



Climate Change Is Threat toward Agronomy (Base of Food, Fiber System), and Food Security

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Abstract

Climate change is a gigantic challenge and threat for food security throughout the globe. Climate change induced by human activities either by natural system manipulation like deforestation, urbanization, industrialization, diversion of behavior for comfortable life passing and by more Greenhouse Gases (GHG) emission for calmness in life. On the other hand, with the calmness in life, changed the Earth's atmosphere and produced aerosols (small particles), and cloudiness in the atmosphere. This aerosol caused global warming and effected agricultural productivity at regional level. There may be a vigorous growth of some crops in raised CO₂ conditions, but there is a trade-off because as temperature raises seed production may be drop especially of maize and soybean in tropical regions. Shifting, vanishing and endangering of the marginal crops is increasing rapidly which a big challenge and threats towards food security. Average temperature of the Earth, which has been increasing for many years. In this Context present study, was investigated at regional level of district swat to evaluate the impact of changing climate on crop productivity at various location and crop responses to the changing climate. It was concluded and suggested that production of maize, soybean tomato, cucumber, squashes, peas, French bean, canola and pulses are vulnerable to extreme temperature and drought stress. Therefore, climate change is a real fact confronting to agriculture productivity. So proper management with bio char, soil amendments, charcoal and other organic matter will might be promoting root density, and will result in more number of roots having more water and nutrients absorption and will ultimately reduce the impact of changing climate.

Keywords: Aerosols; Climate Change; Maize; Soybean; Yield; GHG

Introduction

Climate refers to the average weather conditions in a place over many years (usually at least 30 years, to account for the range of natural variations from one year to the next). For example, the climate in Swat Pakistan (Especially upper swat) is cold and snowy in the winter, while Peshawar Pakistan climate is hot and humid [1-3]. the climate in one area, like the Swat or Peshawar, is called a regional climate. The regional climate has great importance in respect of agricultural productivity, food security, and livelihood. Recent studies have showed that plants and crop responded positively to regional climate and showed ameliorating effect in term of grain yield, plant height, thousand grain weight, dry matter portioning, biological yield, oil yield, and quality of the crops. [4-8]. A significant change in the Earth's climate is occurring slowly and gradually and influencing life on the planet earth. Climate can be defined as "expected weather". When

changes in the expected weather occur, known as climate changes. They can be defined by the differences between average weather conditions at two separate times. Climate may change in different ways, over different time scales and at different geographical scales. In recent times, scientists have become interested in global warming, due to mankind's impact on the climate system, through the enhancement of the natural greenhouse effect [9-14]. The Earth is currently getting warmer because people are adding heat-trapping greenhouse gases to the atmosphere. The term "global warming" refers to warmer temperatures, while "climate change" refers to the broader set of changes that go along with warmer temperatures, including changes in weather patterns, the oceans, ice and snow, and ecosystems around the world [9-14]. The average climate around the world is called global climate. When scientists talk about global climate change, they're talking a pattern of changes happening around the world over many years. One of the most important trends that scientists look for it is the average temperature of the Earth, which has been increasing for many years (Figure 1,2). The increase in temperature adversely

affected all sectors of life but the most vulnerable is agriculture. Water shortage is enhancing day by day due to climate change at arid, and semi-arid region which leads to demolish crop production practices [8,15-19].

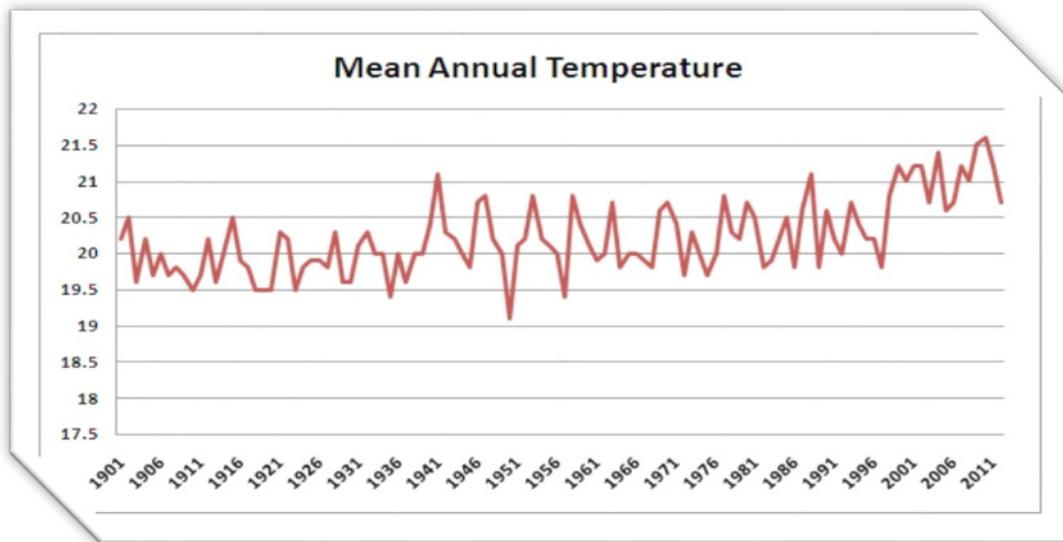


Figure 1: Increasing trends in Mean annual temperature (source, Pakistan Meteorological Department).

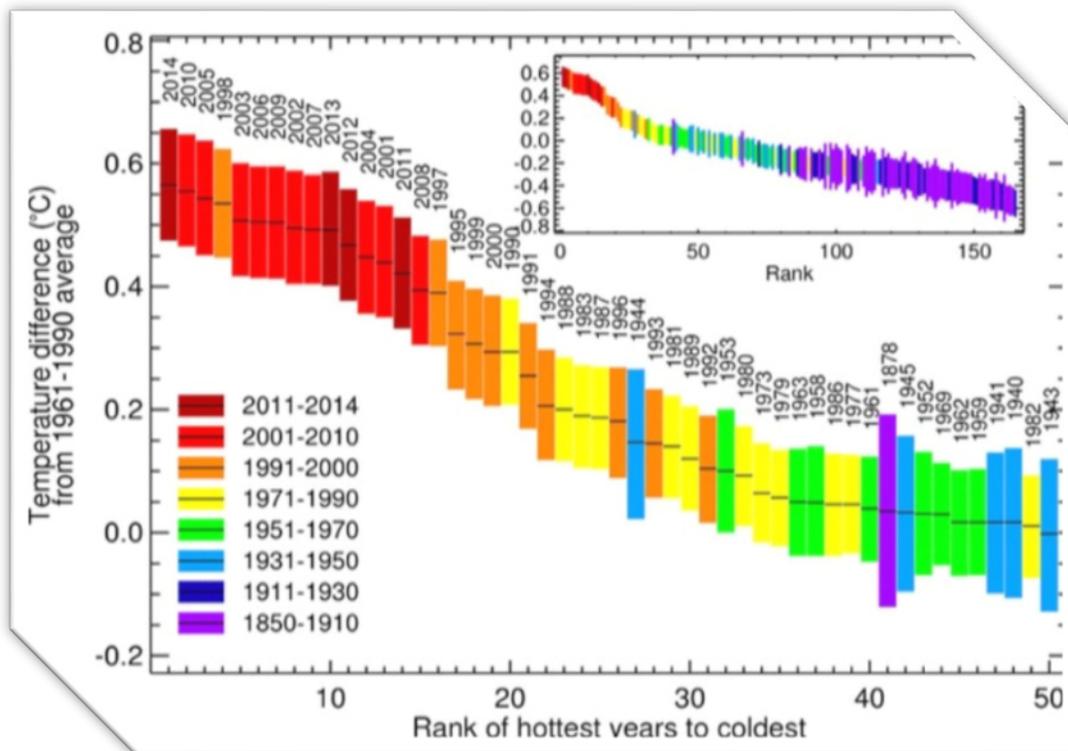


Figure 2: Average temperature difference from 1961 to 1990.

How Climate Change Is a Threat and Challenge for Food Security

The global warming caused by climate change is likely to affect crops throughout the life cycle due to increased temperature, moisture stress, heat waves, the possible emergence of new major insect-pests and disease [2,5,11,20,21]. It has been reported that mung bean has high nutritive value, and due to this, has advantage over the other pulses known as king of the pulse crop. The seed contains 24.20% protein content, 1.30% fat, and 60.4% carbohydrates; calcium (C_a) is 118 and Phosphorus (P) is 340 mg per 100 g of seed but due to increase in temperature the quality and production potential of the crop going to decline. The quality of crops was examined by [2,5,22-26]. They have been reported that pulses are known as poor man's meat and cheap source of vegetable protein containing 20-25% protein. Its production is very low in many regions due to miss management of the inputs. Therefore, if farmers implement more number of tillage practices as compared to conventional, so the nutrients demand will be fulfilled by the leached and adsorbed nutrients, away from root zone by pulverizing the soil, whereas the productivity of the soil will also increase with soft soil, promote root density, and will result in more number of nodules having more nitrogen fixation and will ultimately reduce the impact of changing climate.

Response of Germination to Changed Climate

Crop seeds germinate in a particular range of temperature. Increase in soil temperature by global warming will adversely affect germination and therefore crop stand will be effected respectively. For example, groundnut which is a major crop of KP has an optimum temperature of 25-30°C for germination. Increase in temperature beyond this range during the sowing time will adversely affect crop germination [2,11,20]. They have reported that Canola cultivars positively responded in optimum temperature range to sulphur fertilization in term of seed yield and oil quality. (Barnola et al. (1987), Samreen, et al. (2016), Anwar et al. (2016), Khan et al. (2016) and Imran et al. (2016) [2,10,11,12,20] concluded that Oscar cultivar increased seed yield 53% as compared to control plots when there were no fluctuation in temperature. Sulphur at the rate of 45 kg ha⁻¹ increased seed yield, biological yield, and quality of rapeseed. Imran et al. (2016 & 2015) [2,27] revealed that in optimum temperature number of days to flowering (76), number of pods plant⁻¹ 372), number of seeds pod⁻¹ (24), plant height (173 cm), biological yield (15547 kg ha⁻¹), seed yield (2209 kg ha⁻¹), index (19%), glucosinolate ($\mu\text{mol g}^{-1}$) content (31.03 $\mu\text{mol g}^{-1}$) and oil content (45.81%) was significantly with sulphur treated @ 45 kg ha⁻¹ applied plots as compared to delayed flowering (78 days), shortest (151 cm), pods formation (298 pods), seed pod⁻¹ (21), biological yield (11090 kg ha⁻¹), seed yield (1436 kg ha⁻¹), and oil content (42.62%) in control plots. Among cultivars "Oscar" ranked first in growth stages

and attain more plant height (164 cm), and examined substantial number of pods plant⁻¹ (359), seeds pod⁻¹ (24), seed yield (2005 kg ha⁻¹), biological yield (14298 kg ha⁻¹), harvest index 17%, and oil content 46.29%) as compared to other sowed cultivars. On the basis of the result it is recommended that cultivar "Oscar" treated with sulphur @ 45 kg ha⁻¹ should be applied for higher yield and quality of rapeseed under agro-climatic condition of swat valley [5,7,19,28,29,30].

Response of Changed Climate Towards Growth and Development

Temperature higher than the optimum range adversely affects growth and development of plants due to harmful effects on plant metabolic activities. The rate of photosynthesis may get more sluggish as the temperature increases due to closure of stomata. Besides, higher temperature enhances the rate of evapotranspiration causing moisture stress in plants under rain-fed situations. Also at higher temperature the dry matter accumulation becomes less. shoot cutting duration After Date of Sowing (ADS), (no cutting, 30 days ADS, 40 days ADS, 50 days ADS and 60 days ADS) were used in the experiment with the test cultivar Dunkled. From the results it is observed that rapeseed cultivar positively responded for days to flowering, days to maturity, number of branches plant⁻¹, H.I %, number of seeds pod⁻¹, seed weight (g), biological yield (kg ha⁻¹), seed yield (kg ha⁻¹) and oil yield (kg ha⁻¹) to biochar levels maximum seeds pod⁻¹ (23 seeds), thousand seed weight (3.59 g), biological yield (10310 kg ha⁻¹), seed yield 1169 kg ha⁻¹ and oil yield (600 kg ha⁻¹) was observed in plot treated with 10 ton biochar ha⁻¹. Whereas minimum seeds pod⁻¹ (15 seeds), thousand seed weight (2.41 g), biological yield (6725 kg ha⁻¹), seed yield (923 kg ha⁻¹) and oil yield (401 kg ha⁻¹) was recorded in control plot. Similarly, highest seeds pod⁻¹(22), thousand seed weight (3.3 g), seed yield (1099 kg ha⁻¹) was noted in no shoot cutting plot followed by shoot cutting after 60 days of sowing ADS plots while promising biological yield (9025 kg ha⁻¹), and oil yield (568 kg ha⁻¹) was recorded in shoot cutting after 50 days ADS and after 60 days ADS of sowing. On the basis of the result it was concluded that shoot cutting with 10 ton biochar ha⁻¹ produced highest seed and oil yield with green chop and recommended for higher seed, oil and biological yield in the agro- climatic condition of swat valley.

Response Towards Plant Reproduction

Higher temperature has harmful effects on flowering, pollination, fruit setting, and maturation. Higher temperatures may increase flower and fruit dropping in some crops, and cause stigma and pollens to dry. The anthelmintic activity was very significant against the tested earthworms. Leaf extracts of *Iphionagrantioides* and *P.argutaat* dose of 100 /ml caused death of the worms in 3.33±0.57 and 2.16±0.28 minutes, respectively, which is similar to the effect produced by commercial anthelmintic drug, Piperazine Citrate.

indicated that both the plants have significant antilice potential by showing 100% lice mortality in case of *Iphionagrantioides* leaf followed by its flower (96.67%) and of *Plucheaargutaby* causing 93.33 % lice mortality. *Iphionagrantioides* showed excellent insecticidal (90%) activity against *Callosobruchusanalis*, *Rhyzoperthadominica*, *Sitophilusoryzae* and *Triboliumcasteneum*. *Plucheaarguta* leaf exhibited significant activity against all the tested insect species. The results also depicted excellent effect of both the plants by inhibiting growth of *Lemna minor*. Plant extracts of the plants displayed significant cytotoxicity against brine shrimps. The LD 50 values for all the crude extracts of *Iphionagrantioides* and *Pluchea arguta subsp. glabra* were found to be 34.65, 242.83, 6.21, 29.92 ug/ml and 0.02, 0.03 and 84.66 ug/ml respectively. The present studies showed that ethanolic extracts of *Iphionagrantioides* and *Plucheaargurasubsp. glabra* revealed significant potential regarding anthelmintic, antilice, insecticidal cytotoxic and phytotoxic activity and these plants could be exploited for herbal drugs exploration for the health care of mankind.

Response Towards Crop Duration

The increase in temperature will speed the maturity, so cutting the total duration of the crop. It will result in lower dry matter accumulation and lower yield. The effect of nitrogen on days to flowering was significant. With increase in nitrogen level significant delayed were noted in days to flowering. Plots treated with different decapitation stresses delay days to flowering as compared to plots. The interaction between nitrogen levels and decapitation stress on days to flowering were also found significant with 100 kg nitrogen level and 5 cm decapitation stress shows maximum (111) days to flowering. This might be due to maximum nitrogen enhances vegetative growth and delayed reproductive phase. This statement is supported by Ahmadi and Bahrani (2009) who's reported the effect of nitrogen levels and concluded that

highest N level enhanced plant height, number of branches plant-land maximum days to flowering.

Response Towards Crop Yield and Productivity or Total Biomass

Lower plant stands due to poor germination, low dry matter accumulation, adverse effects on flowering and fruiting, reduced crop duration caused by an increase in temperature will ultimately reduce the crop yield. Still, in case of C3 plants the enhanced level of CO₂ may result in higher rate of photosynthesis and increase yield. But such effects of CO₂ fertilization may get negated due to higher temperature and moisture stress caused by climate change. Imran, et al. (2015) [31] examined that regional climate is very important for an ideal crop growth and production. (Table 1 and 2) shows five different crop average yield grown and different elevation and topography with different rainfall pattern and temperature. Difference in the average temperature of a locality have significant effect on crop growth, yield and productivity (Table 1,2).



Vegetables	Union Councils			Mean (kg)
	Madyan	Behrain	Kalam	
1.Tomato	936.0kg	996.6kg	1026.8kg	986.46
2.Cucumber	1049.7kg	1093.8kg	1124.8kg	1089.43
3.FrenchBean	784.6kg	719.8kg	740.0kg	748.13
4.Squashes	878.6kg	894.3kg	888.3 kg	887.06
5.Peas	456.8kg	482.1kg	462.8 kg	467.23

Table 1: The averages yield data (kg k-1) of different vegetables in Madyan, Behrain and Kalam.

Vegetables	Area in kanals			Total area
	Madyan	Behrain	Kalam	
Tomato	38	137	10	185
Cucumber	17	44	42	103
FrenchBean	54	136	35	225

Squashes	01	39	22	62
Peas	09	04	12	25
Total	119	360	121	600

Table 2: The Area (Kanals) covered by each crop in Madyan, Behrain and Kalam.

Greenhouse Gases Effect and Global Warming

The Sun powers Earth’s climate, radiating energy at very short wavelengths, predominately in the visible or near-visible (e.g., ultraviolet) part of the spectrum. Roughly one-third of the solar energy that reaches the top of Earth’s atmosphere is reflected directly back to space. The remaining two-thirds is absorbed by the surface and, to a lesser extent, by the atmosphere. To balance the absorbed incoming energy, the Earth must, on average, radiate the same amount of energy back to space. Because the Earth is much colder than the Sun, it radiates at much longer wavelengths, primarily in the infrared part of the spectrum. Much of this thermal radiation emitted by the land and ocean is absorbed by the atmosphere, including clouds, and reradiated back to Earth. This is called the greenhouse effect. The glass walls in a greenhouse reduce air flow and increase the temperature of the air inside. Analogously, but through a different physical process, the Earth’s greenhouse effect warms the surface of the planet. Without the natural greenhouse effect, the average temperature at Earth’s surface would be below the freezing point of water. Thus, Earth’s natural greenhouse effect makes life as we know it possible Battle (1996) [32].

It is wisely said that to solve a problem, first you must know and understand the problem Barnola et al., (1987) [20]. The findings revealed that they have had a hazy picture about the climate change and had many biases on the subject largely due to the news emanating from the local and international knowledge source. Climate change has happened in the past also and is a normal and natural process occurring in a cyclical manner due to changes in the planetary movements. As per the Milankovitch Cycle, there are three planetary movements viz., Obliquity, eccentricity, axial precession, and apsidal precession, which cause a major shift in the climate over a period of 41000, 100000, 26,000 and 112000 years, respectively. But the current climate change is not normal and natural process, rather it is largely anthropogenic in nature. Research over the past one century by scientific communities across the world has indicated that the alarming increase in the

amount of different Greenhouse Gases (GHGs), which include carbon-di-oxide, methane, nitrous oxide, and water vapor in the atmosphere, has buttressed warming of the planet. It has also been discovered that there is a proportional change in the global temperature and GHGs released in the atmosphere and has caused the planet to warm by 1°C Celsius in the last one century and is still continuing [33-35].

Among the GHGs, the share of carbon-di-oxide in global warming is highest due to its higher proportional release. The greenhouse effect caused by such gases, is though important to keep the planet congenial for living, as in the absence of ‘normal warming’ earth will become a cold planet. The excess of anything is detrimental so is the case with GHGs. The CO₂ levels today stands at 402 ppm (Ackremate and Stokes., (2003), Adskin., (1998), Barnett., (1999) [33-35] and is further increasing at an alarming rate. (Figure 1) explains how the release of CO₂ by various anthropogenic activities determines its concentration levels in the atmosphere. (Figure 3,4) shows the rate of increment of different GHGs since 0 AD.

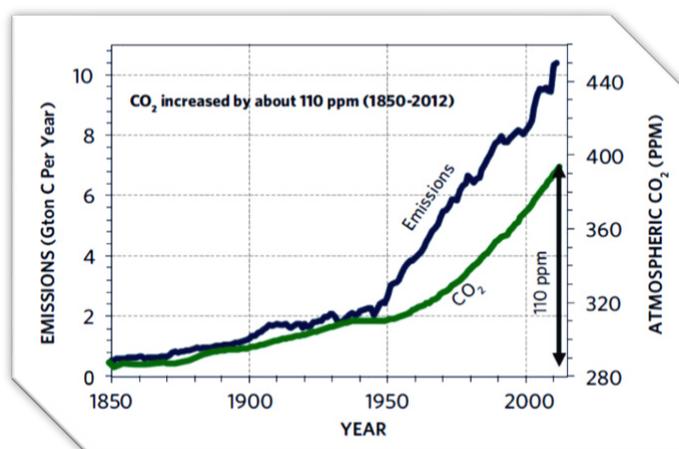


Figure 3: Relationship of global carbon emissions and co2 concentrations on earth.

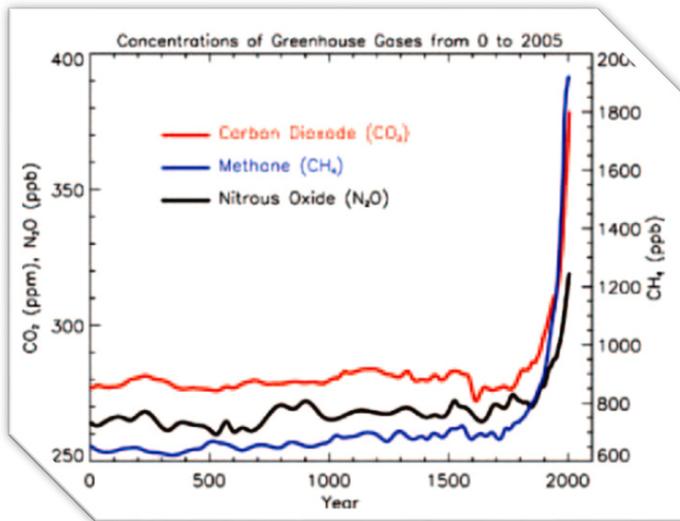


Figure 4: Concentration levels of different greenhouse gases: A trend over the past (Source: U.S. Global Climate Research Program, National Research Council of The National Academies of Sciences, (2011) Int J Environ Sci Nat Res. 2017; 3(3): 555613. DOI: 10.19080/IJESNR.2017.03.555613).

Weather and climate, climate change and climate variability

Weather: The condition of the atmosphere at a particular place and time. Some familiar characteristics of the weather include wind, temperature, humidity, atmospheric pressure, cloudiness, and precipitation. Weather can change from hour to hour, day to day, and season to season.

Climate: The average weather conditions in a particular location or region at a particular time of the year. Climate is usually measured over a period of 30 years or more.

Climate change: A significant change in the Earth's climate. The Earth is currently getting warmer because people are adding heat-trapping greenhouse gases to the atmosphere. The term "global warming" refers to warmer temperatures, while "climate change" refers to the broader set of changes that go along with warmer temperatures, including changes in weather patterns, the oceans, ice and snow, and ecosystems around the world.

Climate variability and Global warming

An increase in temperature near the surface of the Earth. Global warming has occurred in the distant past as the result of natural causes. However, the term is most often used to refer to recent and ongoing warming caused by people's activities. Global warming leads to a bigger set of changes referred to as global climate change. It is normal for the weather to change on a daily or even hourly basis. But when the average pattern over many years' changes, it is a sign of climate change.

Anthropogenic Activities Leading to Climate Change

Human activities contribute to climate change by causing changes in Earth's atmosphere in the amounts of greenhouse gases, aerosols (small particles), and cloudiness. The largest known contribution comes from the burning of fossil fuels, which releases carbon dioxide gas to the atmosphere. Greenhouse gases and aerosols affect climate by altering incoming solar radiation and out-going infrared (thermal) radiation that are part of Earth's energy balance [36]. Changing the atmospheric abundance or properties of these gases and particles can lead to a warming or cooling of the climate system. Since the start of the industrial era (about 1750), the overall effect of human activities on climate has been a warming influence. The human impact on climate during this era greatly exceeds that due to known changes in natural processes, such as solar changes and volcanic eruptions. However, human activities, primarily the burning of fossil fuels and clearing of forests, have greatly intensified the natural greenhouse effect, causing global warming [37]. The two most abundant gases in the atmosphere, nitrogen (comprising 78% of the dry atmosphere) and oxygen (comprising 21%), exert almost no greenhouse effect [38-46]. Instead, the greenhouse effect comes from molecules that are more complex and much less common. Water vapor is the most important greenhouse gas, and carbon dioxide (CO₂) is the second-most important one. Methane, nitrous oxide, ozone and several other gases present in the atmosphere in small amounts also contribute to the greenhouse effect. In the humid equatorial regions, where there is so much water vapor in the air that the greenhouse effect is very large, adding a small additional amount of CO₂ or water vapor has only a small direct impact on downward infrared radiation. However, in the cold, dry polar regions, the effect of a small increase in CO₂ [46-53].



Conclusion

The effect of climate change is not limited to water availability and uneven rainfall distribution only but it also

intensifies floods leads to dampen soil, cause storms and also increase the air temperature which increase the risk of drought and affects various agronomic crop yields and thus the food security and worsens the human living environments. Therefore, a well-coordinated program is necessary to create awareness among different sections of the society including the policy makers, general public, organizations, industrialists and farmers to sustain the food security and the environment in the days to come where climate change has to be experienced round the world.

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