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GLOBAL WARMING AND AGRICULTURE PRODUCTIVITY

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GLOBAL WARMING

Global warming is the increase in the average measured temperature of the Earth's near surface air and oceans since the mid-20th century, and its projected continuation .The average global air temperature near the Earth's surface increased randomly during the 100yr .

EFFECT ON GLACIERS

Global Warming is melting glaciers in every region of the world, putting millions of people at risk from floods, droughts and lack of drinking water. Glaciers are ancient rivers of compressed snow that creep through the landscape, shaping the planet's surface. They are the Earth's largest freshwater reservoir, collectively covering an area the size of South America. Glaciers have been retreating worldwide since the end of the Little Ice Age (around 1850), but in recent decades glaciers have begun melting at rates that cannot he explained by historical trends.

Projected climate change over the next century will further affect the rate at which glaciers melt. Average global temperatures are expected to rise I.4-5.8°C by the end of the 21st century. Simulations project that a 4°C rise in temperature would eliminate nearly all of the world's glaciers (the melt-down of the Greenland ice sheets could be triggered at a temperature increase of 2 to 3°C). Even in the least damaging scenario — a 1°C rise along with an increase in rain and snow — glaciers will continue to lose volume over the coming century.

Although only a small fraction of the planet's permanent ice is stored outside of Greenland and Antarctica, these glaciers are extremely important because they respond rapidly to climate change and their loss directly affects human populations and ecosystems. Continued, widespread melting of glaciers during the coming century will lead to floods, water shortages for millions of people, and sea level rise threatening and destroying coastal communities and habitats

REGIONS AT RISK

- Ecuador, Peru and Bolivia — where shrinking glaciers supply water year-round, and are
- often the sole source of water for major cities during dry seasons.
- The Himalayas — where the danger of catastrophic flooding is severe, and glacier-fed rivers supply water to one third of the world's population.
- Small island nations such as Tuvalu and some of the Solomon Islands — where sea level rise is submerging low-lying land and saltwater is inundating vital groundwater reserves.

NATURE AT RISK

- habitat as the Sundarbans succumb to sea level rise.
- Royal Bengal tiger — endangered tigers that will lose a large portion of their worldwide

- Kittlitz's murrelet —rare birds specialized to hunt in cloudy glacier water and nest on top of ice.
- Coral reefs — unique organisms that can be starved of energy from the sun when sea levels rise.
- Dramatic changes can be seen over a 23 year period at the Aletsch Glacier in Valais, Switzerland. Back in 1979, the Valais, Switzerland. Back in 1979, the end of the glacier reached far down the mountain slopes. By 2002, considerable glacier retreat is visible. The glacier's end is nearly out of sight and new vegetation is covering the slopes.

MEASURING GLACIER LOSS

The most accurate measure of glacier change is mass balance, the difference between accumulation (mass added as snow) and ablation (mass lost due to melting or calving off of chunks). Even if precipitation increases, mass balance may decline if warmer temperatures cause precipitation to fall as rain rather than snow. Mass change is reported in cubic meters of water lost, or as thickness averaged over the entire area of the glacier. Because mass changes are difficult to measure, glacier shrinkage is more often described as a loss of glacier area, or as the distance the front (terminus) of the glacier has retreated.

HABITAT LOSS

While many species are likely to be affected by changes in stream flow and sea level associated with glacier melting, animals that dwell on or near glaciers may be pushed towards extinction by the disappearance of their icy habitats. Far from being barren expanses of ice, glaciers are home to some of the most unique organisms and ecosystems on Earth.

For example, the tiny ice worm spends its entire life on ice, roaming over glaciers at night, feeding on glacial algae, and occasionally being snatched up by a hungry snow bunting46. The physiological adaptation that allows these worms to survive at 0°C remains unknown, and because these worms disintegrate at temperatures over 5°C, their secret may be lost as temperatures rise and their glacial habitat melts away. Even animals that do not live directly on glaciers can be severely affected by their disappearance. Kittlitz's murrelet, for example, is a small, diving seabird that forages for food almost exclusively in areas where glacial meltwater enters the ocean. These birds are already in serious trouble; their global population (located mostly in Alaska) is thought to have plummeted from several hundred' thousand in 1972 to less than 20,000 in the early 1990s41. Several conservation groups have filed a petition to declare Kittlitz's murrelet an endangered species, citing climate change and the loss of critical glacier-associated habitat as one of the primary reasons for the species' decline

CONTAMINANTS

Although persistent organic pollutants (POPs) such as PCBs and DDT are widely banned today, they were used extensively in the middle of the last century. These long-lived pollutants are transported in the air from their source to cooler areas where they condense and are deposited in glacial ice. Until recently, these compounds had remained trapped in the ice, but rapid melting has begun to release them back into the environment. For example, in one Canadian lake, glacial meltwater is the source of 50-97 per cent of the various POPs entering the lake17. At least 10 per cent of this glacial melt is from ice that was deposited between the 1950s and 1970s, as shown by the presence of tritium, a by-product of nuclear bomb tests conducted during this era.

GLACIERS EFFECT ON ASIA REGION

The vast majority of all Himalayan glaciers have been retreating and thinning over the past 30 years, with accelerated losses in the last decade. For example, glaciers in the Bhutan Himalayas Are now retreating at an average rate of 30-40 m per year. In Central

Asia, glaciers are wasting at exceptionally high rates. In the northern Tien Shan (Kazakhstan), glaciers have been collectively Losing 2 sq km of ice (0.7 per cent of their total mass) per year since 1955, and Tuynksu glacier has receded nearly a kilometer since 1923. Glaciers in the Ak-shirak Range (Kyrgyzstan) have lost 23 per cent of their area since 1977, similar to area losses in the northern Tien Shan (29 per cent from 1955-1990) and the Pamirs (16 per cent from 1957-1980). In the Chinese Tien Shan, Ununqihe Glacier lost the equivalent of 4 m ice thickness from 1979-199524, and the Chinese Meteorological Administration predicts that China's north western mountains will lose over a quarter of their current glacier coverage2050. These glaciers supply 15-20 per cent of the water to over 20 million people in the Xinjiang and Qinghai Provinces alone.

WATER SHORTAGES

Seventy percent of the world's freshwater is frozen in glaciers, which buffer ecosystems against climate variability by releasing water during dry seasons or years. In tropical areas, glaciers melt year-round, contributing continuously to stream flow and often providing the only source of water for humans and wildlife during dry parts of the year. Freshwater is already a limiting resource for much of the planet, and in the next 30 years population growth is likely to far exceed any potential increases in available water.

The Himalayan glaciers that feed seven of the great rivers of Asia (the Ganga, Indus, Brahrnaputra, Salween, Mekong, Yangtze and Huang He) and ensure a year-round water supply to 2 billion people are retreating at a startlingly fast rate. In the Ganga, the loss of glacier meltwater would reduce July-September flows by two thirds, causing water shortages for 500 million people and 37 per cent of India's irrigated land. In the northern Tien Shan mountains of Kazakhstan, more than 90 per cent of the region's water supply is used for agriculture and 75-80 per cent of river runoff is derived from glaciers and permafrost, which are melting at accelerated rates. In the dry Andes, glacial meltwater contributes more to river flow than rainfall, even during the rainy season. Most large cities in Ecuador,

Peru and Bolivia rely on meltwater from rapidly disappearing glaciers for their water supply and hydroelectric power, and many communities are already experiencing shortages and conflicts over use.

FLOODING

Rapid melting of glaciers can lead to flooding of rivers and to the formation of glacial meltwater lakes, which may pose an even more serious threat. Continued melting or calving of ice chunks into lakes can cause catastrophic glacial lake outburst floods. In 1985, such a flood at the Dig Tsho (Langmoche) Lake in Nepal killed several people and destroyed bridges, houses, arable land. and a nearly completed hydropower plant. A recent UNEP study found that 44 glacial lakes Nepal and Bhutan are in immediate danger of overflowing as a result of climate change.

In Peru, a chunk of glacier ice fell into Lake Palcacocha in 1941, causing a flood that killed 7000 People; recent satellite photos reveal that another chunk of loose ice is poised over this lake, Threatening the lives of 100,000 people below 7.

EFFECT ON AGRICULTURE PRODUCTIVITY

With global warming one fourth of the total arable land in the world has become barren .If the present trend of global warming continues 70 per cent of land in the drought prone areas in the world would become barren. This would affect adversely more than 1.00billion people in about 100 countries. Unabated global warming will reduce global agricultural capacity at least modestly by late in this century, contrary to some estimates that it will benefit global agriculture over that period. The damages will be the most severe and begin the soonest where they can least be afforded: in the developing countries. The losses will be much larger if carbon fertilization benefits fail to materialize, especially if water scarcity limits irrigation.

Temperatures in developing countries, which are predominantly located in lower latitudes, are lready closer to or beyond thresholds at which further warming will reduce rather than increase agricultural capacity, and these countries tend to have less capacity to adapt. Moreover, agriculture accounts for a much larger share of GDP in developing countries than in industrial countries, so a given percentage loss in agricultural potential would impose a larger income loss in a developing country than in an industrial country. This study starkly confirms the asymmetry between potentially severe agricultural damages in many poor countries and milder effects in rich countries.

A small amount of warming through, say, the next two or three decades might benefit global agriculture (with some countries gaining more than others). But it would be a serious mistake to do nothing about global warming on grounds that some studies have estimated global agricultural gains rather than losses for the first few degrees of warming. The delay of some three decades for ocean thermal lag before today's emissions generate additional warming is a sufficient reason not to stop the clock at, say, 2050 in an analysis of the stakes of climate change policy for world agriculture over the coming decades. This study therefore chooses the f i nal three decades of this century (the "2080s" for short) as the relevant period for analysis.

Cline uses two types of agricultural impact models, "Ricardian" statistical economic models and process based agronomic crop models, combined with leading climate model projections, to develop comprehensive estimates for over 100 countries, regions, and regional subzones in the largest countries. He develops a "consensus" set of geographically detailed estimates for changes in temperature and precipitation by the 2080s and applies these climatic changes to the agricultural impact models.

Increase in yields as a result of increased concentration of carbon dioxide in the atmosphere. Warming at the ocean's surface is initially partially dissipated through heat exchange to the cooler lower layers of the ocean. Only after the lower levels warm sufficiently to reestablish the equilibrium differential from the surface temperature does the "committed" amount of warming from a given rise in carbon concentration become fully "realized." However, damages could continue to grow throughout the following two centuries before atmospheric concentrations of carbon eventually begin to decline once again from mixing into the deep ocean. Even if carbon emissions collapsed after the 2080s back to well below today's levels, the delay of some three decades for ocean thermal lag means that the warming and effects estimated in this study would substantially underestimate the eventual equilibrium warming and damages.

He estimates global agricultural output capacity (including carbon fertilization) to decline by about 3 percent by the 2080s. But if the carbon fertilization effect did not materiali7e, the losses would be at about 16 percent. These losses would be disproportionately concentrated in poor countries. On average, developing countries would suffer losses of 9 percent. Damages would be severe in Africa (17 percent average loss), Latin America (13 percent average loss), and South Asia (30 percent average loss in India and 20 percent in Pakistan). The losses would be much larger

If the benefits from carbon fertilization did not materialize (averaging about 21 percent for all Developing countries, 28 percent for Africa, and 24 percent for Latin America) The findings of this Study strongly suggest that policymakers in both industrial and developing countries should ensure. That international action begins in earnest to curb global warming from its "business as usual" path. Moreover. illustrative summary calculations suggest it would be a serious mistake to downplay the risks of future agricultural losses from global warming on grounds that technological change, for example in new seed varieties, will swamp any negative climate effects.

SOLUTIONS

Worldwide, accelerating glacier loss provides independent and startling evidence that global warming is occurring. It is now clear that the Earth is warming rapidly due to man-made emissions of carbon dioxide and other beat-trapping gases, which blanket the planet and cause temperatures to rise. Climate change is already happening, but we can strive to keep global warming within tolerable limits if we act now. Based on scenarios of projected damage to ecosystems and human communities, WWF seeks to limit global warming to a maximum of 2°C over pre-industrial levels. Although a warming of 1-2°C will clearly threaten human health, water supplies and vulnerable ecosystems, a warming of at least 1°C appears unavoidable. Warming beyond 2°C is likely to result in rapidly escalating damages, with severe threats to human populations and the loss of unique and irreplaceable ecosystems. It is therefore imperative that emissions of the main heat-trapping gas, carbon dioxide (CO_2), are significantly reduced, in order to avoid exceeding this 2°C threshold. The majority of CO_2 pollution is released when fossil fuels such as coal, oil and natural gas are burned for transportation, heating, or the production of electricity. Coal is particularly damaging, as it produces 70 per cent more CO_2 emissions than natural gas for the same energy output. Electricity generation is the single largest source of manmade CO_2, amounting to 37 per cent of worldwide emissions.

WWF is challenging the electric power sector to become CO_2-free by the middle of this century in industrialized countries, and to make a significant shift towards that goal in developing countries. A number of power companies have already signed on to WWF's vision, but in order to reduce emissions significantly, power utilities, financial institutions, consumers, and policy makers must all play a role:

- Utilities can support meaningful global warming legislation, improve the energy efficiency
- of power plants, increase their use of renewable energy sources, and halt investment in new coal plants and coal mining.
- Financial institutions can call upon the companies they invest in to disclose their emissions
- policies, and switch their investments to companies that are striving to be more competitive under future limits on carbon emissions.
- Electricity consumers should opt for "green power" where it is available, demand this
- choice where it is not, and invest in highly efficient appliances.
- Policy makers must ease the transition to a carbon-free energy industry by passing legislation

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