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A MATTER OF EQUITY

Abstract: Climate is Earth's most valuable resource. It should be protected for future generations to the extent that humans are capable. Equity demands both a fair sharing of the resource as well as a fair sharing of the responsibility for sustaining it. Climate change impacts are and will be unequally distributed. Developing countries which are synonymous with the tropics will be at least three times more vulnerable to the adverse impacts of climate change than developed countries. In the short term, most of the benefits of global warming will be reaped in the middle latitudes. The Framework Convention on Climate Change may never be realised unless the equity problem is resolved.

Key words: climate change, equity, anthropogenic climate forcing.

1. Introduction

On Earth, we see our planet one piece at a time. Each „pixel" is unique; it is most likely owned. From space Earth is seen as one piece similar to how we see other planets from here; it is owned collectively by humanity. Two elements connect the Earth and its peoples. The atmosphere which extends from the ground to near space contains gases which make life on Earth possible. Life will not occur, at least not as we know it, without oxygen. Life is also not possible without carbon dioxide. The atmosphere contains a highly variable gas known as water vapour whose most important role is to renew and refresh the Earth as no other gas is capable of and does so over time scales that can vary from many seconds to several millennia. The second „element", the ocean, girdles the Earth in much the same way as does the atmosphere. It is not everywhere but its influence can be felt everywhere. Forced externally by energy from the sun, those two elements combine to create weather and climate. They also cause them to vary over space and time such that weather and climate predictions are best when they are based on coupled atmosphere-ocean models.

Climatologists are not being arrogant when they claim that climate is Earth's most valuable resource. Climate has an outstanding correlation with human development and with humanity itself. Historically, civilisation advanced when climate was favourable and waned when it was not. In China, for example, the Tang Dynasty peaked during a warm period (between the 7th and 10th centuries) while famine and decline prevailed especially in the north during the Little Ice Age. Similar correlations can be found in every continent. But even when it was not deemed favourable, the last ice age for example, climate was renewing Earth. New environments were created which today serve the Earth well. The Great Lakes which contain about 25% of the world's fresh water resources and home to some of the world's biggest industrial complexes is a product of a „bad" climate. It may be easy to divide climate into good and bad in the short term. It is not so easy doing so for the long term. Equally, it may be easy to determine who is winning in the present climate and who is losing; but those who win today may be succeeded by a future generation who will see themselves as losers. Climate is a sacred trust. It should be protected for future generations to the extent that humans are capable. Today, the rewards of a resource to which every part of the planet contributes significantly, even if differently, are not evenly shared. Some parts of the planet use and abuse the resource to a greater degree than they deserve while others suffer downstream consequences of the abuse. Equity demands both a fair sharing of the resource as well as a fair sharing of the responsibility for sustaining it.

2. Principles of Climate Differentiation

Climate differentiation is driven primarily by the uneven distribution of solar energy over the Earth. The heaviest heat load is in the tropics; the smallest at the poles. The consequence is a hot tropics and a cold poles. To maintain stability in climate everywhere, there must be a net flux of energy polewards. This occurs through the atmosphere and the oceans. The moderate climates which prevail between the poles and the tropics owe their qualities to outflows from the two zones. The temperate zone as these in - between places are described contains the world richest nations. It is not an accident, nor is it simplistic to suggest, that climatic resources play a very significant role in creating wealth in the temperate zone.

Tab. 1. Sensible and latent heat flux poleward across the latitude Circle (10^{17} Joules per day) and average per capita GDP (US$).

Latitude	Sensible heat	latent heat	Per capita GDP
0 – 30	104	20.8	1360
31-60	217	54.3	19 020
61-90	65	14.1	1035*

Adjusted for occupied land area

Table 1 shows that the wealthiest places on Earth are the largest sinks for heat and water vapour originating from the tropics. Indeed the line that separates the developed from the underdeveloped world follows latitude 23° almost faithfully. Developed is poleward of the line, the underdeveloped is equator-ward. A second line can be drawn just poleward of the Arctic Circle

with similar outcomes. The latitudes which receive the largest energy imports benefit far more than those which export them. Thus there is an invisible redistribution of one of earth's most vital resources with disproportionate benefits. Those benefits are hidden in differences in technology, food production and nutrition, and in health. What price does society place on this „trade" in atmospheric resources? Should there be a fair price for the energy transported across latitudes or is the atmosphere merely an externality to be used by all as they see fit? Is it a common good when the advantages are so heavily weighted in favour of one group? These questions are pressing because of changing climatic patterns and their consequences. What is changing the climate? What is driving the change? Who are the winners? Who are the losers? What role should equity play in restoring some balance to a climate system that is under siege?

3. A Changing Climate

Climate has changed several times in the long history of Earth. Perhaps the closest humanity has come to living under a prolonged change is the „Little ice Age". However, that event which lasted from about 1570 to 1850 depending on location, occurred when human population was much smaller than it is today. Although it evolved at a rate much slower than that anticipated for the new climate which many believe we are on the threshold of, evidence points to very significant slowing of economic activities in Europe and Asia during that period. It is again no accident that some of the biggest waves of out migration from Europe to new worlds that were much warmer occurred over that period.

The evidence is increasingly compelling that this new century will have a climate different from the last one. Here are some of them:

– Annual global temperature warmed by 0.57°C from 1861 to 1997. From 1901 to 1997, the gain was 0.62°C. The warmest years on record all occurred in the 1990s: in descending order, they were 1998, 1997, 1995, and 1990. The average gain above the 1961-1990 normal ranged from 0.57°C in 1998 to 0.35°C in 1990.
– Need say it again, 1998 was the warmest year on record so far as there is complete data. All indications are pointing to 1999 being the warmest.

The models appear to have called it right. Warming in the northern hemisphere is amplifying polewards with a decidedly winter bias. Canada's „polar" climate warmed 1°C over the past century (annual); 1.2°C in the winter. In 1998, nationwide, Canada's surface air temperature rose 2.3°C with areas in the Arctic experiencing annual temperature increases of more than 4°C.

– Observed *rate* of warming is unprecedented in the last 600 years.
– World glaciers are shrinking at a faster rate than ever before. Several have vanished.
– In Spain the number of glaciers has dropped from 27 to 13.
– In the Caucasus mountains of Russia, about half the glacial ice has been lost in the last century.
– Also the Alps.
– Glaciers in New Zealand have shrunk by a quarter.
– And in equatorial Africa, Kilimanjaro has lost 75% of its glacier, Mount Kenya, 92%.

– The sky is falling. The ionosphere has dropped 8 meters in the last 40 years. The top of the atmosphere is now about 298 km above the Earth. The slump is generally attributed to cooling at the roof of the air layer, a sure sign that heat from earth's surface is being held more effectively close to the ground.
– At the top of Canada, the Arctic High Pressure is losing its punch, so is the Arctic front.

4. Anthropogenic Climate Forcing

That humans affect climate in various ways is well known. Homes are built to create an acceptable climatic environment for its residents. Once built it can be manipulated to adjust to conditions prevailing outdoors. Collectively, houses when they occur in large groups have the capacity to change the local climate around them. The heat island phenomenon is a well known human impact. Those activities which have produced such measurable effects at local and regional scales have the potential of creating similar ones globally. The time horizon over which the equivalent human impact will manifest at a global level is the question. That it will occur some time down the road if current human use of the environment persists should not be in dispute. The correlation between human population growth and the growth rate in atmospheric greenhouse gases is impressive, so is the paleo evidence linking the rise and fall in surface air temperature with changes in carbon dioxide abundance. Following a thorough review of trends in present climate, the Intergovernmental Panel on Climate Change (IPCC) understated that.

> *..the balance of evidence suggests that there is a discernible human influence on global climate...*

As models come to terms with the dynamics of natural sinks for CO_2, the time lines within which change will entrench will be more clearly drawn. The magnitude of impacts will be better defined. However, there is nothing in the immediate horizon that vitiates the current pattern of unequal impacts.

5. Unequal Impacts

The IPCC concluded that developing countries which are synonymous with the tropics will be at least three times more vulnerable to the adverse impacts of climate change than developed countries. Evidence is also emerging that latitudes above the Arctic Circle will also undergo severe changes that are environmentally as unfriendly as their tropical counterparts. In the short term, most of the benefits of global warming will be reaped in the middle latitudes.

5.1. Severe Weather

Based on the science of severe weather, projections that global warming will cause more violent weather are reasonable. Although evidence of increased severe

weather is inconclusive at this time, the trend in insured and uninsured 1980 losses due to severe weather shows a dramatic surge in both the number of claims made and their money value. In 1980, estimated cost of natural disasters (1985 constant dollars) was less than $5 billion. In 1998, it had risen to $90 billion. Although, changes in land use - land cover due to human activities, and increased occupancy of vulnerable land are factors in the losses sustained, the weather stimulus is also clear as is the match between trends in losses and global warming. The inequality in the distribution of impacts is underscored in Table 2 which highlights the tropics and subtropics as preferred locations for weather related disasters.

Tab. 2. Estimate of cost of major natural disasters in 1998.

Disaster type	Country victimised	Damage ($B)	Death toll
Storm/Flood	China (Yangtze)	36	4 000
Storm/Flood	Bangladesh (Ganges/Brahmaputra)	5	4 500
Hurricane	Honduras-Central America(Mitch)	5	11 000
Cyclone	India (Gujarat)	1.7	10 000
Fire/Haze Smoke	Indonesia	4.5	?
Ice Storm	Canada/USA (Eastern Seaboard)	2.5	23

5.2. Agriculture

Impacts of global warming will be highly felt in agriculture. Estimates of change in yield for several crops are listed in Table 3. Major failures will occur in Africa and Asia. There, yield in all staples is expected to fall. The potential for vastly improved yields in the middle latitude is outstanding.

Tab. 3. Estimates of impact of global warming on crop yield.

Region	Crop type	Yield impact (%)
	Wheat	-40 to +234
North America	Maize	-55 to +62
	Soybean	-26 to +258
	Maize	-65 to –5
Sub Saharan Africa	Millet	-70 to –63
	Biomass	-60 to –40
	Rice	-22 to +10
	Wheat	-50 to –10
South -SE Asia	Maize	-40 to –10
	Soybean	-20 to +1

5.3. Permafrost

The Polar regions will be highly stressed and many impacts there will be difficult to control let alone reverse. The permafrost which supports many Arctic and sub-Arctic ecosystems will be severely damaged (Tab. 4).

6. A matter of equity

Climate change impacts are and will be unequally distributed. This inequality will spread across nations, within nations, and across sectors. If present consensus on

Tab. 4. Calculated contemporary and future areas of permafrost In the Northern Hemisphere (10^6 km^2).

Zone	Contemporary	2050	% change
Continuous permafrost	11.7	8.5	-27
Discontinuous	5.6	5.0	-11

attribution is correct, i.e. forcing by greenhouse gases, the evidence points to inequalities in contribution (Tab. 5). Developed nations led by the United States (gross and per capita) and Canada (per capita) are the ranking nations (Tab. 5).

Portfolio of actions required to guide and sustain both the physical and human environments through the change range from mitigation to adaptation to institutional change to technological innovation. The capacity to implement them varies from considerable to negligible, and across both spatial and time scales but is especially latitude dependent. Equity which loosely translated is fairness and justice where existing laws are inadequate should guide international/sectoral negotiations and agreements (procedural equity) and most importantly, their acceptance (consequential equity) through what could be the most serious challenge faced by humankind. The benefits envisaged by the Framework Convention on Climate Change may never be realised unless the equity problem is resolved. A model for resolution exists at local and regional levels where equity issues are resolved via transfers which are not always fingerprinted with attribution. That model should be scaled up to address them at the global scale.

Tab. 5. Average number of persons required to emit CO_2 equivalent to emission by one American since 1950.

Nigerian	24
Pakistani	31
Somali	100
Chinese	7

Earth is as connected by its peoples as it is by its atmosphere and oceans. The human dimensions of failure to act could be profoundly ugly.

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