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21RST CENTURY: "The Game against Nature"

Jan-Erik Lane

Correspondence: Jan-Erik Lane, an independent scholar, 10 Charles Humbert, 1205 Geneva Switzerland

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Abstract

When a decision-maker faces a choice between alternatives of action in a situation of uncertainty, one speaks of a "game against Nature" when he/she faces no interaction with another player or group. In the process of global warming, mankind is the one player facing two alternatives: resilience or precaution. Not knowing fully the consequences of the increase in the emission of greenhouse gases on climate change or the implications of climate change for biological and social system, what action to take? If there were a global benevolent rule, he/she may decide to avoid the worst outcome. But global ecological policy-making requires the coordination among a large number of players, which open up the possibility of reneging as well as carries heavy transaction costs.

Keywords: global ecological policy-making, decrease in ecological capital, collective action, transaction costs, tragedy of the commons**,** pollution of the atmosphere

1. Introduction

When the somewhat 190 governments of the world come together under the UN climate change program or when the G20 group of nations, representing around 70 per cent of global population, meet to discuss ecological policy-making, this sets up a so-called "Game against Nature" (individual decision-making under risk). In a game against Nature, a decision-maker attempts to make a rational decision in a situation of uncertainty. In ecological policy-making, the actor is the UN or the G20, and the uncertainty they face is global warming and its consequences–good or bad.

The general structure of a *game against Nature* (one person game theory) is as follows:

1) The actor; 2) Alternatives of action (policy); 3) Outcomes: favourable or unfavourable; 4) Decision rule: avoid the worst outcome or maximize expected value.

2) In global ecological policy-making, the actor is a collective group of states, either the 190 UN group or the G20 group. The alternatives of policy include *resilience* (do nothing) or *precaution* (take preventive actions). The outcomes range from global warming at 1 degree plus to 6 or more degrees plus, which would be the worst possible outcome for mankind. Individual decision-makers like human beings solve the game against Nature by either avoiding the worst outcome (*minmax*) or calculate the expected value over the alternatives and their probable outcomes (*maxmin*). Only fools like Hitler would always go for the *maxmax* and receive the worst (*minmin*). When objective probabilities are lacking, the rational decision-making resorts to subjective probabilities plus successive updating with Bayes' rule.

All the difficulties in global environmental policy-making appear in this model of choice under uncertainty:

a) Who decides? When many governments come together to decide upon the goals and means of global policy, then the requirement of unanimity is conducive to huge transaction costs;

b) The various governments differ greatly in their estimates of probabilities and outcome costs involved in the alternatives of action;

c) Countries already hit by the consequences of global warming favour precaution, whereas other countries prefer to wait and see – resilience;

d) When preventive measures harm the prospects of economic growth, countries differ in how they trade off the two entities against each other;

e) Collective action strategies – preference distortion, delay, reneging – come in as a major disturbance of the possibility of collective rationality.

f) Given these hinders to a global ecology policy, it is little likely that any such endeavours will succeed in time to halt the growth in carbon equivalent emissions. There will much discussion about what to do, but little consensus upon concrete policies. A major source of conflict is the confusion of greenhouse gases per capita and total emissions, which has a bearing upon the distribution of costs with any common policy.

2. Total and Per Capita Emissions

In the debate about greenhouse gases and CO2 emissions, one does not always refer to the basic numbers. It is vital to distinguish between total emissions and per capita emissions, when comparing countries. Let us first draw a picture of the total emissions by means of a list of the ones with most emissions, measured in millions of metric tons (Table 1).

Table 1. Countries with most emissions of greenhouse gases (mt) 2010

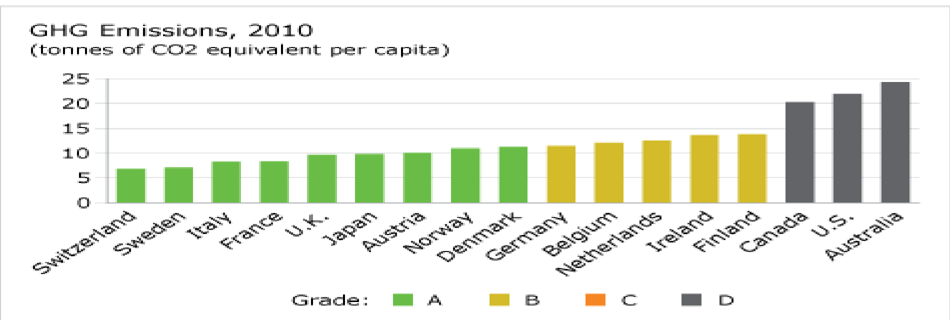
COUNTRY	Greenhouse gases	In per cent
China	9,679.30	22.7
USA	6,668.79	15.6
EU – 28 members	4,663.41	10,9
India	2,432.18	5.7
Russia	2,291.57	5.4
Japan	1,257.10	2.9
Brazil	1,104.64	2.6
Indonesia	814.71	1.9
Canada	710.72	1.7
Iran	698.38	1.6
Mexico	681.87	1.6
South Korea	661.69	1.6
Australia	560.64	1.3
Saudi Arabia	510.14	1.3
South Africa	458.29	1.1
Ukraine	380.89	0.9
Argentina	363. 79	0.9
Nigeria	320.04	0.8
Pakistan	304.85	0.7
Kazakhstan	300.83	0.7
Venezuela	284.99	0.7
Malaysia	282.60	0.7
Taiwan	278.34	0.7
Uzbekistan	215.36	0.5
Total		83%

Source: http://en.wikipedia.org/wiki/List_of_countries_by_greenhouse_gas_emissions

The structure of total emissions of greenhouse gases for global policy-making entails that what a mere 20 countries, responsible for 80 per cent of them, do will decides the outcomes. Were they to reduce their emissions by 5 per cent a year, it would have a tremendous impact upon the risks of climate change. Total emissions are a function of huge economy, sizeable affluence and Soviet legacy. But instead the UN orchestrates mega reunions with all states of the world and confuses total emissions with emissions per capita.

Table 2 shows that the list of countries with very high CO2 emissions per person is very different from Table 2. It includes a number of tiny countries that are little relevant for the global policy aim to reduce emissions significantly, sooner than later.

Table 2. Per capita emission



Source: http://www.conferenceboard.ca/hcp/details/environment/greenhouse-gas-emissions.aspx

It may seem fair that all countries contribute to reduce greenhouse gases like CO2 emissions, but it is not efficient to focus upon emissions per capita.

3. Overall Decline in Ecological Capital

To measure the decrease in global ecological capital is far more cumbersome a task than to measure economic capital in the conventional sense. Yet, ecological capital is more tangible and easier to estimate than the recently much debated form of capital in the social sciences, viz social capital. It remains elusive and difficult to pin down in some index.

Approaching the decline in global environmental capital, one may target recent evidence about various phenomena, like the following:

The decrease in the number of species, although this has been contested;

The increase in the number of endangered animals;

The overfishing of lakes, seas and oceans;

The increased pollution of the oceans;

The concentration of human population in huge urban sites without proper sanitation and access to fresh water;

The slow vanishing of the rain forests and the huge forests in Siberia;

The slow growth of desert areas;

The shrinking of large lakes;

The growing fresh water shortages;

The pollution of the atmosphere by greenhouse gases, leading to climate change and global warming.

All of these phenomena and development above reduce the amount of ecological capital on Planet Earth. There is no one single indicator on this loss of environmental capital. The so-called Ecological Footprint Framework (EFF) launched an ambitious attempt to come up with a single measure on the supply of environmental resources and the demand for them by using the so-called "global hectar per capita measure (http://www.eea.europa.eu/highlights/Ann1132753060).

The idea to have most general or encompassing measure on both environmental capital (supply) and human pollution (demand) is an interesting one. But it is not easy to devise or calculate such a measure. Based on an enormous input of information and effort, these environmentalists come up with what is basically an economic type model with supply and demand. The conclusion that Planet Earth and thus mankind is running a serious and increasing deficit between demand and supply, resulting in an increasing reduction of global ecological capital. This framework is no doubt ingenious, attempting to cover all aspects and dimensions of environmental capital. But there are some problems here in the EF approach.

Table 3 shows such a footprint analysis for demand and supply for some Asian countries, employing per capita measures only, according to the Global Footprint Framework (2009).

Table 3. EAST ASIA and OCEANIA: Total Ecological Footprint, Bio-capacity and Net Result for 2005

	Total per capita Ecological Footprint	Total per capita Bio-capacity	Ecological Deficit or Reserve
Australia	7.8	15.4	7.6
Bangladesh	0.6	0.3	-0.3
Bhutan	1.0	1.8	0.8
Cambodia	0.9	0.9	-0.0
China	2.1	0.9	-1.2
India	0.9	0.4	-0.5
Indonesia	0.9	1.4	0.4
Japan	4.9	0.6	-4.3
Korea DPRP	1.6	0.6	-0.9
Korea Republic	3.7	0.7	-3.0
Laos	1.1	2.3	1.3
Malaysia	2.4	2.7	0.3
Mongolia	3.5	14.6	11.2
Myanmar	1.1	1.5	0.4
Nepal	0.8	0.4	-0.4
New Zealand	7.7	14.1	6.4
Pakistan	0.8	0.4	-0.4
Papua New Guinea	1.7	4.4	2.8
Philippines	0.9	0.5	-0.3
Singapore	4.2	0.0	-4.1
Sri Lanka	1.0	0.4	-0.6
Thailand	2.1	1.0	-1.2
Vietnam	1.3	0.8	-0.5

Source: GFN 2009

Matters are complex, although the ecological footprint is much bigger per capita in richer countries than in poorer ones, with country specific factors playing a large role in shaping eventual surpluses or deficits. Overall, it seems that ecological footprints vary positively with country affluence, while bio-capacity is determined by a host of other factors besides affluence. But when country size is added to the equation, the numbers in Table 3 are totally transformed and quite another picture emerges - see Table 4. What matters crucially is the size of the country in terms of the number of inhabitants.

Table 4. Total Ecological Impact (Deficit/Surplus/Person X Population) 2005

Australia	153.5
Bangladesh	-42.5
Bhutan	1.8
Cambodia	-0.0
China	-1588.0
India	-551.7
Indonesia	89.1
Japan	-550.8
Korea DPRP	- 20.2
Korea Republic	-143.4
Laos	7.7
Malaysia	7.6
Mongolia	29.1
Myanmar	20.2
Nepal	-10.8
New Zealand	25.6
Pakistan	-63.2
Papua New Guinea	16.5
Philippines	-24.9
Singapore	-17.6
Sri Lanka	-12.4
Thailand	-77.0
Vietnam	-42.1

Source: GFN 2009

When the total ecological imprint is estimated, taking population size into account, it is no longer tenable to argue that global ecological footprint follows affluence. On the contrary, poor or medium income countries with large populations may have much more ecological impact than small super affluent countries. China and India are big polluters in the Asia-Pacific region.

Interestingly, although the average person in Papua New Guinea pollutes more than the average in Bangladesh, the total outcome is much more severe in the latter country, as the number of people is crucial when it comes to ecological footprint. Not surprisingly, the bio-capacity of Papua New Guinea is larger than that of Bangladesh, which is vulnerable to flooding and hurricanes. It is possible to compare these scores for the Asia-Pacific region with comparable scores for other regions of the world. Table 5 attempts this, using the same framework of analysis.

Table 5. Global Ecological Impact (Deficit/Surplus/person X population) 2005

World	-3885.6
High Income Countries	-2624.4
Middle Income Countries	0.0
Low Income Countries	-237.1
Africa	360.8
Middle East and Central Asia	-365.6
Asia-Pacific	-2849.6
Latin America and the Caribbean	1327.7
North America	-892.4
Europe (EU)	-1169.5
Europe (Non-EU)	551.1

Source: GFN 2009

The positive numbers for Latin America include the high bio-capacity for Brazil, Bolivia and Peru – numbers that will go down quickly in the future as the rain forest disappears. The same applies to Malaysia where the rain forest in Borneo is decimated every day.

4. Juggernaut: GDP, Energy and Emissions

a) Emissions Growth

Given the enormous risks for mankind in relation to the probability of the worst-case scenario of climate change – 6 degrees or more, it seems negligent on the part of the world powers not to do more. The emission increase in all four types of greenhouse gases is formidable – see Figure 1.

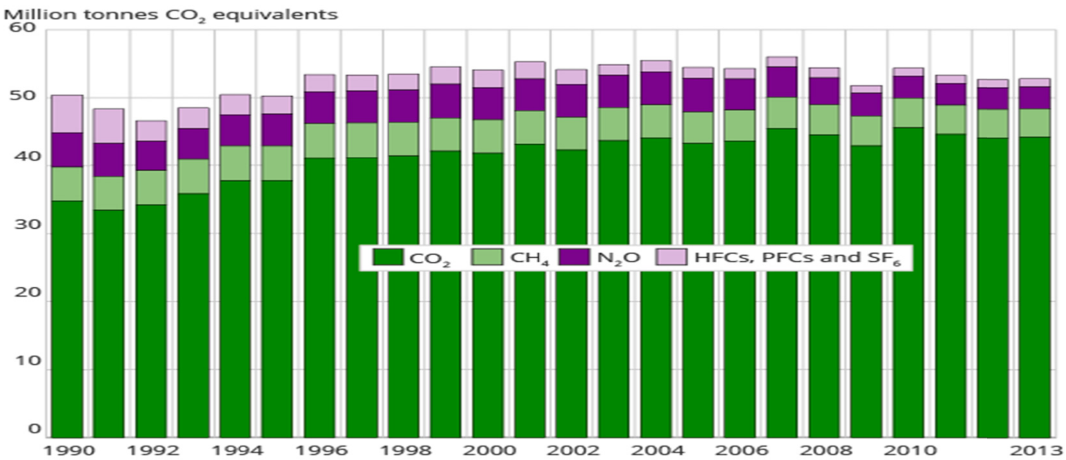


Figure 1. Emissions of greenhouse gases

Source: Statistic Norway

It is the carbon dioxide emission that has kept going up to a level of 40 billion tonnes in 2013. Planet Earth can absorb less and less of these outputs, especially as global forests are decreasing and the acidification of the oceans increase. Thus, the concentration of these four gases increases year in and year out with attending rise in global temperature (Figure 2).

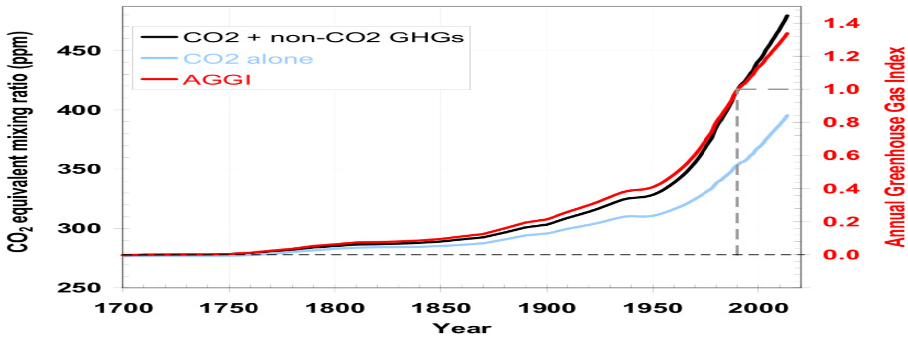


Figure 2. Increase in the emission of greenhouse gases

Source:http://www.esrl.noaa.gov/gmd/aggi/aggi.fig5.png

b) The Links: GDP- Energy–Emissions

What makes the process of global warming seemingly unstoppable is that it is driven by the most mundane incentive among human being, the quest for income and wealth. In order to produce decent living conditions, men and women search for economic development or the growth in GDP. Yet, Figure 3 shows that on the global macro level, the variation in economic development has strong implications for the emission of all kinds of greenhouse gases: the richer and larger a country economy, the more emissions it releases. This finding is, of course, the rationale for the argument that we need another kind of economic growth that builds upon carbon neutral technology. This is no doubt feasible in theory, but in practice we are stuck with the fossil fuel economy. And the destruction of forests and fresh water sources continue.

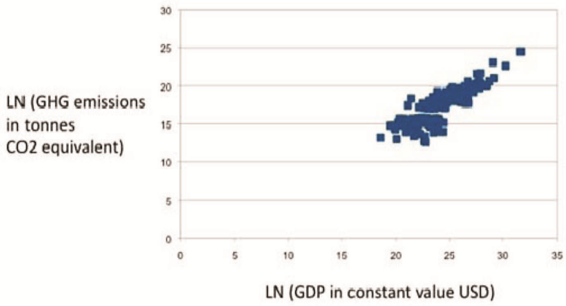


Figure 3. Total emissions and GDP: Equation: LN GDP - LN GHG Total: y=0.81x , R2 = 0.708

Note: GDP vs. Greenhouse emissions for 158 countries in 2011.

Sources: 1. World Bank Open Data, http://data.worldbank.org. 2. CAIT WRI 2.0: Climate Data Explorer, World Resources Institute, http://cait2.wri.org

At global reunions among the politicians and experts, there is much talk about the emissions per capita. Developing countries underline that they tend to display lower emissions per capita than advanced economies. But total emissions count for the policy aim of reducing considerably the poisoning of the atmosphere!

Economic development can, I emphasize again, be environmental friendly. Many micro projects have reduced carbon emissions and yet delivered goods and services more efficiently. However, what counts at the macro level is the overall addition and subtractions. Take the example for Singapore that is well aware of the energy-environmental conundrum. Although it must be admitted that Singapore is doing many advanced projects to promote ecological sustainability, it should be pointed out that it is a big hub for air traffic and see shipping, which both result in greenhouse gases. In addition, Singapore has coal fired power stations and consumer huge amounts of electricity (water cleaning, waste treatment, air conditioning in almost all housing and public buildings).

The same contradictory finding applies to the UAE where lots of investments are done in ecologically friendly projects. But the fact remains that CO2 emissions per capita here are the largest in the world, like Qatar. To understand the close link between total GDP and total emissions one needs to look at global energy consumption.

Economic activity in all forms consumes directly or indirectly huge amounts of energy. This leads to the emission of greenhouse gases, directly or indirectly. To take a somewhat drastic example: the rapid increase in consumption of meat energy has resulted in an enormous growth of the number of cows in the world, which produce methane that is very conducive to climate change and global warming.

It is also the case that rich countries consume more energy per person than poor countries, as higher levels of affluence require more energy – in general. Again, the situation is paradoxical, as rich countries can invest in environment friendly technology but they also consume more energy for upholding their lifestyle. Figure 4 has the finding.

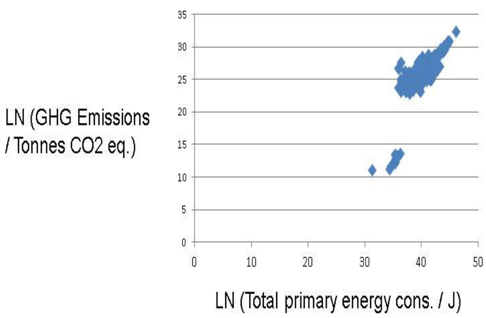


Figure 4. Total greenhouse gases and total energy consumption: Equation: Energy - emissions: y = 1,223x, R2 = 0,616, N=173

It is evident from the Figure 4 above that efforts should be undertaken to shift towards energy from carbon neutral sources, including reducing the greenhouse gases from fossil energy sources. If Shanghai can build a coal fired power station with no carbon dioxide emissions, then so can all Chinese cities or villages.

5. Conclusion

The pollution of the atmosphere through the emission of greenhouse gases is the most dangerous form of decline in global ecological capital. Not only is it the case that global warming augments fresh water shortages, the dying of the coral reefs, overfishing and the acidification of the oceans as well as destruction of forests and pastures. It could also force human beings to move, resulting in conflicts and wars.

Climate change is much talked about, but little concrete action is taken. It is not a top priority for the countries with the 20-25 largest economies in the world. However, they and only they can take measures that halt the increase in yearly emissions and start a process towards zero emissions per year. They represent the player "mankind" in this disastrous game, where we now follow the alternative "resilience" that may give us the worst possible outcome in the future.

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