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The Consumption of a Finite Planet: Well-Being, Convergence, Divergence and the Nascent Green Economy

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Abstract A variety of global metrics indicate the Earth has overshot its capacity to supply source and sink resources without substantial negative feedback. Here the relationship between consumption indicators (oil, freshwater, vehicle and meat consumption, GDP, CO_2 emissions) and well-being is analysed latitudinally across 189 countries and longitudinally over 60 years within three affluent countries. All latitudinal analyses show the characteristic "consumption cliff and affluent uplands" shape: e.g. at low per capita GDP, life satisfaction increases sharply up the cliff with rising GDP; after a threshold, well-being is independent of GDP across the affluent uplands. Longitudinal analyses of Japan, UK and USA since the 1950s show per capita GDP has grown between 3- and 8-fold, but mean levels of well-being remained unchanged. Consumption patterns are now converging on those typical in affluent countries. Indicators for seven baskets of countries: Affluent North America–Europe–Oceania, Affluent Asia, fast developing BRICs and CIVETS, high income Resource Extractors, Poor with Green Peaks, and the Poorest show the factors of consumption between the poorest and affluent (5- to 100-fold) and the fast developing and affluent (2- to 10-fold). A finite planet cannot resource such convergence. One indicator, climate change, grows more of a concern as evidence emerges, yet denial remains strong. A priority is to create opportunities for divergent ways of living. Although material culture has been sought as the means to meet personal well-being, it has failed both the affluent and poorest. A green economy will require human attachments to both place and possessions, thus reducing disposal and damage. Such entanglement produces high affiliation that improves life satisfaction, as does much non-material consumption. As yet, most political and economic systems are far from recognising these imperatives, though there have been notable policy innovations. A shift to a green economy is inevitable. It is simply whether it occurs before or after the world becomes locked into severe climate change and other consequences of harm to natural capital.

Keywords Consumption · Ecosystem services · Green economies · Possessions and places · Well-being

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1 Introduction

On Christmas Eve 1968, after moon transit Apollo eight astronauts Anders and Boorman recorded by hand-held camera the first photographs of Planet Earth as a solitary system with clear boundaries. Such images have become iconic, and have coincided with a growing understanding of the limits of a system within which human activity must source its resource needs. Over the subsequent 45 years, world population doubled from 3.5 to 7 billion, and the size of the world economy grew by 3.8-fold from US $11.2 trillion (at constant 2000 US)$ to $42.5 trillion in 2011 (World Bank 2012a,b). GDP per capita has thus almost doubled. Mean life expectancy has risen from 56 to 69.6 years, driven strongly by a sharp global fall in under-5 mortality rates from 153 to 51 per 1,000 live births (UNICEF 2012). Yet these advances in income and health indicators have also brought depletion of natural capital and threats to ecosystem services, have been spread unevenly across and within countries, and have left a substantial proportion of the world's population in hunger and poverty.

Concerns over the finite quantity of natural capital were articulated by the Club of Rome in *The Limits to Growth* (Meadows et al. 1972), which concluded that the source and sink resources required by the world's economy for continued growth were by definition limited, and that at certain thresholds supply would be outstripped by demand, with negative social and environmental consequences. This would be manifest by rising prices of goods and services together with negative feedback from natural capital and ecosystem services that remained largely unvalued by conventional markets. The Brundtland Commission (WCED 1987) defined sustainable development as forms of economic development that meets human needs and does not damage natural capital in the present or future. The subsequent 1992 Rio conference (and its +10 and +20 events), some international protocols (e.g. Kyoto for CO_2), agreements (e.g. Montreal for ozone), conventions (e.g. Convention on Biodiversity), development targets (e.g. Millennium Development Goals), and international and national ecosystem and climate assessments (e.g. by MEA 2005; IPCC Fourth assessment report. 2007; NEA 2011) appear to indicate progress has been made on limiting the impact of human activity on natural capital vital to economies. Yet the iron cage of arithmetic has become compelling: per capita consumption of capital continues to rise, as does the total number of consuming people.

The compounded relationship between population (P), affluence (A) (a measure of consumption), technology (T) and their impacts (I) has been described by the IPAT and STIRPAT equations (Ehrlich 1968; Holdren and Ehrlich 1974; Dietz and Rosa 1994; Ehrlich and Ehrlich 2010; O'Neill et al. 2010a,b). Advancing technologies might offset the multiples of $P \times A$ to limit adverse impact, but they have to work hard (UK Foresight 2011; Royal Society 2012; Fitter 2013). With both global P and A continuing to rise, the challenge to reduce resulting impacts may be passing beyond human capability (Harper 2013). Although there has been a decline in average energy intensity (by $ spend) by 33 % since 1970, global GDP and population growth have each risen 60–70 % over this period (IPCC Fourth assessment report. 2007). The idea of dematerialisation is alluring, but elusive. Energy intensities have also declined in China—from 8 kg CO_2 per $ of GDP to 3 kg over 1980–2008. Again the arithmetic is critical: marginal improvements in efficiency and productivity through technological improvements (or worse by letting energy-intensive industries transfer offshore) obscure the scale of the necessary reductions in total resource consumption (Waggoner and Ausubel 2002; Jackson 2009; UNEP 2011).

The gains made by efficiency are thus overwhelmed by increases in the size of the economy. This may partly be because of the "rebound problem", by which efficiency gains free money which can then be used for further efficiencies or even other non-material consumptive purposes, but which tends to be used to drive more consumption: the Jevons paradox (Jackson 2009; Sorrell 2009). In 1970, world CO_2 emissions were 21 Gt $CO_{2\text{-eq}}$ per year; by 2012 they had risen to 35.6 Gt per year. The rate of growth of CO_2 emissions has increased from 0.43 Gt $CO_{2\text{-eq}}$ per year to 0.92 Gt $CO_{2\text{-eq}}$ per year. The outcome has been continuing upward pressure on atmospheric CO_2 concentrations: in the pre-industrial era, these were approximately 280 ppm; by the end of 2012, concentrations reached 391.6 ppm, rising by ~2 ppm per year. At this rate, three decades hence will see the global concentration exceed 450 ppm.

A number of global metrics have been developed to demonstrate the impact of human activities on finite Earth. These include the Human Development Index (UNDP), Genuine Progress Indicator (Daly and Cobb 1989), Ecological Footprints using global hectare equivalents (Moffatt 2000; WWF 2010, 2012), the Happy Planet Index (NEF 2013), and planetary boundaries (Rockstom et al. 2009). No single approach has captured all source and sink resource use and impact, nor necessarily satisfactorily resolve complexities back to a single metric (such as global earths, hectares or sector boundaries). However, all conclude that (i) the Earth has already exceeded its capacity to supply source and sink resources without resulting in negative feedback loops that reduce the supply of both, and (ii) consumption and population drivers continue to rise, suggesting that the impacts on both environment and economy will also continue to grow. Overshoot has already begun to occur, in which more resources are being used than can be regenerated each year. Yet conventional economic growth is still a primary political goal in most countries. The Royal Society (2012) concluded that indefinite growth is impossible in a finite world. Overshoots of consumption will provoke crashes when finite limits are reached.

2 Consumption and Well-Being

Consumption contributes positively to human development and well-being when it enlarges the capabilities of people without adverse effects on others, when it is fair to future generations, when it respects the carrying capacity of the planet, and when it encourages the emergence of lively, creative and content communities (Royal Society 2012). However, current consumption patterns fail on these criteria, and are both unsustainable and unfair. Despite the world producing 34 % more food per capita than in 1961, there are still some 800–1,000 million people malnourished and hungry (Pretty 2011a; Conway 2012). Despite the economy growing by nearly 4-fold, more than two billion people still live on less than $2 per day. Despite mean per capita daily domestic water consumption of 170 L, 884 million people have no access to safe water, and 2.6 billion have poor and unsafe sanitation (UNEP 2011). At low levels of consumption, it is evident that a large proportion of the world's population needs to consume more—in order to meet basic needs relating to food, water, housing, security and family health. However, at the aggregate level, the average global citizen is consuming too much. If those without are to have the opportunity to consume more, then by definition those with too much must consume less. This is not widely accepted.

In the industrial era, economic growth has become equated with human progress, with a fundamental assumption that material consumption inevitably leads to improvements in well-being. Here, analysis explores the relationship between GDP and other indicators of economic growth (e.g. input measures such as oil, meat and vehicle consumption, and output measures such as CO_2 emissions) with life satisfaction by latitudinal analyses across countries or longitudinal over time within countries (cf Diener et al. 1992; Inglehart and Klingermann 2000) (data here from UNSD 2009; UNDP 2011; UNICEF 2012; World Bank 2012a,b; FAO 2012; Veenhoven 2012).

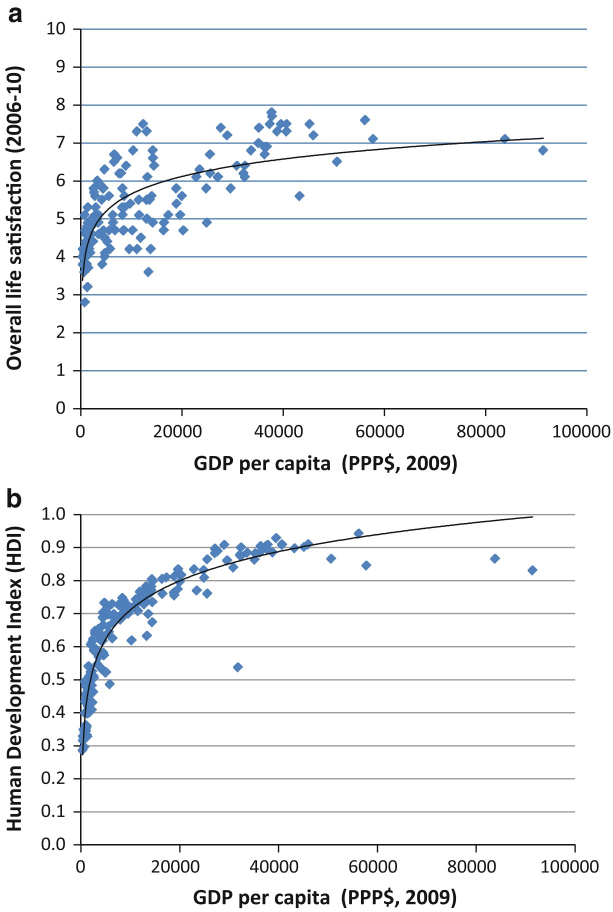

Fig. 1 **a** Relationship between GDP and life satisfaction at country level (n = 145). **b** Relationship between GDP and life satisfaction at country level (n = 173)

All latitudinal analyses (across 189 countries) confirm the distinctive "consumption cliff and affluent uplands" shape, whether for life satisfaction or human development index (HDI) outcomes by per capita country GDP, or for life expectancy and HDI outcomes by per capita country CO_2 emissions (Figs. 1a, b, 3a, b). Life satisfaction surveys undertaken since the 1940s by the World Values Survey (Veenhoven 2012) are a critical indicator for well-being. Latitudinal analysis indicates that at very low per capita GDP, life satisfaction increases sharply with any rises in GDP (Fig. 1a). The cliff is steep. Above a threshold of approximately \$10,000, the affluent uplands bring diminishing returns for life satisfaction, such that it becomes largely independent of further changes to GDP. A similar cliff and uplands slope is found between per capita GDP and HDI, though the scatter around the curve is tighter ($R^2 = 0.89$) than for life satisfaction ($R^2 = 0.58$) (Fig. 1b).

This exposes the false proposition of well-being (as satisfaction or happiness) being based largely on consumption (see Diener et al. 1999). The relentless pursuit of increases to GDP (as a measure of economic and thus human progress) does not result in consistent gains in well-being in countries in the affluent uplands. Again, this is not widely understood or accepted. Ehrlich and Ehrlich (2010) observe this general silence over the relationship between affluence and over-consumption results in consumption of any kind being viewed as an unchallenged good.

There are important variations between countries, with some having distinctly lower life satisfaction at particular GDP points (e.g. Portugal, Botswana, Hong Kong, Bulgaria), and others higher (e.g. Norway, Sweden, Costa Rica, Panama, Venezuela). These individual country circumstances are illuminating and will provide pointers for future progress towards greener and happier economies: those above the curve have positive observed life satisfaction: GDP quotients (their citizens obtain more satisfaction per unit of GDP); those below the line have lower than expected LS:GDP quotients (see Table 1 for quotients by country group).

GDP closely predicts CO_2 emissions by country (Fig. 2, $n = 184$, $R = 0.61$). Variation between countries suggests a range of efficiencies—those above the predicted relationship emit more CO_2 per unit of GDP (and thus are "carbon inefficient" countries), while those below emit less CO_2 than the mean (and are "carbon efficient"). A slope of zero would indicate complete decoupling of economic performance measured by GDP for carbon emissions. Across all countries, mean per capita CO_2 emissions are 4.4 t CO_2 per year. High carbon efficient countries per unit of GDP include Norway, Sweden, Switzerland, Hong Kong, Iceland, France, Singapore, Austria and Israel, and low carbon efficient countries per unit of GDP include Australia, Canada, Kazakhstan, Saudi Arabia, Trinidad and Tobago, UAE, Ukraine and the USA. Increases in CO_2 emissions in low consumption countries result in a sharp rise up both the life expectancy and HDI cliffs (Fig. 3a, b). Poor countries obtain benefits by consuming more and emitting more, but above approximately 2 t CO_2 emitted per capita, the relationship again becomes largely independent. In the uplands, economic activity leading to carbon emissions produces no further improvements in the two well-being indicators of life expectancy and HDI. The relationship between per capita CO_2 emissions and life satisfaction has a similar shape to Figs. 1a, b and 3a, b.

Longitudinal measures of life satisfaction since the 1940s–1950s (Veenhoven 2012) show a decoupled relationship between GDP and life satisfaction for affluent countries, which can be assumed to have already met basic needs prior to this period: once in the uplands, well-being benefits do not accrue over time. Figure 4a, c shows relative changes in per capita GDP for Japan, UK and USA since the 1940s and early 1950s against changes in mean life satisfaction within each country (on a scale of 1–4). It is clear that continuing economic growth in these countries (in Japan by 8.8-fold, in UK by 3.4-fold, in USA by 3.2-fold) has not coincided with improvements to mean life satisfaction. Over this period in the USA, the proportion of homes with dishwashers increased from 9 to 50 %, with tumble-driers from 20 to 70 %,and with air conditioning from 15 to 73 %. "Does this mean we have happier people", asked Schwartz (2004)? "Not at all".

The conclusions for many are counter-intuitive: people in the 1950s at a time when there was lower income and material consumption were on average as contented as they are today. Victor (2008) has observed that "Americans have been more successful at decoupling GDP from happiness than in decoupling it from material and energy", a tragic tale for modernity (Kasser 2002). It is important to note that it cannot be concluded that individuals will not have seen improvements or declines in well-being across decades. Changes in life circumstances, partly driven by changes in consumption, will have had positive and negative impacts for some people. But at the aggregate level, such changes have been zero-sum: gainers in well-being have been balanced by losers.

The growing gap between mean life satisfaction and rising per capita GDP may, however, be illustrating something subtlety different. It is conceivable that some consumption and GDP increases have produced more life satisfaction, but that this has been eroded

Table 1 Consumption patterns in seven baskets of countries

	CO_2 emissions (t/capita/year)	Domestic water use (l/capita/day)	Meat consumption (kg/capita/year)	Vehicles per 100 people	Under-5 mortality (per 1,000 live births)	Life satisfaction: GDP quotient
Affluent North America–Europe–Oceania	11.8	457	95	64	5	0.25
USA	17.3	528	123	81	8	0.16
UK	8.5	113	85	53	5	0.2
Germany	9.6	157	88	63	4	0.18
Sweden	5.3	290	78	52	3	0.20
Australia	19	1122	123	73	5	0.19
New Zealand	7.8	645	117	72	4	0.25
Canada	16.4	713	78	62	6	0.20
Netherlands	10.5	89	71	52	4	0.58
Affluent Asia	9.0	266	51	38	4	0.18
Japan	9.5	375	46	59	3	0.19
Korea	10.6	374	56	38	5	0.23
Singapore	7.0	48		16	3	0.13
BRICs	5.2	195	50	16	26	0.79
Brazil	2.1	228	81	26	16	0.66
Russian federation	12.1	281	61	27	12	0.29
India	1.5	126	3	2	61	1.52
China	5.2	143	54	8	15	0.69
CIVETS	3.4	194	32	8	26	0.92
Colombia	1.5	319	44	7	18	0.71
Indonesia	1.8	78	11	8	32	1.31
Viet Nam	1.5	171	41	1	22	1.79
Egypt	2.6	169	22	4	21	0.83
Turkey	3.9	215	24	14	15	0.4o
South Africa	8.8	210	49	16	47	0.46
Resource extractors	23.0	271	56	26	34	0.21
Saudi Arabia	17.2	222	54	34	9	0.27
Qatar	53.5	315	55	53	8	0.07
UAE	34.6	348	85	31	7	0.21
Botswana	2.5	108	25	11	26	0.27
Equatorial Guinea	7.3	361	59	1	118	nd
Poor with green peaks	1.3	131	24	6	44	2.12
Costa Rica	1.8	nd	49	17	10	0.66
Bhutan	1.1	83	3	5	54	3.72
Ghana	0.4	26	14	3	78	2.96
Cuba	2.8	382	39	4	6	0.55
Kenya	0.3	32	16	2	73	2.73
Poorest five	<0.1	16	8	0.7	123	7.9
Liberia	0.1	20	4	0.3	78	10.6
Chad	0	9	14	0.6	169	nd
Mozambique	0.1	8	6	1.2	103	5.3
Burundi	0	16	4	0.5	139	9.7
Niger	0.1	29	11	0.8	125	5.9

Sources: UNSD (2009); UNDP (2011); UNICEF (2012); World Bank (2012a,b); FAO (2012)
Resource Extractors defined by oil and mineral extraction. Poor with Green Peaks selected for combination of policies that support agricultural sustainability, renewable energy, social group formation, protected area designations, and national systems to promote well-being

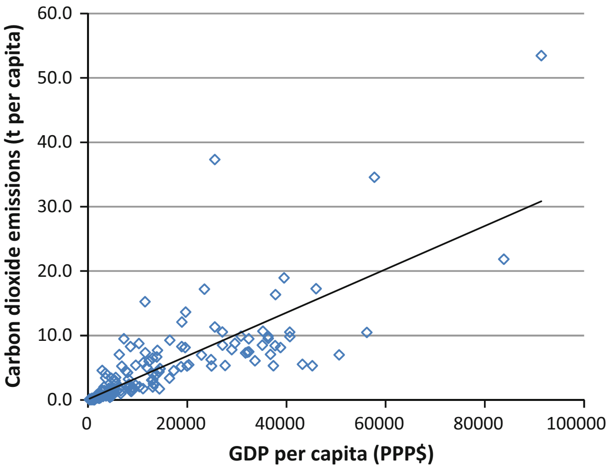

Fig. 2 Relationship between GDP and carbon dioxide emissions at country level (n = 185)

by the effects of growing negative environmental and social externalities (largely unvalued by markets) impacting on both natural capital and social capital, and thus directly reducing well-being (Csikzentmihalyi 2000). Many affluent countries, including Japan, UK and USA, have become more unequal, with observed declines in both social and natural capital (Putnam 1995; Pretty 2003; Pretty et al. 2005b; MEA 2005; Wilkinson and Pickett 2009; NEA 2011). The wealthy are also less empathetic and less prosocial (Piff et al. 2010, 2012). The environmental Kuznets curve (Torras and Boyce 1998), in which pollution and negative externalities are predicted to decline as countries become richer, has only been rarely demonstrated (for only atmospheric sulphur and particulate pollution) (Bassetti et al. 2013). For most consumption and impact indicators, these continue to grow as countries become richer. The side-effects may have reduced well-being (Pretty 2011b).

Jackson (2009) concludes that humans have been "betrayed by affluence", and Dasgupta (2010) observes that "the rogue word in GDP is gross", as it does not deduct the depreciation of vital capital assets. The concept of the wealth of nations (a "commonwealth": Berry 2012) should include measures for natural capital, social capital and individual well-being. It currently does not.

3 The Convergence of Consumption

Despite the independence of relationship both within countries and across time between economic growth (after essential needs are met) and well-being outcomes, it is the increasing convergence of aspirations on high consumption patterns that continue to drive upward movements in consumption (Pretty 2007, 2011a,b; Jackson 2009; Royal Society 2012; Harper 2013). The affluent have set desirable benchmarks, and others aspire for the same choices and opportunities. This convergence on patterns of material consumption cannot be fully resourced by Earth.

There is evidence that consumption tends to converge on higher rather than lower levels (Veblen 1899/2009; Frank 1999; Schwartz 2004). Two drivers influence behaviour: relative

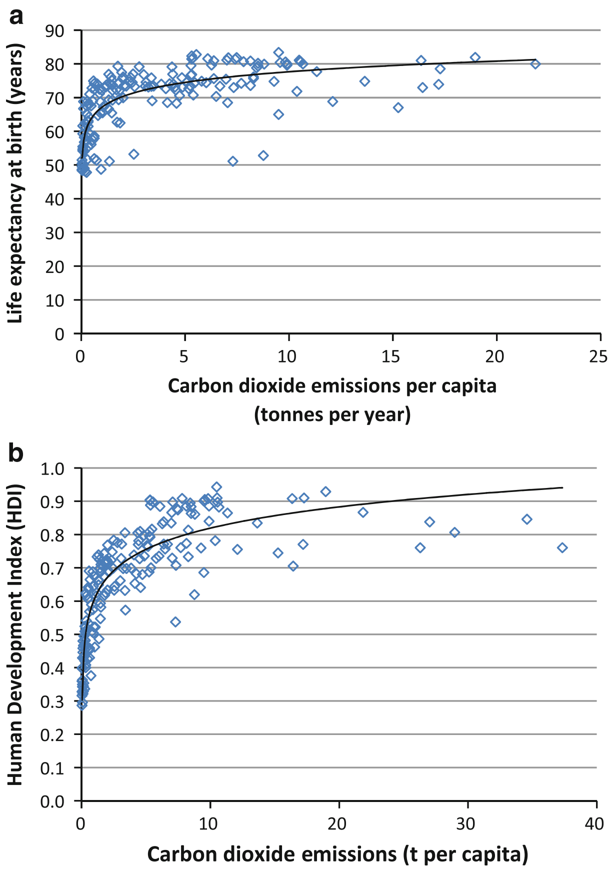

Fig. 3 **a** Relationship between carbon emissions and life expectancy at country level (n = 184). **b** Relationship between carbon dioxide emissions and Human Development Index by country (n = 184)

positioning and adaptation. Humans can choose what to spend and consume, and so appear to have free will, but they cannot choose what someone else spends. The result is that relative positioning recalibrates norms and expectations. It has been established that humans are more satisfied with a given level of income if it is higher than it was in the previous year, but dissatisfied with the same salary if last year it was higher. Adaptation is the process by which individuals become used to goods and services, and take them for granted or even become dissatisfied. Adaptation is useful in a world of misery: it allows people to cope. But in a context of plenty, then "adaptation defeats your attempts to enjoy good fortune" (Schwartz 2004). Jackson (2009) has called this the "stagnant life-satisfaction paradox", which arises from the tendency to measure relative increases against others or with the past, hedonic adaptation by which we become used to certain goods or levels and want more, or that behaviours have emerged with negative externalities (e.g. breakdown of families, drugs, crime).

Such rising over-consumption creates scarcity at both ends of the economic chain: source with regard to resource use and extraction, and sink with respect to the capacity of ecosystems to assimilate wastes arising from consumption. Here, a variety of measures and proxies for consumption are used to analyse the relationships between GDP globally and for specific country groups. Consumption patterns in seven baskets of country are compared: (i) Affluent North America–Europe–Oceania, (ii) Affluent Asia, (iii) fast-developing BRICs, (iv) fast-

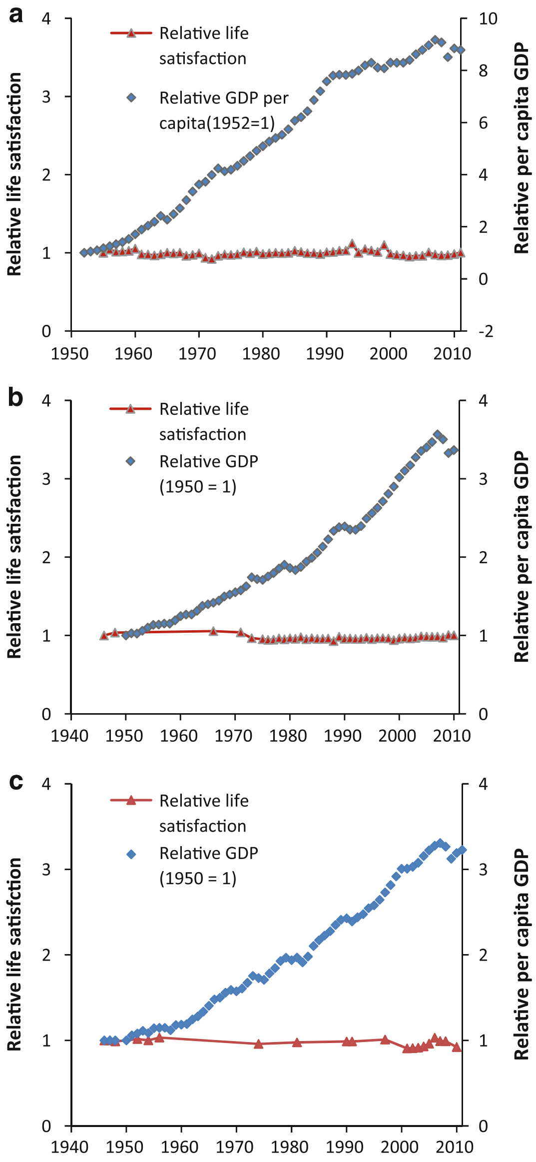

Fig. 4 **a** Changes in per capita GDP and life satisfication, Japan (1952–2011). **b** Changes in per capita GDP and life satisfication, UK (1946–2011). **c** Changes in per capita GDP and life satisfication, USA (1946–2011)

developing CIVETS, (v) high income Resource Extractors, (vi) Poor with Green Peaks, and (vii) Poorest five (Table 1). Figure 5a, b show these factors of consumption for Affluent North America–Europe–Oceania compared with five other groups (not the poorest) and for Affluent Asia compared with the other five.

Figure 6a, c illustrate how increases in per capita GDP result in per capita increases in vehicle numbers, domestic water withdrawals and oil consumption. Again, as countries become more affluent, so they consume more source resources in aggregate as well as seeing individuals consuming more per capita.

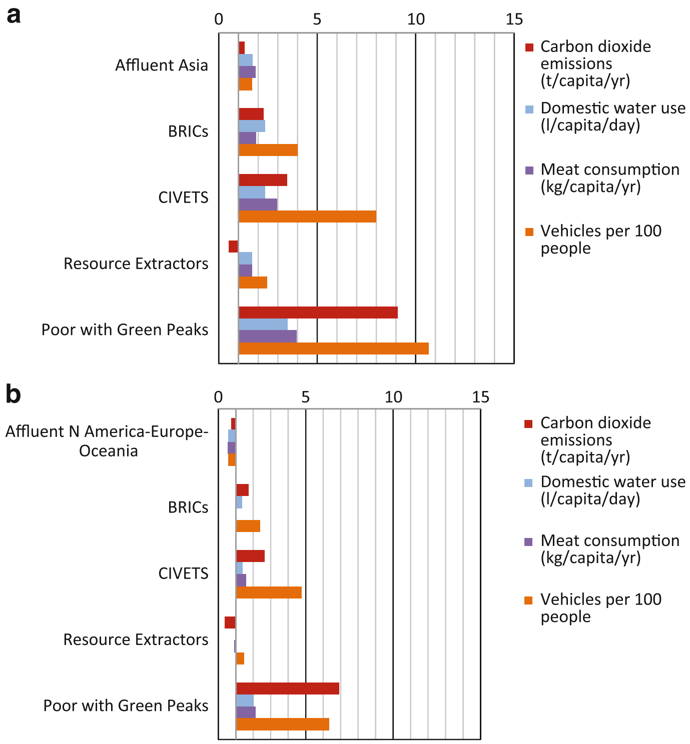

Fig. 5 **a** Factors of consumption: Affluent North America–Europe–Oceania compared with five other groups. **b** Factors of consumption: Affluent Asia compared with five other groups

Vehicles require non-renewable resources to manufacture, and their use results in considerable environmental and social externalities (e.g. air pollution, carbon emissions, congestion) (CEP 2008). There are currently 1.127 billion motor vehicles worldwide, producing a country mean of 16.1 per 100 people (Fig. 6a). Current use predicts an increase in vehicles of 1.3/100 people for each $1,000 rise in per capita GDP. Mean vehicle numbers per 100 people is 64 in the Affluent North America–Europe–Oceania countries, 38 in Affluent Asia, 16 in the BRICs, 8 in the CIVETS, 26 in the Resource Extractors, and generally below 10 elsewhere (Table 1). The contrast between the highest vehicle owing country, the USA at 81.2, and the fastest growing with rapidly rising demand for vehicles, China at 8.3, is instructive. The variations between the highest vehicle ownership and use countries and the lowest are also substantial. Some countries, though, have high GDP and low vehicle numbers, either because of high inequity (e.g. Equatorial Guinea, UAE) or limited physical space (e.g. Hong Kong, Singapore). Within country variation is also important: in the USA, the average vehicle-km travelled per person in the north-east (13,200) is nearly 4,800 fewer than in the south, and 3,200 fewer than in the midwest (CEP 2008).

The world's 1.13 billion vehicles travel 15.5 trillion km per year, of which 10 trillion km are in the countries of the OECD. Vehicle kilometres (VKT) per capita vary from 15.9×10^3 in the USA, Canada 10.1, Australia 9.8, Korea 2.3, Turkey 0.89 and Mexico 0.7. Affluent countries have more vehicles, and vehicles in these countries travel further. Mean distance travelled is 13,750 km per vehicle, and as cars emit 130–390 g CO_2 per km, they each produce

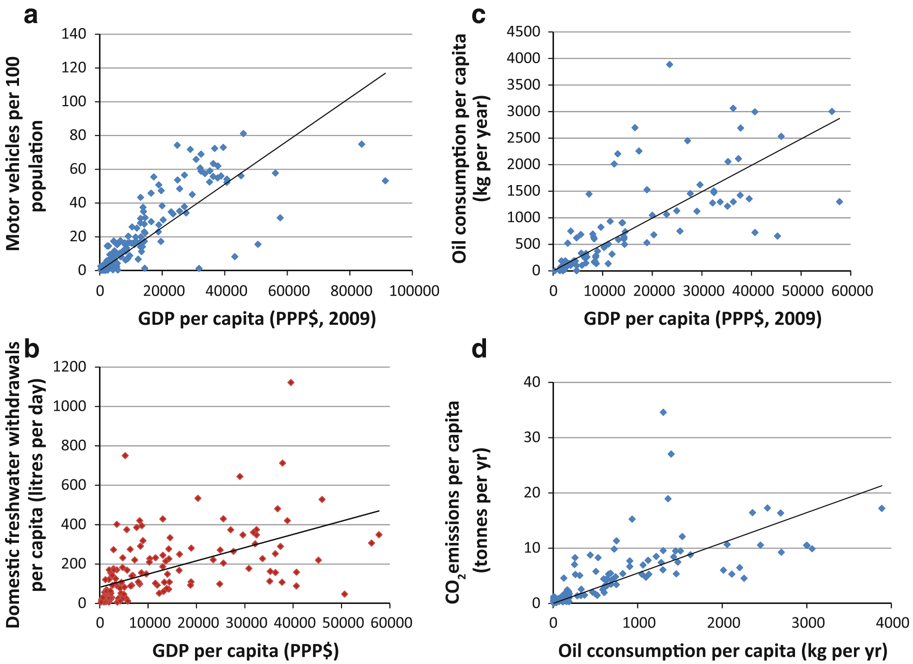

Fig. 6 **a** Relationship between per capita GDP and vehicle ownership (n = 171). **b** Relationship between GDP and freshwater withdrawals (n = 150). **c** Relationship between per capita GDP and oil consumption (n = 184). **d** Relationship between per capita oil consumption and carbon dioxide emissions (n = 102)

annual emissions of between 1.8 and 5.4 tonnes. Thus each $1,000 rise in per capita GDP increases emissions by 0.4 t CO_2 per capita. The upward pressure on both car ownership and use in middle and low income countries is considerable (Myers and Kent 2004; World Bank 2012a,b). Population increase predicts further vehicle numbers, with a rise from 7 to 8 billion people bringing an additional 161 million vehicles (at current ownership), and additional annual emissions of 0.29–0.87 Gt CO_2. Once again the iron cage is evident: more people multiplied by more vehicle ownership per person.

Worldwide, mean daily domestic water withdrawals amount to 170 L per capita (for domestic plus industrial withdrawals: 458 L per capita daily). Figure 6b shows a wide range of consumption at each GDP band, with 13 countries consuming more than 400 L per capita daily. The mean for Affluent North America–Europe–Oceania is 457 L; for both Affluent Asia and Resource Extractors 270 L; for BRICs and CIVETS 195 L, and for the poorest 130 L. This suggests water efficient and inefficient countries akin to carbon emissions.

Not surprisingly, per capita oil consumption also rises with GDP (Fig. 6c), and predicts CO_2 emissions (Fig. 6d). As with vehicles, energy consumption within affluent countries increases with household income (Table 2). The richer do not become more careful or responsible; they simply consume at greater rates.

Global oil consumption amounted to 9 billion barrels per day in 2012. US vehicles consumed 90 million per day, 1 % of the world's daily oil. Some have predicted that oil consumption will be falling by 2020, not because it is running out, but because the economy needs it less. For example, legislation in the US and Europe is forcing manufacturers to increase petrol (aka gas) efficiency, and electric and hybrid cars are becoming more popular.

Table 2 Energy consumption by household income cohort, USA (CEP 2008)

Household income ($1,000 per year)	Energy consumption per household (Mwh)
15–20	23
30–40	26
75–100	33
>100	40

Table 3 The contrast between equatorial Guinea and Cuba (from Jackson, 2008, updated)

	GDP per capita ($)	Under 5 mortality (per 1,000 births)	Vehicles (per 100 people)	CO_2 emissions (tonnes per capita)
Equatorial Guinea	31,000	118	1	7.3
Cuba	9,800	6	4	2.8

However, electric car sales in the US rose by 2 % in 2011, whereas total car sales rose by 10 %. An electric car incurs running costs of approximately 2 c per km, while petrol cars incur 8 c per km in the US and 12.5 c per km in Europe. High capital costs of electric vehicles deter widespread adoption (some argue that the full life cycle costs of EVs are higher than conventional: Hawkins et al. 2012). Murray and King (2012) point to the high national and regional financial costs of reliance on oil imports. The USA and Europe spend $1 billion per day on oil imports; within the US, consumers spent $280 million more per day on petrol in 2011 than the previous year owing to price rises. With such large sums leaving consumer pockets, it is clear that oil price rises contribute to recessionary economies. Murray and King (2012) observe that the world is "not running out of oil, but running out of oil that can be produced cheaply".

Table 1 illustrates some further important differences between country groups. Annual carbon emissions are extremely high in the Resource Extractors (23 tonnes per capita), 2–3 t more than world mean in Affluent countries, and close to the current mean in the BRICs and CIVETS. The data for under-5 mortality rates indicates how successful have been investments in health care in the Affluent countries (mortality now 4–5 per 1,000 live births). Progress is still needed in BRICs and CIVETS (26 per 1,000), and much needs to be done in the poorest countries. The two countries of Equatorial Guinea and Cuba are reminders that policy choices make a dramatic difference to well-being indicators (Table 3).

Table 1 contains values calculated for life satisfaction: GDP quotients, illustrating how much satisfaction is obtained for each unit of conventional GDP. Life satisfaction per unit of GDP quotient is 0.18–0.21 in the Affluent and Resource Extractors, rises to 0.8–0.9 in BRICs and CIVETS, but is >2.0 in the selected five poor countries with green peaks. These poorer countries contain sub-populations needing to raise consumption to escape poverty and hunger, but the current high life satisfaction: GDP quotient is instructive of a central future challenge: how to grow consumption in ways that improves life satisfaction.

At current world population and levels of consumption, planetary overshoot has occurred. However, the poorest still need to consume more in order to meet basic needs. The world economy as a whole, though, cannot grow forever on a finite planet. The factors of consumption between the poorest and most affluent are between 5- and 100-fold, and between the fast developing BRICs and CIVETS to the most affluent are 2- to 10-fold (Table 4). With world population expected to rise by 2–3 billion (30–40 %) before stabilising (assuming low to

Table 4 Factors of consumption from poorest to fast developing and most affluent countries

Consumption metrics	Poorest to Affluent North America–Europe–Oceania	Poorest to Affluent Asia	Fast developing (BRICs and CIVETS) to Affluent North America–Europe–Oceania	Fast developing (BRICs and CIVETS) to Affluent Asia
Vehicles	91.4×	54.3×	5.3×	3.2×
Domestic water	28.5×	16.6×	2.3×	1.4×
CO_2 emissions	118.0×	90.0×	2.7×	2.1×
Oil consumption	38.0×	97.3×	3.9×	10.0×
Meat consumption	11.9×	4.8×	2.3×	1.3×

medium fertility scenarios) (Royal Society 2012), then this will add further pressure to total desirable consumption. The impact of current consumption is already serious, without the combined effect of rising aspirations and convergence, and the continuing growth in world population.

4 Climate Change Outcomes

The scale of the challenge created by convergence of aspirations for lifestyles is most clear with respect to future climate change risks. Recent analysis has shown that growing consumption has led to the breaching of planetary and regional boundaries for climate change, nitrogen pollution and biodiversity loss, and has put further pressure via atmospheric aerosols and chemical pollution, land use, freshwater, phosphorus, stratospheric ozone and ocean acidification (Rosshydromet 2008; Rockstom et al. 2009). From pre-industrial atmospheric concentrations of 280 ppm, CO_2 has increased to 392 ppm (in 2012), methane from 0.72 ppm to 1.77 ppb, and nitrous oxide from 270 to 323 ppb (both 2012). Since industrialisation, CO_2 levels have already substantially exceeded the natural variation of 80 ppm that occurred between the waxing and waning of the ice ages. Over this period, 1 Tt C have been emitted by human activities, resulting in a radiative forcing of +1.6 (0.6–2.4) Wm^{-2}.

Current rates of emissions and expected growth are predicted to add 1–2 Tt more C to the atmosphere (Bowerman et al. 2011; New et al. 2011). CO_2 radiative forcing increased by 20 % from 1995 to 2005, the largest change for any decade over the last 200 years. The impacts already include changed weather patterns, greater extreme events, more acidic oceans (a mean of decrease of pH of 0.1 since 1750), and ill-effects on health (Lancet 2009). The area of Arctic sea ice fell between 1982–2012 from nearly 15 million km^2 to 13.5 million km^2 in March, and from 5 to 2 million km^2 in September (University of Illinois Sea Ice Dataset 2012), and local and indigenous people's accounts of climate change have added detail to this understanding of impacts on species abundance and physical environments (Pretty 2011a,b, 2013; Marin and Berkes 2012). Some of the worst effects of rising CO_2 levels will be on the least developed countries such as those in the Sahel (Potts et al. 2013).

The IPCC's Fourth Assessment (2007) concluded the following probabilities for the impacts of climate change to the mid to late twenty first century:

(i) Virtually certain (>99 % probability): over most land area, warmer and fewer cold days and nights, warmer and more frequent hot days and nights;

Table 5 Carbon dioxide emissions needed for stabilisation and effect on global temperatures and sea levels (from IPCC Fourth assessment report. 2007)

CO_2 concentration at stabilisation	Change in gross CO_2 emissions required by 2050 (% of 2000 emissions)	Global mean temperature increase above pre-industrial (°C)	Global mean sea level rise above pre-industrial (m)
350–400	−85 to −50 %	2.0–2.4	0.4–1.4
400–440	−60 to −30 %	2.4–2.8	0.5–1.7
440–485	−30 to +5 %	2.8–3.2	0.6–1.9
485–570	+10 to +60 %	3.2–4.0	0.6–2.4
570–660	+25 to +85 %	4.0–4.9	0.8–2.9

(ii) Very likely (>90 % probability): warmer spells, heat waves, frequent increases over most land areas of heavy precipitation events, frequency increasing over most areas;
(iii) Likely (>60 %): intense tropical cyclone activity increases, increased incidence of extreme high sea levels.

This indicates that some of the atmospheric sink impacts of past consumption are virtually certain. Yet aggregate consumption is set to grow, as is world population. There are two challenges: to stabilise emissions and atmospheric concentrations, and to achieve such stabilisation at a level low enough to limit severe damage. The IPCC Fourth assessment report. (2007) calculated the change in global carbon emissions required by 2050 for atmospheric CO_2 stabilisation targets between 350 and 660 ppm (Table 5). Thus to restrict global temperature increases to between +2.0 and 2.4 °C and restrict sea level rise to +0.4–1.4 m, a 50–85 % reduction in carbon dioxide emissions would be required by 2050. Figure 7 shows CO_2 emissions for 184 countries, for which mean annual emissions are 4.4 t per capita. Assuming a mid-point emissions target of 67 % (between 50 and 85 %) this will require mean emissions to be cut to 1.45 t per capita per year (at current population levels). This would need 111 countries to cut emissions so that the current total emissions of 30.8 Gt would be reduced to between 4.6 and 15.4 Gt. Emissions, though, are increasing. There is little current prospect of stabilisation of emissions let alone of atmospheric concentrations.

At the time of the IPCC Fourth assessment report. (2007), it was thought that the worst possible outcome was a 4 °C warming by 2100. But later analyses project potential global warming of 5–5.5 °C by 2100; plus 4 °C could have occurred by the 2070s or perhaps 2060s if carbon feedbacks are severe (such as permafrost melts, dirty ice sheets, rapid glacial melting). Anderson and Bows (2011) demonstrate how hard it is to stabilise even between 550–750 ppm, and conclude that "only the global economic slump has had any significant impact in reversing the trend of rising emissions". This decline is partial proof that the modern economy is the cause of atmospheric carbon increases. Between 2000 and 2007, CO_2 emissions grew by 3.6 % per year, then in 2008 by 2 %,and in 2009 fell by 1 % (Betts et al. 2011). The decline in OECD countries and Russia was 7 % in 2009 alone. Yet the desire for a return to normal economic growth will simply lead to renewed rises in emissions, unless policy and investment choices change.

All climate stabilisation scenarios share a common feature: they require order of magnitude increases in non-polluting technologies (Wilson et al. 2012), and order of magnitude reductions in consumption by the affluent (Table 4). With oil consumption a significant driver of CO_2 emissions by country (Fig. 6d), it could be argued that the problem is that oil is not

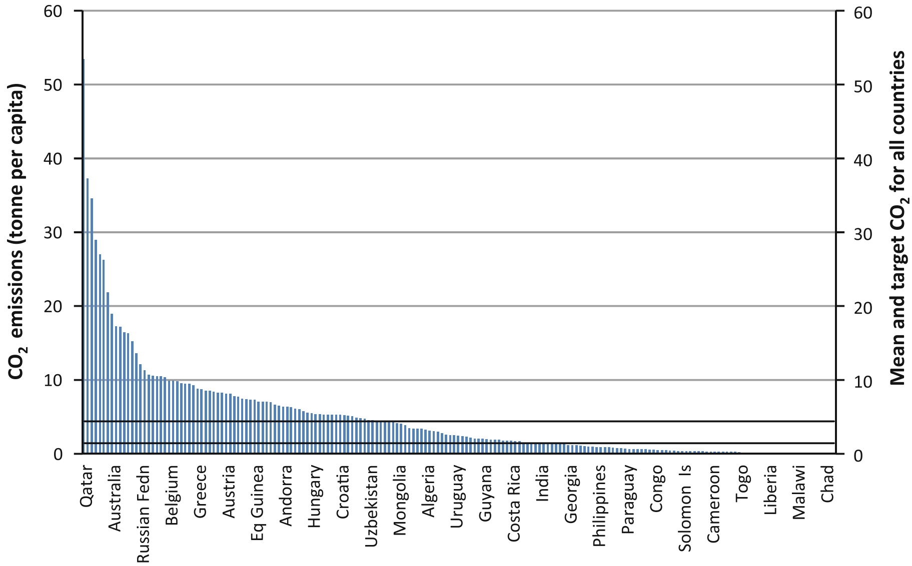

Fig. 7 Annual carbon dioxide emissions per capita (n = 184 countries, 2008) (*upper line* is mean of 4.4 t; *lower line* is target for 350–400 ppm stabilisation)

running out soon enough. Dasgupta (2010) has noted that there is now a substantial probability that future generations will be poorer than today. Extreme changes in mean temperature will have substantial health effects (Lancet 2009), and a 4 °C mean increase in temperature would raise sea levels by 0.6–2.9 m. With 600 million people today living within 10 m of sea level, such rises would result in the forced displacement of 187 million people, 2.4 % of the global population (Nicholls et al. 2011).

5 Denial and Divergence

Despite the scientific evidence that anthropogenic sources of carbon are leading to rising atmospheric concentrations that are in turn causing climate change, and that source and sink impacts of consumption are growing, there are six denial narratives that are preventing the necessary changes in policy and behaviour:

(i) Economic growth can continue without impact on natural capital and ecosystem services, and such impacts would anyway not result in negative effects on GDP;
(ii) Increases in GDP linearly improve life satisfaction and well-being through increased consumption;
(iii) Technological innovation will inevitably produce sufficient changes in the energy intensity of material goods and so will protect source and sink natural capital;
(iv) Harm caused to natural capital and ecosystem services has no feedback on human well-being;
(v) As the poorest countries need to consume more, their pathways to economic development will have to be the same as those adopted by the currently affluent countries;
(vi) Affluent countries do not need to reduce consumption, as conventional economic growth will eventually deliver environmental benefits.

The macropolitical responses have been dismal. The 1992 UN Framework Convention on Climate Change committed signatories to prevent "dangerous anthropogenic interference with the climate system". It has had little effect. It had been previously thought that a 2 °C temperature rise would be a "safe guardrail", with such a limit requiring all industrialised countries to cut emissions by 80 % on 1990 levels by 2050 (Rodelj et al. 2009). Some conclude that there is virtually no chance of limiting warming to 2° (see Rodelj et al. 2009; Anderson and Bows 2011; Betts et al. 2011; New et al. 2011). It may be that the cuts required are too great, the political will too small, and alternative economic models too disbelieved. Existing pledges by countries are not great enough, and pledges have not led to action. This indicates the scale of the political and technological challenge. Self-interest will clearly slow or prevent transitions, with economic sectors reliant upon fossil fuels likely to continue to promote doubt, following the tobacco industry which has stated that "doubt is our product" (Oreskes and Conway 2010).

As indicated earlier, two factors have to be addressed: consumption per person and damage per unit of consumption. Yet two problems arise when progress is made: "rebound effects" when money saved by efficiency advances is spent on other damaging goods and services, and "leakage effects" where created natural capital is rapidly spent or lost. The 150 Mha of zero- or low-tillage agriculture adopted in the past 20 years has, for example, resulted in the creation of substantial carbon sinks in soils (Kassam et al. 2009). Yet a return to ploughing would oxidise the sequestered carbon and release it back to the atmosphere.

I suggest the central challenge will be to seek and create opportunities and desires for divergence from current pathways of development. There are four options:

(i) Major disruptive and technological innovation followed by widespread and rapid adoption, resulting in the transformation of a large number of economic subsectors;
(ii) Making goods, possessions, places and environments meaningful and valued, and thus more persistent and longer lasting;
(iii) Fixing pro-environmental and low carbon behaviours into societies and economies by cultural moulding;
(iv) A penetrating policy focus on the links between consumption and well-being and satisfaction, the complete decoupling of the current pursuit of GDP growth as a policy outcome, and increases in investments in the green economy.

None of this will be easy, but experience from many communities and cultures worldwide could be cause for optimism. There is much that can be learned from both inherited and intentional "eco-cultures" (Pilgrim and Pretty 2010; Pretty 2011a), and a number of voluntary simplicity movements have emphasised the values of ways of living that prioritise well-being. These include the Slow Food and Slow Cities movements, Transition Towns in the UK, Simplicity Forum in the USA, and Downshifting Downunder in Australia (Elgin 1981; Jones 2007; Quilley and Barry 2008). All these express similar values of belonging and attachment. Yet such ecocultures and simplifiers remain marginal and often at odds with modern society (Jackson 2009).

Divergence arises from an increased support for localised cultural values (Pretty 2013, forthcoming). Such cultural moulding can be sufficient to maintain different consumption patterns from those that are the norm elsewhere. A distinctive national example is meat consumption in India, where spiritual and religious values have held annual consumption at about 4 kg per capita even as GDP has increased (Fig. 8). The contrast with Brazil, China, UK and USA is considerable. Another example of cultural moulding is the spiritual values incorporated in many sacred sites that through protection tend to have high biodiversity value and produce other valued ecosystem services (Anderson 1996; Colding and Folke 2001;

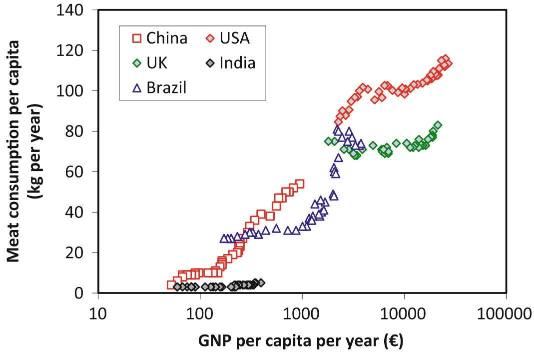

Fig. 8 Relationship between per capita GDP and meat consumption in China, India, Brazil, UK and USA (1961–2007)

Pretty 2007; Berkes 2008; Verschuuren et al. 2010). Hunter-gatherers and foragers were called by Sahlins (1972) the original affluent society. Ethical behaviour towards animals is central to hunting by all recorded indigenous groups, and bad behaviour causes hunts to fail. Intense emotional relationships with animals are common, as is self-management of hunting effort (Nelson 1983; Lee and Daly 1999; Bird Rose 2000). Both farming and hunter-gatherer peoples have consistently maintained and improved resources by intentional sowing of wild seeds and roots, irrigation of wild grasses, and burning to stimulate growth and attract game (Kent 1989; Kelly 1995; Bharucha and Pretty 2010).

The large literature of cultural difference is often framed by an assumption that traditional, indigenous and non-modern people will reject their old values and take on the modern. The Amish are a culture within the USA which has remained resolutely divergent from surrounding modernism. They are often viewed as an anachronism, yet have low rates of mental ill-health, low divorce rates, high physical activity, strong families, do not drive motor cars, and use horses in farming (Kraybill 1989/2001; Pretty 2013). Farmer David Kline documents in *Great Possessions* (Kline 1989) the rhythms of Amish farms and their abundant wildlife, and was asked to write about the advantages and disadvantages of their way of life. "This bothered me all summer", he writes. "Quite honestly, I couldn't think of any disadvantages". This is not to suggest that any culture is perfect or immune from criticism, but a central priority of any green economy will be to lock-in these kinds of pro-environmental and low carbon behaviours by any available political, social and fiscal means. Turner (1996) concluded that reason has not compelled moderns to respect and care for nature, and there is no basis to believe it will in the future. However, some advances may be achieved by recognising the spiritual and personal values that can be incorporated into both places and possessions (Christie 2013).

6 Possessions, Places and Attachment

A simple question rests at the centre of a need for substantially different consumption patterns: how to persuade people to retain possessions for longer, and look after natural places more? Consumer culture has increased the turnover of possessions, and may also have undermined self and identity, thus also reducing well-being (Tuan 1977; Belk 1988; Walker 2011). Sartre noted that people seek, express and confirm a sense of being through their possessions, and Marx used the term "commodity fetishism" to indicate the structural relations of capitalism that result in detachment, with consumers coming to believe commodities have some kind of magical power to make them happy (Hirsch 1977(2006); Jackson 2006). Yet Walker (2011) has observed that "our contemporary market system sells, more than anything else, discontent and unhappiness". The modern economy needs disposal and replacement; it is centred on ephemerality. Yet if people become more attached to both possessions and natural places, and thus do not purchase new goods or repair harm to ecosystems, then the economy will suffer. In contradiction, the planet would benefit incrementally from each increase in attachment.

A prerequisite is the deliberate pursuit of behaviours that increase attachment. When possessions and places acquire a high degree of attachment for people, then they are less likely to be disposed of or damaged (Kleine and Baker 2004; Pretty 2007). Importantly, high attachment and affiliation also improve mental and physical well-being. A growing evidence base now shows that health benefits arise from activities undertaken both in urban and rural green places (Barton and Pretty 2010; Pretty et al. 2011b; Ward Thompson et al. 2012). These health services are part of the range of services derived from ecosystems (NEA 2011; Fitter 2013), and can be protective to individuals in both the short and long term. Nature-based consumption that substitutes for material consumption also brings substantial cost-savings for economies. The annual cost of physical inactivity and sedentary behaviours in the UK amounts to £8.3 billion, and worldwide results in 1.9 million deaths. In the UK, under-5 infant mortality fell from 21.8 per 100,000 in 1960 to 5.0 today, but now obesity in 10 year olds affects 16 % of the population, and mental ill-health affects one in ten 10–16 year olds (UK Foresight 2007). Both fitness and fatness tend to track into adulthood, yet a shift of 1 % sedentary people to active lifestyles would save the UK £1.4 billion per year and reduce mortality by 1,000 (Nice 2009).

A second component of attachment is cathexis: the process of charging an object, activity or place with emotional energy (Belk 1988), which is in turn related to memory creation. Attachments are formed with specific material objects, evolve over time, emerge from experience and personal history, and are thus a form of self-expression (Kleine and Baker 2004). Possessions with such meaning tend not to be substituted, and therefore are more likely to be kept for a long time (Bell 1997). This in turn leads to greater well-being: cherished possessions and places with high affiliation value result in higher life satisfaction (Sherman and Newman 1977; Christie 2013). This has been recognised in hospitals: patients are viewed by staff as more socially-capable and less dependent by medical staff if they display personal possessions in wards (Millard and Smith 1981).

People also invest more in possessions and natural capital when they are cathected with emotional energy (Anderson 1996; Turner 1996). The more strongly home-owners cathect their dwellings, for example, the more frequently they invest in mowing grass, painting, cleaning and remodelling. Sherman and Newman (1977) showed that the elderly with family possessions depicting grandchildren and key events, relationships and memories are happier than those who do not. When people are deprived of their valued possessions and places, their personal identity is harmed too (Albrecht 2005, 2010). Possessions linked to memorable past events help to verify that the event occurred, and emotions (good and bad) are fixers of memory. In this way, possessions and places can be thought of as magical vessels (Belk 1991), carrying stories, values and memories that are tangible proof of life events (Basso 1996; Kane 1998/2010; Warner 2011; Christie 2013).

Retention creates cultural challenges that work against the grain of current norms of high material consumption. The health benefits of ecosystems suggest a need for reorientation of spatial and transport planning to encourage more physical activity, changes to schooling to promote green education, promotion of green care and therapies, and the regular undertaking of a "dose of nature" (Louv 2005; Orr 2006; Fuller et al. 2007; Hine et al. 2008; Barton and Pretty 2010; Haubenhofer et al. 2010). Emerging from these activities is the potential for entanglement in which interactions lead to the creation of memory, meaning and personal histories. Each of these could result in the substitution of low carbon-intensity activities for planet-damaging consumption. This may require the creation of new cultural traditions (Hobsbawm and Ranger 1983), or the greater celebration of existing activities: fishing, gardening, and bird-watching are already multi-million mass participation activities in the UK. Each improves well-being, results in greater attachment, will increase social capital if undertaken collectively, and are typically low carbon intensity, unless much fossil-fuel in transport is necessary (Pretty et al. 2005a; Barton et al. 2009). Kasser's (2002) study of happiness concluded that what works best also has low carbon intensity: go for a walk, read a book, do voluntary work, meditate, play with your children, go dancing or paint a picture.

Something uncomfortable must also be concluded for this rational age: the decline of spirituality associated with formal religious ceremonies has removed some opportunities for engagement with community and place. Modern society has become indifferent to, or even discouraging of, spiritual traditions, especially in the public sphere (Nhat Hanh 2008; Walker 2011; Christie 2013). Material culture has filled the gap. Spiritual leaders and philosophers have the opportunity to create a contrast to corporate signals and messages. Wes Jackson (1994) has called for the human condition to be improved by becoming native to our own places, and one need will be to build cultural fortresses to protect this emerging nativeness. This inevitably results in divergence—an uncomfortable position for universalists who assume all cultures will (or should) converge on similarly modern ways of living. What may be required is a new materialism (Simms and Potts 2012) combined with contemplation for a new land ethic (Leopold 1949; Christie 2013).

7 Towards Independence with Green Economies

> We had no doubt where we were going. We were going to inherit freedom—that was all that mattered. The possibilities for us were endless, at least so it seemed at the time (Achebe 2012).

In this way, Achebe described the march towards independence for Nigeria. In some sense, the hopes for a green economy echo the aspirations of many people in countries prior to their independence from colonial authorities in the mid-twentieth century. Today the equivalent escape from authority is from material consumption and conventional economic growth; those seeking independence have hopes but few precedents. As shown earlier, a largely unchallenged assumption for the past half century has been that increased material consumption and rising GDP leads to increased well-being. Now a priority is to redefine prosperity (McKibben 2007, Jackson 2009), and by substituting activities that improve social cohesion, happiness, mental and physical well-being, and memory creation for material consumption, the impact on natural capital and ecosystem services will be reduced whilst improving well-being.

Green growth and the green economy have become important targets for national and international organisations (Boyle and Simms 2009; O'Neill et al. 2010a,b; UNEP 2011; Jacobs 2012), including the OECD (2011); UNEP (2011); World Bank (2012a), the Rio+20 conference (UNCSD 2012), and the Global Green Growth Institute (2012). UNEP (2011) defines the green economy as "resulting in human well-being and social equity, while significantly reducing environmental risks and ecological scarcities". Jacobs (2012) distinguishes between forms of *standard* and *strong* green growth, noting that a discourse that focuses on limits to consumption and the need to constrain conventional growth is unattractive to most politicians. Deep political commitment is rare, even though Stern (2007) pointed to the economic value of early action with respect to climate change: the cost of stabilising all GHGs was 1 % of global GDP, a "significant but manageable" quantity, but a failure to reduce emissions would result in annual costs of 5–20 % of GDP. Recently UNEP (2011) concluded that investments amounting to 2 % of world GDP into the green economy could reduce energy-related CO_2 emissions from 30 to 20 Gt per year resulting in the possibility of limiting atmospheric CO_2 concentrations to 450 ppm. Business as usual sees emissions rise to 50 Gt by 2050.

Some countries are promoting a green agenda, including China, Denmark, Ethiopia, South Africa and South Korea: such a pursuit of the green economy could lead to a new industrial revolution (Stern and Rydge 2012). China has invested $100 billion since 2000 in eco-compensation schemes, mostly forestry and water management. A total of 65 countries have implemented feed-in-tariffs to encourage renewable energy generation (Renewables 2012). By 2010, renewable energy sources had grown to supply 16.7 % of global energy consumption, the fastest growing sector being solar PV. The science and technology vision for the Republic of Korea (Korea National Science and Technology Council 2010) envisages a future for a "convenient world supported by technologies", in which its advanced carbon economy is driven by clean energy, low carbon use and green growth. Priority technologies include polymer electrolyte fuel cells, space solar power, integrated water and sewage management, bio-oil synthesis, zero-emissions housing, seawater desalinisation, wearable robotics, vertical farms, self-diagnosing materials, automated driving systems, floating cities, smart dust technologies and rotation buildings for sharing sunlight and views.

It will, however, be difficult to ensure that sufficient low-carbon intensity innovations are developed quickly enough (Fitter 2013). Some governments have sought to change behaviours with policies. The revenue of many poor countries is absorbed by the costs of oil imports: for example, Kenya, Senegal and India spend 45–50 % of export earnings on energy imports. Investing in renewable energy benefits these three countries by saving export earnings, increasing self-reliance, and improving domestic natural capital. Kenya has introduced feed-in-tariffs on energy generated from wind, biomass, hydro, biogas, solar and geothermal sources from 2008 (UNEP 2011). In this way, a green economy that dramatically changes aspirations and consumption patterns by increasing consumption of the currently poor and reducing that of the affluent, increases well-being and protects natural capital, is not likely to look much like the current economy (though it is worth noting the term green economy is often used to promote an old economic policy agenda without actually addressing the underlying logic). It will be disruptive, but as Stern (2007) indicates, less than the impact of an advancing future bringing severe climate change and other outcomes of damaged natural capital. The notion of a steady-state (Daly and Cobb 1989) implies a cultural understanding of how much is enough (Durning 1992; Diener 2000). Without this, material consumption will continue to grow. How, then, can a mode of consumption based on "enough not more" be created, so resulting in mass behaviours of "enoughness" (O'Neill et al. 2010a,b)?

In the green economy, other forms of consumption will be valued, such as of story-telling, listening to birdsong and engaging with nature. It will be cooperative, as it enhances social capital formation and reduces inequity. This may bring positive feedbacks, as prosocial behaviours cause others to be prosocial, thus building social capital (Wilson 2011). It will offer four options to consumers and citizens: resist consumerism by opting out (e.g. downshifting, voluntary simplicity), retain possessions for longer (before replacement), make different choices (ethical or green consumerism) and substitute non-material consumption activities (e.g. nature consumption) (Wachtel 1983). It will encourage religious consolation as a substitute for materialism. As part of the solution for a green economy is interactional activities that lead to entanglement and attachment, then the greener economy will be located in difference rather than conformity (Walker 2011).

The emergence of new social movements may help the transition, proving to be what Hawken (2007) calls a global immune system. Some sectors have already seen transformations in social organisation, such as in watershed, joint forest, irrigation and integrated pest management, in farmer field schools, and in microcredit groups (Pretty 2003; Pretty et al. 2011a). In the UK the formal cooperative movement continues to grow. In 2012, there were 5,900 independent cooperative entities with 13.5 million members in health care, housing, farming, sports, credit unions, shops and schools (Cooperatives UK 2010). In addition, there are many community-based enterprises, sports clubs, libraries, local repair shops, craft businesses, writing centres, and community social groups that deliver social capital, belonging and well-being. Haxeltine and Seyfeng (2009) identify ways by which these niche activities can affect whole regimes: (i) replication, resulting in aggregated changes; (ii) growth in scale but attracting more, and (iii) translating into the mainstream. Such niche-regime interactions will be essential if localised efforts at creating green economies could result in behaviour changes significant enough to reverse planetary harm and make widespread improvements to well-being. But equally, this sector might generate few taxes, labour use is inefficient (by conventional measures), it does not contribute to formal economic growth, and thus existing political systems will find it hard to support.

World population will increase, and every additional person will need to consume. Technologies with low carbon-intensity and favourable natural capital outcomes will be developed. Yet impact on the planet will grow, unless there is dramatic change in the behaviours and choices of the currently affluent and their political leaders.

8 Conclusion

Conventional economic growth based on rising consumption of currently prevailing goods and technologies is not tenable. It will leave billions poor and under-consuming, it will leave the affluent unhappy, it will so damage finite natural capital that necessary mitigation and adaptation expenditure will be too great to contemplate. A shift to a green economy is inevitable. It is simply a question of whether it occurs before or after the world becomes locked into severe climate change and other harm to natural capital. On the assumption that *before* is preferable, then the following five commitments need quickly to be made and implemented:

- (i) Commitments by affluent countries to reduce their material consumption by a factor of ten;
- (ii) Commitment by affluent countries to invest in improving the status of women in the poorest countries and support increased consumption of the poorest so that they can climb the consumption cliff;
- (iii) Commitments by all countries to invest in displacement technologies that improve natural capital whilst providing the necessary services to improve human well-being;
- (iv) Commitments by all countries to limit spending in areas that deplete natural capital;
- (v) Commitments by all countries to employ taxes and market instruments to shift domestic consumer preferences and behaviour in all major economic sectors of energy, transport, buildings, agriculture, industry, forestry and waste.

It my all turn on affection for places and possessions, observed both Forster (1910/2012) and Berry (2012). "Because a thing is going strong now, it need not go on strong forever", said Margaret in Howard's End, "it may be followed by a civilisation [that] will rest upon the earth".

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