Modern Agricultural Practices and its Unsustainable Role Towards Soil including Climate Change:

An Analysis of the Environmental Effects

Zoë Ortega May 5, 2023 Climate change is currently happening and warrants action since global temperature is on the rise. Climate change is already having effects globally and solutions with action are needed to prevent further increase in temperatures, so that we don't reach extremely dangerous temperatures with devastating irreversible consequences. The Holocene era, where the earth's carbon and temperature balanced, is being threatened by people-related forces and throwing off this balance has dire consequences. In 2015, The United Nations held a conference in Paris to talk about climate change and the action needed. An environmental pledge, COP21, was presented to the world by the French minister of agriculture, Stephan LeFoll, in efforts to mitigate climate change by changing agriculture practices.

The soil being heavily affected by modern day agricultural practices has great environmental effects and is another contributor to problems, such as excessive amounts of carbon dioxide in the atmosphere, desertification, and food production. The rise in temperature and the consequences from this rise warrant action that requires an important platform, much like this conference in Paris, to allow climate change solutions to be addressed. The subject of climate change should be addressed with acting on solutions, and this paper examines climate change and solutions that could alter future consequences, particularly with soil and agriculture.

The Increasing Need for Food Production While Differing from the Status Quo of Agriculture

In 2021, a report from the United Nations addressed the increase of population, food security of the population, and the changes needed in agriculture. This report states that the increase of population is expected to reach 9.7 billion by the year 2050. This report spoke on how the planet and people are being failed in the way that the current food system is. The way that the current food system is impacting the environment is through a quarter of greenhouse

gases produced, degrading the soil, as well as the loss of biodiversity. With the food system continuing with the way it is now, putting stress onto the environment has future implications on our ability to produce food. Food security is already being threatened by climate change from affecting changes with precipitation and natural events. The changes required in agriculture are to include sustainability as the goal for food production globally. This report looked at a scenario of the future of food and agriculture, by 2050, that if no changes were made to agriculture and it stayed at the status quo there would be great increases to the amount of people that experience undernourishment and malnutrition. Especially since currently and globally, hunger will not be eliminated by 2030. However, if the production of food is made to be more sustainable and equitable this scenario would counter food insecurity and the betterment of the environment as well as nutrition. This report suggests that by transforming agriculture to be more sustainable and coincide more with ecosystems, we'll address food insecurity. These recommendations of food production globally in a more responsible manner are a way to benefit our environment through ecosystems and change the amount of greenhouse gases that are being emitted into the atmosphere.

Industrialized agriculture seemed to have been the solution for the rapid rising of population and may seem like a deal perhaps even a steal for the price of food in markets; however, this report from the UN suggests that this process in not sustainable and more harmful to the environment. This has a price that is not accounted for or factored into the price of the food produced by this modern agriculture. An article for the UNs Environment program, suggests that the industrialized agriculture has large costs that are not at the front nor reflect the cost of the food produced by modern agriculture. These costs show up externally such as from poor nutrition related diseases that require treatment as well as the treatment of decontaminating polluted drinking water. (United Nations, 2020)

Risks with the Status Quo of Agriculture

Soil has this great capacity to hold in moisture as well as to take in carbon from the atmosphere. Allen Savory delivers a talk about desertification and the effects it has on climate change. He discusses that when we harm or even damage the soil, what is happening is that the soil loses its ability to absorb and store water and carbon. What happens when too much bare ground is created from having no living plant, there is more evaporation even after rainfall which turns to drying out the soil. So, the soil turns into dirt or dust which is a process called desertification- which is simply areas turning to desert. He estimates about 2/3 of the world is experiencing desertification. When soil is left uncovered compared to covered, such as by plants, the uncovered ground causes much more heat to come off of this bare soil at midday and then much colder at night. He states that leaving ground bare is going to change the microclimate, but then leaving even larger areas is going to change more than the microclimate this will change the macroclimate as well as release carbon. On a global scale, desertification is a cause of climate change.

Figure 1.

Vegetation, 2022

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Note. The map shows vegetation globally in February 2022. Adapted from NASA. (2003). *Vegetation.* [Map] NASA. <u>https://earthobservatory.nasa.gov/global-maps/MOD_NDVI_M</u>

Figure 2.

Carbon dioxide visualization, June 2006



Note. The map shows carbon dioxide levels for April 2006. Adapted from Putman, W. (2014a, November 17). A Year In The Life Of Earth's CO2. [Map] NASA. https://svs.gsfc.nasa.gov/11719#media_group_21460

Figure 3.

Carbon dioxide visualization, September 2006



Note. The map shows carbon dioxide levels for September 2006. Adapted from Putman, W. (2014a, November 17). *A Year In The Life Of Earth's CO2.* [Map] NASA. <u>https://svs.gsfc.nasa.gov/11719#media_group_21460</u>

In reference to Figure 2 and Figure 3, NASA Goddard Space Flight Center's Global Modeling and Assimilation Office created a visualization of the carbon dioxide and the amounts from natural and artificial sources in the atmosphere that shift in correlation to the seasons of growth cycles of plants. Showing significant increases in carbon dioxide during winter months before and after significant times of plant growth during summer months. (Putman, 2014) In reference to Figure 1: "Satellites observe global-scale patterns of vegetation that scientists use to study changes in plant growth as a result of climate and environmental changes as well as human activity. Photosynthesis plays a big role in removing carbon dioxide from the atmosphere and storing it in wood and soils, so mapping vegetation is a key part of studying the carbon cycle." (NASA,2003)

A conclusion that could be drawn from this is the way that we are using modern agriculture is that we are plowing the soil which is releasing moisture and carbon dioxide into the atmosphere and then as we are damaging and weakening the soil, we plant crops that then are sprayed with toxic chemicals to yield harvests. This is harmful in such a way that it is creating a situation where our soil is turning into dirt, it is causing our planet to go through a process called desertification. And with this harming of our soil, we are causing carbon dioxide as well as other greenhouse gasses levels to rise in our atmosphere, which is causing huge environmental problems, such as global warming.

The Use of Different Agricultural Practices as Part of the Solution

A study published in 2014, examined how row covers could be used as a way to control erosion. This was a two-year study that determined that under a row cover of fleece the soil loss was reduced to an average of 76% as well as another row cover that was net reduced soil loss to 48% compared to using no row covers. (Übelhör, et al., 2014)

Another study that was published in 2022, evaluated differing practices of tillage for the effects of emissions of carbon dioxide from soil. This study was conducted through field experiments with differing incorporations of straw. This study concluded that certain factors such as how deep soil was tilled, the temperature of the soil, and the moisture of the soil had effects on how much the soil had emitted carbon dioxide. Tiling that occurs in warmer weather, such as in summer before planting, caused the soil to have more carbon dioxide to be emitted. The data

from this study suggests that the more coverage of the surface of the soil, such as from straw, up to 80% to 100% especially in warmer weather not only keeps more moisture in the soil and maintains soil temperature, but can also have the capability of reducing the amount of carbon dioxide that comes off of the soil to around 50% Whereas when tilling occurs with practices of covering the soil surface, carbon dioxide emissions from the soil sit around 10% to 15% (Mühlbachová, et al., 2022)

Limiting climate change and global warming can be done through sequestering carbon in the soil. Soils have the great ability to counteract climate change which means we should be sustainably using soils. Not only sequestering carbon in the soil as a way to fight against climate change but it also increases the health of the soil as well as increases moisture retention Which leads to sustainable food production. (Guðmundur Halldórsson, et al., 2015)

Conclusions and Recommendations

Globally we should listen to the recommendations from the Paris agreement to change agriculture practices and sequester carbon through soil for great beneficial environmental impact.

The impacts from modern agriculture are not just environmental but social issues as well.

In conclusion, today, globally, our topsoil is being heavily affected by how we are farming, by the way we are using modern agriculture. Harming our soil is creating environmental problems, so to fix our soil by agriculture mimicking nature would be to aid in fixing our environmental problems. A conclusion that can be brought from this environmental analysis, is regenerative agricultural practices of mimicking nature by covering soil surface, no tilling, and having the relationship between soil and plants to sequester carbon is a way to provide soil health and solutions to climate change.

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Appendix

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