

Sustainable technologies: the promising role in combating the effects of climate change and environmental degradation

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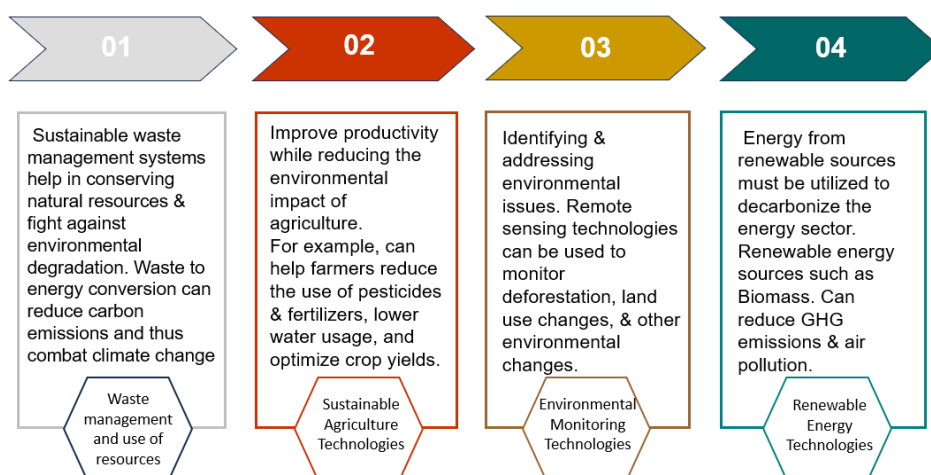
Thematic Area: Environmental monitoring, Environmental chemistry & renewable energy

Abstract

The triple global crisis that humanity is currently facing: climate change, nature loss and pollution and waste, require addressing these environmental challenges and finding solutions on a global scale. As humanity suffers from the practical consequences of climate change on a global scale, the role of technology is paramount in providing innovative solutions, mitigating environmental degradation, and preserving natural resources. In this context, technology plays a multifaceted role, serving to achieve a radical change in the energy, agriculture, and industry sectors. From reduce global emissions and even manage waste and reducing pollution, supporting environmental monitoring, renewable energy technology that helps to reduce environmental and carbon footprint, to industrial carbon capture and storage. Moreover, advanced technology provides innovative solutions to reverse environmental degradation. It enables ecosystem monitoring and assessment and informed conservation strategies. Advanced sensors and satellite imaging technologies, for example, facilitate the collection of real-time data on environmental pollution. In addition, technology promotes sustainable resource management practices by optimizing resource use, reducing waste, and promoting circular economy principles.

In this perspective, research efforts are needed to shed light on the all problems of climate change and present new environmental technologies solutions via this call for papers CIMEE24 regular and special sessions, from reduce global emissions and even manage waste and reducing pollution, supporting environmental monitoring, renewable energy technology that helps to reduce environmental and carbon footprint, to industrial carbon capture and storage.

Keywords: pollution and waste management, sustainable agriculture technologies, environmental monitoring, natural resource, circular economy, biomass, Carbon Capture and Storage, renewable energy.



Graphical abstract: Innovative technology approach to tackle triple planetary crisis

Introduction

Technology plays a crucial role to solving the biggest environmental problems and offers a promising pathway to address these challenges: Conservation of Resources, waste management, Reduce carbon footprint and carbon capture and storage. Faced with the environmental challenges mentioned above, technology has become powerful in the fight to protect the planet. Several innovative applications are emerging that help preserve and restore nature. Here are some of them:

I - Waste management and use of resources

1) Air and water pollution. The lack of proper management of waste, including wastewater, often involves intensive processes that emit pollutants into the air and water. These pollutants can have negative effects on air and water quality.

Air pollution by harmful gases in excessive amounts, such as carbon dioxide, sulfur dioxide, nitric oxide, and methane, are introduced into the Earth's atmosphere. The main sources are the burning of fossil fuels, factories, power plants, mass agriculture, and vehicle emissions. The consequences of air pollution include negative effects such as global warming, where the increased amount of greenhouse gases in the air traps heat energy in the Earth's atmosphere and causes an increase in global temperature. Water pollution through human activities such as domestic waste, industrial effluents, insecticides and pesticides are among the most common water pollutants. A specific example is the discharge of inadequately treated wastewater into natural water bodies, which can lead to the degradation of aquatic ecosystems.

2) Natural Resource Depletion: The approach adopted is based on the protection and preservation of natural resources and built with a long-term perspective. There are several types of resource depletion, the most serious being aquifer depletion, deforestation, mining of fossil fuels and minerals, contamination of resources, soil erosion and overconsumption of resources. These changes are mainly due to agriculture, mining, water use and consumption of fossil fuels.

3) Waste management. The treatment, recycling and proper final disposal of waste generated by human activities. One of its main strategies is source reduction, and the adoption of recycling and the circular economy is another key element of waste management. Recycling reduces the need to extract new raw materials or manufacture new materials and consumes less energy. Similarly, the implementation of sensors and tracking technologies allows for more accurate monitoring of waste flows. On the other hand, it stimulates the search for new materials. Efficient management of natural resources. This is essential to ensure long-term sustainability and reduce the environmental impact of human activities. This consists of using natural resources responsibly, optimizing their consumption, adopting the principles of reduce, reuse, and recycle to minimizing waste according circular economy principle.

II - Sustainable Agriculture Technologies. The adoption of precision agriculture technology, this approach involves the precise application of inputs such as fertilizers, pesticides, and water. That mean more efficient use of land, water, fuel, fertilizer, and pesticides strategy for attaining agricultural sustainability. In addition, the important role of agroecology as the most comprehensive solution to the many challenges of the agricultural sector.

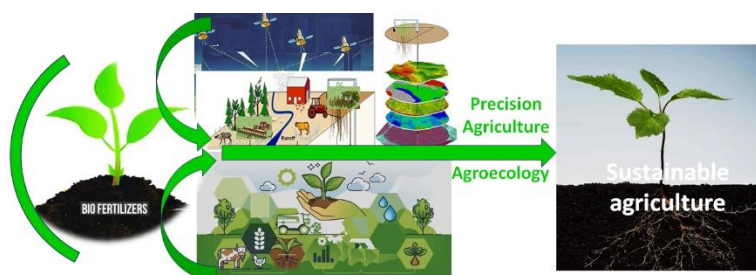


Figure 1: Agroecology, precision agriculture and biofertilizers as solutions for sustainable agriculture.

III - New environmental technologies to fighting the effects of climate change. Global concerns, primarily about climate change, have led to the development of new environmental technologies aimed at solving the biggest environmental problems. This involves conserving, monitoring or reducing the negative impact of human activities through a transition to a more sustainable and low-carbon economy. This section will focus on the development of environmental technology such as renewable energy, Environmental Monitoring using smart technologies and carbon dioxide removal.

1 - Renewable energy technologies. Modern environmental technology has enabled us to convert it into electricity or useful heat through device. It has become a key element in protecting the environment and transitioning to a sustainable future. It comes from unlimited natural sources, such as biomass. In general, it helps reduce greenhouse gas emissions, and decrease dependence on fossil fuels. In this sense, the use of new technologies favors their use, to the detriment of fossil fuels.

2 - Environmental Monitoring Technologies

The production of greenhouse gases (GHG) mainly from human activities and the increase in their concentration in the atmosphere lead to a long-term change in the Earth's average weather pattern at local, regional and global scales. This has also contributed to the disruption of Earth's natural ecosystems. Therefore, environmental monitoring has become necessary to manage the environment sustainably and minimize negative impacts on the environment and thus achieve the goal of natural resources protection.

a) Smart Sensors in the Environmental sustainability as a valuable tool for Air Water Quality and soil Monitoring. Smart technology plays a central role in encouraging environmental sustainability and developing innovative solutions to address environmental challenges. Smart technology uses devices such as sensors that can be remotely monitored in order to be as energy efficient as possible and to respond to the needs of the users.

b) Remote sensing involves using satellite imagery to monitor an area. This technology is especially useful for tracking changes in land use, deforestation, and large-scale pollution as well as to monitor large areas more effectively and more efficiently.

3 - Carbon capture and carbon Removal and Storage.

The carbon emitted into the atmosphere is one of the biggest concerns for the environment in today's world. Carbon capture and carbon removal are two of the most prominent solutions to reducing carbon emissions. While both of these techniques focus on mitigating carbon dioxide emissions.

i) Carbon removal, is an important technology in the fight against global warming: A new way of efficiently removing carbon pollution from the atmosphere. There are many different methods for removing carbon from atmosphere.

It focuses on removing carbon dioxide from the atmosphere permanently. This can be done via natural or technological processes. Technological approaches to carbon removal include direct air capture, which works by filtering carbon dioxide from the atmosphere using chemicals. The captured carbon dioxide is then transported and stored underground. It uses the principle of a process that occurs naturally over millions of years, which is the reaction of certain rocks and minerals with the carbon on the atmosphere to store in underground.

a) Methods for removing carbon using biomass. Biomass Carbon Removal and Storage, BiCRS, are processes that use plant biomass to remove carbon dioxide from the air and then store it for long periods of time. These include creating biochar, bio-oil; and permanently storing carbon-rich biomass in vaults.

On the other hand, Biomass carbon removal and storage, BiCRS, processes can provide net carbon removal. For example, many forest and agricultural wastes, such as tree bark, nut shells, and corn husks and stalks, are burned or left to decompose; using these materials for biomass carbon removal and storage can be beneficial from a climate perspective.

b) Geochemical Carbon Dioxide Removal(gCDR), which proposes to accelerate the natural reaction of atmospheric CO₂ with rocks or anthropogenic materials. This technology is the most promising pathway toward large-scale negative emissions. [1]

ii) Carbon capture

a) Bioenergy carbon capture and storage is another carbon removal pathway that involves producing energy from biomass and then capturing and sequestering the resulting CO₂ emissions. BECCS, that is important in many economy-wide decarbonization scenarios is converting biomass to hydrogen, which could result in a carbon-negative fuel. BECCS, is the process of burning crops or agricultural residue for electricity or using them to produce biofuels, and sequestering the related emissions underground.

Carbon capture is a critical component of the clean energy transition and has become increasingly significant in recent years, particularly in countries with high carbon emissions. The Carbon capture refers to the process by which carbon dioxide is collected from industrial emissions or power plants and transported via pipelines or ships to underground storage.

b) Direct Air Capture: Direct air capture is one of today's most promising carbon removal technologies. Direct air capture, or DAC, is the mechanical process of sucking large amounts of air through a chemical filter to remove the carbon dioxide. This technology combines its direct air capture technology with permanent underground storage.

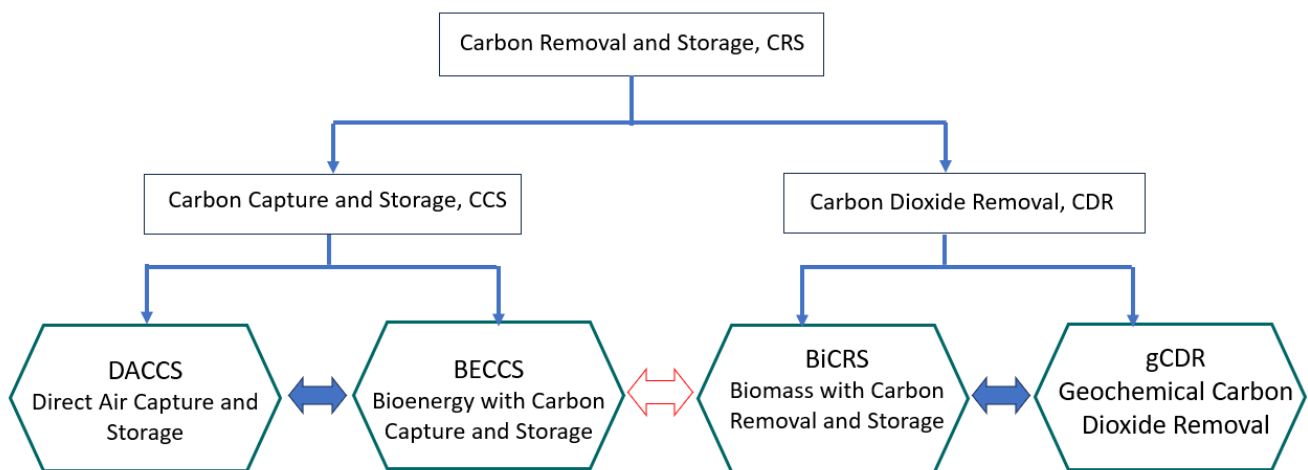


Figure 2: A greater role of Carbon removal and carbon capture and storage technologies to reduce carbon dioxide emissions from the atmosphere.

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