treatment. The consumption of water in Africa is based on groundwater, surface water, and rain water. But unfortunately, contamination of their water is polluted by fluoride, arsenic, nitrate, iron, and more recently, chromium from natural geological sources or agricultural and industrial activities. Debilitating diseases such as cholera, hepatitis A, typhoid, and polio are also linked to contaminated water sources. Furthermore, the low-quality sewer system and water management led to excess salinity due to seawater infiltration. The bad water quality jeopardizes a child's chances of survival. Somalia is among the world's highest, and only 56 percent of households use safe drinking water. Children under five years old are more than 20 times more likely to die from diseases linked to unsafe water and sanitation than from direct violence.<sup>100</sup> Today mining activity is undergoing expansion in many countries in: Burkina

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<sup>98</sup> Pukhraj Rakhecha 2020: 155.

<sup>99</sup> Pukhraj Rakhecha 2020: 156.

<sup>100</sup> Unicef 2022: 4.

Faso, Guinea, Niger, and Ghana as the leader in gold mining. It is known that gold exploitation, mainly artisanal and small-scale gold mining, contributes to water pollution by mercury and cyanide leading to serious water and soil pollution and health problems.<sup>101</sup> High concentrations of fluorine were observed in water used by populations in south-central Senegal and the Maradi area in Niger. If fluor accumulates in humans it increases bone/tooth and skeletal defects.<sup>102</sup> Cadmium, arsenic, and mercury have been quantified and found at unacceptable levels in the mining communities of Enigma, Mkpuma Akpatakpa, Ameka, Amorie, Amachara, and Alibaruhu in Nigeria.<sup>103</sup> In Zambia, the amount of zinc and nickel in the water resources is also very high. Health risks associated with a high accumulation of toxic heavy metals in human tissues include, for example, Parkinson's disease, acrodynia, arsenicosis, seal noise, Alzheimer's disease, hair loss, mental retardation, and abortion in nearby women. Researchers have shown that roughly 115 people die in Africa every hour from diseases that are closely related to poor hygiene, improper sanitation, and polluted water.<sup>104</sup> At the dawn of the new millennium, Africa faces several serious socio-economic problems that call for urgent remedial action if current trends towards endemic poverty and pervasive underdevelopment are to be turned around. The crucial role of water in accomplishing the needed socio-economic development goals is widely recognized. Africa needs to develop long-term water quality management, which requires consideration of policy, technical, institutional, and financial approaches. One of the main goal of "Agenda 2063: The Africa We Want", is the water security and sustainable natural resource management and biodiversity conservation. However, if the world really wants to see a prosperous Africa, based on inclusive growth and sustainable development, then the developed countries must have a duty to provide assistance to the black continent and its nations.

The United Nations asserts that only six essential components of health systems should be considered, when analyzing the effects of water and sanitation on human health: national policy and administration, funding, service provision, technologies and infrastructure, labor, and information systems.<sup>105</sup>

- National policy and administration: National plans and regulations to guarantee investment sustainability.

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<sup>101</sup> Samuel Pare – L. Yvonne Bonzi-Coulibaly 2013: 89.

<sup>102</sup> Samuel Pare – L. Yvonne Bonzi-Coulibaly 2013: 90.

<sup>103</sup> Limin Ma 2021: 381.

<sup>104</sup> Limin Ma 2021: 380.

<sup>105</sup> The United Nations World Water Development Report. 2020: 76.

- Funding: Utilize risk management techniques to calculate the cost of extra climate-related risks and incorporate them into funding plans for water and health as well as running and financing plans for water supply and sewage facilities.
- Service provision: Reducing water shortage by recharging aquifers and using wastewater in irrigation safely.
- Technologies and infrastructure: Strengthen the infrastructure for water, hygiene, and health.
- Labor: Ensuring a sufficient number of workers and worker knowledge for water and sewage services.
- Information systems: In particular, during severe weather conditions and water-related catastrophes, strengthen tracking and surveillance programs for drinking, irrigation, and leisure water.

The Hungarian-Russian collaboration, where these points of departure prevail, is an excellent example of the United Nations plan. The water in the Central Ural region is already undrinkable owing to industrial pollution, and any usage is hazardous due to the extremely high degree of radioactive contamination. The city's water purification equipment is primarily obsolete, and a Russian-Hungarian joint venture (Ural Water Company) was formed to address this issue, with the goal of resolving Sverdlovsk County's water purification issues. Ural Water Company, currently has two active projects in Sverdlovsk County. The Hungarian side offers the technical base (pumps, membranes, and other equipment) and work (design, management, and building) of Hungarian engineers with experience in the water business for the investments.

In addition, we must emphasize as well, that in the healthcare industry, water quality critically underpins patient safety and the management of medical technology, with different grades of water quality required depending on different pharmaceutical uses. Sterile water is required to treat wounds, prevent infection, and clean reusable surgical instruments. In the clinical diagnostics space, pure water is required at every stage of operation and, as diagnostics tests become more sophisticated and sensitive, consistent water quality is more important than ever. The pharmaceutical industry also devotes considerable resources to the development and maintenance of water purification systems to ensure that water for the manufacture of medicinal products is at the highest quality.

We can see that water pollution is one of the main concerns of the world today, especially for underdeveloped and developing countries, where there the population rapidly grows and

they cannot provide an adequate safe water supply to the population. The amount of pollutants in freshwater determines the suitability of water for many human uses such as drinking, cooking, bathing, and agriculture. Moreover, pollution of freshwater ecosystems can impact the habitat and quality of life of wildlife as well. Therefore, providing safe water and eliminating irresponsible wastewater discharge are among the most important factors affecting the health of the world.

#### **II.4. Challenge: The agriculture case to feed the growing population**

Since the First Industrial Revolution, the world's population has started to grow rapidly. There has been a significant transformation, particularly during the Third Industrial Revolution of the twentieth century. At that time, there were 2.5 billion people in the mid-twentieth century. But seventy years later, on 15 November 2022, the world's population reached 8 billion people, it is a milestone in human development.<sup>106</sup> The world's population is more than three times larger than it was in the mid-twentieth century. This is huge and extremely fast population growth, which has never happened before in human history. In addition, further signs do not show that the growth trend will stop, but rather that it will continue to grow. It is a critical fact, that the population of underdeveloped countries and developing countries is growing the fastest, where there is already a large water stress. This means that the biggest challenge for these countries in terms of their development will be the sustainability of the state, since their economic growth is far from growing at the same pace as their population growth. The world population is projected to reach 8.5 billion in 2030, and to increase further to 9.7 billion in 2050 and 10.4 billion by 2100.<sup>107</sup> This means that feeding people will be one of the major challenge in the twenty-first century.

For instance, far eastern Asia's Mekong region is experiencing rapid population growth. The total basin population in 2020 is estimated at 72.1 million, of which 25.4 million are in Thailand, 19.8 million in Vietnam, 13.4 million in Cambodia, 6.3 million in China, 6.2 million in Lao PDR, and 0.8 million in Myanmar.<sup>108</sup> There is a big pressure to achieve food, water and energy security for all consistent. In order for everyone to profit from the growth of the basin's water resources, including those who are most vulnerable, the Mekong River Commission

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<sup>106</sup> <https://www.un.org/en/global-issues/population> (Date of access: 05/22/2023)

<sup>107</sup> <https://www.un.org/en/global-issues/population> (Date of access: 05/22/2023)

<sup>108</sup> 2021–2030 Basin Development Strategy & MRC Strategic Plan 2021–2025. 2021: 36.



works to ensure that everyone can fulfill their fundamental requirements. Because of this the, Mekong River Commission strengthened water, food, and energy security for basin community well-being. Thus, access and supply of safe water to people in vulnerable situations improved. Capture fisheries regulatory frameworks improved to support food security. The Mekong River Basin supports one of the world's most diverse freshwater environments with around 1,200 fish species recorded. Unfortunately, the total biomass is estimated to have declined considerably over the past 100 years due to agricultural land development including massive expansion of rice farming and deforestation, intensive fishing pressure, hydropower development, sediment extraction, urbanization and industrial development and associated pollution.<sup>109</sup> The impact on fish numbers raises significant questions about both food security and the way of life for those who are susceptible. The Mekong River Basin's fisheries are a significant supply of food industry. Over the last 10 years the industry has experienced average annual growth of more than 11 percent.<sup>110</sup> As a result of its better economic returns and the impact of salinity incursion on farming yields, aquaculture production is expected to continue expanding rapidly, especially in the delta. Despite significant obstacles, there are possibilities for further aquaculture growth, including in reservoirs, in the Mekong River Basin. In addition, investment and associated measures to adapt to changes in fish populations and catch composition identified and implemented.<sup>111</sup> Thus, in the region, fishing may be the driving force of the economy, solving hunger concerns even at the regional level as well.

Agriculture is currently the largest user of water, accounting for about 70 percent of global water withdrawals.<sup>112</sup> As I mentioned before, that only 3 percent of the water resources on the Earth is freshwater and we use the 70 percent of it for agriculture. So agriculture uses most of our freshwater supply. However, the water required for the production of different foods is very different; for example cabbages, cucumbers or peppers require more water than other vegetables. In addition, increased livestock production and associated meat processing consume large quantities of water and produces significant amounts of contaminated wastewater. Thus the agricultural water use is extremely consumptive. Presently, agricultural water usage makes up a sizeable share of withdrawals in many developing and lower-income nations where food production makes up the majority of GDP. For instance, in 2009, agriculture accounted for 94

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<sup>109</sup> 2021–2030 Basin Development Strategy & MRC Strategic Plan 2021–2025. 2021: 34.

<sup>110</sup> 2021–2030 Basin Development Strategy & MRC Strategic Plan 2021–2025. 2021: 43.

<sup>111</sup> 2021–2030 Basin Development Strategy & MRC Strategic Plan 2021–2025. 2021: 82.

<sup>112</sup> Sustainable Growth: Taking a Deep Dive into Water. 2013: 6.

percent of total water withdrawals in both Cambodia and Ethiopia, and reached 90 percent of withdrawals in India (which has to feed 20 percent of the global population).<sup>113</sup> Basically, these countries which are already under high water stress, uses their entire water resources for agriculture. Thus, their use related to agriculture is much more demanding than in other economic sectors.

As the production and distribution of any agricultural good requires the consumption of water. Meat products require much more water than grains. For example, the virtual water content of beef is roughly 17 times the amount in maize and 12 times the content in wheat.<sup>114</sup> So, the freshwater footprints of meat products are substantially larger than those of most plant-based products, nuts being one of the few exceptions. In some countries where economic growth and the expansion of the middle class are increasing, especially in emerging countries such as the BRICS countries, people have shifted from predominantly plant-based foods to more water-intensive products such as meat and dairy products. For example, as China's middle class grew from less than 1 percent of the total population in 1990 to 40 percent of the population today, per capita pork consumption increased almost 100 percent to reach 38.4 kilograms per person in 2012—1.5 times the per capita level in the United States.<sup>115</sup> Moreover, meat imports from the Philippines, Vietnam, and Sub-Saharan Africa also surged. Which captures a large share of additional imports for all meat types. Meat consumption has been high and mostly stable in much of the developed world for decades. Each person in Germany consumes an average of 60 kg a year, while in the United States and Australia it is more than 100 kg.<sup>116</sup> Developing nations like Argentina, India, Indonesia, Mexico, Pakistan, and Vietnam have joined top meat-producing nations like Brazil, China, the European Union, and the United States. According to statistics, beef production in developing countries will be 16 percent higher in 2026, relative to the base period and account for 80 percent of the additional beef produced. As much as 75 percent of this additional beef production is attributed to Argentina, China, Brazil, India, Mexico and Pakistan.<sup>117</sup> The continuous expansion of the middle class in emerging economies means further demand for meat products in the future.

International meat trade will expand in response to growing demand from countries in the developed and developing countries where production will remain largely insufficient to

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<sup>113</sup> Sustainable Growth: Taking a Deep Dive into Water. 2013: 14.

<sup>114</sup> Sustainable Growth: Taking a Deep Dive into Water. 2013: 15.

<sup>115</sup> Sustainable Growth: Taking a Deep Dive into Water. 2013: 16.

<sup>116</sup> MEAT ATLAS Facts and figures about the animals we eat: 2021. 12.

<sup>117</sup> OECD-FAO AGRICULTURAL OUTLOOK 2017-2026. 4.

meet demand. As a result, agricultural goods will cost much more money. Nominal price increases are foreseen, especially in middle-income countries where meat demand is responsive to income. This is especially relevant for the pigmeat sector. Over the first years of the projection period, supply constraints in several Asian countries, particularly China where the middle class rapidly grew, will induce higher import demand and lead to higher prices. Beef prices are forecast to rise 33 percent higher by 2050, as inventories and cattle stock levels increase in key exporting countries such as Argentina, Australia and the United States. Poultry prices are expected to closely track grain prices given the high share of feed costs in production and the rapid response of production to global growing demand. The benchmark pork price is forecast to rise to meet strong demand, especially from China, but this will be dampened by rising exports from Brazil, the European Union and the United States. Population growth is clearly the main driver of increased consumption, and the projected global increase of 11 percent will underpin a projected increase of 14 percent in global meat consumption by 2030.<sup>118</sup> Unfortunately, the price of not only meat products but also other agricultural products will increase. Nevertheless, prices for major grain crops like rice, wheat, maize and soybeans will increase by up to 60 to 70 percent, over the next few years, even without climate changes and water stress. Bearing in mind the predicted weather changes an additional 32 to 37 percent for rice, 52 to 55 percent for maize, 94 to 111 percent for wheat and 11 to 14 percent for soybean can be expected.<sup>119</sup> It is obvious that as prices rise, it becomes more and more difficult for people to maintain their standard of living. So this might lead the society into high tensions and outrages.

As I previously stated, as a result of the rising demand from rich and emerging nations, the global food trade will increase (particularly the trade in meat), and it means that there will also be a significant water trade as well. Since the preparation, production and distribution of any agricultural product requires a lot of water consumption, the trade of products can also be analyzed as the trade of water resources of one region with another region. For example, when a country imports any kind of agricultural product, such as wheat, that country is actually importing virtual water, i.e. the water needed to produce the crop. Thus, trade in agricultural products enables the transfer of water resources from water-rich nations to water-scarce regions. International trade movements have shown signs of this trend. The number of food trade relationships and the associated virtual water volumes both grew significantly. This difference in trends induced a 25 percent increase of the average link weight (i.e., the volume of virtual

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<sup>118</sup> OECD-FAO Agricultural Outlook 2021-2030. 171.

<sup>119</sup> Climate Change: Impact of Agriculture and Costs of Adaption. 2009: 6.

water traded between each pair of trading partners) between 1999 and 2007.<sup>120</sup> There are some regional and national changes. Asia's virtual water imports have grown from 97 km<sup>3</sup> in 1986 to 261 km<sup>3</sup> in 2007, and they are now mainly coming from South America. Indeed, South America's share in Asian imports went up from 8 percent in 1986 to 39 percent in 2007, whereas North America's share decreased from 42 percent to 25 percent.<sup>121</sup> The trade of soy from Brazil, the United States, and Argentina to China plays a significant role in the recent global virtual water trade increase 19 percent of the increase from 1986 to 2007.<sup>122</sup> This finding reveals that high virtual water flows between nations in every year. For example, in the Middle East, Saudi Arabia, which is experiencing severe water shortages, is trying to ease the strain on water resources by replacing domestic wheat production with imports. In this way, they are able to save water consumption which would be used for domestic wheat production. So these virtual water flows provide an opportunity for relatively freshwater-rich countries to reduce and slow down water consumption by less freshwater-rich countries. So, the trade relationship contributes to global water savings if it moves from a relatively more efficient country to a relatively less efficient country. Actually, international food trade can lead to global water savings. In 2000, global water savings accounted for 4 percent of water used in agriculture, and this proportion increased to 9 percent in 2007.<sup>123</sup> Virtual water trading enables greater efficiency in water use. It highlights the important role of international trade in the efficient distribution of resources, and helps developing countries meet changing dietary demands.

Currently, agriculture uses the most freshwater. As a result, farm water control is crucial to the creation of agricultural goods, food, and crops. Because of this, managing more frequent instances of water deficits or excess (through flood protection and drainage) is crucial. When changes in periodic rainfall patterns and higher temps make rainfed agriculture too unpredictable to meet levels of demand for food staples, sustainable water management will be the main adaptation strategy. As a consequence, as the effects of aridity and water scarcity are felt by producers, it is anticipated that strain on the freshwater resource base will increase and agronomy will become more fruitful with regard to water. This is what the report of the United Nations suggests:

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<sup>120</sup> Evolution of the global virtual water trade network. 2012: 5989.

<sup>121</sup> Evolution of the global virtual water trade network. 2012: 5990.

<sup>122</sup> Evolution of the global virtual water trade network. 2012: 5992.

<sup>123</sup> Evolution of the global virtual water trade network. 2012: 5993.

- *Mild' alternate wet*: Dry cultivation of rice has been shown to reduce methane emissions, maintain yields and potentially reduce water demand by up to 24 percent when compared with continuous flooding.<sup>124</sup> Moreover, reduced pumping expenses and reduced cereal arsenic concentrations are possible additional advantages.<sup>125</sup>
  
- *Agroforestry*: This system incorporates trees and shrubs into agricultural and livestock cultivation methods.<sup>126</sup> In order to produce advantages for the ecosystem, the economy, and society.<sup>127</sup> It may benefit groundwater replenishment, runoff and erosion management, soil nitrogen cycling, soil water infiltration, soil water storage, wildlife, and biodiversity.<sup>128</sup> In addition, in temperate zones where forests attract high levels of occult precipitation and bind upland soils, forested catchments may be encouraged or protected since they can also sustain higher levels of baseflow for urban water supply.<sup>129</sup> Agroforestry is a very old agricultural method that is still commonly used in several European nations, such as Scandinavian or Spanish countries or Russia as well.
  
- *Trends in zero grazing of livestock*: Resulting in the concentration of water demand in fewer locations, straining local and regional aquifer systems, notably groundwater, for the production of fodder and the watering/cooling of livestock.<sup>130</sup> Advantages of this approach include more effective grass use and an extend of the grazing season, as well as better usage of areas that are too far away for the cows to go to. However, the downsides of this strategy include: additional labor and mechanical expenditures to harvest and carry, and harvesting might be difficult if the weather is severe.
  
- *Promote agro-climate-based tools*: To encourage the use of agroclimate-based instruments at the national and worldwide levels to foresee rising climate risks (rainfall intensity, duration and frequency, as well as diurnal temperature range, humidity and evaporative power). Tools aimed towards farmers and rural communities require effective delivery channels and may take use of developments in rural information and communications technology, for example: smartphones.

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<sup>124</sup> The United Nations World Water Development Report. 2020: 93.

<sup>125</sup> The United Nations World Water Development Report. 2020: 93.

<sup>126</sup> The United Nations World Water Development Report. 2020: 93.

<sup>127</sup> The United Nations World Water Development Report. 2020: 93.

<sup>128</sup> The United Nations World Water Development Report. 2020: 93.

<sup>129</sup> The United Nations World Water Development Report. 2020: 93.

<sup>130</sup> The United Nations World Water Development Report. 2020: 92.

In summary, agricultural water use is extremely demanding. It accounts for 70 percent of our fresh water supply. Water withdrawals from several lower-income nations are primarily used for agricultural cultivation. Climate change stress and agricultural water stress will certainly increase inequalities between regions of the planet. People have switched from primarily plant-based meals to more water-intensive items like meat and dairy in some nations where economic growth and the middle class are expanding, especially in rising nations like the BRICS countries. The demand on the world's freshwater resources is also rising as a result of this. The unequal distribution of water, however, may be reduced and more effective water utilization made possible via virtual water trade.

## **II.5. Conclusion**

With the start of the industrial revolution, mankind has advanced and modernized quickly. The fast exploitation of natural resources was facilitated by new innovations, mass manufacturing, improvements in military equipment, scientific and technological advancements, the growth of globalization, and the emergence of multinational businesses. Humanity has officially evolved into a mass consumer in recent decades. The true threat, however, comes from how quickly mankind is populating the planet and how much of the planet's natural resources are being wasted. The situation had already become so bad by the start of the twenty-first century that the most essential natural resource for human life, water, was in jeopardy.

Life itself is in water. Water is necessary for life, and without it, you cannot survive. Both human survival and the sustainability of the planet depend on water. Water is essential for healthy ecosystems, economic growth, and human life, and it is at the heart of sustainable development. It is essential for enhancing population health, welfare, and productivity, as well as lowering the worldwide illness load. So, the existence of living beings, economic growth, and environmental stability all depend critically on the availability of water resources on our planet. In many ways, like air, water is a natural right, a commodity, and a resource that supports life. As a result, every choice you make and every action you perform in relation to water is crucial and incredibly significant. Overall, freshwater is essential to all facets of life.

Globally, freshwater stress is already present or will be prevalent from America to Africa, via Asia, to the Far East. Water scarcity is becoming a major issue on a worldwide scale.

More than 40 percent of individuals are now affected by the fresh water shortage. It is over half of all people on the planet. But, one of the most alarming statistics is that during the past century, the globe has lost 70 percent of its natural wetlands. One of the most ecologically productive environments is a wetland. About half of the world's population is affected by global water shortage, particularly in the third world and emerging nations, but also large global corporations and the private sector in wealthy nations are aware of the issue. The global water crisis has had a significant influence on every part of our lives. The main causes of the world's severe water stress are the unequal distribution of vital water resources, climate change, pollution and poisoning of water sources, and the need for agriculture to support an expanding population.

We can simply claim that the Earth is referred to as "the water planet" or "the blue world" since images taken from space clearly show that our planet has more water than land. Yet, fewer than 3 percent of the water on our planet is freshwater, with the majority (approximately 97 percent) being salt water. The majority of the freshwater on Earth is submerged in aquifers or frozen in glaciers and ice caps. We can readily obtain freshwater, which makes up less than 1 percent of the total amount of water on Earth. Hence, 1 percent of the freshwater resources are shared by everyone. The limited fresh water resource on earth is dispersed unevenly throughout the world. While some nations and regions are largely desert and have long droughts, others have more rivers and lakes and receive regular rainfall. Occasionally there are significant differences even within a same nation, as in China or the United States. Nowadays, there are 195 nations in the globe. But in reality, just ten countries account for more than 60 percent of the world's freshwater supply. Concerns about shortage are intensified by the rising demand for water in emerging nations. In recent decades, the use of freshwater has significantly expanded in emerging nations. Due to physical scarcity and conditions of overpopulation compared to their carrying capacity regarding the water supply, these countries, which are found in North Africa, the Sub-Saharan Africa region, the Middle East, South Africa, middle Asia, northern China, and India, will experience very severe water shortages.

From 1880, the Earth's temperature has increased on average by 0.08° Celsius every decade since the pre-industrial period. Every area of life, including our economics, communities, and the environment, are significantly impacted by climate change. The hydrological cycle and climate are closely related; therefore climate change has a big influence on the world's water supplies as well. In certain parts of the world, climate change is already causing major problems for water resources. The precipitation has decreased. The result is drought. The increase in precipitation and severe weather is the second factor. The result is

floods. Thirdly, the temperature rises as a result. Heat waves are produced. The rise in temperature is the fourth factor, which is the thawing and melting of frozen land, snow, sea ice, and glaciers. Moreover, irregular weather patterns like drought and flooding can destroy crops, overload agricultural storage facilities, and increase the uneven distribution of the world's water supply. When water supplies grow more limited, the dry areas will probably be most affected. Overall, climate change and harsh weather conditions make managing water resources even more difficult.

Water contamination is one of the key issues facing the globe today in our interconnected society. There are several contaminants that endanger water supplies, but the most pervasive is caused by ineffective resource management, including the discharge of raw sewage into natural streams, which is especially true in underdeveloped and emerging nations. Sewage, sludge, trash, and even dangerous contaminants are all poured into the water in these nations. The majority of sewage disposal takes place in undeveloped nations, although it is also widespread in developing nations like China, India, and Iran. Chemical waste that is discharged into surface waterways by businesses and governments is a serious issue as well. According to the World Health Organization, diarrheal disease accounts for around 2.2 million deaths globally each year, or 3.7 percent of all fatalities, and at any given moment, more than half of all hospital beds worldwide are occupied by patients with water-related illnesses. Additionally, as urban population expansion has outpaced the construction of municipal sanitary infrastructure, increasing urbanization of developing countries also significantly contributes to pollution. Freshwater pollution is a severe problem in many developing countries where the population is expanding quickly and they are unable to provide enough safe water to the people due to inadequate wastewater treatment facilities and inefficient management of water resources. The provision of clean water and the abolition of careless wastewater discharge are two of the most significant variables impacting global health.

With the First Industrial Revolution, population growth has accelerated globally. There has been a significant transformation, particularly during the Third Industrial Revolution of the twentieth century. Around the middle of the twentieth century, there were 2.5 billion people on the planet. Yet when the world's population reached 8 billion on November 15, 2022, seventy years later, it marked an important turning point in the history of humanity. The population of developing and poor nations, where there is already significant water stress, is expanding at a catastrophic rate. This indicates that one of the biggest challenges in the twenty-first century will be feeding people. At the moment, agriculture uses the most water, making up around 70 percent of all withdrawals worldwide. Presently, agricultural water usage makes up a sizeable



share of withdrawals in many developing and lower-income nations where food production makes up the majority of GDP. Many nations which are already under high water stress, uses their entire water resources for agriculture. As every agricultural product must be produced and distributed, water must be consumed. People have switched from mostly eating plant-based meals to more water-intensive goods like meat and dairy products in nations where the middle class is rising. This has led to an increase in the demand for freshwater resources across the world.

The United Nations World Water Development Report gives many examples, ideas and solutions, but the total effects go much further. Food security, human health, urban and rural settlements, energy production, industrial development, economic growth, and ecosystems are all freshwater-dependent. Given the obvious connections between water and the Sustainable Development Goals (SDGs), the organization believes that this should be enough to get people's attention and influence decision-makers at all levels of government. It should also spur the water and climate change communities to work more closely with other water-dependent sectors to take more focused and coordinated action. The Mekong River Commission's function is evolving from collaboration that focuses mainly on knowledge accumulation and sharing to extensive cooperation on the development and control of water resources throughout the entire Mekong River Basin. In order to increase regional benefits, lower regional costs, and provide a higher degree of water security during drought and rainy seasons, the commission creates new industry initiatives, including major collaborative and national projects. Additionally, it supports coordinated basin management activities to avoid and handle water-related crises as well as coordinated infrastructure operations (like hydropower cascades) in a basin that is becoming more developed and more prone to more severe weather events. In addition, the current fragmented water-related monitoring, modeling, and information systems need to be consolidated and modernized to a level that is suitable for proactive regional planning, coordination of basin operations, and disseminating information to important stakeholders and the general public. The goal of the multinational, regional, and global organization is to promote economic development and growth is higher and more sustainable across the planet than it otherwise would be based only on uncoordinated national plans, as well as aiding in enhancing water security and the economic worth of industries connected to water through regional collaboration. Better equitable growth and sustainability in the energy, transportation, environment, and fisheries sectors are some of the outcomes, along with expenditures in irrigated agriculture and other associated activities.

Higher levels of regional collaboration between all nations, backed by regional groups, initiatives, and programs, are urgently necessary to address the possibilities, risks, and challenges mentioned above.

### **III. Water: Emerging Innovations & Opportunities**

I went into great depth in the previous part of my thesis about how the water problems of today have developed into a severe, unavoidable global issue. Even so, there is no one-size-fits-all strategy for these extensive water experiments, which are primarily local or regional in scope. Despite the reality that we must overcome specific challenges and tests, the effect of severe weather on the need for water infrastructure and the requirement to adjust to shifting climatic conditions are both unavoidable in the twenty-first century, according to national governments, municipal water suppliers, and local government officials as well. Delivering a safe water future is an enormous domestically, household, and industrially task, but accomplishing it is essential for preserving human health, economic sustainability, and the environments of our planet. It is crucial that businesses in important economic sectors increase their efforts to conserve water and find ways to handle their own complex water requirements as awareness of the global water crisis and the desire to fix it grows.

Throughout history, human civilization has faced many challenges. But human ingenuity and creativity have always helped us through the storms of history. A trait of human ingenuity is the creation of something original and worthwhile. Numerous historical events have demonstrated the strength of human inventiveness, such as the first clicked spearheads from the Stone Age, the Renaissance, or the Enlightenment, etc. Based on these, we can be sure that human knowledge will impromptly aid the great issues of the future as they are encountered by the great global challenges of the twenty-first century.

New possibilities are emerging globally as a result of the new innovation opportunities in the water industry. For instance, developing new market conditions, offering new transport methods, and researching new marketplaces. All of these creative projects have the power to change the economic and technical landscape. Despite these limitations, there are more and more possibilities for technologies that allow improved efficacy in current water infrastructure systems and solutions that turn wastewater into a resource. There is a need for a variety of options, such as extra conveyance and storage systems, productivity improvements, recycling efforts, and conservation efforts. In order to meet requirements more affordably and boost

infrastructure resilience, communities are also considering incorporating green infrastructure, like the „sponge cities”.

The majority of people on the street would likely respond that natural gas initiatives, inventive innovations, or technical advancements are where the majority of the world's investments are being made. The massive investments in water initiatives that are currently being made all over the globe would not even cross our minds. The water project known as Toshka received nearly 90 billion dollars from Egypt, earning it the distinction of biggest investment in history, but in terms of the land of the pharaohs, we can even bring up the solid investment known as Al Mahsama, which would serve the desert nation as one of the biggest water recovery facilities in the entire globe. These absurdly large-scale initiatives aim to develop new agricultural territory, generate new employment opportunities, and draw millions of people to the newly developed regions. The Great Man-Made River, the biggest irrigation project in the world, is being built in Libya.<sup>131</sup> The nation of North Africa is fortunate to have sizable freshwater reserves at the bottom of its sand oceans. A vast network of subterranean pipelines that completely encircles the nation ensures the population's constant access to water. Piped through an underground network from the Nubian Sandstone Aquifer System in the Great Sahara desert to the coastal urban centres, including Tripoli and Benghazi, the water covers a distance of up to 1,600 kilometres, currently transports almost 2.5 million cubic metres of water daily.<sup>132</sup> Of course, massive expenditures in pure water must include China in the Far East. China has made two impressive expenditures. One is the Yangtze River's Three Gorges Dam, the world's biggest hydroelectric generating facility. On the other hand, the South–North Water Transfer Project, would convey water from south to north, guaranteeing the flow of drinking water for half of the Chinese people, as well as would maintain China's economy developing. The papers that follow provide a summary of the most important new innovations and possibilities.

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<sup>131</sup> <https://en.qantara.de/content/libyas-great-man-made-river-irrigation-project-the-eighth-wonder-of-the-world>  
(Date of access: 05/22/2023)

<sup>132</sup> <https://en.qantara.de/content/libyas-great-man-made-river-irrigation-project-the-eighth-wonder-of-the-world>  
(Date of access: 05/22/2023)

### III. 1. Renaissance of water pipelines

Pipelines have been built in many locations around the globe for a very long time to transport water for farming and drinking. For example, bamboo pipelines were used by the ancient Chinese to move water. Moreover, there are references to the Egyptians using copper pipe to transport water in 3000BC, the Cretians used earthenware pipe for water in 2000BC to 1500BC, and the Greeks used earthenware, lead, bronze and stone pipes from 1600BC to 300BC. Ancient civilisations such as the Persians and Romans all used pipes of some type; for example, metal pipe was used as far back as 500 BC when the Romans used lead pipes to distribute water in highly developed towns.<sup>133</sup> Consequently, pipelines were an obvious solution to the transportation problems.

Then, in the process of history, since the nineteenth century, oil transportation has replaced pipelines' original, most significant function. Numerous railroad firms persisted in their efforts to control the price of production and monopolize the transportation of gasoline. The railroad firms joined forces with the businesses that carry pipelines. For instance, in response to these alliances, the Standard Oil Company, the biggest refiner in the world at the time, constructed its own pipes and storage facilities. Other parts of the world, such as Azerbaijan's capital city of Baku, were building pipeline networks and experiencing significant transportation cost reductions. One of the first long pipelines was built in 1891. It was 120 miles (192km) long, and it carried gas from fields in central Indiana to Chicago.<sup>134</sup> The construction of long-distance, large-diameter pipelines, which was pioneered in the USA in the 1940s due to the energy needs of the Second World War, was the next significant development in pipeline architecture. The "Big Inch" and "Little Big Inch" pipelines built from East Texas to the northeastern states during World War II are the finest examples of these early long distance pipelines, which are consortium of the formerly private company known as the Standard Oil Company, (today called as Exxon Mobil Corporation). The twentieth century saw many improvements in pipeline engineering, and the oil and gas industry is still enormous today.

Who would have imagined that building water pipelines would once again be essential for our sustainable growth in the twenty-first century, just as it was for past societies, and ancient civilizations. As I mentioned in my previous chapter, that the earth's small fresh water supply is unevenly distributed across the planet. Some regions and countries have more rivers and lakes and get regular rain, while others are mostly desert and suffer years of drought.

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<sup>133</sup> P. Hopkins: PIPELINES: Past, Present, and Future. 2007: 4.

<sup>134</sup> P. Hopkins: PIPELINES: Past, Present, and Future. 2007: 9.

Sometimes the difference is huge even within a country. Just ten countries account for more than 60 percent of the world's freshwater supply. Notably Brazil 13 percent of global resources, the Russian Federation 10 percent, Canada 7 percent, the United States of America 7 percent, the People's Republic of China 6 percent, Colombia 5 percent, Indonesia 5 percent, Peru 4 percent, India 3 percent, Myanmar 2 percent, and rest of the world countries 38 percent. As a result of the uneven global distribution, 2.3 billion people live in water-stressed countries, of which 733 million live in high and critically water-stressed countries.<sup>135</sup> The growing demand for water in developing economies heightens concerns about scarcity. Freshwater consumption in developing countries has increased rapidly in recent decades. A large portion of the affected population resides in developing countries and close to two-thirds live in the BRICS countries (Brazil, Russia, India, and China). It will be a huge challenge for the future leading emerging BRICS economies, Brazil, Russia, India, China, and South Africa, to sustain their economic growth. In addition, the third-world countries and developing countries, where there is a big drought and a huge demand for water supplies such as North Africa, the Sub-Saharan Africa region the Middle East, South Africa, middle Asia, will face very severe water shortages due to physical scarcity and the condition of overpopulation relative to their carrying capacity concerning the water supply. In my opinion, new pipelines can assist in resolving the water issue. This will necessitate sizable financial outlays, sizable infrastructure, and global cooperation. I think, China is a fine illustration of how water pipes can be an excellent answer to the planet's unequal distribution of fresh water resources. In the words that follow, I will give a detailed explanation.

First of all, we have to examine China's geographical features. China can be split into North China and South China geographically. The Yellow and Yangtze rivers approximately form the boundary between these two areas. These two regions vary from one another not only in terms of people, dialect, climate, and economic output, but also—and this is crucial from the standpoint of our thesis—in terms of hydrography. North China is significantly drier than South China, in the south the spread of precipitation and river courses are also much more consistent, reliable, and abundant in navigable rivers and waterways in the south. In the south, where a monsoon environment predominates, strong summer rainfall are fairly typical.

The South, with average rainfall of over 2,000 mm/year, is more waterabundant than the North, where rainfall only averages about 200–400 mm/year. Per capita water availability

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<sup>135</sup> <https://www.unwater.org/water-facts/water-scarcity> (Date of access: 05/22/2023)

in northern China is only 757 m<sup>3</sup>/year, less than one-fourth that in southern China, one-eleventh of the world average, and less than the threshold level of 1,000 m<sup>3</sup> /year commonly defined as “water scarcity.”<sup>136</sup> So the north has less total water resources than the south. The south uses more water in absolute terms than the north, but uses only 11 percent total water resources compared to the north, which 55 percent.<sup>137</sup> The aforementioned statistics and information provide no justification for why the nation with the largest population in the world should experience any significant potable water shortages. But in reality, this would be a very basic and shallow strategy. But if we are going to comprehend the severe water problem that continues to put strain on Chinese society even today, we need to look more closely at the country's northern water resources. The water problem in China is primarily concentrated in Northern China. The country's water problem is primarily concentrated in Northern China. China's north has 63 percent of cultivated land and produces 49 percent of industrial added value, but only accounts for 16 percent of the nation's water resources. Additionally, 8 out of the dry 11 regions and all water deficit regions are in the north.<sup>138</sup> This geographic mismatch is particularly severe in the Yellow River, the Huai River and the Hai River basins where only 7.5 percent of the nation's water resources are shared by 34.7 percent of the population and 32.1 percent of the gross domestic product (GDP) is produced on 39.3 percent of the agricultural land.<sup>139</sup> 80 percent of the rivers in Shanxi region were considered unsuitable for human use. The Yellow River provides 750 cubic meters of natural drinking water per individual annually, which is a very small quantity. Only 1.5 percent of the country's water supplies are available to sustain 10 percent of the total Chinese population, affecting 130 million people, in the Hi Hé basin, which contains Beijing and Tijnj.<sup>140</sup> The environment in Northern China is already cold and arid, and as the Gobi desert advances toward the northwest, it is causing more desertification, which makes the situation worse. The regions in this region depend more and more on the use of subterranean water, which frequently cannot provide the necessary amount due to the unavailability and scarcity of surface water. This excessive exploitation, which is harmful to groundwater, can hasten the drying up of lakes and marshes, cause land subsidence in many areas, and hasten the loss of groundwater reserves. To evaluate and comprehend the rapidly changing water issues and challenges in an already overpopulated China, I think the water summary stated above is crucial. It is obvious that the extremely unequal territorial

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<sup>136</sup> Xie Jian, 2009: 20.

<sup>137</sup> <https://www.chinawaterrisk.org/the-big-picture/north-south-divide/>

<sup>138</sup> <https://www.chinawaterrisk.org/the-big-picture/north-south-divide/> (Date of access: 05/22/2023)

<sup>139</sup> Jun Xia, Yongqin David Chen 2001: 910.

<sup>140</sup> Xie Jian, 2009.

allocation of water resources does not correspond to the spread of the population or of agricultural territory, and that the amount of water used per person differs from the amount used by residents of other regions. With China's hydrographic division, it is obvious that a consistently stable state and further long-term growth cannot be guaranteed. The issue is how much China's position as a great power will be jeopardized in the future by the hydrographic divide between North and South China? The Beijing government has devoted itself to build such ambitious projects as, for example, the South–North Water Transfer Project, demonstrating its awareness of the problem's severity.

Beijing's leadership started the South–North Water Transfer Project at the turn of the twenty century, which is the biggest water diversion project in the globe. According to the plans, the Yangtze, China's longest river, will feed the water-scarce northern regions. It is the third-largest river in the globe with a length of 6,300 kilometers, making it the longest river in both the nation and the continent. It comes from Tibet, travels through China's "rice bowl," then runs through the eastern plains and into the East China Sea close to Shanghai. The river has been used for millennia to move cargo between cities and settlements. The river contributes to around 42 percent of China's GDP and is important for both the nation's food and energy security.<sup>141</sup> The Yangtze River still has much better water quality than any other open water in northern China.

Northern China's water shortage is not a recent issue. The South–North Water Transfer Project was a concept that the great leader Mao Zedong (1893–1966) had before it was finally put into action by the Chinese government after decades of careful planning and study. In 2002, the biggest water transfer project in the world got under way. Three paths will be used by the Chinese government to transport water from the south to the north. The eastern path that uses the lower Yangtze River and the already-existing Great Canal to transfer water to the north. The path also links four lakes that will serve as reservoirs: Dongping, Nansi, Hongze, and Luoma. The eastern route's end in Tianjin, and its overall length is 1,156 kilometers.<sup>142</sup> In the middle path, water from the Danjiangkou Shuiku reservoir, a tributary of the Yangtze River, is redirected using channels so that it travels through the provinces of Henan and Hebei to reach Beijing and the nearby Tianjin. Construction of the central route began in December 2003. It was planned to be finished before the commencement of Beijing Olympic Games in August 2008 to provide Beijing with drinking water. However, by September 2008, only 307km of the

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<sup>141</sup> Hu Feng 2016.

<sup>142</sup> Liu Yuan Shu, Yan Fu Zhang, He Yun Hua, Gao Yu Ping 2006: 2.

central route had been completed.<sup>143</sup> The center path is 1,267 kilometers long in total.<sup>144</sup> Data showed that the eastern and middle routes have boosted industrial and agricultural output for cities on the receiving end by almost 100 billion yuan per year. During the past five years, the middle route has diverted 25.5 billion cubic meters of water, benefitting more than 58.59 million people along the route. Around 70 percent of tap water in Beijing is pumped in through the middle route, which is also responsible for the lion's share of water supply in more than 20 cities including Beijing and Tianjin, as well as cities in Hebei and Henan provinces.<sup>145</sup> Construction of the western route – which involves working on the Qinghai-Tibet Plateau – between 3,000m–5,000m above sea level – is scheduled to begin in 2010 and will involve overcoming some major engineering and climatic challenges. Once completed in 2050, the project will bring 4 billion cubic metres of water from three tributaries of the Yangtze – the Tongtian, Yalong and Dadu rivers – nearly 500km across the Bayankala Mountains and then on to northwest China.<sup>146</sup> The western route's primary goal is to address the issue of water scarcity in the upper reaches of the Yellow River, which includes the provinces of Qinghai, Gansu, Ningxia, Inner Mongolia Autonomous Region, and Shanxi. It is intended to begin from the higher reaches of the Yangtze River. Due to the danger of desertification in the majority of these regions, the supply of drinking water is urgently needed.

Over the past five years, the middle and eastern routes of the project have benefited more than 120 million people, according to the Ministry of Water Resources. More than 70 percent of tap water in Beijing's main urban areas is from the water pipeline, benefiting over 12 million residents, nearly half of the city's total population.<sup>147</sup> The Chinese government's news service, Xinhua News, interviewed with the local residents in 2019, and turned out that the outcome of this grandiose project is successful and brings satisfaction to the people of northern China. The following information was provided by the interviewees: "Instead of being destroyed by sending water to the north, our ecological environment has benefited from the project," said 35-year-old Zhang Weibin, chief engineer of a local sewage plant.<sup>148</sup> This water diversion project helps both the farming areas and the metropolitan population by supplying potable water supplies. This correspondent went on to say the following: "This year, I can harvest 10,000 kilograms of oranges, which is expected to bring me more than 20,000 yuan

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<sup>143</sup> [https://www.water-technology.net/projects/south\\_north/](https://www.water-technology.net/projects/south_north/) (Date of access: 05/22/2023)

<sup>144</sup> Liu Yuan Shu, Yan Fu Zhang, He Yun Hua, Gao Yu Ping 2006: 2.

<sup>145</sup> [http://www.xinhuanet.com/english/2019-12/11/c\\_138623052.htm](http://www.xinhuanet.com/english/2019-12/11/c_138623052.htm) (Date of access: 05/22/2023)

<sup>146</sup> [https://www.water-technology.net/projects/south\\_north/](https://www.water-technology.net/projects/south_north/) (Date of access: 05/22/2023)

<sup>147</sup> [http://www.xinhuanet.com/english/2019-12/11/c\\_138623551.htm](http://www.xinhuanet.com/english/2019-12/11/c_138623551.htm) (Date of access: 05/22/2023)

<sup>148</sup> [http://www.xinhuanet.com/english/2019-12/11/c\\_138623551.htm](http://www.xinhuanet.com/english/2019-12/11/c_138623551.htm) (Date of access: 05/22/2023)



(around 2,841 U.S. dollars),".<sup>149</sup> Two years ago, Tan and his wife opened a rural family inn to serve tourists visiting the Danjiangkou Reservoir. His family's income has exceeded 100,000 yuan this year.<sup>150</sup> With an estimated cost of this grandiose project is 500 billion yuan (about 71 billion U.S. dollars).<sup>151</sup> The biggest water transfer project in the world, China's south-to-north project, has recently been the only source of water for the country's dry north.

Although it must be noted that its execution was extremely timely, it is possible to say that the South–North Water Transfer Project is an effective Chinese venture. Currently, the northern regions are presently protected from drying out by the eastern, central, and western water pipelines routes. It is becoming more challenging to give towns with water as a result of China's rapid development. The quality of drinking water is still terrible, especially in the north. But, the South–North Water Transfer Project is a good initiative to deal with the water crisis, which takes place in the northern part of China. But the the real question is how many more opulent expenditures will the Chinese government has to make in order to avert a complete collapse brought on by a lack of fresh water?

In my opinion, the above issues for the pipeline industry are contrasted by a general view that the industry is probably entering its most exciting era in the twenty-first century. In the future more waterpipeline proposals are being made despite the economic and environmental dangers as the region's temperature becomes drier. As I mentioned in the previous chapter of my thesis, currently there are 195 nations in the globe, but in reality, just ten countries account for more than 60 percent of the world's freshwater supply. Considering that, these countries will have the ability to use freshwater as an economic power in the international arena, to achieve their own purpose, goals, objectives and interests in the global community. By controlling water resources, it means that a country has the ability to control the economy and population as well.

One of the largest building initiatives ever created is China's Belt and Road Initiative (BRI), also known as the New Silk Road project. Launched in 2013 by President Xi Jinping, the vast collection of development and investment initiatives was originally devised to link East Asia and Europe through physical infrastructure.<sup>152</sup> A new era of commerce and economic development for economies in Asia and elsewhere may be ushered in by these enormous

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<sup>149</sup> [http://www.xinhuanet.com/english/2019-12/11/c\\_138623551.htm](http://www.xinhuanet.com/english/2019-12/11/c_138623551.htm) (Date of access: 05/22/2023)

<sup>150</sup> [http://www.xinhuanet.com/english/2019-12/11/c\\_138623551.htm](http://www.xinhuanet.com/english/2019-12/11/c_138623551.htm) (Date of access: 05/22/2023)

<sup>151</sup> [http://www.xinhuanet.com/english/2019-12/11/c\\_138623052.htm](http://www.xinhuanet.com/english/2019-12/11/c_138623052.htm) (Date of access: 05/22/2023)

<sup>152</sup> <https://www.cfr.org/background/chinas-massive-belt-and-road-initiative> (Date of access: 05/22/2023)

infrastructure expenditures. The only way to travel along this overland commerce path, which links the Far East and the West, is through Central Asia. Central Asian countries are very rich in fossil fuels and mineral resources, but the most important issue in the region is freshwater. The reality that the Aral Sea has virtually vanished since the 1960s serves as an excellent illustration of how severe the situation is, because of the poorly thought-out and misguided Soviet farming strategy, which directed the rivers that supplied its water to irrigate regions with low rainfall. The Aral Sea, once the fourth-largest brackish lake in the world, started to get smaller as a result of less water getting to it; today, it is only a tenth of what it once was. The majority of the fish in what was remained of the lake were killed off by increasing salt concentrations, leaving former lakeside cities stranded and robbing fishing communities of their source of income. However, by building a dam to hold back water coming from the Syr Darya River into the north of the Aral Sea, Kazakhstan has managed to restore a tiny portion of the Aral Sea at the cost of some of the southern remnants. The ensuing tension and actual trouble are difficult to overstate, and the landscape devastation and environmental pollution are both very significant issues. At the end of May 2018, when water shortages had already resulted in significant agricultural losses, windstorms picked up salt from the dried-up lake bed and distributed it several centimeters deep over the wheat and cotton-growing areas of Uzbekistan and Turkmenistan.<sup>153</sup> Additionally, the reality that most of Afghanistan experienced a 70 percent rainfall shortfall in 2018 makes the situation in Central Asia even worse. 2 million people are expected to become severely food insecure and in desperate need of life-saving humanitarian assistance in the coming six months.<sup>154</sup> In the 20 regions most impacted by the drought, nearly 15 million people depend on farming, raising cattle, or employment prospects connected to agriculture as one of their primary sources of income. Obviously, competition for water has often been a source of tensions, particularly between the neighbours. The issue is caused, in part, by the fact that the Syr Darya, Amu Darya, and Irtis, the three major rivers of Central Asia, cross multiple nations. As a result, choices made about water management in one nation have an impact on those situated further downstream. For example, in 2008 Kazakhstan accused Uzbekistan of failing to allow sufficient water to transit via its territory, while in 2014 a fight broke out between villagers on the two sides of the Kyrgyz-Tajik border after irrigation water from Tajikistan to a downstream area in Kyrgyzstan was cut off.<sup>155</sup> In addition, competition for water in this heavily inhabited area coexists with racial conflicts, for example:

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<sup>153</sup> <https://www.fergananews.com/news/30189> (Date of access: 05/22/2023)

<sup>154</sup> <https://www.unocha.org/story/drought-grips-large-parts-afghanistan> (Date of access: 05/22/2023)

<sup>155</sup> Martin Russell 2018: 6.

in 2010 mobs attacked ethnic Uzbeks living in southern Kyrgyzstan, killing hundreds. Uzbekistan is particularly dependent on the flow of water from upstream Kyrgyzstan and Tajikistan, due to the importance of its cotton sector, which requires copious water supplies for irrigation. In the early 2000s, cotton accounted for up to 40 percent of exports; it is still one of the country's main exports, although by 2017 that share had declined to 10 percent.<sup>156</sup> Central Asian countries are major agricultural producers, including of water-intensive crops such as cotton, but with little water coming from rainfall they rely on irrigation. Agriculture is by far the biggest water user in Central Asia, and per capita water use in Central Asia is much higher than in European countries.<sup>157</sup> Turkmenistan is the most wasteful user of water, not only in Central Asia, but in the whole world, consuming 6 million litres per inhabitant per year – enough to fill two Olympic-size swimming pools. Not only agriculture is to blame for this; capital city Ashgabat consumes the same amount of water as Chicago, despite having just one-quarter of its population.<sup>158</sup> According to Global International Waters Assessment estimations, freshwater shortage is responsible for about 70 percent of the developmental problems in the regions.<sup>159</sup> It is clear that Central Asia is the epicenter of water problems. All the nations there, would be crucial players in the new global commerce path that would link Eurasia, which is another issue. Kazakhstan, a large part of which is outside the Aral Sea basin, draws most of its water from rivers that are shared with China. In addition, growth on both sides of the Kazakh-Chinese frontier is putting more strain on the Ili and Irtysh Rivers. Fortunately, the two nations have approached water sharing largely constructively, perhaps reflecting their mutual reliance and consequent interest in upholding good relations. China is a significant investor and energy-export market for Kazakhstan, while for China, Kazakhstan is a vital link in Beijing's Belt and Road initiative projects developing trade routes between Europe and Asia. But if the water issues are not resolved quickly, none of this will be possible.

From the east, Chinese power and interests are very strong in Central Asian nations. The question may arise as to whether if China will keep constructing the western portion of the South-North Water Transfer Project up to the boundary with Kazakhstan? Just to help sustain the development of the Central Asian region. China has already built a number of impressive investments and buildings throughout its past. If they made a comparable decision, I don't believe we would be at all shocked. The continent would then be virtually linked thanks to

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<sup>156</sup> Martin Russell 2018: 7.

<sup>157</sup> Martin Russell 2018: 4.

<sup>158</sup> Martin Russell 2018: 9.

<sup>159</sup> Igor Severskly 2004: 52.

waterpipes. I believe that there can be another key player in solving Central Asia's water challenges, and that is Russia. I have already stated in earlier sections of my thesis that only 10 nations control 60 percent of the world's pure water supply. The Russian Federation comes in second with 10 percent of this. Like the communist government of China, Moscow can begin constructing and innovating comparable water pipes if it is successful in supplying fresh water of a minimal standard. But why would Russia be drawn to and inclined toward such a massive undertaking? Well, Moscow's ambitions have a much broader sweep because of the relatively fresh memories of imperial control, the presence in the area of several million Russians, and the Kremlin's desire to reinstate Russia as a major global power. Moscow's foreign policy statements have made it plain that it views the entire space of the former Soviet Union as a zone of the Kremlin's special geostrategic interest, from which outside political and even economic - influence should be excluded. Water will undoubtedly be used as an economic force in the future to investigate a state's impact and interest in the global arena. Before Russia invaded Ukraine, the European Union was highly dependent on Russian energy resources. In 2021, EU countries imported 155 billion cubic metres (bcm) of Russian gas, which accounted for about 45 percent of total gas imports. Prior to the war, Russia was one of the largest suppliers of crude oil to the European Union (about 108.1 million tonnes) and the largest supplier of petroleum products – 91 million tonnes. In 2021, member states also imported 51.4 million tonnes of coal from Russia, which represented nearly half of total EU coal imports.<sup>160</sup> I believe that if oil and gas can be used to expand a country's economic power and influence in order to achieve its goals and objectives, it will be even more possible to do so with freshwater in the near future. In my opinion then, Russia would recover geopolitical significance in the area and could utilize its water supply (the world's second biggest) as an economic power. And the construction of water pipelines fits neatly into the concept proclaimed by the Chinese government as the "new silk road" (Belt and Road Initiative), which connects the Far East with Europe via infrastructure such as an upgraded railway network and highways. Currently in Central Asia, there are numerous international rivals. Russian Federation in the north, Turkey and the United States in the west, Iran in the south, and China in the east. Ultimately, Central Asia's future is likely to be shaped by an even more complex set of circumstances, with the fate of its states determined by the intricate interplay of Russian, Turkish, Iranian, and Chinese interests, as well as by the degree to which the United States conditions its relations with Russia on Russia's respect for the independence of the new states. The reality of that interplay precludes either empire or

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<sup>160</sup> <https://ecfr.eu/article/conscious-uncoupling-europeans-russian-gas-challenge-in-2023/> (Date of access: 05/22/2023)

monopoly as a meaningful goal for any of the geostrategic players involved. Rather, the basic choice is between a delicate regional balance-which would permit the gradual inclusion of the area in the emerging global economy while the states of the region consolidate themselves and probably also acquire a more pronounced Islamic identity or ethnic conflict, political fragmentation, and possibly even open hostilities along Russia's southern frontiers. The attainment and consolidation of that regional balance has to be a major goal in any comprehensive U.S. geostrategy for Eurasia. There are many global competitors in Central Asia. From the north Russian Federation, from the west Turkey, and United States, from the south Iran and from the east China. It is a given that the international player with the largest impact in its game will be the one who can put economic pressure on the area. And there is only one method to accomplish this: the freshwater.

Water pipes will once again be a major factor in the twenty-first century, just as they did in past civilizations like the Sumerian, Indian, Egyptian, and Roman, which decided how people lived their everyday lives and how well a state's economy would do economically. We are probably entering the most exciting era of water pipes in the twenty-first century, which will experience its renaissance. The neoliberal idea that water control would be better handled via the expansion of markets and the injection of private sector discipline runs parallel to this thinking. Water supply management in the private sector would minimize expenses, opportunistic management, and 'regulatory capture,' while enhancing investment, openness, and efficiency. Full cost pricing based on the market would result in higher efficiency, more appropriate allocation to the highest-value applications, and the ability for utilities to recoup their expenses and reinvest in infrastructure. According to the neoliberal perspective, it generates the essential incentives for management and cost control while also generating the required market conditions. Furthermore, enhanced allocation and waste reduction, as well as improved infrastructure and service delivery, will result. In terms of institutions, water sector reform was primarily aimed at creating new opportunities for markets and the private sector by rewriting legislation and the state's role. Why we all should be interested in waterpipelines? It delivers water reliably and safely, cheaply, with minimal environmental damage and a reasonable profit for consumers as well. Pipelines will be required to not only continue safely and economically into the future, but also be able to carry greater loads. A stream of investable chances to expand the blue economy in a manner that helps local economies and national economies, while safeguarding resources for future development, will be created by investing in better governance. The promotion of healthy management of aquatic resources and the

environment, as well as assuring biodiversity and ecosystem resilience, are prerequisites for ensuring that communities are resilient to various disruptions, including climate change. By lowering risks and offering incentives for invention, effective governance will also aid in developing an atmosphere that is conducive to ethical private sector investments across the entire value chain. The macroeconomic impact of fisheries, aquaculture, and mariculture will be increased through efficient administration, which will help increase the sector's exposure and, as a result, resource distribution. Half the population of the developing world are suffering from water-related diseases; one billion people have no source of drinking water. New pipelines can help solve the water problem. This will require huge investments, huge infrastructures, and international cooperation.

### **III.2. Virtual Water Trade System**

As I mentioned before in my thesis that agriculture is currently the largest user of water, accounting for about 70 percent of global water withdrawals. In addition I also mentioned before, that only 3 percent of the water resources on the Earth is freshwater and we use the 70 percent of it for agriculture. This is a huge differences. So agriculture uses most of our freshwater supply. As the production and distribution of any agricultural good requires the consumption of water. Meat products require much more water than grains, for instance. For example, the virtual water content of beef is roughly 17 times the amount in maize and 12 times the content in wheat. So, the freshwater footprints of meat products are substantially larger than those of most plant-based products, nuts being one of the few exceptions. In some countries where economic growth and the expansion of the middle class are increasing, especially in emerging countries such as the BRICS countries, people have shifted from predominantly plant-based foods to more water-intensive products such as meat and dairy products. For example, as China's middle class grew from less than 1 percent of the total population in 1990 to 40 percent of the population today, per capita pork consumption increased almost 100 percent to reach 38.4 kilograms per person in 2012—1.5 times the per capita level in the United States. Moreover, meat imports from the Philippines, Vietnam, and Sub-Saharan Africa also surged. Which captures a large share of additional imports for all meat types. Meat consumption has been high and mostly stable in much of the developed world for decades. Each person in Germany consumes an average of 60 kg a year, while in the United States and Australia it is more than 100 kg. Developing nations like Argentina, India, Indonesia, Mexico, Pakistan, and

Vietnam have joined top meat-producing nations like Brazil, China, the European Union, and the United States. Beef production in developing countries will be 16 percent higher in 2026, relative to the base period and account for 80 percent of the additional beef produced. As much as 75 percent of this additional beef production is attributed to Argentina, China, Brazil, India, Mexico and Pakistan. The continuous expansion of the middle class in emerging economies means further demand for meat products in the future. International meat trade will expand in response to growing demand from countries in the developed and developing countries where production will remain largely insufficient to meet demand. As a result, agricultural goods will cost much more money. Nominal price increases are foreseen, especially in middle-income countries where meat demand is responsive to income. This is especially relevant for the pigmeat sector. Over the first years of the projection period, supply constraints in several Asian countries, particularly China where the middle class rapidly grew, will induce higher import demand and lead to higher prices. Beef prices are forecast to rise 33 percent higher by 2050, as inventories and cattle stock levels increase in key exporting countries such as Argentina, Australia and the United States. Poultry prices are expected to closely track grain prices given the high share of feed costs in production and the rapid response of production to global growing demand. The benchmark pork price is forecast to rise to meet strong demand, especially from China. but this will be dampened by rising exports from Brazil, the European Union and the United States. Population growth is clearly the main driver of increased consumption, and the projected global increase of 11 percent will underpin a projected increase of 14 percent in global meat consumption by 2030. Unfortunately, the price of not only meat products but also other agricultural products will increase. Nevertheless, prices for major grain crops like rice, wheat, maize and soybeans will increase by up to 60 to 70 percent, over the next few years, even without climate changes and water stress. Bearing in mind the predicted weather changes an additional 32 to 37 percent for rice, 52 to 55 percent for maize, 94 to 111 percent for wheat and 11 to 14 percent for soybean can be expected. As prices rise, it becomes more and more difficult for people to maintain their standard of living. Producing agricultural goods will become more and more challenging as some areas struggle to obtain sufficient quantities of water resources. Prices for food will rise extremely, which could endanger the security and stability of nations, and can enable interstate collaboration for the purpose of sustainable growth.

In the foreseeable future, we will need to deal with all of these issues. The greatest answer to this problem, which jeopardizes our sustainability, must be found. It can emerge the virtual water trade system as a significant solution. The core of virtual water trading is that when

agricultural products are traded primarily on the worldwide global market, then actually water is also exchanged. Thus, virtual water commerce refers to the covert flow of water in food or maybe other items from one nation to another. Since the preparation, production and distribution of any agricultural product requires a lot of water consumption, the trade of products can also be analyzed as the trade of water resources of one region with another region. For example, when a country imports any kind of agricultural product, such as wheat, that country is actually importing virtual water, i.e. the water needed to produce the crop. Thus, trade in agricultural products enables the transfer of water resources from water-rich nations to water-scarce regions. International trade movements have shown signs of this trend. The number of food trade relationships and the associated virtual water volumes both grew significantly. This difference in trends induced a 25 percent increase of the average link weight (i.e., the volume of virtual water traded between each pair of trading partners) between 1999 and 2007. There are some regional and national changes. Asia's virtual water imports have grown from 97 km<sup>3</sup> in 1986 to 261 km<sup>3</sup> in 2007, and they are now mainly coming from South America. Indeed, South America's share in Asian imports went up from 8 percent in 1986 to 39 percent in 2007, whereas North America's share decreased from 42 percent to 25 percent. The trade of soy from Brazil, the United States, and Argentina to China plays a significant role in the recent global virtual water trade increase 19 percent of the increase from 1986 to 2007. This finding reveals that high virtual water flows between nations in every year. The goal of virtual water commerce is to convert the amount of water used to create agricultural goods into the equivalent amount of agricultural goods produced.

The virtual water concept, also known as embodied water, was coined by British geographer John Anthony Allan (1937-2021). He was awarded the Stockholm Water Prize in 2008 for his revolutionary virtual water concept. Professor John Anthony Allan has developed crucial information and communication tools for effective and sustainable water resource management and policy as a scientist, instructor, and adviser. Having been a long time water analyst with emphasis on the Middle East, he coined the term virtual water in 1993 after having been inspired by Gideon Fishelson from Tel Aviv University, who criticised his government over the amount of water that had been used to produce and export citrus fruits to the European Union.<sup>161</sup> Allan then researched trade figures of Middle Eastern states to conclude that this water-scarce region was only able to survive through large quantities of food imports in grain,

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<sup>161</sup>[https://www.europarl.europa.eu/meetdocs/2009\\_2014/documents/stoa/dv/04c\\_allan\\_wilderer\\_cv\\_/04c\\_allan\\_wilderer\\_cv\\_en.pdf](https://www.europarl.europa.eu/meetdocs/2009_2014/documents/stoa/dv/04c_allan_wilderer_cv_/04c_allan_wilderer_cv_en.pdf) (Date of access: 05/22/2023)



livestock etc. Thus, the region was not dependent on its own scarce water resources but could purchase water already embedded in agricultural produce.<sup>162</sup> In a conference paper, Allan argued that water should be seen as liquid capital. He claimed: *How then is it possible to argue that there are substitutes for water? The answer is partly that they have already been found ... [Many countries] either have sufficient water or they do not need it since they can substitute oil revenues to purchase food which cannot be produced at home because of water shortages.*<sup>163</sup> He argued that countries adopting virtual water as an international trade and natural resource management philosophy would receive immense economic benefits, as food often costs less to import than to grow domestically. For instance, in nations with limited water supplies, cereal cereals have been important virtual water carriers. Therefore, shipments of grain can be extremely important in making up for the local water shortage. But in the future, low-income nations might not be able to finance such goods, which could result in food instability and starvation. Low-income nations presently experience severe water scarcity.

Some studies have also indicated that virtual water trade could allow for greater efficiency of water use. A good example is Saudi Arabia, the country which is trying to reduce the stress on its water supplies by importing wheat in place of producing it domestically. There is not a single permanent watercourse or natural lake in the desert country. Groundwater, desalinated saltwater, and reclaimed water are Saudi Arabia's three main sources of water. (usually used for power generation). More than 80 percent of Saudi Arabia's total water usage was accounted for by the agricultural industry, which was also the biggest user. This percentage is considerably greater than the global average, where the agricultural industry uses 65 percent of all freshwater.<sup>164</sup> Almost all of Saudi Arabia's groundwater is used to irrigate fields; groundwater accounted for 83 percent of all irrigation in the country. In 2016, there were 22.9 billion cubic meters of this freshwater used for irrigation.<sup>165</sup> Most of the water withdrawals come from deep fossil aquifers, and some predictions suggest that these resources may not last more than 12 years.<sup>166</sup> Numerous studies have urged the government to cease funding the cultivation of products that require a lot of water. Water use from nonrenewable groundwater has increased as a result of water policy gaps, laws promoting the production of water-intensive

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<sup>162</sup>[https://www.europarl.europa.eu/meetdocs/2009\\_2014/documents/stoa/dv/04c\\_allan\\_wilderer\\_cv\\_/04c\\_allan\\_wilderer\\_cv\\_en.pdf](https://www.europarl.europa.eu/meetdocs/2009_2014/documents/stoa/dv/04c_allan_wilderer_cv_/04c_allan_wilderer_cv_en.pdf) (Date of access: 05/22/2023)

<sup>163</sup> Kaitlin Stack Whitney and Kristoffer Whitney. 2019: 1.

<sup>164</sup> World Bank Group. World Development Indicators. 2018

<sup>165</sup> GASTAT: General Authority for Statistics 2016

<sup>166</sup> MEWA. Ministry of Environment Water & Agriculture. 2018

products, and overall inefficiencies in water use within the farming sector. Saudi Arabia will continue to have water issues. It is obvious, that to manage its finite supply of renewable water, the nation must discover methods to justify its water use. As one of the world's most water-scarce nations, Saudi Arabia faces problems with its water resources caused by population expansion, climate change, pollution, and deteriorating water quality. John Anthony Allan created the idea of virtual water to close the water gap and attain water security because water is frequently underpriced. Professor Anthony Allan talked about how commerce in agricultural and food products can create a virtual water market by allowing nations with limited water resources to purchase crops with high water requirements.

Saudi Arabia should consider importing crops (importing virtual water) instead of using scarce local water. The improvement of water security may depend on the virtual water commerce. Saudi Arabia can expand its water supplies by importing more through virtual water commerce. The purpose of this study is to outline the advantages of using the idea of virtual water exchange as a link to close the gap between Saudi Arabia's local water supplies and food consumption. Knowledge of the effects of making these goods with local water resources is increased by research on the virtual water content of different agricultural crops. This promotes reducing water use when growing foods that use a lot of water and importing those commodities from nations with plenty of water. For example, to produce a kilogram of wheat requires about 1000 liters of water, so the virtual water of this kilogram of wheat is 1000 liters.<sup>167</sup> Countries can evaluate how to use water more effectively in the agricultural sector by knowing the virtual water composition of each agricultural business, calculating how much virtual water is exchanged, and calculating their net import balance for virtual water. Additionally, it provides a better image of how to monitor and improve the availability of virtual water when creating future growth plans.

The Saudi government's agricultural strategy is clearly unsustainable over the long run, as my thesis research demonstrates. However, the Saudi royal family's stance has shifted recently, and the country has begun importing plants with high water use rates as a result of the new laws' growing inclusion of water saving measures, which they can use to conserve a significant quantity of subterranean freshwater. The nation's agricultural strategy has undergone a full transformation since the 2000s. The following information further demonstrates this. Saudi Arabia started using the concept of virtual water trade system. Production of cereals, vegetables, and fruit crops decreased by 55 percent, 34 percent, and 10 percent, respectively,

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<sup>167</sup> Hoekstra, A. Y. and Hung P. Q. 2002

from 2000 to 2017. Virtual water consumption for agriculture increased by 38 percent between 2000 and 2017. Because of this, Alfalfa production increased by 71 percent during the same period because many wheat farms turned to alfalfa after government support for wheat fell in 2008. Furthermore, virtual water trade consumption for cereals and fruit decreased by 111 percent and 18 percent, respectively, during this period, but virtual water consumption for vegetables and alfalfa increased by 9 percent and 78 percent, respectively.<sup>168</sup> As cereal was imported from overseas during this time, Saudi producers shifted to more water-intensive vegetable products.

Saudi Arabia imported approximately 314 m<sup>3</sup> cap<sup>-1</sup> yr<sup>-1</sup> of virtual water in 2000 and it increased to 768 m<sup>3</sup> cap<sup>-1</sup> yr<sup>-1</sup> in 2012. Saudi Arabia was the second largest importer in the region of Middle East and North Africa.<sup>169</sup> The water dependency statistic for Saudi Arabia is equal to 42.5 percent = $[213.9/(213.9+289.2)]$ , which means that 43 percent of Saudi Arabia's water comes from virtual net imports.<sup>170</sup> The self-sufficiency ratio of water was 57.5 percent, which shows the problem of using scarce domestic water resources rather than import (higher than found which was 33.2 percent).<sup>171</sup> In this case, Saudi Arabia was heavily dependent on virtual water import for all cereals crops. In 2000, Saudi Arabia was identified as one of the most influential importers of virtual water in the MENA region, and the United States and Australia were the most influential exporters. However, Saudi Arabia's commerce strategy and food management have altered recently. Between 2006 and 2012, the influential exporters moved to the Russian Federation, Ukraine, and Brazil. Over the course of the time, Saudi Arabia imported more simulated water than it exported. Net imports totaled 21.4 billion m<sup>3</sup> in 2013 but fell to 8.9 billion m<sup>3</sup> in 2016.<sup>172</sup> The current political problems between Russia and Ukraine during that period also depressed exports to Saudi Arabia, which the state has to face with. Total virtual water imports of Saudi Arabia increased from 7.6 billion m<sup>3</sup> in 2000 to 9.4 billion m<sup>3</sup> in 2016.<sup>173</sup> Vegetables were the second leading group for virtual water imports, increasing from 28 million m<sup>3</sup> to 845 million m<sup>3</sup> over the period to reflect the impact of declining domestic production of vegetables and increasing consumption.<sup>174</sup> The virtual water from fruit imports increased from 13 million m<sup>3</sup> to 43 million m<sup>3</sup> during the study period.<sup>175</sup> It is evident that the

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<sup>168</sup> Yosef Alamri, Michael Reed. 2019: 18.

<sup>169</sup> Sang-Hyun Lee, Rabi H. Mohtar, Seung-Hwan Yoo 2019: 564.

<sup>170</sup> Yosef Alamri, Michael Reed. 2019: 19.

<sup>171</sup> Yosef Alamri, Michael Reed. 2019: 19.

<sup>172</sup> Yosef Alamri, Michael Reed. 2019: 19.

<sup>173</sup> Yosef Alamri, Michael Reed. 2019: 19.

<sup>174</sup> Yosef Alamri, Michael Reed. 2019: 19.

<sup>175</sup> Yosef Alamri, Michael Reed. 2019: 19.

Saudi government is predisposed to enact new agricultural regulations to restrict the export of crops that require a lot of water, which will ease the strain on non-renewable freshwater supplies. An example of this is the government's choice to forbid the export of alfalfa. Saudi Arabia received 214.5, 2.8, and 3.4 billion m<sup>3</sup> of virtual water through cereal & alfalfa, vegetable, and fruit trade, respectively, from Ukraine, Russia Federation, Australia, Argentina, and India. This are the five top countries exporting virtual water to Saudi Arabia. The Saudi Arabia's management to stop exports of some agricultural goods have produced remarkable water-saving results so that there are almost no exports of virtual water for the alfalfa and cerea group.

In general, Saudi Arabia relies on agricultural imports to provide virtual water to overcome its scarcity. If Saudi Arabia did not import these crops exclusively on local production (using the concept of virtual water), than it would take roughly more than 50 percent of the overall water resources in the area. The objective of this study is to demonstrate the advantages of using virtual water trade as a way to alleviate Saudi Arabia's lack of readily available water sources for its growing population. The research shows that using the idea of virtual water trade in Saudi-Arabia, by cereals and fruit decreased by 111 percent and 18 percent, respectively, using the concept of virtual water, while consumption increased by 9 percent and 78 percent for vegetables and alfalfa, respectively, during the period.<sup>176</sup> The results of the study also demonstrate that Saudi Arabia virtual water exports of fruits exceeded its imports. The concept of virtual water trade system demonstrate that Saudi-Arabia retains most of its fresh water supply. This opens up new opportunities in the world trade for Saudi Arabia. The final recommendation is, that the external agricultural investment activity needs to be directed towards some strategic key commodities needed by Saudi Arabia which are challenging and difficult to produce domestically because of water shortage, such as cereals and alfalfa products. It is necessary for Saudi-Arabia to reevaluate the framework of international commerce so that products with high water requirements are imported and restricted water resources are used to create fresh produce, like vegetables. More studies on Saudi Arabia should concentrate on the effects of various variables, such as relative water abundance, distance, free trade deals, and other trade and water variables, on virtual water commerce. The population of our planet is expanding very quickly, especially in the emerging and third worlds, where there is already a huge water scarcity. As I've demonstrated in the preceding chapters, using virtual water trade system, effectively stabilized Saudi Arabia's

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<sup>176</sup> Yosef Alamri, Michael Reed. 2019: 21.

farmland and sustainability. I think that this is an absolutely good strategy, solution and many water-stressed nations (such as Israel and Jordan) must seek trade policies that limit water-intensive goods exports. As a result of global warming, Russia may even come out of the situation as a winner, because with the melting of the vast Siberian landscapes, the land will be usable for agricultural production. Russia's agricultural exports could ensure the food supply of developing countries (Russia is already a grain exporter) and the third world, since these nations would not have to use their own water resources for agriculture. In fact, the virtual water trade would become a key player here. In the increasingly crowded globe, Russia has the potential to become an agricultural exporter. The issue is especially relevant because, in the development of the new global world order, Russia is expanding its international relations, cooperation with these emerging countries. As an agricultural exporter and user of virtual water trade, Russia has the potential to assume even more leadership in the new international order.

As a conclusion, since food is frequently cheaper to import than to produce locally, virtual water trade as an international trade and resource management philosophy would reap enormous economic benefits. Water-rich nations might use virtual water trade to help the issues of water-scarce countries, allowing these countries to become independent of irrigated agriculture, which takes a considerable amount of water. Thus, the virtual water trade system would promote global harmony by averting conflict over water resources. Virtual water provided a conceptual framework for viewing water itself as a globally traded product at exactly the same time that Western governments were moving from national, "command and control" environmental laws to neoliberal, market-based forms of global environmental administration. The system of the virtual water have increased exponentially since John Anthony Allan won the Stockholm Water Prize in 2008. The Stockholm Water Prize seems to have significantly helped John Anthony Allan and his virtual water trade infrastructure. Since Allan's initial hand-made chart of projected profits and deficits, the idea has advanced significantly. But we must mention that virtual water trade would not have been feasible without the significant advancements in technology and the quick development and spread of computer programming, and modeling, particularly at world sizes. Virtual water is now widely accepted thanks to developments in computer-aided modeling, the endorsement of a prominent industry award, and the historical framework of neoliberal environmental management. The idea of virtual water trade fits perfectly with the Neoliberal philosophy, where the market is the most significant source of economic regulation, with the goal of making the highest profit at the lowest feasible cost. In terms of institutions, water sector reform was primarily aimed at creating

new opportunities for markets and the private sector by rewriting legislation and the state's role. Which also includes removing price restrictions, liberalizing capital markets, lowering trade obstacles, and minimizing government impact in the economy, particularly through privatization and austerity measures. The virtual water trade system is a quintessentially neoliberal form of water modeling reducing global water flows to commodity flows in hopes of using trade to solve water crises. A fundamentally neoliberal approach to water modeling, virtual water reduces global water flows to market flows in the hopes of using trade to address water problems. Even watersheds have evolved into commerce. Through ideas like "virtual water," there has been a significant change over the past three decades toward measuring nature for neoliberal forms of environmental management. It is uncertain who has the authority to decide which figures are "correct" and how they should be decided, which makes this quantification process problematic in and of itself. All resources and goods will have a market price that accurately reflects their worth. Money does not or does not adequately assess the most significant resources. Natural resources, such as water, are not generated by the market or by corporations, but are easily and freely available. Businesses and the market cannot calculate the price of these since the computation cannot include expenses, such as the capital and labor necessary for their development, because such costs did not exist. From the standpoint of the market, these "givens" have no costs and hence no products. There is already a societal cost if the air, soil, and habitat become polluted, natural resources run out, or water supplies become limited. The state, working on behalf of society, already calculates and prices the resources utilized as a "given" by enterprises. These are not market pricing, but social prices: the most significant cost aspect of the price is the societal regeneration and conservation of the supplied natural resource. Academic scholars have differing opinions about how to quantify and analyze simulated water. In this case, quantification serves a dual neoliberal conceptual function: it makes water calculable and manipulable through international trade, while also attempting to depoliticize that trade by reducing water management to a technological matter of bookkeeping using "objective" numbers. In the end, simulated water blurs the lines between models and reality as well as between policy and science. With the development of virtual water trade, which was later recognized with an industry award, John Anthony Allan transformed water into liquid capital, a fungible good that can be optimized through global trade while being deprived of its biological and political context. Although awards and neoliberal tendencies in environmental management can greatly advance the intellectual approval of ideas like "virtual water," it is still uncertain whether such ideas could or should be applied to the world of hydro politics.

### **III.3. Floodplain management**

A comparison of the achievements in hydraulic technology during antiquity with the contemporary practices is an excellent example and motivation for the environmental and conservation issues of our present time. In the Neolithic cultures already developed the ability to construct enormous ditches and mud barriers. The Sumerian civilization, the earliest known civilization in the historical region of southern Mesopotamia began upon the floodplain of the lower parts of the Tigris and Euphrates rivers because the rivers were close to the land it was fertile and enabled the people to grow food. With the excess of food people could settle down to village life and with these new settlements towns and cities were created. Humans have regarded fish as a food source since the beginning of our time, and for recent indigenous peoples, fish was the principal source of protein. When the rivers flooded, the people who lived near them acquired larger quantities of fish, and when the water retreated, the fish were trapped in flats with no flow, from which they could no longer return to the riverbed. Fish were collected by hand in these shallow waters, using branches or (basket) coverings, as is being done today in flooded places. Therefore, people could recognize the benefits of the flood very early on. It was also clear that the fish flock to the shallow waters to breed, and that the next generation of fish is produced here (next year's loot). People attempted to work with nature to enhance the amount of flooding by increasing the size of the flooded regions while also ensuring that the water did not get stuck in the empty depressions and instead returned to the river, however, in such a way that the fish must also be filtered out of the water in the interim. Rivers, on the other hand, have the essential feature of walling themselves up with sediment deposited directly on the shore. As a result, these natural dams stopped the development of smaller tidal waves, and if the river burst through its barrier here and there during high water, the sediment kept the flood from retreating. It is probable that backwaters along rivers were created as early as the New Stone Age to allow the proliferation of smaller waterways and their exploitation (fishing) by fishing. They could also observe that when water breaks into a small trench, it can create a wide bed for itself in a short period, implying that cutting through the ramparts was not an issue for the Neolithic civilisation that was building it. Among others, the Danube river and other rivers' bends were cut even in the previous century by employing so-called pilot ditches. However, these bank cuts and canals, could not persist in their original shape and were swept away by the river over time. Therefore, later centuries had to repeat similar procedures innumerable times, with more experience and expertise, and with better planning, expediency, and organization. Because of the constant changing of the floodplain, nearly nothing could have remained not

only from prehistoric times, but also from subsequent eras, and even from the previous century. Even the artificially created heights were surrounded by silt, so they gradually fell and melded with the surrounding environment. However, the walls and moats of the moat-free levels have withstood the test of time better, and we know of many excellent ancient structures and other moats created with still-unknown reasons even today.

I am convinced that the concept and practice of diverting large waters of water into floodplains originated in the ancient times, and that "water management" is founded on this as well. By the way, it should be noted that this floodplain water management flourished in Europe during the Middle Ages, especially in the Danube basin. The extraordinary economic and intellectual prosperity of the Danube area was generated not just by a free gift from nature, but also by a high degree of water management understanding. Thus, the often mentioned, legendary abundance in fish of Hungary at the Middle Ages (as it was reported by a french monk in 1308 and regarded comparable only with that of Norway) was not merely the gift of nature, but also a result of human interference, of the cooperation with nature. The "fok"-s permanent canals, boat-ways, artificial hill, embankments, watering places, ensured already in the Middle Ages the inland traffic in this region and at the same time its connection with the waterway of the Danube. In the Middle Ages the area along the Danube was one of the most densely populated, richest and most cultured territory.<sup>177</sup> The desire to catch fishes was the reason what motivated people to comply the river's natural features. Over time, people grew increasingly aware of the additional advantages of collaboration with the rivers.

The traditional floodplain economy have a range of advantages for the local population, environment and economic.

1. Water bursts can be avoided by equally channeling the rising volume of water during floods. Moreover, devastation by flood waves could be avoided.
2. It can prevents the water from sitting on the breeding vegetation and rotting, which would have resulted in the extinction of not only the fish living in the water, but also the vegetation, trees, bushes, and grass that had been covered for a longer period of time, by diverting the water back when it receded.
3. Flooding of floodplain section created spawning grounds with optimal depth of inundation. Thus the reproduction of fish stocks was ensured. Fishing in the notches provided protein-rich nutrition even in times of food shortage. Plankton that reproduces more intensely in shallow, hot water, as well as fish and other creatures that dwell on it

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<sup>177</sup> Dr. Andrásfalvy Bertalan 1972: 69.



(water fleas, slipper animals, and so on), all contributed to the supply and growth of river fish.

4. The short-term flooding by the floodplain management also fertilized the forests, orchards, vegetable gardens mowing fields. It keeps meadows well-watered all the year round for mowing and grazing and in increasing the fertility of alluvial soils by the deposition of nutrient-rich mud.
5. Floodplain farming can be fully integrated into the food production work schedule.
6. Measures have a positive impact on water quantity.
7. It preserve the world's wetlands from extinction, and to restore those that have already been lost.
8. The artificial canals between oxbows, swales and backswamps also functioned as waterways in otherwise inaccessible area.<sup>178</sup>

According to ethnographer Andrásfalvy Bertalan (1973-), a "notch" (in Hungarian: fok) is a man-made ditch cutting through natural levees and letting water flow out over the entire floodplain during high stages and back to the channel during recession. The best "fish ponds" in Hungary, according to medieval certifications, were largely near the Danube river. It was made out of a collection of backwaters, natural depressions, and lakes connected by steps to notch water. Thus, after cutting through the steep bank of the river, the notch frequently directed the water through ditches and canals for hundreds or even thousands of meters to bigger, floodable lakes. The larger backwaters and lakes received water at several levels, but they all led the water "upstream"; that is, the water filled it from below, from the lower end of the backwater, the lake up to the (fish) lake. They cleverly secured two things with this management:

1. As little sediment as possible entered the lake beds.
2. During water recedes, the majority of the water in the fish pond backwater, as well as the water in depressions and temporary water reservoirs, might be totally dewatered the meadows, woodlands, and pastures surrounding them. As a result, the water did not flood the fields and meadows for an extended period of time.

In the nature, large expanses of reeds, cattails, and sedges provided as useful raw material in floodplain areas that were covered with water for longer or shorter periods of time. The reeds were used for roofing, thatch, and reed walls. The mat was used to make fish baskets, bags,

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<sup>178</sup> Dr. Andrásfalvy Bertalan 1972: 20.

beehives, and carpets, but it was also used for binding. Black sedge was ideal for tying vines, whilst other sedge species were utilized for feed. They did not attempt to introduce plant cultures that are inappropriate for growing on the floodplain due to differences in ecological parameters. Furthermore, farming was not confined to a single plant type or variety, but rather included a wide range of species and kinds.

The other important feature of the floodplain management is that backwaters, natural depressions, and lakes connected by notch to rivers are the perfect coastal fish ponds. Because fishes may be caught using a variety of ways and tools. The method utilized was determined by the size of the fishing water, the fish species that lived in it, the weather. Previously, it was normal to capture fish by hand using various nets, most of which were constructed of reeds and the chamber that shuts the notch was designed and controlled and cooperated by a group of mens as well. Well, several historical sources and data suggest that floodplain water management might benefit the fish sector. This might be a big assist in the food sector in delivering food to the world's ever-growing population, particularly in rising economies like the BRICS.

Aside from the numerous fishing methods, substantial meadow, pasture, and woodland management was also undertaken in high level. For example, oaks densely covered the floodplain areas. Thus, hardwood provided fuel and construction material, as well as frame material for mills and pens. Furthermore, softwood woods may furnish the raw material for a variety of storage containers, the willow cane being one of them. Aside from gathering forest fruits, huge floodplain orchards were maintained. Apple, plum, pear, and walnut trees could be the most prevalent in that area. The numerous fruits can be regarded a commercial commodity in addition to local usage. Plants that are abundant and easily available, such as reeds, sedges, cattails, and the bread grain substitute sulyom, can also play an important role. So, clearly visible that the floodplain farming is therefore a complex kind of agriculture, with all components fully integrated into the woodland management and the food production work schedule.

River water control has been drastically altered and revolutionized in recent years, in the wrong direction due to inadequate expertise. Mostly as a result of new flood protection, river transportation, water extraction and storage, hydropower usage, river sediment mining, agricultural land use, and forestry. These extensive modifications prevent natural flooding, morpho-dynamics and habitat formation across Europe. In Europe, up to 90 percent of floodplains functionally extinct. The resulting floodplain loss of 70–100 percent over the past

centuries, which was estimated for larger European rivers, and the high impact of hydromorphological pressures in nearly all European countries are well-known. The majority of large rivers are not free-flowing.<sup>179</sup> Between 1980 and 2010, 37 European countries registered 3,563 floods in total. The highest number of floods was reported for 2010 (321 floods), when 27 countries were affected. This number is associated with the 'Central European floods', which occurred across several Central European countries during May and June 2010. Based on reporting from nine countries, the report maps the share of population living in floodplain areas. Among those countries, Italy has the largest population living in flood-prone areas (6.7 million people, 11 percent of the population) whereas Hungary has the highest relative share of people living in such areas (1.8 million, 18 percent of the population).<sup>180</sup> The floods in Ireland and the United Kingdom from April 2012 onwards were caused by a series of weather events that lasted through the winter of 2013.<sup>181</sup> Central Europe was hit by extreme floods in May and June 2013, affecting both the Elbe and Danube river catchments.<sup>182</sup> In many locations, these floods caused the highest water levels and/or discharges ever recorded. In May 2014, a low-pressure cyclone affected a large area of south-east and central Europe, causing floods and landslides (e.g. along the River Sava).<sup>183</sup> Serbia and Bosnia and Herzegovina suffered the greatest damage. In Serbia alone, there were over 50 fatalities, roughly 32 000 people were evacuated and over 1.5 million people were affected.<sup>184</sup> However, the future cost of floods in Europe will be determined by a number of other important factors, such as disaster risk management activities and changes in resilience and vulnerability, which vary among risks and areas. Europe must start restore its own floodplain management system, because floodplains have an important role in flood risk management, by modifying the river discharge and protecting societies and economic activities from damage. Annual flood losses can be expected to increase fivefold by 2050 and up to 17-fold by 2080.<sup>185</sup>

Furthermore, it is anticipated that temperatures will continue to rise throughout the planet and in all seasons. By 2060 under the worst-case projections, the average annual basin-wide temperature could be up to 3.3°C higher depending on the global emissions trajectory. As a result of climate change, new adaptation measures are required. In the future, even with excellent

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<sup>179</sup> Lidija Globevnik 2020: 8.

<sup>180</sup> <https://www.eea.europa.eu/highlights/floodplain-management-reducing-flood-risks> (Date of access: 05/22/2023)

<sup>181</sup> European Environment Agency. 2016: 10.

<sup>182</sup> European Environment Agency. 2016: 10.

<sup>183</sup> European Environment Agency. 2016: 10.

<sup>184</sup> European Environment Agency. 2016: 10.

<sup>185</sup> <https://www.eea.europa.eu/highlights/floodplain-management-reducing-flood-risks> (Date of access: 05/22/2023)

flood protection, it will be vital to preserve water during periods of low precipitation. Floods would inflict significant damage to riverbank populations and industrial infrastructure in the case of a hypothetical dam failure, and a brief water cover at the start of the growing season would imply less harm to agricultural regions. A lengthy spell of inland water or drought, on the other hand, might result in significant agricultural losses. I believe that it is critical to capitalize on variances in microtopography that influenced agriculture practices prior to river controls. Floodplains are thought to be particularly sensitive and vulnerable to the effects of climate change, thus well-planned floodplain management is becoming increasingly crucial as demand for floodplain ecosystem services grows. During the restoration, which integrates floodplain management concepts while adapting to current conditions, we may obtain a lot of fresh knowledge that might be applied in numerous regions around the nations. With this new information, we may reconsider the roles of floods, droughts, agriculture, and climate change. In my opinion, we may make ecologically responsible use of our most vital natural resources, agricultural land and water. Furthermore, I must emphasize again that, in just 50 years - since 1970 - 35 percent of the world's wetlands have evaporated.<sup>186</sup> 40 percent of all plant and animal species live or breed in them.<sup>187</sup> Currently, wetland plants and animals are therefore in crisis and many indigenous species are at risk of extinction. Wetlands are deteriorating from pollution, climate change, and irresponsible unsustainable political and decision-making decisions. If we would start the floodplain management, there would be significant changes, because this system has the potential to preserve the world's wetlands from extinction, and to restore those that have already been lost.

In summary, when the Sumerians founded the first civilisation on Earth six thousand years ago, the temperature in Mesopotamia was significantly higher than it is now on the European continent. Despite this, they were able to sustain a flourishing culture for almost 2000 years because they effectively adapted to natural circumstances and implemented adequate water control. The essence of ancient water use outlined on the basis of abundant hydrographical, plant- and settlement-geographical and ethnographical data, was the cooperation with nature. At the rising of the water level the artificially cutting of in Hungarian so-called „fok"-s and channels opened the way for the water through natural ridges and entrenchments along the river onto the flood plains. To these lower lying areas, water was conveyed, considering the direction of flow always from downstream to attain an uniform filling up and to avoid sediment

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<sup>186</sup> <https://news.un.org/en/story/2022/02/1111052> (Date of access: 05/22/2023)

<sup>187</sup> <https://news.un.org/en/story/2022/02/1111052> (Date of access: 05/22/2023)

deposition of greater quantity and, during falling, to enable the undisturbed returning of the water into the river bed through the same channel.<sup>188</sup>

With the uniform and planned distribution of water the flood damage could be prevented and in the shallow water of the flood plains, easily warming up, optimum conditions could be ensured for the proliferation and growing of fish. This contributes to infrastructure protection and the growth of the food sector. Following water recession, at the mouth of the "fok" the bigger fishes were seeped out by the aid of boxes prepared from wood and wicker or net.

Thus, the often mentioned, legendary abundance in fish of Hungary at the Middle Ages (as it was reported by a french monk in 1308 and regarded comparable only with that of Norway) was not merely the gift of nature, but also a result of excellent human interference, of the cooperation with nature. The "fok"-s permanent canals, boat-ways, artificial hill, embankments, watering places, ensured already in the Middle Ages the inland traffic in this region and at the same time its connection with the waterway of the Danube. Thus, water transport, transportation, and traffic all make a consistent contribution to the country's economy. In the Middle Ages the area along the Danube was one of the most densely populated, richest and most cultured territory.<sup>189</sup>

If the inundating floods cover the flood plain only for a short time and the recession passes undisturbed, it has a fertilizing effect on the meadows, pasture lands, orchards and forests as well. This encourages plants to blossom and develop fruit, boosts plant resilience, and enhances the flavor of fruits and vegetables. For example, the area along the Danube was once renowned for its stock breeding, remarkable richness in fruits and forests. Besides the old and famous horticulture of the islands on the flood plains agriculture and cultivation of cereals took only a secondary part. Mainly the cabbage, paprika, onion, beans and flax were produced in these areas, where the accumulated stable-manure produced during winter in the sties of animals kept there for a longer period, could be used too.<sup>190</sup> The area of the floodplain management is also a flourishing, rich vegetable garden. It contributes to livestock husbandry and food supply.

Climate change will expose more and more places of the world to the threats it brings. Our existing surface water treatment is ineffective and unsustainable in the long run, therefore drastic adjustments will be required sooner or later, and they must be implemented as soon as possible. The floodplain management planning creates a long-term strategy for managing flood, drought, risk within a catchment, in addition it benefits wetlands, biodiversity, endangered

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<sup>188</sup> Dr. Andrásfalvy Bertalan 1972: 69.

<sup>189</sup> Dr. Andrásfalvy Bertalan 1972: 69.

<sup>190</sup> Dr. Andrásfalvy Bertalan 1972: 69.

species, the food industry, and water quality. The floodplain management system hold a central role in supporting the status of rivers, nature conservation, climate change mitigation and adaptation, and ecosystem services. It would be beneficial if we began employing the practices of our forefathers, which would assure a lot more ecologically friendly and sustainable living than we currently have.

### **III.4. Conclusion**

Throughout history, human civilization has faced many challenges. But human ingenuity and creativity have always helped us through the storms of history. A trait of human ingenuity is the creation of something original and worthwhile. New possibilities are emerging globally as a result of the new innovation opportunities in the water industry as well. For instance, developing new market conditions, offering new transport methods, and researching new marketplaces. All of these creative projects have the power to change the economic and technical landscape. Despite these limitations, there are more and more possibilities for technologies that allow improved efficacy in current water challenges.

The above issues for the pipeline industry are contrasted by a general view that the industry is probably entering its most exciting era in the twenty-first century. In the future more waterpipeline proposals are being made despite the economic and environmental dangers as the region's temperature becomes drier. Currently there are 195 nations in the globe, but in reality, just ten countries account for more than 60 percent of the world's freshwater supply. Water pipes will once again be a major factor in the twenty-first century, just as they did in past civilizations like the Sumerian, Indian, Egyptian, and Roman, which decided how people lived their everyday lives and how well a state's economy would do economically. We are probably entering the most exciting era of water pipes in the twenty-first century, which will experience its renaissance. It delivers water reliably and safely, cheaply, with minimal environmental damage and a reasonable profit for consumers as well. Pipelines will be required to not only continue safely and economically into the future, but also be able to carry greater loads. A good example, that Beijing's leadership started the South–North Water Transfer Project at the turn of the twenty century, which is the biggest water diversion project in the globe. According to the plans, the Yangtze, China's longest river, will feed the water-scarce northern regions. It is the third-largest river in the globe with a length of 6,300 kilometers, making it the longest river in

both the nation and the continent. Three paths used by the Chinese government to transport water from the south to the north. The eastern path that uses the lower Yangtze River and the already-existing Great Canal to transfer water to the north. The middle path, where water from the Danjiangkou Shuiku reservoir, a tributary of the Yangtze River, is redirected using channels so that it travels through the provinces of Henan and Hebei to reach Beijing and the nearby Tianjin. Currently, 70 percent of tap water in Beijing is pumped in through the middle route, which is also responsible for the lion's share of water supply in more than 20 cities including Beijing and Tianjin, as well as cities in Hebei and Henan provinces. The western route will bring 4 billion cubic metres of water from three tributaries of the Yangtze – the Tongtian, Yalong and Dadu rivers nearly 500km across the Bayankala Mountains and then on to northwest China. The western route's primary goal is to address the issue of water scarcity in the upper reaches of the Yellow River, which includes the provinces of Qinghai, Gansu, Ningxia, Inner Mongolia Autonomous Region, and Shanxi. It is intended to begin from the higher reaches of the Yangtze River. Due to the danger of desertification in the majority of these regions, the supply of drinking water is urgently needed.

Currently, half the population of the developing world are suffering from water-related diseases; one billion people have no source of drinking water. Considering that, some countries will have the ability to use their own freshwater as an economic power in the international arena, to achieve their own purpose, goals, objectives and interests in the global community. By controlling water resources, it means that a country has the ability to control the economy and population as well. The future potential of water pipelines offers enormous opportunity. According to Global International Waters Assessment estimations, freshwater shortage is responsible for about 70 percent of the developmental problems in the regions. If Moscow starts building and innovating equivalent water pipelines to Central Asia and is effective in delivering fresh water of a basic quality. Then, Russia would recover geopolitical significance in the area and could utilize its water supply (the world's second biggest) as an economic power. And the construction of water pipelines fits neatly into the concept proclaimed by the Chinese government as the "new silk road" (Belt and Road Initiative), which connects the Far East with Europe via infrastructure such as an upgraded railway network and highways.

Agriculture is currently the largest user of water, accounting for about 70 percent of global water withdrawals. So agriculture uses most of our freshwater supply. As the production and distribution of any agricultural good requires the consumption of water. In some countries where economic growth and the expansion of the middle class are increasing, especially in

emerging countries such as the BRICS countries, people have shifted from predominantly plant-based foods to more water-intensive products such as meat and dairy products. The greatest answer to this problem, which jeopardizes our sustainability, must be found. It can emerge the virtual water trade system as a significant solution. The core of virtual water trading is that when agricultural products are traded primarily on the worldwide global market, then actually water is also exchanged. Thus, virtual water commerce refers to the covert flow of water in food or maybe other items from one nation to another. Since the preparation, production and distribution of any agricultural product requires a lot of water consumption, the trade of products can also be analyzed as the trade of water resources of one region with another region. Virtual water trade as an international trade and resource management philosophy would reap enormous economic benefits. In my thesis, I especially explored and analyzed Saudi Arabia's agricultural approach and how they deal with their own water resources. Groundwater, desalinated saltwater, and reclaimed water are Saudi Arabia's three main sources of water, I've demonstrated that using virtual water trade system, effectively stabilized Saudi Arabia's farmland and sustainability. The 43 percent of Saudi Arabia's water comes from virtual water trade imports. Unlike earlier, when 83 percent of the country's water supply was used for agricultural irrigation, they can now save a considerable portion of their fresh water supply and use it for other uses, because of the virtual water trade mechanism. The idea of virtual water trade fits perfectly with the Neoliberal philosophy, which also includes removing price restrictions, liberalizing capital markets, lowering trade obstacles, and minimizing government impact in the economy, particularly through privatization and austerity measures. The virtual water trade system is quintessentially neoliberal form of water modeling reducing global water flows to commodity flows in hopes of using trade to solve water crises. A fundamentally neoliberal approach to water modeling, virtual water reduces global water flows to market flows in the hopes of using trade to address water problems.

Eventually, it is anticipated that temperatures will continue to rise throughout the planet and in all seasons. By 2060 under the worst-case projections, the average annual basin-wide temperature could be up to 3.3°C higher depending on the global emissions trajectory. As a result of climate change, new adaption measures are required. In the future, even with excellent flood protection, it will be vital to preserve water during periods of low precipitation. Floods would inflict significant damage to riverbank populations and industrial infrastructure in the case of a hypothetical dam failure, and a brief water cover at the start of the growing season would imply less harm to agricultural regions. Between 1980 and 2010, 37 European countries



registered 3,563 floods in total. The highest number of floods was reported for 2010 (321 floods), when 27 countries were affected. This number is associated with the 'Central European floods', which occurred across several Central European countries during May and June 2010. Among those countries, Italy has the largest population living in flood-prone areas (6.7 million people, 11 percent of the population) whereas Hungary has the highest relative share of people living in such areas (1.8 million, 18 percent of the population). In many locations, these floods caused the highest water levels and/or discharges ever recorded. In May 2014, a low-pressure cyclone affected a large area of south-east and central Europe, causing floods and landslides. A lengthy spell of inland water or drought, on the other hand, might result in significant agricultural losses.

The only and most obvious answer to the impacts of climate change is the introduction and reuse of old floodplain management, as practiced in ancient Sumerian civilization or medieval Hungary. The traditional floodplain economy have a range of advantages for the local population, environment and economic.

1. Water bursts were avoided by equally channeling the rising volume of water during floods. Moreover, devastation by flood waves could be avoided.
2. It can prevents the water from sitting on the breeding vegetation and rotting, which would have resulted in the extinction of not only the fish living in the water, but also the vegetation, trees, bushes, and grass that had been covered for a longer period of time, by diverting the water back when it receded.
3. Flooding of floodplain section created spawning grounds with optimal depth of inundation. Thus the reproduction of fish stocks was ensured. Fishing in the notches provided protein-rich nutrition even in times of food shortage. Plankton that reproduces more intensely in shallow, hot water, as well as fish and other creatures that dwell on it (water fleas, slipper animals, and so on), all contributed to the supply and growth of river fish.
4. The short-term flooding by the floodplain management also fertilized the forests, orchards, vegetable gardens mowing fields. It keeps meadows well-watered all the year round for mowing and grazing and in increasing the fertility of alluvial soils by the deposition of nutrient-rich mud.
5. Floodplain farming can be fully integrated into the food production work schedule.
6. Measures have a positive impact on water quantity.
7. It preserve the world's wetlands from extinction, and to restore those that have already been lost.

8. The artificial canals between oxbows, swales and backswamps also functioned as waterways in otherwise inaccessible area.

Europe and other regions and countries in the world must start or restore its own floodplain management system, because floodplains have an important role in flood risk management, by modifying the river discharge and protecting societies and economic activities from damage. Climate change will expose more and more places of the world to the threats it brings. Annual flood losses can be expected to increase fivefold by 2050 and up to 17-fold by 2080. The floodplain management planning creates a long-term strategy for managing flood, drought, risk within a catchment, in addition it benefits wetlands, biodiversity, endangered species, the food industry, and water quality. The floodplain management system hold a central role in supporting the status of rivers, nature conservation, climate change mitigation and adaptation, and ecosystem services.

## Conclusion

In my master's thesis, I tried to select and expand a topic about which we do not have much information and knowledge, yet the question of its topic is more urgent and more pressing than ever before. In the course of my research, I realized that today's welfare-nihilistic, consumerist culture is completely unaware of the grave threat it will confronts. On the global level, from America to Africa through Asia to the Far East, freshwater stress is already present or will be present. Water stress has now become a global problem. Every aspect of our life has been profoundly impacted by the worldwide water problem.

The earth's small fresh water supply is unevenly distributed across the planet. Some regions and countries have more rivers and lakes and get regular rain, while others are mostly desert and suffer years of drought. Nowadays, there are 195 nations in the globe. But in reality, just ten countries account for more than 60 percent of the world's freshwater supply. As a result of the uneven global distribution, 2.3 billion people live in water-stressed countries, of which 733 million live in high and critically water-stressed countries.<sup>191</sup> The growing demand for water in developing economies heightens concerns about scarcity. Freshwater consumption in developing countries has increased rapidly in recent decades. A large portion of the affected population resides in developing countries. Maintaining fresh water security will be a big concern for these communities.

The current climate change has a significant influence on our planet's fresh water supplies, because temperature and the hydrological cycle are inextricably linked. Climate change is already posing serious challenges to our freshwater resources.

In addition, according to World Health Organization estimates that worldwide some 2.2 million people die each year from diarrhoeal disease, 3.7 percent of all deaths, and at any one time over half of the world's hospital beds are filled with people suffering from water-related diseases. Today in our global world, many pollutants threaten water supplies.

Moreover, agriculture uses the most water, making up around 70 percent of all withdrawals worldwide. It will be a major challenge to feed the rising population, not to mention the increasing scarcity of water.

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<sup>191</sup> <https://www.unwater.org/water-facts/water-scarcity> (Date of access: 05/22/2023)

Within the framework of sustainable development, we may make the following basic findings in relation to the global water issue, climate change, population growth, and the dangerous causes of water pollution.

In the course of my research, I had to realize that we are not yet in such a hopeless situation that we cannot remedy and improve our freshwater supplies for the sake of our sustainability. Throughout history, human civilization has faced many challenges. But human ingenuity and creativity have always helped us through the storms of history. A trait of human ingenuity is the creation of something original and worthwhile. Numerous historical events have demonstrated the strength of human inventiveness, such as the first clicked spearheads from the Stone Age, the Renaissance, or the Enlightenment, etc. Based on these, we can be sure that human knowledge will impromptly aid the great issues of the future as they are encountered by the great global challenges of the twenty-first century. New possibilities are emerging globally as a result of the new innovation opportunities in the water industry. For instance, developing new market conditions, offering new transport methods, and researching new marketplaces. All of these creative projects have the power to change the economic and technical landscape. Despite these limitations, there are more and more possibilities for technologies that allow improved efficacy in current water infrastructure systems and solutions that turn wastewater into a resource. There is a need for a variety of options, such as extra conveyance and storage systems, productivity improvements, recycling efforts, and conservation efforts.

**First of all**, water pipes can be once again be a major factor in the twenty-first century, just as they did in past civilizations like the Sumerian. We are probably entering the most exciting era of water pipes in the twenty-first century, which will experience its renaissance. It can transport freshwater from water-rich regions to water-scarce regions. This can connect nation-states in terms of collaboration at the regional level for their economic development and interest. Pipelines will assist the irrigation district preserve freshwater in terms of agriculture by enhancing delivery efficiency. Thus, it expands regional market opportunities among nations. In addition, it improves farm efficiency by raising crop yields and agricultural revenue while also conserving energy. Pipelines will be required to not only continue safely and economically into the future, but also be able to carry greater loads. A stream of investable chances to expand the blue economy in a manner that helps local economies, markets and national economies, while safeguarding resources for future development, will be created by

investing in better governance. New pipelines can help solve the water problem. This will require huge investments, huge infrastructures, and international cooperation.

**So secondly**, it can emerge the virtual water trade system as a significant solution. The core of virtual water trading is that when agricultural products are traded primarily on the worldwide global market, then actually water is also exchanged. Thus, virtual water commerce refers to the covert flow of water in food or maybe other items from one nation to another. Thus, trade in agricultural products enables the transfer of water resources from water-rich nations to water-scarce regions. Moreover, international food trade can lead to global water savings. Virtual water trade as an international trade and resource management would reap enormous economic benefits. The virtual water trade would save water not just in regional level, but also in international level. This way, we could conserve a lot more freshwater and avoid wasting it. This can connect nation-states in terms of regional and global collaboration for our economic progress, sustainability, and interest. The idea of virtual water trade fits perfectly with the Neoliberal philosophy, which also includes removing price restrictions, liberalizing capital markets, lowering trade obstacles, and minimizing government impact in the economy, particularly through privatization and austerity measures. The virtual water trade system is aquintessentially neoliberal form of water modeling reducing global water flows to commodity flows in hopes of using trade to solve water crises. In addition to our present dying monetary system, freshwater may be utilized as a form of payment between countries. This would be a revolutionary invention in the world's financial history.

**Thirdly**, there are exceptional potential for the rebirth of antique, old water management methods, which is utilized by Sumerians or Hungarians long time ago. The floodplain management planning creates a long-term strategy for managing flood, drought, risk within a catchment, in addition it benefits wetlands, biodiversity, endangered species, the food industry, and water quality. The floodplain management system hold a central role in supporting the status of rivers, nature conservation, climate change mitigation and adaptation, and ecosystem services. This strategy saves significantly more energy and money than we invest in combating global warming. This traditional technique have a range of advantages for the local population, environment and economic. It expands the food market and contributes to the creation of new water trade routes. Floodplain management has the potential to bring humans and the environment into mutual harmony.

I believe it is critical for the governments and international organizations to implement a wise land use strategy that safeguards the threatened ecosystems that supply water to increasing towns and industries. Furthermore, major urban watersheds and rural populations' water security should be consistently enhanced. It would also be critical to raise people's awareness of their surroundings. All of these natural changes would benefit public health, conserve the natural landscape, boost tourism, create new employment, and a fruitful cooperation with nature.

Looking around in the world, we can see that many regions currently have or will soon have water scarcity. On all continents, changes are predicted. While Canada has an abundance of fresh water, several regions in the United States may face water shortages in the next decades. As a result, Americans will be obliged to import water from Canada, most likely at a high cost. Latin America, which already has poor water quality and is becoming more populated and impoverished, will be unable to provide an appropriate quality of drinking water to its population. This will result in large-scale migration (which is already occurring), with the top destination being the United States, followed by Europe. Keeping Tibet will be a matter of pride for China in Asia, since some think there are vast water reservoirs beneath Tibet. The conflict between India and Pakistan over water will increase more. There have been multiple armed battles in the Middle East as a result of the usage of water from the Jordan River and the Sea of Galilee. The exploitation of the Euphrates' resources, the majority of which are utilised by Turkey, is also a question of life and death. The Nile problem is inescapable in Africa; Egypt would be the largest loser from Ethiopia's hydropower advancements, and as a result, relations between the two nations are becoming increasingly tense. Water is already scarce in the Sahel area. As a result, future exploitation of rivers and fresh water resources would be more difficult, potentially leading to armed conflicts. The scarcity of drinking water across the Black Continent will serve as an ongoing justification for the vast surge of migration. In Europe, Barcelona, the capital of Catalonia, already imports drinking water. However, Portugal, Italy, and Greece are also under water crisis. In the heart of Europe, Hungary is a water rich country. As a result, I believe that if it manages its water resources correctly, it could even become a freshwater superpower in the near future, and even could play a decisive role in global politics. It will be very significant how politicians and stakeholders will implement laws, policies, and financial decisions on water. Local government and social responses to these interventions follow suit. With such environmental stakes on the line, the responsiveness of a country may disrupt the water resources available to others. The importance and the affairs of water diplomacy and

international cooperations will be very significant in the future, which will determine the trajectory of the countries in the global politics. The key to understanding this process lies prevention, management and resolution of water rights conflicts at the domestic and international level. This perspective is critical for the prosperity and stability of any nation in the Twenty-first century as water resources become more scare. This scarcity will recast the balance of power in the world politics.

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