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International Journal of

Water Management and Diplomacy

Official Journal of the Hydropolitics Association

A Letter from the Editor-in-Chief

Demographic growth, urban development, new lifestyles, consumer habits are economic development are all factors that contribute to increasing water, food and energy needs. In this context, particular attention must be brought to interactions between these sectors as well as conflict and cooperation potential on these issues

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Dursun Yıldız
Editor-in-Chief

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EU WATER DIPLOMACY

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Abstract

Water is essential for life. With increasing water demand due to population growth[2] and the growing impact of climate change, water scarcity affects a quarter of the world's population and is growing. Water crises are recognized as one of the five major global risks by the World Economic Forum[3]. In this scenario, it becomes essential to ensure effective cooperation between countries in the management of water resources.

Tensions and conflicts over access to water continue to rise, as the world's water resources and ecosystems deteriorate, and the threat of water scarcity spreads. 36% of the world's people live in water-scarce regions. Today billions of people still lack access to safe drinking water and sanitation and most of them live in fragile and violent regions.

In order to address these challenges, the Council of Foreign Affairs of the EU adopted Conclusions on Water Diplomacy on 19 November 2018[4] which recognized the potential of water scarcity to affect peace and security and announced the EU intention to enhance its diplomatic engagement on water. Through its water diplomacy, the EU aims to support peace, sustainable development, respect to human rights and a rules-based multilateral system.

The Council Conclusions of 2018 updated the previous ones of 2013[5] and developed a new approach to water in a post-2015 world, which reflects increasing new challenges such as climate change and links water to security. The Council recalled that water is a prerequisite for human survival and dignity and a fundamental basis for the resilience of both societies and the environment.

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[2] Global water use has increased by a factor of six over the past 100 years and continues to grow steadily at a rate of about 1% per year. UN 2020 World Water Development Report.

[3] World Economic Forum 'The global risks Report 2020" 15th Edition.

[4] Council of the European Union, 'Council Conclusions on Water Diplomacy', Brussels 19 November 2018. https://www.consilium.europa.eu/en/press/press-releases/2018/11/19/water-diplomacy-council-adopts-conclusions/

[5] Council of the European Union, 'Council Conclusions on EU water diplomacy', Brussels 22 July 2013 https://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/EN/foraff/138253.pdf

This article reviews the EU approach to water diplomacy, as outlined in these Council Conclusions, which reflect the EU's readiness to support international cooperation, prevent conflict and encourage negotiated solutions to ensure a fair and sustainable management of water resources for the benefit of human dignity and peace.

Keywords: EU approach to water diplomacy, water, diplomacy, water conflict

1.WATER AS A TOOL FOR PEACE

There is a long history of conflicts over water resources, and a recent increase in targeting of water resources and infrastructure in armed conflicts, featuring both States and non-State actors. The limited availability of water and the conflicting claims of communities or countries about its use are key factors that can lead to conflicts and mass displacements.

The link between water and security is visible in different regions of the world. For instance, in the Middle East and North Africa, the combination of recurrent droughts, increasing water scarcity, poor water quality, armed conflict, forced displacement, poor water governance and weak institutional performance contribute to a growing water crisis. In Lake Chad or the Aral Sea, water areas have shrunk dramatically and are expected to be under greater pressure due to climate change or unsustainable use. Construction of large dams in international rivers such as the Nile, Mekong, Tigris or Euphrates is becoming more frequent and contributes to tensions among riparian States.

Water can be not only a source of conflict but also of peace and cooperation. The 2017 Report of the Global High-Level Panel on Water and Peace 'A matter of survival'[6] acknowledged that water is not only about development and human rights but also about peace and security and contained a set of recommendations to use water as an asset for peace.

In 2018, the Council noted the potential of water scarcity to affect peace and security, as water-related risks can have grave human and economic costs, all of which can have direct implications for the EU in an interconnected world. The Council announced the EU intention to enhance its diplomatic engagement about water as a tool for peace, security, stability .It's firmly condemned the use of water as a weapon of war. Conflict prevention early warning mechanisms need to take int account security challenges linked to water. This should contribute to the EU's early action to prevent conflicts. The EU will continue assisting with water and sanitation to disaster or conflict-affected populations caught in humanitarian crises.

2.SUPPORTING TRANSBOUNDARY WATER MANAGEMENT

Aquifer systems, lakes and rivers do not necessarily follow State borders and their use requires international cooperation. There are 153 countries in the world that share

[6] 'A matter of survival. Report of the Global High-Level Panel on Water and Peace'., Geneva 2017 https//www.genevawaterhub.org/resource/matter-survival.

transboundary rivers, lakes and aquifers, but only 17 have all their shared waters governed by transboundary arrangements (UN WATER 2018 a).

Enhancing EU's diplomatic engagement on transboundary water cooperation and promoting the sustainable management and water use is essential to fostering peace and stability. The Council underlined the EU's commitment to promoting transboundary and integrated water management as well as effective water governance, giving priority to regional and integrated actions.

The EU has a wealth of expertise in the management of transboundary river basins such as the Rhine, the Danube or the Duero. It also has a strong tradition in policy dialogue with third countries as well as financing and implementing projects in water cooperation in countries all over the world.

The EU encourages and supports all relevant stakeholders to develop transboundary arrangements and to set up institutional mechanisms designed to facilitate relations among riparian states. Compliance with international environmental and nuclear safety standards, as well as the participation of all riparian and upstream countries, is essential.

The EU will continue to promote the accession and implementation of international agreements on water cooperation, such as the Convention on the Protection and Use of Transboundary Water Courses and International Lakes (Helsinki Water Convention 1992) and the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (New York 1997), and other relevant international agreements. These conventions offer a useful framework to develop cooperation on the basis of mutual interest.

In March 2018 the European Union carried out an outreach among more than 65 countries worldwide to promote accession to the UNECE Water Convention of Helsinki, which began as a regional convention and has been opened to global membership beyond Europe. The outreach highlighted a strong interest in the Water Convention and in acceding to it by the vast majority of the countries contacted. At the same time, the outreach also revealed the need for clarifications and capacity building in most of the countries to be able to accede to the Convention and implement it properly. The EU decided to launch an action that will enable it to respond to the needs and requests for support to accede to the Water Convention emerged from the outreach.

Most countries' accession depends on how the implementation of the Convention benefits water management at the regional, national and local levels, while for some countries the relevant decision is also linked with the accession of neighboring countries. Therefore, it is crucial to promote accession in a regional context, by all riparian countries in transboundary basins, including currently underrepresented upstream countries.

3.PROMOTING WATER GOVERNANCE AND UNIVERSAL ACCESS TO WATER AND SANITATION

The Council Conclusions of 2018 have underlined the need to strengthen water governance at all levels: local, national, regional and international. Water governance should take into account the interlinkages between water, energy, food security and ecosystems. The

increasing and competing demands on the water make it difficult but also more necessary to find a balanced solution to the different uses of water: to drink it and for domestic consumption, to produce food, to generate green energy and as a platform for ecosystems at risk. In its water diplomacy, the EU promotes integrated water resources management and effective and inclusive water governance to ensure sustainable use based on cooperation.

The EU has actively promoted water resource management, water governance, and the universal access to water and sanitation through its development cooperation over the last decade, disbursing more than EUR 2.5 billion in 62 countries and providing access to clean water to more than 70 million people and sanitation to over 24 million. Since 2014, water is a focal sector in 13 countries[7] and was covered by some regional programs[8] for a total budget of almost EUR 800 million. Water and sanitation are mainstreamed in other focal sectors such as food security, rural development, health, energy, regional integration, environment or peace and security.

The EU has been a key supporter of the expansion and implementation of the UN Water Conventions. Actions also include Transboundary Water Management, the Nexus Water Energy Food Security (almost 80 countries), support to Water Centres of Excellence, twinning activities between Water Utilities and support to the Union for the Mediterranean Water agenda in the Mediterranean Region.

Cooperation within the EU Water Initiative Plus with EU's neighbours and enlargement region helped align policies and management practices with the EU Water Framework Directive. The EU has developed a constructive dialogue on water and energy issues in Central Asia, which has already led to initial agreements and to the EU-Central Asia Platform for Environment and Water Cooperation.

The Partnership Instrument is supporting water platforms in India and China as a central pillar of EU's policy dialogue with these countries.

4. LEAVING NO ONE BEHIND

Access to water and sanitation for all is one of the sustainable development goals (SDGs) of the 2030 Agenda, adopted by the UN in 2015. SDG 6 includes the following targets: achieve safe and affordable drinking water; achieve access to sanitation and hygiene and end open defecation; improve water quality, wastewater and safe reuse; increase water-use efficiency and ensure freshwater supplies; implement integrated water resources management and protect and restore water-related ecosystems.

Progress on SDG 6 is essential for the achievement of other SDGs; and water plays a cross-sectoral role in many other policies such as security, human rights, health, climate change, food security, energy or gender equality.

In 2018 the UN High-Level Political Forum on Sustainable Development in New York reviewed the state of implementation of SDG6 based on a report produced by UN-Water(UN WATER, 2018 b)Unfortunately, the world is not on track: 844 million people lack basic water

[7] Angola, Bolivia, Burkina Faso, Cook Islands, Djibouti, Lesotho, Palestine, Papua New Guinea, Samoa, Sao Tome & Principe, Senegal, Solomon Islands and Togo.

[8] Central Asia, Central and Latin America, Eastern and Southern Africa and Neighbourhood.

services, 2.1 billion lack equitable access to safely managed drinking water and 4.5 billion to safely managed sanitation. Women and girls are very heavily affected. Water pollution is worsening. Inadequate collection and treatment of wastewater in many parts of the world are profoundly affecting the quality and amount of water available to meet human needs and sustain ecosystems and economies. Every year, around 2 million people die because of water-related diseases. Water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes continue to degrade in many parts of the world. For instance, the world has lost 70 % of its natural wetlands over the last century, with profound economic development and social and environmental stability. The world could face a shortfall in water availability[9] that could reach 40% by 2030.

Recognizing that current progress is insufficient, the EU has reaffirmed its determination to increase its efforts to implement the 2030 Agenda and its Goal 6, encouraging others to do the same. All stakeholders should play their role in realizing, integrated water resources management, including at the transboundary level. In order to enhance the implementation of SDG6, updated and reliable indicators and data, are required not only to monitor progress but also for accountability and transparency.

5.THE RIGHTS TO WATER AND SANITATION

The Council Conclusions stressed the EU's commitment to the human rights to safe drinking water and sanitation, as components of the right to an adequate standard of living (in accordance with UN HRC Resolution (A/HRC/RES/39/8) of 27 September 2018). They recognize that "the human right to safe drinking water entitles everyone, without discrimination, to have access to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic use and the human right to sanitation that entitles everyone, without discrimination, to have physical and affordable access to sanitation in all spheres in life, that is safe hygienic, secure, socially and culturally acceptable and that provides privacy and ensures dignity".

EU water diplomacy has a gender perspective, taking into account that women are particularly affected by the lack of access to water and sanitation. Often women and girls in developing countries have to spend hours fetching water which hampers their prospects of education and economic independence. Lack of sanitation in schools is also an obstacle to girl's education. It is necessary to consider women not only as beneficiaries but also as agents of change.

Environmental human rights defenders defending water resources need protection. Across the world, human rights defenders protecting and promoting the rights to safe drinking water and sanitation are often subjected to prosecution, threats and violence. The European Union protects and pays special tribute to those who stand up every day for fundamental rights and the protection of the environment.

On 17 June 2019, the EU Foreign Affairs Council developed this human rights dimension of the EU water diplomacy, adopting Conclusions on EU Human Rights Guidelines on Safe

[9] UN and World Bank High-Level Panel on Water projects.

Drinking Water and Sanitation[10]. These will guide the implementation of this policy in order to have a real impact. They set out a new human-rights based approach built on the Universal Declaration of Human Rights, International Human Rights Covenants, as well as the EU rights-based approach to development cooperation. Building on existing human rights norms, these guidelines give instructions and guidance on how to use the available EU foreign policy tools, including development cooperation, to promote and protect the human rights to safe drinking water and sanitation. The main target groups of the guidelines are officials and staff members of the EU Institutions, EU Member States and EU delegations across the world.

6.WATER AND CLIMATE CHANGE

'If climate change is the shark, then water is its teeth"[11]. The impact of climate change is often felt through water; either too much or too little. Floods and droughts are becoming more frequent and extreme, as climate change is slowly becoming part of our lives.

The UN 2020 World Water Development Report [12]has warned that climate change will have a severe impact on water resources, both in terms of quantity and quality. It is estimated that climate change and the increasing frequency and intensity of extreme weather events such as storms, floods and droughts, will aggravate the situation in countries already under 'water stress' and generate similar problems in areas that have not yet been severely affected. The report highlights that poor water management tends to exacerbate the impacts of climate change and recommends adapting and mitigating climate change effects through sustainable water management. Climate change consequences on water also affect human health as diseases linked to food, water and parasites will increase.

This means that climate negotiations should tackle water-related issues and could be used to advance the water international agenda. On the other hand, the water community needs to go beyond its traditional approach and take climate change into account.

The 2018 Council Conclusions on water diplomacy expressly recognize this link between EU Water diplomacy and EU Climate diplomacy supporting the Paris Agreement. There is a need to address the water-related consequences of climate change and building synergies between water diplomacy and climate diplomacy, as set out in the Council conclusions on Climate Diplomacy of 26 February 2018 and of 20 January 2020[13] These have outlined the basis for a more strategic approach to Climate Diplomacy in line with the new European Green Deal[14] and the European Council conclusions of 12 December 2019.

[10] Council of the European Union "EU Human Rights Guidelines on Safe Drinking Water and Sanitation" Brussels 17 June 2019

[11] Paul Dickinson, founder of the Carbon Disclosure Project.

[12] https://en.unesco.org/themes/water-security/wwap/wwdr/2020

[13] Council of the European Union, "Council Conclusions on Climate Diplomacy', Brussels 20 January 2020. https://data.consilium.europa.eu/doc/document/ST-5033-2020-INIT/en/pdf

[14] European Commission, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions The European Green Deal, Brussels 11 December 2019 COM (2019) 640 Final.

7.WATER AND CIRCULAR ECONOMY / INNOVATION

Efforts to deal with increasing water scarcity need to enhance water use efficiency and water reuse. In its Council Conclusions on Water Diplomacy, the EU stressed the significant contribution of the Circular Economy to water savings including by re-use.

The Council Conclusions also underlined the role of digital and innovative solutions, such as nature-based solutions, and encouraged the Commission and EU Member States to finance and incentivise research and partnerships on water innovation, involving public and private stakeholders. Research, science and innovation have to be mobilized to tackle global water challenges.

8.WATER AND COVID-19

The coronavirus outbreak has evolved into a global pandemic with a devastating economic impact and a spillover on social stability and international security. The COVID-19 crisis has exacerbated the global challenges linked to water and is affecting the hardest the most vulnerable populations. The crisis has made it more urgent to provide access to clean water because washing hands with clean water is an effective way to prevent becoming infected. Research shows that providing access to sanitation is also crucial to fight the spread of the virus.

On 8 April 2020, the EU launched a 'Team Europe' package[15], supporting the most vulnerable countries in the fight against the coronavirus crisis, with overall financial support of more than Euros 20 Billion. This package included help to allow access to water and sanitation for people most at risk, including children, women, the elderly, and disabled people, as well as migrants, refugees, internally displaced persons and their host communities. EU support on water focused both on responding to the most pressing humanitarian needs and strengthening health, water and sanitation systems.

9.SUPPORTING THE MULTILATERAL SYSTEM ON WATER

The EU supports multilateral solutions and is an active player who contributes to concerted international efforts on the water at the United Nations and other international fora (such as now the G20 under the presidency of the Kingdom of Saudi Arabia). The EU is also very active on the water in regional institutions such as the Union for the Mediterranean.

Although not a member of the UN Security Council, (UNSC) the EU welcomes discussions linking water, climate, peace and security in the UNSC and encourages its Member States to continue including these issues in the debates of the UNSC.

The Council Conclusions underlined the importance of effective coordination of the UN's work on water and sanitation, notably through UN Water, to improve coherence, increase knowledge and facilitate system-wide strategic discussions. UN-Water is the United Nations

[15] EC-EEAS Joint communication to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the global EU Response to COVID19, Brussels 8 April 2020. JOIN (2020) 11 final

inter-agency coordination mechanism for all freshwater related matters, including sanitation. Among its members are UNDP, UNESCO, World Bank, UNHCR, UNEP, UNICEF, CBD, etc… However, some have proposed to enhance the UN institutional architecture on water, arguing that water lacks a proper institutional home in the UN system.

The Council Conclusions highlighted the need for a High Level UN meeting on water and welcomed the launching of the UN Decade on Water 2018-2028, as a contribution to accelerating progress towards the achievement of SDG 6 and the other water-related targets of the 2030 Agenda. In its resolution 71/222 (December 2016) the UN General Assembly proclaimed the period from 2018 to 2028 the International Decade for Action, "Water for Sustainable Development" (the "Decade"), to further improve cooperation, partnership and capacity development in response to the ambitious 2030 Agenda.

The December 2018 UN General Assembly resolution on the "Midterm comprehensive review of the implementation of the International Decade for Action, 'Water for Sustainable Development' 2018-2028" (A/RES/73/226), called for a Conference on the Midterm Review of the Water Action Decade to be convened in New York from 22 to 24 March 2023. The preparatory process and the one-day high-level meeting to be convened by the President of the General Assembly in 2021 will help promote the implementation of the water-related goals and targets of the 2030 Agenda while allowing all partners to identify practical solutions to the water and sanitation crisis through all relevant lenses such as climate change, agriculture, energy, peace, and security. The government of Tajikistan has announced two international conferences on water in Dushanbe (one foreseen in 2020, which has been postponed, and another in 2022) which could serve as a preparatory meeting for the 2023 conference.

In terms of international meetings, 2021 will be an important year to advance the international agenda on water: Senegal will be hosting the World Water Forum and the President of the UN General Assembly will organize a high level international meeting.

10.MOVING TO ENHANCED ACTION

The investments made in water and sanitation are critical for economic and social development, bring important economic returns and create jobs[16].However, the gap between needs and resources is vast: over 80 % of countries lack financial resources to meet national water, sanitation, and hygiene targets, costing an average of 2-3% of their GDP. In many countries, the situation is further complicated by weak governance and capacity, growing pressures on water resources and water-related ecosystems and by climate change. Agriculture, which accounts for nearly 70 % of global freshwater withdrawals, has to be part of the solution. EU-supported investments, including in agriculture and cities, can make a significant contribution to providing equitable access to clean water and sanitation and better managing water resources.

The Council Conclusions encourage EU institutions and EU Member States to deploy all available tools to ensure that integrated water policies address the full range of challenges. It is expected that due consideration to the importance of water will be given in the programming of future EU financial and technical cooperation with third countries. The EU

[16] http://www.unesco.org/new/en/natural-sciences/environment/water/wwap/wwdr/2016-water-and-jobs/

is preparing its new Multiannual Financial Framework (MFF) for 2021-2027, and water deserves to be recognized as an important area of future EU cooperation.

However, public finance alone will not be enough. Therefore, encouraging private sector investment and partnerships in water infrastructure and capacity building is very important. It is necessary to make more use of blending mechanisms and guarantees to leverage more investments in water and sanitation infrastructures and to improve the enabling environment for investment in sustainable water-related infrastructure and services. This needs to be complemented by policy dialogue, strong national sector policies and the implementation of integrated water-resource management.

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Water is one of the key global challenges of the 21st century. The EU is determined to strengthen its diplomatic engagement on the water as a way to promote peace and stability, support transboundary and integrated water management; protect the rights to water and sanitation, implement the UN sustainable development agenda and the Paris Agreement. Strengthen the multilateral system, mobilise partners (both public and private) and take action to make sure that these objectives are reflected in its policy dialogue and development cooperation.

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The World After COVID-19

Urbanism & water management

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Abstract:

The purpose of this article is to raise awareness among governments, social workers and municipal and service bodies about the real dimensions of the COVID-19 pandemic that spread across the world since December 2019, and to investigate the possible solutions that are derived from human history and the recent developments in information technology, as well as how human societies are adapting to these developments. Taking into consideration that the article is researched and written in the lockdown conditions away from my library, digital media and documents were extensively used, which also included video coverage of interviews with public figures who expressed their opinions about the topic. The main findings are that the world will probably have to live with the reality of COVID-19 for some years and that certain changes will have to be made to the way we live, the way we care for and interact with others, both socially and physically, and the communication technologies we use. The world will certainly never be the same after this pandemic. *In* conclusion; further and extensive research and development (R&D) will be needed, and it has to be done wisely and in complete transparency, as it will affect us all.

Keywords: Corona; COVID 19; Urban; Urban Design; Smart City; Infrastructure; Water Management; Economic Order.

1.INTRODUCTION

The world after Corona, or more precisely the "World with Corona" is what the title of this article should be as many circles in health care and politics believe that it is more probable that we will have to live with the Pandemic for an extended period of time. And, actions were taken by governments and business communities to minimize the negative effects of the Pandemic and which have proven to be viable, sustainable, and could easily be the normal rather than the exceptional modus operandi. Working from home, online education, home delivery and video conferencing are just a few examples of what could be the new way of doing business, as these practices became acceptable to both the providers and the receivers

of services. We may afterall shout thank you Corona for letting us know. The world, including the developed countries, has been taken by surprise by the Corona COVID 19 pandemic. Countries like China, Italy, Spain, Germany, the United Kingdom, and the United States are among those who got the most hits under their belly, suffering from high numbers of cases and deaths. Many views have been exchanged by scientists and policymakers about the nature of the pandemic, what caused it, how to handle and get it to stand still, and what would be the situation in the aftermath of the pandemic. I have been looking into varieties of these opinions, which appeared in the media as articles, TV interviews, and social media elaborations. As a reader, I am not satisfied with what I have seen and read and believe that there is more into it than just suspense and trying to calm the population down. In the following lines, I would like to share some ideas on mainly how life with median urban citizens like myself will be affected by the pandemic, what things will change, and by whom. My hope and intention at this stage are not to give prophecies and ready-to-grapp solutions, rather it's to exchange ideas with those who care.

The ideas will be discussed under the following headings: The nature of the Pandemic, How the world economy will react, managing the post-pandemic world, the urban phenomenon, employment and income, education and the internet, and finally how cities implementing Smart City applications would manage their infrastructure under the new conditions resulting from the Corona pandemic.

2.NATURE OF COVID-19

COVID 19 is a viral infection caused by a virus from the Corona family. The reason why it is so deadly and widespread lies in its nature and system of multiplication which is new and the health care system has no previous experience with. The only proven method of prevention so far is by quarantine. Wikipedia https://en.wikipedia.org/wiki/Coronavirus_disease_2019 writes as follows in brief ;

"Coronavirus disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease was first identified in December 2019 in Wuhan, the capital of China's Hubei province, and has since spread globally, resulting in the ongoing 2019–20 coronavirus pandemic. Common symptoms include fever, cough, and shortness of breath. Other symptoms may include fatigue, muscle pain, diarrhea, sore throat, loss of smell, and abdominal pain. The time from exposure to onset of symptoms is typically around five days but may range from two to 14 days. While the majority of cases result in mild symptoms, some progress to viral pneumonia and multi-organ failure. As of 9 April 2020, more than 1.5 million cases have been reported in more than 200 countries and territories,[16] resulting in more than 90,000 deaths. More than 340,000 people have recovered.

The virus is mainly spread between people during close contact often via small droplets produced during cough, sneeze, or talk. While these droplets are produced when breathing out, they usually fall to the ground or surfaces rather than being infectious in the air over large distances. People may also become infected by touching a contaminated surface and then their face. The virus can survive on surfaces for up to 72 hours. Coronavirus is most contagious during the first three days after onset of symptoms, although spread may be possible before symptoms appear and in later stages of the disease.

The standard method of diagnosis is by real-time reverse transcription-polymerase chain reaction (RRT-PCR) from a nasopharyngeal swab. The infection can also be diagnosed from a combination of

symptoms, risk factors, and a chest CT scan showing features of pneumonia. Recommended measures to prevent infection include frequent hand washing, social distancing (maintaining physical distance from others, especially from those with symptoms), covering coughs and sneezes with a tissue or inner elbow and keeping unwashed hands away from the face. The use of masks is recommended for those who suspect they have the virus and their caregivers. Recommendations for mask use by the general public vary, with some authorities recommending against their use, some recommending their use, and others requiring their use. Currently, there is no vaccine or specific antiviral treatment for COVID-19. Management involves the treatment of symptoms, supportive care, isolation, and experimental measures.

The World Health Organization (WHO) declared the 2019–20 coronavirus outbreak a Public Health Emergency of International Concern (PHEIC) on 30 January 2020 and a pandemic on 11 March 2020. Local transmission of the disease has been recorded in many countries across all six WHO regions."

3.POST CORONA WORLD ECONOMY AND URBANISM

The COVID 19 pandemic has spread over most parts of the world causing closures and interruptions to the normal operation of economic and social life and businesses have come to a standstill in both industry, commerce, tourism, education, and literally all workplaces. Labor layoffs became an ordinary reaction of businesses, and millions have lost their source of income. As a result, the awaited economic crises became evident and countries and international organizations like the World Bank, the International Monetary Fund, and European Union have started to consider what needs to be done to minimize losses and putting the economy back on track. Many countries are considering that they will have to live with the Pandemic for an extended period of time, years not months.

According to a study conducted in Japan in a survey of more than 10,000 Japanese businesses, more than 63% projected that COVID-19 would have a "negative impact on their business performance". Many considered going online and remote working could create opportunities for some businesses, forcing a reflection on Japan's long-hours working culture. More time spent at home is also prompting families to reconsider traditional domestic roles. (Jones, Palumbo & Brown, 2020) (Takeshita, 2020).

Other countries have already considered the experience they accumulated during the closures had given them proof that new work protocols, like working from home, home delivery, social distancing, and remote education and conferencing are going to be the normal, not the exceptional way of doing business. At the same time businesses like transportation services, even those with online applications like Uber will suffer business losses and will have to adapt to the situation by diversification of services according to new norms that consider personal hygiene and social distancing. So the world after Corona will be the same as it was before the Pandemic. The same consideration applies to the planning and urban design and even architecture and interior design. It will be evident that the physical setup of metropolitan areas, urban densities, and the building stock, will have to be modified to adapt to the new regimes of urban interactions. This will be discussed in further detail in the following parts of this paper.

3.1.Post Corona Urbanism

To be able to generate a philosophy and a work plan to remedy the urban areas after the Pandemic, one must understand two things: urbanism and interest groups. Urbanism is the process of planning and design of cities and replanning and design after a severe change in conditions and policy. Interest groups are those citizens, groups, companies, and business communities, and the general system of governance that make them interact and work for a common cause agreed upon by most if not all.

From my personal experience, back in 1980, I was appointed by the late mayor of Amman city, Isam Ajlouni to constitute a team that will prepare a comprehensive urban development plan. From day one I was faced with powerful interest groups from within the municipality, and from the community at large. For most of them, the lack of a plan was a better option. Why? Because, they were heavily involved in an immense real estate activity to convert agricultural and vacant lands in housing, commercial, industrial, and other urban uses, and the plan may limit that activity. Urban sprawl was devastating in the vicinity of the city and its surrounding towns and villages. I thought something needed to be done. So I came up with an idea of preparing a comprehensive urban policy that includes better use of land resources in a coordinated way to the real and reasonable needs of the population and the economic and social activity that take place in the city, for the present, and in the future. Areas zoned for urban activities were estimated to accommodate 10 million inhabitants if built according to the zoning regulations in action. The population at that time was one million and could double to two million in twenty years. A waste of valuable resources of land which were mainly used for agriculture. The plan we prepared and submitted for approval in 1988 envisaged a different policy, that of densification within the already zoned areas, and stop any new zoning. Now with the advent of the Corona Pandemic, some interest groups advocate that the city must be de-densified so social distancing and better urban design principles could be applied. This is well-said advocacy for the wrong cause, to my humble opinion. If something needs to be done it is rethinking the already zoned and largely built-up areas, to create more space for a walking, playground, transit-oriented with less private cars, and the regulatory frameworks that make that happen. In a lecture I presented back in 2017 at the Jordanian University of Science and Technology entitled: "Spatial Architecture Between Education and Practice", I drew attention that a majority of present students of architecture and planning may have to work in fields not related to the studies they are having at present. The same applies to other disciplines as well. Many of those who stated their opinions on the post-COVID-19 economy gave similar examples that will be prevalent at a much larger scale; this time covering not basic work skills, but sectors of the economy and economic class structures. Mainly mentioning those paid by the day or the hour, their chances to get employed, and their contribution to the purchasing power that keeps the economy running. So I believe that re-education and having flexible skills will be a must for the majority of the workforce in the coming days. One other concern is related to the role of the public sector in the provision of basic services like health and education and social security. As we hear many voices who once advocated privatization and liberal economy are now less enthusiastic about these trends and advocate a stronger involvement of the public sector; a drawback from the liberal economy.

Cities are the stages where most episodes of history are written and rewritten. Cities were going hand in hand with the general aims of states, democratic, autocratic, or otherwise. The

way cities are planned, designed, and constructed, developed, and declined always goes in harmony with the overall story or ideals imposed by the leading class. Pandemics, however devastating to the societies and businesses, are also game-changers in the way they are shaped or reshaped. This Pandemic is not an exception and it will certainly change the way we perceive urban living, styles, and amenities. The following are excerpts from major planning and architecture media, talking about the anticipated changes:

Managing rural-urban development and linkages. This example is from Turkey; As part of their new responsibility, the Metropolitan Municipalities, MM's legal obligations to provide services have expanded to rural settlements. This requires geotechnical studies, new development plans, and a strategy for providing infrastructure services to former villages that are now designated as 'neighborhoods' within the MM. In Gaziantep, there are 670 former villages; in Malatya, there are 494; and in Mugla, 396 villages that are now designated as neighborhoods, a daunting and expensive task of preparing the spatial and comprehensive plans required by law. Protecting agricultural land from urban encroachment is a common concern across all MMs. In Mugla, the emerging priority is to limit the pressures of tourism development on agricultural land. In Malatya, the development of a landscape/green area strategy for urban and rural districts is a growing need. Gaziantep has already started a project called 'Eco-village' in Şahinbey to limit the growth on agricultural land and give directions/limitations for future developments; however, these efforts are fragmented and do not include a comprehensive look at the interlinkages across other neighborhoods. Developing local economic development opportunities for rural districts was a common theme for the MMs.

Spatial information and analysis. Evidence-informed planning has become an essential planning and management tool for understanding key trends that are influencing the economic, environmental, and social development of municipalities. Indicators are increasingly being used at different spatial scales to measure progress toward national development goals, measuring regional growth and/or disparities, and the impact of specific programs often at the local level. Each MM/utility needs some level of assistance in developing its GIS's capabilities for different purposes such as improving the efficiency of planning between the MM and the districts; raising local revenue through the identification of taxable properties; inventorying and mapping cultural heritage sites and monuments, and mapping poverty within the MM to better understand how to target services for lower-income neighborhoods and vulnerable communities.

Social sustainability. Citizen inputs, when integrated into improvement plans, services, municipal policy, governance, and investments have a more sustainable communitywide impact. Leveraging community knowledge and assets can also ensure a constructive dialogue that will align public investments with citizen priorities, strengthen accountability, and enhance social inclusion through explicit recognition of the particular challenges faced by marginalized communities. Investigating and tracking the social sustainability of municipalities/utilities aims to support partners in deepening their understanding of and the management of social aspects of their operations and activities. Pending further development, the latest social sustainability framework for partner cities are based on (a) opportunities for participation, (b) levels of engagement, (c) transparency about the availability of information, (d) transparency in terms of access to information, and (e) feedback.

How recovery built cities; Waves of epidemics following European contact in the 15th century devastated cultures across the Americas, leaving towns emptied and sophisticated knowledge lost. Cholera and other outbreaks in the crowded and unsanitary cities of the 19th century led not only to major sanitary reforms but to the institutionalization of public health measures and town planning practices. The desire for ventilation and daylight that Victorian-era epidemics reinforced influenced the streets, parks, urban spaces, and homes we planned and built through the 20th century.

Disease shapes cities. Some of the most iconic developments in urban planning and management, such as London's Metropolitan Board of Works and mid-19th century sanitation systems, developed in response to public health crises such as cholera outbreaks. Now COVID-19 is joining a long list of infectious diseases, like the Spanish flu of 1918 in New York and Mexico City or the Ebola Virus Disease in West Africa in 2014, likely to leave enduring marks on urban spaces.

For Michele Acuto, professor of global urban politics in the School of Design at the University of Melbourne, the intersection of urban design and public health is an increasingly critical territory. He's the director of the Connected Cities Lab, a leading center for advancing urban policy development; he's worked on urban health in a number of capacities, including with the European Commission and the World Health Organization's Western Pacific Regional Office. While the University of Melbourne scrambles to accelerate a COVID-19 vaccine, the Lab is working to understand the urban planning dimensions of pandemic preparedness.

CityLab spoke to Acuto about why COVID-19 could change how we study cities — and how we live in them.

Much of the coverage of the new coronavirus feels unprecedented as if this is the first time urban spaces and global movement of goods and people have given rise to the threat of a pandemic. But the stories of cities have always also been those of infectious disease.

Anyone you talk to on the urban or medical side would tell you this is not new. You can draw parallels between COVID-19 and many other epi- and pandemics, from the plague to SARS and Ebola. The line of caution we need here is not to draw too many parallels or rushed conclusions without evidence. COVID-19 is not as deadly as Ebola, which had a mortality rate of 60%, or SARS and MERS at 30%.

But if the risk of death is lower, the transmission is much higher, and that makes it challenging globally. Quarantines only work insofar as you can identify all dangerous cases, and with COVID-19's symptoms and delayed onset, you can't spot it that easily. In that way this is much more similar to the 1918 Spanish flu epidemic, which infected 500 million and killed up to 50 million.* The question is whether we are prepared to avoid that.

Looking back, did we miss something in the way we were thinking about the intersection of urbanization and infectious disease? Were we looking in the wrong places?

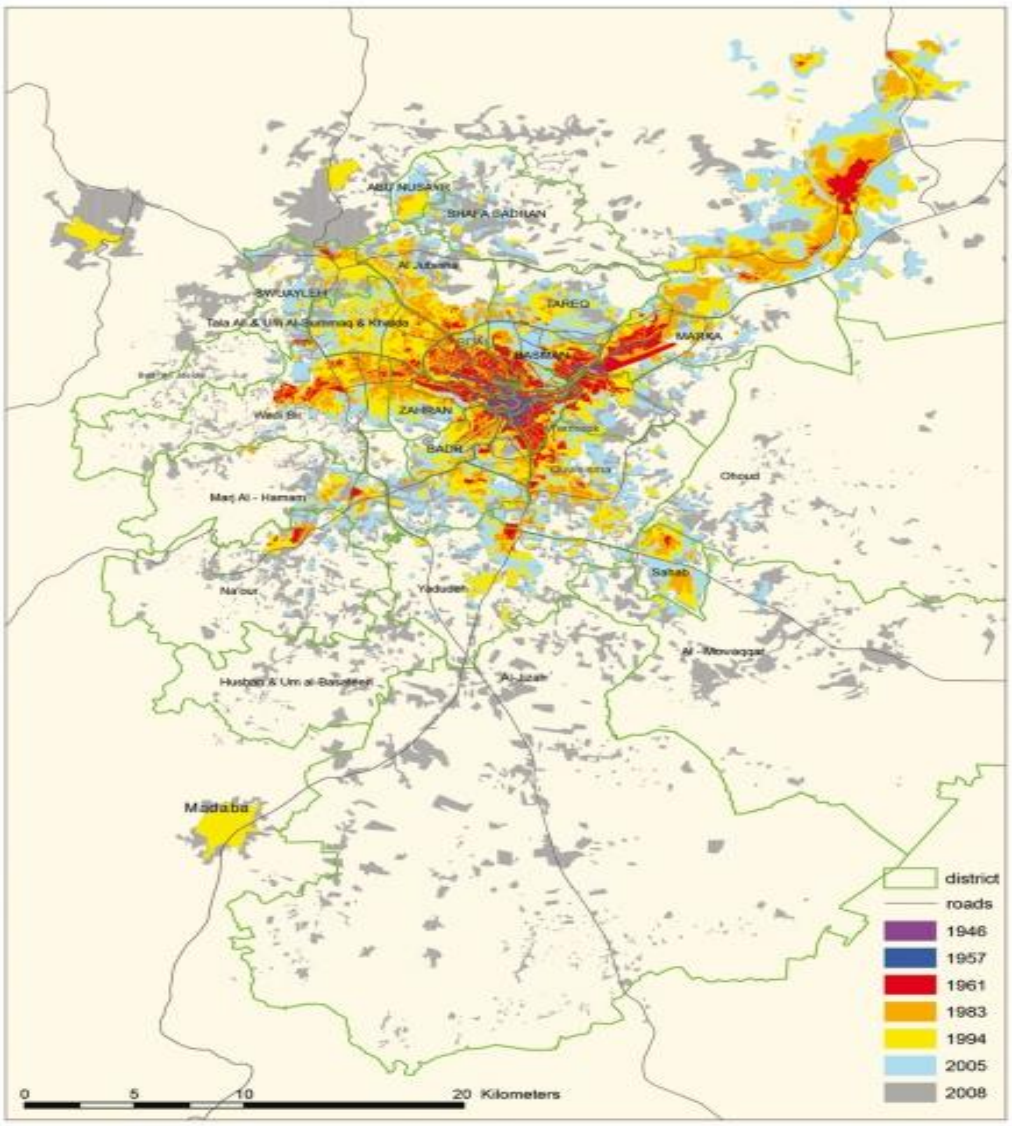
Yes, to a degree. We have perhaps been a bit too biased toward global cities. COVID-19 is a story of peri-urban and rural-to-urban connections, in places that are often not on the global

map. Roger Keil, Creighton Connolly, and Harris Ali recently argued for this suburban view. They tell the story of how the spread to Germany starts with a car [parts] factory in the outskirts of Wuhan. A person travels from Wuhan to Germany to help with training. This is a story of peri-urban Wuhan to semi-suburban, tertiary-city Bavaria. So sure, you have some of the global connections at airports, but it's a much more complex urban system.

This is a rich point. It's easy to look at these major cities and global supply chains, and say of course we have an epidemic — this is how globalization plays itself out. But you're telling a different story — one about non-global cities, tertiary cities, and peri-urban areas.

Yes, it's actually about a much wider set of urban areas. This is the story in Washington state [where COVID-19 first emerged in Snohomish County], or the Italian story, which is still largely suburban.https://www.youtube.com/watch?v=IFjD3NMv6Kw 7 principles for building better cities, Peter Calthrope on TED

Giving an example from the Amman Zarqa Conurbation in Jordan, the cities of Amman, Zarqa, Salt, and Madaba and the smaller townships in between witnessed huge waves of migration from neighboring countries due to wars and civil unrest, and the Jordanian hinterland, in the last seventy years. Emigrants had to be accommodated in refugee camps and makeshift housing at the beginnings, then as the economy developed and remittances from Jordanian migrant labor in the oil-rich countries began to arrive, a huge trend of urban sprawl started until the early 1980s. Zoning additional land continued at a fast track to accommodate the need for urban plots continued without an overall plan for the metropolis, and even the separate townships, a high surplus of zoned lands was made available, and service agencies began to realize that serving vast areas with little population densities is a burden they cannot handle. The comprehensive plans prepared for both Greater Amman 1988, and Greater Zarqa 1996 both suggested a halt to urban sprawl and over zoning. Instead a replanning policy of already zoned areas with moderate urban densities and better infrastructure coverage. The second metropolitan for Greater Amman in 2010 came up with a similar policy as there was still a place to accommodate urban population and activity growth for another twenty years to come. Now in light of the post-COVID-19 concerns new sounds from planners, urban designers and architects claim that a rethinking of the adopted urban densification policy is needed to cope with low-density development claims of the post Pandemic era. As a planner who participated in the preparation of the regional development plan 1980, the Comprehensive Plan of 1988 and the creation of the Greater Amman Municipality 1987, and the Greater Zarqa Plan of 1996, I believe that this reconsideration of the urban growth policy should not be done in a reactive way to the post Pandemic fears. Instead, it must be done in the context of a Metropolitan plan that covers the total area of Greater Amman, Greater Zarqa, Greater Salt, and Greater Madaba, and accompanied by a well designed urban design policy that uses the existing urban space and street network in creating walkable areas, cycling and green areas. Otherwise, it will lead to a new wave of urban sprawl with unpredconsequences. The following plan shows the development of the said metropolitan areas over time since the 1950s.



Source : Extraction from Landsat Image 1961, 1983, 1994 and 2005 by the Royal Jordanian Geographical Center for IFPO, 2009.
For 1946 and 1957 : Map of Amman extension by the RJGC published in 1983. For 2008, Greater Amman Master Plan.

Figure 1. Urban development in the central metropolitan region in Jordan, showing the geographical spread of development. Almost six million urban inhabitants live in this area out of 9.4 million total country population.

4.EDUCATION AND THE INTERNET

The World Economic Forum states in a study that The internet is a fundamental part of daily life that delivers immense economic and social benefits around the world. In 2018, internet connectivity finally reached over half the world's population. Yet some 3.4 billion people – about 50% of the world's population – are still not online.

Although much progress has been made in closing this digital divide, the challenge remains overwhelming, complex, and multidimensional. It requires a collaborative, multi-stakeholder approach to overcome four key barriers to internet inclusion: infrastructure; affordability; skills, awareness, and cultural acceptance; and relevant content.

The World Economic Forum launched the Internet for All in 2016 to provide a platform where leaders from the government, private sector, international organizations, non-profit organizations, academia, and civil society could come together and develop models of public-private collaboration for internet inclusion globally.

Significant barriers to digital accessibility and connectivity still exist worldwide. Almost one-third of the world's inhabitants cannot access 3G coverage. Meanwhile, 80% of online content is only available in one of 10 languages, excluding millions of people.

Importantly, the internet is also the fundamental enabler of the Fourth Industrial Revolution. The industries enabled by the Fourth Industrial Revolution are likely to reshape the global economy, creating immense opportunities for those able to develop them.

The internet has become a pervasive and fundamental part of daily life. Its impact on both economic development and solving problems in areas such as health, education, basic financial services, and agriculture is well documented. But, more than half of the world's population is still not online.

Populations are not connected because they live in hard-to-reach areas or do not have access to digital or other basic infrastructure. Some do not see the benefits of being connected, often because of limited relevant digital content. Still, others are illiterate, and many are poor. Inequality – in terms of gender, income, or other factors – compounds the problem.

The barriers are real, and the costs are high. But we need to ask ourselves: what are the costs of inaction – of not extending access and use? (WEF 2020).

Developing new economic and business models that are digitally driven, creating sustainable value for an inclusive economy.

The Fourth Industrial Revolution is rapidly driving transformational disruption across every sector. By 2022, over 60% of global GDP will be digitized. An estimated 70% of the new value created in the economy over the next decade will be based on digitally-enabled platforms. Currently, about 50% of the world's population does not participate in the digital economy at all – and growth in internet adoption is slowing. The G20's Global Infrastructure Hub estimates a global funding shortfall of nearly $1 trillion for information and communications technology infrastructure by 2040.

The COVID-19 pandemic has driven big spikes in interest in telemedicine software, electronic signature tools, and Web conferencing platforms, according to recent research from Trust Radius (Covid-19, 2020) The biggest increase in interest since March 9 has been in the telemedicine software category, with search impressions up 613%. That's followed by the electronic signature (+511%), Web conferencing (+500%), mobile app development (+366%), antivirus (+357%), remote desktop (+281%), video platforms (+265%), webinar (+226%), Web portal (+199%), and live chat (+194%) categories. The products with the biggest spikes in

interest since March 9 on the Trust Radius (Covid-19, 2020) platform are Intermedia Any Meeting (Web conferencing category), Google Classroom (learning management system), Blackboard Collaborate (web conferencing), Zoom (Web conferencing), and Webex Events (webinar).

4.1.The Fastest Growing Software Categories During COVID-19

The COVID-19 pandemic has had a staggering impact on every element of life. It's impacting both personal and professional lives. Companies are closing, businesses are struggling but amidst the chaos – some software companies are thriving.

Global SaaS sales were projected to reach more than **$132 Billion by the end of 2020,** but since the outbreak, SaaS companies have been laying off staff, investors have been writing essays about the importance of cutting back spending and many are guessing that there will be a significant downturn in SaaS revenue. Yet… The differences between the way the world operated during the last financial crisis (2008) and the world today are significant.

Technology is much more advanced than it once was. People are being advised to stay home and thus, they're spending time online. And many organizations are trying to operate as usual but with staff working entirely from home. So that leads the industry to ask a simple question:

What software are people looking for?

To answer this question, the team at Trust Radius (Covid-19, 2020), a review site for software & service companies analyzed traffic data across all of their categories compiled a list of the fastest-growing. The results are in:

1. Telehealth Software
2. Electronic Signature Software
3. Web Conferencing Software
4. Antivirus Protection Software
5. Remote Desktop Software
6. Video Platform Software
7. Webinar Software
8. Web Portal Software
9. Live Chat Software

5.SMART CITY, SMART BUILDINGS, AND SMART INFRASTRUCTURE

Smart city solutions would become a rather necessity in cities for many reasons: *First,* as people become digitally connected, they will need to utilize their connectivity in making their lives easier, more time and energy conscious, more productive in terms of unit per person per time unit and more open to social, cultural and technological interactions. *Second,* service providers will tend to maximize their profit by using technological advancements like the Internet of Things IT and even the Internet of Everything IET and Machine Learning (ML) in the design, operations and spreading their service to a wider audience, this in specific will make the utilization of scarcely available resources like water, energy and mineral resources more economic and more justly available to all. Smart City applications will be specifically utilized in urban systems like transport, and many successful examples are already in place in large metropolises around the world.

As the Corona Pandemic has forced millions around the world to stay home for extended periods, people had a chance to put into practice concepts like remote education, working from home, using home delivery services, attending educational, work, and cultural interactions using Webinars. This allowed individuals and businesses to rethink their work and life routines and use these facilities on a more permanent scale. A positive by-product of the Pandemic. To give an example of developments in infrastructure provision in urban areas, it would be useful to examine the anticipated developments of the products of the Fourth Industrial Revolution is one of the most stressed resources of our urban life in the coming years, namely water.

6.THE WATER CHALLENGE

Hundreds of millions of people across the planet do not have access to safe drinking water. Billions suffer the health impacts of poor sanitation and millions of others live without sustainable supplies of water, or are threatened by floods or droughts.

Without improved sanitation and sustainable supplies of water of sufficient quantity and quality, many countries will suffer from increased poverty and disease, food and energy insecurity, economic dislocations, and cross-border and regional tensions. These problems have the potential to undermine economic development, exacerbate migration pressures, increase civil unrest, aid terrorist recruitment, reduce trade and export opportunities, and prevent countries from advancing policies and programs important to the United States. Safe water and sanitation are fundamental to solving challenges to human health, economic development, and peace and security.

Water problems are difficult to solve. The poor and marginalized, in particular women and girls, are the most difficult to reach. Local capacity is often weak and financial resources limited. Water-related issues are frequently not a priority for local or national governments; this is especially true for sanitation. Weak policy and regulatory environments can make local capital hard to find and hinder coordinated decision-making around the management of water resources. At a national level, water is often viewed as a strategic resource with national security implications.

Water is also an opportunity. Water is an entry point to advance core democratic values around equality, transparency, accountability, women's empowerment, and community organization. Governments that deliver basic water and sanitation services are often seen as

working on behalf of the people – creating a more stable environment. Countries that cooperate on the water are less likely to go to war and networks established for water and sanitation service delivery have been used to strengthen community responses to challenges such as Ebola and other infectious disease outbreaks. In other words, water can be a means of strengthening governance, civil society engagement, and resilience at all levels.

Finally, the United States benefits directly from engaging in international water issues. U.S. technologies, experience, and best practices are in high demand, which presents an opportunity for the U.S. private sector. The global water and wastewater market currently exceeds $700 billion annually and is growing. Demonstrating U.S. approaches and technologies globally can increase U.S. exports and jobs. Work on water globally gives us access to knowledge and expertise that can help us address water-related challenges at home

Gillan Taddune, CEO of Banyan Water, notes in an article titled "Water Wise: The Role of Water Management in the Smart City Revolution" that appeared in Environment + Energy Leader;

"By the year 2050, the United Nations predicts, the global population will have risen to an astounding 9.8 billion people. While our population surges, a dramatic relocation is occurring, drawing individuals from rural areas to urban hubs. The drivers of this migration—economic opportunity and quality of life—will bring an estimated 70% of the global population to cities by the time we reach 10 billion human beings, according to the Population Reference Bureau. This means literally millions of more people inhabiting the same cities we live in today; where networks like energy, transportation, and water treatment and distribution are already stressed. We can also expect the emergence of an expanded global middle-class, set to deservedly become prosperous consumers. To support this kind of population density, cities around the globe are going to require major improvements to infrastructure and efficiencies.

"Smart water" is one of six components that define a smart city; the others include energy, mobility, buildings, public services, and integration. The goal of these efforts is to make the city more sustainable and efficient, according to Water World, and effectively improve the quality of life. Smart water generally refers to a holistic approach to managing this priceless resource, and the infrastructure systems surrounding its sourcing, treatment, and delivery. As we update and invest in our water infrastructure with more internet-enabled tools, and a wealth of data becomes available, these networks must communicate with one another. This will allow for not only the measurement of important indexes such as reservoir and groundwater supply, and triage of infrastructure updates, but will improve efficiencies across water-related disciplines. As an example, Water World cites predictive capabilities of flood mapping when looking at historical flood data paired with real-time and predicted weather and precipitation data.

By recognizing anomalies in consumption patterns for both the utilities and end-users, cities can optimize and eliminate water waste and cost in delivery. The high-energy demand of a city's water treatment and delivery networks are often underestimated, meaning that

improving operational efficiency through actionable data will reduce greenhouse gas emissions and cut costs simultaneously.

It seems as though the impact these technologies could have on problem anticipation is boundless. Automatically prioritizing repair projects will help avoid major catastrophes like what happened to the Oroville Dam in California in 2017. As global water demand grows and climate change creates a question mark in the future of water's security, likely, we won't be able to afford resource losses at this scale. Perhaps a network of water treatment plants communicating in real-time as a system of checks and balances could have prevented or at least mitigated the damage done to the community in Flint, Michigan.

Implementing smart solutions comes with pivotal—and sometimes costly—challenges and limitations. To update our aging water infrastructure with the most current technologies, tens of billions will need to be spent through both public and private investment. Juniper Research estimates $15 billion will be invested in software alone by 2021. In addition, smart sensors need the power to take readings, creating a huge new source of energy demand. Small scale solar can work in some areas, but is it likely that cloudy Seattle or a Chicago winter will maintain enough light to power these tools? As these systems and sensors age or as technology improves, who will bear the rising maintenance costs of smart infrastructure? There are also significant issues of privacy to address and whether all this data and information should be available to the public. What sorts of security measures will need to be taken to ensure the safety of our water resources from terrorism and cyber attack? These are all questions that will require input from the public, private and NGO stakeholders to resolve.

Though we do not have all the answers today, now is the time we must start investing in this smart infrastructure. On a global scale, it is even more important as developing countries are some of the most densely populated places on the planet. We must ensure access to the most powerful and modern tools available as industrialization sweeps the globe. To invest in anything but the most current technologies will be more costly in the long term and may risk human health and safety in dense urban areas.

Luckily, the cost of these technologies is set to rapidly decline in the coming years, making smart solutions more feasible and powerful than ever before. Frankly, if we do not steadily move in the direction of smarter and more efficient cities, we won’t be able to handle the overload of people that is inevitably coming in the near future (Taddune, 2018).

Traditional water systems in urban areas have been developed using available resources, usage habits, sanitation conditions, and network technologies. Most of these parameters may still be available for many years to come, but utilizing digital developments will certainly be beneficial to both the providers and receivers of this vital resource. Traditionally, the following policy approaches were developed as the population increases over time: Comparative easy access to water at low cost and simple technologies were utilized in a low inter-sectoral competition that is easily maintained. As population increases, service providers have to get into a supply management phase, where technical and logistic challenges become more apparent and cost increases. In the following phase, service providers are obliged to have a holistic view on the water, where intersectoral competition

becomes more evident and complicated to maintain, and environmental competition becomes more of daily business, as sectors compete for lower cost and less controlled environmental management. In the highest phase of operational stress, service providers are forced to get in-demand management, as the resources become more strained, and costs and technical complexities become major issues. Some of the methods applied are scarcity values, allocation priorities and a continuous effort to achieve the best possible overall use. The following figure which is adopted from a figure that appeared in a European Union report on cooperation on water resource management simplifies this development. Figure 2. Development under conditions of growing water scarcity must be based on a strategy where the best possible use of available resources will be stimulated, probably alongside scrutiny of the need for additional withdrawals. A combination of supply-side and demand-side management will be natural as countries climb "the management ladder".

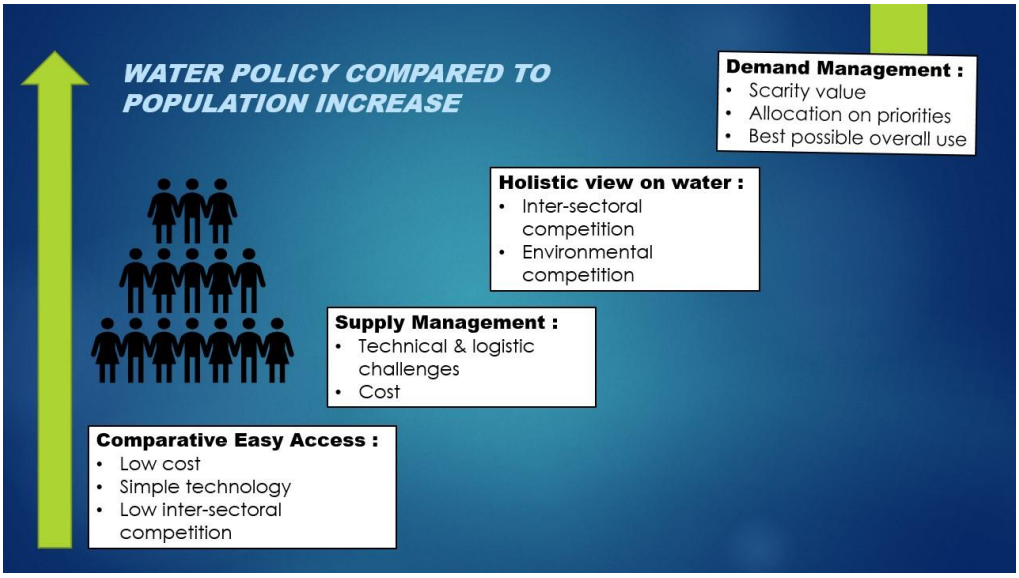


Figure 2. Increasing population in relation to available water resources.

Water Management in Developing Countries - Policy and Priorities for EU Development Cooperation, A Background Document for an EC Communication on Water and Development

The recommendation was performed by the Stockholm International Water Institute (SIWI).

Lead Author Dr. Gunilla Björklund.SIWI Report 12 Published 2001 by Stockholm International Water Institute Sveavägen 59 SE-113 59 Stockholm Sweden.

Integrated Water Resource Management - Cross-sectoral coordination with other development sectors: In addition to its importance for human survival and well-being, water is a basic ingredient in many productive and non-productive activities. As already outlined, there are many cross-sectoral considerations to be taken into account, and there is a need to

apply an integrated approach when indicating the policy priorities to focus on. When growing and incompatible sectoral demands claim for more water, choices will have to be made in terms of how should the water withdrawn be allocated between different sectoral uses, including food security, industries, and energy, environment, etc. Such allocation challenge is particularly pertinent in areas where the overall availability is poor. It could be choices between major urban centers including the peri-urban areas and the surrounding agricultural lands and wetland ecosystems. It must be handled through a combination of regulatory measures and managing principles.13 This implies in particular moving towards pricing water services to reflect the cost of their provision. Effective systems to assess the value of water are necessary, to balance economic efficiency against social equity or environmental sustainability.

Organizational water footprint consists of two elements; Direct water, water used from taps, or irrigation systems from countries' resources. And, Virtual water, water used through the life cycle of a product or activity (from cradle to grave), more complex to measure but not less important. From Water, the next Carbon, discussion paper, ACCA. (www.accaglobal.com).

- **Smart water meters**. Around 60 percent of the city's 500,000 water customers have smart meters, which gather data on water usage every 15 minutes. In the future, this technology will give customers real-time leak alerts and conservation advice.
- **Proactive roadside air filtration**. Bridges along the city's main overpass are fitted with air quality monitors and air filtration technology, which senses and cleans pollution to prevent it from affecting nearby neighborhoods.
- **Community sentiment analysis.** Houston uses Zencity technology to analyze data from social media and the internet, identifying trending topics to understand residents' opinions about the city.

7. PUBLIC OPINIONS

The current Pandemic came in a time of widespread digital media, and almost everybody with a computer or smartphone contributed to the exchange of opinions on the causes of the Pandemic, the precautionary actions taken by authorities at all levels, and even suggested remedial steps to the effects of the Pandemic. Locally speaking for Jordan, Maen Qatameen, a Jordanian web personality, and economist stated the following possibilities for economic development that occurred in front of the Jordanian economy in the post Corona era:

- *Online businesses as professional services,*
- *Online reach to neighboring markets will give Jordanian professionals and businesses a wider reach to outside potential customers, doctors, engineers, lawyers, etc.*
- *Full operation will give the Jordanian economy a competitive edge, especially as other countries are still struggling to get out of the Pandemic.*
- *Online learning will give schools and higher education a chance to reach a more diversified community locally, nationally, and internationally, as education establishments will minimize the need for class space, transportation, and support staff.*
- *Intelligent government, better abilities to reach, analyze, and develop the services provided by ministries, municipalities, and non-governmental organizations.*

- *Artificial Intelligence AI, machine learning, and robotics will be more widespread and will enable service providers to reach previously unthinkable levels of efficiency, minimize time, and lower cost.*
- *Online media, as communication networking and production, viewing mediums are more widespread, will open better markets for entertainment, culture, and sport and will open better business opportunities for media companies, like Netflix which has increased its share in the market by 40% during the Corona Pandemic as people where forces to stay at home. Small producers will also benefit from this growth of the business.*
- *Online work from home for office staff, will benefit businesses as they will need less office space, transportation, and energy to provide a service.*
- *Online marketing services and delivery will open new frontiers for small and large businesses to reach a more diversified customer body and growth of employment and skills.*

The Corona Pandemic has given communities an unprecedented chance to test the actual operation of these applications. A chance will never be available in normal times.
Qatameen, in another TV program, explains how COVID 19 has contributed to the actuation of the digital revolution and governments that used to do lip service on the importance of digitalization, with very little real effort to take real steps in making the fourth industrial revolution a reality. In Jordan for instance open data and the smart government is still in the twilight zone despite available well trained Jordanian professionals who are capable of creating this system, and they are employed in different countries on these applications.(Mark Zuckerberg and Yuval Noah Harari conservation 26 April 2019)

According to Yuval Harari**,** the famous bestseller author of "Sapiens" argues in a public interview, that a gradual shift is taking place from humanity to algorithms, algorithms that understand you better than you understand yourself!. We are moving towards being hackable animals, as Biotechs become more common. In the former Soviet Union, the KGB, the secret service of the state, collected enormous amounts of information about individuals, families, and groups to anticipate their possible actions against the state. But they lacked sufficient means to analyze the piles of dossiers to understand what the actual beliefs and anticipated actions would be. Instead, they have to act on a selective basis, which did not reflect the reality in most cases. With the available means of information technology, accurate anticipation of human actions are possible, and even hacking of human feelings could be done in a most accurate way. A story has to be formulated to start any social or technological change.

One perceived development of technological development and especially in machine learning is that a new class of humans will be a massive problem in front of governments, that of useless citizens! As more people become unemployed and can generate no income, by the result they become unable to spend on goods and services. People will become gradually more connected by the means of information technology, but without being in harmony. And that in itself will be a major problem in future societies. In the upcoming digital Metabolic world, we will not have people who are employed, and unemployed, we will have citizens who are doing things useful to the society, and simply useless people, they don't produce anything, they have no jobs that they are paid for, and thus have no resources to spend on buying products.

Noam Chomsky the famous American philosopher, explains the post-Corona world as follows: Cities are becoming Metropolitan in terms of planning, management, economic development, and infrastructure. This development is not necessarily what the business community likes, because they believe that dealing with dispersed municipal bodies is more beneficial to them, in terms of taxation (and tax evasion!) and licensing for businesses becomes cheaper. Harari, says that in another interview, the post Corona era and gradually into the 2030s and further on, control will shift from humans to algorithms. Algorithms that understand you better than yourself, it's info technology with Biotechs. So, we will be hackable animals. In the past Soviet era, the KGB was piling up information about every citizen, but had no means to process that huge amount of data, and had to act on a selective basis in treating citizens. A story has to be told to create a hackable city which is part of a Metabolic system.

In his contributing article to the report on the effects of Covid-19 Pandemic on the Jordanian economy Jaafar Hassan an ex-minister of planning, and a once fierce defender of privatization in the economy, states that the COVID 19 Pandemic has accelerated the transmission to wider use of information technologies and entering the era of the fourth industrial revolution, in fields like education and remote learning, work from home, remote negotiation, and artificial intelligence AI. Adding that these developments will not replace traditional ways of doing business, but will be more widespread, and Jordan will be urged to provide the needed infrastructure and the regulatory framework for its operation. The government will be more electronic rather than conventional. Dr. Hassan also defended in his article that the role of the public sector will be more vital in the provision of services. This is worth noting from a defender of privatization and active implementer of the transfer of many basic industries from public to private property. This opinion is also supported by columnist, MP Jamil Al Nimri that the Jordanian policy must be; Let's be poorer, but happier in the post-Corona era.

Another article by former foreign minister Marwan Muasher defends that; in the work plan for national action after the Pandemic should consider the protection of the working class and its sources of income, and work must be done with the private sector to secure availing the necessary funds for a firm, and a gradual return to full operation of the economy. Paying up of national debts to foreign aid agencies should not be a priority at this stage, according to Muasher.

8. LESSONS LEARNED

The current pandemic challenges contemporary planning prescriptions for urban livability and economic vitality. Cities face significant risks during density-susceptible epidemics, with numbers of cases and death rates linked to population density and city size. Many cities have closed the green spaces intended to provide recreation for the residents of dense neighborhoods, leaving home-bound residents of small units feeling trapped, especially if they have children to keep active and engaged. The poorest urban residents lack adequate shelter and sanitation to stay safe and socially distanced. Essential transit systems often feared as nodes and corridors for virus spread, are operating below capacity. Mixed-use zones with concentrations of cafes, fitness studios, and restaurants are struggling to survive as the "third places" valued for social interaction have had to go virtual. Higher death rates among racialized populations and racist attacks against Asian residents threaten planning's

commitment to diversity and integration. The usual strategies for designing cities may need to be reconsidered.

8.1. What can cities learn from lockdown?

What lessons can cities draw from this crisis to inform future planning? We may need to reconsider the push for higher urban densities. Crowded housing increases contagion risks. After being cooped up in towers for months on end, urban dwellers may begin to look at suburban lots more longingly than they did in the past: living preferences may change. Everyone needs some access to outside space for mental health and exercise. We may want to consider broader park paths or longer benches that enable physical distancing, or better strategies for managing who uses space when. Those who can walk to work or shop are appreciating that ability during these times, but we need to ensure that more have that choice. The pandemic has brought inequality into stark relief. Everyone needs a living income to keep us all safe. Governments need to plan decent housing for all, not only for social justice reasons but for public health. Although it's too early to predict the long-term impacts of the pandemic on our cities, our societies and ourselves, we know that things will never be quite the same again. We need to learn the lessons of our current difficulties and plan effectively to meet the challenges ahead.

Smart metering and smart water demand management can also save a lot of money that would be otherwise needed to remedy the consequences of not having a smart water management system. For instance, if you invest one 1$ on improving the water supply system, you can save 8$ on health. Many municipalities and water supply companies claim that in some cases up to 50% loss of water as non accounted for water, which the authorities fail to identify where it really goes.

8.2.Roadmap For Future Work

The road map to be adopted by the governments and municipalities in the post-COVID 19 policy making, could be as follows, and subject to further elaboration by individual professionals and think tanks:

1. Comprehensive coverage of the performance of the economic sectors, businesses, and employee groups should be prepared and made available to national, sectoral, and international entities. This can help decision-makers to base their decisions on a solid, reliable data source.
2. Creative solutions should be developed for governments and local authorities for maintaining public hygiene and social distancing while allowing businesses to operate and meet the requirements of the population in terms of basic necessities and personal services.
3. As some businesses which are dependent on high occupancy rates, like mobility, food and beverage and tourism, proved to be the most affected by the Pandemic, action must be taken to put new regulatory norms that would allow them to return to business gradually until full operation.
4. Special attention must be given to widening the use of communicative and data-based applications that make distance learning and work from home more widespread. Such applications may need a regulatory framework to operate in certain countries that

would protect stakeholder rights, transparency, and the right to information and data security.

5. Urban planners, architects, and spatial designers should be specially invited to come forward with solutions to maintain social distancing and de-densification of neighborhoods and cities using to the extent possible the existing building stock and roadway space, and protecting the natural environment at the same time. A new dimension of spatial planning will have to emerge after this Pandemic. Planning think tanks, universities, and professional associations must make that possible through online Webinars, research, and publications. Local authorities must help in formalizing these activities and turn the resulting ideas into operational tools.
6. Resource management especially in the fields of water, energy, and food production must be developed in accordance with new norms of sustainability, maintenance of public interest, and stakeholder involvement, and engagement. Public agencies like ministries, universities, and municipal bodies should prepare the grounds for these developments.
7. Water being one of the most critical resources to sustain human life, should be given a priority in the selection of best development options, and activities with low water footprint should be selected from a variety of options.

9.RESULTS & CONCLUSIONS

This paper has been an eye-opener for me in many ways; First being locked down at home away from personal interaction with colleagues and the general public, has urged me to be 100% dependent on the internet and social media, and I found it quite satisfying, as did thousands of researchers and public policy analysts all over the world. For all of us, a new era of interaction and dialogue has started. Second, Being home locked, people who needed to work and reach community services were urged to use available networking and online facilities to use these facilities at its fullest for working, education, receiving home delivery goods and webinars to connect with groups that share their areas of interest. All this has been an opportunity for experimenting with the actual use of online applications. Something that has been advocated for a long time, without having a chance for implementation in the real world.

Two areas of interest for me in person and many colleagues with which I have been in contact with, namely urbanism and water resource management under Pandemic conditions, have also found their way to be tested in real-world conditions. Although we have not found the resources, nor the arrangements to do real scientific research, what we found through observation and dialogue was more than satisfying. I am sure that many institutions and experts on the matters have come to similar convictions.

The expected high population growth reaching a world population of more than nine billion until the year 2050, seventy percent living in cities, will put a great burden on already strained urban areas as well as on the rural hinterlands which are drained from natural resources, agricultural land, and natural resources. As being not enough problematic to a sustainable livelihood, the Pandemic has come with additional threats and needs for action; Urban densification policies to maximize the use of available resources and infrastructure, are now considered outdated and need to be replaced by less densely populated areas, a return to nature and rural living and redesign of city space to allow for social distancing. Even the trend

to use transit instead of car-based urbanism has been under reconsideration for some. This situation really needs further scrutiny by academic and practitioner circles to come up with solutions that are not reactionary but sustainable and economically viable.

Water resource management is another area of priority for research and development R&D as it relates primarily to human basic needs, and to the soundness of infrastructure design and implementation to meet human needs and agricultural production will be most needed and at a high priority on decision-makers tables. As water resources are already strained a new policy of Demand Management should be put in place. This in my opinion is a priority that must go hand in hand with any urban policy. Urban area management and planning will also need to be rethought of, not only in nature and scale but also in pure geography. A three-level policy should be considered; Metropolitan, City, and Local level analysis and intervention. This is also a new scale and field of interest that planners of urban development and systems should consider in the post-crisis era.

At last, a work plan must be formulated at the city, region, and state levels, to deal with all these considerations. From my side, any attempt to propose such a plan would be arbitrary and lack a practical basis, if not done by a well-formulated professional arrangement. So, I suggested a roadmap for action that will give the general framework for such a policy and planning.

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Consequences of the Droughts in the Euphrates - Tigris Basin

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Abstract

In Euphrates Tigris Basin (ETB), droughts are a regular feature in the region and have significant social, environmental, and economic impacts, particularly in places where there are already pressures on existing water resources. Drought has a negative impact on health, the agricultural production, and the economic condition of most people who live in ETB; and food scarcity makes migration from these dry areas and expected to increase further in the future.

Droughts are a regular feature in the region and they have significant social, environmental, and economic impacts where rainfed farming is important. Therefore there is an urgent need to build resilience and adaptive capacity of riparian states focusing on innovative regional-based drought and agricultural investment strategies.

In this paper, the economic, social, cultural, and environmental aspects of drought in the Euphrates and Tigris basin is evaluated. An integrated or nexus approach to resources management and cooperation appears to be the evident way forward. The nexus approach identifies water, energy, and food as the central sectors and advocates for better physical as well as policy and governance integration.

Keywords: Drought, Euphrates and Tigris Basin, Nexus approach, Food Security

1.INTRODUCTION

In this paper, drought is defined as the consequence of a period of low lower than expected or lower than normal precipitation over an extended period leading to a water shortage for some activities, groups, and environmental sectors. (UNESCWA. 2005). Besides low precipitation levels, the occurrence of drought results from evaporation, which is affected by temperature, wind, vegetation, type of soil, and it's capacity to store water, as well as the presence of groundwater supply.

Iraq and Syria both rely on major shared rivers for water but equally, there are parts of the country that rely on rainfed farming. The 4-year drought, which started in 2006, has had major consequences with mass migration from the countryside to the cities and is thought to

be a significant contributor to the overwhelming problems now facing Syria. The ETB is associated with ancient civilization where irrigation schemes had been developed about the 5 millennium B.C. The headwater basin generating ET flows was entirely located in the north and eastern parts of the basin in the highlands of Turkey, Iraq, and Iran as a result of watershed's topography.

2. HYDROLOGICAL AND SOCIO-ECONOMIC CHARACTERISTICS OF THE BASIN

Euphrates and Tigris Rivers are the longest Rivers in southwest Asia. The main utilizers of the water of these rivers and tributaries are Turkey, Syria, Iran and Iraq(Ansari 2018). The two rivers rise in Turkey, which makes it the upper riparian. Some of the tributaries of the Tigris and Shat Al-Arab Rivers rise in Iran, which makes it the second upper riparian for these rivers.

The annual precipitation in the upstream of ETB typically exceeds 1000 mm whereas in the south of Iraq and Syria it was found to be less than 100 mm. Most of this precipitation occurs as snow in winter and the water resources are mostly available in the form of snowmelt water during spring and winter. There are various dry periods, which affect these countries, especially during the past 15 years. Among these four countries, Turkey has less severity and frequency of drought than the other three countries, and Syria has the most.

Figure 1. Euphrates and Tigris River Basin

Although oil supports some economies, agriculture is still an important part of the region's GDP and essential for maintaining national food security. Over the past 30 years, flows in the Euphrates-Tigris river system was reduced to almost 50 percent of the average annual flow in drought years. The Intergovernmental Panel on Climate Change expects a decline of 29 percent in Tigris flows and 73 percent in the Euphrates flows in the future as a result of declining rainfall in the main catchments in Turkey's highlands (Voss et al., 2013).

The severe drought that began in 2006 in Syria was responsible for a large number of farmers abandoning their farms and migrating to the cities and is considered by some as a factor in the civil war which has seen the major loss of life. (Bazza 2018).Frequent droughts, causing yield reduction exceeding 20 percent of the normal, occurred in 1970-1973, 1977-1979, 1983-84, and 1989 in Syria (Bazza 2018). The recent most severe droughts affecting the majority of zones occurred in 1999–2001. Since 2006, the country has endured four consecutive drought years. Poor and erratic rainfall since October 2007 caused the worst drought to strike Syria in four decades. Rainfall in eastern Syria fell to 30 percent of the annual average in 2008 – the worst drought in 40 years (Bazza, 2018).

The effects of climate change in Syria are already evident from the cycles of drought, which have shortened from a cycle of 55 years in the past to the current cycle of seven or eight years.

- Syria's inherent vulnerability may best be captured by the fact that food security is mainly determined by rainfall, particularly in rural areas, where 70 percent of the total population lives. Quantity and distribution of rain is thus a central determinant of crop success.
- Over the past 30 years, flows in the Euphrates-Tigris river system were reduce to almost 50 percent of the average annual flow in drought years. The Intergovernmental Panel on Climate Change expects a decline of 29 percent in Tigris flows and 73 percent in the Euphrates flows in the future as a result of declining rainfall in the main catchments in Turkey's highlands (Voss et al., 2013).
- In Iran, Although Iran has a history of drought, over the last decade, Iran has experienced its most prolonged, extensive, and severe drought in over 30 years. The droughts of 1998– 2001 and 2003–2011 affected many farm families and rural communities across most of central, eastern, and southern Iran. A review of long-term annual rainfall trends (over 32 years) indicated that in some parts of Iran drought has a return frequency of 5–7 years, while the national expectation was every 20–30 years (Eskandari, 2001).

2.1.Socioeconomic facts

Recurrent droughts and periods of water scarcity negatively affect food production, aggravating the current imbalance between food supply and demand inside the country. In 2011, the number of food-insecure Iraqis was 5.7 percent of the population (1.9 million people) (WFP, 2012).

Since the internal supply is not enough to satisfy the needs of the population, food consumption is largely satisfied through food imports, which reached a peak between 2006 and 2008. Droughts cause food insecurity and poverty to increase, especially in rural areas where most of the population relies on agriculture as its main source of livelihood (Bazza 2018).

Water-related migration registered an increasing trend. The south of Iraq experienced a huge population movement due to the drainage of the Marshlands; people were displaced due to the insufficiency of water. Between December 2007 and June 2009, 4,263 families (25,578 individuals) were displaced due to drought in Iraq (UNESCO, 2014). According to the Ministry of Health, the highest number of diseases transmitted through contaminated water and food were registered between 2007 and 2010, during the most severe droughts (UNESCO, 2014).

The most vulnerable community groups (UNDP, 2013) to drought are inhabitants of the rural areas. Farmers and herders (Bedouins) using marginal lands are particularly vulnerable. Other groups vulnerable to drought are internally displaced persons (IDPs); rural communities under the poverty line; and women head of households.

In Syria, in 2007-2008, nearly 75 percent of 206 000 households suffered total crop failure affecting farming in the middle north, southwest, and northeast of the country (UNDP, 2008).

In Syria, in 2009, approximately 30 000 families migrated and in 2010, as many as 50 000 families, mostly small-scale farmers migrated. In some areas, up to 70 percent of the population, including whole families, has gone to the cities in search of alternative work after two years of drought and failed crops (Bazza 2018).

In Iran, during the 1998-2001 drought, thousands of villages were partially or completely evacuated and the nearby cities were crowded by the rural people. A UN Technical Mission to Iran reported that "over 60 percent of the rural population may be forced to migrate to cities" (Bazza, 2018). Such immigrations create many social and cultural problems in the urban areas and for the emigrants (Siadat et al., 2001). The extreme drought conditions of the period 2003–2011 led to widespread migration, particularly from villages to the cities (Keshavarz et al., 2013)

3.THE SPECIFIC DROUGHT CHARACTERISTICS OF THE BASIN

In the basin, future predictions suggest lower precipitation accompanied with higher temperatures (Al-Ansari et.al., 2014). This condition will lead to more evaporation and drought periods in the basin (Hameed et al., 2018).

3.1 Iraq Case

Four droughts were recorded in Iraq in 2000, 2006, 2008, and 2009. Eleven governorates were affected in 2008 (UNESCO 2014). In 1969, drought-affected 500 000 people and caused economic damage of US$2 million. More recent droughts were recorded in 2007-2009 and from 2010-2011 (UNESCO 2014).

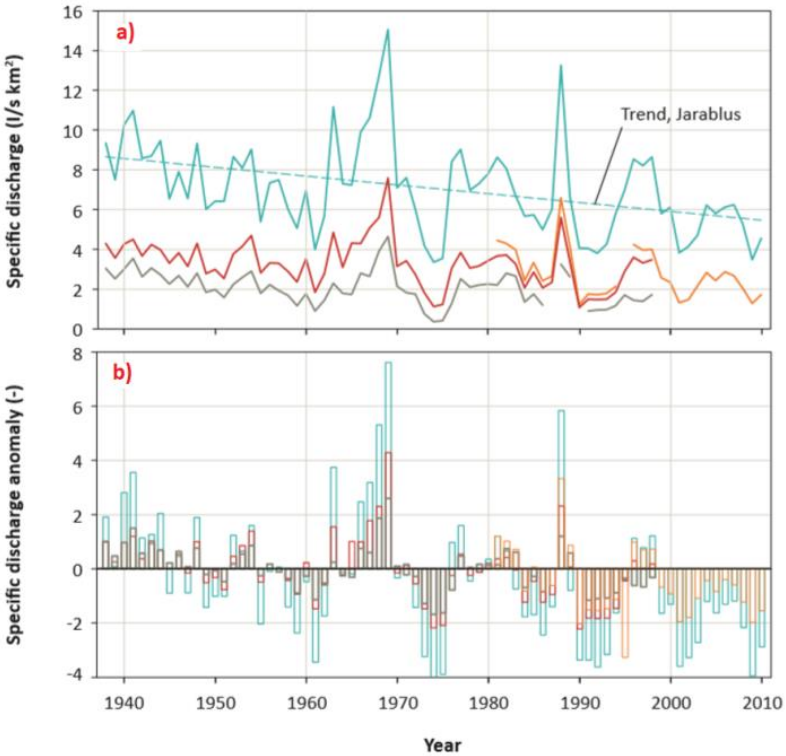
The drought that affected the country in the two consecutive years, 2008 and 2009, damaged almost 40 percent of the cropland in the country, especially in the northern governorates.

From 2006 to 2007, barley production fell from 422,900 tons to 238 500 tons and wheat from 486,400 to 396,800 tons (UNESCO, 2014). In central and southern Iraq, the total production for irrigated barley decreased by 21 percent between 2007 and 2008, while wheat production fell by 31 percent.
In addition to agriculture, several industries are affected by water scarcity, which may result in capital losses and layoffs, thus increasing unemployment. Hydropower generation represents the most important renewable energy source in Iraq accounting for nearly 10 percent of the electricity generation mix in 2010 (IEA, 2012). This reached a peak of 20 percent in 2005 but it dropped back to 7 percent in 2009, suggesting a possible effect of drought (UNESCO, 2014).

In 1999-2000, Iran imported nearly 7 million tons of wheat, making it one of the largest wheat importers in the world. The government recently approved an emergency aid package for US$183 million to assist drought-affected farmers (Khorasanizadeh,2012). In 2014, cereal imports were forecasted at 12.6 million tons including 6 million tons of wheat, some 24 percent more than the previous year (GIEWS, 2014).

3.2.Frequency and severity of droughts

Future projections indicate wetter winters, on the other hand, drier summers.

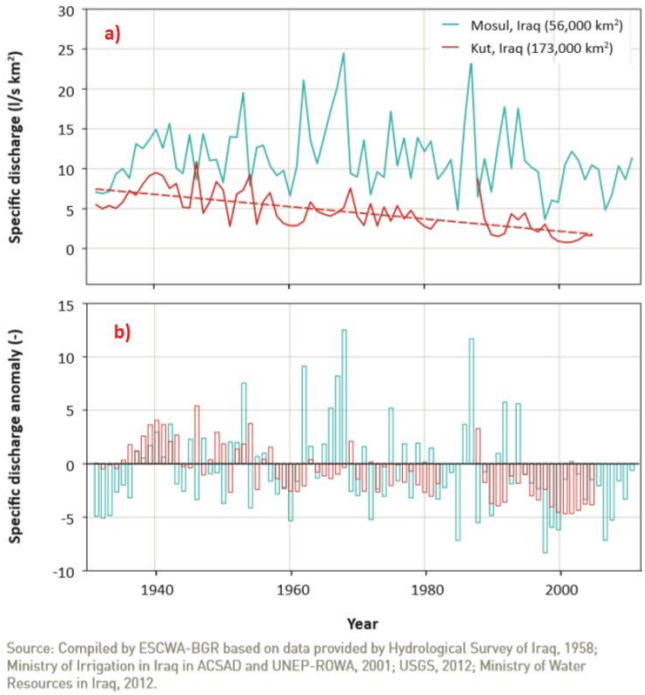


Source: Compiled by ESCWA-BGR based on data provided by the Ministry of Irrigation in the Syrian Arab Republic in ACSAD and UNEP-ROWA, 2001; USGS, 2012; Ministry of Irrigation in the Syrian Arab Republic, 2012.

Figure 2 a) specific mean annual discharge and b) discharge anomaly time series of the Euphrates (1937-2010)

Figure 2a. shows a statistically significant negative trend for the period of record (1937-2010) on the Euphrates at Jarablus indicating a decrease in mean annual discharge. Before 1973, the mean annual flow of the Euphrates at the Syrian-Turkish border (Jarablus) was around 30 BCM, but this figure dropped to 25.1 BCM after 1974. In the inventory, it says that "*This is most likely due to climate variability and more frequent drought periods, and the construction of large dams in Turkey as part of the Southeastern Anatolia Project (GAP)*" (UN-ESCWA, 2013).

Figure 2b shows the mean annual discharge anomaly in terms of water surplus (positive) and deficit (negative) compared to the long-term mean discharge throughout the record from 1937 to 2010. It shows wet and dry periods and reflects the impacts of stream regulation. The period of record exhibits four prolonged drought cycles (1958-1962; 1972-1976; 1983-1995; 1999-2011). (UN-ESCWA,2013).



Source: Compiled by ESCWA-BGR based on data provided by Hydrological Survey of Iraq, 1958; Ministry of Irrigation in Iraq in ACSAD and UNEP-ROWA, 2001; USGS, 2012; Ministry of Water Resources in Iraq, 2012.

Figure 3. a) Specific mean annual discharge, and
b) discharge anomaly time series of the Tigris (1931-2011).

Figure 3 b shows that in terms of discharge anomalies of the Tigris River. A major wet period in the 1960s is more pronounced compared to the overall mean. Below-average values since the 1990s can also be observed (UN- ESCWA, 2013).

The region is one of the most vulnerable to climate change, situated in arid and semi-arid climate regimes. The combined effect of increased temperature, leading to increased evapotranspiration, and reduced precipitation will result in large scale relative changes in annual runoff (water availability). For the period 2090-2099 relative to 1980-1999, the decrease in runoff is predicted to be in the range of 5-40% for a majority of the basin (IPCC2007). For the Euphrates River, it has been estimated that 88% of the water in the river derives from precipitation falling in Turkey (Cullen and deMenocal, 2000), which means that downstream water availability is very sensitive to changes in the precipitation in this sub-basin, as well as

the management of the water resources in this basin. In the Tigris River, it is estimated that about 60% of the water in the river is received through precipitation in the sub-basins downstream from Bagdad.

A study by Fredrick Semazzi and Baris Onol shows that there will likely be a large decrease in rainfall over the southeastern Turkey region as well as a shift in rainfall patterns over Syria and Iraq in the next twenty-five to fifty years. This change in weather patterns would result in an increase in precipitation during the fall months and a decrease in precipitation for much of the winter season.

Another study carried out by Yıldız et al. clearly shows that streamflow trend of the Upper Euphrates River has decreased since 40 years mainly due to natural factors and it is prone to continue (Yıldız, 2019).
A broader climate assessment for the Tigris–Euphrates River basins evaluated the hydrologic impacts of climate changes (Bozkurt and Sen, 2013) showed that higher temperatures and evaporative demand in the basins, with the greatest increases in the highland areas, where precipitation is greatest. Precipitation changes were variable, with decreases in the northern portions of the watersheds and increases in the southern portions.

Statistically significant reductions of 25%–55% in annual surface runoff from the headwaters regions of the Euphrates–Tigris watersheds were seen in all simulations, along with a shift in the timing of runoff. The authors noted that these runoff changes ''suggest that the territories of Turkey and Syria within the basin are most vulnerable to climate change as they will experience significant decreases in the annual surface runoff.

3.3.Recorded and expected impacts

Drought impacts include a reduction in surface water flow, lowering of groundwater levels, the drying-up of open shallow surface wells, increasing water salinity and soil salinization, progressing desertification, decrease in agricultural production, growing frequency of dust storm conditions, and an associated increase in respiratory infections.

Transboundary water quantity and water quality is an important impact of the droughts. The historical Mesopotamian marshes used to be freshwater bodies. The drought of 2009 generally caused severe impacts on Iraq and Iraqi marshlands environment, in particular. These impacts can be summarized as decreased water quantity and cover area, reduced water quality, more concentrated pollution, increased soil salinity and abandoned agriculture lands, disrupted and fragmented marshlands ecological systems, decreased fauna and flora diversity, and increased human and animal diseases outbreaks (UNEP, 2010).

The droughts cascading to supply chain issues for other business create socio-economical problems as well as reduce hydro energy production

3.3.1 Syria

In Syria, the impact of successive droughts has been dramatic for both small-scale farmers and herders. In the affected regions, the income of these groups dropped by as much as 90 percent. Many families were forced to reduce food intake: 80 percent of those affected were reported to live on bread and sugared tea. The effects of drought on livestock and rangelands are linked. With a decreased range of resources, livestock is more vulnerable to drought. The

current livestock population can no longer be maintained on natural rangelands throughout the year. This results in a chronic inadequate feed supply for livestock, with dramatic consequences in dry years (United Nations, 2009).

In Syria, during the 1983-84 drought, the national sheep flock declined by 25–30 percent (2.5 million head) due to starvation, crisis slaughter, and emergency export (Bazza, 2018). Meat prices collapsed and grain prices rose to cause a serious crisis in the nascent private sector poultry industry, with numerous bankruptcies (USDA, 1985).

3.3.2 Iraq

In Iraq Drought during 2008 and 2009 damaged almost 40 percent of cereal crops in the north (Raphaeli, 2009). In central and southern Iraq, the total production for irrigated barley decreased by 21 percent between 2007 and 2008, while wheat production fell by 31 percent.

In Iraq, hydroelectricity generation reached a peak of 20 percent in total in 2005 but it dropped back to 7 percent in 2009, suggesting a possible effect of drought (UNESCO, 2014).

In Iraq, According to the Ministry of Health, the highest number of diseases transmitted through contaminated water and food were registered between 2007 and 2010, during the most severe droughts (UNESCO, 2014).

3.4. Civil unrest and conflict

Severe multiyear drought beginning in the mid-2000s in Syria contributed to the displacement of large populations from rural to urban centers, food insecurity for more than a million people, and increased unemployment—with subsequent effects on political stability. There is some evidence that the recent drought is an early indicator of the climatic changes that are expected for the region, including higher temperatures, decreased basin rainfall and runoff, and increased water scarcity (Gleick 2014). Therefore the region is prone to civil unrest under the effect of climate change if regional cooperation can't be developed in a foreseeable future.

4.ENHANCING "REGIONAL COOPERATION APPROACH " ON FOOD, WATER, ENERGY SECURITY

Emerging threats force enhancing regional cooperation in the Middle East through regional development projects created with a mutually beneficial approach.

The region, which is mostly rich in conventional energy resources such as oil and gas, but the most water-scarce and food import-dependent in the world. Existing insecurities in water, energy, and food in the region have been linked to some of the conflicts in the region acting as a threat multiplier as well as pressure points.

One recent example is the devastating ongoing war in Syria which started as the result of complex interrelated sociopolitical and economic factors including, as well as challenges associated with climate variability and changes in the availability of freshwater.

The water and food insecurities are expected to be further intensified with the projected impacts of climate change, increase in the resettlement of internally displaced population,

coming back of refugees from neighboring countries, and the ongoing security conflicts in the region.

The Middle East faces a highly complex and fragile security system. Increasing climate change effects, political uncertainty, forced migration and internally displaced people resulting from regional conflicts put food security of the region in danger. Although the priority in the region is setting up political stability, in parallel to this effort, regional cooperation on agricultural production and food security is also vital for the near future of the region

4.1. The emerging need for a vision for "The Day After"

In a valuable report prepared by FAO (FAO, 2018), it is indicated that "Climate change will affect world regions unevenly. It is already affecting vulnerable countries and will pose a major threat to their food security. Climate change will alter conditions for agriculture. This could lead to changes in comparative advantage across regions and consequently to changes in agricultural trade."

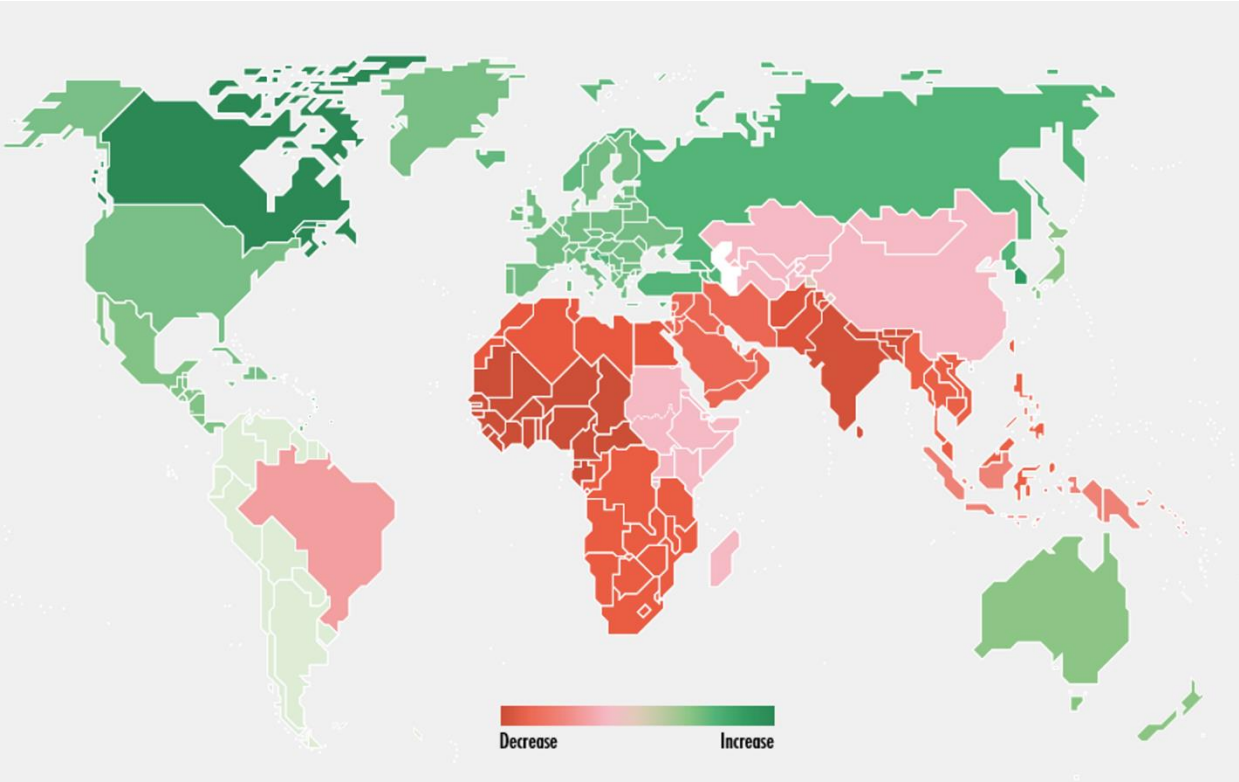


Figure 4. Changes in agricultural production in 2050: climate change relative to the baseline

Source: Based on data provided by Wageningen Economic Research. 2018. Climate Change and Global Market Integration: Implications for global economic activities, agricultural commodities, and food security. SOCO 2018 Background Paper, Rome, FAO (FA0, 2018)

In this valuable report it is also indicated that compared with the baseline, climate change is expected to result in declines in agricultural production in large parts of Africa, the Middle East, and South and Southeast Asia (Figure 4).

Someday the conflicts in the Middle East will be over and post-conflict reconstruction will begin. Therefore a vision is needed for the day after so that a region coming out of violence does not relapse into it again. Such a vision has to promote mutual inter-dependence and harness resources in the Middle East in the best interest of all the people.

4.2 Requiring need for a new regional concept

A regional concept starting from a bilateral relationship on the base of regionalization, institutionalization, civil society interrelation, strategic agricultural investment. Having effective institutionalized dialog can be a first step to adapt climate change, achieve regional water–energy–food security nexus (Farajalla, 2017).

Climate-related water scarcity will also affect the types of crops grown in the region. Water scarcity constraints may contribute to changes in the crop basket. Against this backdrop of decreasing agricultural production due to water constraints, a regional-based approach is needed. Intra-regional trade in the Middle East only accounts for 5 to 10% of the total trade of the region (Ekanayake, 2009). Some innovative and integrated approaches to improve strategic agricultural investments and interregional agricultural product trade are essential in the region.

5. CONCLUSIONS

Having the information given above, which shows that a decreasing trend is mainly due to natural climate factors dominating the region, it can be concluded that there is an urgent need to build resilience and adaptive capacity of riparian states focusing on innovative regional-based drought strategies and food security project. In this regard, preventive steps have to be undertaken to move towards a drought risk management approach in the Basin.

Increasing climate change effect, political uncertainty, forced migration and internally displaced people resulting from regional conflicts put food security of the region in danger. The regional food security approach will also be important during the transition period to relative stabilization.

For supporting these steps, there is a need to implement a drought early warning system which is consisting of monitoring, prediction, and well-developed information delivery structures and mechanisms among the countries. Furthermore, as realized by Turkey in the upper basin, downstream countries, namely Syria and Iraq, should promote new approaches, long-term strategies, and innovative methods to include modern farming systems, resources, and livelihood in drought-prone areas in the basin. In addition to this, the downstream countries should implement policies at all levels to encourage the uptake of more water-efficient technologies such as new methods of irrigation and rehabilitation of traditional water storage.

As known it is very difficult to deal with drought threats in such a conflict-ridden region, additionally to propose a roadmap and suggest guidance by taking into account climate change variations in reducing the water shortage/stress.

However, such an attempt could be very helpful for the water authorities of the concerned countries particularly for the efficient and effective use/management of the scarce regional water resources emphasizing the significance of their collaboration/cooperation.

Partnerships between institutions with an applicable road map can enhance coordination for more effective water-energy-food nexus policies. Enhancing institutions with innovative approaches and investment in region-wide agricultural development projects are essential steps to be taken in soon in the region.

An integrated or nexus approach to resources management and cooperation appears to be the evident way forward. The nexus approach identifies water, energy, and food as the central sectors and advocates for better physical as well as policy and governance integration.

Under the threat of climate change-induced drought and its experienced consequences, it seems that innovative approaches to co-operate around water, food, and energy nexus are essential in the region.

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Why the Middle East is So Far Away From Peace?

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Abstract

To start an article on the Middle East with such a negative and discouraging note may seem weird but it is the truth and nothing but the truth so it should not surprise anyone who has a bit of knowledge on the region. It should not come as a surprise either if I say "the only peaceful times were when the Ottomans ruled the region for about five centuries." This is why David Fromkin's famous book on the peace treaty of 1919 after the First World War is called, "A Peace to End All Peace." In this article ,we focused on the Middle East peace in terms of regional and international relationship. It is unfortunate that this region is so far away from peace in many respect.

Keywords: Middle East,Water Peace,Jordan River,Middle East Future,Middle East Affairs

1.INTRODUCTION

Leaving ancient history and thus the Hittites, Commagenes, Assyrians, ancient Egyptians, Iranians and others who were at war with each other at all times -and even petrol and gas were not known then- for some reason or other, the Middle East was and still is the most continuous conflict and war theatre of the world and there is little hope that this will change. This is despite the fact that The region, in general, is much more rich now. However, this richness brought by wast petrol and gas fields seems to cause even more problems then it has solved.

2.FOREIGN INFLUENCE AND INTERFERENCE

One of the most influential factors in the destabilization of the region is no doubt constant and deep foreign involvement and interference in the region's affairs be it domestic or external. It may seem to be a contradiction but this interference is brought by the rich resources of the region, namely petrol and gas. The ever-present and increasing competition among the leading industrial powers since World War I over who will dominate the Middle East petrol and gas is the main source of wars and even domestic upheavals in the region. After the collapse of the Ottoman Empire, the Middle East has become the favorite playground of Britain, France, and Germany. After the Second World War, the USA first replaced Germany and then gradually pushed back France and Britain. In the process, the USA found in Israel a good, valuable, and indispensable -for both sides-ally.

The Sykes-Picot Treaty between Britain and France effectively partitioned the Middle East between these two while The Arab Union despite its name was created again by the British, not as a unifying but dividing instrument of the new Arab states, the borders of which were drawn by the so-called archaeology -in fact, intelligence agent- Gertrude Bell. One may wonder what the Arabs were doing while all those were happening. They were for the first and till today last time united against the retreating Ottoman Empire and in that they

cooperated closely with the British! Remember Lawrence of Arabia! When King Abdullah I of Jordan, son of Sheikh Hussein of Jordan, the leader of the Great Arab Revolt realized what was in the making it was already too late.

2.1.State of Israel

The end of the World War I saw also the creation of an artificial state made to measure; Israel. The very first steps that led to the Israeli state in fact taken by two Ottoman sultans. Sultan Selim, I overruled the AD 90 decision by the Senate of Rome which deported Jews from Palestine and prohibited their return. Suleiman the Magnificent for his part allowed a considerable number of Jews to return. However, it is the British who made the very first seeds of the Israeli state be sawn and the USA pushed for more Jew migration to what was Palestine. The USA from the very first day saw the Jewish state as a convenient tool for its Middle East policy which was aimed at controlling the petrol fields and the Arab states that they belong.

Of course not all and always should be attributed to the ill will of foreign powers. Domestic peculiarities and weaknesses of the region and nearly all the newborn Arab states have contributed and still contribute vastly to the situation.

2.2.The role of the Arab states

Most of these states are since their first days, governed by some kind of an authoritarian regime dominated by families. Good governance is something unheard of let alone accountability. Some of these countries are governed by religious sects of Islam founded on the most distorted interpretation of the religion. Secularism is despised by these rulers and democracy is just something that should be avoided and blocked at all costs in order not to bring the end of many ruling families. Except for a few like Jordan, the rule of law simply means the law of the ruling family. This makes these states easy prey for foreign powers as bringing under control the ruling family this way or other simply means taking hold of the country as a whole. Such a comfortable situation explains very well also why the foreign powers don't care about democracy, human rights, and rule of law and cooperate with the authoritarian regimes of the Arab countries. It also makes it much more easy for foreign powers to manage the Arab-Israeli dispute. It is not rare to have at least some even leading Arab states to support plans and proposals which undermine even the most rightful expectations of the Palestinians. And Palestine is the “common Arab cause” for all Arab states when it comes to posturing!

Egypt the most powerful and influential Arab state does not move even a finger without first weighing it from the point of view of how it will affect its "leader of the region and Arabs” policy and position. And when we speak of the leadership of the region we have to think about the other contender for the title, Iran. Here we face another crucial fact that makes the issue even more complicated.

2.3.Iran. The Shia enemy

Iran is Shia while nearly all other Arab states in Maghreb and Mashrek are mostly belong to the Sunni sect. Nearly all Arab states see Iran as their most fearful enemy. The struggle between these main sects of Islam goes back to the days of Mohammed and will most probably

not disappear never. So another element that prevents Arabs from getting united around any cause even the Palestinian.

The war between Iran and Iraq took 8 years to bring to an end with a devastating human and material loss for both countries. The Iraqi occupation of Kuveyt on the other hand was a war between two Sunni states and pave the way for two USA Gulf Operations and brought about the end of unified Iraq. Destabilization of Iraq by the USA first using the Iraqi occupation of Kuveyt as a pretext and then the non-existent nuclear and chemical weapons for the second operation led to chaos not only in Iraq but in the region as a whole.

2.4.Gulf Wars and their repercussions

The first US Gulf War of the early 1990s created the Kurdish autonomous region in Northern Iraq to the detriment of the political unity and territorial integrity of Iraq. It also led to negative developments in Turkey and on its fight against the Kurdish separatist terror organization, PKK.

The Second Gulf Operation led to even more frightening developments like ISIL (The Islamic State in Iraq and the Levant) and destabilized Syria and Iraq with enormous consequences for all three countries and for the region as a whole.

Although despotic under Esad, secular and stable Syria is now a war thorn country divided into three distinguishable parts detrimental to the vital interests of not only Syria but Turkey too due to the YPG/PYD element raised and supported by the USA, EU, and Israel under the pretext of fighting the ISIL.

2.5.The disintegration of Syria and Return of Russia to the region

It is quite safe to assess that the Kurdish entities in northern Iraq and North of Syria are seen by the USA, EU and Israel and to some extent by the newcomer to the region Russia as a quasi-state that could easily be manipulated to promote and guard the interests of the said powers and further divide and destabilize the Arab Middle East.

Russia which had been absent from the Middle East scene since the collapse of the Soviet Union and the Warsaw Pact grabbed the once in a lifetime opportunity to make a strong come back to the region, a development which has already proved to be a determining factor and which will have long time repercussions on region's affairs.

Another element that adversely affected and still affects peace and stability not only in the Middle East but even in Europe is large groups of refugees fleeing from the Syrian war. Huge numbers of migrants put a great burden on countries like Turkey - though she is also responsible for this outcome- and Jordan and caused havoc in Europe. Like Palestinians that were pushed to Jordan after various wars between the Arab States and Israel, Syrian refugees most probably will keep on playing a negative role in interstate and regional affairs.

3.THE ARAB SPRING AND THE MIDDLE EAST PEACE PROCESS

In fact, all these developments have been also a result of the Arab Spring which was deliberately misplayed by the West, and when things went out of control instead of trying to remedy the situation it was used to further destabilize the region. Libya and Syria are the most striking examples of this deliberate mismanagement. Arab Spring was a huge opportunity that was sacrificed to petty interests of big powers who proved through the years that despite

all their might, they were either not willing or unable to bring peace to the region. Another of such lost opportunities was the Middle East Peace Process of the 1990s.

When in 1991 Israeli-Palestinian, Egypt-Israel and later Jordan-Israel Peace Treaties were signed the region, for the first time felt that maybe the peace was reachable. The assassination of Rabin and the rise into power Bibi Netenyahu in 1996 unfortunately swept away all hope once again. The new government in Israel was back to old and well known aggressive and expansionist policies and soon the Peace Process was in shambles.

Israel under Netanyahu refrained from implementing even the tiniest of all its undertakings making life very difficult for Jordan for example who had taken a lot of risks by signing a peace treaty with Israel. At the same time, the inter Arab footwork once again came to fore, and Egypt who had her own bilateral peace treaty with Israel kept on criticizing Jordan for signing a peace treaty with Israel. Childish acts like assassination attempt against Khaled Meshaal in Amman ruined all prospect for peace for good just when Turkey was trying to bring together Israel and Jordan and was shepherding activities within the Multilateral Peace Talks to build confidence and establish permanent channels of communication between the regional countries like Jordan and Israel.

3.1.Lack of intention and hidden agendas killed the Peace Proces: Jordan River case.

Water had always been a valuable resource in the Middle East and it was and still is even more important for Jordan which is the driest of all Arab countries. For this reason, Annex II of the Jordan-Israeli Peace Treaty of 1994 included an agreement on the 'rightful allocation' of the Jordan River Basin water resources. The agreement was bilateral and the three other riparian countries Syria, Lebanon, and Palestine where the lesser tributaries of Jordan River, Hasbani, Banyas, and Dan were either originate and/or flow in Syria and Lebanon were not included in the agreement. Not including these riparians despite their importance to a comprehensive and sustainable agreement on water resources in the Jordan River Basin was a flaw from the outset.

Figure 1. Jordan River Basin, including the upper catchment north of Lake Tiberias and the lower catchment south of the lake. The upper catchment is shared between Lebanon, Syria and Israel, the lower catchment is shared between Syria (Yarmuk), Jordan, Palestine and Israel.

The Yarmouk River the largest tributary of Jordan River has four tributaries in Syria and one in Jordan. It forms the borders between Jordan and Israel (Fig.1).

Annex II specifies allocations of the Yarmouk River that Israel may extract during the summer and winter periods for its needs. In exchange, Jordan is allowed to store water from the same in Lake Tiberias during the winter; Israel is to release this water back to Jordan each year during the dry season. The same Annex specifies also that Israel may maintain extraction levels on the Jordan River, equivalent to its level of use in 1994, and Jordan may withdraw an equal amount when there is sufficient supply

The Annex allocates specific amounts of groundwater to Israel south of the Dead Sea and it allocates certain spring water to Jordan near Lake Tiberias. It also stipulates that Israel and Jordan will cooperate to "find" an additional 50 million cubic meters of water for Jordan. A Joint Water Committee was formed where Jordan and Israel cooperate in fields like water storage technology and the Annex II allowed Jordan to build new storage dams. The two sides would jointly seek new sources of water for Jordan through the use of new technologies such as desalination. In 2005, Israel, Jordan, and the Palestinian Authority endorsed a plan to build a water conduit to carry water from the Red Sea to the Dead Sea, which is rapidly shrinking due to the extraction of water from Jordan River. However, nearly none of the stipulations of the Annex were realized due to mostly Israeli unwillingness to implement them. While in Amman as Ambassador of Turkey (1995-1998) I have witnessed how Israel dragged its feet to avoid her undertakings.

4.ROLE OF TURKEY

In 1990s Turkey was a respected but above all a role-model country for most of the Arab nations if not for the Arab rulers as a democratic, secular country with a strong and growing economy; one of the leading members of NATO with the third strongest armed forces in the Organisation and a prospective member of the EU. It had a long experience in the then CSCE (Conference on Security and Cooperation in Europe.) now OSCE (Organisation of Security and Cooperation in Europe) and a party to the CFE (Treaty on Conventional Armed Forces in Europe). Its experience in Confidence and Security Building Measures (CSBM's) could be beneficial also in the Middle East where a "crisis of confidence" was the rule not only between Israel and the Arab states but even more than that among the Arab states themselves. Turkey was ready to share this experience of her's with all the interested parties in the Middle East and successfully did so in the course of Peace Process Multilaterals.

Turkey also had a very valuable resource namely water and a better knowledge of its optimum use. That was something extremely important for Israel and nearly all Arab countries except maybe Irak. And Turkey was ready to enter into cooperation with countries like Syria and Irak to make optimum and reasonable use of water that flows in her transboundary rivers possible. In other words, water from Turkey could be an element of peace and prosperity for the region. Turkey had even well-thought plans that took into consideration the reasonable needs of her neighbors and other projects such as transporting water from Turkey to Israel and Jordan via pipelines.

Efforts by Turkey to bring together for instance Jordan and Israel to build confidence between these two countries were quite successful until Netenyahu Government came to power. Similar undertakings by Turkey to spread this cooperation to all Arab states taking part in Arms Control and Regional Security Group (ACRS) had also paid well. However, the Netanyahu government and the ever negative and sabotaging attitude of Egypt prevented further steps.

5.CONCLUSIONS

Middle East today is a much more complex and difficult area in comparison with the 1990s for instance to bring peace and stability.

Israel once again under Netanyahu who is now politically much weaker and dependent on radicals is following the most aggressive and expansionist policies since the founding of the

Israeli state. Its main ally and supporter, the USA which had always been and still is the main player and broker in peace initiatives is supporting Israel blindfolded and taking steps like recognizing Jerusalem as the capital of Israel and preparing plans which will leave West Bank of Jordan River to Israel, make even the slightest hope for peace to vanish.

Irak and Syria are disintegrating. Egypt has no power to bring together let alone lead Arab states against Israeli aggression and expansionism. On the contrary, it has joined forces once again with Israel in the Eastern Mediterranean intending to exploit the gas fields. Saudi Arabia is following the footsteps of Egypt. Jordan has no other choice but to join them which she is doing also in Libya.

Russia's come back has changed the balance of power rather deeply and will influence the region even more in the near future. With Russia present achieving peace between Palestine and Israel is now more difficult if one takes into account also the Russian-Iranian relations/partnership and Iran's opposition to İsrael.

Turkey unfortunately is now only an onlooker which has more or less no leverage either on Israel or on any of the Arab states. She is at odds with nearly all of them and with Israel too. Turkey's contribution to future peace in the region in security and economic -especially cooperation in water issues- fields may only be feasible when Turkey could revise its foreign policy stand vis-a-vis the Middle East and if and when the situation both domestic and external in the region change drastically.

Unless many if not all of these circumstances take a positive turn, peace in the Middle East will be a faraway dream still for a long time to come.

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The New Concept of Natural Resource and Its Derivations

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Abstract

As the real world changes faster than the theoretical concepts formulated to explain it, after a certain elapsed time these concepts lose accuracy. They start gradually lagging behind the facts they once explained until they became rather narrowed and imprecise. Considering that, concepts have to be reviewed periodically to incorporate new facts and perspectives in order to converge their meanings to the new realities. This research aimed to reveal faults and inaccuracies concerning the concept of natural resources and its derivations. Additionally, we intended to update and expand them in order to recover their weakened explanatory power. Methodologically, this research undertook a conceptual revision based on authors of various backgrounds. Then, these concepts were confronted to new facts to corroborate their current inaccuracy. Thus, we drew some conclusions that allowed us to present a new definition of natural resources. To replace the dualist definition of renewable X non renewable resource, we proposed a new classification considering durable and exhaustible resources, being the first divided in four subcategories: renewable, reproducible, naturally recyclable and inexhaustible. The exhaustible resources, by their turn, were divided in two subcategories: finite and renewable badly used.

Keywords: Natural resource, Renewable, Reproducible, Durable, Exhaustible, inexhaustible, naturally recyclable.

1. INTRODUCTION

Initially, natural resource notion as "any nature's element that may be exploited by mankind" can be useful for us as a conceptual base. However, analysing it more carefully, some new questions may arise.[17] Is natural resource something material or could it carry non-material

[17] Concept is the shared idea of something; definition explains it and starts to exist through the written speech.

nature's aspects? Can a natural element be considered a resource even though there is not demand for it? If there is demand for a resource, but there is no access to it, will it be considered as such? Should natural resource purposes be made explicit in the definition? If so, can natural resources meet either social or cultural wishes, beyond necessities? Finally, should the definition be limited to an economic system or should it have a universal character? These issues of social and physical characters arise from the fact that natural resources matters lie on the interface between society and nature. The word 'resource' itself indicates its social and historical character because we only search for something that has demand. On the other hand, the word 'natural' indicates the physical-chemical resources essence, which determines its occurrence and distribution on Earth. Therefore, it is essential for the concept to integrate these two dimensions.

2. METHODS AND MATERIALS

As a theoretical research, our methodological proceedings were basically the analysis of a number of concepts from different authors, including some geographical and environmental dictionaries. This analysis revealed inaccuracies and raised some variables that based our study, such as: materiality, historicity, finality and universality. By confronting some conceptual derivations, we revealed the false antagonism between renewable x exhaustible resources, the difference between renewable and reproducible resources, reordering all definitions based on the ballast of empirical examples of the reality. Have done that, we drew a new conceptual proposal systematised in a table.

3. DEVELOPMENT

The first issue to be settled, then, is related to the materiality of a natural resource. The word *element* of the initial definition conveys the idea that resource must be something material of immediate utilisation. This idea is widely shared throughout different definitions. This is the case of the IBGE[18] definition that describes natural resource as "Name applied to all raw materials, renewable or non-renewable, which are acquired directly from nature, and exploited by mankind". (IBGE, 2004, p.266). Guerra (1980) also reinforces the idea when he defines natural resources as "all life-giving goods supplied by nature" (p.11). British authors also emphasise this material essence of natural resources, as Mayhew (2009), who defines them as "any property of the physical environment, such as minerals, or natural vegetation, which is exploited by humans" (p. 342); or Saunier and Meganck (2009) who describes them as "anything that is provided by nature, such as minerals deposits, forests, water, wildlife, etc." (p.211).

Nonetheless, a number of natural resources is non-material and of indirect use, and perhaps the best example is nature itself. The Conservation Unities National System (SNUC, in Portuguese) establishes the *indirect use of natural resources* in National Parks for education

[18] Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics). See www.ibge.gov.br

purposes, recreation and contemplation, not allowing the extraction of any element for transformation and use.

In the real estate market, properties with the same standard of building may be more or less expensive according to their proximity to certain landscape aspects, as overlooking the sea, for example. The material essence takes place in these properties' price variations. The possibility is real, once we look from the cultural perspective; some landscape aspects are more valued than others are.

Figure 1 – Appropriation of the landscape as a natural resource. Although it is non material and indirect use, the landscape will be accounted in the price of the property.

The topography is another landscape aspect, which is exploited in a non-material way. In the process of mechanised agriculture, planed surfaces make possible the direct and material use of soil resources. In the process of generating hydropower, irregular topography enables the material and direct use of the water resource.

Figure 2ab – Indirect and non-material use of landforms making viable the direct and material use of *arable soils* and *water* for hydropower, respectively.

In some cases, topography, itself, can be exploited by tourism industry as a landscape aspect of prominence.

Figure 3 – Landforms may be indirect appropriated for tourism purposes. Note that for non material uses, the natural resource is not displaced, i.e., the demand has to move towards it.

Therefore, to include immaterial resources in the concept it was necessary to add the word *aspect* to the initial definition. Nevertheless, by doing so, it becomes relevant to explain the possibility of *indirect use* related to the aspect, besides the direct use related to the element. The matter can be solved adding, between commas, either directly or indirectly to the concept, as follows:

"Any nature element or nature *aspect* can be explored, directly or *indirectly*, by mankind."

Historical perspective is the next issue to be included in the concept. Natural goods can be demanded in a certain historical context, and no longer be in another one. Or yet, a natural element that has never constituted a natural resource may become one when emerges demand and means for its appropriation. Zimmerman (1966) stated that "resources are not: they become", what makes clear the difference between natural element and natural resource. Only when demand exists a natural element becomes a natural resource. And demand changes historically. Godard (2002) reinforces the historicity of the concept when he claims:

> [...] resources cannot be fixed once and for all; the contents of what we call resources change historically and they depend either on the evolution of the environment or on the evolution of the technical possibilities, as well as the social necessities and economic conditions. (p. 207)

The idea had already been stated by Oliveira when he asserted that "the majority (of resources) is found in limited quantities and acquire utility, i.e. become valuable at the moment mankind explore it"[19]. The importance of demand is also present in foreign authors' works, as Park (2011) who defines natural resources as "any feature of the natural environment that is of value in *meeting human needs* [...]"(p.299); or Thomas and Goudie (2003)

[19] Inaugural class given by Professor Oscar de Oliveira about "Natural Resources and Development" at University of Brazil (RJ) on March 09, 1962. (Apud GUERRA, 1980, p.11)

who define them as "components of the natural environment that *have utility* to human kind [...]"(p.332).

Thus, just by including the word *demand* in the initial definition we included the historical perspective to it. Even though the word *resource* already fulfils this function, once it designates something that is needed (Cunha , 1982).

Yet, another question remains open: utility for what? The most probable answer would be to fulfil the necessities of humankind, as the notion of materiality lingers strongly. However, many resources, either by their nature or by their form of appropriation have no relation with necessity and survival, but with wishes. Living in a place, which overlooks the sea is more a cultural wish than a necessity. Therefore, the inclusion of the expression *material and cultural necessities* embraces the social and natural dimensions of natural resources.

According to GODARD (*op cit*):

> Natural resource is a concept located in the interface between social and natural processes: it is the result of humankind's view of the biophysical environment, a look cast by their necessities, their knowledge and savoir-faire. (p.205)

Bringing now the issue of the universality, in the Social Sciences, natural resource has been related to labour, by which society appropriates nature, incorporates it into the productive system and reproduces itself. According to Leff (2007), "The natural resource and the labour force are not natural beings existing independently of the social, but they are the biologic determined of production and reproduction conditions of a given social structure" (p.121). Nevertheless, when we lock the concept in an economic system, such as capitalism or any other, the concept loses its universality. Natural resources in any society or system, either feudal or socialist, or even in the indigenous primitive societies in which labour does not exist in the sense we understand it. For this reason, the insertion of the expression *in any time or space* widened the concept, which became universal again. By doing so, we can now draw a new concept of natural resources that incorporates all those initial questions: materiality, historicity, finality and universality, which are expressed, respectively, by the bold words of the following definition:

> *Natural resource can be defined as any element or* ***aspect*** *of nature which is in* ***demand****, or being used by mankind, either directly or* ***indirectly****, as a way of to satisfy their* ***material and cultural*** *necessities at* ***any time and space****.*

By incorporating social and physical elements, the geographical perspective has been reinforced as well as the explaining potential of the concept.

3.1. Some supplementary question

A definition establishes a limit of the concept coverage, the boundary between what is and what is not comprise by it. In most cases the boundary is loose and not very precise. In the

case of natural resources definition, it happens due to the fact that it is a very wide universe of elements and aspects, and mainly because they may present different levels of change in their natural condition. For example: up to what level of change or processing of a resource can it be still considered natural? Oil is a natural resource while gasoline is not. Yet, there are different stages of refining between oil and gasoline. Which of them marks the limit between natural and non natural resource? Clay is a natural resource while porcelain is not. But there are levels of kaolin processing that are in the middle of these two products. Similarly, iron ore is a natural resource while steel is not. However, during iron ore processing thin residues are left, which are then transformed in iron pellets used in the steel industry. Materially speaking, these pellets are natural, but structurally they are not, in the sense that these "iron pellets" are not found in the nature. Even the non-material resources can be in this condition. A natural park can be subject to landscape infrastructure interventions. What is the level of transformation that establishes the boundary between a natural park and a planned park? The conceptual accuracy will always be limited if we want to keep the concept universality. From a "certain level" of change, a resource will no longer be natural, but a manufactured product; and each case must be analysed separately. The issue is important not only scientifically, but in the public administration scope as well, once the natural and produced elements are subject to rather different taxes.

In the geographic analysis, the territorial mobility of a natural resource is also a question to be considered. In order to understand how the mobility takes place, we shall resort to the *local value* concept. A high local value resource presents low sale price, high utility, it involves large quantities and it is, generally, irreplaceable, for instance raw materials (sand and gravel) for the building sector. These combined characteristics limit these resources to the place they occur, once transport costs make them not viable economically. On the other hand, the high price of some resources increases their territorial mobility, as petroleum and aluminium. An interesting variation of mobility refers to indirect uses of natural resource. For instance, a landscape of high cultural and aesthetic value is a natural resource that does not move. Moving is, in this case, a prerogative of the demand. Additionally, some natural resources of direct and material use do not move, as is the case of arable soils for growing crops (although there are some experiences of transferring fertile soils form one place to another, such is the case of the polders of Netherlands). It is important to notice that, depending on the use, the same resource can be found in one class or another, for instance soils that are used for landfill and sanitary landfill can be considered inexhaustible, but for agricultural purposes they may be exhaustible.

Another issued related to natural resources is the impact while drastic change of state, and this can happen during the process of exploitation, appropriation, use or disposal. Considering the wide range of natural resource, it is not possible to add this issue to the concept. Therefore, impacts must be analysed either separately or in groups. For example, the agriculture activities beget specific impacts, as deforestation, soil erosion, siltation of rivers etc.; mining activities will impact differently, as shale gas exploitation, rivers impoundment and so on. Thus, impacts may be local, regional (when the atmosphere or the hydrographical network are affected), seasonal (for instance the use of fertilizers in agriculture) or irreversible

(as it normally occurs in mining areas). It is also worthy of attention that impacts can have positive sides (socially and environmentally). Considering social impacts, when we analyse natural resources in relation to the GDPs (Gross domestic product) and the HDIs (Human Development Index) of countries, it becomes clear that there is not necessarily a correspondence of these three aspects. On the contrary, in many cases countries rich in natural resources present a low GDP and HDI (like Democratic Republic of Congo, Venezuela etc), while countries poor in natural resources show high GDP and HDI (such as Japan, South Korea etc). Hence, natural resources are not synonymous of natural richness. The conversion of the first in richness is not somehow assured, but highly dependent on social policies, regardless the natural availability. Guerra (1980) points in this direction when he claims:

> It is important to highlight the fact that natural resources constitute potential wealth, and only mankind is able to transform this wealth into power. Thus, a nation's main wealth is humankind, because only through them it is that resources may lead to social development. (p.19)

Another issue we forwarded refers to the vital natural elements to humankind's survival. Can the air we breathe be considered a natural resource? In this case, the use of air is not historical, yet physiologically automatic, and therefore it does not fit the definition. Nevertheless, we may think of aspects related to air as freshness, purity as in climatic resorts, for therapeutic and recreational purposes. In this case, the element air is reintroduced to the definition.

Finally, the individual use of any element or nature feature has little meaning. When an individual collects seashells from the beach for their own purposes, we are not talking about natural resource. However, if a community collect them to make utensils or handicrafts to sell to tourists, then seashells become a natural resource. In the geographical analysis, the appropriation and use of natural resources is meaningful only through a collective perspective, socially shared.

3.2 Renewable resources X exhaustible resources: only an apparent antagonism

Concepts are formulated in order to define objects and facts. Thus, they must present conformity with the real world. Yet, concepts lose accuracy related to the object or the fact that they designate insofar as the world develops. This section and the next sections aim at the precision of some definitions related to natural resources, which will create a conceptual base to help the study of any natural resource.

The division of natural resources between renewable and not renewable is highly accepted, being the latter synonymous with exhaustible and, normally, referring to minerals. Guerra's definition is (1980): "we must highlight that some (natural resources) are renewable, as soils, vegetation; while others are non renewable as minerals" (p.11).

Here, we will show that these two categories are not opposite, as well as non-renewable is different from exhaustible.

There is a wide variety of natural and social factors that may increase or diminish the renewability of a resource. Arable soils, for example may be more or less renewable

depending on natural conditions: under tropical weather, the high humidity and heat intensify the weathering process. Therefore, soils may renew itself faster than in areas with little water, less heat, or both.

On the other hand, if we consider the same soil subject to the same weather conditions, even though renewability may be wider or more constricted depending on social factors, such as different ways of handling it. The alternation of crops and fallow techniques may increase the renewability of soil, while intensive plantations may enfeeble it. In any case, we realise that the concept of renewability lies on the notion of time. However, there are two times to be taken in account. Considering that all resources on Earth renew themselves continuously (even within different speeds), in principle, all resources would be renewable. Nevertheless, in a social perspective, only the resources whose renewing speed happens within a human time scale are those that are considered renewable. Because of this, oil is not a renewable resource. Still, being naturally renewable within a human time scale is not enough to be classified as renewable conclusively, because the rhythm of exploitation can be superior to rhythm of natural recover, so becoming exhaustible, such is the case of soils, forests, and fish among others. Park (2011, p 378) defines renewable resource as:

> A natural resource (such as fresh water, a forest, or renewable energy) that is replaced at a rate which is at least as fast as it is used, which has the ability to renew itself and be harvested indefinitely under the right conditions, but which can be converted into a non-renewable resource if subject to overexploitation […].

With the expression 'right conditions' the author links renewability to the resource handling (besides its natural dynamic) and points to the possibility of a renewable resource becomes exhaustible when used under wrong conditions. Hence, the same resource can be either renewable or exhaustible, which it nullifies the opposition between these two categories. In Mayhew's definition of renewable resource (2009, p425), the notion of natural time and rhythm of use are also present:

> [...] a recurrent resource which is not diminished when used but which will be restored, such as wind-energy. Renewable resources may be consumed without endangering future consumption as long as use does not outstrip production of new resources, as in fishing. In principle, wood is a renewable resource, but in the absence of well-planned management, short-term exploitation can induce environmental impacts or conversion other uses yielding results better likened to mining than sustainable use […].

This definition encompasses the main elements, as the notion of time, when it refers to the speed of use in relation to the natural renewal, and articulates the social and natural perspectives. The author uses the expression "In principle..." to refer to nature's dynamic, and then, to incorporate handling and use planning.

Subtly different from *rhythm*, resource exploitation *continuity* may jeopardize its renewability, because sometimes the threat is not in the speed of exploitation, but in its continuous

exploitation, without truces, so that the natural recovering is no longer assured. Besides the notion of time (rhythm, speed and continuity), *spatial dimension* is essential to better understand the renewability of resources. Let us have a rainforest as an example: It is a naturally renewable resource in the human time scale, and so it will be if its use happens in a rhythm equal or inferior to its renovation. Yet, there is a spatial determinant. Depending on the deforestation scale, a rainforest cannot renew itself anymore

Figure 4ab - Different scales mean different possibilities of renewing.

The chances of a forest to recover are inversely proportional to the deforested area extension, once that renewing conditions as soil fertility and humidity stem mainly from the forest itself, besides the necessary genetic material to its regeneration.

Being the natural rhythms more permanent, the renewability of a resource depends mainly on social aspects, once humankind is who determines the rhythm of use. Yet, there are cases in which renewability depends on other factors, besides rhythm and extension of use. Recent studies on the Brazilian Caatinga biome have shown that this kind of vegetation renews itself with more limitations than others, because deforestation increases the soil temperature, and impairs the natural seeds germination on the soil. (Souza and others)[20].

If renewable resource is not synonymous with inexhaustible resource, because the first can be exhausted if the time and scale determinants are not favourable to its renewing, neither their opposites are synonymous. That is, non-renewable resource is not necessarily exhaustible. Some non-renewable resources occur in so large quantities that they happen to be inexhaustible. This is the case of raw materials (construction industry) that are the base of the Earth's material, or aluminium, the most abundant metal on the planet. And also, there are minerals which, besides existing in large quantities, as evaporites (salts) opposing the idea that every mineral is exhaustible or non-renewable. Finally, water, as one of the most abundant resources on the planet is inexhaustible.

[20] Souza, B. I.; Macedo, M. L. A.; Silva, G. J. F. Temperatura dos solos e suas influências na regeneração da Caatinga nos Cariris velhos – PB. RA'EGA, 2015. (Temperature of soils and its influence on the regeneration of the Caatinga biome in Cariris velhos)

3.3 Renewable or inexhaustible resources?

Wind and solar energy are imprecisely considered renewable. In the previous definitions, Park (2011) and Mayhew (2009) added renewable energy or wind-energy to their definitions of renewable resource. Yet, these definitions allude to *rhythm of use* and *stocks recovering*, issues that make no sense to solar and wind energy. Would the rhythm of the use of solar energy be equal or inferior to the rhythm of its natural renewing? Would the recovering of wind stocks be guaranteed by the adequate rhythm of wind-energy exploitation? The 'right conditions' mentioned in the previous definitions is a nonsense notion here, given that under *any condition*, much as humankind commits mistakes and whatever it is the rhythm and the speed of the imposed use, these sources will be emanating energy indefinitely. These sources of energy must be defined simply as *inexhaustible*. Otherwise, they would be in the same category of forests and species of animals, making the concept of renewable resources lose accuracy.

Figure 5ab – Wind and Solar energy: not renewable but ***inexhaustible*** resources.

We can include in this category of *inexhaustible resources* the geothermal energy, coming from the Earth's internal heat, the energy of tides and any other energy ruled by universal laws and that will never be extinguished, howsoever may be its handling and howsoever may be the rhythm of its use. That is, they are sources of energy that exist independently of mankind, and nothing mankind does may affect them.

David Thomas and Andrew Goudie, resorting to Rees (1990) focus on the difference between renewable and inexhaustible resources forming two categories, as in the definition below:

> Two categories of flow resources can be discerned: those where flows are dependent on human activity, and whose future availability may be compromised by excessive use […] and those where human usage has no impact on future availability. To this effect, Rees (1990) gave solar energy, air, water (at the global scale), wind and tidal energy as examples of the latter, termed non-critical zone flow resources, and fish, forests, soil and water in aquifers as examples of those in danger of losing their renewability through human actions. These can be termed critical zone flow resources, and in effect they can become stock resources if their ability to regenerate is compromised. (THOMAS; GOUDIE, 2000, p.205)

Then, according to the authors, the renewable natural resources lie on a *critical zone* where they can be exhausted by mismanagement; and in a *non-critical zone*, when they are independent from mankind and whose use does not reduce stocks. Those latter we classify just as *inexhaustible*.

3.4 The difference between renewable resource and naturally recyclable resource

Water is mistakenly defined as a renewable resource. Because this concept refers to *stock recovering* it is inadequate for define water, once its quantities have been stable on the planet for at least two billion years (Christopherson, 2012, p.1177). What happens to water is not renewing, but a continuous change of state and place due to the hydrological cycle. Water molecules can be in the ocean, then in the atmosphere, in glaciers, in the underground, in rivers and lakes. In addition, while passing from a state and from a place to another, it only performs a part of the cycle. Fragmenting this cycle results, inevitably, in a fragmented analysis. Considering only freshwater and defining it as a renewable resource (by atmospheric discharge), it is logically equivalent to accept that freshwater is being destroyed when rivers reach the ocean. In other words, water must be understood within the water cycle. Doing so, it becomes easy to conceive water as a *naturally recyclable* and an *inexhaustible resource*, owning to its enormous quantity.

3.5 The difference between *renewable resource* and *reproducible resource*

Considering all organic resources as renewable, indistinctively, is unanimity. Park (*op cit*, p.378) includes forests and cultivation in this category: "[…] which has the ability to renew itself and be harvested indefinitely […]". Here, forest, reforesting, animals or livestock are in the same category in which, once again, the concept loses accuracy. It is incumbent on us to adopt a new category, because, differently from forests and animals that occur naturally, agriculture, reforestation and livestock have an important social component: the use of techniques that accelerates the natural processes. Godard (2002, p.207) alert to the difference, and he refers to the reproducible character of some resources, in order to differentiate them from renewable ones through natural processes.

Figure 6ab- Forests and crops are conceptually different, being respectively renewable and reproducible.

Reproducible resources are those whose rhythm of production is accelerated by techniques, as it occurs in agriculture and livestock. A sugar cane plantation, for instance, does not *renew by itself*, so it cannot be considered a renewable resource. Even fresh water, when desalinated by processes that accelerate the hydrological cycle, can also be defined as a reproducible resource.

4. RESULTS AND CONCLUSION

There is a wide variety of elements and aspects that occur in nature and that react differently to the different means of exploitation and use. Because of this, the natural resources analysis must always combine natural and social aspects in a contextualised way.

A fixed list of resources from one kind or another can be only an initial reference. Nevertheless we must take into consideration that the renewability of resources can be related sometimes to their natural proprieties and sometimes to the conditions of handling or both, which make renewability a flexible notion. Restricting the wide universe of natural resources to only two categories – renewable and non-renewable – means neglecting all possible variations, as inexhaustible resources, reproducible resources and naturally recyclable ones.

Table 1 – New classification of natural resources

NATURAL RESOURCES	
DURABLE	**Renewable** (forests, animals, soils in specific conditions, river stream energy, firewood, biogas, etc)
	Reproducible (agriculture, forestry, livestock, salt, freshwater, etc)
	Naturally recyclable (water, nitrogen, etc)
	Inexhaustible (solar, wind and geothermal energy, tidal, wave energy, aluminium, sand, rocks, salt, water, etc)
EXHAUSTIBLE	**Finite** (oil, coal, arable soils under specific conditions, etc).
	Renewable subject to mismanagement or overexploitation.

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Growing Cities and Subnational Hydropolitics

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Abstract

Although academia doesn't expect water wars in the 21st Century, we should be ready to prevent the water conflicts between provinces at the subnational level. This is not only because %60 of the world population will live in urban and metropolitan areas when we reach the year 2050 but also because of a lack of visionary approach and adequate governance arrangements to prevent and resolve conflicts over water use. In addition to these two effects when we count on climate change effects on water resources it means that we are moving towards stronger water conflicts at different levels compared with the 20th Century.

Increasing sub-national water conflict between cities and federal states is mainly driven by decentralization policies and climate change effects on shared water resources.The role of growing metropolitans in water management is increased worldwide as a result of decentralization. Our past experiences in Turkey and ongoing low-level conflicts are also pointing out that this issue will need more attention from now on.

In this article, we aim to focus on growing water conflicts between sub-national actors, including municipalities, states, and provinces. We also aim to define some existing conflicts that need innovative sub-national hydropolitics while potential growing conflict needs to preventive measures.

Keywords: Growing cities, Water shortage, Subnational Hydropolitics, Hydro Diplomacy

1.INTRODUCTION

Population growth, economic expansion, and climate change are increasing the pressures on water resources around the cities. In his book(Moore S. 2018), Scoot Moore stated that "subnational hydro politics are an important feature of several large countries, including the United States, India, and China. Moreover, disputes between water users in shared river basins have often persisted despite repeated attempts by central governments to resolve them through both persuasion and coercion. Yet despite the growing threat of water scarcity around the world, little research exists on subnational politics of shared or reallocated water resources"

According to the Zhanga et al study (Xiang Zhanga at al, 2019) in the first two decades of the 21st century, 79 global big cities have suffered extensively mainly climate change-driven drought disaster putting tremendous pressure on a city's water supply. In addition to this

although they are not located in naturally arid areas, several cities in the world are subject to droughts and water scarcity of severe proportions; For example; Beijing has reached a 3,6 billion cubic meters water consumption yearly, far more than the 2,1 billion cubic meters locally available. Istanbul has reached a 1.2 billion m3 yearly consumption,35 percent of this amount comes 165 km away from Istanbul city. Nearly one in 10 watersheds in the United States is 'stressed,' with demand for water exceeding natural supply.(Capodaglio G.A.at al, 2016). Several growing cities, which are dependent on water reallocation from out of their provincial borders have a high potential for conflict between municipalities. Growing cities and growing challenge over water call for preventive subnational hydropolitics

2.GROWING CITIES

Over half of the world's population live in urban areas that occupy only a small percentage of the Earth's surface. Urban water demand is projected to increase by 50– 80% by 2050 (Florke , Schneider, Mc Donald 2018). Their growing water demand has been supplied from increasingly distant places by long-distance pipelines.For instance; Istanbul depends on additional water transfer[21] from 165 km. away while Ankara does from 60 km. away. These can be impressive feats of engineering, but both of them are long-distance, a large amount of inter-basin water reallocation[22] to growing urban economies and populations.

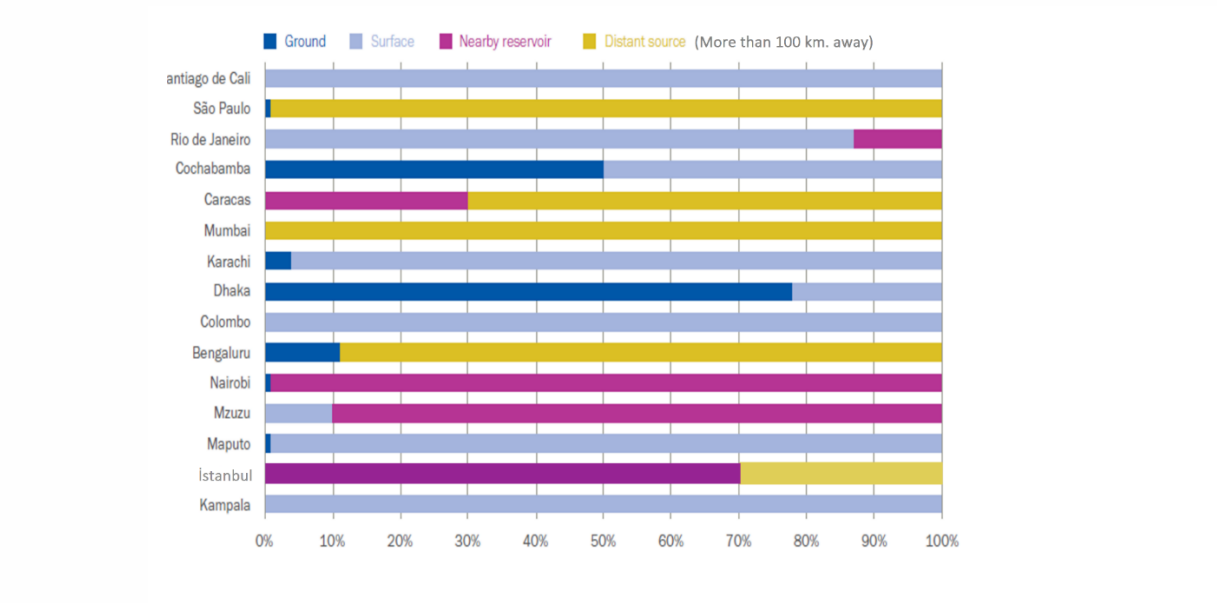

Figure 1. Urban water utilities rely on nearby or distance water resources (After Mitlin, Beard, Satterthwaite, and Du. 2019).

[21] **Transfer:** A transfer refers to the physical movement of water. It differs from 'reallocation' in that the water is not necessarily formally allocated and used.

[22] **Water reallocation:** Transfer of water between users who are committed formally or informally to a certain amount of water when the existing allocation is physically impossible, economically inefficient, or socially unacceptable.

When they grow, they need to allocate water from out of their boundaries and neighboring water basins. As shown in Figure 1,Sao Paulo, Mumbai,Caracas, Bengalure , İstanbul rely on water sources more than 100 km.away from the cities.

2.1 City Development and Water

It is a traditional and commonly accepted rule that the lack of available freshwater can hamper the development of a city and can result in a true 'human suffering disaster' conditions. Therefore additional drinking and domestic water supply to growing cities have been a priority for water management authorities. But during the second half of the 20th century, most growing cities have prioritized securing their economic and financial viability without considering sustainability. In addition to this during the decentralization period, states, provinces, and municipalities have become increasingly important players in natural and water resource management across the globe.

From the beginning of the 21st Century, especially in developing countries, metropolitan city mayors have taken more responsibility for city development to raise the living standards of the city residents. The resulting development plans firstly required more water or innovative water management, a water-smart city approach. Unfortunately, most of the developing word's cities don't have enough institutional capacity as well as efficient water infrastructure. Most of the city managers have chosen the shorter way to extract more water than applying efficient water use policies that may take longer than his/her elected period. Municipalities are less willing to invest in long-term and largescale programs that require substantial investments and continuity over time or that do not demonstrate immediate results. This situation is generally led to more water allocation from local and neighboring basins.

Therefore subnational hydropolitics in practice are going to face to cope with the emerging trends of water demand between neighboring cities as well as federal states. To put water diplomacy into action, we need a strategy with new language to share, new approaches, methods, new mechanisms and innovative tools to apply.

2.2 Emerging Water Transfer From Rural Area to Growing Cities

Water security of the growing cities has been a priority issue and water reallocation from rural to urban regions has become a common strategy to meet their demand. Due to this strategy and rapid urbanization, particularly in the Global South, it is estimated that competition for water between cities and agriculture will grow.

In their remarkable study, Flörke et al (Florke , Schneider, Mc Donald 2018) examined 482 of the world's largest cities with estimates of future water demand and predictions of future water availability. In the study, urban surface-water deficit is projected as of 1,386–6,764 million m^3.It is also obtained that more than 27% of cities studied and 233 million residents, will have water demands that exceed surface-water availability. Results obtained showed that 19% of cities, which are dependent on surface-water reallocation, have a high potential for conflict between the urban and agricultural sectors since both sectors cannot obtain their estimated future water demands. In many

countries, this situation can rise tension between cities, local government, federal states that call for innovative sub-national hydro diplomacy.

The new research complements updates to WRI's Aqueduct tool, which recently found that by 2030, 45 cities with populations over 3 million could experience high water stress.

Growing cities have always been dominant to secure their fast-growing water demand asking more water from even out of their boundaries. internal displacement from rural area to the cities will not be easy to stop in a short period. Therefore limiting water allocation can be a starting point to the cities in case they don't use current water potential as efficiently as possible in a circular water management concept. Improvements in agricultural water-use efficiency also could free up enough water for urban use.

Water demand in growing cities grows much faster than rural water demand. For instance, in every year, İstanbul Municipality subscribe 200 000 new water subscribers while Ankara,İzmir 100 000 and 70 000 respectively.

This rapidly growing demand and climate change effects indicates that we urgently need to shift our paradigm. Priority must be given to use water as efficiently as possible instead of right away water supply to the cities.

Cities water demand under the pressure of internal displacement is likely to grow.Some studies showed that 69 urban agglomerations receiving water through 103 reallocation projects (Garrick at al, 2019). This trend has already shaped a perception that the urban area is a net water receiver while rural is a donor. For example, Florke et al (Florke , Schneider, Mc Donald 2018). estimate that a 10% increase in irrigation water-use efficiency could reduce urban surface- water deficits by 2.7 billion m^3 by 2050, affecting almost 240 million city residents. This is an acceptable but incomplete approach that only points out the necessity of an increase in irrigation water-use efficiency in rural.

The high pressure of the growing population and the priority of drinking water supply made the cities primary water receiver.It should be noted that supplying more water is not a sustainable way to the cities. Therefore we urgently need to paradigm shift. Priority must be given to use water as efficiently as possible instead of right away water supply to the cities. Especially in Developing World, we need an innovative approach to use water as efficiently as possible.

The status and trends of water reallocation from rural to urban regions based on academic literature and policy documents have been examined by Garrick (Garrick at al, 2019). According to their findings "*approximately 16 billion m^3 of water per year moving almost 13 000 kilometers to urban recipient regions with an estimated 2015 population of 383 million. Documented water reallocation shares of watercourse are concentrated in North America and Asia with the latter constituting the majority of watercourse pairs implemented since 2000*."

Growing cities has put increasing pressure on water resources,in context of emerging water reallocation from rural to urban areas. In arid and semi-arid zones, this reallocation can create a particularly important conflict in terms of the water rights of rural communities.

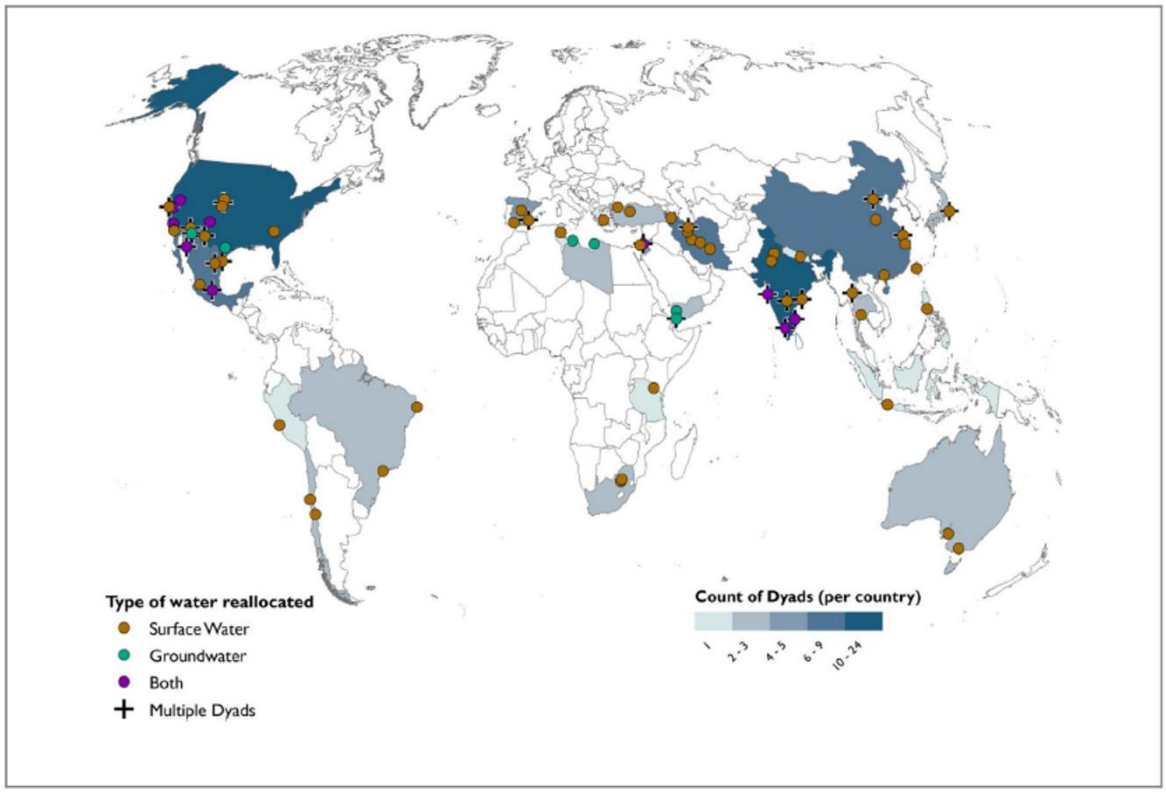

Figure 2.Water reallocation from rural to urban regions: watercourse pairs in the global reallocation database (GRaD) (Garrick at al, 2019).

In their study, Garrick (Garrick at al, 2019). stated that" *Asia and North America account for the vast majority of reallocation region (watercourse pairs) documented by the current literature. Of the 103 watercourse pairs, 49 are in Asia, while 33 watercourse pairs are in North America*" (Figure 2).

In Turkey, the top three cities with the highest population İstanbul, Ankara and İzmir have already reached the limit of their local water potential. Because of internal displacement-based rapid population growth and climate variability, these three cities have depended on large amounts of water transfer from other basins for the last ten years. These three cities can be seen as plotted points in Figure1 given by Garrick at al. continue to grow up and water dependency also grows up. This will certainly increase the pressure on water resources in the donor basin with rainfall variability.

3.METROPOLITAN MUNICIPALITIES DOMINATE WATER MANAGEMENT

Integrated water resources management (IWRM) approaches have most often in the form of river basin management councils. Therefore for instance,the European Water Framework Directive divided the continent into 110 river basin districts (Newig, Schulz and Jager, 2016). Although this approach is a commonly accepted base for sustainable water management, still provision of water infrastructure, service delivery, and related administrative tasks, are typically held by local governments, or municipalities.

In terms of implementing water management activities, municipalities are in a relatively unique position and have maintained their administrative competencies at the local level.

Growing population and climate change effect could bring serious difficulties to carry out their basic administrative competencies Under the growing pressures, municipalities want to expand the scope of their activities to address the basin level that can create conflicts with the other cities on water allocation. Although municipalities do not have direct authority for the basin located outside their municipal borders, especially metropolitan municipalities could be dominant to allocate water originate both within and outside of municipal boundaries. This is because of that decisions involving the distribution and use of water resources are inherently political,

This can create serious emerging and chronic conflicts between municipalities located in the same watersheds. When central government policy fails, a national water policy or water governance institutions are nonexistent to articulate the relationship between municipalities, conflicts can grow up faster creating a high-conflict watersheds. Under these circumstances, this high-conflict watersheds.need to subnational hydropolitics and municipalities need to focus exclusively on more efficient water management within their territories,

4.WATER SHORTAGE -INDUCED WATER DIPLOMACY BETWEEN TWO CITIES

Increase in urban water demand is projected as of 50– 80% by 2050 resulting competition between cities and agriculture for water. This challenges between the city of Los Angeles and the Owens Valley started in the early 20th century (Libecap, 2009). Urban population has rapidly increased since 1960 and created new water sharing conflicts globally since last 20 years (Garrick at al, 2019).

In October 2014, the Cities of Phoenix and Tucson USA announced an agreement for Phoenix to divert some of its share of Colorado River water to Tucson to be stored underground there for future use. Because Phoenix uses only about 70 percent of the amount of water it subcontracts from the Central Arizona Project, it proposes to send the excess to Tucson for storage as a hedge against likely future shortages on the Colorado River. When shortages occur, it was an effective resource management strategy with mutual benefits for two cities (Zarghami, 2015)

4.1 Strategic Investment in Solutions

Even in more centralized countries, however, the division of powers and responsibilities between central and subnational levels of government creates ambiguity in who is responsible for certain issues, as well as inherent coordination problems between levels of government.

As cities develop, societal expectations grow, and as water resources reach the limits of sustainable exploitation, urban water managers are being faced with increasingly complex and multi-faceted challenges.

One of the main challenges to water resource management in urban areas is the pollution and depletion of shallow and deep aquifers that traditionally supplied the urban area with drinking water. The subject is worth investigation and research by scholars. Several proposals have been provided until now. City Planner Kamal Jalouqa in his lecture on "Stormwater management in Greater Amman" provided some solutions to these problems through improving filtration to aquifers by good urban design, well-designed drainage systems and transfer to watersheds that are nearby and have less or no urbanization (Jalouqa, 2015)

Foreseeable climate change and population growth challenges facing large cities will need for strategic investment in solutions that will deliver long-term, lasting sustainable outcomes for donor and recipient regions

4.2 Preventive Measures and Hydro Diplomacy

Preventive sub-national hydro diplomacy would firstly require applying a systems approach and a long-term perspective to identify unexpected consequences of water reallocation and distributional implications.

On the base of this identification, it is needed to build capacity that creates a systems perspective that links reallocation with wider discussions regarding development, infrastructure investment and institutional strengthening.In addition to this grassroots level hydro diplomacy can help to identify the common myths and perceptions of reallocation to guide engagement, communication and compensation approaches.

Use of technological advancement in mainstream practice in the water and development industries can take time for developing regions. Therefore increasing investment in human capital with building capacity may be a starting point to facilitate effective hydro diplomacy at the grassroots level.

Instead of relying on traditional, technical, linear management approaches, innovative hydro diplomacy requires an integrated, adaptive, coordinated and participatory approach for both rural and urban sustainable water management.

Preventive Hydro Diplomacy that is based on water use efficiency and the fairness of compensation approaches, including new infrastructure, alternative water supplies, community development, can play an effective role to lessen the resistance of donor region and debates about the ownership of water

5.CONCLUSION AND RECOMMENDATIONS

Although it includes some similarities between international and sub-national water conflicts, resolving subnational water conflicts require deeper attention than that of the international water conflicts. Firstly we should be aware of that the root of subnational conflicts in water management is not seen yet. Conflicts of interest are growing slightly at the local level. When these conflicts are projected beforehand, preventive measures can play an important role to avoid them. Therefore governments, multilateral institutions, and researchers should devote much attention to analyze the potential water conflicts at the subnational level.

Preventive measures can be collected in four main areas

1. Raising awareness on the current trend and analyze continuing low-grade conflicts in the basins
2. Capacity building to facilitate grassroots level effective hydro diplomacy
3. Good water governance and fairness approach to the rural area together with technological assistance and compensation policies
4. Accelerate the transition to the circular water management concept in cities

In general, subnational water conflicts potential can be seen as a matter of local and mainly sectoral interest that can be prevented easier than that of the international one. It is also presumed that national leaders can play a powerful role in bringing parties to the table and brokering consensus. But past experiences showed that this didn't work efficiently. Local actors play a more important role in inbuilt confidence and appropriate implementations. to solve these anticipated conflicts

It should also be noted that being late to prevent it can shape a national security threat with the growing effects of climate change on local water resources. This requires the political sensitivity of local water issues and at the same time would encourage the involvement of NGOs and multilateral institutions to provide actionable perspectives. If NGOs and other players have the right to provide input on water decision-making, grassroots-based water diplomacy may play an important role to avoid potential conflicts in water diplomacy.

Good water governance can bring different stakeholders together to achieve the most equal and efficient water use not only at present but also in the future water shortage period. The donor area should have technological assistance as well as need to be convinced equitable and reasonable sharing of local water potentials. The concept of benefit-sharing' may also offer a constructive and practical path forward

Consequently, water reallocation from rural to urban areas as well as from neighboring municipalities watershed will remain a key policy response to the trends of increasing urbanization, changing water supply reliability under climate change, and growing populations in cities.Any reallocation of water from rural to urban areas is often opposed to as a net loss to rural communities.
Win-win outcomes for both donor and recipient regions can only be available if integrated basin-wide development plan is implemented strictly. Otherwise, the city side weighted water

allocation can bring significant consequences for donors and recipients, as well as the environment.

In conclusion, we would say that water conflict at each level ,from local to international is in emerging trend ,But this conflict is not inevitable with the right institutions and incentives, the cooperation of stakeholders. Subnational hydropolitics as well as digital water concept (Sarni,Webb,Cross,Glotzbach, 2019) and increasing treated wastewater reuse approach in growing cities will also be helpfull to avoid this raising tension.

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Some Methods of Water Conservation in Agriculture which may also be Integrated to Achieve Higher Productivity and Quality Ecologically

I. Impacts of Global Warming and Climate Change on Agricultural Production

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Abstract

While global warming is changing the climate dramatically and adversely impacting many aspects of the physiology of plants, and fertility of soils, the need for more efficient use of water in agricultural practices is increasing. Although there are many well established and widely used practices improving water retention and use efficiency in agricultural production, some others still need to be introduced and/or reminded to new prospective users in different regions or to the farmers growing different crops etc. Because, some of the results obtained by researchers in the laboratories or experimental fields do not attract attention of practitioners, or some successful applications in some regions may not draw interest of the scientists and prospective beneficiaries living elsewhere.

It is attempted to review and discuss some of such promising methods and practices here, in order to attract attention to the need of evaluation and assessment of new approaches to find solutions to the intensifying environmental and socioeconomic problems.

Keywords: Plant physiology, global warming, ecological agriculture, water economy

1.INTRODUCTION

As known, in spite of experiencing the intensifying various impacts of anthropogenic global warming and climate changes, "An important opportunity was lost as COP25 ended in compromise, with a modest agreement, widespread disappointment that no overall consensus was reached on increased climate ambition, The European Union, for example, Committed to carbon neutrality by 2050" was the conclusion reached by United Nations (UN News, 2019). Euronews also regretted by saying "Watch again: COP25 talks end with no deal on carbon trading." (Euronews, 2019). UN News, on the other hand, attracted attention to the declaration of commitments by high number of nations, regions, cities, businesses and investors to reach carbon neutrality by 2050. Famous Swedish activist Greta Thunberg, on the other hand, branded EU legislation to tackle climate change as a surrender, and added that the Green Deal package of measures gave the world much less than a 50 per cent chance to limit global warming to 1.5℃ (Ecowatch, 2020).

It is very difficult to predict the answer of the vital question to be asked at this point, what will happen until reaching carbon neutrality by 2050? Unfortunately there are high number of pessimistic projections, which cannot be neglected (Higgins, 2019; Buis, 2020; United Nations, 2020). Aminzade (2018) in fact, presented data and her evaluations on worsening water problems under the title of "Projections of Future Drought"; Abobatta (2019) drew attention to the chronic water shortage and related soil solution saltiness in Middle East North Africa region.

Loboguerrero, A. M., Campbell, B. M., Cooper, P. J., Hansen, et al. (2019) drew attention to human activities related with land, through agriculture and forestry, impacting functioning of ecosystems, and stressed the importance of agriculture in adaptation and mitigation activities addressing global warming and climate changes to ensure water and food security for the growing global population. They added that climate change and its agricultural outcomes were risking the efforts to reach at least 7 of the 17 Sustainable Development Goals, although 103 nations had committed themselves to reduce greenhouse gas emissions from agriculture, because of the lack of sufficient support in adaptation and mitigation actions within agriculture still receiving insufficient support from local to international level. They reviewed a series of climate change adaptation and mitigation options that could support increased production, production efficiency and greater food security for 9 billion people by 2050, and supported climate-smart agriculture, which could help foster synergies between productivity, adaptation, and mitigation, although trade-offs might be equally apparent. Vandeweerd, V., Glemarec, Y. Billett, S. et al. (2012), on the other hand, attracted attention to the impacts of the heightened financial barriers by rich countries for the vulnerable groups, such as the poor people and women; and concluded that this reluctance was threatening the achievement of poverty eradication goal of global sustainable goals.

There are some sources, such as International Institute for Sustainable Development (IISD), on the other hand, let their readers to reach their conclusions by offering both of optimistic and pessimistic perspectives (Ospina ve Asadollahi, 2017). Actually, the same difficulty is valid for predicting the technological developments in the near future, which can provide applicable solutions to mitigate global warming and avoid most catastrophic impacts of climate change until reaching carbon neutrality by 2050. Such attempts range from scrubbing carbon dioxide from the stacks (Boyd, Chidambaram, et al. 2019) to store solar energy for very long periods up (Wang, Roffy et.al , 2019), to produce and use the nuclear fusion energy (International Atomic Energy Agency –IAEA (2018).

Sustainable food production target covers some solutions which are considered as climate independent ones, such as hydroponics and aquaponics; as Yep and Zheng (2019) put it in their comprehensive review article, aquaponics was offering solutions to limited fresh water availability, pollution, increasing fertilizer costs, depletion of fertile soils. They detailed the current trends and technological advancements, successes and challenges for commercial and research applications. The question to be asked here is the economical feasibility of such techniques for underdeveloped and developing countries. Sulma, Gimenes, and Erlaine (2019) studied on this subject, by describing their aim as examining the economic viability of a hydroponic system using a distinguished approach to treat investment risk, considering the

high value of initial investment. Some other factors such as operation and maintenance costs, which may be proportionally higher in underdeveloped and developing countries.

It will be attempted here to review benefits of some of the agricultural practices that have been proved to be environmentally and economically sustainable at some areas, and/or for some production systems, in order to attract attention to their potential in other several application areas. Special emphasis will be paid on climate crisis and water economy in relation with water use efficiency (WUE), classically defined as the amount of carbon assimilated as biomass or grain produced per unit of water used by the crop considering the intensity of consequent various stress conditions projected by IPCC and FAO experts [Elbehri, A., Challinor, A., Verchot, L., Angelsen, A., et al. (2017)].

2.CLIMATE IN ECOLOGY

Stenseth N. C., Mysterud, A., Ottersen, G. et al. (2002) reminded the fact that ecological processes were influenced by prevailing climatic conditions and criticised the earlier studies which overlooked: the holistic nature of the climate system, and focused typically on local weather parameters such as temperature, precipitation, and snow depth. They emphasised the importance of increasing attention paid to large-scale patterns of climate variability with marked ecological impacts on interannual and longer time scales, such as North Atlantic Oscillation (NAO), El Nin˜o–Southern Oscillation (ENSO), which accounted for major variations in weather and climate globally and had been shown to affect terrestrial vegetation, distribution of herbivores and carnivores, marine biology and fish stocks directly and indirectly. They stressed the importance of increasing awareness and interactions between biologists and climate scientists in the critical issue of the response of ecosystems to climate variability and climate change; mutual interest in climate processes.

As they put it, climate is a determinant, spatial synchronizer of distribution of populations as described in population ecology as 'Moran's theorem' or the 'Moran effect'. In short, Moran stated that the time correlation of two separate populations of the same species was equal to the correlation between the various environmental variabilities of the habitat, they lived in (Blasius and Stone, L. 2000). Stenseth et al. (2002) gave the example of rainfall changes associated with ENSO, producing a highly synchronic pattern of changes in massive germination of annual plants, terrestrial vegetation and consequently fauna through both direct and indirect pathways over arid and semiarid regions, as described by Lima, Julliard, Stensth and Jaksic (2001) for a small rodent species.

This complex relations network dominates the biogeographical distribution network, which is the subject of biogeography. As Nehra (2016) described, biogeography studies the past and present distribution of the world's many species, often relates to the examination of the physical environment, which affects species, communities, populations and ecosystems, shaping their distribution across space over geological timescales. Organisms and their communities often varied in a regular fashion along geographic gradients of latitude, elevation, isolation and habitat area in a very dynamic manner. Biogeographic regions were

exhibiting differences in the average composition of flora and fauna, which were the result of historic and current causes were affected by global warming induced climate changes.

2.1 Climate Crisis and Plant Biology

The book by Archer and Rahmstorf (2010) titled "The Climate Crisis: An Introductory Guide to Climate Change", reflected the expression used by Al Gore in his Nobel Lecture, who warned for the threat of the climate crisis, as a threat that was real, rising, imminent and universal (United Nations, 2007). In another document titled "The Climate Crisis – A Race We Can win", it was referred to the speech by who said "The climate emergency is a race we are losing, but it is a race we can win"(United Nations, 2007). Considering the above summarized dominancy of climate in biogeographical distribution of living organisms by limiting the abundancy of autotrophs, it can be stated that biological properties and ecological tolerances of plants are vital factors effective in winning the race against global warming driven climate crisis.

Koricheva and Gurevitch (2014) discussed the uses and misuses of meta-analysis in plant ecology, considering the wider fluctuations in temperatures and increasing levels of aridity in many regions that were making their lives of those highly complex and sensitive organisms more difficult. They added that, even in relatively more stable climate zones today, variations in light intensity could reduce growth rates and crop yields, by exceeding the limits of protective cell physiological mechanisms of the plants, which have been developed to protect them against the deleterious effects of higher light intensities on photosynthesis,. They referred to another study on the genetical control of the level of the enzymes named as V, P, and Z, which were playing the key role in the regulation of the adaptation process. Since overexpression of these enzymes retarded growth, higher levels of photoprotection might be interfering with the operation of other mechanisms involved in plant growth.

The practical aspects of their conclusion can be summarized as follows: Contrary to confident suggestions of some research groups, they found it difficult to produce plants that were better adapted to climatic changes. They evaluated their results as the data evidenting the complication of adaptation of plants to facilitate satisfactory adjustment to changing climatic conditions. There were no simple or universal solutions to enable plant spp. to cope with the challenges posed by climate change. The reason of the complexity was the tight interconnection of the physiological processes involved. It would be impossible to predict the consequences of the effects of multiple changes, thus the relevant approach to adaptation phenomena should be a holistic one. The research team coordinated by Leister involved in analysis of complex relationships and understand how plants reacted to biotic and abiotic environmental factors, such as drought, light and temperature, by analyzing their impact on the concentrations of all measurable metabolites, transcripts and proteins in plant cells, which could lead to identification of the key components facilitating plants to cope with varying conditions, and underlying the trade-offs, mechanisms between growth rates, increases in biomass and yields of crop plants; as they named it, 'assisted evolution' aiming to find

sustainable solutions. They referred to some progress that had already been made in certain species of algae, which serve as sources of potentially useful models of genetic mutations that could be introduced into green plants.

Wang, D., Wang, H., Wang, P., et al. (2019) pointed out the lack of information on the effects of different methods used in the studies on the responsive pattern of plant ecophysiology to climate warming. In order to fill the gap, they applied a comprehensive meta-analytical method to climate warming manipulative studies, aiming to reveal ecophysiological aspects of responses to multiple dimensions of climate change and their implications for different species under different experimental settings. They presented results indicating increased specific leaf area and enhanced leaf dark respiration, which were accompanied by decreased net photosynthetic rate and leaf nitrogen content. The positive and negative effects of warming were different for C_4 and C_3 plants, as would be expected, the effects on plant ecophysiological traits also varied among different response variables and by the magnitude of temperature change and experimental methodology.

The literature presented above clearly show the need for utilization of methodology of the studies named as Environmental Plant Physiology, Environmental Plant Ecophysiology, Plant Ecophysiology, Physicochemical and Environmental Plant Physiology, and Comparative Ecophysiology. An attempt was made by Lüttge and Scarano (2004) to delineate the meaning of Ecophysiology and presented a brief historical overview of methodological and instrumental developments along with sampling strategies for analyses of physiological performance in the field. Actually, ecophysiology was developed from aut-ecology, as they pointed out, which was dedicated to the behaviour of individual plants, species or higher taxa, viz. physiotypes, i.e. physical characteristics of organisms distinguishing them in particular habitats, leading to the development of ecophysiological diversity, and ultimately integrative physiological synecological studies on communities. As mentioned by the authors, these communal studies compare morpho- and physio-types within a habitat or ecosystem and across a range of habitats or ecosystems.

The applications of some analytical methods used for such purposes were included in the review article on the environmental physiology of *Musa spp.* by Turner; Fortescue and Thomas (2007). In their brilliant short communication "Focus on Ecophysiology", Ainsworth, Bernacchi and Dohlman (2016) drew attention to the wide range of current environmental challenges and the projections on further warming on natural and managed plant systems, which had adapted to an incredible range of environments. Ecological and environmental plant physiology, which provided mechanistic understanding of their survival, distribution, productivity, and abundance of plant species across the diverse habitats. They added that this could be realized by using the methods of plant physiology to understand the changes in metabolism, water economy and use, hormonal control, responses to abiotic and biotic stresses, from instantaneous to evolutionary timescales and from tissues to canopy, ecosystem, region, and globe scales.

Their conclusion was that, the advancements in ecophysiological understanding and stimulation of adaptation of plant spp. to multiple stresses by breeding climate resilient varieties of field crops, which put plant ecophysiology at the center of understanding plant

evolution and productivity, nutrient use efficiency; adaptation potential of spp. and managed ecosystems, acceleration of breeding for higher tolerances, which would also serve to mitigation of global warming and impacts of climate changes.

2.2 Some Critical Parameters of Effects Exerted on Plants by Climate Change

Becklin, Anderson, Gerhart, et al.(2016) summarized the multiple effects of warming climate and their profound impacts on the physiological functioning of plants and interactions between plants and other organisms, and also ecosystems; thus, they combined findings in plant physiological ecology and evolutionary biology. Changes in photosynthetic rates would shift plant growth rates, overall productivity, and resource use, levels of leaf sugars, phenological processes such as dormancy break and flowering time, shifts in source/sink relationships of photosynthate which could influence seedling survival, whole-plant growth and competitive power, resilience against selective pressures put by altered thermal and precipitation regimes and CO_2 level, global warming changes patterns of natural selection on plant physiology, morphology, and life history.

Considering seed and bud dormancy, germination, flowering and defoliation dependence on different factors in genera, classified as neutral, short day, long day plants, viability of species and communities will considerably change in near future. Differences in phenotypic plasticity, root system, water use efficiency (WUE) and soil types will also be elective. As they also stated, species would ultimately have to evolve or migrate change to avoid extinction, and many already had shifted to higher latitudes and elevations or disappeared.

Ramegowda, V. and Senthil-Kumar, M. (2015) reviewed the literature on the effects of combined biotic and abiotic stresses and the consequent limitation on crop yields, considering the scientific developments in understanding the molecular basis of their interactions. They attracted attention to the tailored physiological and molecular responses exhibited by plants as part of their stress tolerance strategy, which could not be inferred from individual stress studies. They focused on the complex physiological changes induced by different signaling mechanisms in cases of simultaneous drought and pathogen stresses, and attempted to highlight the tailored negative, i.e., susceptible or positive, tolerant strategies developed by plants;referred to previous reports evidenting an increase in disease susceptibility of several crops at combined pathogen and high temperature stresses. They concluded that those studies showed that both basal and the *R*-gene-mediated defense responses were suppressed during combined high temperature and pathogen infection, although this trend was not evident in plants exposed to individual stresses. They also added that plant growth inhibitor, Abscisic acid (ABA), the primary regulator of drought stress response was also known as an pathogen response altering agent. Some of the physiological mechanisms involved in the water use, metabolism and economy will be briefly discussed below.

Beckling, et al. (2016) put emphasis on phenotypic plasticity as a fundamental response mechanism to a changing environment, and added that the direction and adaptive value of plasticity could be assessed experimentally by exposing genotypes to contrasting conditions.

As typically named, acclimatization or acclimation, stimulation of adaptive physiological response is a method used to decrease the susceptibility of organisms to stress factors, in other words, increasing their resistances, as far as to the limits of their genetic potential. Leuendorf, Frank & Schmülling (2020) described the process as developing strategies to remember the first priming stress to respond to the following one. They observed that Arabidopsis thaliana seedlings exposed to sustained cold treatment developed a higher freezing tolerance, an effective memory which was associated with an altered physiological state and lifecycle, from germination to growth and florescence; although chilling was known to affect growth and development, freezing temperatures led to a state named 'physiological drought', which means wounding and death. They referred to some articles describing acclimation by formation and accumulation of cryo-protectants like e.g. soluble sugars, prolines, flavonoids or anthocyanin, changes in lipid and protein compositions of cellular membranes and major changes in the plant transcriptome and proteome. The synthesis, levels and activities of hormones and inhibitors must be added to the control mechanisms of acclimation and consequent resistance.

Meyers, Ancel, and Lachmann (2005) used a transparent mathematical model to illustrate the concept of genetic potential to show that the relation between decreasing environmental variability and evolvement of populations distinct steady state conditions in terms of organismal flexibility, genetic potential, and genetic robustness. They examined fluctuating selection for hydrophobicity in a single amino acid as a specific example of this concept, and they concluded that environmental fluctuations could produce distinct allele distributions. They also attracted attention to the current rate of environmental changes, which are high and still increasing (Lindsey and Dahlmann, 2020).

Another important series of impacts of climate change are on soils and plant-soil relations, as comprehensively reviewed by Prentice, Cramer, and Harrisont, (1992) and recently by Karmakar, Dutta and Rakshit (2016). Prentice et al (1992) presented a model to predict global patterns in vegetation physiognomy by using physiological considerations influencing the distributions of different functional types of plant, considering the fact that the terrestrial biomes arise as combinations of dominant types. They used global environmental data such as monthly means of temperature, sunshine, precipitation, drought index incorporating the seasonality of precipitation, soil texture class and available water capacity of the soil, and they found good agreement between their predictions of global vegetation patterns and the mapped distribution of actual ecosystem complexes. They listed the driving variables were mean coldest-month temperature, annual accumulated temperature over 5^{o}C, and a drought index incorporating the seasonality of precipitation and the available water retention capacity of the soil. The model was found suitable for predicting the plant types that could fit in a habitat, and selection of potentially dominant types, except where intensive agriculture obliterated the natural patterns. They concluded that the model could be used in assessment of impacts of future climate changes on potential natural vegetation patterns, land-surface characteristics and terrestrial carbon storage. Karmakar et al (2006) also stressed the importance of recent changes of climate and vegetation on soil formation and developments in the soils, in addition to their use and management, considering the importance of climate in the formation of soil with important implications for their development, use and

management perspective with reference to soil structure, stability, topsoil water holding capacity, nutrient availability and erosion. They added indirect effects of climate on plant growth rates and water use efficiencies, vegetative cover, organic matter turnover and CO_2 dynamics.

They commented also on the effect of climate change on agricultural production and said that the generally obtained yield much less than the half of the genetically offered potential by a selected cv. at the cultivated site. The deficite should be the result of climate and selected cv. if all other factors were kept optimal at the site, so this consideration lead several agriculturalists, scientists and economists to study on the adverse effects of climate change. They added that the major role of the soil in the determination of yield, inevitably lead the research teams to study on the changes in the physical, chemical and biological properties of cultivated fields. They concluded that, in spite of the progresses in understanding the relationships between particular soil properties and climate change, comprehensive explanation of the key factors involved were still lacking, and their review article aimed to describe the impact of climate change on soil properties, possible mitigation or adaptation strategies. They presented the average yield reducing factors as weeds, pests, diseases and plant density; best farmer yield limiting factors as water and nutrients, attainable yield defining factors as climatic factors and crop characteristics. In the present study, it will be attempted to evaluate the efficiency of some methods, techniques in filling such yield limiting, reducing factors in global warming related climatic changes era, inevitably without going into many details of the topics to be covered here.

Nortcliff, Hulpke, H., Bannick C. G. Et al (2006) for instance, presented an article on the complicated science of soil and its important role in agricultural production in the chapter titled Soil, Definition, Function, and Utilization of Soil. As physics, physical chemistry, chemistry, macro and microbiology and their interrelations involved in soil science, their summary included a list of subtitles starting with Definition, Ecological and Political Aspects of Soil Protection, Function and Utilization of Soil, Soil Ecosystems, Ecological Soil Functions, Regulating Functions, Habitat Function for Organisms in and upon the Soil, Productive Function, Agriculture, Forestry, Other Soil Functions, Utilization of Wastes, Raw Material Deposits, Land Utilization and Soil Destruction (Statistics), Land Utilization, Soil Destruction, and Forecast. Some important terms such as soil structure and texture, soil moisture, soil moisture retention, soil solution, ionic exchange capacity, soil pH were had to mentioned in the subtitles listed above.

Ouyang, H., Lana, S., Yang, H. et al. (2017) studied on another aspect of water retention capacity of soils, non-rainfall water (NRW), the most frequent water source of drylands, could be significantly boosted by biocrusts. They added that the mechanism of biocrustal promotion and utilization of NRW had been little studied, thus they studied on its accumulation patterns, photosynthetic activities and CO2 exchange of different biocrusts (2 cyanobacteria crusts-ACs, 1 cyanolichen crust-LC1, 1 green algae lichen crust-LC2, and 1 moss crust-MC) under NRW through in situ mesocosm experiments in the Hobq Desert of China during the autumns of 2014 and 2015. Structural equation models showed that crustal properties feedback affected

the degree of meteorological parameters on NRW accumulation, in which the effect of surface temperature gradually decreased with the development of biocrusts while that of subsoil temperature and light intensity increased. Anyway water is the first limiting factor of lives, especially in drylands. The formation and development of biocrusts also needed water,though the amount is much less than that required by vascular plants, they could utilize additional water sources, such as nonrainfall water (NRW), which could be used by other organisms, but its availability was measured at an older study they referred as approximately 200 nights per year even in the northern Negev desert. Several other studies were mentioned, showing that NRW was comprising a great proportion of the total annual precipitation, or even it was the only water source in some places. They drew attention to the fact that there was a threshold of water availability that could activate carbon fixation, the effectiveness of NRW on biocrusts was of vital importance to determine the boundary of inoculation-based technology, in which the carbon gain particularly related to NRW quantity and duration. NRW was also the most frequent water for the photosynthetic carbon fixation of cryptogams in biocrusts.

They also presented vast literature showing that easily peeled-off biocrusts, firstly colonized and stabilized by cyanobacteria, occupied more than 70% of the living coverage in arid and semi-arid areas, contributing to the stabilization, fertilization, and hydrological regulation of topsoil, fixing sandy surface, which made utilization of biocrust technology. Utilization of biocrust technology was unquestionably sustainable, with broad application prospects and advantages, as its successful application in more than 40 km^2 desert region in China, and applications in different geographical regions of continents evidented.

Wanga, Tiana, Liua et al. (2017) studied on the effects of increasing anthropogenically active nitrogen (N) deposition on soil organic carbon (SOC) decomposition, and consequently affecting SOC storage in terrestrial ecosystems, considering its specific influence might depend on the different types of N deposition and soil nematodes. They wanted to investigate the interrelationship between N deposition and soil nematodes and SOC cycle process in a temperate forest, and evaluated the effects of different types of N deposition on SOC decomposition under the conditions of applying nematocide against control parcels. They concluded that anthropogenic atmospheric N deposition favored the increase of C stocks in soil by reducing the SOC loss, and N types should be considered during assessment of N deposition effects on soil C cycle processes, referring to literature reporting anthropogenically reactive nitrogen (N) deposition in the terrestrial ecosystems had increased more than 300 % in 20th century and would continue to increase, particularly in China. Widespread effects, such as soil biodiversity loss and alteration of SOC decomposition to be important, as the literature they referred showed that the SOC amount in terrestrial ecosystems was more than thrice the amount of atmospheric C.

3.AN INCONVENIENT QUESTION: WHAT IF WE'RE THINKING ABOUT AGRICULTURE ALL WRONG?

This question was asked by Hay (2020) depending on the successful realization of the Project called "New Forest Farm", which was started at 100 acres of spent field by Mark Shephard in 1994, the author of the book titled "Restoration Agriculture, Real World Permaculture for

Farmers" published in 2013. She told that Shepard combined permaculture, information and design intensive technique, which will be described below, and habitat restoration with the goal of using nut trees and animals to produce staple foods. In short, she told that Shepard had begun by researching biomes, large, natural communities of distinctive biota, and discovered the widest one, savana, a grassy area scattered with shrubs and trees, and the most common type, the oak savana, which was composed of tall, nut-bearing trees, oaks, chestnuts, and beeches, apples, hazelnuts, cherries, plums, peaches, raspberries and blackberries, gooseberries and currants, grapes, grasses, and certainly microbiota. Shepard had decided to found a farm mimicking an oak savana grow annual grains, he decided, he would design a farm that mimicked the oak savanna, with nuts and meats as staple foods, and planted thousands of shrubs and trees. He had converted the former row-crop grain fields into a wild yet organized landscape: curving lines of mixed chestnuts, walnuts, hazelnuts, apples, and elderberries alternating with alleys of grass grazed by cattle, pigs, sheep, andpoultry.

Actually, mycologist Howard (1921) introduced his approach to agriculture in the book titled as 'An Agricultural Testament'; he was the first pioneer of the sustainable agriculture method, who studied agriculture at Cambridge University, and expanded his knowledge in practical research and study in the West Indies, India, and England, where natural agriculture was practiced. His 26 years long vast experience at the field as a mycologist proved the value of soil biota in agriculture. He tried to find an answer to the problem in his mind, "Can mankind regulate its affairs so that its chief possession - the fertility of the soil - is preserved? He realized the fact that forests manured themselves,. the native Indian peasants, who had the healthiest crops and animals were those who were not using chemical fertilizers, and succeeded to be the Pioneer of organic agriculture. Dr. Rudolf Steiner introduced 'biodynamic, biological dynamic agriculture' practice in Poland in 1924 (Paull, 2011), and Müeller and Rusch introduced minimal input using 'Closed System Agriculture' at thirtees (Food and Agriculture Organization, 2014) and Howard (1921) titled as 'An Agricultural Testament', which is considered as the milestone of modern organic agriculture. Zonis (2006) wrote an article titled "Organic versus Biodynamic Agriculture Organic Matter" and compared these practices for the enthusiast audiences; if summarized very briefly here, while organic agriculturists were focusing on the increase of plant nutrient supply by the soil biota, biodynamic agriculturists accepted soil as a dynamic, living organism, as they handle their agricultural ecosystem, and tried to align their activities with circadien rhythm of the plants they grew. Thus, they accepted organic agriculture as it was, and criticised the practice as a mechanical approach, neglecting most of the natural needs of organisms. Actually, Zonis (2006) also drew attention to the Howard's view on the relationship between health of humankind and animals, plants in his book, which depended on his observations of infection resistant livestock when they were fed by grasses grown on fertile soil in the field. Howard, in fact, described healthy, fertile soil in terms of high level of natural organic matter supporting greater diversity of soil organisms, from useful bacteria, to mycorrhizal fungi to earthworms, as the very well known and generally accepted fact nowadays (Delgado-Baquerizo, et al. 2017). Howard utilized the methods of cross-fertilization, conscious irrigation, mycorrhizal symbiosis, soil drainage and aeration, fruit tree growing, weed control and integral health protection (Zonis, 2006). bu ileri görüşlülüğünün kendisine saygı gösterilmesi yanında ekstremist damgasının vurulmasına da neden olduğunu bildirmektedir. Heckman, J.

(2006) shared the description of Howard in his book titled The War in the Soil, that can be summarized as the conflict between the rights of humanity to have healthy food from the healthy soil and the capital investors and their organizations selling chemical fertilizers and agricultural chemicals. It is worth to mention here that, Sprengel-Liebig minimum law, stating that growth is dictated not by total resources available, but by the scarcest resource, limiting factor was accepted and practiced widely by plant nutritionists (Reilly, and Fuglie, 1998), but importance of recycling was neglected, depending on the promising developments in chemical and mechanical Technologies, which were named as 'green revolution' for a long period (Pingali, 2012).

A recent review on the topic, covering comparisons for the enthusiasts was published by Dhiman, V. (2020). It can be worth mentioning very briefly here that, while organic agriculture focuses on protection of consumers' health, biodynamic agriculturists also try to protect, improve and sustain the health of the entire ecosystem, as much as they can. As a matter of fact, there are two independent international organizations of organic and biodynamic agriculture practitioners, entitled to certify the producers; Demeter Biodynamic Assoc. (https://www.biodynamics.com) and IFOAM Organics Assoc. (https://www.ifoam.bio).
Whitney, C (2013) on the other hand, compared biodynamic agriculture with permaculture, literally permanent agriculture, who described it as a philosophy-design farming and living method that grew out of the books and courses of Australian farmers and researchers, B. Mollison and D. Holmgren. Permaculture systems were modeled ones on some patterns observed in nature; structures, access and water systems were also energy efficient and placed as an element of the system rather than a simple, individual component to be fixed. He referred to Holmgren's description, "Traditional agriculture was labour intensive, industrial agriculture is energy intensive, and permaculture-designed systems are information and design intensive", and added that permaculturists were expected to spend most of their time and energy for planning the farming system, in turn to pay less and less attention for its maintenance. Permaculture was not expected to have an unconditional ecological, organic or biodynamic perspective; so, there were not legal limits and regulations. It is worth to refer to the inconvenient question asked by Hey (2020), and underlying reasons, here, as it is very well known that monocultural intensive agricultural practices lead to destruction of complex ecosystems consisting of annual and perennial, and annuals. She referred to "Special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems" (IPCC, 2020) and regretted that approximately third of the world's ice-free land was cleared by cutting forests down and plowing prairies to create agricultural fields; she added that crop production activities also made 23 % of the total sera gas emissions. The consequences of such impacts of human activities reached to a level that irritated World Health Organization and warn (WHO, 2020). The questions included impacts of land degradation, desertification, loss of arable lands and pastures on food and fresh water supply, malnutrition, atmospheric dust, hygiene, epidemies, air quality, public health.

As described by Hay (2020), the overstory of Mark Shephard's New Forest Farm was composed of tall, nut-bearing trees of *Fagaceae* family, oaks, chestnuts, and beeches, beneath that were apples, hazelnuts, cherries, plums, peaches, raspberries and blackberries, gooseberries and

currants, grapes, grasses, mushrooms and other plants populated the oak savannas, excluding the edible annual grains, in order to mimic the oak savanna with nuts and meats as staple foods by planting thousands of shrubs and trees, to convert the former row-crop grain fields into a wild yet organized landscape by curving lines of trees and shrubs alternating with alleys of annuals grazed by livestock and poultry. She reminds that the people of northern Italy have long relied on chestnuts and they named them as "the bread tree", distribution of tree crops like honey locusts in North America had been linked to former indigenous village sites, where botanist W. Bartram recorded extensive cultivation of tree crops, in particular, hickory nuts, by Native American tribes in what is now the southeastern U.S. She added that, the U.S. government leaned heavily on trees for relief, planting some 220 million trees on the Great Plains between Canada and Texas in an effort to curb erosion During the Dust Bowl years. As part of the New Deal, FDR started programs in agricultural areas like Tennessee — degraded by decades of cotton, corn, and tobacco — to restore the land with millions of tree crop seedlings. Hay (2020) also reminded that Columbia University professor J. Russell Smith, studied agriculture at home and around the world, called the cereals as weaklings, and tree crop as a permanent agriculture, considering their yearly production ability. She gave some more examples of assessment of edible and other economical tree products from some other countries, such as Greece.

Papanastasis, K., Mantzanas, O., Dini-Papanastasi, et al (2014) exemplified that agroforestry systems were a traditional land use practice in Greece, that were widely distributed all over and constituted important elements of the rural landscape; three types of systems were present, silvoarable on arable land, silvopastoral involving trees and pasture/animals grown on forest and arable land, agrosilvopastoral on arable land with trees, crops and grazing animals. Natural or planted, evergreen or deciduous forest trees, cultivated fruit trees, annual or perennial crops and sheep, goats, cattle, pigs or poultry were present in the systems covering approximately more than 3 million ha., 23% of the country. All systems were delivering a great variety of goods and services for a considerably long period of the year in a sustainable manner, also by improving the environment. Despite these benefits and importance, the systems have been degraded over the last few decades due to extensification/intensification processes imposed by socio-economic changes. Thus, Papanastasis et al (2014) attempted to analyse their economic, ecological and cultural roles, discussed their recent evolution and made recommendations for their inventory, conservation and sustainable management.

In an article titled Agroforestry, Food and Agriculture Organization-FAO (2020) summarized the traditional and modern agroforestry concepts and analyzed the differences between them. It was said that although there was great regional differences, the practice of maintaining or integrating trees in the agricultural landscape had a long history in land use management, from ancient times to the present. In Europe, the the history of Spanish 'Dehesas', of a system in which pasture for cattle, swine, sheep covered by scattered oaks was said to have its origins dating back 4 500 years. In the Americas, numerous communities practiced multi-story agriculture mimicking complex forest ecosystems during the pre-Columbian period in order to enjoy their multiple benefits, which are also the economical expectations nowadays. The Indian Peninsula was given as the example of agroforestry practices in Asia, with its traditional millenial homegardens; some of them with specific systems had received support

from the rulers. It was added that in Africa trees traditionally covered ground crops, Swidden cultivation, also known as shifting cultivation, was stil widely used and one of the first agricultural techniques ever developed. Atangana, Khasa, Chang, et al. (2014), in fact, acknowledged the lack of interest in tropical agroforestry, and presented comprehensive data and information on the agroforestry in a 375 pages book, which was covering information from tropical bioms to biological nitrogen fixation and mycorrhizal associations in agroforestry, agroforestry for soil conservation, integrated pest management in tropical agroforestry, several other topics and and finally agroforestry modelling. They considered the increasing interest in carbon sequestration, mitigation of climate change and reducing emissions from deforestation and forest degradation, including conservation and sustainable management of forests and the enhancement of forest carbon stocks mechanisms. Smith, J. (2010) on the other hand, interested in the history of temperate zone agroforestry.

The term agroforestry has been used since seventees, as one of the alternative approaches to solve growing environmental problems, and high number of national, international organizations founded, finally in 2018 world's leading forestry and agroforestry organizations merged for accelerated impact against climate change (Center for International Forestry Research - CIFOR, 2018). As a matter of fact, IPCC (2019) considered agroforestry as an essential practice for sustainable land use and a solution to global warming, and EU immediately expressed its support to this consideration through European Agroforestry Federation (Euraf, 2019).

Aschi, A., Aubert M , Riah-Anglet, W. et al. (2017) presented a study on the crop rotation by using legumes to observe the benefits regarding the structure and function of soil microbial communities, and designed an experiment by Wheat-Beet-Faba Bean-Rape-Wheat (Leg+) and Wheat-Flax-Wheat-Beet-Wheat (Leg−) rotations. Soil samples were collected and analyzed for Soil microbial biomass and soil enzymatic activities (β-glucosidase, cellulase, urease and arylamidase activities) were assessed. Soil microbial diversity was evaluated with two complementary approaches: Phospholipid fatty acid profiling (PLFA) and the metabolic capabilities. They found that soil organic carbon and total nitrogen were significantly and respectively 1.5 and 1.3 times higher in faba bean's rotation. Soil microbial biomass did not differ significantly, but Legume+ rotation resulted in the greatest carbon mineralization and β-glucosidase and arylamidase activities, modified microbial populations and induced differences in the catabolic capability of soil microbial communities, modified the surrounding habitat of microbial communities by providing available carbon and nitrogen as well as suitable soil pH.

They mentioned the presence of numerous studies on innovative practices that had emerged to reduce the impact of agriculture on climate and environment changes with a focus of scientists on the way crop rotation can be designed to contribute to weed control and decrease in diseases and pest attacks, selection of plant spp. in rotation also for increasing the soil water holding capacity by reducing soil erosion, contribution to the amount and quality of organic matter entering the soil. They added that according to the spp. selected, the mineralization of residues could release important quantity of nutrients maintaining soil fertility. Such benefits of biodiversity can be obtained by using agroforestry systems by selection of Mimosoidae trees

and shrubs, which are very well known to include numerous native desert spp. (Panwar, Tak and Gehlot, 2014)

4. AGROFORESTRY AND WATER ECONOMY

Malik, Oroan, Kumar et al. (2019) described the functions of trees in agroforestry systems as fertilizer trees for land regeneration, soil health and food security; fruit trees for nutrition; fodder trees for livestock; timber and energy trees for shelter and fuel wood; medicinal trees to cure diseases and trees for minor products viz. gums, resins or latex products, and added that many of these trees were multipurpose ones, providing a range of benefits. They presented the area of estimated total green cover in the agroforestry system of India as 111,554 km², 3.39 % of geographical area, which would be doubled and supported according to The National Agroforestry Policy announced in 2014, in order to reduce poverty in rural India, where the gap of demand and supply of forest products was widening and forests were unable to fulfill the demand. Agroforestry was also expected to play an important role in filling this gap and conservation of natural resources including water, and also offer a considerable contribution to food supply.

They reminded that agriculture was the largest single user of fresh water, accounting for 75% of current human water use, and 7% of the world's population were living in areas where water was scarce, and predictions were indicating a rise to a staggering 67% of the population by 2050, while arable land would also be declined by erosion, desertification and other developments. Their conclusion was the future increases in production would have to come from higher productivitysupported by higher water use efficiency. They added that irrigated and rainfed agriculture was using only 10–30% of the available water for plant growth, and in arid and semi-arid areas it was only 5% or so in rainfed crops. This picture could be improved by using the potential of higher water use efficiency of agroforestry, if the very low level of awareness regarding the water management in agroforestry systems. There was, therefore, great potential for improving water use efficiency in agroforestry, particularly, in those areas where the need was greatest in this world's first country adopted a comprehensive agroforestry policy.

Gomes, L.C., Bianchi F.J.J.A., Cardoso I.M., et al. (2020) also considered the severe impacts of global warming and analyzed the effect of projected changes in 2050 on the major coffee production area of Brasil. One of the intended areas of the study was the potential of agroforestry systems to mitigate the projected effects in the region, by comparing the results calculated for unshaded plantations and in agroforestry systems. The climate models they used included the changes in substantial increases in the temperature and changes in precipitation regimes indicated that the annual mean air temperature is expected to increase 1.7 °C±0.3 and considerable decrease of precipitation in the study region, which would lead to almost 60 % reduction in coffee production in unshaded plantations by 2050. 50 % shade cover by the trees of the agroforestry systems could still maintain 75 % of the area suitable for coffee production in 2050, by reducing the mean temperatures and nature conservation.

Hatfield and Dold (2019) reviewed the literature on the definition of water-use efficiency (WUE) and the related advances and challenges with it in the global warming era; they also included agroforestry practices in their brilliant article. They tried to find an answer to the question, if WUE was defined as the amount of carbon assimilated as biomass or grain produced per unit of water used by the crop, how plants would respond to changes in environmental factors affecting their WUE at stress levels, as the response was directly related to the physiological processes controlling the gradients of CO_2 and water in the leaf. There a variety of methods available to screen genetic material for enhanced WUE under scenarios of climate change. At canopy level the dynamics of crop water use and biomass accumulation should be related to soil water retention and evaporation rate, transpiration from the leaves, and the growth pattern of the crop. They added that enhancing WUE at that level could be achieved practices increasing soil moisture retention reducing the soil water evaporation, and diverting more water into transpiration by crop residue management, mulching, row spacing, and irrigation, in addition to crop selection. As well known and summarized by them selection of annuals and herbacious perennials depend on the factors such as their photosynthesis type, phenological properties, leaf morphology, root system, growth season, volatile chemicals emissions etc., with the exception of photosynthesis types, same criteria can be used for the woody perennials. They also mentioned that, each plant species had a unique arrangement of a set of single leaves and arrangement of canopies affecting the exposure of their leaves to solar radiation, so photosynthesis and dry matter production of annuals were varying wıthin the growing season, while such changes throughout the growing season were not that large at the canopy of woody spp. Although there was a direct relationship to WUE and increasing CO_2 increase at leaf scale, the direct relationships between WUE and changes in climate parameters were less obvious and often not detectable, thus quantification of the accumulation of dry matter and water used by the in growth season was needed. They referred to several articles presenting the methods used for this purpose.

On the expected increase in CO_2 over the remainder of this century, they stated that the effect would be a decrease in transpiration which would have a positive impact on plant water use efficiency. Increasing temperature, on the other hand, would stimulate the rate of growth and, especially reproductive development and water use, the net result would be shortened period of vegetative growth, smaller leaf area and reduction of the seasonal water use. A shift toward crops with a longer growing season or perennial crops would increase the seasonal crop water use because of the longer leaf area duration. After summarizing the results of previous experiments obtained on different crops by other researchers, they concluded that increasing CO_2 at moderate temperatures increased WUE; however, the positive effect diminished with the temperature increases above the optimum temperature for the species. There were offsetting effects between canopy temperature increase stimulated by increasing air temperature and larger leaf area, which kept the changes in evapotranspiration (ET) small. Referring to a study taking the feedbacks between transpiration and leaf temperature under changing CO_2 for a soybean growth model, they presented ET data showing seasonal decrease under irrigated and rainfed conditions. They added that simulated WUE showed an increase, which was attributed to prolonged use of soil water in the rainfed environments. They concluded that there was a need to understand the interactions of soil water, CO_2, and temperature during the growing season in order to develop more effective management strategies to cope with the changing climate.

Another important topic covered by Hatfield and Dold (2019) was the effect of the changes in solar radiation, 'solar dimming', caused by particles and aerosols accumulated in the atmosphere, which was often overlooked, but affecting the photosynthetically active radiation, (PAR) and consequently gross photosynthetic production (GPP), which is a function of the PAR absorbed by the canopy (APAR) and the capacity of utilization of the photosynthetic products. Low frequency (day-to-day) variation in GPP is associated with crop phenological stage and physiological status. They presented literature showing that changes in the solar radiation regime would affect photosynthesis and GPP, WUE, and found that both radiation use efficiency (RUE) and WUE decreased linearly with increasing direct PAR; in another study it was observed that observed that the fluctuating light would increase productivity, because of photoprotection mechanisms, C_4 plants were more sensitive than C_3 plants to fluctuating light conditions. In another study referred, it was showed that changes in canopy architecture would have positive effects on the overall productivity of crops. They concluded that changes in the radiation would increase RUE and WUE because of the more uniform radiation supplied be scattered light on the maize canopy, and . such changes in the solar radiation under climate change needed to be included in evaluations of the effects of temperature and precipitation.

5.EFFECTS OF CROPPING SYSTEM ON WUE

As it was mentioned in above sections, Hatfield and Dold (2019) also interested in and studied on the complex relation between crops, their phenology, physiology, cropping systems and climate, and global warming. They referred to the studies on potato, showing that WUE increased by increasing ambient temperature up to 1.5°C above normal and then began to decrease, it also decreased linearly by increasing annual precipitation over 310 mm. The explanation was the increase in respiration, which was observed and reported before for coniferous trees, thus respiraton rate should be measured and its changes should be included in the future studies on WUE and productivity. They added that impacts of climate change on productivity could be extended beyond the direct impacts on photosynthesis and water use by canopies to the impacts related to changes in cultural practices affecting the respond of canopies to climate variation. They referred to several previous studies on the effects of different practices on WUE, such as seasonal ambient temperature, precipitation, baseline soil fertility, and fertilizer management. Presented results of some previously reported studies on mulching evidented increased WUE and yield considerably by decreasing soil water evaporation especially in semi-arid regions, mulching and micro-dosing of NPK fertilizer increased WUE in low-input agriculture in a semi-arid climate. They also referred to studies on tall fescue and alfalfa, which showed that limiting nitrogen nutrition had a negative effect on WUE by decreasing transpiration/evaporation ratio, and supported the conclusion reached by the authors of the study, interactions between nitrogen status and water deficits should be investigated to improve WUE.

Although irrigation had been considered as the most effective solution to solve the water scarcity and deficit problems, Hatfield and Dold (2019) attracted attention to the fact that, the impact on WUE could be substantial, if the production increase compared to the amount of water used by the crop . They referred to a previous report presenting the results of a meta-analysis on 49 experiments of irrigated wheat and cotton throughout China under furrow and micro-irrigation systems, to determine the optimum water use level to achieve maximum

WUE. They said that, water use by wheat could be reduced by 30% at the cost of grain yield loss of 15%; however, in cotton 51% drop in water consumption was caused a 52% yield reduction. Micro-irrigation reduced wheat water use by 23% and increased yield by 37%, but in cotton water use dropped 37% and yield was 21% less. Micro-irrigation reduced evaporation early in the season and limited almost all the evaporation from the surfaces of the leaves and increased WUE, as expected.

Another factor should be manipulation of row spacing which would affect evaporation/transpiration ratio, narrow rows would decrease evaporation and increase WUE, but the previously reported experimental study on maize increased WUE only 17% if nitrogen nutrition and water were limited. The conclusion was an increase in WUE in water limited, variable rainfall conditions. In another previous study simulation models used and reduction of row width was recommended as an effective strategy in rainfed production, especially for the regions where soil water evaporation loss were high, in areas with clay soils with frequent rain events and low atmospheric demand.

Another adaptive strategy to increase WUE, diversifying the crop rotation to increase the resilience of the overall cropping system was also reviewed by Hatfield and Dold (2019). The referred studies compared different rotations to determine if adding them would increase WUE and crop production than the monocultures, and rainfall variation among growing seasons was found to be the main determinate of water use and WUE. The conclusion was that intercropping system would offer advantages for more efficient water use in water-limited environments, as mentioned above for agroforestry systems.

Finally Hatfield and Dold (2019) referred to some articles on the increase of WUE levels over time by releasing new hybrids offering higher WUE at various soil water contents on the basis of product quantity, reflecting higher assimilation rates under temperature and water-deficit stress.

6.CONCLUSION

Climate is a complex phenomenon, soil has a complex structure and texture, soil biota also comprises an enormous diversity of organisms, any changes in their delicate equilibria are also reflected to flora and fauna, consequent changes in flora and fauna lead to dramatic changes in the other components of the ecosystems. Solving the concurrent problems considering the future ones desperately need integral approaches by interdisciplinary groups of specialists. It is well known that biodiversity and physiodiversity, functional diversity boost ecosystem stability, productivity, where each species, has an important role to play, a larger number of plant species increase the resilience, sustainability of the ecosystem. Healthy ecosystems can better withstand and recover from a variety of disasters. All of the specialists need to appreciate the value of interdisciplinary approaches to the environmental problems, people and decision makers have to be convinced that Einstein was right in saying "We cannot solve our problems with the same thinking we used when we created them", they must see that climate change and other environmental problems cannot be solved by the same paradigm.

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