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Climate Change and Health: An Appraisal on Implications for Research, Monitoring and Policy.

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Abstract.

The impact of climate change on the various sectors was appraised and the findings showed that climate stress on agriculture may mean up to 300 million additional victims of malnutrition world-wide each year(Ojoye, 2006). Extreme floods and drought are projected to become more severe as global warming worsens. These extremes were found to be responsible for the non availability and supply of safe drinking water. Diseases associated with flooding, could affects millions more people every year. Extreme weather events, like the abnormal storms and flooding that have devastated many communities' across the country in recent times. The world's leading authority on global warming, the intergovernmental panel on climate change (IPCC) has concluded that unchecked global warming will cause a significant increase in human mortality due to extreme weather and infectious disease. Malaria could become even more common as global warming worsens, it was projected that a warmer temperatures spread north and south from the tropics, and to higher elevations, malaria carrying mosquitoes will spread with them.

Introduction.

Global warming and climate change in Perspectives

Global warming and climate change refer to an increase in average global temperatures. Natural events and human activities are believed to be contributing to an increase in average global temperatures. This is caused primarily by increases in "greenhouse" gases such as Carbon Dioxide (CO_2).

What is the Greenhouse Effect?

The term *greenhouse* is used in conjunction with the phenomenon known as the *greenhouse effect*.

- Energy from the sun drives the earth's weather and climate, and heats the earth's surface;
- In turn, the earth radiates energy back into space;
- Some atmospheric gases (water vapor, carbon dioxide, and other gases) trap some of the outgoing energy, retaining heat somewhat like the glass panels of a greenhouse;
- These gases are therefore known as greenhouse gases;
- The greenhouse effect is the rise in temperature on Earth as certain gases in the atmosphere trap energy.

Six main gases considered to be contributing to global climate change are carbon dioxide (CO_2), methane (CH_4) (which is 20 times as potent a greenhouse gas as carbon dioxide) and nitrous oxide (N_2O), plus three fluorinated industrial gases: hydro fluorocarbons (HFCs), per fluorocarbons (PFCs) and sulphur hexafluoride (SF6). Water vapor is also considered a greenhouse gas.

Many of these greenhouse gases are actually life enabling, for without them, heat would escape back into space and the Earth's average temperature would be a lot colder. However, if the greenhouse effect becomes stronger, then more heat gets trapped than needed, and the Earth might become less habitable for humans, plants and animals.

Climate change and human health.

In environmental health there is a close relation between epidemiological research and those monitoring activities, which seek evidence of changes in the environmental

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or health status of populations. A distinction is usually made between monitoring and surveillance, the latter being the continuing standardized recording of the occurrence of disease. In the context of climate change and health, however, both monitoring and surveillance are needed to:

- Identify important changes in disease incidence, health risk indicators, or health status;
- Determine whether these changes are likely to be the result of local, regional, or global environmental changes;
- To help develop countermeasures and assess their effectiveness; and
- To develop hypotheses about the potential health effects of climate change. Monitoring should also help in the detection of unexpected events

The Research Challenge.

Since there is uncertainty about the profile and rate of future climate change it is necessary to estimate effects on health in relation to specified probable climate scenarios. This process differs in several important ways from the more familiar empirical procedure of quantitative risk assessment. The latter is usually conducted in relation to some existing index of environmental exposure for which there is prior empirical evidence of direct (usually toxicological) health risks across an exposure range which includes the index exposure.

The three main approaches to health risk assessment based on scenarios are extrapolation based on specific (historical) analogue situations for some aspects of climate change; formal integrated mathematical modeling; and generalized assessments drawing on expert judgment of the range of health consequences (physical, microbiological, and psychological) of diffuse and complex demographic, social, and economic disruption.

Summarily entails on.

- Health risk assessment based on scenarios encompasses extrapolation, integrated mathematical modeling, and generalized assessments of the consequences of demographic, social, and economic disruption
- Uncertainty is unavoidable because of such factors as the unpredictability of future industrial activities, and differences in sensitivity of disease systems and vulnerability of populations to climate change
- Monitoring of health indicators and disease surveillance activities must be integrated with global observing systems currently being developed for climate change and its impact
- The potentially serious effects of climate change on health heighten the urgent need for policies to limit greenhouse gas emissions

Historical Analogues

Historical analogues probably come from recent times, although earlier documented experiences may also be informative. Most useful are those situations, which seem to simulate aspects of future climate change. For example, epidemiologists have begun to study the regional health consequences of the worldwide climatic fluctuations associated by "teleconnection" (remote linkages) with the El Niño southern oscillation.

El Niño events—partial analogues for future climate change?

- The El Niño southern oscillation is a large, irregular, unstable

atmosphere-ocean system, which produces relatively short-term climate changes over the Pacific region.

- Events related to the El Niño southern oscillation (that is, El Niño warm events and La Niña cold events) strongly influence climate variability between years and are associated with regional land and sea surface warming, changes in precipitation and in the occurrence of tropical cyclones.
- These anomalies impinge primarily on countries bordering the Pacific and Indian Oceans but also affect other continents.
- El Niño events can affect human health—epidemics of malaria and dengue fever are more likely to occur in the year of an El Niño event or in the year following; the occurrence and distribution of harmful coastal algal blooms is also associated with El Niño events.
- Weather disasters are twice as frequent worldwide during the year of an El Niño event.

These studies can be useful in assessing the vulnerability of populations to climate change, although the relatively short time scale makes direct extrapolation to the effects of global warming on health difficult.

Dealing with uncertainty

As with all forecasting, assessing the impacts of global climate change entails unavoidable uncertainties. These uncertainties arise from the intrinsic unknown element in future trends in human industrial, demographic, and trading behaviour; from the nature of the non-linear and interactive relations within the various complex natural systems; and from the variable (and population specific) sensitivity of the health outcome to the change in climate and environment. Uncertainty also arises from the stochastic nature of the biophysical systems being modeled.

Differences in vulnerability between populations are another source of variability. These occur because of the heterogeneity and changeability of human culture, social relations, and behaviour. As Balbus and Patz state: "While a given disease system may be particularly *sensitive* to the effects of climate change based on biological or physiological characteristics, the ultimate *vulnerability* of a given population to that disease may be considerably lessened by adaptive responses." Some populations and geographical regions will be particularly vulnerable. For example, populations whose food supplies are insecure are vulnerable to downturns in agricultural productivity caused by climatic factors, and people living on the edge of regions where infectious diseases borne by vector organisms are endemic are most likely to experience the early extensions in range of these diseases.

Another dimension of complexity in the assessment task results from the interplay of several environmental stresses that are coexistent. Interaction between local environmental degradation and changes on a larger scale—climate change, population growth, and loss of biodiversity—may significantly influence the effects on health. For example, local deforestation caused by increased population pressure may directly change the distribution of vector borne diseases while also causing a local increase in temperature (in addition to its contribution to a global temperature increase by depleting one of the biosphere's great carbon dioxide "sinks").

Major Research Needs.

Important research needs include the following:

- Improvements in mathematical models for predicting the impact of climate change on health, including higher resolution to enable local and regional impact assessments to be made with more emphasis for further studies to;

(a) Distinguish more clearly between the effects on health of climate and of air pollution;

(b) Determine the extent to which, in different regions, a reduction in mortality related to cold might offset the impact of more frequent heat waves; and

(c) Assess the longer term health effects, if any, on populations living in locations with different climates;

- Analysis of infectious disease epidemics associated with recent regional changes in climate, using these as analogues of future climate change. For example, a systematic examination of vector borne outbreaks in regions affected by climatic events related to the El Niño southern oscillation would improve our understanding of the relations between climate and health;
- For vector borne diseases, there is a need for basic laboratory and field investigations of arthropod vector ecology and pathogen infectivity at raised temperatures and varying humidity and ecological studies on the climate sensitivity of diseases in locations at the margins of endemic areas;
- Assessment of how changes in food production—as a result of climate and weather changes, increased ultraviolet irradiation, sea level rise, changes in pest ecology, and socioeconomic shifts in land use practices—could affect human health and nutrition;
- Study of the association of extreme climatic events with global warming and the occurrence of disasters affecting large human populations;
- Modeling studies of the potential public health implications of forced migration from climatically vulnerable regions;
- Ecological studies of the range of possible public health impacts of reductions in biodiversity related to the climate;
- Assessment of the potential health impacts of strategies to mitigate greenhouse gas emissions (for example, the health risks of biomass fuels).

Monitoring for changes in health related indices.

- Global observation systems

The monitoring of health effects should be integrated with global observation systems that are currently under development. The Global Climate Observing System is a joint initiative of the World Meteorological Organisation and other international agencies and will encourage the development of coordinated climate observations by national and international organizations. Its coverage will exceed that of current monitoring programmes, such as Global Atmosphere Watch and World Weather Watch, which comprise a network of satellites, telecommunications and data processing facilities. The Global Ocean Observing System, operated by the Intergovernmental Oceanographic Commission of UNESCO, includes monitoring of sea level rise, sea surface temperature and, eventually, biological measures such as the phytoplankton

concentration. The Global Terrestrial Observing System is being established under the auspices of the United Nations Environment Programme (UNEP) and other international agencies. It will be used to detect and monitor response of terrestrial ecosystems to global change including new patterns of land use and climate change.

Ecosystem monitoring

It has been increasingly recognised that ecosystems have important influences on human health—for example, through changes in key indicator species such as insects and rodents, this may have both direct and indirect effects. Algal blooms in marine ecosystems can act as reservoirs for certain pathogens including *Vibrio cholerae*. Monitoring indicator species could help our understanding of important links between climate change and its effects on health.

Remote sensing

Remote sensing, particularly by satellites, can be used to monitor a range of variables relevant to climate change, including sea surface temperatures, algal blooms and changes in terrestrial ecosystems. For example, vegetation indices produced by high-resolution radiometry have been correlated with mortality and the population density of tsetse flies. Data from remote sensing may need to be validated by local data on the vector organisms and diseases of interest. The table summarises a framework for the development of monitoring systems for the health impacts of climate change

General and specific policies to reduce climate change or its impacts

Agriculture

- Reduced land conversion through improved farming techniques
- Improved tillage to reduce fossil fuel combustion
- Improved feed use for ruminants to reduce methane emissions
- Reduced biomass burning

Forestry

- Reduced deforestation with concurrent improvement in agricultural productivity (tropical forests have maximal potential for sequestering carbon)
- Regeneration of degraded lands for reforestation

Human settlements

- Buildings with improved thermal integrity
- Condensing furnaces and heat exchangers
- Solar water heaters and insulated water storage
- Financial incentives for energy conservation
- Building codes and utility regulations
- Planting shade trees to reduce "heat islands"

Energy supply

- More efficient power generation
- Natural gas turbines in place of oil or coal
- Gasification of fossil fuels before combustion
- Alternative energy sources (solar, wind, geothermal energy, etc)

Industry

- Cogeneration and steam recovery
- Alternative materials (e.g., replace concrete with wood)

Transportation

- Improved public transport
- Facilitation of cycling and walking
- Urban traffic control for shorter transit times
- Use of ethanol and methanol fuels

Policy Implications:

The implications of climate change for public policy are wide ranging. Mitigation options aim to reduce greenhouse gas emissions or to increase carbon dioxide sinks—for example, by promoting reforestation. Some options directly affect health, such as the promotion of bicycling, which would increase fitness and lower cardiovascular risk while helping to reduce carbon dioxide emissions. Renewable energy sources should be assessed for their impact on health since some may have adverse consequences. Hydroelectric dams for example may cause population displacement and social disintegration.

Population growth is an important driving force of climate change. It is estimated that half of the increase in carbon dioxide emission between 1992 and 2022 will be a result of population growth. Although most will occur in developing countries, any growth in developed countries is an important contributor because of the much higher per capita consumption of fossil fuels. Currently only around 1% of international donor aid is spent on family planning, whereas just 2-3% would give worldwide access to contraception. Policies such as these, which meet short-term local needs as well as long-term environmental goals, should be priorities for implementation.

Tension between the priorities of conventional economics and environmental Protection has led to the development of "environmental economics." This attempt to assign a market value to the otherwise uncounted costs of the adverse impact of environmental degradation. "Ecological economics" seeks to incorporate the concept of sustainability and thus to avoid compromising the health and survival of future generations. There is clearly a need for greater public and professional debate about the long-term consequences of climate change and the balance between the immediate economic impact of mitigation strategies and their potential to reduce the impact on health and well being in the future.

Finally, global environmental hazards to health should feature in school curricula since much of the anticipated impact on health would occur within the coming decades. Meanwhile, in the spirit of primary prevention, health professionals should advocate to policy makers early application of strategies to minimize climate change in order to limit the anticipated impact on health. That impact, mediated through disruption to life supporting biophysical systems, has unprecedented importance for the sustainability of human health.

Conclusion.

Regional climate stress on agriculture may mean up to 300 million additional victims of malnutrition world-wide each year. Extreme floods and drought are projected to become more severe as global warming worsens. These extremes may threaten the availability and supply of safe drinking water. Diseases associated with flooding, could affects millions more people every year. Extreme weather events, like the abnormal storms and flooding that have devastated many communities' across the country in recent times.

The world's leading authority on global warming, the intergovernmental panel on climate change (IPCC) has concluded that unchecked global warming will cause a significant increase in human mortality due to extreme weather and infectious disease. Malaria could become even more common as global warming worsens, it was projected that a warmer temperatures spread north and south from the tropics, and to higher elevations, malaria carrying mosquitoes will spread with them.

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Lastly, Global warming will have numerous damaging impacts on human health, spreading infectious diseases, longer and hotter heat waves and extreme weather will all claim thousands of additional lives nationwide each year. If global warming continues unabated, both we and our children will pay a terrible price.

We simply cannot afford to ignore the global warming problem

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