CLIMATE CHANGE: WHY SHOULD WE CARE?

Climate change is driven by human activities and affects our live and that of future generations. It is up to us to make a change for a liveable future on earth. In this article we will explain climate change from a LIFE OrgBalt project view. We will explain causes and consequences by answering the following questions: What is climate change, what are driving causes, which are the main related challenges and what can be done to tackle them?

In recent years important steps and actions have been taken on European level culminating in the launch of the European Green Deal at the end of 2019, in which the European Union commits itself to become climate neutral by 2050 - with greenhouse gas (GHG) emissions in balance with their sequestration. Progresses are already recorded with EU greenhouse gas emissions showing a reduction tendency [1]. But let's get into the topic to understand better what climate change is and how it affects the environment and our daily lives.

Long term changes in global temperatures have always occurred as natural cycles of cooler (ice age) and warmer (interglacial) periods. However, according to commonly agreed IPCC [2] findings, the accelerating increase in global temperatures recorded since the industrial revolution cannot be explained with the natural periodic cycles and is evidently induced and exacerbated by human activities.

When approaching the topic of climate change challenges and possible solutions we therefore refer to man-made (anthropogenic) climate change.

But what causes climate change?

The Earth's atmosphere contains certain gases such as carbon dioxide (CO2), methane (CH4), ozone (O3), nitrous oxide (N2O), chlorofluorocarbons (CFC-11, CFC-12), that function like glass panels of a greenhouse letting sunlight passing the atmosphere. Solar light is then transformed on the earth's surface into heat energy and reflected back into the atmosphere where it cannot pass the greenhouse gas "shield". This prevents heat from leaving, thus heating up the atmosphere – quite in the same principle as in a horticultural greenhouse. Therefore, the phenomenon is generally referred to as greenhouse effect which regulates the

temperature on our planet allowing life on Earth as we know it. Human activities however increase the concentration of greenhouse gases in the atmosphere, in particular of CO2, making the atmospheric greenhouse gas shield more “tight” (less permeable) for heat radiation and thus shifting the natural greenhouse effect balance and leading to a rapid global warming. Among the main factors responsible for the rapid increase of greenhouse gas emissions in the atmosphere are anthropogenic greenhouse gas emissions from utilisation of fossil carbon resources like oil, gas, coal, and peat. These fossil resources contain organic carbon that has been removed and sequestered from the atmospheric carbon cycle (by photosynthesis of plants) and is under natural conditions stored for Millennia to Millions of years. The removal and sequestration of atmospheric carbon in organic soils happens on ecosystem level. Be it the fern forest of the carboniferous or tropical, boreal and arctic peatlands of the Holocene these ecosystems share the same feature: Their biomass productivity is higher than the decomposition and due to conservation of dead plant material by permanent waterlogging, acidity, or frost microbial turnover and release of organic carbon back to the atmospheric carbon cycle is hampered and soil carbon stocks increase over time. These ecosystems on the long-term are the most space efficient terrestrial carbon stores on earth. Peatlands today cover of only 3% of the global land cover but they contain twice the organic carbon of all forest biomass on 30% of the global land cover. Thus, peatlands play a disproportional important role for global carbon balance. Since the start of the industrial revolution in the 2nd half of the 18th century release of fossil carbon has increased and dramatically accelerated in the last 100 years in all sectors of human activity: Industry, energy, transport, agriculture, land use, waste. Besides direct combustion an exploitation of fossil fuels land reclamation of peatlands by drainage for agriculture, forestry peat mining and infrastructure turned peatlands with their organic soils from carbon sinks into carbon sources.

Peatland drainage leads to oxidation and microbial turnover of the stored organic carbon and finally a release of fossil carbon as CO2. Thus, organic soils in peatlands can act as absorbers, reservoirs and emitters of greenhouse gases depending on land use. In particular pristine peatlands (mires) are typically carbon dioxide sinks acting as cooling ecosystems. Additional to conversion into CO2 sources by drainage, unsustainable land management practices as: Overuse (long lasting harvesting above increment); overgrazing; imbalanced intensive crop cultivation (incl. application of artificial fertilisers and pesticides) and use of heavy machineries, degrades peatlands and organic soils leading to subsidence and loss of organic soil carbon. The alarming raise of global temperature is human influenced and we are called to (re-)act and join forces to tackle climate change mitigation and adaptation challenges now to ensure a fair and liveable future on this planet. According to the European Environment Agency “Global mean near surface temperature during the last decade (2010-2019) was 0.94 to 1.03 °C warmer than the pre-industrial level, which makes it the warmest decade on record. European land temperatures have increased even faster over the same period, by 1.7 to 1.9 °C. [3]"

What are the consequences of this human-driven climate change we are currently experiencing?

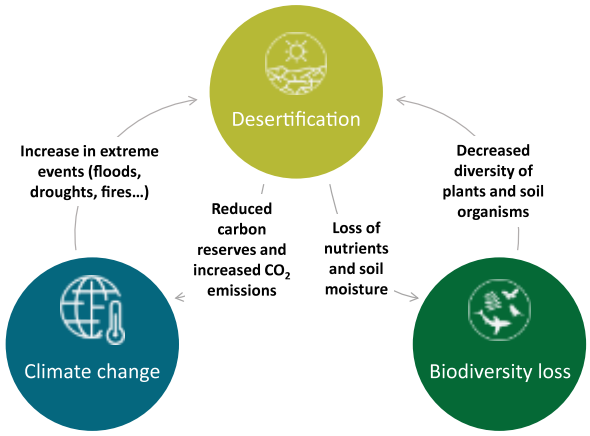
One of the main impacts of climate change is its multiple effects on water management with a clear impact on our health and the economy as well as on all freshwater dependent ecosystems. Temperature rise impact water-related cycles are making extreme weather and climate-related events more frequent and intense and are therefore leading to different kinds of risk. Climate change models show that the distribution of precipitation will be increasingly irregular and extreme. On one hand

the evaporation of water caused by high temperature together with the lack of precipitation increases the risks of severe droughts decreasing the ground water level and water level in rivers and lakes. Global warming threatens fresh water availability and quality, promoting salinisation, growth of toxic algae and bacteria. This affects agriculture and forestry by: Preventing the growth of trees and crops; increasing pest attacks and extent wildfires and diminishing water availability and habitat variety. Extreme droughts are becoming more common in Europe with increasing damages [4]. The rise in temperatures and droughts along with the lack of precipitation accelerates land degradation and loss of productive and fertile land and to increased vulnerability to desertification. Soil degradation in turn boosts climate change by increased GHG emissions, loss of moist and cooling landscape elements and accelerates desertification and loss of biodiversity (see Figure 1).

The projected increased numbers and intensification of storms, wildfires, land degradation and pest outbreaks are likely to make soil carbon stock vulnerable and to be partially lost into the atmosphere [5].

On the other hand, climate change is expected to increase the frequency of floods and heavy rainstorms, due to an increase in peak precipitation events. In the last three decades river flooding has become a common natural disaster in Europe which along with storms have affected millions of people causing accidents and large economic losses [6]. Changes in water related cycles also affect coastal areas, bringing to land loss by the rise of the sea water level. According to the European Commission's data an average 60-80 cm rise in the sea level in Europe is predicted by the end of the century, mainly depending on the rate at which the Antarctic ice sheet melts, and on seawater thermal expansion rates. Flooding and coastal erosion caused by the sea level rise will clearly have a significant impact on people and nature as well as on business. According to the European

Figure 1. Relationship between desertification, biodiversity loss and climate change



Source: ECA, based on World Resources Institute, Ecosystems and Human Well-being: Desertification Synthesis, 2005, p. 17.

Commission's data around a third of the EU's population lives within 50 km of the coast and these areas generate over 30% of the Union's total GDP [7].

Are we taking actions to tackle climate change?

With the Paris agreement, for the first time all world nations signed a binding agreement to combat climate change and adapt to its effects. Adopted by 196 Parties on 12nd December 2015 and entered into force on 4th November 2016, the agreement commits all United Nations Framework Convention on Climate Change member countries to limit the global temperature increase (global warming) to well below 2 °C (preferably 1,5 °C) above the pre-industrial level [8]. As highlighted by the European Environment Agency, without drastic cuts in global greenhouse gas emissions, the 2 °C limit will already be exceeded before 2050 [9]. To fulfil the commitments to the Paris agreement countries aim to achieve a climate neutral world with net-zero emissions by 2050. Europe plays a great role in this respect aiming to become the world's first climate-neutral continent with the European Green Deal a roadmap to make the EU's economy sustainable announced on December 11

2019. Along with this ambitious and outstanding goal Europe also aims to become a climate-resilient society able to not only reduce greenhouse gas emissions, but also to adapt to climate change impacts by mid-century [10].

How can carbon neutrality be achieved?

Human activities impact and alter natural global carbon cycles, the natural carbon balance on our planet between atmosphere and oceanic and terrestrial carbon stocks (deep sea floors, organic soils and living organisms). As explained above, since the industrial revolution humans have increasingly interfered with this cycle by burning fossil fuels and exploiting land which has resulted in the opening of those closed cycles and releasing emissions in the atmosphere. To achieve climate neutrality, society therefore needs to shift from an industrial competing model that exploits fossil and other natural resources to a carbon neutral and cooperative model which focuses on closed and sustainable carbon cycles in order to restore the carbon balance. Land plays an important role in this process. The LIFE OrgBalt project is contributing to climate change mitigation actions by trying to stimulate the needed transformation in the land use sector. This is realised by three work-packages: 1. Research for the improvement of greenhouse gas emission calculation and reporting for drained nutrient-rich organic soils; 2. Identification and demonstration of sustainable, resilient and cost-effective climate change mitigation measures applicable for nutrient-rich organic soils; 3. Development of tools and guidance for the elaboration, implementation, and verification of the results of climate change mitigation policies. And providing policy makers with an international scientific knowledge base.

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LIFE ORGBALT TEAM

[1] https://ec.europa.eu/clima/policies/eu-climate-action/law_en
[2] The Intergovernmental Panel on Climate Change (IPCC) https://www.ipcc.ch/
[3] https://www.eea.europa.eu/data-and-maps/indicators/global-and-european-temperature-10/assessment
[4] https://ec.europa.eu/clima/policies/adaptation/how_en
[5] https://op.europa.eu/webpub/eca/special-reports/desertification-33-2018/en/#A12
[6] https://ec.europa.eu/clima/policies/adaptation/how_en
[7] https://ec.europa.eu/clima/policies/adaptation/how_en
[8] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement
[9] https://www.eea.europa.eu/data-and-maps/indicators/global-and-european-temperature-10/assessment
[10] https://ec.europa.eu/clima/policies/eu-climate-action_en

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