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Use of AI for Climate Change and Global Warming

Snehal D. Patil[1]* , Neha V. Patil[2] , Dr. K. M. Alaskar[3]

*[*1,2]Student , Department of Master of Computer Application, Bharati Vidyapeeth (Deemed to be University) Pune Institute of Management, Kolhapur Maharashtra India.*
[3]Assistant Professor, Bharati Vidyapeeth (Deemed to be University) Pune Institute of Management, Kolhapur Maharashtra India.

[*]Corresponding author

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Abstract

Climate change in an area of science that has been studied for many years. The fossil record has taught humankind much about conditions on Earth long prior to our arrival. We now live in a unique time in that our scientific abilities have not only given us a precise age of the planet, but of the universe itself. Yet there are many things we do not understand, and some of the questions that remain before us may have a significant impact on the quality of our lives in the future. As our current civilization observes an unquestioned period of warming on Earth, the issue of the nature of this change remains a topic discussion for both scientists and the public at large. It is important, therefore, for those of us in the educational community to help our students get the best information with which to guide their own thoughts and decisions in a changing world.

Keywords: Climate Change and Global warming.

1. Introduction

1.1. Global Warming

2011-2020 was the warmest decade recorded, with global average temperature reaching 1.1°C above pre-industrial levels in 2019. Human-induced global warming is presently increasing at a rate of 0.2°C per decade.

An increase of 2°C compared to the temperature in pre-industrial times is associated with serious negative impacts on to the natural environment and human health and wellbeing, including a much higher risk that dangerous and possibly catastrophic changes in the global environment will occur. For this reason, the international community has recognised the need to keep warming well below 2°C and pursue efforts to limit it to 1.5°C.

1.2. Impact of Climate Change

The Impact of Climate Change on Agriculture and human well-being include-

1.2.1. The Biology effects of Climate change on Yields

Rising temperatures and changes in rainfall patterns have direct effects on crop yields, as well as indirect effects through changes in irrigation water availability.

I. Direct Effect on yields: rainfed and irrigated crops

In developing countries, yield declines predominate for most crops without CO_2 fertilization. Irrigated wheat and irrigated rice are especially hard hit. On average, yields in developed countries are affected less than those in developing countries. For a few crops, climate change actually increases developed-country yields. In calculating these projections, the East Asia and Pacific region combines China, which is temperate for the most part, and Southeast Asia, which is tropical. The differential effects of climate change in these two climate zones are concealed. In China, some crops fare reasonably well because higher future temperatures are favorable in locations where current temperatures are at the low end of the crop's optimal temperature. Yields of important crops in Southeast Asia fall substantially in both scenarios unless CO_2 fertilization is effective in farmers' fields. South Asia is particularly hard hit by climate change. For almost all crops, it is the region with the greatest yield decline. With CO_2 fertilization, the yield declines are lower; in many locations, some yield increases occur relative to 2000. However, rainfed maize and irrigated and rainfed wheat still see substantial areas of reduced yields. Sub-Saharan Africa sees mixed results, with small declines or increases in maize yields and large negative effects on rainfed wheat. The Latin America and Caribbean region also has mixed yield effects, with some crops up slightly and some down.

II. Indirect effects: Irrigated crops

Climate change will have a direct impact on water availability for irrigated crops. Internal renewable water (IRW) is the water available from precipitation. Both climate scenarios result in more precipitation over land than would occur with no climate change. Under the NCAR scenario, all regions experience increased IRW. Under the CSIRO scenario, the average IRW increase is less than occurs with NCAR, and the Middle East and North Africa and Sub-Saharan Africa regions both experience reductions of about 4 percent. In addition to precipitation changes, climate change-induced higher temperatures increase the water requirements of crops. The ratio of water consumption to requirements is called irrigation water supply reliability (IWSR). The smaller the ratio, the greater the water stress on irrigated crop yields.

1.3. Prices, Production, and Food Consumption-

1.3.1. Prices

World prices are a useful single indicator of the effects of climate change on agriculture.Figure3 reports the effects of the two climate-change scenarios on world food prices, with and without CO2 fertilization. It also reports the effects with no climate change. demonstrate world price effects for livestock production and major grains, respectively, assuming no CO2 fertilization.

1.3.2. Production

The negative effects of climate change on crop production are especially pronounced in Sub-Saharan Africa and South Asia. In South Asia, the climate scenario results in a 14-percent decline in rice production relative to the no–climate-change scenario, a 44- to 49-percent decline in wheat production, and a 9- to 19-percent fall in maize production. In Sub-Saharan Africa, the rice, wheat, and maize yield declines with climate change are 15 percent, 34 percent, and 10 percent, respectively. For East Asia and the Pacific, the results are mixed and depend on both the crop and the model used. Rice production declines by around 10 percent, wheat production increases slightly, and maize production declines with the drier CSIRO scenario but increases with the NCAR scenario. Comparing average production changes, developing countries fare worse for all crops under both the CSIRO and NCAR scenarios than do developed countries.

1.3.3. Food Consumption

Agricultural output used for human consumption is determined by the interaction of supply, demand, and the resulting prices with individual preferences and income. It also reports consumption with no climate change.

1.4. Biofuels

The expansion of ethanol based on grain feedstock is quite different from that of ethanol production based on sugar cane, especially in Latin America. The tradeoff between food and fuel is quite limited in the case of sugar cane based ethanol. Sugarcane expansion would occur primarily in Latin America, then in other countries with low-cost sugar production. Most of this expansion will occur on land for which competition among crops is limited. By contrast, ethanol based on grains has a direct effect on several important competing crops, including oilseeds. The expansion of biodiesel as a strong and direct implication for vegetable oil prices and the feedstock and food demand are in direct competition. A large bio-diesel expansion will push vegetable prices higher. Hence, the expansion of biofuel based on grains and oilseed products is a potential factor of exacerbation of high food prices and could compromise the access to food or the poorest on the planet. The most affected food prices would be grains, vegetable oils, meat, and dairy products which are intensive in feedstocks. However, if cellulosic/biomass ethanol can become profitable, this trade off between food and fuel may be less important and confined to oilseed bases biofuels. The development of biofuels is also determined by their return. The latter is largely determined by fossil energy prices and feedstock prices. Low fossil energy prices will undermine the development of large biofuel sectors and would reduce the tradeoff between food and fuel. Of course large and forced biofuel mandates could change this result. It is difficult to know what policies will prevail in 2050.

1.5. Land expansion

Globally, the most productive land has been put in production. Vast reserves of unused land remain in Brazil, and some land in the U.S. and the EU has returned from agriculture to forest or has been idled because of environmental fragility. With this qualifier, readily available, high quality arable land is scarce globally. However, there is a large supply of lower quality land which has not been tapped, including idled land under farm programs in the EU and the US, land in Africa, and land in the former USSR (see Background Figure 3). Putting some of this land in profitable production would require some new infrastructure expenditure, especially in Africa. Any major expansion of a crop on existing high quality land may come at the cost of reducing other crops or reducing high quality pasture such as in Argentina.

Global warming through droughts, rising temperature, and salinity issues is likely to make some land inappropriate in Africa, parts of Asia and Australia. For example, Garnaut reports that there is a 10% probability that most of the Murray-Darling river basin might become unsuitable for wheat, rice, and other major crops grown in the bread basket of Australia because of extremely high temperature, drought, and salinity.

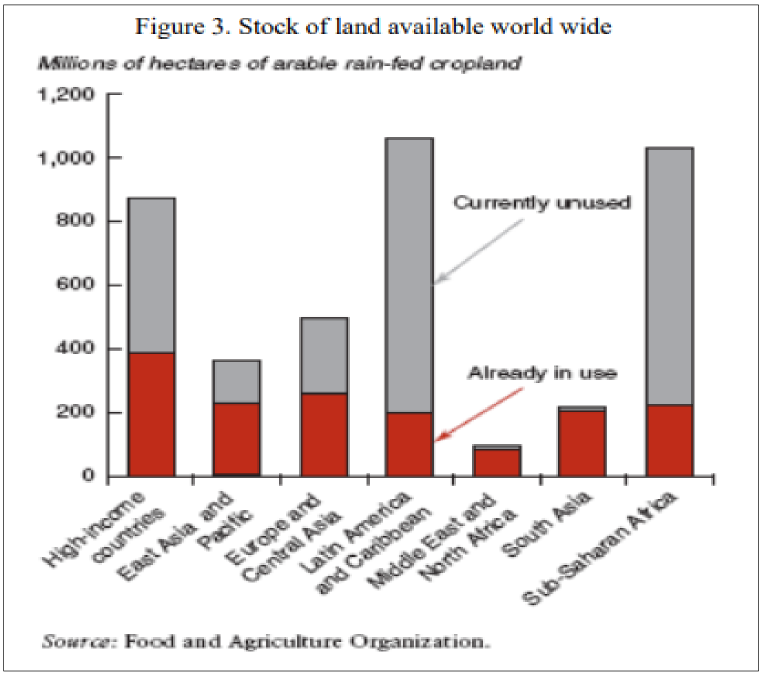

Figure.3. Food and agriculture chart

2. Benefit of AI for Climate Change

2.1. Improve Energy Efficiency

According to the Capgemini Research Institute, artificial intelligence should improve power efficiency by 15% in the next three to five years. Machine learning supports efficiencies in power generation and distribution, from autonomous maintenance and leak monitoring to route optimization and fleet management. Google's Deep mind AI can predict wind patterns up to 36 hours in advance to optimize wind farms. Electricity systems create vast amounts of data. So far, energy companies aren't leveraging this data for learning to the extent that's possible. Machine learning can comb through this data to understand and forecast energy generation and demand to help suppliers better use resources and fill in gaps with renewable resources while reducing waste. The uses of AI for energy efficiency might start at the industry level, but use cases go down to the household and individual levels.

3. Optimize Clean Energy Development

In the Amazon basin, developers of hydropower dams have typically developed one at a time with no long-term strategy. A group led by Cornell University that included computer scientists, researchers, and ecologists developed an AI computational model to find sites for dams (hundreds of hydropower dams are currently proposed for the basin) that can produce the lowest amounts of GHG emissions. The AI model revealed a more complicated and surprising set of considerations to lower GHG emissions than had ever been considered before.

3.1. Avoid Waste

Companies, governments, and leaders frequently deploy AI solutions to avoid waste. Whether AI is used to reduce energy waste from buildings (accounts for one-quarter of CO_2 emissions) or understand supply and demand, a huge way AI can power climate change strategy is to reduce waste in all forms (time, money, material, etc.)

4. Can AI Save Humanity From Climate Change?

Artificial intelligence is among the most poorly understood technologies of the modern era. To many, AI exists as both a tangible but ill-defined reality of the here and now and an unrealized dream of the future, a marvel of human ingenuity, as exciting as it is opaque.

It's this indistinct picture of both what the technology is and what it can do that might engender a look of uncertainty on someone's face when asked the question, "Can AI solve climate change?" "Well," we think, "it must be able to do something," while entirely unsure of just how algorithms are meant to pull us back from the ecological brink.

5. Where climate change and machine learning meet?

Recent years have seen the beginnings of a shift in that paradigm, with groups like Climate Informatics and the Computational Sustainability Network focusing on how computational techniques can be leveraged to advance sustainability goals.

Taking this notion a step further, a group of young experts in machine learning and public policy founded Climate Change AI in 2019, a non-profit that aims to improve community-building, facilitate research and impactful work, and advance the machine learning-climate change discourse.

6. Conclusion

This analysis brings together for the first time detailed modeling of crop growth under climate change with insights from an extremely detailed global agriculture model. The results show that agriculture and human well-being will be negatively affected by climate change. Crop yields will decline, production will be affected, crop and meat prices will increase, and consumption of cereals will fall, leading to reduced calorie intake and increased child malnutrition. Conclusion These stark results suggest the following policy and program recommendations:

• Design and implement good overall development policies and programs.

• Increase investments in agricultural productivity.

• Reinvigorate national research and extension programs.

• Improve global data collection, dissemination, and analysis.

• Make agricultural adaptation a key agenda point within the international climate negotiation process.

• Recognize that enhanced food security and climatechange adaptation go hand in hand.

• Support community-based adaptation strategies.

• Increase funding for adaptation programs by at least an additional $7 billion per year.

These investments may not guarantee that all the negative consequences of climate change can be overcome. But continuing with a "business-as-usual" approach will almost certainly guarantee disastrous consequences.

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