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THE GLOBAL EXPECTED HEALTH AND ENVIRONMENTAL EFFECTS OF CLIMATE CHANGE PHENOMENON

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Introduction

A number of predictions have been made about the increase in temperature that is likely to occur over the next century or so as the result of the steady accumulation of greenhouse gases in the atmosphere. The scientists on the Intergovernmental Panel on Climate Change (IPCC) examined a number of scenarios and calculated that, the global mean temperature will increase by about 0.3 C per decade (with a range of 0.2-0.5 C per decade). This will lead to an increase in the global mean temperature of about 1 C above the present value by 2050 and 3 C by 2100. These are realized rises in temperature, and they account for only about 60%- 80% of the final rise because the thermal inertia of the oceans acts as a buffer (Houghton, 1990).

A number of feedback mechanisms can come into play, and these can either increase or reduce change.

1. The effects of temperature increase

Increase of temperature may affect a number of categories of disease, particularly cardiovascular, cerebrovascular, and respiratory diseases (Andrew, 1998). In the United States, under conditions of doubled atmospheric carbon dioxide concentrations, the number of summer deaths due to high temperature has been predicted to rise from an estimated current total of around 1150 to around 7400. about 60% of the deaths are predicted to occur among persons aged 65 and over. It has been suggested that, even with acclimatization, the number of summer deaths associated with the rising temperature is likely to exceed greatly the reduction of winter deths.

A study in which small numbers of volunteers were exposed to moving air at 41 C for 6 hours caused rising core temperatures of 0.8 C, a fall in weight of 1.8 kilograms despite access to water, a rise in heart rate of around 30 beats per minute and a fall in blood pressure (Andrew, 1998).

Acclimatization to high temperatures may ameliorate the effect of temperature, but the elderly and those with cardiovascular and other major diseases may adapt less well. In general, elderly people whose number are increasing in many countries will suffer the most serious consequences of increased temperatures.Clearly, over all impact will depend on the degree to which reductions in mortality due to cold weather are counterbalanced by increases due to hot weather, which in turn are likely to vary according to geographical location (Rogot, 1976).

2. The effects on communicable diseases

There are several mechanisms by which the incidence of communicable diseases may be affected. There will be effects on vectors, which will influence the distribution of disease that are currently prevalent mainly in tropical and subtropical regions. There may also be direct effects on the quality of water for drinking and cooking and changes in soil characteristics, which may in turn affect flatworms infections. Population movements may facilitate the spread of communicable diseases.

An increase in temperature may cause an expansion or a shift in the distribution of vectors to higher latitudes

or altitudes. It could also cause acceleration of the development of parasite stages in a vector.

In the case of malaria, the length of the development cycle for the parasite mosquitoes also varies with temperature, the shortest cycle occurring at 26 C (WHO, 1990).

Large numbers of individuals are currently at risk from major vector-borne diseases. The population at risk from malaria is 2.1 billion, that from schistosomiasis 600 million, and that from lymphatic filariasis 100 million, the respective prevalences being 270 million, 200 million, and 90.2 million (WHO,1990). The distribution of all three of these conditions is likely to be affected by global warming. In areas which border malarial regions or in which malaria is currently endemic, climate change could lead to increase density of vectors.

Drought and desertification in some areas will result in a reduction in density of water-related vectors but may increase the transmission in these regions of diseases such as dracunculiasis (guinea-worm).

Water-borne diseases include diarrheal disease, viral diseases, giardiasis, and amoebic dysentery, they could be affected by lack of access to clean drinking water, which may occur with migration and resettlement all of which could also be affected by poor sanitation (Gillett, 1991).

3. Effects on respiratory diseases

Climate may affect the respiratory tract in several ways. There may be direct effects, specific weather conditions (such as thunderstorms and cold fronts), seasonal effects and combined effects of weather conditions with other environmental or topographical factors. The seasonal effects are acute bronchitis and bronchiolitis are more common in winter in temperate countries. By contrast, asthma and hay fever trend to peak in incidence in the summer months, and there is a second peak of acute asthma in autumn. Thunderstorms can induce asthma attacks and have been responsible for major outbreaks (Ayres, 1990).

4. Effects on food production

The regions that seem most sensitive to the effects of climate change on food production are some semi-arid tropical and subtropical regions and some humid tropical and equatorial regions. Additionally, some regions that are currently major exporters of cereals could be affected by reduced rainfall and thus a decrease in production, which could have important implications for global food prices and food stocks **(**Parry, 1990).

In some part of the world, climatic change could result in the shifting of agricultural borders by 200-300 kilometers per centigrade degree of warming. While there may be some ability to adjust to such changes. The number of very hot days could become significantly more common in some regions. Relatively, small decreases in rainfall or increases in evapo-transpiration could lead to more frequent and more severe droughts in areas already prone to such phenomenon.

Although under controlled conditions higher levels of atmospheric carbon dioxide may speed the growth of some crops such as wheat, rice, and barley. The investigations also found increased starch grain accumulation in the leaves of the plants exposed to the high CO2 level, which could disrupt their function. In addition, there were increased losses of CO2 from the soil and a great loss of nutrients in response to high levels of CO2 (Korner, 1992).

Pollutants such as Ozone, Sulfur dioxide, and nitrous oxide may have adverse effects on crop production. In the case of Ozone damage to crop may begin to show at levels as low as 0.05 ppm for prolong exposure of 16 days or more in the growing season (Brown, 1990).

Climate change also has the potential to affect farm animals. It has been suggested that, in North America

there might be an extension of the horn fly season under some scenarios of climate change. It already causes considerable losses in the beef and dairy cattle industries. There could be an extension of a distribution of the insect carrier of anaplasmosis, a rickettsial infection of ruminants (Rosenzweig, 1998).

5. Effects on food safety

Evidence, information and data are daily published on climate change and its multiple impacts on food safety. These impacts start at the production stage through transport, processing, packing, storage and end at the consumer table. The world has already witnessed the effects of the climatic changes on plant and animal behavior and survival. The consequences of that on both food security and safety are eminent (Ibnoaf, 2010).

With the present continuous and accelerating population increase and the consequent need to more and safe food and with the increase in greenhouse gas emissions which are man-made and the environmental degradation it is observed that losses in life, costs of medical care and lost time due to food borne diseases will be difficult to estimate and therefore, difficult to control. This gloomy situation if continues might lead to a global distraction of the natural patterns that are responsible for sustaining the global health and the human health as well.

United Nations Organizations and relevant sister institutions are increasingly concerned about these impacts and the very high risk of these deleterious effects particularly on poor and least developed countries, that lack the ability of adaptation to the emerging climate changes.

6. Effects on Water Supply

Although its impossible to predict exactly what will happen at a local level as a result of climate change, there is relative confidence in the types of changes that may occur at a continent level. For instance, in North America in 2020, there is predicted to be an increase in rainfall up to 20% in winter and decrease of 5-10% in summer months.

Nearly three-fourths of the water used currently is for agricultural purposes, although salination of irrigated land is quite widespread and climate change could further impair the capacity for development of new irrigation schemes and the maintenance of those currently existing (Myers,1998).

7. Effects on Sea level

The IPCC scientists do not foresee a rise in sea level greater than one meter during the next century. However, in a number of densely populated countries large numbers of relatively impoverished people are threatened by even small rises in sea level. Those countries include, Bangladesh, Egypt, Pakistan, Indonesia, and Thailand. Floods caused the death of millions in many of these countries, in the Ganges Delta in Bangladesh and the Nile Delta in Egypt, 49 million people are potentially threatened. In addition, sea level rise could cause salination of costal areas. Low-lying islands such as the Maldives, might no longer be habitable if sea level were to rise to the mid-range of current projections. (Broadus, 1986).

The global mean sea level has already risen by around between 10-25 centimeters during the past century. According to a number of studies, the sea has been rising at the rate of 1-2 millimeters per year over the past 100 years. Measuring past and current changes in sea level, however, is extremely difficult. There are many potential sources of error and systematic bias, such as the uneven geographic distribution of measuring sites and the effect of the land itself as it rises and subsides.

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It is likely that most of this rise in sea level has been due to the concurrent increase in global temperature over the last 100 years. Global warming should, on average, cause the oceans to warm and expand, thus increasing sea level. Climate models indicate that about 25% of the rise in sea level this century has been due to the thermal expansion of seawater. A second major cause of rising sea level is the melting of land-based ice caps. Presently, it is uncertain to what extent the melting of the Greenland and Antarctic ice caps has contributed to global sea level rise during the 20th century.

Forecasts of a rising sea level are based on climate model results, which indicate that the earth's average surface temperature may increase by up to 5.8°C over the next 100 years. Climate change is expected to cause a further rise of between 9 and 88 centimeters by the year 2100, depending on how future greenhouse gas emissions are uncontrolled. For most scenarios this expected rate of change is significantly faster than that experienced over the last 100 years.

Forecasting sea-level rise, however, involves many uncertainties. While most scientists believe that man-made greenhouse gas emissions are changing the climate, they are less sure about the details, and particularly the speed, of this change. Global warming is the main potential impact of greenhouse gas emissions, but other aspects of the climate besides temperature may also change. For example, some studies suggest that changes in precipitation will increase snow accumulation in Antarctica, which may help to moderate the net sea-level rise. Another complication is that the sea-level would not rise by the same amount all over the globe due to the effects of the earth's rotation, local coastline variations, changes in major ocean currents, regional land subsidence and emergence, and differences in tidal patterns and sea water density.

Nevertheless, some areas of Antarctica have warmed by 2.5°C during the past 50 years, a rate of warming 5 times faster than for the Earth as a whole. Whilst scientists believe this to reflect mostly regional changes in climate, the recent disintegration of the Larsen Ice Shelf has renewed speculation that climatic changes in the high latitudes have the potential to cause severe impacts via a rise in global sea level over the next 100 to 200 years.

1.1. Impacts of Sea Level Rise

7.1.1. Low-lying Islands and Coastal Zones

Higher sea-levels would threaten small islands in the Pacific and Indian Oceans. The projected future rise in sea-level rise may be only tens of centimeters, but the forecasted rise would put millions of people and millions of square kilometers of land at risk. The most vulnerable land would be unprotected, densely populated, and economically productive coastal regions of countries with poor financial and technological resources for responding to sea level rise. Clearly, a rise in sea level would create irreversible problems for low-lying island nations such as the Maldives and the Pacific atolls. The costs of protecting this land from the sea and preventing constant erosion would be enormous. Additional investments would also be needed to adapt sewage systems and other coastal infrastructure. However, some localities, such as shallow ports, would benefit from a higher sea level.

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7.1.2. Groundwater Salination

Groundwater in some coastal regions would become more saline. Rising seas would threaten the viability of freshwater aquifers and other sources of fresh groundwater. Communities may have to pump out less water to prevent aquifers from being refilled with seawater. Coastal farming would face the threat of inundation, freshwater shortages, and salt damage.

7.1.3. Wetlands and coastal rivers

The flows of coastal rivers, and low-lying irrigation systems would be affected, and tidal wetlands and mangrove forests would face erosion and increased salinity. Wetlands not only help to control floods, but they are critical to biodiversity and to the life cycles of many species. While many marshlands would be able to migrate inland as the sea rose, some species would suffer serious losses during the transition. Flat river deltas, which are often agriculturally productive, would also be at risk.

7.1.4. Storm Surges and Flood Damage

The damage caused by floods, storms, and tropical cyclones might worsen. Major harbors areas would experience more frequent flooding during extreme high tides and, in particular, during storm surges. Countries already prone to devastating floods, such as low-lying Bangladesh, would be the most affected. Warmer water and a resulting increase in humidity over the oceans might even encourage tropical cyclones, and changing wave patterns could produce more swells and tidal waves in certain regions.

Light energy from the sun passes through the atmosphere to warm the Earth's surface. In turn, the land and oceans release infrared radiation or heat into the atmosphere, balancing the incoming energy. The blanket of gases covering the Earth traps some of this radiation while the rest is re-radiated towards space. This absorption of heat maintains the Earth's surface temperature at a level necessary to support life. This natural process is called the greenhouse effect. Without heat-trapping greenhouse gases, the surface of the Earth would have an average temperature of -18°C rather than our current average of 15°C. Unfortunately, human actions such as burning fossil fuels and land clearing are increasing the concentration of greenhouse gases in the atmosphere, resulting in an increase in the heat trapped. This is called the enhanced greenhouse effect. The major consequence of this is an increase in temperature on the Earth's surface. The greenhouse effect is different to the hole in the ozone layer. The enhanced greenhouse effect and ozone depletion are two different processes, although some of the same gases contribute to both problems.

Ozone depletion is occurring because CFCs and some other ozone-depleting substances are breaking down the ozone layer above the Earth. The key impact of this is that more of the sun's harmful ultraviolet radiation reaches the Earth, increasing our risk of skin cancer. The 2004 Arctic Climate Impact Assessment reports that the ozone depletion over the Arctic region has been severe and predicts the current generation of Arctic young people will receive a lifetime dose of ultraviolet radiation that is about 30 per cent higher than any previous generation.

While the ozone hole is different to the enhanced greenhouse effect, CFCs are also powerful greenhouse gases that trap heat energy in the atmosphere, adding to the greenhouse problem.

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8. Impacts of Changing Ocean Circulation Patterns

The oceans store an immense amount of heat energy, and consequently play a crucial role in the regulation of climatic patterns. Changes in global surface temperature, therefore may influence ocean circulation and further exacerbate climate changes due to greenhouse gas emissions.

At present, northern-western Europe, including the UK, is warmed by heat carried towards the pole by the Gulf Stream. When the warm water meets cold polar air in the North Atlantic, heat is released to the atmosphere and the water cools and sinks. The bottom water so formed, called the North Atlantic Deep Water (NADW), forms part of the global ocean circulation. A number of the theories have been put forward concerning the role of the NADW for future climate change. Some scientists believe that global warming may reduce the strength of the Gulf Stream, or divert its current path further south. This would have severe climatic consequences for those countries influenced by its warming effect, particularly in winter. Whilst the Earth may warm as a whole, a change in the Gulf Stream could make winters in the UK much colder than at present.

The El Niño ocean circulation, a natural phenomenon, affects the global climate every 2 to 7 years. El Niño is a warm body of ocean water in the eastern equatorial Pacific which brings heavy rainfall to South America and drought to Australia and south-east Asia. Whilst El Niño has been occurring naturally for hundreds, perhaps thousands of years, there is speculation that global warming may change its frequency and intensity. Some climate models have projected that if global warming continues as a result of mankind's greenhouse gas emissions, El Niño may return every year instead of every 5.

9. Other Possible Impacts

Several factors may make major disasters more likely as a consequence of climate change. There may be greater instability of climate, leading to an increased number of storms, although (IPCC) has suggested that, there is no clear evidence whether or not tropical or mid-latitude storm will increase. The rise in sea level combined with current patterns of storms could in itself increase the frequency of major floods. Droughts in the interior of continents could also cause major population shifts.

A number of studies of the survivors of disasters have suggested long-term impacts on mental health. Climate change will occur against a background of other global threats, including stratospheric ozone depletion, increasing poverty, and continuing population growth in many countries. Over 90% of the projected increase in population will occur in developing countries, although in some areas AIDS will have a negative impact on population growth.

An increasing refugees fleeing from environmental degradation can be perceived as threatening the security of weather or less affected countries. For instance, increasing numbers of migrants and refugees from North Africa are already attempting to enter Europe, and the flow of people from Central and South America to North America could increase to an even higher level than it is present (Anderson, 1988).

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10. Predictions for the future

Further climate change is anticipated as concentrations of greenhouse gases in the atmosphere continue to rise. In its Third Assessment Report, the (IPCC) concludes that, the impacts of climate change will become increasingly detrimental for more of the world's regions and systems as the extent of global warming increases.

A report into climate change in 2008 predicted that, fewer frosts but more-frequent droughts, heat waves, rainstorms and strong winds. The report found a worst-case scenario could see a 70 per cent increase in drought frequency by 2030.

It also predicts more-intense and more-frequent extreme rainfall events to coastal eastern Australia in the next 40 years. Extreme rainfall events cause significant damage from flooding each year affecting the increasing urban population in these coastal regions.

Australia is in danger of losing flora and fauna in unique ecosystems that are particularly vulnerable to climate change such as high mountainous regions. A 2004 Australian Greenhouse Office Report on the Potential effects of global warming on the biota of the Australian Alps predicts that rare and sensitive small mammals, such as the Mountain Pygmy possum, adapted to the extremes of winter, are particularly under threat.

Australian soils and climate and land-management practices are unique - the findings of overseas research do not always apply in the Australian environment. The CRC for Greenhouse Accounting is examining the effects of climate change from the level of individual plants and soils up to the continental scale under Australian conditions to ensure we have the most applicable data and can develop greenhouse mitigation strategies suitable for Australia.

The specific predictions include:

- Continuing global warming - a rise of the Earth's temperature from 1.4°C to 5.8°C by 2100
- Changes in weather and climate - e.g. more severe droughts and floods
- Greater rises in sea level - from 9 to 88 cm by 2100

The likelihood of European summer temperatures reaching the extremes of the heat wave of 2003 is projected to increase 100-fold over the next four decades. Under the worst case scenario Europe could have similar heat waves every other year.

Many species of plants, birds and animals are predicted to become threatened or extinct as climate change alters habitat, access to food resources, species distribution and interaction with other species.

Even if greenhouse gas emissions were drastically reduced today, the effect of global warming is predicted to continue to cause major physical, ecological, sociological and economic impacts around the world. Greenhouse gases are long lasting. For example, the IPCC reports that several centuries after carbon dioxide emissions occur, around one quarter of the resulting increase in carbon dioxide concentration will remain in the atmosphere.

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Although the evidence supporting human-induced global warming and climate change is mounting, many uncertainties still remain. The interaction of the multiple changes occurring and their potential flow-on effect is not completely understood and further research is needed to monitor the current situation and improve predictions for the future.

The Cooperative Research Centre for Greenhouse Accounting is contributing to world knowledge about the impact of climate change on plant growth, nutrient uptake, plant responses to stress, changing distribution of species and changes in the water cycle.

Conclusion

Global climate change can have direct and indirect effects on human health. The most worrying impacts are those on availability of water and food and sea-level rise, but the direct effects of temperature on diseases patterns, on the vector of communicable diseases, and on the patterns of respiratory disease also give rise to concern.

In any event, it seems clear that the potential magnitude of the effects indicates the need for major policy changes now. It has been suggested, for instance, that in order to cut annual carbon emissions worldwide to around 2 billion tons, the average per-capita emissions of carbon would have to be around one-eighth of the current European level by 2030 (Brown, 1990). This would require measures far beyond those currently being discussed at a governmental level. Health professionals can play an important role in informing the debate about the need to minimize climate change by investigating further the potential impacts of global warming on health, and by disseminating information about the potential areas of concern (Last, 1993).

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