



## How Could Plant Scientists Contribute to Tackling Climate Change?

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### I. The Climate Emergency

Humanity is facing an unprecedented challenge from climate change. The CO<sub>2</sub> concentration in the atmosphere has almost doubled from 280 ppm (pre-industrial) to 420 ppm within 150 years. As a consequence, the global average temperature has increased by 1.5°C. This anthropogenic climate change is associated with altered rainfall patterns, extreme weather events and less predictable weather patterns. This presents a major challenge to crop production and food security and thus threatens the foundations of human civilization.

### II. Agriculture as a Contributor to Climate Change

Agriculture is both a victim and perpetrator of global climate change as between 20-25% of GHGs are released through agricultural activities. Apart from CO<sub>2</sub>, significant amounts of methane and nitrous oxide are emitted from agriculture which represent more potent greenhouse gases than CO<sub>2</sub> (>30 and 300 times respectively). Methane is produced by irrigated rice agro-systems, livestock (via enteric fermentation and manure) and organic waste in landfills. Nitrous oxide emissions are an indirect product of organic and mineral nitrogen fertilizer use.

Given the central importance of food, a reduction of greenhouse-gas emissions from agriculture poses a major challenge and will require the implementation of a range of techniques, from capturing or reducing methane emissions at the source, more efficient use of fertilizers, and efficiency improvements in meat, dairy and cereal production.

### III. Challenges for Future Global Food Production

Growing global populations, shifting dietary patterns towards greater meat consumption, and increased food waste at both the consumer and supply chain levels, are major factors impacting global food systems. It is unclear how food production will increase by 70-100% to meet global demands in either a sustainable or equitable manner. Given the widespread degradation of terrestrial systems, there is no major surplus of arable lands on which to cultivate new crops. Likewise, any further conversion of forests into agricultural land via deforestation threatens biodiversity, contributes as a major source of CO<sub>2</sub> emissions, and further jeopardizes planetary health. To increase food production by current agricultural practices would require the use of more chemical fertilizers and pesticides, with major negative environmental, climate and human health related impacts. With the majority of land suitable for agriculture already in use, fertile agricultural

land is increasingly becoming the preserve of wealthy nations and/or industry, heightening economic disparities between the global North and South. Short term agronomic solutions include changing farming practices, such as rotating crops to match water availability and/or adjusting sowing dates to temperature and rainfall patterns. Plant scientists can also contribute by identifying microbes and plant traits for generating (in the medium to longer term) crop varieties showing increased heat- and drought-resistance, enhanced water-use efficiency and, in general, improved resilience to the changes in environmental conditions. In this context, PlantACT! will alert, engage and work on solutions to reduce agriculture-based GHG emissions and facilitate a more equitable and sustainable global food production system.

Tackling climate change requires the use of new cropping as well as the development of crop varieties thereby reducing the negative impacts of climate change on agricultural systems and ensuring stable yields. Diversification of agricultural production has positive effects on ecosystems and biodiversity and promises to enhance crop resilience to biotic and abiotic stresses but can also improve carbon sequestration and storage. Plant breeding can provide better climate change-adapted crop production systems. The development of new plant species and varieties involves the preservation of landraces and wild relatives of domesticated species.

#### **IV. Plants, Soil, and Microbes as Actors for Mitigation**

Besides a physical and chemical structure, soil is now recognized to host a diverse living community of soil organisms that are essential for crop production. Soil microorganisms form beneficial symbiotic help plants in nutrient uptake, control of diseases and also play a role in soil water holding capacity and can contribute to mitigating climate change by maintaining or increasing soil carbon content. Holistic approaches of the soil-plant-microbe ecosystem have to be considered in the future to achieve sustainable solutions. Besides agriculture, landscaping and land restoration of unused land could also provide novel solutions to climate change. PlantACT! supports the idea that soil restoration could play a key role in improving agriculture and carbon capture as well as long term carbon sequestration.

#### **V. Conclusions**

Given the complexity of the effects of climate change at all levels of planetary life, current thinking has to be readjusted both at the institutional, funding, as well as subject levels to enable multidisciplinary scientific approaches. New forms of interdisciplinary conferences and communication need to be established. Information access to farmers, scientists and decision makers via open access platforms is needed to find and evaluate different approaches and solutions. Solutions have to be fact-checked not only in terms of global carbon but also in terms of social and societal impact. The time constraints for proposed solutions have to be considered and weighed against immediate solutions. Overall, no solution for all will be possible and solutions will need to be shaped and targeted differently to reflect geographical and local needs and contexts. Overall, if we want to preserve a livable planet, we have to leave our well-trodden disciplinary paths and search for novel interdisciplinary solutions and approaches. PlantACT! aims to urgently accelerate these new interdisciplinary interactions and solutions by stimulating new forms of working and funding.