Iran Chamber of Commerce, Mine, Industries and Agriculture
Water, Environment and Green Economy Commission

Climate Change and its Impacts on Business Environment

Background of International Climate Change Negotiation

Since the beginning of the industrial revolution, industries and factories have been developed remarkably. Consequently, it leads to the dominant increase in the consumption of fossil fuels, the amount of forest degradation and the area of land use change throughout the world. On the other hand, these elements also lead to a significant increase in the volume of Green House Gasses (GHGs). For example, specifically, the concentration of CO_2 has increased rapidly from 280 ppm in 1750 up to 408 ppm in February 2018 (NOAA ESRL, 2018)

Finally, because of increase in CO_2 concentration, the average temperature of the Erath has increased by 1.3 degrees Celsius (C˚) in 2016 relative to the second half of 19th century (1850-1899). Conducted research show that if the average temperature of the Earth increases to over 2 degrees (C˚) in the future relative to the 19th century, the frequency, and intensity of natural disaster will increase; so scientists try to find solutions to steady temperature rise in about 1.5 degrees (C˚). GHGs emission increase leads to not only temperature rise but also climate variable fluctuations in the earth system (IPCC, 2017)

In 1990, to prevent the adverse effects of climate change and reduce greenhouse gas emissions, the General Assembly of the United Nations formed the Intergovernmental Negotiating

Committee (INC) to formulate the United Nation Convention on Climate Change (UNFCCC). The draft Convention on Climate Change was adopted in 1992 at the United Nations Headquarters in New York. The convention was prepared at the Earth Summit in June 1992 in Rio de Janeiro, Brazil, for signing members. The convention was signed by 154 countries during the Rio meeting and came into force on March 21, 1994. By mid-1999, more than 175 UN member states had ratified or accepted it. Iran also became a party to the convention in 1996 after the ratification of the government and the Iran Islamic parliament.

In 1997, the UNFCC member states approved the Kyoto Protocol. The Kyoto Protocol legally forces developed countries to reduce greenhouse gas emissions. The first protocol commitment period began in 2008 and ended in 2012. The second commitment period commenced on January 1, 2013, and will end by 2020. At present, there are 192 Kyoto Protocol countries.

The Paris agreement, adopted on December 12, 2015, in Paris, and is the latest step in the evolution of the United Nations climate change regime. The Paris Agreement is a new era in the global effort to tackle climate change. The Paris agreement is intended to accelerate and intensify the actions and investment required for a sustainable carbon in the future. Its main objective is to strengthen the global response to the threat of climate change by maintaining global temperatures in this century below 2 degrees Celsius compared to pre-industrial levels and continuing efforts to limit the temperature rise to 1.5 degrees Celsius. The agreement also aims to strengthen countries' ability to deal with the effects of climate change.

The latest efforts to reduce greenhouse gas emissions were held in 2017 in Bonn (Germany). The conference included the 23rd Conference of COP (COP23), the Thirteenth Summit Meeting for the Kyoto Protocol (CMP13) and the second meeting of the Parties for the Paris Agreement (CMA2). The purpose of the conference was to discuss and implement anti-climate change plans

and details of how Paris agreed after 2020. Although the COP23 focused mainly on the technical provisions of the Paris Agreement, it was the first conference after Donald Trump's announcement to withdraw from the agreement (UNFCCC, 2018)

Concepts of Climate Change (Dr. Massah-Bovani)

The atmosphere, Cryosphere, Biosphere, and Hydrosphere are the main elements of the global climate system. There are different gases in the atmosphere which attracts, diffuses and reflects various wavelengths of solar radiation, and they also control various phenomena such as atmospheric temperature (IPCC, 2013).

The most important atmosphere gasses are GHGs such as water vapor, CO_2, CH_4, N_2O and CFCs which control the global temperature. This is because when the short wavelength of solar radiations is reflected by earth surface, they change to long wavelength radiations which can be absorbed by those GHGs in the top layers of the atmosphere. Therefore, this phenomenon leads to an increase in surface temperature called greenhouse effect.

Different factors disrupt the components' conditions of the global climate system, which can affect other components. These factors can be divided into two parts including internal factors, which are due to interactions between the elements of the climate system, and natural external factors, which are due to solar radiation, volcanic activity and abnormal increase in greenhouse gases (Fig. 1).

Changes in the climate system of the Earth, which are the result of interactions between the components of the climate system is called internal climate variability, such as El-Nino phenomenon. On the other hand, solar radiation and sometimes volcanic activity are two external and natural factors which affect the global climate system. The sun is the most important external

source of ground heating. Sunlight sometimes is affected by many suspended particles enter the atmosphere after volcanic activity. They prevent sunlight from reaching the lower atmospheric levels, and it causes a temporary reduction in temperature in particular area. These changes which are due to external natural factors and the changes caused by the internal fluctuations of the system are called Natural Climate Variability.

Among the factors mentioned above, the only factor that has an abnormal effect on the climate system of the Earth is the increase in GHGs. After the industrial revolution in the mid of 18th century, investigation of the status of GHGs emission shows that the proportion of the GHGs volume has changed obviously as a result of extreme industries development and the increase of fossil fuels consumption, and especially the amount of CO_2 has increased. This increase causes the infrared waves emitted from the earth to be absorbed more by GHGs, and it also causes the globe's atmosphere to warm up. The warming of the Earth also affects the status of other components of the climate system and causes a well-known phenomenon called climate change (IPCC, 2013).

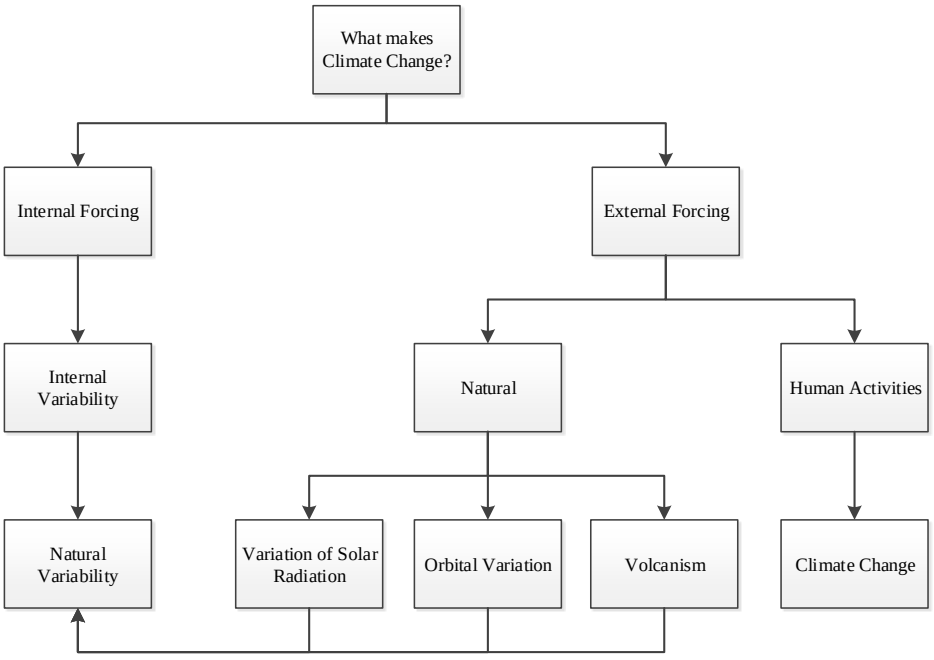


Figure 1- Interconnection between climate change and climate variability

Impacts of Climate Change on Iran (Climate and Agriculture Sectors) (Dr. Naseri)

During the past decades, different signs of climate change and climate variabilities have been detected in Iran. Several studies about detecting changes in different climatic variables of temperature and precipitation variables have been carrying out in Iran including maximum and minimum temperature, precipitation, and 27 extreme variables of temperature and precipitation including warm nights (TN90p), cold nights (TX90p), hot days (TN10p), cold days (TX10p), consecutive dry days, and so on. According to these results (Fig. 2), the trend of maximum temperature is 0.03^{o}C /decade, while minimum temperature trend is 0.06^{o}C /decade which is double of the maximum temperature trend during 1975-2010 period (Soltani et al., 2016).

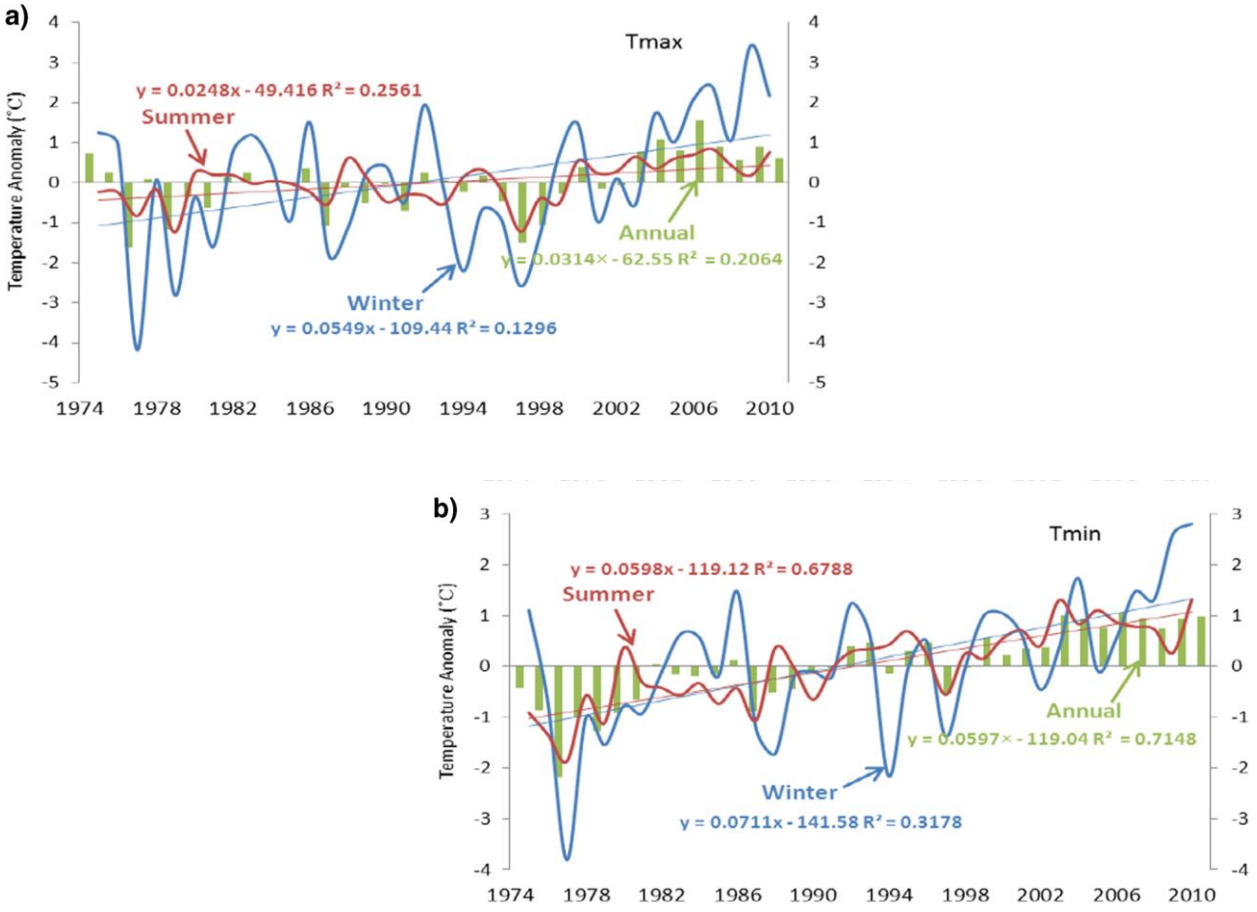


Figure2- The extreme variables of temperature and precipitation, Soltani et al., (2016)

Also, the trends of change in maximum and minimum temperature in winter are more than those in summer. In another word, the trends related to maximum and minimum temperature in winter are 0.05 and 0.07 ^{o}C/decade and those of summer are 0.02 and 0.06 ^{o}C / decade, respectively. Minimum temperature trend being double of maximum temperature trend has been proven in other studies. Based on these studies, in most of Iran's area, the trend related to warm nights (over 90% of the stations) and warm days in the period of 1975- 2010 has been increasing, while the increasing trend of warm nights is more than that of warm days. In contrast, the opposite way is observed for cold nights and days in Iran (Third National Climate Change Communication, 2017).

The projections of precipitation in 2016-2030 show that in contrast with temperature, precipitation does not hold a regular change during the seasons through the country. In other words, AOGCM models simulate a variety of differences for one region under the same climate change scenario. It means that changes of precipitation in a region fluctuate between increase and decrease for the period of 2016-2030 in comparison with the baseline period (1982-2009).

It proves lack of certainty in precipitation projection during the upcoming years. To guess precipitation differences for upcoming years, the mean scenarios' results obtained from the different model projections were studied. Spring precipitation in upcoming years decreases in comparison with baseline period in some western, northwestern (decrease about %10), southern (decrease about %30) and central parts of Iran, and there is no specific patterns on the other areas. Eastern parts also have about %10 increase in precipitation (Fig.3). Summer precipitation relatively does not fluctuate through Iran except southeastern and western parts which increase regarding quantity, in addition a drought line from North to South has been detected (Fig. 4). Due to having the least precipitation in summer and insignificant season's precipitation, it will

not affect in annual precipitation in Iran (Fig. 4). Autumn precipitation in the east and northeastern parts and also west and southwestern parts of Iran decrease about %20 (Fig. 5). While southeastern and northwestern parts will not have fluctuation, or if they have some, it will be about %10 increase in precipitation. Also, winter precipitation in east, northwest and southwest parts of the country will be faced with a %20 decrease (Fig.6). While, the other part changes in precipitation, will be depressed (Third National Climate Change Communication, 2017)

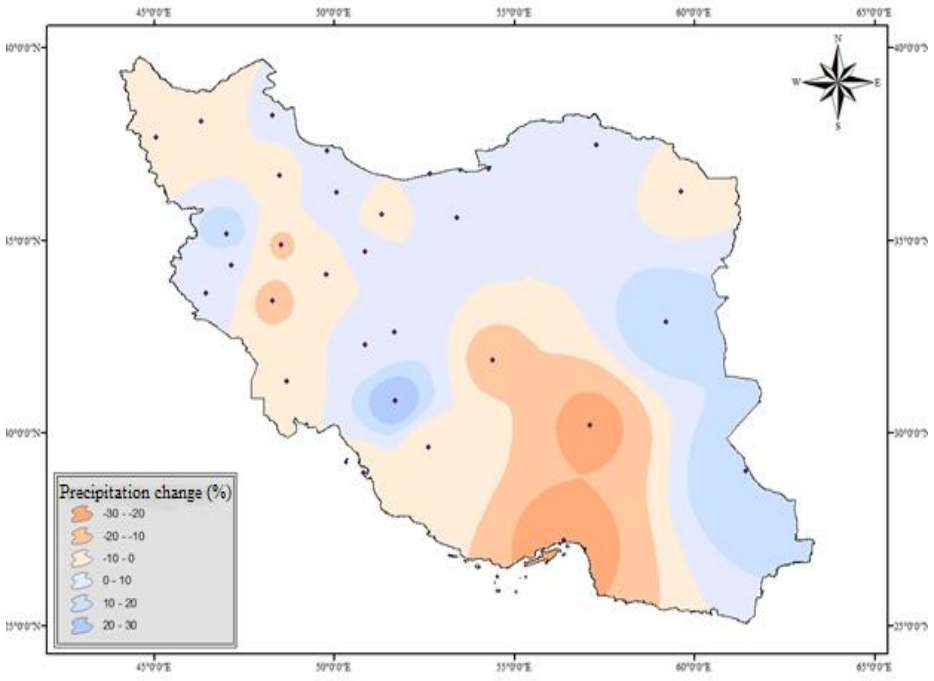


Figure3- Spring Precipitation Change in Iran in 2016-2030 Comparison to 1982-2009

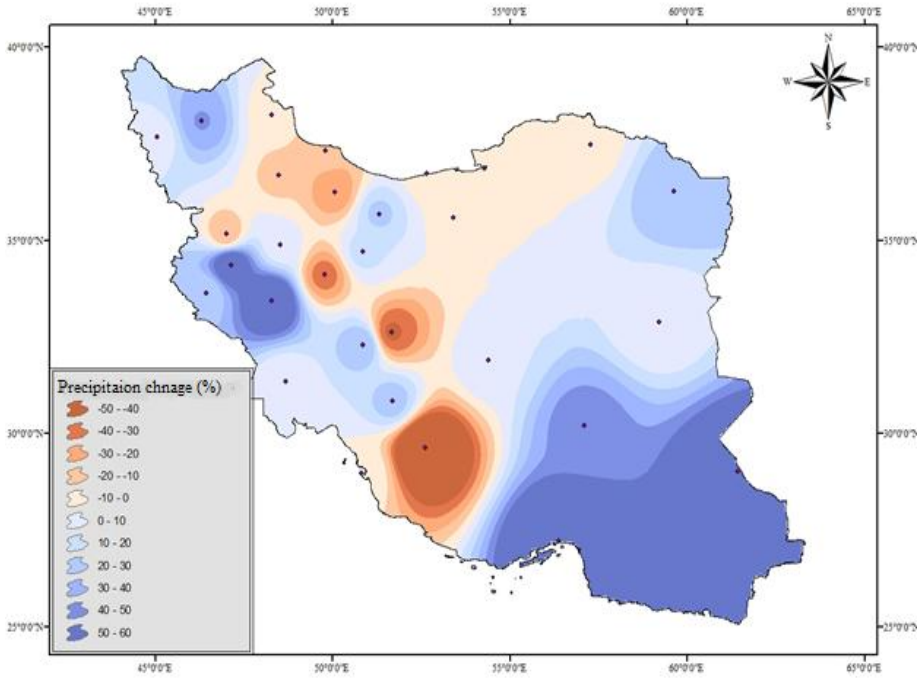


Figure 4-Summer Precipitation Change in Iran in 2016-2030 Comparison to 1982-2009

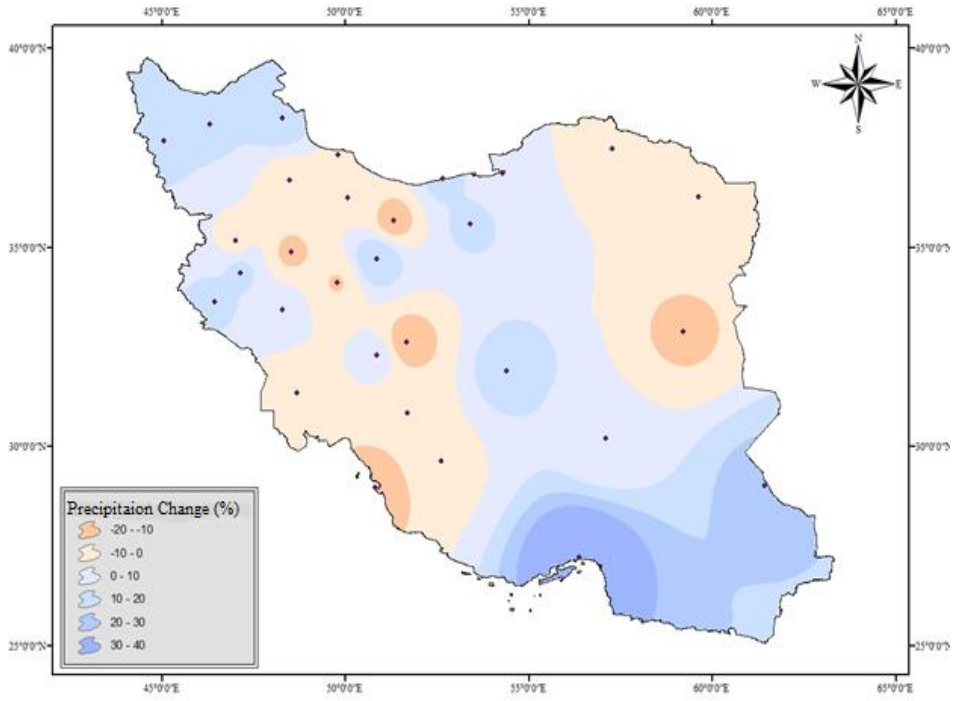


Figure 5- Autumn Precipitation Change in Iran in 2016-2030 Comparison to 1982-2009

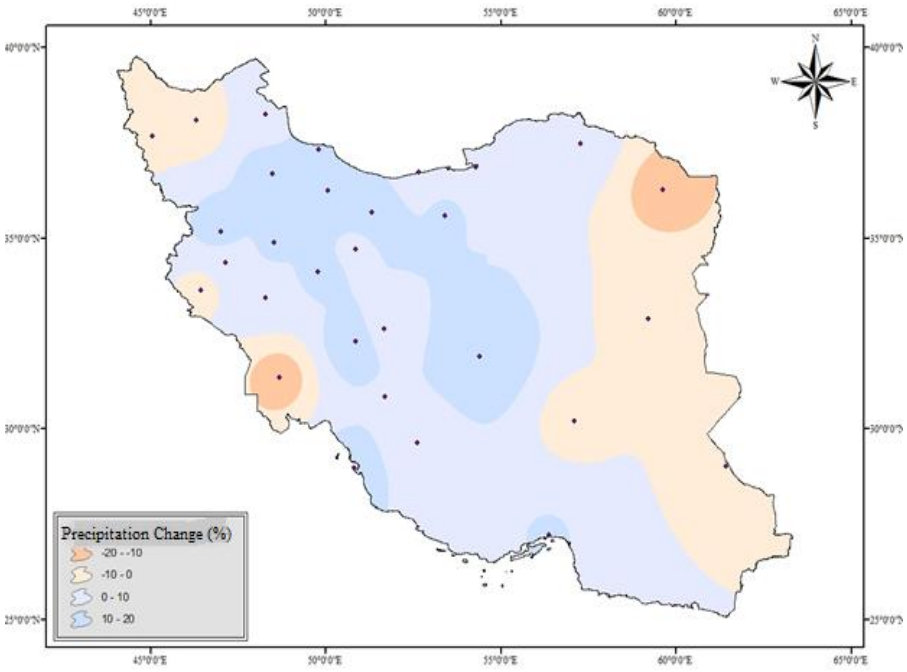


Figure 6- Winter Precipitation Change in Iran in 2016-2030 Comparison to 1982-2009

Based on the mentioned Iran's climatic pattern, changing in seasonal behavior obviously has been occurred. Also, changes in extreme events (warm or cold weather and even flood occurrence) are also important point must be studied and their pattern should be recognized (Third National Climate Change Communication, 2017)

To estimate the broader economic impacts of the direct effects of the climate change in Iran's agriculture sector, the Input-Output framework has been used. Backward and forward linkages[1] of 52 economic activities based on the demand-driven model of Leontief and supply driven or Ghosh model were calculated. The coefficients of backward linkages of Iranian crops and livestock sub-sector are 1.797 and 2.235, and their forward linkages coefficients are equal to 1.719 and 1.482, respectively. Base on the results, the total economic damage of climate change on Iran's economy in pessimistic and median scenarios is estimated equal to 52997.5 and

[1] Backward linkages for given sector determine the amount of its demand for the use of other sectors outputs as inputs and indicate how much other sectors benefit from the investment in that sector. Forward linkages, in turn, show the number of products supply of a given sector for use in other sectors and is a criterion for measuring requirement of another sector to the output of a specific sector.

19747.5 billion Rials per year, respectively. In contrast, the total direct and indirect effects of optimistic climate scenario which anticipated 23.4% increase in rainfall, is estimated about 42351.5 billion Rials increase in the gross domestic product of all economic sectors. The proportion of consumers from total damage (benefits) of climate change in scenarios varied between 55 to 86 percent in the pessimistic and optimistic scenario, respectively. The proportion of crop and livestock producers from these losses (benefits) changes from 16.9 to 9 percent and for other sectors of the economy (indirect effects) varies from 13.6 to 24.5 percent. Also, the raw cost of climate change in agriculture sector based on the worst climate change scenario will be approximately equal to 12000 billion Rials per year. (Third National Climate Change Communication, 2017).

Impacts of Climate Change on Iran (Water Resources Sector) (Dr. Zahraei)

Climate change has significantly impacted water resources of many basins around the world, so the basins in Iran are not exceptions. Even though in many basins in Iran, total annual precipitation has not significantly changed due to climate change, the precipitation regime has changed considerably in the past two decades. The share of light rains (below 10 mm) in total annual rainfall pattern has increased. Increasing share of the light rains as well as the increased temperature has resulted in high evaporation losses and reduction in the amount of soil moisture, surface runoff generation, and groundwater recharge. The published reports by the Ministry of Energy, I. R. Iran, show that the climate change has caused the snow line to shift upward about 200 meters and share of snow in the total precipitation over the country has reduced significantly. Ministry of Energy also reported %20 reduction in surface runoffs generated in the country during these decades

When assessing runoff reductions, it is important to differentiate between direct and indirect human impacts on water cycle in basins. Direct human interventions include all activities that directly influence water cycle elements. Example of such interventions includes building dams, change in land use, groundwater overdraft, etc. Indirect human impacts include all effects of global warming on the water cycle. To differentiate between these two sets of interventions and their impacts on water resources, different methodologies introduced in the literature (e.g. Sankarasubramanian et al., 2001, Tang et al., 2011), can be used. Results of case studies of applying such methodologies to Karkheh and Karun basins in the southwest of Iran have shown high impacts of direct human interventions after the mid-90s which is the time in which change of surface runoff regime has happened in most basins in Iran (Fig. 7). In some of the basins such as Karkheh River basin, which is among the basins in the country with very high impacts of direct human interventions, %25 up to %30 of surface runoff reductions experienced in the past the two decades has been associated with climate change. In other basins in the southwest of Iran, the share of climate change in reduction of surface runoffs has been between 25 to 50%.

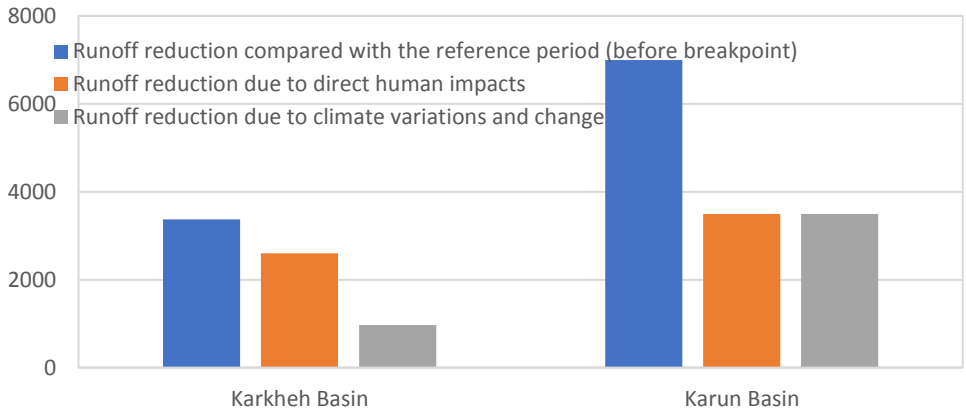


Figure 7- Shares of Direct Human Impacts and Climate Variations and Change in Runoff Reduction (MCM/year)

In these basins, projections of precipitation, temperature, and evaporation based on various GHGs emission scenarios, show that even though some of the basins in the southwest of Iran such as Karkheh basin are going to generate further runoffs compared to observations in the past two decades, but long-term 45 average runoffs will not be observed. This is mainly due to significant anthropogenic changes in hydrologic cycles of these basins.

Projections published by the Department of Environment (DOE), as part of the studies carried out for National Communication to UNFCC have shown that in pessimistic scenarios of climate change impacts on water resources in Iran, most provinces, will not experience surface runoff reductions more than %20. However, human interventions will continue to negatively impact surface and groundwater resources of the highly populated basins in the country (Third National Climate Change Communication, 2017).

Quantifying shares of indirect and direct human impacts of climate change in all basins in the country is a prerequisite for designing climate change adaptation strategies, otherwise misguided strategies will be designed which may attribute most of the surface runoff reductions and groundwater depletion to climate change.

Impacts of Climate Change on Iran (Business and Economic Sectors) (Dr. Maknoon)

1) Human and nature relation could be explained in three significant historical periods:

A-about 10000 years ago till the Industrial revolution: mostly adopting wild plants and animals by the humans (wheat, rice and corn, sheep, pork, and cow).

B-Industrial revolution till about half a century ago (development based on materials and energy)

C-1972 till now: Starting the paradigm shift toward environmental protection attitudes (Sustainable Development: replacing Millennium Development Goals (MDG) with Sustainable Development Goals-SDG)

2) During the second historical period (Industrial revolution in Great Britain), there has been significant changes and damages to the Iran Environment such as Increase in Energy intensity, ecosystems and lake drought such as Uremia lake, dust and haze in major provinces and air Pollution in megacities in Iran.

3) Climate Change predictions present important changes in Iran weather conditions, including less precipitation and warmer temperature.

4) The future Roadmap for Iran Sustainable Development model should consider the resource extraction model (materials footprint), The Production and consumption model (green economy approach) and the waste management model (reduce, reuse and recycle approach).

5) Regarding the climate Change convention and the world commitments, Iran is also committed to reducing the greenhouse gas emissions. The current suggestions in Iran show the methods, the efficiencies and the expenses for each suggestion.

6) The top economic countries in the year 2050, according to the Economist journals are China, USA, India, and Indonesia which has started the new approaches for their developments regarding the Convention. These approaches will influence the future of Iran business especially China and India.

7) The silk roads suggested by China and also the India-Iran cooperation in Chahbahar port (in Oman sea) for north-south transit line in Iran may play an important role for Iran future transit plan in the Mediterranean area.

8) Few items such as energy Intensity, low carbon energy production, virtual water trade, water-energy Nexus, are among the areas for consideration in Iran business and industries.

Adapting Investment to Climate Change (Dr. Madani)

At present, these crises have grown globally, and it seems that there is no way but to prevent the severity of these changes for humanity. The four channels of risk and opportunities are:

1- Physical: More frequently weather events

2- Technological: Advances in batteries, electric vehicles or energy efficiency, etc.

3- Regulatory: Subsidies, taxes, and energy efficiency rules, etc.

4- Social: Changing consumer and corporate preferences.

Investment in mitigation

- Transition to renewable energy sources (Fig. 8): New investment in renewable energy by region (2004-2015)

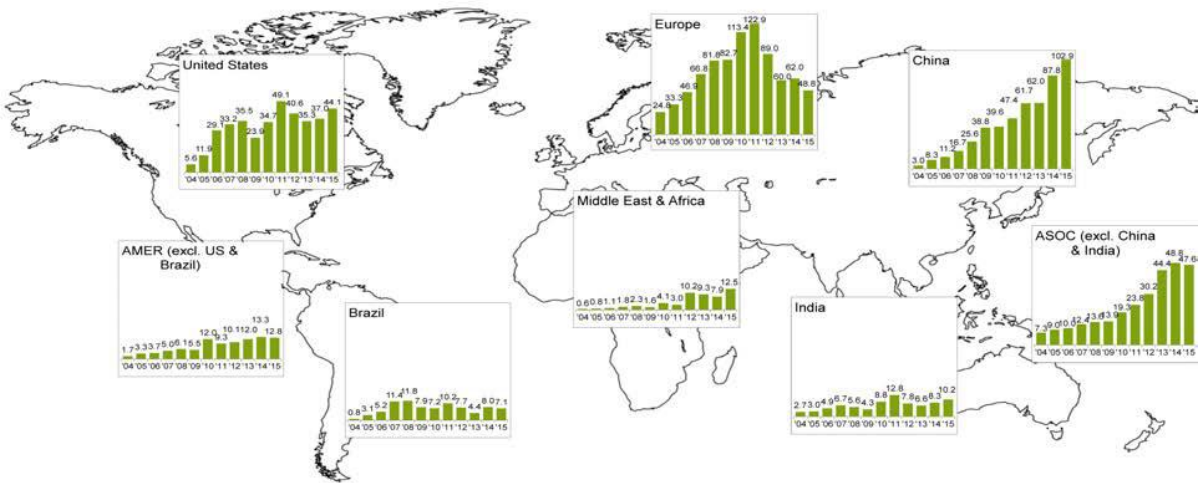


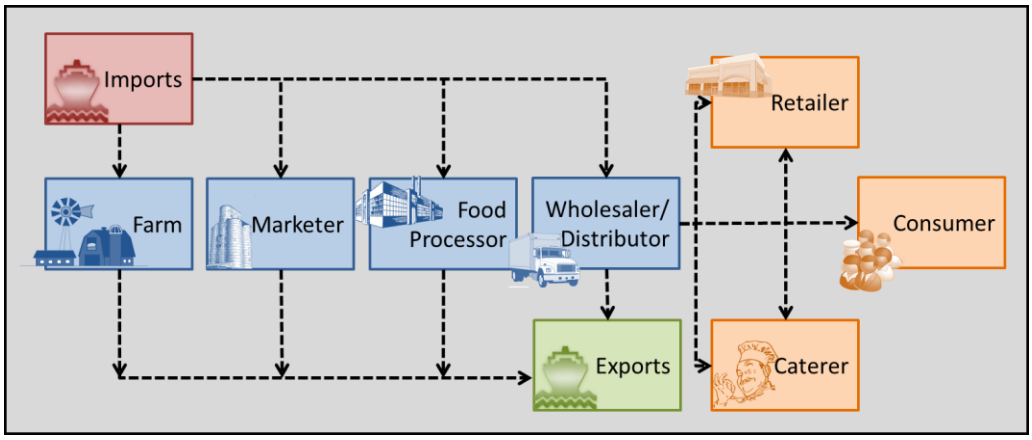
Figure 8- New investment in renewable energy by region (2004-2015), Source: UNEP, Bloomberg

- Energy efficiency improvements

Investment in adaptation

- New investments in water and agriculture: Now changing and modifying the pattern of agricultural production towards low water demand products, reforming the pattern of water consumption in different sectors especially agriculture, modifying the pattern of food consumption and agricultural products towards sustainable consumption and decreasing food losses and waste,


- Understanding and securing the whole supply chain



- Building insurance contracts to equitably distribute weather and climate risks across the supply chain

There is not a choice but an inevitable necessity in dealing with and managing the consequences and damages of climate change in countries.

Countries are moving towards using renewable energy, optimizing and modifying energy consumption patterns, reducing fossil fuel consumption, reforming the construction model, transporting and intelligent public services and adapting development programs in order to cope with the effects of climate change which indicate a major development in the future of industry and trade with a sustainable development approach.

Iran has adjusted its strategies based on national interests and line with the global agenda which maximizes its potential in wind and solar renewable energy sources and by changing the existing approaches in transportation, recycling and water reuse, waste management, increasing productivity and moving towards a green economy and green productivity to reduce emissions.

References

Iran's Third National Climate Change Communication to UNFCCC, 2017.

IPCC (2013) Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

IPCC (2017) Sixth Assessment Report cycle, http://www.ipcc.ch/

NOAA ESRL (2018) Mauna Loa Observatory, Hawaii: https://www.co2.earth/

Sankarasubramanian, A., R. M. Vogel, J. F. Limbrunner (2001), Climate Elasticity of Streamflow in the United States, Water Resources Research, 37 (6), 1771-1781.

Soltani, M., Laux, P., Kunstmann, H. et al. Theor Appl Climatol (2016) 126: 775. https://doi.org/10.1007/s00704-015-1609-5

UNFCCC (2018), COP23, https://cop23.unfccc.int/

Tang, L., Yang, D., HU, H. & Gao, B. (2011). Detecting the effect of land-use change on streamflow, sediment and nutrient losses by distributed hydrological simulation. Journal of Hydrology, 409, 172-182.