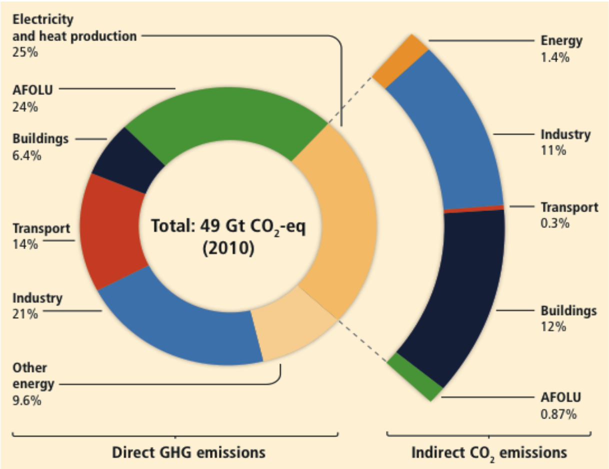
Introduction

Gian Carlo Delgado Ramos

Climate change, an anthropogenic phenomenon caused by the emission of cumulative greenhouse gases (GHG), mostly from fossil fuel combustion (see Figure 1)[1] has become a ponderous issue, as attested by many unprecedented changes over time (IPCC 2014a). As the Intergovernmental Panel on Climate Change (IPCC) said, the last three decades has been successively warmer on the Earth's surface than any preceding decade since 1850, while the period from 1983 to 2012 was *likely* the warmest 30-year interval of the last 1,400 years in the Northern Hemisphere (ibid). As a result, the global average temperature has increased by 0.85oC since 1880 and it is expected to further rise by 1.5oC by the end of the century in relation to the average temperature of the 1850–1900 period (ibid).

Figure 0.1: GHG emissions by Economic Sectors



Besides the increase in oceanic temperature (measured to a depth of 75m) by about 0.11oC per decade since 1971, the absorption of increasing loads of CO2 by oceans has resulted in their surface acidification: pH has decreased by 0.1, corresponding to a 26 per cent increase in acidity, a change that has negative implications for marine biodiversity, mainly on coral reefs (ibid). Additionally, global sea level has risen since

1901 by 0.19m, while the Greenland and Antarctic ice sheets, as well as glaciers, have shrunk (ibid). Cumulative emissions between 1750 and 2011 are estimated at 2,040 ±310 GtCO2eq, of which 40 per cent still remains in the atmosphere. Despite a growing number of climate change mitigation policies, states the 5th Assessment Report of the IPCC, annual GHG emissions grew on average by 1.0 GtCO2-eq (2.2 per cent) per year, from 2000 to 2010, compared to 0.4 GtCO2eq (1.3 per cent) per year, from 1970 to 2000 (ibid). And, since half of total anthropogenic emissions occurred in the last 40 years, economic and population growth are now acknowledged, without doubt, as the main drivers of climate change (ibid).

The correlation of economic growth and the use of energy and materials by human societies during the last century is clear cut: while human population increased fourfold and the global economy about 14 times, material and energy use increased tenfold on average. Biomass use increased 3.5 times, energy use 12 times, metal ores 19 times, and construction minerals, mainly cement, about 34 times (Krausmann et al 2009). By the end of the XX century, humanity used about 500 thousand petajoules of primary energy and about 60 billion tons of raw materials yearly (Weisz and Steinberger 2010). Unequal use is however significant, as the highest consuming 10 per cent of the world population uses 40 per cent and 27 per cent of the world's energy and materials respectively (ibid).

Accordingly, human transformation of nature is of such magnitude that biochemical cycles of the planet are being eroded, a context in which extreme climate events are only a partial manifestation.

Observed human impacts on nature have been documented and categorized by some as the Anthropocene era (Crutzen 2002). Impacts are indeed a transgression of *planetary boundaries*, meaning 'limits' of anthropic disturbance of the planet Earth's critical processes which, if they were not perturbed, would result in a relatively safe operating space for human life. In that sense, Steffen et al (2015) point out sensibly that '…it would be unwise to drive the Earth System substantially away from a Holocene-like condition'. Yet, that is indeed what is occurring.

Two levels of planetary boundaries are proposed by Steffen et al (2015). On a first level, climate change and biosphere integrity are considered core boundaries since they have the potential to change the operation of the Earth System on their own. On a second level, there are several other boundaries with the potential to affect the quality of human life and at the same time influence the core boundaries; however, on their own they cannot cause a new state of the Earth System. These are stratospheric ozone depletion, ocean acidification, nitrogen biochemical cycle, phosphorus biochemical cycle, land-system change, human use of fresh water, atmospheric aerosol loading and the introduction of novel entities (such as chemical pollution). Table 1 summarises the main features of such planetary boundaries as Rockström *et al* 2009 and Steffen *et al* 2015 as described them) and their current state.

Table 0.1: Planetary Boundaries

Planetary boundary	State before 1850	Proposed boundary		Current state
		Rockström et al. 2009	Steffen et al. 2015	
Climate change	280 parts per million	<350 parts per million	<350-540 parts per million	396.5 parts per million
			Energy imbalance +1.0Wm-2	2.3 Wm-2
Change in biosphere integrity		Loss of biodiversity (10 species per million)	Genetic diversity (10 species per million, with a proposed goal of 1 per million)	100 species per million
			Functionality of diversity (90% intact biodiversity index)	84% (based on Southern Africa only)
Stratospheric ozone depletion	290 DUs***	276 DUs	<5% reduction from preindustrial level of 290 DUs (5% - 10%) assessed by latitude.	283 DU (Rockström et al 2009); only transgressed over Antarctica during southern hemisphere springtime (-200 DUs; Steffen et al 2015)
Ocean acidification**	3.44 arag**	2.75 arag**	≥80%-≥70% of preindustrial aragonite saturation state of ocean surface average.	290 arag (Rockström et al 2009); about 84% of the preindustrial aragonite saturation state (Steffen et al 2009)
Nitrogen biochemical cycle	0 tons per year	35 million tons per year	62 Tg N per year-1	121 million tons/year (Rockström et al. 2009); about 150 Tg N/year-1 (Steffen et al 2015)
Phosphorus biochemical cycle	1 million tons per year	11 million tons per year	Global cycle not greater than 11 Tg P per year-1	8.5 - 9.5 million tons per year (Rockström et al. 2009); about 22 Tg P per year-1 for the global cycle and about 14 Tg P per year-1 for the regional cycle (Steffen et al 2015)
			Regional cycle not greater than 6.2 Tg per year-1	

Land-system change	Low	15%	Area of forested land as % of original forest cover on a global scale (75-54%); and area of forested land as % of potential forest as part of a biome (tropical: 85-60%; temperate: 50-30%; boreal 85-60%)	11.7% (Rockström et al 2009); 62% (Steffen et al 2015)
Human use of freshwater (alteration of water cycle)	415 cubic kilometres	4,000 cubic kilometres yearly1	Global use of 4,000 cubic kilometres yearly1 and monthly withdrawal no greater than 25-55% at basin level in low-flow months; 30-60% in intermediate flow-months, and 55-85% in high-flow months.	2,600 cubic kilometres yearly1
Atmospheric aerosol loading	-----	-----	Global Aerosol Optic Depth (AOD).	0.30 AOD in the Southern Asian region.
			AOD as seasonal average for a given region (Study case, monsoons in South Asia)	
Introduction of novel entities	Non-existent	Unknown****		Unknown****

Source: Compiled by the author, based on Rockström et al, 2009, 'Planetary Boundaries: Exploring the Safe Operating Space For Humanity', *Ecology and Society,* Vol. 14. No. 2. Article 32; Steffen et al, 2015, 'Planetary Boundaries: Guiding Human Development on a Changing Planet', Sciencexpress. DOI: 10.1126/science.1259855.

Notes: *It is estimated that, as from 1751, 337 billion tons of carbon have been emitted, exclusively by burning fossil fuels.
**A reduction in the value means an increase in acidification. Figures represent the state of aragonite saturation.
***A Dobson Unit, or DU, is the equivalent of 0,01 mm. depth of the ozone layer under normal pressure and temperature conditions.
****There are no indicators that might enable us to measure this type of pollution in a standardized way, although there are some methodological proposals for specific toxic substances. Some of the substances singled out are persistent organic polluting substances, plastics, endocrine disruptors, heavy metals, radioactive waste and nanomaterials.

The transgression of planetary boundaries, starting with climate change, has profound implications for practically all biophysical and human systems. Food production, water resources, land and costal ecosystems, as well as human health are causes for special concern due to their particular sensitivity and implications for the resilience of nature and life quality of future generations. Other implications derived from the above could be related to the exacerbation of existing challenges such as land tenure insecurity, poverty and inequality (including gender issues), marginalization of poorer (principally rural) populations, climate induced migration, and resource wars or conflicts.

As suitably expressed by Klein, '…the thing about a crisis this big is that it changes everything. It changes what we can do, what we can hope for, what we can demand from ourselves and our leaders. It means there is a whole lot of stuff that we have been told is inevitable that simply cannot stand. And it means that a whole lot of stuff we have been told is impossible has to start happening right away' (Klein 2014:28). This is doubly true in the case of developing countries where climate change implications will be felt more keenly because of biophysical reasons, but also because inequality and lack of governance are particularly challenging issues, remarkably in low-income countries.

Considering that both, biophysical and socioeconomic issues determine human vulnerability, it can then be said that the poorest population already suffers and will certainly experience most of climate change impacts. In words of the IPCC, '…climate change will amplify existing risks and create new risks for natural and human systems. Risks are unevenly distributed and are generally greater for disadvantaged people and communities in countries at all levels of development' (IPCC 2014a:13). Yet, climate change implications may be phased down through climate policy and corresponding commitments and actions.

Thus, an approach from the global South for adaptation and mitigation of climate change, as the one offered by this book, is certainly necessary and appropriate for enhanced future options, preparedness, integrated responses and cooperation, chiefly when GHG contributions are asymmetrical. For example, Africa contributes less than 4 per cent of global GHG emissions while Europe, with a smaller population, is responsible for more than three times that amount (about 13 per cent). Furthermore, a differentiated historical responsibility for climate change has been acknowledged:[2] while Annex I Parties[3] have positive historical differentiated responsibilities, non-Annex I Parties have negative historical differentiated responsibilities in relation to their contribution to climate change, and this doesn't account for indirect emissions related to imports which are relevant as high-income countries are importing large embodied emissions from the rest of the world, mainly the upper middle-income countries whose GHG emissions have risen steadily over the last decade with substantial differences between mean and median per capita emissions (in this case, China, now the greatest global GHG emitter, serves as an example) (IPCC 2014b).

Since GHG emissions keep rising in a context of only half-successful mitigation, the risk of abrupt or irreversible changes increases, as it is correlated to the magnitude of global warming. Bearing in mind that many aspects of climate change and its associated impacts will continue for centuries, even if anthropogenic GHG emissions are checked, international climate negotiations have set a goal to ensure that the increase in temperature is not greater than 2° C (relative to the 1861-1880 period). This requires, however, that accumulated CO2eq emissions since 1870 don't exceed 2,900 Gt of CO2eq, in a context in which it is to be noted that at the end of 2011 about 1,900 Gt of CO2eq had already been released (IPCC 2014a).

The future of climate depends then on both historical and future emissions and the absorption capacity of carbon sinks (plants, soils and oceans), apart from natural climate variability. Therefore, in order to tackle climate change, more efforts are needed at multi-scale levels (international, regional, national and subnational), including a more comprehensive long-term and integrated vision, political will and suitable and democratic governance structures, funding, effective decision-making and capacity to respond, as well as further articulated actions that will differ across sectors and regions. As the IPPC puts it: '…*adaptation and mitigation responses are underpinned by common enabling factors. These include effective institutions and governance, innovation and investments in environmentally sound technologies and infrastructure, sustainable livelihoods and behavioural and lifestyle choices.*' (ibid: 26).

While it is true that mitigation actions are needed from all parties, it is without doubt a specific requirement to major emitters, or all Annex-I countries and the more economically dynamic upper-middle income countries. Adaptation actions, which should better be implemented from a comprehensive and integrated climate change (adaptation-mitigation) agenda, are of particular relevance to low-middle income countries since socioeconomically induced climate vulnerability is higher among the poorer population, as has already been explained.

In addition to the above, one may plead for challenging current power relationships and inequalities while upholding human rights as a starting point for the construction of genuine alternative development pathway(s) capable of transcending socioeconomic inequalities and embracing cultural diversity, while keeping the planet under a Holocene-like condition.

Taking the above into account, and from a global South point of view, academic (and non-academic) inquiries on the multifaceted nature of climate change become necessary and appropriate, including those analysing socioeconomic, political and cultural aspects. This was one of the main goals of the Comparative Research Workshop on 'Inequality and Climate Change: Perspectives from the South' of the South-South Collaborative Programme of CLACSO-CODESRIA-IDEAS, celebrated on 24 and 25 July 2014 in Dakar, Senegal. Additionally, it aimed to identify common spheres for cooperation amongst the countries of the South, as well as to address any shared perspective to enhance informed participation in global debates on climate change.

This book is an outcome of this workshop, and certainly a fresh contribution in the context of preparations for the 21st Climate Change Conference to be held in Paris by the end of 2015.

The papers included have been organised geographically, starting with those dealing with African case studies, followed by those from Latin America and Asia. Authors' contributions are widely multi- and interdisciplinary, and embrace a plurality in their appraisals on a set of issues, from renewable energy, climate induced migration, gender and poverty, to the use of traditional pharmacopeia in a climate change context, international cooperation for biofuel production, water-energy nexus and water disputes in urban settlements, flooding disasters and their social implications, and the impact of heat waves on workers.

The ample biophysical differences from one case study to the other, as well as their particular social and cultural realities, make this book invaluable and unique, as it offers a vantage point from which to examine some of the current perspectives on inequality and climate change from the global South.

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Notes

1. It is estimated that 78 per cent of anthropogenic GHG emissions since 1970 are due to fossil fuels combustion and industrial processes (IPCC 2014a). Of the total source of greenhouse gases at present, CO2 contributes 76 per cent; CH4 about 16 per cent, N2O about 6 per cent and the combined fluorinated gases (F-gases) about 2 per cent (IPCC 2014b).
2. From 1850 to 1960, GHG emissions increased due to a large industrialisation process, particularly in the US but also in Germany and UK; however, by the 1950s, China and Russia started seeing their emissions climb as well (still behind the top emitters mentioned before, particularly the US). From 1960, the US kept its place as the top GHG emitter until 2005 when China emerged as the top world GHG emitter (other Asian emergent economies saw their emissions climb as well in comparison to their own historical trajectory). Therefore, one may conclude that there is a historically differentiated responsibility from those countries that have experienced a major and sustained industrialization process since 1850, such as the US, Germany and UK. In this context, reticence from China to commit to a major GHG reduction effort is associated to such historical responsibility, as it has been argued that such climate commitments may impose limits to its recent economic development. The truth is that developed countries have already spent most of their carbon budget.
3. According to the Framework Convention on Climate Change, Annex I Parties include the industrialized countries that were members of the OECD (Organisation for Economic Co-operation and Development) in 1992, plus countries with economies

in transition (the EIT Parties), including the Russian Federation, the Baltic States, and several Central and Eastern European States. Non-Annex I Parties are mostly developing countries (http://unfccc.int/parties_and_observers/items/2704.php).

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