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The Threat of Climate Change on Food Scarcity and Farming Practices

Climate change has been documented to have rapidly increased after the industrial revolution began in the late 1800's early 1900's. Around this time, we began excessively burning fossil fuels to power our inventions. As a result, studies have shown that in the last 100 years, we have run into the issue of global warming due to burning fossil fuels. Burning fossil fuels for vehicles, homes, and factories has released far too much carbon into the atmosphere. Certain types of farming practices have also resulted in the loss of carbon from the soil to the atmosphere. The more carbon there is in Earth's atmosphere, the more heat from the Sun's rays are trapped inside instead of reflecting into space. The increase in carbon has led to globally warmer temperatures, harsher weather, increased drought, and is now threatening our food security.

Rising temperatures cause significant issues for the agriculture industry. Climate change has led to an increase in temperatures, irregular precipitation patterns, droughts, heatwaves, sea-level rise, and a higher risk for natural disasters. These problems give way to less land for agriculture, lower crop yields, and harsher weather for the plants to grow in. In 2021, NASA researchers conducted a study in which they found that global warming is going to affect the production of wheat and corn as early as 2030. Corn crop yields are expected to decline by 24% and wheat is expected to increase by 17% then decline. (Gray, 2021) This is because corn and wheat grow in different zones. Corn is best grown in equatorial regions, whereas wheat grows best in temperate climates. This means that as temperatures increase there will be less suitable areas to grow corn than wheat. Another good point was made that higher levels of carbon dioxide in the atmosphere can contribute to increased crop yields, but at a cost of lower nutritional levels. (Gray, 2021) So, despite having possibly more wheat, the nutritional value of that wheat will be reduced. In a world where people already struggle with finding healthy, nutrient-dense food that is not heavily processed, this could have even more detrimental effects to the global population's health. While this is something that will affect the entire world, there

are definitely groups that are more at risk of suffering from these effects than others. For example, “In many parts of less developed countries in Africa and Central America, maize is a key component in the daily diet and plays a key role in achieving food security in those areas.” (Balzer et al., 2011) So, if the global corn supply truly does decrease by almost a quarter in 2030, that could have drastic (if not deadly) consequences for many of the people in poorer regions. Mathematically speaking, if the global population continues to increase (which it will), the demand for food is going to naturally increase. But if there is increased demand and decreased supply, this will no doubt lead to a global crisis.

Not only will climate change cause issues with reducing the production of vital crops like corn and wheat, but it will also impact the oceans, and thus, the fishing industry. In many parts of the world, fishing is a primary source of income and/or food. Increased global temperatures include that of the oceans, which is a delicate ecosystem in and of itself. Even the slightest temperature fluctuations can damage coral reefs and influence plants like algae. When these types of plants and animals are affected, the entire aquatic food chain will be disrupted. Sharp declines in the availability of fish will also contribute to food insecurity. “We have already seen climate effects on yields in a number of areas, including Europe and southern Asia, since the last IPCC Assessment Report in 2007. Unfortunately, it is the populations in many tropical areas and the southern parts of Europe and North Africa who will pay a great price. These population groups - especially the poor - are the most vulnerable in terms of failing harvests, higher prices and malnutrition in the near future.” (Balzer et al. 2011) In many tropical locations and island nations, the heating of oceans will be catastrophic for their way of life.

In addition to the dilemmas that are plummeting corn yields and aquatic food supplies, there are also many agricultural practices that contribute to carbon emissions. Some of these include deforestation, draining of wetlands for crop use, overgrazing, bare fallowing, and monoculture cropping. An especially significant portion of land degradation can be attributed to chemical use, such as pesticides, fungicides, and herbicides. While using these chemicals may create higher yields and decrease losses from things like pests, there is often runoff from fields sprayed with these chemicals that then go on to negatively impact other ecosystems and pollute water supplies. These chemicals also are not healthy for people who consume those crops, especially on certain fruits and vegetables that are heavily sprayed for certain pests and fungi. Unfortunately, using chemicals such as these is often less expensive than performing organic practices that would be healthier for the population, in addition to being more regenerative in the

long run. Therefore, many conventional farms resort to these degradative measures to ensure their profit margin. As Ben Riensche says: “capital is most available to farmers with the most traditional, low-return production systems. In short, generally the systems that are least regenerative, emit the most greenhouse gases, and result in the most land degradation, are the most likely to have access to capital.” (2019) This is a large reason why smaller, more sustainable farms have been dying out, because they cannot compete with large corporational farms that have been taking over. Unfortunately, the mindset of many farming corporations has had to shift from quality to quantity in order to keep up with rising food demand. However, those same practices are the ones that are causing degradation in soil quality and thus resulting in higher carbon emissions. It is easy to see how this quickly becomes a vicious cycle. The question thus becomes, how does an ever-growing population ensure proper crop output while also preventing that process from negatively affecting the environment and future generations? The answer will likely lie in the incorporation of regenerative farming practices.

While the issue of global warming and its relationship to agriculture is a vastly multifaceted one, there is hope for farming solutions that may help make farmland into more of a carbon sink than a carbon emitter. Since the beginning of agriculture, approximately 133 gigatonnes of carbon have been lost from soils globally, the equivalent of 480 $GtCO_2$ emissions. (Teal & Burkart, 2022) Recently this problem has come to the attention of the World Resources Institute (WRI) and they have engineered several regenerative farming practices to trap carbon in farming soil. One of the main reasons why carbon is released from the soil is because when the sun bakes the soil the nutrients in the soil are washed away with time. A way to combat this is to maintain vegetation cover on the soil as much as possible. This will help to keep the soil cool and create a diverse ecosystem where the crops can thrive. Regenerative farming is almost like organic farming except the WRI is pushing for things like grass cover for waterways, crop buffers, and integrating livestock management. Some other regenerative methods include reducing tillage, incorporating cover crops, agroforestry, and the utilization of organic waste (compost) to increase soil health. Despite claims from the WRI that the efficacy of these practices is up for debate, there have been many field experiments that have proven the ability for regenerative practices to create carbon sinks in farmland. (Teal & Burkart, 2022) In fact, there are many long-term regenerative farms already in practice. One concern that is apparent while practicing regenerative farming is if the crop yield will be the same as farms who practice monocropping. The short answer is no, but a regenerative farm can be built to a point where it can produce very close to what a large farm already produces. It takes a longer time for farmers

to engineer a farm in a way where it will help sustain itself in the long run. Many farmers also have a hard time with adopting practices that are out of their normal routine because the practices that will help the soil in the long run cost more. To help farmers out, the United States has created conservation finance programs to assist farmers in becoming more profitable while using regenerative practices. Large companies are also starting to realize that we are going to be coming into hard times if we continue our large-scale farming practices without considering the consequences this has on our soil. Recently, Unilever has announced that they will be carbon neutral across their entire supply chain before 2040. They have launched a $1.1 billion restoration fund to help in the global transition to a more sustainable and equitable agricultural system. (Teal & Burkart, 2022) Danone and General Mills have also jumped on board with trying to help farmers by paying them to adopt practices to help increase soil sequestration.

Overall, global warming and its effects on climate change is something that is impacting our food supplies even now, and it will only continue to get worse in the next few years. Global warming contributes to food insecurity by increasing drought occurrences, reducing most crop yields, creating less nutritious foods, and negatively affecting ocean life. Global warming has been significantly impacted by some agricultural practices that release carbon into the air, as well as pollute the soil and water. This creates a vicious cycle of trying to produce enough food to meet demand but also making it harder for future generations to produce that food as well. Thankfully, scientists and engineers are working on regenerative practices that can be easily implemented, as well as new incentives that governments can establish to promote sustainable agriculture. Technologies like autonomous farm equipment, chemical-free weeding mechanisms, and atmospheric sensing equipment (such as drones for detecting nitrous oxide emissions on farms) are all things that engineers and scientists can use to help reduce the impact that certain farming practices have on our environment. However, it will be up to engineers, farmers, politicians, and corporations to find a way to integrate these practices effectively while also maintaining an increasing output to sustain the global population. While a daunting task, this will be essential for the sustainability of humankind.

Resources

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