Africa 2050 – Growth, Resource Productivity and Decoupling

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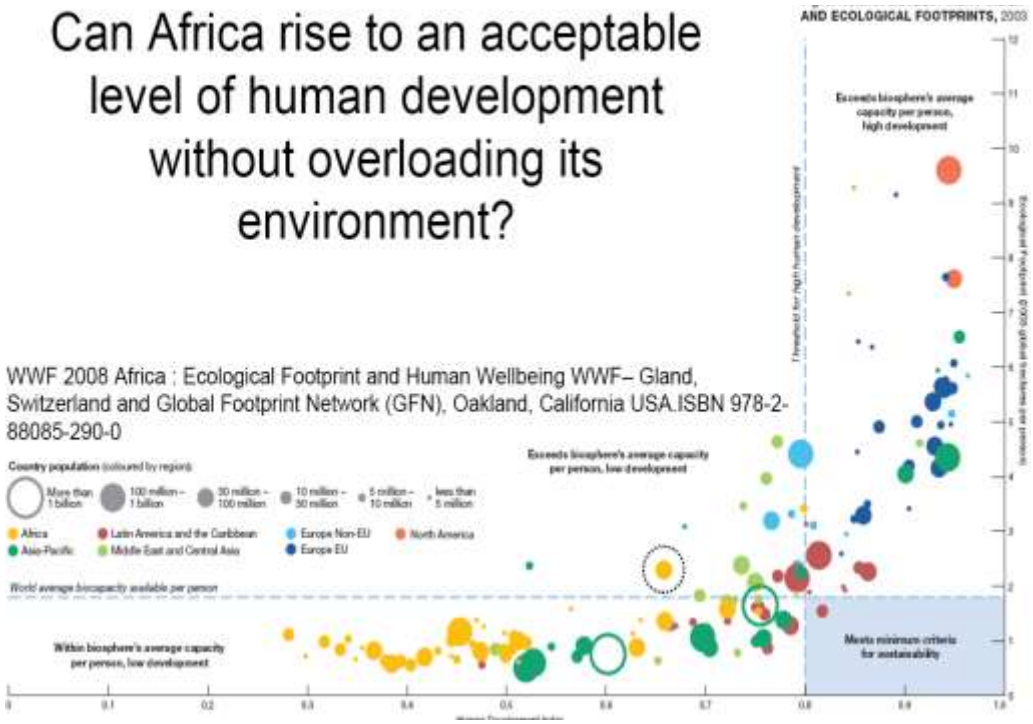
Introduction

There is a new wave of optimism sweeping across Africa as growth rates climb, consumer spending rises and returns on investment escalate higher than most other parts of the world since the onset of the economic recession in 2007. By 2008 Africa's collective GDP was $1.6 trillion, roughly equal to Brazil's and Russia's. Real GDP has increased by 4.9% per year since 2000, more than twice what it was in the 1980s and 1990s. Although these levels of growth are not uniform across all of Africa's sub-regions (see Figure 2 below), at current growth rates, GDP by 2020 is projected to be $2.6 trillion underpinned by a rapidly urbanising youthful and increasingly educated population with over 128 million households moving into the middle class to become vibrant consumer spenders.

However, Africa cannot escape the resource depletion challenges that face the rest of the world. If Africa invests in a growth and development path that is resource and energy intensive, it might end up undermining the key conditions for growth and development that it is dependent on in order to eradicate poverty and rise up on the human development index. As Figure 1 below suggests, most countries that rate high on the Human Development Index also have high ecological footprints (i.e. they are resource and energy intensive). The Latin American countries, which tend to cluster more closely around the nexus between lower ecological footprints and high human development indexes, can provide useful models for an alternative development pathway to the one selected in developed economies (especially those in Europe and North America).

Africa (the yellow dots) will be forced to choose: it can either try to follow the same pathway to prosperity as the developed world, or it can strive to achieve its developmental goals by finding a pathway that is not resource and energy intensive. If it opts for the former, it will gradually end up lagging behind the rest of the world technologically because many other countries (in particular Europe and China) are rapidly advancing by investing in resource productivity and energy efficiency. If it opts for the latter, it will need to invest in human capital and technological innovation on an unprecedented scale. Indeed, there is already evidence that the most significant contributors to African growth are economies that are diversifying by doing just this. The challenge is how far is Africa prepared to go towards the building of rapidly growing green economies. It will be suggested in this paper that the notion of 'decoupling' offers African policy-makers ways of thinking about development strategies that are less dependent on primary resource extraction and export. Indeed, Africa may well need to discover ways of 'leapfrogging' over stages of industrial development that have been particularly destructive and resource intensive in the developed economies.

Figure 1: Countries measured along the Human Development Index and Ecological Footprint indicators, 2008



(Source: WWF 2008)

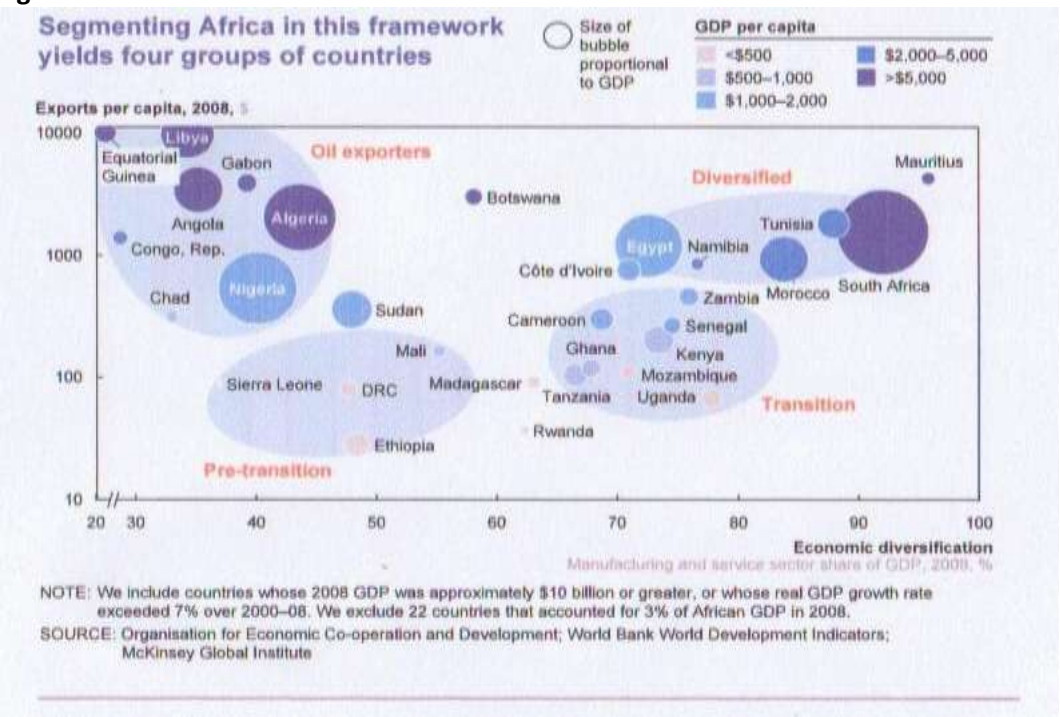
Dimensions of African Growth

Although the boom in resource prices has clearly been a dominant driver of African economic growth, it would be a mistake to assume that other economic sectors remained stagnant. In reality, growth was spread out across a number of sectors. During the period 2002-2007, the sector share of change in real GDP was as follows (McKinsey Global Institute 2010:3):

Resources: 24%
Wholesale and retail: 13%
Agriculture: 12%
Transport and telecommunications: 10%
Manufacturing: 9%
Financial intermediation: 6%
Public administration: 6%
Construction, real estate and business services: 5%
Tourism: 2%
Utilities: 2%
Other services: 6%

According to the African Development Bank's 2010 African Economic Outlook Report released in May 2010, the average 6% growth rate for 2006-2008 dropped to 2.5% in 2009. However, the Report was optimistic that growth would rebound to 4.5% in 2010 and 5.2% in 2011 due to sound macro-economic policies, counter-cyclical interventions, sustained aid flows and increased international loans. In reality, it was continued strong demand despite the economic recession for primary resources from other fast industrialising Asian countries (in particular China) that has been particularly significant in protecting Africa from steep declines in GDP growth rates.

Figure 2: Africa's Four Clusters



(Source: McKinsey Global Institute 2010:4)

The McKinsey Global Institute has clustered Africa's economies into four distinct clusters (see Figure 2). The "diversified economies" (Egypt, Morocco, South Africa and Tunisia) are Africa's "growth engines" with significant manufacturing and service industries. These economies are characterised by growth in the service sectors, rapid urbanisation and growth in consumer spending of between 3-5%. The "oil exporters" have the highest GDP per capita but the least diversified economies. Their key challenge is to ensure that oil wealth is re-invested in education and infrastructure as a basis for more diversified growth. The "transition economies" such as Ghana, Kenya and Senegal have lower GDP per capita than the diversified economies and oil exporters, but they are growing steadily as they gradually diversify and benefit from intra-African regional trade. The "pre-transition economies" are very poor but are growing rapidly albeit in unstable ways. Much will depend on whether they can get the "basics" in place, such as stable governments, macro-economic stabilisation, and reliable food production (McKinsey Global Institute 2010:5-6).

What is common to all these clusters is the high level of dependency of future growth and development will be on investments in education/human capital, infrastructure (in particular urban infrastructure) and the management of resource exploitation and the related matter of resource prices.

Africa in Global Context

Like the rest of the world, Africa is facing the combined challenge of a global economic crisis exacerbated by the multiple impacts of a global ecological crisis. However, unlike all the other continents, Africa is confronting these challenges without the benefit of an adequately developed knowledge infrastructure to drive the kinds of innovations that are required to both withstand the global ecological-economic crisis and take advantage of the crisis to position itself more advantageously within the global economy. Nevertheless, various African Governments have started to develop climate change response strategies and Green Economy policies which suggest that they may be recognising the ecological dimension of the crisis as an opportunity that Africa may be able to exploit to its own advantage. For example, Ethiopia intends to be carbon neutral by 2020 via a combination of investments in renewable energy and reforestation which, in turn, could attract substantial carbon finance.

Africa and the global community face a 'polycrisis' that consists of a multiple set of nested crises that tend to reinforce one another. The key dimensions of this 'polycrisis' are being recognised as discussion of a "Green New Deal" gathers momentum. Attention is increasingly on the intersections between global warming, eco-system breakdown, resource depletion, the global economic crisis, poverty and urbanisation. Global warming by a minimum of 2 degrees, exacerbated by the 70% increase in GHG emissions between 1970 and 2004, is both an outcome of an unsustainable economy and the most significant catalyst for change. As the Stern Report made clear, poorer countries (especially in Africa) will suffer "first and most" from the consequences of global warming even though they have "contributed least" to global warming (Stern 2007). The global economic crisis will exacerbate this suffering as the global economy shrinks and over 50% of the value of listed companies is lost over the two year period starting in October 2007 (Gore 2010).

According to the ILO, unemployment in developing countries rose by end of 2009 by between 18 and 51 million people over 2007 levels. When food prices rose by almost 60% during the first half of 2008, the number of people living in poverty increased by between 130 and 155 million. The 2010 OECD-FAO Agricultural Outlook estimated that the total number of people who are now hungry has edged over the 1 billion mark (OECD & FAO. 2010).

The International Energy Agency predicts that global demand for oil will increase by 45% by 2030 without any evidence that it will be possible to find this amount of oil as peak oil sets in across the world's conventional oil fields, thus further undermining traditional drivers of economic recovery (International Energy Agency 2008). This may be good news for Africa's oil producers, but the bonanza will not last longer than a decade.

The United Nations Millenium Ecosystem Assessment that reported in 2005 found that 15 out of the 24 key eco-system services that we humans depend on are degraded or used unsustainably, often with negative consequences for the poor – 1.3 billion people live in ecologically fragile environments located mainly in developing countries, half of whom are the rural poor and a large bulk live in Africa.

At the same time, as the world's population is expected to grow from the current 6 billion to 8 billion by 2030, a massive urbanisation wave is underway that has already pushed the world population across the 50% urbanised mark in 2007. The inevitable result is the unprecedented expansion and creation of new cities across the developing world. African

and Asian cities will absorb the additional two billion people expected on the planet even though they are the least equipped to handle this challenge.

The Inter-Governmental Panel on Climate Change (IPCC) received the Nobel Prize for its 2006 report on Climate Change. African Governments have noted that this report makes it very clear that Africa is most likely going to feel the greatest impacts of global warming even though it has contributed least to the problem. The daily lives of millions of Africans will be affected. By as early as 2020 (and the IPCC estimates are all regarded as highly conservative), between 75 and 250 million people are projected to be exposed to increased water stress; in some countries yields from rain-fed agriculture could be reduced by up to 50% thus severely compromising what is already a food insecure continent; towards the end of the 21st century projected sea level rise will affect low-lying coastal areas many of which are the locations of large and growing cities – just adapting to these changes is projected to cost between 5-10% of GDP; and by 2080 the amount of arid and semi-arid land is project to increase by 5-8%.

Africa's Farms and Cities

It is widely recognised that the growth rates of key agro-food products are either declining or negative in Africa. A largely unrecognised underlying driver is the fact that this is caused by rapidly deteriorating soils. The Washington-Based International Food Policy Research Institute estimates that 65% of all agricultural land in Africa is degraded. This results in declining yield growth rates as the effects of nutrient mining take their toll. This explains why millions of hectares of land in Africa are being abandoned and why millions get pushed into Africa's cities that depend on charcoal for energy that further exacerbates soil degradation as the trees disappear. But the world's leading foundations (Rockerfeller and Gates) allied with the biggest agricultural institutions think the problem is inadequate fertilizer and poor seeds (which Africans must now buy from Western multinationals). The United Nations Environment Programme holds a different opinion, advocating modern high yield agroecological farming methods that focus on the rebuilding of soils, support for smallholders and technical solutions that respect indigenous knowledge systgems (United Nations Environment Programme 2008).

Africa's cities are growing fast – 27 of the 100 fastest growing cities in the world are in Africa. No less than 62% of all urban dwellers in sub-Saharan Africa live in slums, compared to Asia where it varies from 43% (Southern Asia) to 24% (Western Asia), and in Latin America and the Caribbean where slums make up 27% of the urban population (UN Habitat 2008b). The large majority of cities in Sub-Saharan Africa are, therefore, slum cities. Given the fact that urbanisation rates in Africa are the highest in the world at 3.3% (UN Habitat 2008a: 4), the slum cities of Sub-Saharan Africa will be with us for the foreseeable decades. Africa is now 40% urbanised and is projected to be 60% urbanised by 2050, which translates into an increase in the *urban* population from the current 373 million to 1,2 billion by 2050 (UN Habitat 2008a: 5). If Africa's Governments continue to ignore this problem (by insisting that slumdwellers are only a problem because they refuse to go back to the rural areas), the additional 800 million urban dwellers will land up in Africa's mushrooming slums. The opportunity is obvious: urbanisation requires investments in urban infrastructure, and a growing number of largely urban-based consumers can become a key source for financing these investments.

Africa's Dependence on Resources

In 2001 *Time* magazine ran an article entitled *Looting Africa*. This signalled a realisation that Africa's economic fortunes were once again changing. Growth rates in the 1980s averaged below 2%, but by the end of the 1990s were getting close to 3%. By 2005, growth rates were reaching 5% as the prices for primary resources rose as global growth drove up demand. Africa had become strategically important again to the world, especially China and India. However, the resource curse has not gone away. In 2000, the export of primary natural resources accounted for nearly 80% of all exports from Africa. This is much higher than the rest of the world – the export of primary natural resources accounted for only 31% of all exports from all developing countries in 2000 and 16% of the exports from advanced industrial countries in the same year. According to the UN Conference on Trade and Development, in 2003 many African countries were dependent on the export of a single resource – for example, crude oil (Angola, Congo, Gabon, Nigeria, Equatorial Guinea), copper (Zambia), coffee (Burundi, Ethiopia, Uganda), tobacco (Malawi) and uranium (Niger). Many more were dependent on the export of just two or three primary products.

In a remarkable 2005 report entitled *Where is the Wealth of Nations?*, the World Bank estimated the "genuine savings" of all countries by adjusting the national income and savings accounts by deducting the costs of resource depletion and pollution, and then adding investments in education (World Bank 2006). Resource depletion includes the gradual depletion over time of natural assets which includes forests, mineral reserves, and energy resources (e.g. oil). Echoing the clusters described in the McKinsey Report cited earlier, the countries that were the most dependent on exports of primary resources and lowest capital accumulation (measured in terms of "genuine savings") included some of the largest resource exporters, namely Nigeria, Zambia, Mauritania, Gabon, Congo and South Africa. Below is the Table from the report that lists all the African countries that were studied. The results are clear: resource extraction and export at prevailing global prices undermines investments in long-term development infrastructures and human capital.

Table 1: African countries' adjusted national wealth and 'savings gaps', 2000

	Income per capita	Population growth rate	Adjusted net saving per capita	Change in wealth per capita	Saving gap
	($)	(%)	($)	($)	%GNI
Benin	360	2.6	14	–42	11.5
Botswana	2,925	1.7	1,021	814	
Burkina Faso	230	2.5	15	–36	15.8
Burundi	97	1.9	–10	–37	37.7
Cameroon	548	2.2	–8	–152	27.7
Cape Verde	1,195	2.7	43	–81	6.8
Chad	174	3.1	–8	–74	42.6
Comoros	367	2.5	–17	–73	19.9
Congo, Rep. of	660	3.2	–227	–727	110.2
Côte d'Ivoire	625	2.3	–5	–100	16.0
Ethiopia	101	2.4	–4	–27	27.1
Gabon	3,370	2.3	–1,183	–2,241	66.5
Gambia, The	305	3.4	–5	–45	14.6
Ghana	255	1.7	16	–18	7.2
Kenya	343	2.3	40	–11	3.2
Madagascar	245	3.1	9	–56	22.7
Malawi	162	2.1	–2	–29	18.2
Mali	221	2.4	20	–47	21.2
Mauritania	382	2.9	–30	–147	38.4
Mauritius	3,697	1.1	645	514	
Mozambique	195	2.2	15	–20	10.0
Namibia	1,820	3.2	392	140	
Niger	166	3.3	–10	–83	50.3
Nigeria	297	2.4	–97	–210	70.6
Rwanda	233	2.9	14	–60	26.0
Senegal	449	2.6	31	–27	6.1
Seychelles	7,089	0.9	1,162	904	
South Africa	2,837	2.5	246	–2	0.1
Swaziland	1,375	2.5	129	8	
Togo	285	4.0	–20	–88	30.8
Zambia	312	2.0	–13	–63	20.4
Zimbabwe	550	2.0	53	–4	0.7

(Source: World Bank 2006:64)

The calculations in this table hold the key to understanding the sustainable resource management challenge in Africa. It provides a measure of the wealth per capita of each African country and shows whether this wealth (or genuine savings referred to here as

'Adjusted net saving') is rising or falling over the accounting period (in this case the year 2000). The assumption is that as the population grows the available wealth must be spread across a greater number of people. This is unproblematic if wealth is accumulating at a rate that is greater than the population growth rate. If not, then wealth per capita will decline as the population increases. In Table 1 "Adjusted net saving" (or genuine savings) per capita is gross savings per capita minus resource depletion and pollution plus investment in education per capita. If the accumulation of genuine savings is faster than population growth, then genuine savings per capita will increase over time. This is reflected in the column "Change in wealth per capita" which reflects how much poorer/wealthier people get as the population expands (in $). The last column – "Savings Gap" – is a measurement of how much extra effort is needed for a country to break even (measured as percentage increase in GNI). For example, South Africa is just on the breakeven point because genuine savings per capita is just about large enough to cope with population growth. Botswana, Mauritius, Namibia, Seychelles and Swaziland are countries where there is growing wealth (i.e. genuine savings) per capita because wealth creation has been able to stay ahead of population growth. There are a number of countries where genuine savings per capita is positive (Adjusted net saving column), but because of high population growth rates wealth per capita is declining (e.g. Benin, Burkina Faso, Cape Verde, Ghana, Kenya, Madagascar, Mali, Mozambique, Rwanda, Senegal, and Zimbabwe). The resource exporters (e.g. Rep. of Congo, Gabon, Nigeria) are clearly visible: genuine savings are negative because of the rapid depletion of natural assets without compensatory re-investments in human capital plus high population growth rates which results in massive savings gaps.

The key conclusion that can be reached from this World Bank study is that unless growth rates are decoupled from resource depletion rates, and unless resource rents are reinvested in human capital development, real wealth accumulation per capita (genuine savings) will not keep up with population growth.

The above cited World Bank report comes after more than 20 years of trade liberalisation. Contrary to the development strategies pursued by the successful Asian tigers over the same period, African Governments were strongly encouraged - some would say even compelled - to lift protective tariffs across the board thus undermining local industries that were unable to compete with prices of imported goods. In the name of increasing trade, the opposite was achieved. According to Christain Aid, "[t]rade liberalization has cost sub-Saharan Africa $272 billion over the past 20 years. Overall, local producers are selling less than they were before trade was liberalized." (Christian Aid 2005)

In response to global recessionary conditions the European Union has concluded that "[d]espite recent price falls, raw material prices are still very high from a historical perspective". In late 2008 it urged its members to use international fora to prevent Africans from increasing the prices of primary resources (European Commission 2008). If Africa continues to get poorer as it increases exports of primary resources at discounted prices, it will struggle to build up the financial resources required to invest in the kind of human capital and physical infrastructures that are required for poverty-eradicating development strategies funded from the proceeds of endogenous growth engines that are less dependent on resource exports. An obvious question is what African Governments can do to ensure better prices for their exported materials.

Africa and Decoupling

The challenge facing African Governments is how best to improve human wellbeing (as measured by the Human Develoment Index) without depleting the natural resource base (as measured by the ecological footprint). For those countries with large reserves of non-renewable resources (fossil fuels, minerals and ores), the challenge is about how best to ensure that resource rents are re-invested in human capabilities, technologies, renewable natural resources (e.g. soils, forests and water resources) and infrastructures that will be needed to sustain development once the natural resources have been depleted. This is where the notion of 'decoupling' can be particularly useful for rethinking economic growth and development strategies. Indeed, if African countries want to leapfrog into becoming leading c.21st economic players capable of eradicating poverty, decoupling economic activities from rising levels of resource use may be an essential precondition for this to happen.

To understand what decoupling means, it is useful to start with an understanding of the trends in resource use and environmental impacts.[1] While water and land resources are difficult to quantify, Material Flow Accounting (MFA) provides a useful means of tracking the use of materials in economic activities. Up to 59 billion metric tons of raw materials are extracted globally each year, and this figure is increasing rapidly (see Figure 3). Between 1900 and 2005, material extraction rose by a factor of 8, with the most significant growth coming from construction materials (growing by a factor of 34) and ores/industrial minerals (growing by a factor of 27). In 1900, biomass accounted for almost 75% of total material use, but its share had dropped to only one third by 2005. The global economy has gradually reduced its dependence on renewable materials (i.e. biomass) and increased its dependence on finite mineral resources that cannot be replaced. The world needs to find its way back to a dependence on renewable resources.

[1] . This section draws on the Decoupling Report of the Resource Panel

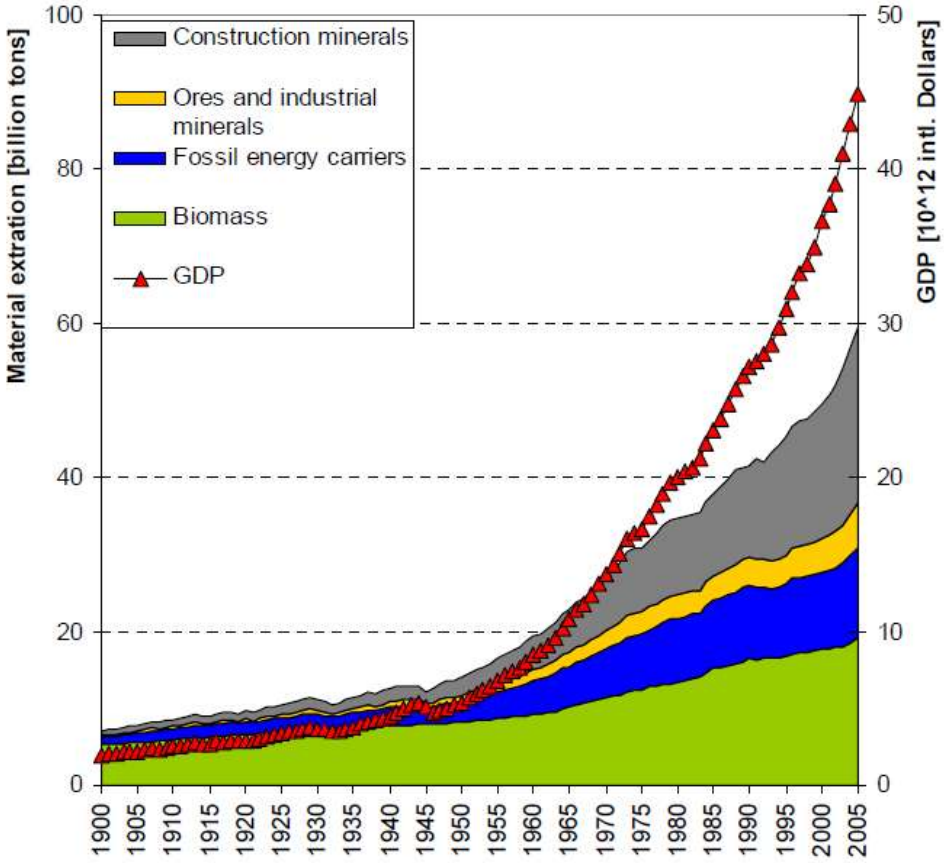


Figure 3: Global material extraction in billion tons, 1900-2005

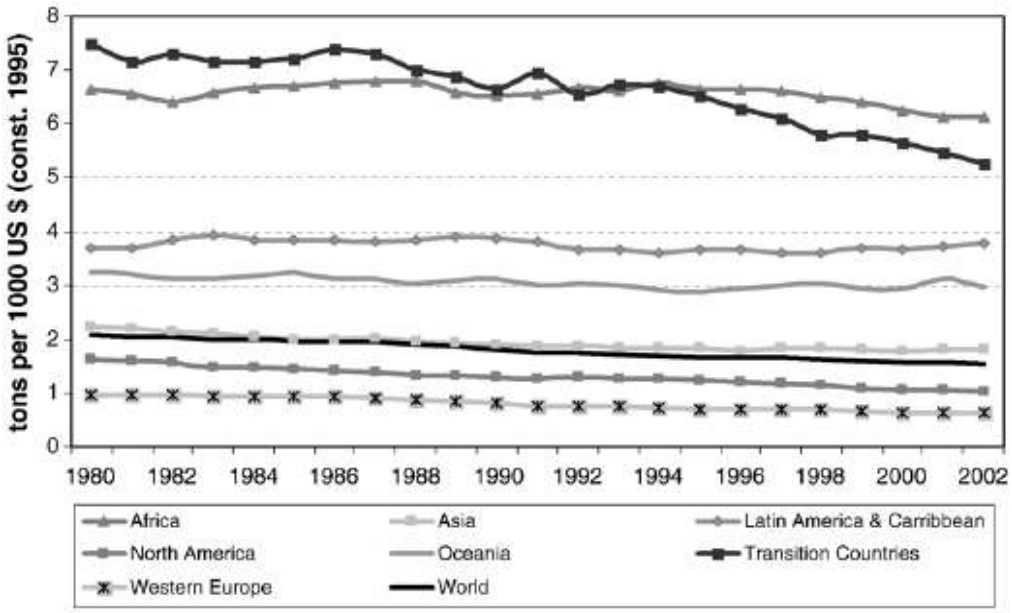
Contrary to what one might expect, increasing demand for limited resources has been accompanied by declining prices. Resource prices declined by an average of 30% during the 20th century. Price increases have only been temporary, and are typically followed by a continuation of the downward trend. Despite this, rates of growth in the extraction of raw materials (a factor of 8) have been slower than rates of growth in economic activity (a factor of 23), indicating that a certain amount of resource decoupling has occurred spontaneously. For those resource-rich resource exporting African countries, the general trend of rising demand for natural resources and declining real prices up until at least 2000 poses very serious challenges for economic growth and development policy. Although colonial and post-colonial relationships ensured that African countries were prevented from strengthening their market position in order to secure higher resource prices, weak and unstable governance has also meant that resource rents were misdirected into elite consumption rather than into the development of human capabilities, infrastructures and renewable natural resources. The solution clearly lies in making sure that resource prices are fair and that resource rents are properly re-invested.

At the same time, as Figure 4 below demonstrates, the overall material intensity of the global economy has declined from 2.1 tons in 1980 to 1.6. tons per 1000 US $ in 2002. In other words, 25% less material input was required in 2002 compared to 1980 to produce one unit of real GDP. This advance has to do with the innovations made possible by investments in human capabilities, infrastructures and (from the 1970s onwards) the information and communications technology revolution, new materials and biotechnologies. Even in Africa, where material intensity is highest (i.e. 6-7 tons per 1000 US $), there has

been an improvement as some economies have redeployed resource rents into economic diversification.

This process of relative resource reduction on a global scale has been a key driver of global GDP growth, mainly to the benefit of the majority of citizens in industrialized countries and a growing middle class in the new industrialising countries. Figure 3 also reveals that Western Europe and North America were the most efficient economies due, of course, to their investments in infrastructures and technological capabilities, and the overall process of relocating extractive industries into other parts of the world. By contrast, the resource-rich resource exporting countries in Latin America, Africa, Oceania (due mainly to Australia's rapid rise as a coal and iron ore producer) and Asia were either highly inefficient (Africa or Transition Countries) or were building fast growing economies that were increasingly dependent on construction minerals, ores and fossil fuels (Asia and Oceania). The material intensity of Latin American countries has remained stable at 3-4 tons per 1000 US $ of output which suggests that high growth rates driven by natural resource exploitation is generating significant resource rents that are being reinvested in economic diversification.

Figure 4: Resource use per 1000 US$, 1980-2002



Average metabolic rates at the global level have risen in recent years as large high density developing economies have attempted to enhance quality of life by accelerating manufacturing and resource exploitation. . This represents a significant challenge for decoupling in developing countries as there is less room for reducing metabolic rates than is the case in industrialised nations where the majority of basic needs have been met and the large bulk of the required infrastructures are in place. Africa, of course, is in exactly the opposite position.

According to the World Bank Africa's unmet annual infrastructure investment requirement is $22 billion plus an additional $17 billion per annum that needs to be spent on operations and maintenance. To address this problem, the AU Heads of State Summit resolved at its July 2007 meeting to establish the Pan-African Infrastructure Development Fund (PAIDF). The aim of the PAIDF is to mobilize public sector funds to leverage private sector

investments via public-private-partnerships. The focus of this fund is energy and power, telecommunications, transport, and water and sanitation. Without these investments in infrastructures that will conduct key strategic natural resource flows through African economies in more efficient and effective ways, current projections for future growth will not be realized. The question, of course, is what kind of infrastructures will be built? Will they set up African economies to be resource efficient and low-carbon, or will they be built in accordance with the same criteria that have been used to build the unsustainable infrastructures in developed countries?

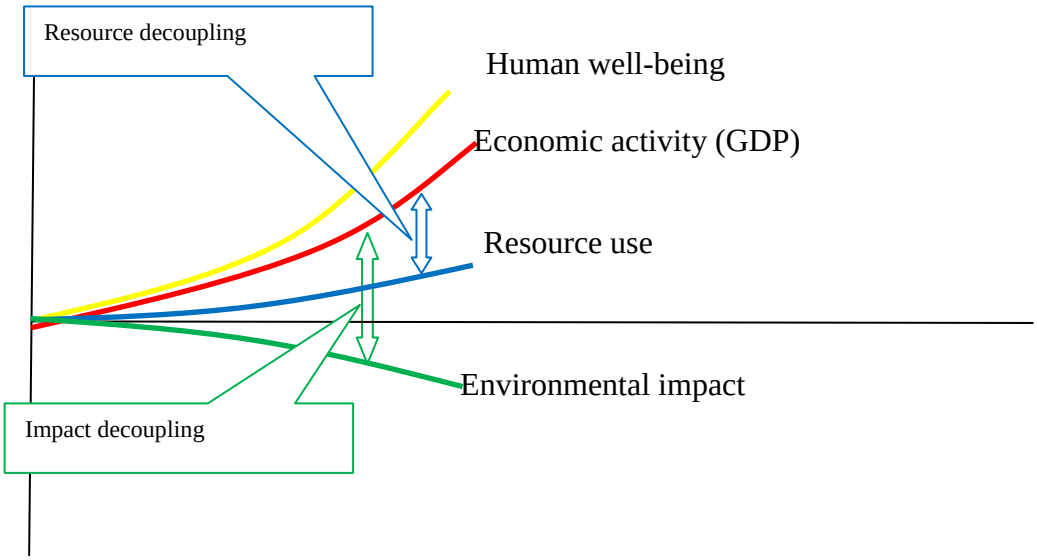
Defining Decoupling

Resource decoupling refers to decoupling the rate of use of (primary) resources from economic activity**,** which is equivalent to "dematerialization". It implies using less material, energy, water and land resources for the same economic output. If there is resource decoupling, there is an increase in resource productivity or, in other words, an increase in the efficiency with which resources are used. Resource productivity can usually be measured unequivocally: it can be expressed for a national economy or for an economic sector or even for a certain economic process or production chain by dividing added value by resource use (e.g. GDP/Domestic Material Consumption). If this quotient increases with time, resource productivity is rising. Another way to demonstrate resource decoupling is comparing the gradient of economic output across time with the gradient of resource input: if the latter is smaller, there is resource decoupling (see Figure 5).

Impact decoupling, by contrast, refers to the relation between economic output and (various) negative environmental impacts. There are environmental impacts associated with the extraction of resources required (such as groundwater pollution due to mining or agriculture), environmental impacts from production (such as land degradation, wastes and emissions), environmental impacts associated with the use phase of commodities (for example mobility resulting in CO_2 emissions), and there are post-consumption environmental impacts (again wastes and emissions). Methodologically, these impacts can be estimated by life cycle analysis (LCA) in combination with various input-output techniques. If environmental impacts become dissociated from added value in economic terms, there is impact decoupling. On aggregate system levels such as a national economy or an economic sector, it is methodologically very demanding to measure impact decoupling, because there is a whole number of environmental impacts to be considered, their trends may be quite different or not even monitored across time, and system boundaries as well as weighting procedures are contested.

Another distinction has often been made between "relative" and "absolute" decoupling. Relative decoupling means that the growth rate of the environmentally relevant parameter (be it resources used or some measure of environmental impact) is lower than the growth rate of its economic driver (for example GDP). There still exists a positive association, but the elasticity of this relation is below 1. Absolute decoupling, in contrast, was used for a situation in which resource use declined, irrespective of the growth rate of the economic driver. This latter relation is implied by the so-called environmental Kuznets curve that claims that if prosperity rises beyond a certain point, the environmental impact of production and consumption decreases. This model, the empirical evidence suggests, applies only in exceptional cases. While relative decoupling seems to be common, absolute reductions in resource use are rare. An absolute reduction in resource use occurs when the growth rate of resource productivity exceeds the growth rate of the economy.

Figure 5: Stylised depiction of resource and impact decoupling



Future scenarios of global materials use

The increased demand for resources that accompanies development presents serious threats to remaining reserves. The following scenarios for the period 2000-2050 indicate the kind of impacts that can be anticipated based on UN population projections, the assumption that the composition of demand for materials will stay the same, and the assumption that the relationships between population density and metabolic rates will remain the same:

Scenario 1: Business as usual (Freeze and catch up)
In this scenario, relative decoupling continues in industrialised countries, and their metabolic rates stay constant (freeze) at 2000 levels while developing countries increase their metabolic rates to similar levels (catch up) without any form of decoupling. This assumes little innovation will take place to drive reductions in resource use and is in accordance with current trends. It is likely to see the doubling of metabolic rates in developing countries, the tripling of annual resource extraction and consumption (raising the global average to 16 tons per capita), the quadrupling of emissions to a dangerous 26.8 GtC/yr and the transgression of all environmental limits.

Scenario 2: Moderate contraction and convergence (Factor 2 reduction and catch up)
In this scenario, industrial countries pursue strategies to reduce resource use by a factor of 2 by 2050, and developing countries aim to catch up to these reduced rates by decoupling growth rates from rates of resource use. This could achieve a comfortable middle class lifestyle for all, but would require substantial changes to modes of production and consumption in developed countries and innovation for decoupling in developing nations. Between 2000 and 2050, global average metabolic rates would remain more or less unchanged (at 8 tons per capita) whilst annual resource extraction levels would increase by 40%, and global emissions would more than double to 14.4 GtC/yr. Overall constraints aren't likely to be transgressed beyond current levels, and the greenhouse gas emissions are in line with the mid-range of IPCC forecasts.

Scenario 3: Tough contraction and convergence (Freeze at 2000 levels and converge)
In this scenario, the target level of global resource consumption in 2050 equals that of the year 2000. Metabolic rates of industrial countries decrease and those of developing

countries increase, converging at around 6 tons per capita. This requires significant measures to reduce resource use in industrialised countries in order to reduce their metabolic rates by a factor of 3-5, and relative decoupling by developing countries to reduce average metabolic rates by 10-20%. This would require extreme restraint and unprecedented innovation, but it would allow for population growth without increases in environmental pressure beyond 2000 levels. Global emissions would stay constant at 2000 levels of 6.7 GtC/yr, approximately 20% above recommended levels (GCI 2003).

The business as usual scenario provides an insight into what lies ahead if we do not change the approach to resource use. Unless significant resource use reduction relative to growth is achieved, it will not be possible to eradicate poverty and continue to meet the needs of a growing population. As the implications of resource depletion start to work their way through the economy, the pressure for policy change and innovation for decoupling will become difficult to resist. African countries, in particular, may well find themselves in an interesting new economic position in the world. For developed economies to make the transitions envisaged in scenarios 2 and 3, innovations that result in significant improvements in resource productivity will be required. This, in turn, could translate into a willingness to pay higher prices for primary resources; or put differently, rising resource prices might be a necessary condition for investments in innovations aimed at improving resource productivity. Either way, African stands to benefit, especially if the rising value of resource rents translates into increased investments in human capabilities, technological development, infrastructure and renewable natural resources.

Decoupling and Future Choices

Governments that lead the way by facilitating investments in innovation will reap the benefits when inaction is no longer an option, and those that are late to respond will find themselves dependent on technology transfers from elsewhere. Constraining global warming to a 2 degree temperature increase as demonstrated in Scenario 3 will require greater levels of innovation than Scenario 2, supported by a global consensus that poverty reduction cannot be achieved with business as usual approaches. The comforts of modern lifestyles need not necessarily be threatened, but certain established modes of consumption will need to change to be less resource-intensive (e.g. the design of products to last for a short period of time which results in high waste outputs).

Recent financial crises have led governments around the world to question their approaches to economic growth, and there is a growing realization that there is congruence between economic and environmental interests. Investing in resource productivity and energy efficiency is being seen as an opportunity to create jobs, improve infrastructural services, build new knowledge industries and rebuild the ecosystem's capacity to support life. The United States, China, South Korea, Costa Rica, Sweden, South Africa and Ethiopia are examples of countries that have made substantial commitments to 'Green New Deals' aimed at stimulating economic growth through the creation of millions of 'green collar' jobs. UNEP argues that the $2-3 trillion assigned to reviving the global economy should be channelled into a 'Global Green New Deal' that would go beyond economic stimulus to ensure that the most vulnerable are protected, extreme poverty is ended by 2025, and substantial advances are made in reducing carbon dependence, water scarcity and environmental degradation (Barbier 2009).

To conclude, African governments face a choice: will resource depletion and the global investments in innovation be ignored in order to pursue traditional resource/energy

intensive growth and development strategies; or will the potential for leapfrogging be recognised as a major opportunity for new kinds of investments that will result in investments in human capabilities, technological innovations, infrastructures and renewable natural resources (such as soils, water resources and forests) that set up African economies for a long-term sustainable future? The PAIDF initiative and accelerated urbanisation are clearly opportunities for innovation, as is the renewed interest in African agriculture as food prices rise. It has been suggested in this paper that the notion of decoupling may provide a useful framework for rethinking Africa's growth and development strategies.

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