Natural Resources and Sustainable Development: a comparative analysis of the Brazilian and the South African strategies

Final Version

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1. Introduction

South Africa and Brazil occupy significant territorial geographies on the planet. Both countries are rich in biodiversity and each has considerable deposits of minerals and metals. Each of the two countries has also made substantial progress towards the achievement of the Millennium Development Goals of the United Nations which are due in 2015. Even though millions of people have benefited from various state-driven development programmes in either country, the challenges of redressing centuries of inequality, combined and uneven development within mere successive electoral terms cannot be complete or universal.

The global discourse on the post-2015 developmental agenda has also progressed with both countries playing important roles in defending multilateralism and promoting equality as outcomes of development. Whilst pursuing improving the quality of each country's human population, recent reports of crisis's in the global economy, environment, inequality, food, finance and climate (amongst others) has brought back into focus the paradox of inhabiting a finite planetary ecosystem. This has been bolstered by a recent report by the World Wildlife Fund that the current generation of human beings have overseen the extinction of 52% of other life forms within the previous forty-four years.

Also significant is the current debate on the renaming of the current stratigraphic era from the Holocene to the Anthropocene converges a number of discrete explorations on the capacity of the planet to consistently absorb human-induced pollution and emissions. The International Commission on Stratigraphy of the International Union of Geological Sciences seeks to finalise this transition in 2016. Understanding the changing context within which development is conceptualised and contested becomes even more important for the purposes of strategic analyses.

This paper provides a selected comparative analysis of the natural resources of Brazil and South Africa with the objective of generating strategic alternatives that enable both countries

to advance sustainable development. The paper comprises five sections. After this Introduction, we turn to conceptualising the contemporary context. We then outline the developmental challenges of sustainability. The next section synthesises the international multilateral environment with a specific focus on the emerging global developmental agenda. This is represented as the shift from the Millennium Development Goals to the Sustainable Development Goals. The concluding section outlines emergent strategic alternatives for Brazil, South Africa and the collaboration between the two countries.

2. Appreciating our Contemporary Context and the Developmental Challenges of Sustainability

Our hominid sub-species, *Homo Sapiens Sapiens*, have collectively occupied the planet Earth for at least 200,000 years. Our history is of course older, in so far as our separation from the other primates is estimated to have occurred nearly seven million years ago. The fossil record, whilst incomplete, does reveal that during the interregnum, we shared the planet with at other hominin sub-species. Notwithstanding this long evolution, we can assume that, like other life-forms on the planet, a large part of our pre-historic times was devoted to securing protection from predation, shelter from the elements and food for nutrition and our metabolism.

In our shorter two hundred millennia history, modern human beings initially shared the planet with three other hominins who subsequently became extinct. Over time, our diets expanded and we began to make tools to assist us in our everyday lives. This became highly specialised during the Palaeolithic era which spanned from 2.5 to 2 million years ago until approximately 10,000 years ago. This period is also more popularly referred to as the 'stone age.' In this long period, the fossil record clearly evidences our expanding technical capabilities, and especially our tool-making specialisation. It is also speculated that this capability formation co-evolved with the emergence of socio-culture affording our sub-species the emergence of learning and the capacity for the transmission of knowledge within groups of individuals and amongst society as a whole. Our expanding knowledge-specialisation also correlates with an increasing intensity of our competencies for exploiting our natural environments.

Our apparent advantage seems to have been our capacity for creativity and adaptive versatility as our existence today is evidence for our various adjustments to the uncertainties of environmental and climate change. However, biotic crises and significant climate change did take its toll variously on the sub-species. Approximately 74,000 years ago (between 69,000 and 77,000 years ago) a super-volcanic eruption occurred at Lake Toba in Sumatra, Indonesia. This initiated a decade-long winter and resulted in a millennium of global cooling. Our species did nearly become extinct and it is estimated that our whole population was

reduced to just about 15,000 individuals of whom 10,000 were adults of reproductive age. From this base population, we have grown to our current scale of approximately 7.2 billion people.

Most significant to our expansion has been our development of agriculture and the domestication of some of the other animal species. A Neolithic Revolution approximately 8,000 years ago transformed hunter-gatherer cultures into settled agriculture. This occurred unevenly and whilst essentially representing a peak in Stone Age technologies, also included the introduction of metalworking, writing, or other aspects relating to social organisation and stratification. Foraging was replaced by farming and the technological advances over time provided the platform for social, economic and political adaptation.

Climate changes and a rapid acceleration in the rate of innovation saw the domestication of plants and animals spread rapidly amongst the human species. As has been argued by Friedrich Engels (1876) and Vere Gordon Childe (1936) amongst others, human evolution separated from being but a product of natural selection through the improved learning and communicating capabilities that allowed humanity to generate technological innovations and transmit such ideas across generations. It is generally accepted that humans today can no longer exist purely in nature without tools, equipment and technique.

An Urban Revolution transformed Neolithic agriculture which was generally characterised as small, family-based, non-literate agricultural villages into becoming more complex, hierarchical systems of manufacturing and trade. This helped establish human settlements that became large, socially complex, urban societies. An Industrial Revolution massively expanded productive capabilities, increased outputs of commodities and expanded trade on an international scale. All three of these Revolutions were rooted in changes in the material base of the societies and modes of production and reproduction arose from the development of the forces of production.

The resulting dynamics of relations of production have acted as a motor of history, as conflict between classes are intertwined with expanding capacities, improved capabilities and increasing competences of our species. Whilst the human species has indeed accumulated considerable competencies through research, science, and technology, our collective global knowledge remains uncertain and incomplete. Humanity still lacks a grand unified theory that captures the totality of the complex systemic underpinning of life on earth and in the wider cosmology. The ascendency of capitalism is premised on the separation between labour and capital. It is a recent development in the longer time-line of human evolution. Its deployment and expansion into global relations has revolutionised human life on this planet.

The requirements of reproducing capitalism now shape and influence the direction of human development. According to Immanuel Wallenstein (2011), the driving underlying objective of capitalists in a capitalist system is the endless accumulation of capital, wherever and however this accumulation may be achieved. Since such accumulation requires the appropriation of surplus value, this drive precipitates the class struggle. The first stage of industrial capitalism is often caricatured as a period of liberal (laissez-faire) competition. The establishment of the capitalist mode of production proceeded on the brutal separation of people from property.

The ensuing relations of production between owners of capital and those with only their labour to sell matured over a long period until the end of the 19th century CE. For capitalist production, both the means of production and wage-labour had to be initially purchased. According to Karl Marx (1867), the capitalist mode of production was essentially the process of commodity production whose sole purpose was the accumulation of surplus value. The basis of Capitalism can be described as process of exploiting labour power with the object of accumulating surplus value for the continued reproduction of capital.

Karl Marx had argued in 1867 that "… nature does not produce on the one hand owners of money or commodities, and on the other hand men possessing nothing but their own labour-power. This relation has no basis in natural history, nor does it have a social basis common to

all periods of human history. It is clearly the result of a past historical development, the product of many economic revolutions, of the extinction of a whole series of older formations of social production" (166). One hundred and forty-eight years later, and the world we currently occupy is riven by inter- and intra-national inequalities derived from the accumulation of capital and the immiseration of vast sections of the population.

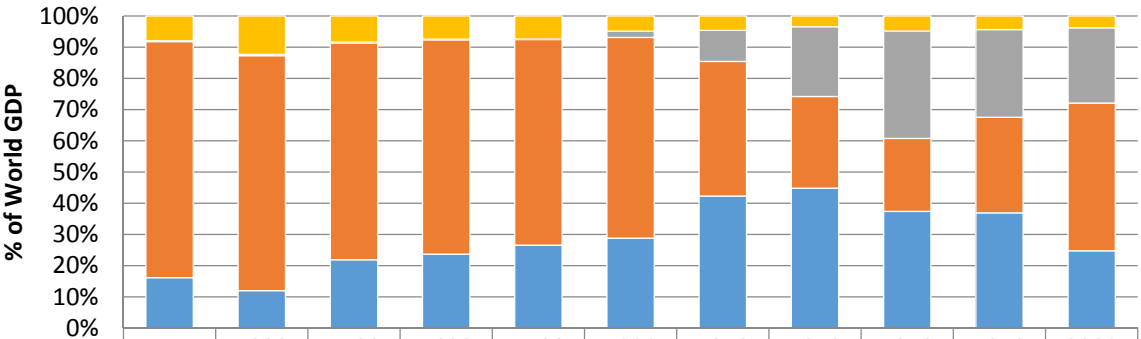
David Harvey (1982) recognised that in the circuit of capital described above, the suppliers of the means of production and labour would ultimately also have to be the potential customers demanding the product. With its combined value having to exceed itself, additional funds needed to be created. As a closed system, the same firm would need to generate the additional value which could then only be realised in the future. It is against this difference between the full cash value of today's product and commodity values that are yet to be produced that the credit system was established and 'fictitious capital' was created. The latter category represented money brought into circulation as capital without any material basis in commodities or productive activity. It is upon this basis that the banking system expanded and eventually would come to occupy such a significant role in contemporary society.

Scholars such as Hilferding described the transformation of competitive and pluralistic liberal capitalism into monopolistic 'finance capital' in 1910. The unification of industrial, mercantile and banking interests had defused the earlier liberal capitalist demands for the reduction of the economic role of a mercantilist state and finance capital rather sought a centralized and privilege-dispensing state. According to Hilferding, this changed the demands of capital and of the bourgeoisie from when its initial constitutional demands affected all citizens alike towards now seeking, under the direction of a strengthening Finance Sector, state intervention on behalf of the wealth-owning classes: capitalists, rather than the nobility of the Feudal and earlier modes of production.

This second stage of the capitalist mode of production has variously been identified as a period of monopoly capitalism with Lenin defining the period as the highest stage of

capitalism: imperialism in 1916. This stage took root from the beginning of the 20th century and extended well until the early 1970s. Whilst the basic thrust of this stage was expanding capitalist relations of production across the globe, the period also witnessed the unleashing of various strategies including the integration between banks and industry, the export of capital, the exacerbation of inter-imperialist conflict, a reduced life cycle for fixed capital, accelerated technological innovation, the permanent military economy, the growth of multinational corporations and the expansion of credit with resultant global indebtedness.

Figure 1: Changing Regional Contributions to World GDP in the Common Era



	1	1000	1500	1600	1700	1820	1870	1913	1950	1973	2003
Africa	7.6185	11.493	7.8017	7.0795	6.9397	4.5013	4.0716	2.908	3.8099	3.4325	3.2314
USA	0.2581	0.432	0.322	0.181	0.1419	1.8065	8.8549	18.928	27.307	22.072	20.606
Asia	72.802	70.503	64.931	65.475	61.835	59.384	38.313	24.907	18.594	24.119	40.464
Europe	15.549	11.235	20.479	22.587	24.932	26.599	37.592	37.939	29.655	29.006	21.127

Source: Maddison (2004)

According to an assessment by John Bellamy Foster, Brett Clark, and Richard York (2010), the source of our ecological crisis lies in the paradox of wealth in capitalist society, which expands individual riches at the expense of public wealth, including the wealth of nature. In the process, a huge ecological rift is driven between human beings and nature, undermining the conditions of sustainable existence: a rift in the metabolic relation between humanity and nature that is irreparable within capitalist society, since integral to its very laws of motion. Fundamental changes in social relations must occur if the ecological and social problems currently confronting the planet are to be transcended. Their analysis points importantly towards moving beyond the current regime of capital which may be characterised as a form

of neo-liberalism; and the prerogatives of ensuring the survival of the species and thereby advancing towards a society of sustainable human development.

To advance along such a suggested path it is however necessary to deepen our understanding of this current phase of global capitalism. Neo-liberalism represents a historical process which has systematically sought to dismantle many of the structures that limit and regulate the operation of the market, both with regard to relationships between capital and labour and with regard to relationships between different capitalist enterprises.

Neoliberalism is the current hegemonic paradigm of empire and ideological system in the 21st Century. It comprises at least six main characteristics. Firstly, the liberation of enterprises from all regulatory boundaries previously established by governments acting as the state towards the objective of the total freedom of movement for capital, goods and services. Secondly, public expenditure on social services including health, education and welfare has been significantly reduced. The ideological framing of welfare as a burden on the public fiscal mechanisms has been used to justify this approach which breaches the liberal social contracts of Thomas Hobbes (1651) and John Locke (1689) amongst others.

Thirdly, neoliberalism has sought to reduce the social wage and safety net of poor. This has included further reductions in fiscal spending and includes disinvestment in the maintenance of infrastructures such as shelter, water, transport and other amenities whilst increasing the subsidisation of private enterprise interventions through tax credits, direct transfers of authority and other means which privilege the ruling classes. Fourthly, another key aspect of neoliberalism has been its focus on extensive deregulation, including dismantling environmental protection, health and safety provisions.

The fifth defining feature of neoliberalism is the selling of state-owned enterprises, goods and services to private investors. This form of privatisation has generally included development

finance institutions, capital goods industries, railroads, toll highways, electricity, schools, hospitals and even fresh water. Privatisation has sought to achieve the objectives of increased efficiencies and maximum resource optimisation. The global results however indicate an increased concentration of wealth in a few hands and increases in costs to users of utilities. In some instances, privatisation as an explicit policy is pursued though corporatisation of public entities which provides the cover for private sector behaviour behind the façade of public sector authority.

The sixth main characteristic of neoliberalism is a summative feature through which the very concept of "public goods" and even the notion of community is being replaced by individual responsibility. This has the effect of shifting the blame to victims whilst increasing the alienation of the poor. The elite beneficiaries of neo-liberalism increasingly agglomerate around shared cosmopolitan values and are delinked from and opposed to the real struggles of the marginalised in various underdeveloped territories.

The ultimate consequence of the political economy of global capitalism, its neoliberal ideology and the conflation of multiple crises unleashed is a massive increase in inequality across the wide world and within national political units. This gross effect correlates the growing intra-national and international inequalities. Dissatisfaction, unrest and insecurity are increasing together with the deployment of State Terrorism[2] as organised violence becomes the only mechanism available to maintain the status quo and ensure its reproduction.

The contemporary world is largely shaped by global capitalism, particularly under conditions of corporate imperialism enforced through Empire and known as neo-liberalism. Environmental degradation is exacerbated intensified exploitation and oppression through mass unemployment in the formal sectors, short-term contract work, 'casualisation', increasingly meaningless and boring labour punctuated by periods of unemployment and

[2] Amnesty International defines organised violence as: arbitrary detention, unfair trial, torture, and political murder or extrajudicial execution.

short-time work, declining real wages, and a rapidly diminishing social wage, and from wholesale alienation bringing about escalating mental health problems and anti-social crimes.

As noted in the discourse on the Anthropocene: “through mining activities alone, humans move more sediment than all the world’s rivers combined. Homo sapiens has also warmed the planet, raised sea levels, eroded the ozone layer and acidified the oceans” (Monastersky: 2015: 145). It is within the construct of contemporary Capitalism that we have created the conditions of current over-production and under-consumption that itself results in huge impacts on and through our natural resources.

The relentless and ultimately self-destructive drive for profit underpinning capitalism also advances environmental destruction. Improvements in the material living conditions of humanity have resulted from the extension of the provision of various infrastructures including water supply, housing, electricity, transport connections and a wide range of essential products and cultural activities. This is however not universalised and has increasingly become dependent on international linkages in global chains of production for their provision and maintenance. The costs with respect to these infrastructures are again being disproportionally borne by the working class and those entering the margins of the middle strata.

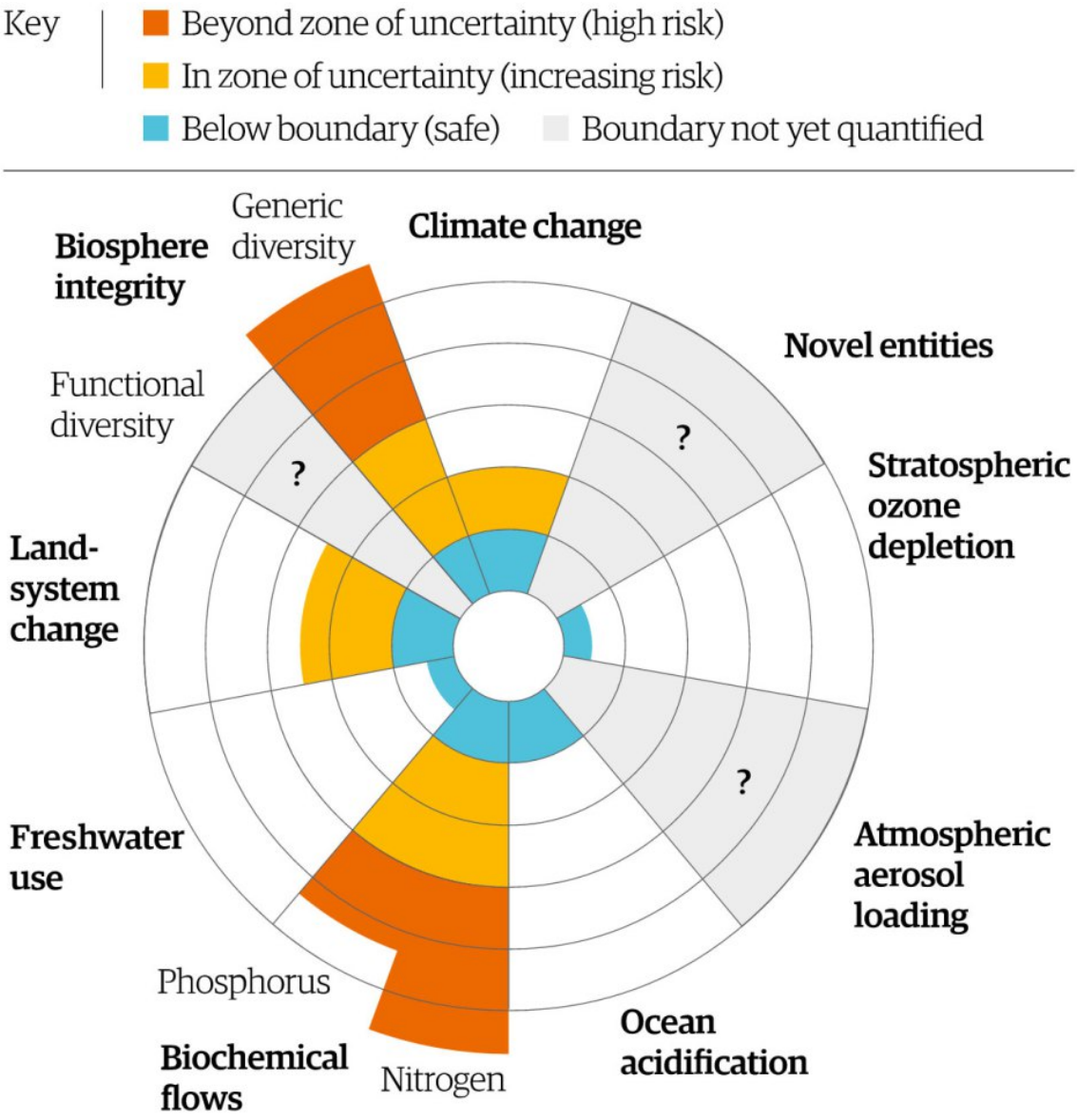
Whilst humanity has inordinate power to materially alter our planetary realities, this potential remains constrained by the limits of its knowledge and technological capabilities and competences. Such precariousness stands in stark contrast to the increasing brutality though which repressive state machineries of the nationalist elites impose their self-determined agenda in pursuit of narrow short-term accumulation strategies at the expense of global sustainability and in comprador relations with global capitalism.

As recognised by the United Nation's Intergovernmental Panel on Climate Change: "there's a more than 90 percent probability that human activities over the past 250 years have warmed our planet. The industrial activities that our modern civilisation depends upon have raised atmospheric carbon dioxide levels from 280 parts per million to 379 parts per million in the last 150 years" (IPCC: 2007). The panel also concluded there's a better than 90 percent probability that human-produced greenhouse gases such as carbon dioxide, methane and nitrous oxide have caused much of the observed increase in Earth's temperatures over the past 50 years.

The planet currently faces multiple tipping points that will ultimately signal the failing of some of the world's ecosystems with life-threatening consequences for all. The IPCC maintains that "with increasing warming, some physical systems or ecosystems may be at risk of abrupt and irreversible change" (2014). According to an international team of scientists examining numerous interdisciplinary studies of physical and biological systems, nine environmental processes were determined that could disrupt the planet's ability to support human life (Stockholm Resilience Centre: 2009). The nine earth system boundaries identified are:

1. Climate Change;
2. Stratospheric Ozone;
3. Land Use Change;
4. Freshwater Use;
5. Biological Diversity;
6. Ocean Acidification;
7. Nitrogen and Phosphorus Inputs to the Biosphere and Oceans;
8. Aerosol Loading; and
9. Chemical Pollution.

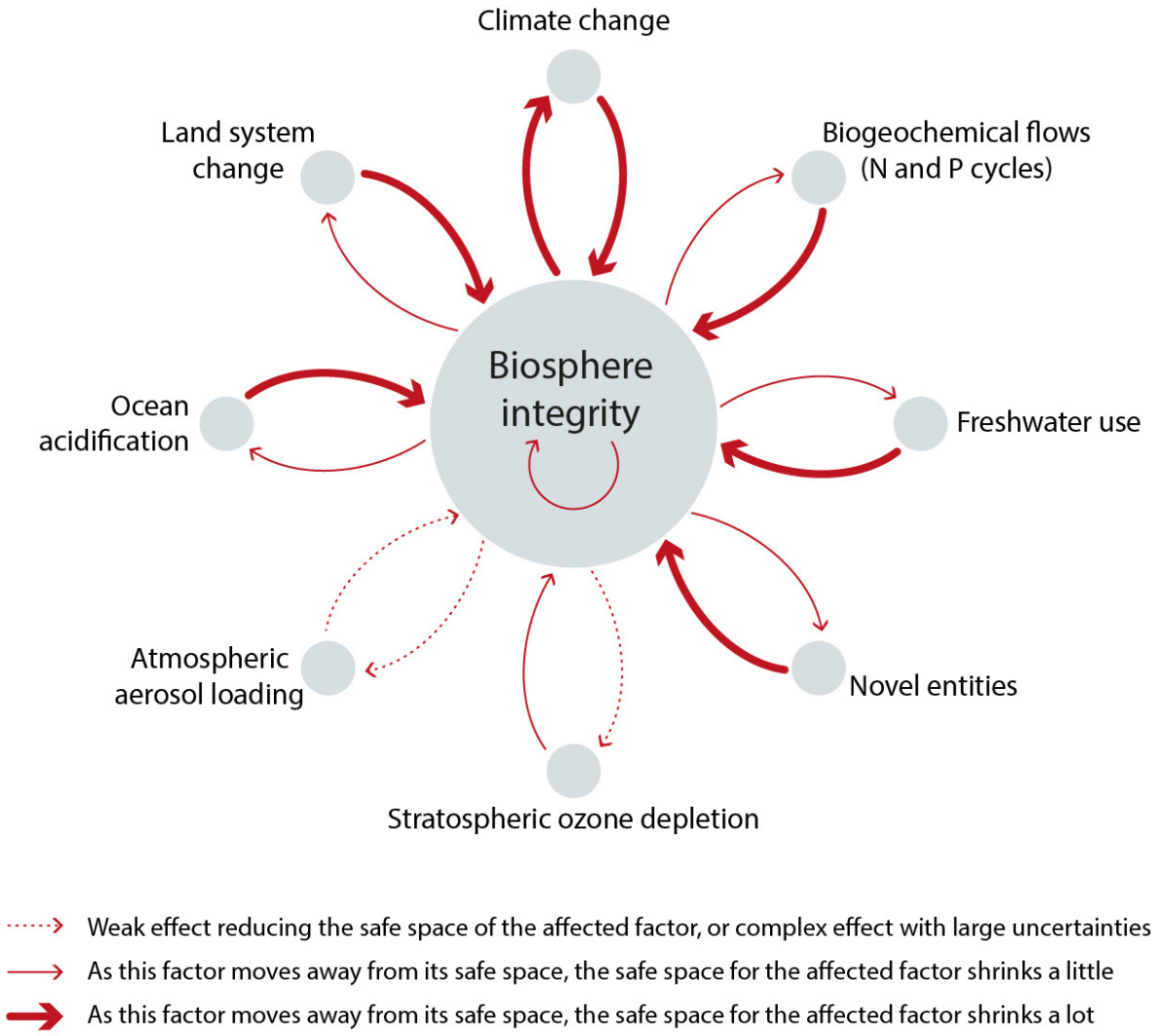
Figure 2 Planetary Boundaries



Source: Steffen et al (2015)

The boundaries for these processes recognise the limits within which humankind can safely operate. All of the boundaries are interconnected and changes in one area has an influence on each of the others.

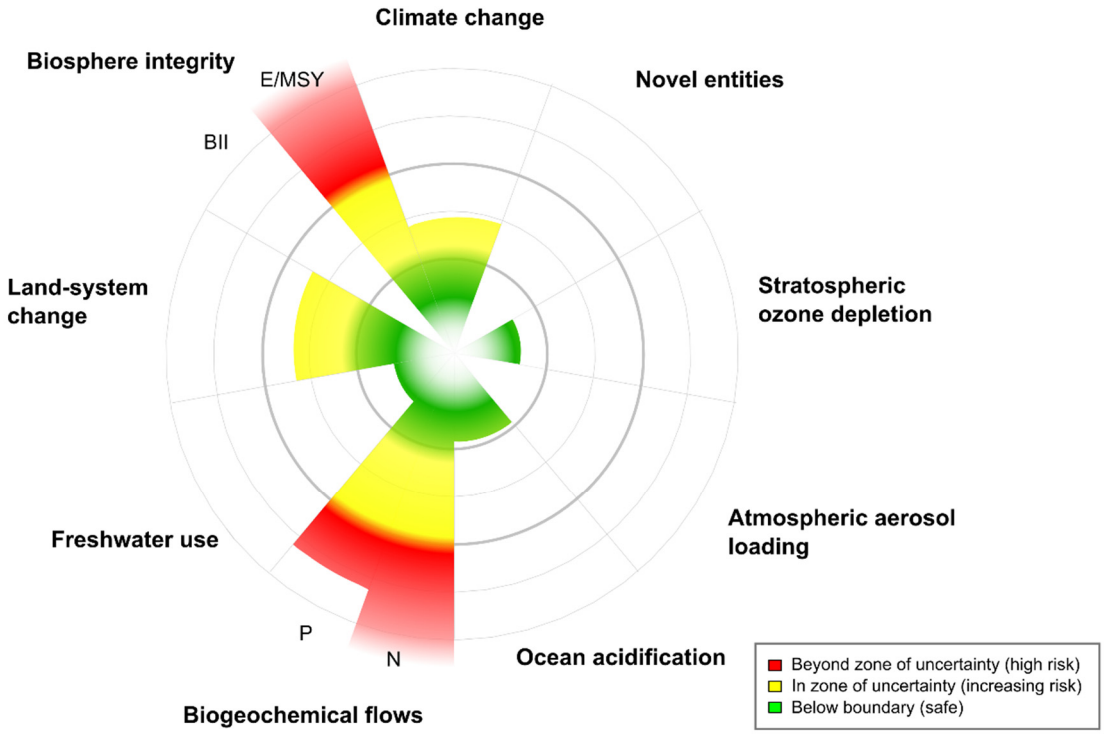
Figure 3 Interaction between the Biosphere Integrity Planetary Boundary and other Planetary Boundaries



Source: Mace et al. (2014).

Seven of these processes have clear boundaries established by science whilst complying with the uncertainty principle. Three of those boundaries—for climate change, ocean acidification and stratospheric ozone depletion—represent tipping points, and the other four signify the onset of irreversible degradation. The remaining two processes comprising atmospheric aerosol pollution and global chemical pollution have no determined limits due to their recent age and lack of long datasets. According to the most recent update to the seminal study, four of the boundaries (climate change, biological diversity, nitrogen input to the biosphere, and change in land use) may now have already been transgressed (Steffen et al.: 2015). The last mentioned parameter refers to deforestation whereby vegetation is cleared for agriculture.

Figure 4 Current Status of the control variables for the Nine Planetary Boundaries



Source: Steffen et al (2015)

Current changes to the climate and potentially irreversible climate change implies the loss of productive land, extreme weather conditions, rising sea waters, massive dislocation of people, desertification and serious economic and social upheaval. Other resource shortages like fresh water, forests, agricultural land, and biodiversity are being severely impacted. Depletion of oil and gas reserves impacts directly on the lives of the billions of people of the world and the fragile biosphere. The current production paradigm remains locked into fossil fuel dependencies that include long distance transportation; factory production systems; as well as many other systems and commodities. This system will become increasingly difficult and constitute an important site of conflict in the face of recognising the planet as a finite system in itself.

The mineral endowments of the planet developed over billions of years yet its rate of extraction has accelerated with the advance of science and technology. The net effect is that

the stocks of planetary resources are being depleted faster than nature can replenish them and without intergenerational concern.

According to the UN, "The central challenge in designing the post -2015 development agenda is to ensure that efforts to improve the quality of life of the present generation are far - reaching, broad and inclusive but do not compromise the ability of future generations to meet their needs. Accomplishing this goal hinges on the ability of the international community to ensure access to resources for growing numbers of people, eradicate poverty, move away from unsustainable patterns of consumption and production and safeguard the environment" (2015)

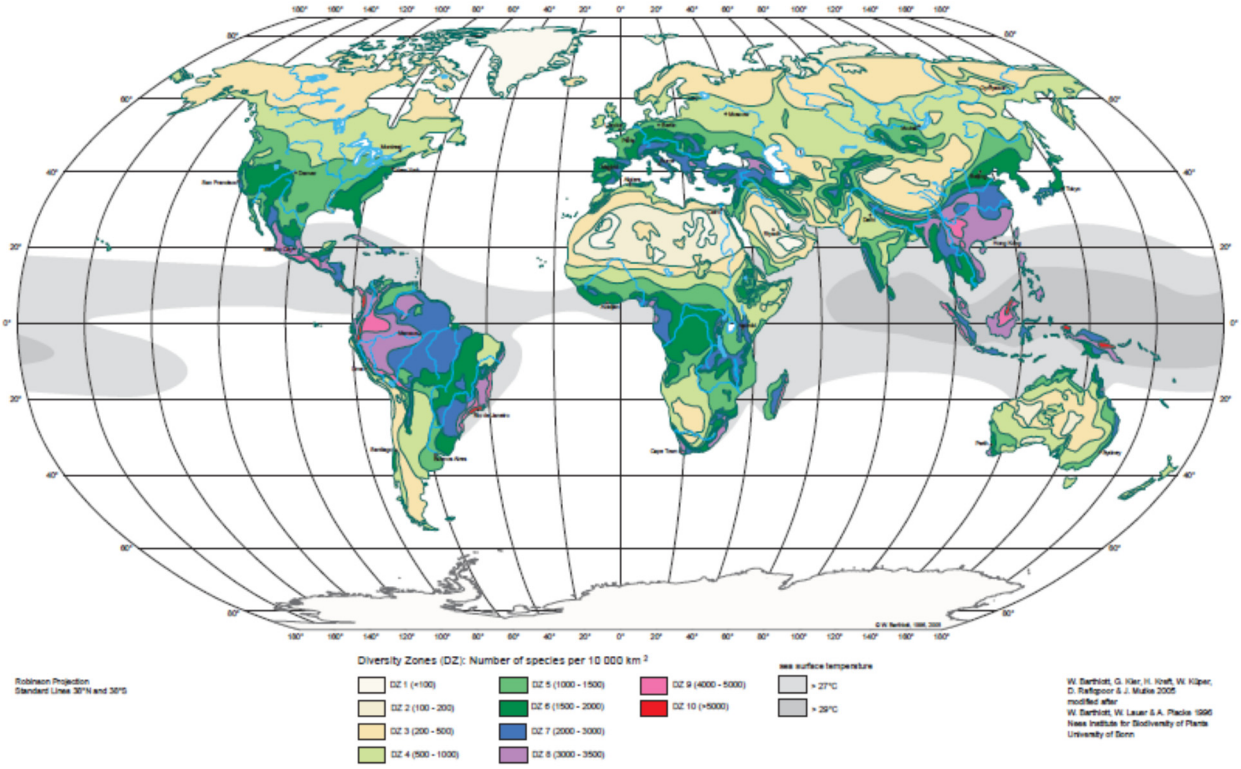
Humanity is only just beginning to appreciate the limits of the Earth's carrying capacity. Our species continues to expand both in terms of population as well as with respect to developmental needs. The system of global capitalism has enveloped the planet and is marked by a distinct patter of combined and uneven development. The resulting inequalities, marginalisation and exclusion requires a fundamental reassessment of some of life defining aspects characterising our social, economic and political paradigms as the edge of the ecological catastrophe we have generated. Converging global living standards between the more developed with the rapidly developing parts of the world further strain the planetary thresholds whilst the vast majority of countries remain outside the realm of benefits. Epochal changes are required though such agitation may still be ascribed as demanding the impossible.

3. Natural Resources of Brazil and South Africa

The geophysical resources of the planet are often the result of primordial origins. This has resulted in an uneven distribution of these resources. These continents were forged out of plate tectonics, whereby the several plates that comprise the planet's outer layer, glide over the mantle which forms the rocky inner layer above the core. This has resulted in combinations into super-continents and their separation into contiguous land-masses over time. It is estimated that the most recent of a series of supercontinents on Earth: Pangaea, formed about 270 million years ago and broke apart about 200 million years ago. Gondwana split into Africa, South America, Australia, India and Antarctica approximately 180 million to 170 million years ago. Thus, the continents of South America and Africa were essentially created by them drifting apart at a rate of just a few centimetres per year. Today, the shortest distance between the two is 2,838 kilometres measured between Brazil in South America and Liberia in Africa.

Contemporary Brazil occupies an area of approximately 8,515,767 square kilometres and South Africa occupies 1,221,037 square kilometres. This makes them respectively the 5th and the 25th largest counties by area in the contemporary world-systems. Brazil is mainly located within the latitudes 6°N and 34°S, and longitudes 28°W and 74°W. South Africa is largely located within the latitudes 22°S and 35°S, and longitudes 16°E and 33°E. Figure 5 provides a visual representation of the distribution of vascular plants across the planet. It is clearly identifiable that both Brazil and South Africa are hosts to an amazing biodiversity as evidenced in the numbers of species present in both countries.

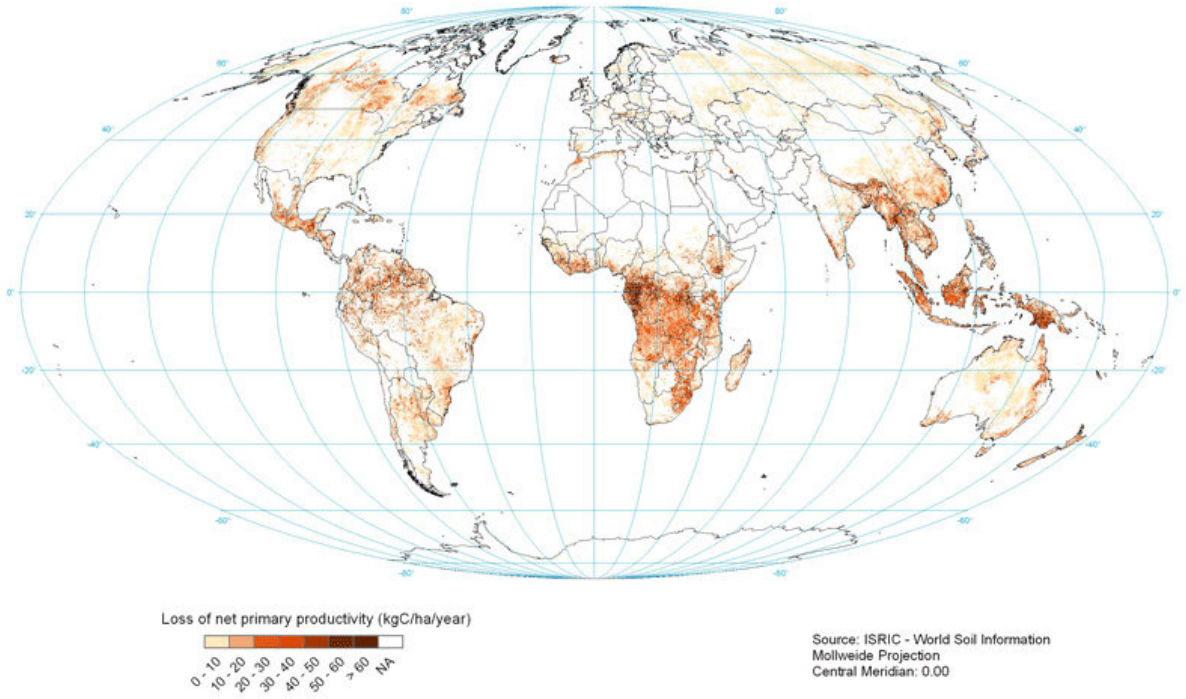
Figure 5 GLOBAL BIODIVERSITY: SPECIES NUMBER OF VASCULAR PLANTS



Source: Barthlott et al (2007)

The biodiversity represented in the species varieties are however under threat from environmental degradation. Figure Six shows the decreasing Net Primary Productivity over a period of eighteen years. Land degradation is defined by the FAO as the long-term loss of ecosystem function and productivity caused by disturbances from which the land cannot recover unaided. It is measured by the change in net primary productivity (NPP) which is the rate at which vegetation fixes CO2 from the atmosphere less losses through respiration and the deviation from the norm may be taken as an indicator of land degradation or improvement. The decreasing productivity can be seen to also be unevenly distributed with particular concentrations within the sub-national boundaries of the two countries.

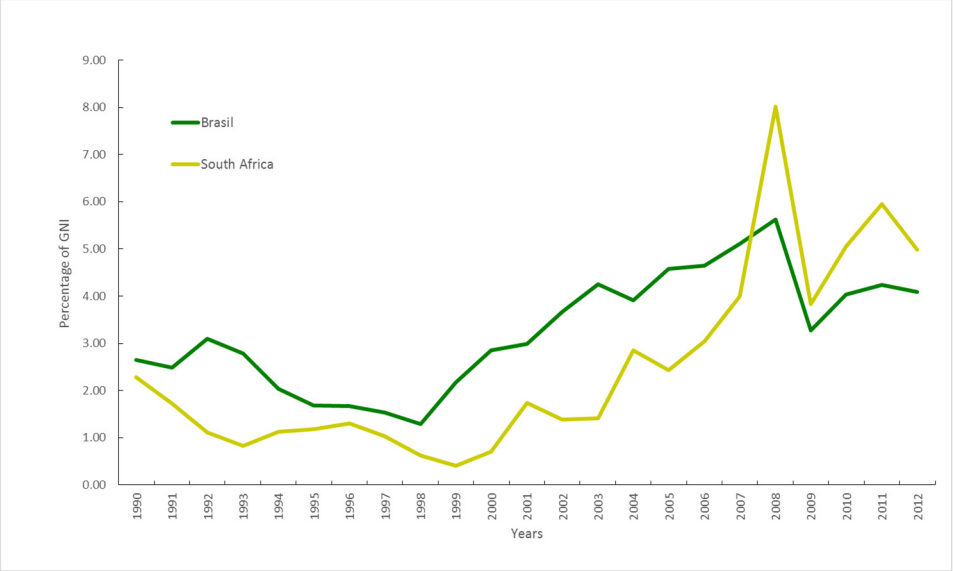
Figure 6 Global loss of Net Primary Productivity in degrading areas, 1981–2003



Source: Bai et al (2008)

The uneven nature of the soil degradation has peculiar implications for local governance and planning. In the Brazilian case, this would mean that some States would have higher impacts than others. In the case of South Africa, this would have Provincial implications. Natural resource depletion is the sum of net forest depletion; energy depletion; and mineral depletion. Net forest depletion is unit resource rents times the excess of round-wood harvest over natural growth. Energy depletion is the ratio of the value of the stock of energy resources to the remaining reserve lifetime (capped at 25 years). It covers coal; crude oil; and natural gas. Mineral depletion is the ratio of the value of the stock of mineral resources to the remaining reserve lifetime (capped at 25 years). It covers tin; gold; lead; zinc; iron; copper; nickel; silver; bauxite; and phosphate. Figure Seven provides the data trends for both Brazil and South Africa.

Figure 7 Adjusted Savings: Natural Resources Depletion (% of GNI)

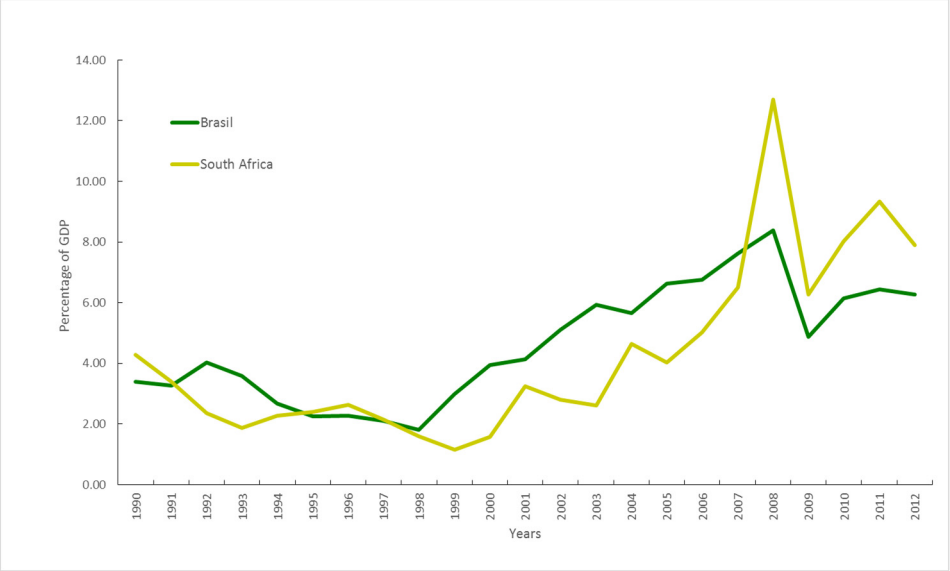


Source: Derived from World Bank (2015)

As shown in the Figure Seven, both countries have similar trend lines for the period of time. According to the World Bank, the natural resources depletion as a percentage of gross national income was 3.64 in Brazil (2011) and 6.05 in South Africa (2010). South Africa's rate of natural resource depletion exceeded that of Brazil at the peak of the global economic crisis of 2008. From then on, the trend-line shows that Brazil appears to maintain a lower ratio than South Africa until the present time.

Figure Eight shows the total natural resource rents as a percentage of gross domestic product for both Brazil and South Africa. The trend-line tracks the performance described in Figure Seven though it would appear that South Africa was initially extracting higher rents. The decline in the natural resource rents coincide with South Africa's transition to a national democracy which was finalised in 1994. Whilst the new democratic government redressed the anomaly briefly, by 1998 the trend again shows a lower return than that achieved by Brazil. This 'under-recovery' of natural resource rents continues under what is increasingly becoming recognised as a period of intensive neo-liberalisation in South Africa.

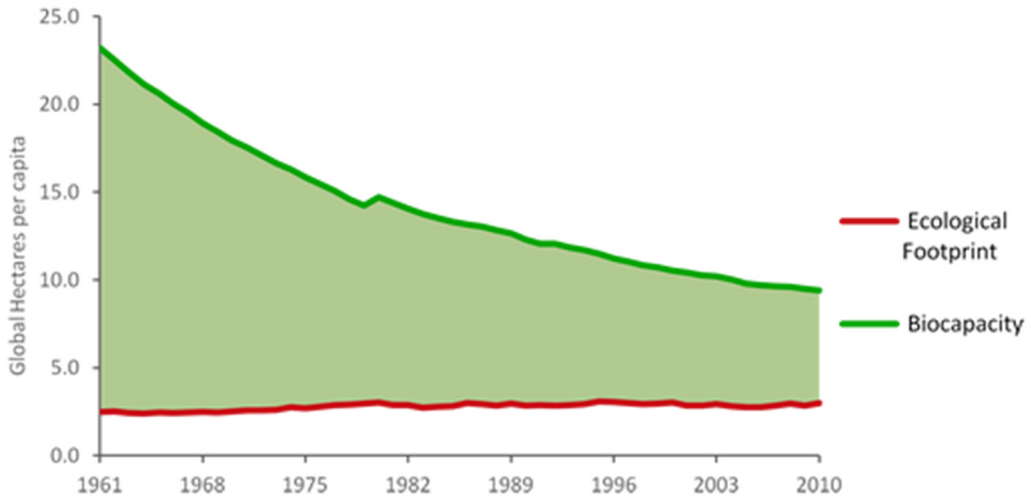
Figure 8 Total Natural Resources Rents (% of GDP)



Source: Derived from World Bank (2015)

During the global economic crisis of 2008, South Africa again surges ahead of Brazil in deriving higher rents for its natural resources. This trend continues into the present though both lines tend downwards. Another tool to appreciate the link between the natural environment and our exploitation thereof is the notion of an ecological footprint. This measures "human appropriation of ecosystem products and services in terms of the amount of bio-productive land and sea area needed to supply these products and services" (GFN: 2013: 2). Biocapacity varies each year with ecosystem management, agricultural practices (such as fertilizer use and irrigation), ecosystem degradation, and weather, and population size. Footprint varies with consumption and production efficiency. Figure Nine shows the Ecological Footprint and the Biocapacity of Brazil from 1961 until 2010.

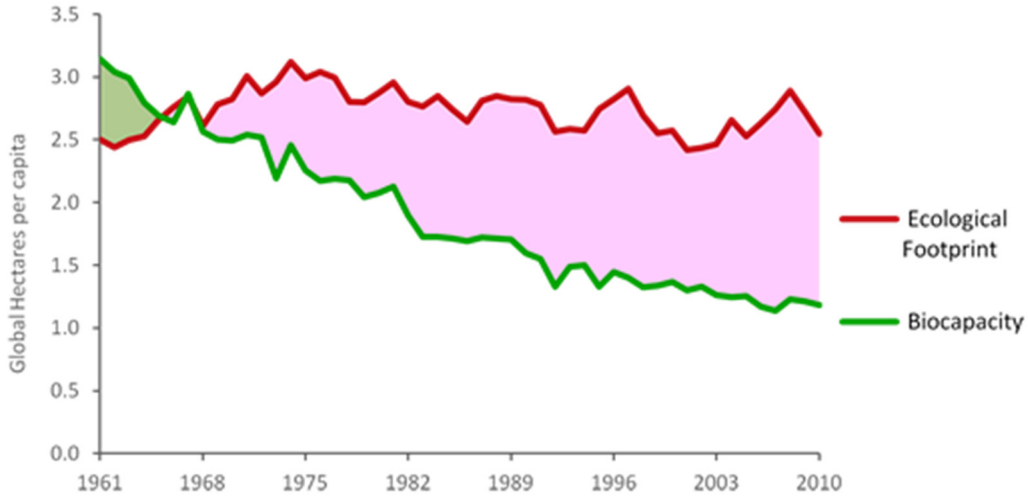
Figure 9 Ecological Footprint and Biocapacity of Brazil



Source: GFN: 2013.

Figure Nine shows that Brazil has managed to ensure that its Ecological Footprint has remained under the threshold of its Biocapacity. Whilst positive, the decreasing Biocapacity and the rising (albeit at a slow rate) Ecological Footprint will place pressures on public policy formulations over time. Figure Ten provides data on the same issues for South Africa.

Figure 10 Ecological Footprint and Biocapacity of South Africa



Source: GFN: 2013.

As is clearly noticeable, South Africa's Ecological Footprint has been achieved over significant losses in its Biocapacity. This 'overshoot' coincides with the country's adoption of intensive commercial agriculture and an inward industrialisation strategy that was based on the production of fuel from its low-quality coal deposits. Nearly 37% of South Africa's liquid fuels are derived from its coal reserves. South Africa had already commissioned 10 new power plants by the decade beginning in 1950 ranging from a relatively small coal power plant in Hex River which had an initial maximum installed capacity of 60MW, to the relatively large Taaibos and Kelvin stations. The need for electricity however exceeded the built capacity by the 1961, and there is a strong correlation with the formation of the 'minerals-energy complex' and the performance indicated in Figure Ten (cf. Maharajh: 2011).

As noted by Peter Harben "the basic distribution pattern of mineral resources is obviously determined by geology" (2006: 14). Thus, in the geological distribution of countries, both territories are now vested with resources that have accumulated over the long span of the planet's history. Harben does add that there is a distinction between the naturally endowed reserves and the resources available to countries (ibid). He argues that the following factors help explain the differences and that include: "mineral grade and consistency, amenability to mineral beneficiation, geographic location, demographics, labour rates, tax and investment incentives, political stability, entrepreneurial skills, transportation options, market demands, research and development, price competitiveness, economic climate, environmental regulations, government intervention, and timing" (op cite). The following table presents Brazil and South Africa's production of minerals as a percentage of world production.

Table 1: Distribution of world industrial minerals production by commodity (% of World Production)

	Brazil	South Africa
Andalusite	n/d	73
Antimony	n/d	4
Asbestos	9	1
Barite	1	<1
Bauxite,	10	n/d
Bentonite,	3	1
Beryllium minerals,	< 1	n/d
Chromite,	3	46
Diamond (Gem)	< 1	7
Diamond (Industrial)	1	12
Diatomite,	1	n/d
Feldspar,	3	1
Fluorspar,	2	5
Fuller's earth	n/d	< 1
Graphite,	9	n/d
Gypsum,	1	< 1
Iron oxide pigments	1	< 1
Kaolin,	4	< 1
Kyanite,	1	n/d
Lithium,	1	n/d
Magnesite,	3	1
Manganese	10	18
Mica,	2	< 1
Nitrogen (ammonia)	1	1
Perlite,	n/d	< 1
Phosphate rock,	4	2
Salt	3	< 1

Phosphate rock	3	2
Soda ash	1	n/d
Sodium sulfate	< 1	1
Sulfur	n/d	1
Talc	6	< 1
Titanium concentrates (rutile)	n/d	24
Titanium concentrates (titaniferous slag)	n/d	54
Vermiculite,	4	29
Zirconium mineral concentrates	3	36
Source: Derived from Harben (2006)		

However, whilst nearly 90% of Brazil's contemporary energy requirements are generated hydroelectrically, the majority of South Africa's electricity, approximately 94%, is derived from burning its stock of low quality coal resources. South Africa's geopolitical sovereignty over an immense share of the planet's stock of natural minerals and metals reserves. These reserves have recently been estimated to be potentially valued at approximately US$ 2.5 trillion[3] assessed by the in situ value of these resources (CITI: 2010: 1). South Africa's broader dependence on mining is embedded in the fact that this primary sector occupies 8.3% of the country's GDP (CoM: 2015). This represents a huge and significant change from the peak when mining contributed 21% of South Africa's GDP (ibid).

The contribution of mining to Brazil's GDP is approximately 4% in 2013 (Olivera: 2013). In contrast, it is estimated that the Mining Sector had a combined direct and indirect contribution to the whole economy of 17%. The primary and beneficiated mineral exports of South Africa represents 38% of the country's total merchandise exports. The Mining Sector also constitutes 19% of private sector investment and 11.9% of total investment in the economy. Half of the total volume transported via the country's rail and port infrastrutures are classified as products of the Mining Sector. The Mining Sector is also responsible for 16% of direct and indirect formal sector employment and accounts for R78 billion spent in

[3] CITI determined the volume reserve position in key commodities based on data sourced from the USGS and as such had the same methodology behind the assumptions. The data does not take into account the economic nature of the reserves, but purely looks at the raw interpretation of the data. It is therefore acknowledged that the actual dollar value of the reserves calculate may be overstating the actual reserve position. With the volume reserve base, they then multiply through their long term price assumptions to determine the in situ reserve value. CITI (2010) The Richest Country in the World is…? Citigroup Global Markets: Metals and Mining Strategy, CITI Investment Research and Analysis, Citigroup Global Markets Incorporated, 21 April.

wages and salaries. The inequalities generated between the salaries and the wages in South Africa Mining Sector contributes to the high general income inequalities and underdevelopment in the country.

4. International Relations and the Emerging Global Developmental Agenda

In 1992, the United Nations Conference on Environment and Development (UNCED) convened in Rio de Janeiro, Brazil. This 'Earth Summit' was seized by evidence of the interconnected environmental challenges of global warming, pollution and biodiversity and, the social challenges of poverty, health, and population growth and mobility. The gathering committed to "a programme of action for sustainable development worldwide" known as Agenda 21; and also adopted the Rio Declaration on Environment and Development which comprised 27 principles (1992). A major guiding principle for development that was derived from the 'Earth Summit' is the notion of common but differentiated responsibilities. Whilst this principle would largely influence the various positions of the global South, the global North represented by the more advanced and mature capitalist countries such as the USA, Japan and those in the European Union, largely sought to relegate the concept to essentially environmental and climate change issues.

At the transition to the new millennium, a new set of international developmental goals was discussed and adopted. The Millennium Development Goals (MDGs) set out a set of targets that became due in 2015. The MDGs had sought to generally redress conditions of absolute poverty and deprivations. Whereas it sought to enable a less inequitable international order, the shaping of the eight international development goals by the development financing instruments of the Bretton Woods agreement saw them being implemented as mainly objectives of the global South. This was largely the consequence of their articulation as being focused on poverty reduction.

Table 2: Millennium Development Goals

#	**Goal**
1	Eradicate extreme poverty and hunger
2	Achieve universal primary education
3	Promote gender equality and empower women
4	Reduce child mortality
5	Improve maternal health
6	Combat HIV / AIDS, malaria and other diseases
7	Ensure environmental sustainability
8	Develop a global partnership for development

Source: UN (2000)

Goal Seven directly targeted ensuring environmental sustainability. It was translated into the following four results: a) Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources; b) Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss; c) Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation; and d) By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers (UNDP: 2000). In its penultimate report, the United Nations noted that "Major trends that threaten environmental sustainability continue, but examples of successful global action exist Global emissions of carbon dioxide continued their upward trend and those in 2011 were almost 50 per cent above their 1990 level. Millions of hectares of forest are lost every year, many species are being driven closer to extinction and renewable water resources are becoming scarcer. At the same time, international action is on the verge of eliminating ozone-depleting substances and the proportion of terrestrial and coastal marine areas under protection has been increasing" (UNDP: 2014: 4).

Work on the successor regime began in 2011. This post-MDG package is radically different from the previous two iterations (Agenda 21 and the MDGs). The successor regime to the MDGs, are a range of sustainable development goals (SDGs). These have been drafted in seventeen (17) goals and 169 targets. The following table presents the current draft goals.

Table 3: Draft Sustainable Development Goals	
#	**Goal**
1	End poverty in all its forms everywhere
2	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
3	Ensure healthy lives and promote well-being for all at all ages
4	Ensure inclusive and equitable quality education and promote life-long learning opportunities for all
5	Achieve gender equality and empower all women and girls
6	Ensure availability and sustainable management of water and sanitation for all
7	Ensure access to affordable, reliable, sustainable, and modern energy for all
8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
10	Reduce inequality within and among countries
11	Make cities and human settlements inclusive, safe, resilient and sustainable
12	Ensure sustainable consumption and production patterns
13	Take urgent action to combat climate change and its impacts
14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17	Strengthen the means of implementation and revitalize the global partnership for sustainable development
Source: UN: 2014: Report of the Open Working Group on Sustainable Development Goals established pursuant to General Assembly resolution 66/288, New York City, September.	

The change in global policy objectives represented in the transition from the MDGs to the SDGs is a massive regime change as well. Brazil was the first developing country to set an emissions reduction target for itself that was not conditional on other countries taking action, (but was conditional on international financing that was referred to in the Copenhagen pledge) in 2009. According to these commitments, Brazil will reduce its emissions by 36.1% to 38.9% in 2020 compared to Business as Usual (BAU) emissions (UNFCCC: 2011). These commitments also explicitly includes emissions from land use, land-use change and forestry (LULUCF) activities. The targeted reduction was incorporated into the country's national laws in December 2010 and that version excluded the conditionality of international funding.

South Africa declared its intention to reduce its emissions below baseline by 34% in 2020, and by 42% in 202 (UNFCCC: 2011). It officially submitted its commitments to the Copenhagen Accord on 29 January 2010. The emission level derived from South Africa's pledge is 417–602 MtCO2e in 2020 excluding LULUCF activities. Based on this, South Africa's emissions should peak between 2020 and 2025, plateau for approximately a decade and then decline in absolute terms thereafter. This characterises a peak-plateau-decline (PPD) trajectory that is conditional on a fair, ambitious and effective agreement in the international climate change negotiations under the Climate Change convention and the Kyoto Protocol and the provision of support from the international community (ibid.).

5. Conclusions: Policy and Strategy Implications

As argued by Steffen et al "there is an urgent need for a new paradigm that integrates the continued development of human societies and the maintenance of the Earth system in a resilient and accommodating state" (2015: 736). UNCTAD is supportive of this view and has argued that a very important part of the challenge is for a developing countries to ensure that development is sustained environmentally, economically, financially, socially, politically and in other dimensions as well (2013). They further emphasise the need for a "broader, developmental concept of sustainability – ensuring that development can be sustained in all its dimensions, rather than only seeking to minimize environmental impacts" (ibid.). In sum this requires the establishment of an integrated developmental agenda that encompasses both "more viable and inclusive national development strategies and changes in the global economic system to accommodate and support them" (ibid.). Thus framed we may recognise the need for an endogenous response towards natural resources and an enabling global environment (sic) that sustains and nurtures such an approach.

Both Brazil and South Africa, have indicated their respective commitments to existing multilateral agreements. As the new regime of the SDGs takes hold, the need for each country to integrate its environmental nee ecological stance with its other policy pronouncements becomes even more important. As noted by the TST[4] of the UN, "mainstreaming STI into other SDGs appears to be a necessary complementary requirement for promoting knowledge-sharing and for building capacity to face the multiple challenges posed by sustainable development. Many statistics and indicators on STI related issues are available, but they rarely connect or measure the input of STI in achieving development goals. In the light of the complexity of STI, knowledge-sharing and capacity-building and their multiple impacts on and contribution to sustainable development and poverty eradication, a series of goals, targets and indicators could usefully be considered" (2014: 7).

[4] The Technical Support Team (TST) is co-chaired by the Department of Economic and Social Affairs and the United Nations Development Programme and the brief was prepared by UNESCO, with contributions from IFAD, ITU, UNAIDS, UN-WOMEN, UNDP, UNEP, UNISDR, UNOOSA, WFP, WIPO and WMO.

In the Memorandum of Understanding on Cooperation in Science, Technology and Innovation between the Governments of the Federative Republic of Brazil, the Russian Federation, the Republic of India, the People's Republic of China, and the Republic of South Africa, the BRICS countries acknowledged their desire to "further strengthen cooperation in the fields of science, technology and innovation for accelerated and sustainable socio-economic development amongst the five countries" (2015: 1). On the basis thereof, they recognised the "importance of cooperation based on the principles of voluntary participation, equality, mutual benefit, reciprocity and subject to the availability of earmarked resources for collaboration by each country" (2015: 2).

The BRICS have thereby established the modalities for nine mechanisms for enhanced cooperation that includes: 1) Short-term exchange of scientists, researchers, technical experts and scholars; 2) Dedicated training programmes to support human capital development in science, technology and innovation; 3) Organization of science, technology and innovation workshops, seminars and conferences in areas of mutual interest; 4) Exchange of science, technology and innovation information; 5) Formulation and implementation of collaborative research and development programmes and projects; 6) Establishment of joint funding mechanisms to support BRICS research programmes and large-scale research infrastructure projects; 7) Facilitated access to science and technology infrastructure among BRICS member countries; 8) Announcement of simultaneous calls for proposals in BRICS member countries; and 9) Cooperation of national science and engineering academies and research agencies (op cite: 3-4). Inducing the research themes of natural resources and developmental possibilities either as BRICS or even if just as the bilateral Brazil and South Africa would undoubtedly unlock more benefits for our respective countries, the citizens and the biodiversity which we have the privilege of having been accorded custodial roles.

As global dynamics advance geopolitically, both Brazil and South Africa have the opportunity to seize the research opportunities to better prepare for a changing, less-familiar natural world. This has significant repercussions in advancing beyond the narrow constructs of contemporary capitalism and its neo-liberal financialised form. A new paradigm for better

appreciating our natural resources, redressing the metabolic rift and building an egalitarian, just, and sustainable society on the planet earth is within our collective reach

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