A SAFE AND JUST SPACE FOR HUMANITY

CAN WE LIVE WITHIN THE DOUGHNUT?

Kate Raworth

Oxfam

Humanity's challenge in the 21st century is to eradicate poverty and achieve prosperity for all within the means of the planet's limited natural resources. In the run-up to Rio+20, this discussion paper presents a visual framework – shaped like a doughnut – which brings planetary boundaries together with social boundaries, creating a safe and just space between the two, in which humanity can thrive. Moving into this space demands far greater equity – within and between countries – in the use of natural resources, and far greater efficiency in transforming those resources to meet human needs.

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Author's note

Oxfam's GROW campaign is committed to growing a better future – and as a priority that means ensuring food security for all. But it also means cultivating a broader notion of prosperity in a resource-constrained world. Oxfam believes that, over the next decade, we need a rapid transition to a new model of prosperity, one which delivers economic development, respects planetary boundaries, and has equity at its heart.[*]

In the run-up to Rio+20, this Discussion Paper is a first exploration of what such a model of prosperity might look like. It builds on a long tradition of thinking on sustainable development – from the Brundtland Commission, to the 1992 Rio Declaration and Agenda 21 – and is inspired by the more recent approach of planetary boundaries put forward by the Stockholm Resilience Centre.

The framework set out in this paper does not represent Oxfam policy; rather an idea put forward by Oxfam to stimulate further discussion and debate.

The ideas presented here have been greatly enriched by suggestions and critiques from government representatives, scientists, economists, and development specialists. But the framework remains very much a work in progress. Oxfam welcomes feedback on its strengths and weaknesses, uses and potential, and hopes that the ideas will contribute to an enriched debate on sustainable development.

Please send feedback to kraworth@oxfam.org.uk or add a comment on the blog about this paper at: http://oxf.am/oef. The blog will remain open for comments until 30 June 2012.

[*] R. Bailey (2011) Growing a Better Future, Oxfam: Oxford. Available at: http://www.oxfam.org/en/grow/reports (last accessed November 2011)

EXECUTIVE SUMMARY

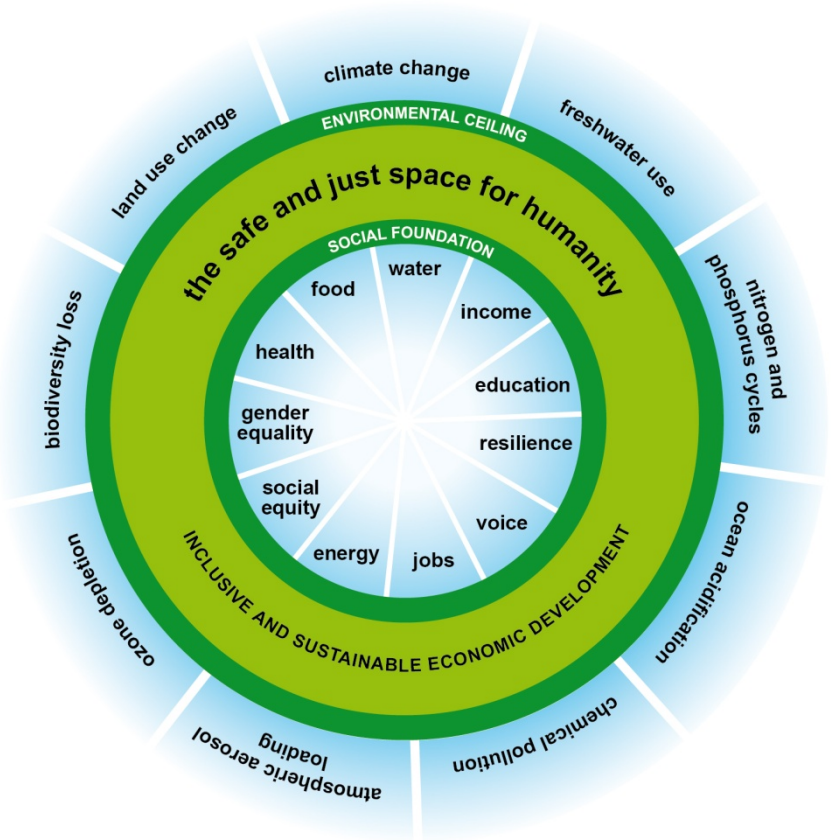
This Discussion Paper sets out a visual framework for sustainable development – shaped like a doughnut – by combining the concept of planetary boundaries with the complementary concept of social boundaries.

Achieving sustainable development means ensuring that all people have the resources needed – such as food, water, health care, and energy – to fulfil their human rights. And it means ensuring that humanity's use of natural resources does not stress critical Earth-system processes – by causing climate change or biodiversity loss, for example – to the point that Earth is pushed out of the stable state, known as the Holocene, which has been so beneficial to humankind over the past 10,000 years.

In the lead-up to the UN Conference on Sustainable Development in June 2012 (known as Rio+20), and the High-Level Summit on the Millennium Development Goals in 2013, there is a growing debate on how to draw up renewed and expanded global development goals which bring together the twin objectives of poverty eradication and environmental sustainability.

Figure I below brings them into a single framework. The social foundation forms an inner boundary, below which are many dimensions of human deprivation. The environmental ceiling forms an outer boundary, beyond which are many dimensions of environmental degradation. Between the two boundaries lies an area – shaped like a doughnut – which represents an environmentally safe and socially just space for humanity to thrive in. It is also the space in which inclusive and sustainable economic development takes place.

Figure 1. A safe and just space for humanity to thrive in: a first illustration



Source: Oxfam. The 11 dimensions of the social foundation are illustrative and are based on governments' priorities for Rio+20. The nine dimensions of the environmental ceiling are based on the planetary boundaries set out by Rockström et al (2009b)

First attempts to quantify the social and planetary boundaries turn the framework into a global-scale compass, and show that humanity is far from living within the doughnut. Deep inequalities of income, gender, and power mean that millions of people are living below every dimension of the social foundation. Nearly 900m people face hunger; 1.4 billion live on less than $1.25 a day, and 2.7 billion have no access to clean cooking facilities. At the same time, the environmental ceiling has already been crossed for at least three of the nine dimensions: climate change, nitrogen use, and biodiversity loss.

Dynamics in the doughnut

The challenge of moving into the safe and just space for humanity is complex because social and planetary boundaries are interdependent. Environmental stress can exacerbate poverty, and vice versa. Policies aimed at moving back within planetary boundaries can, if poorly designed, push people further below the social foundation, and vice versa. But well-designed policies can promote both poverty eradication and environmental sustainability – bringing humanity into the doughnut from both sides.

Would eradicating poverty put planetary boundaries under stress? No. Available data imply that the social foundation could be achieved for every person alive today with strikingly few additional resources:

- **Food:** Providing the additional calories needed by the 13 per cent of the world's population facing hunger would require just 1 per cent of the current global food supply.
- **Energy:** Bringing electricity to the 19 per cent of the world's population who currently lack it could be achieved with less than a 1 per cent increase in global CO_2 emissions.
- **Income:** Ending income poverty for the 21 per cent of the global population who live on less than $1.25 a day would require just 0.2 per cent of global income.

In fact, the biggest source of planetary-boundary stress today is excessive resource consumption by roughly the wealthiest 10 per cent of the world's population, and the production patterns of the companies producing the goods and services that they buy:

- **Carbon:** Around 50 per cent of global carbon emissions are generated by just 11 per cent of people;
- **Income:** 57 per cent of global income is in the hands of just 10 per cent of people;
- **Nitrogen:** 33 per cent of the world's sustainable nitrogen budget is used to produce meat for people in the EU – just 7 per cent of the world's population.

Adding to the pressure created by the world's wealthiest consumers is a growing global 'middle class', aspiring to emulate today's high-income lifestyles. By 2030, global demand for water is expected to rise by 30 per cent, and demand for food and energy both by 50 per cent. In addition, the inefficiency with which natural resources are currently used to meet human needs – for example through wasted food, leaky irrigation, and fuel-inefficient vehicles – further compounds the pressure.

Moving into the safe and just space for humanity means eradicating poverty to bring everyone above the social foundation, and reducing global resource use, to bring it back within planetary boundaries. Social justice demands that this double objective be achieved through far greater global equity in the use of natural resources, with the greatest reductions coming from the world's richest consumers. And it demands far greater efficiency in transforming natural resources to meet human needs.

The framework brings out a new perspective on sustainable development. Human-rights advocates have long highlighted the imperative of ensuring every person's claim to life's essentials, while ecological economists have emphasised the need to situate the economy within environmental limits. The framework puts the two together, creating a closed system that is bounded by both human rights and environmental sustainability. The resulting space – the doughnut – is where inclusive and sustainable economic development takes place. It implies no limit to human well-being: indeed, within this space is humanity's best chance to thrive.

1 IN SEARCH OF A 21ST CENTURY COMPASS

Humanity is currently living far beyond the planet's means, consuming the Earth's renewable resources as if we had one and a half planets to draw upon.[1] At the same time, many millions of people live in appalling deprivation. There are three long-standing reasons for this injustice.

First, and most importantly, many governments have, for decades, failed to prioritise tackling domestic and international poverty, at the same time as giving far too little attention to understanding and respecting the limits of sustainable natural resource use. In both cases they have allowed the interests of powerful elites and lobby groups to dominate over the interests of marginalised communities, and humanity as a whole.

Second, mainstream economic policies have so far failed to deliver inclusive and sustainable economic growth, and policymakers continue to rely on economic indicators – such as GDP growth – that are not up to the task of measuring what matters for social justice and environmental integrity. As the 2009 Stiglitz-Sen-Fitoussi Commission on the Measurement of Economic Performance and Social Progress concluded,

> Those attempting to guide the economy and our societies are like a pilot trying to steer without a reliable compass… We are almost blind when the metrics on which action is based are ill-designed or when they are not well understood.[2]

Third, the action plan for achieving sustainable development agreed more than two decades ago has not been put into practice. The Brundtland Commission's 1987 report, *Our Common Future*,[3] paved the way for far-reaching international commitments, set out in the 1992 Rio Declaration and Agenda 21.[4] But these commitments have not been followed through, and today environmental, social, and economic concerns are too often handled in parallel by separate government ministries, championed by separate NGOs, and debated by separate journalists in the media. However the rising global challenges of climate change, financial crises, food price volatility, and commodity price increases may finally be forcing the international community to recognise that these issues are unavoidably interconnected and must be tackled together.

The 2015 target date for the Millennium Development Goals (MDGs) is fast approaching, and many governments and civil society organisations support the idea of renewing, updating, or expanding the MDGs for the coming decades. At the same time, preparations for the UN Conference on Sustainable Development (known as Rio+20) in June 2012 have helped spark international dialogue around the proposition of creating Sustainable Development Goals to help guide humanity in the future.

Any vision of sustainable development fit for the 21st century must recognise that eradicating poverty and achieving social justice is inextricably linked to ensuring ecological stability and renewal. Progressing towards that vision requires clear goals and indicators to act as a compass for the journey ahead. This Discussion Paper aims to present a framework and explore ideas that could help to provide such a compass.

2 A SAFE AND JUST SPACE FOR HUMANITY

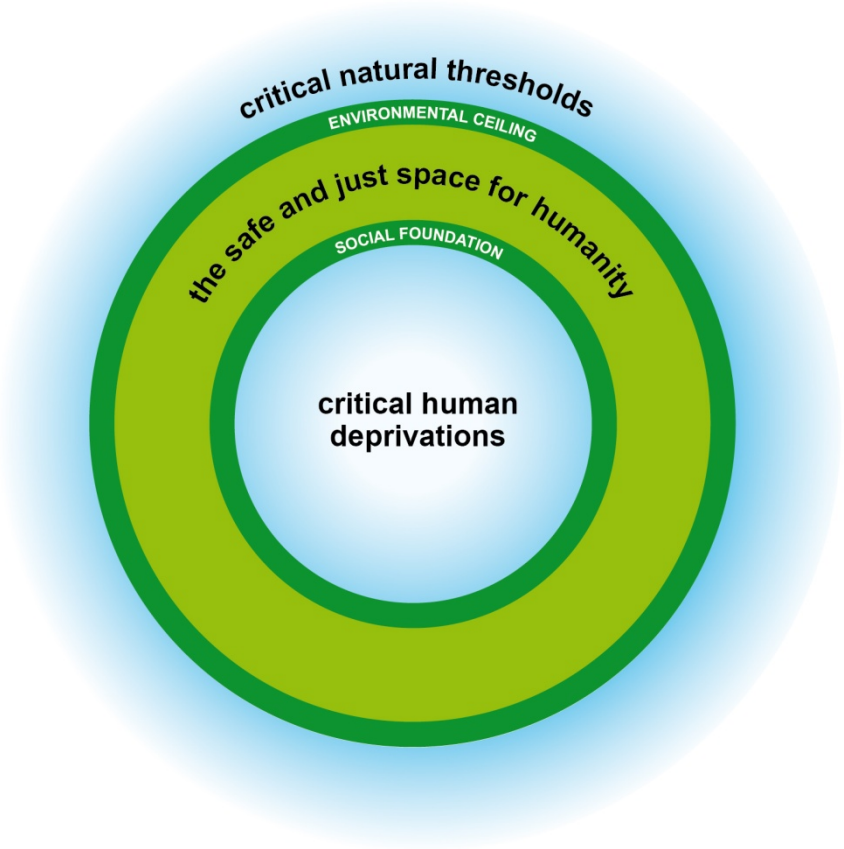
Central to pursuing sustainable development is the imperative of eradicating poverty, so that all people lead lives free of deprivation. This depends in good part on ensuring that humanity's collective use of natural resources remains within sustainable limits. Figure 1 (below) provides a simple visual representation of this double objective.

At the centre of the image is a space of critical human deprivations – such as hunger, illiteracy, poverty, and voicelessness. The first priority must be to ensure that all people are free from such deprivations, and are empowered with the rights and resources needed to provide a social foundation for leading lives of dignity, opportunity, and fulfilment.

At the same time, sustainable development requires that humanity's use of natural resources remains within environmental limits. This means recognising that many Earth-systems have critical natural thresholds or gradients of increasing risk – such as climate change, biodiversity loss, and land use change – which must not be crossed if the Earth is to remain in its current stable state, known as the Holocene, which has enabled many human civilizations to arise, develop, and thrive.[5]

Between a social foundation that protects against critical human deprivations, and an environmental ceiling that avoids critical natural thresholds, lies a safe and just space for humanity – shaped like a doughnut (or, if you prefer, a tyre, a bagel, or a life saver). This is the space where both human well-being and planetary well-being are assured, and their interdependence is respected.

Figure 1. Envisioning a space for sustainable development



Source: Oxfam, inspired by Rockström et al (2009b)[6]

This framework takes a global-scale perspective of both human deprivations and environmental degradation. There are, of course, many inequalities contained within this global picture – in terms of poverty, power, natural resource use, and environmental stress. Addressing these inequalities is critical for achieving sustainable development.

How do social and planetary boundaries compare?

There are important characteristics that these two concepts have in common:

- **The fundamentals of sustainable development:** Ensuring all people's lives are built upon a social foundation is essential for sustainable development, but so is staying below the environmental ceiling: crossing over either of these boundaries can trigger both social and ecological crises. Sustainable development can only succeed if poverty eradication and environmental sustainability are pursued together.
- **Boundaries based on norms:** Both the social foundation and the environmental ceiling are essentially normative boundaries. What constitutes human deprivation is determined through widely agreed social norms. Likewise, although science focuses on giving an objective description of the planet's biophysical reality, the question of where to set the boundaries of natural resource use is ultimately a normative one, based on perceptions of risk, and of the desirability of staying within the Holocene.
- **Global to local:** Both the local and the global matter for staying within planetary and social boundaries. For example, deforestation within a country can be a tipping point towards localised flash flooding and soil degradation, long before it affects land-use change at the Earth-system scale. Likewise, minority social groups within a country may experience severe marginalisation long before their exclusion is evident in national, let alone global, data on social inequalities.

There is one significant difference between the environmental ceiling and the social foundation: their initial states of stress. Earth-system processes were in a 'safe space' prior to the industrial era when human activity began to add significant stress: the aim must now be to move back into that 'safe space'. In contrast, the human population has never all lived above the social foundation in a 'just space': the aim now must be for all of humanity to reach it.

What perspectives can this framework open up? Three angles.

1. An integrated vision: With sustainable development as the central concern, it is clear that everyone's lives must be built on the social foundation of human rights while remaining below the environmental ceiling, and that economies must be structured and managed to make that possible. This framework highlights the interconnectedness of the social, environmental, and economic dimensions of sustainable development.

2. A refocusing of economic priorities: Within this framework, social and environmental stresses are no longer portrayed as economic 'externalities'. Instead, the planetary and social boundaries are the starting point for assessing how economic activity should take place. The economy's over-arching aim is no longer economic growth in and of itself, but rather to bring humanity into the safe and just space – inside the doughnut – and to promote increasing human well-being there.

3. Metrics beyond GDP: Economic development cannot be assessed in monetary terms alone. Whether economic activity is leading towards or away from planetary and social boundaries determines just how inclusive and sustainable economic development is. Policymakers must be more accountable for the impact of economic activity on planetary and social boundaries, defined both in natural metrics (such as tonnes of carbon emitted) and social metrics (such as the number of people facing hunger).

Building on this conceptual starting point, the Discussion Paper fills out the framework, setting out possible dimensions for the social foundation (Section 3), and for the environmental ceiling (Section 4), and attempting to quantify them. It also explores the complex interactions between planetary and social boundaries (Section 5), and highlights the extreme inequalities and inefficiencies of resource use within the doughnut (Section 6). Finally, it poses questions for taking the framework forward (Section 7).

3 A SOCIAL FOUNDATION: HUMAN RIGHTS

Human rights provide the essential social foundation for all people to lead lives of dignity and opportunity. International human rights norms have long asserted the fundamental moral claim each person has to life's essentials – such as food, water, health care, education, freedom of expression, political participation, and personal security – no matter how much or how little money or power they have. As the UN's Universal Declaration of Human Rights (1948) says, 'recognition of the inherent dignity and of the equal and inalienable rights of all members of the human family is the foundation of freedom, justice and peace in the world'.[7]

Of course, a social foundation of this kind only sets out the minimum of every human's claims. Sustainable development envisions people and communities prospering far beyond this, leading lives of creativity and fulfilment. But, given the extent of deprivation and extreme inequality in the world, ensuring that this social foundation of human rights is achieved for all must be the first focus.[8]

Since 2000, the MDGs have provided an important international focus for development, and have addressed many deprivations, whose urgency has not receded: eradicating hunger and extreme poverty; achieving universal primary education; promoting gender equality and women's empowerment; reducing child mortality; improving maternal health; combating HIV and AIDS, malaria, and other diseases; and extending access to water and sanitation.

The priorities set out by the MDGs remain critical for achieving the social foundation for all, but additional concerns and challenges in recent years are extending that agenda. Shocks and volatilities – in terms of food and energy price spikes, financial crises, and the impacts of climate change – have drawn attention to the importance of people building their long-term resilience through climate-change adaptation, disaster-risk reduction, and well-designed social protection schemes. There is also increasing awareness of the need to provide decent work for a rapidly growing global labour force; to bring electricity and clean cooking facilities to billions of people who still live without them; to tackle extreme inequalities within and between countries; and to ensure people's empowerment in influencing the political and economic processes that shape their lives.

Inequalities between women and men run deeply through all these concerns, reflecting enduring disparities in control over natural resources, in employment and earnings, and in social and political participation. Gender biases are embedded in markets, politics, and institutions, and can be reinforced by poorly designed economic policies and development strategies. Tackling the source of these disparities is critical for achieving the social foundation for all, to the benefit of women, their families, and society.

The High-Level Summit on the MDGs in 2013, along with interest in creating Sustainable Development Goals out of Rio+20, will most likely launch a process of exploring how global development goals should be renewed, updated, or expanded to reflect these emerging concerns. This process is, effectively, an opportunity to draw up a set of internationally agreed priorities for the social foundation, to be achieved over coming decades.

In advance of international agreement on what those social foundation priorities should consist of, one current indication of international concerns comes from governments' stated social priorities for Rio+20, as set out in their national and regional submissions (see Annex 1). Analysis of those submissions reveals 11 social priorities, which can be grouped into three clusters, focused on enabling people to be:

- **Well:** through food security, adequate income, improved water and sanitation, and health care;
- **Productive:** through education, decent work, modern energy services, and resilience to shocks;
- **Empowered:** through gender equality, social equity, and having political voice.

This set of 11 government priorities for Rio+20 leans, unsurprisingly, towards social issues that require natural resources in order to be realised. In the context of sustainable development, they highlight the major challenge of fulfilling all people's economic and social rights in a highly unequal and resource-constrained world. But people's empowerment in claiming their rights, through having voice, information, and political influence, is of course essential if this is to be achieved.

No one should be living in deprivation in any of these 11 dimensions, but illustrative indicators show that humanity is currently falling below this social foundation on every dimension for which data are available (see Table 1 and Figure 2).

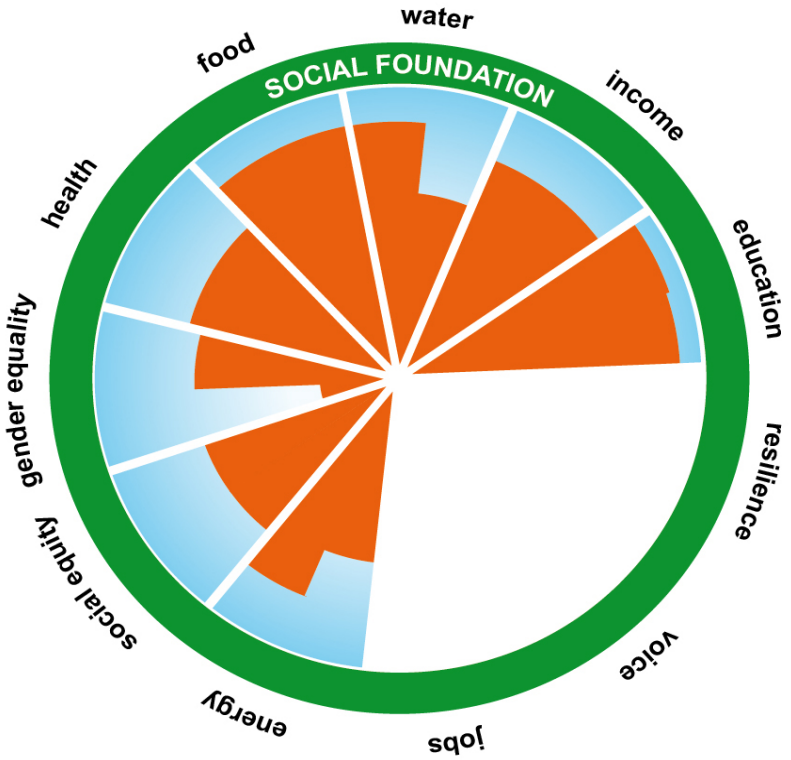
Table 1. How far below the social foundation is humanity? An illustrative assessment, based on governments' social priorities for Rio+20

Social foundation	Extent of global deprivation (illustrative indicators)	Percentage	Year
Food security	Population undernourished	13%	2006–8
Income	Population living below $1.25 (PPP) per day	21%	2005
Water and sanitation	Population without access to an improved drinking water source	13%	2008
	Population without access to improved sanitation	39%	2008
Health care	Population estimated to be without regular access to essential medicines	30%	2004
Education	Children not enrolled in primary school	10%	2009
	Illiteracy among 15–24-year-olds	11%	2009
Energy	Population lacking access to electricity	19%	2009
	Population lacking access to clean cooking facilities	39%	2009
Gender equality	Employment gap between women and men in waged work (excluding agriculture)	34%	2009
	Representation gap between women and men in national parliaments	77%	2011
Social equity	Population living on less than the median income in countries with a Gini coefficient exceeding 0.35	33%	1995-2009
Voice	E.g. Population living in countries perceived (in surveys) not to permit political participation or freedom of expression	To be determined	
Jobs	E.g. Labour force not employed in decent work	To be determined	
Resilience	E.g. Population facing multiple dimensions of poverty	To be determined	

Sources: FAO[9], World Bank[10], UNStat[11], WHO[12], IEA[13], and Solt 2009[14]

Figure 2 below plots these data within the framework of the doughnut. Focusing on the social foundation, it indicates how far humanity is falling below that foundation by depicting the deprivation gap for each dimension. In the case of food, for example, the dark shaded wedge represents the 87 per cent of the world's population who have sufficient food. The gap between that wedge and the edge of the social foundation represents the 13 per cent of the world's population (850m people) who are still undernourished.

Figure 2. Falling below the social foundation: An illustrative assessment based on Rio+20 priorities



Source: Oxfam, based on data in Table 1 above. Social dimensions with two indicators in Table 1 are represented by split wedges, showing both of the deprivation gaps.

Hidden within this global snap-shot of deprivation are complex dynamics, both in terms of trends in progress, and in terms of inequalities between people. The past decade has brought significant progress in reducing some dimensions of deprivation. In developing countries, net primary school enrolment ratios rose by 9 per cent from 1999 to 2009, and the ratio of girls-to-boys enrolled rose from 0.92 to 0.96. Worldwide, deaths from malaria fell by 20 per cent, 2000–2009, and the number of people receiving antiretroviral therapy for HIV or AIDS increased 13-fold from 2004 to 2009. An estimated 1.1bn people in urban areas and 723m people in rural areas gained access to improved drinking water sources, 1990–2008.[15]

Despite these gains, there are many enduring inequalities of deprivation, by wealth, gender, ethnicity and location. Children from the poorest households, those living in rural areas, and those who are girls are still the most likely to be out of school. Out of the world's 760m illiterate adults, two-thirds are women. And children living in rural areas of developing regions are twice as likely to be underweight as are their urban counterparts.[16] The social foundation will only be achieved for all by tackling these enduring inequalities.

If humanity is falling below every dimension of the social foundation, where do we stand in relation to the environmental ceiling? This is explored in the following section.

4 AN ENVIRONMENTAL CEILING: PLANETARY BOUNDARIES

The planetary boundaries concept provides a strong starting point for understanding the natural resources and processes on which humanity depends for sustainable development. In 2009, the Stockholm Resilience Centre brought together 29 leading Earth-system scientists, who proposed a set of nine critical Earth-system processes with 'tipping points' or gradients of increasing risk. Crossing such thresholds could lead to irreversible and, in some cases, abrupt environmental change, effectively moving Earth out of the stable state of the past 10,000 years – known as the Holocene – which has been so beneficial to humankind. The consequences for humanity would be devastating, with the impacts falling first and hardest on people living in poverty, most of whom depend directly on natural resources for their livelihoods.

In order to keep the risk of crossing these thresholds low, it is necessary to determine a safe boundary below the threshold or danger zone of each Earth-system process, and to stay within that boundary. Together the nine planetary boundaries create what the Stockholm Resilience Centre refers to as 'a safe operating space for humanity'. Where the international community ultimately decides to set the boundaries will largely depend on perceptions of risk, on public debate and powerful lobby groups, and on international political power. But the levels at which they are set must be informed by the best possible science of the planet's biophysical realities.

Given that this conceptual framework is focused on quantifying boundaries of environmental stress at the planetary scale, there are of course important caveats around what it does not capture. Beneath this global-scale picture of resource use lie huge inequalities in terms of where resources are being used and by whom. Likewise, the global perspective does not reveal critical local or regional thresholds of resource stress (such as for freshwater and phosphorus use), even though these may have serious consequences long before showing up at the planetary scale.[17] Many of the Earth-system processes identified do not have a single 'tipping point', but rather face a gradient of increasing risk, and the location of many boundaries depends, in good part, on how resources are managed, on the spatial distribution of resource use, and on knock-on effects caused by stresses on the other boundaries.[18] The proposed variables and their suggested boundary levels are first estimates only due to significant knowledge gaps.[19] Even if accurate, they should not be misinterpreted as targets for policymakers, thereby allowing governments to delay action until it is too late.[20] These caveats are presented along with the framework by its authors, and are important to keep in mind when using it.

The value of adopting this planetary boundary approach for understanding sustainability is significant. It provides a global perspective of how close humanity is to over-stressing the Earth-systems on which all people depend for their fundamental well-being and development. Because of the global importance of these processes, and because of global trade in resource use, none can be governed at the national level alone, and so a planetary perspective is essential for shaping their governance. The planetary boundaries approach is a wake-up call for the international community to formally recognise that such thresholds and risks do exist, to promote scientific research into their nature, and to take collective responsibility – from the local to the global level – for respecting them.[21]

These nine Earth-system processes overlap significantly with the environmental concerns raised by governments in their submissions to Rio+20 (see Annex 1). A first attempt by the Stockholm Resilience Centre to quantify the boundaries indicates that at least three of them – climate change, biodiversity loss, and nitrogen use – have already been crossed (see Table 3), and on current trends, freshwater use and land use change are rapidly moving towards their boundary levels. More recent research suggests that the phosphorus boundary may also have already been crossed.[22]

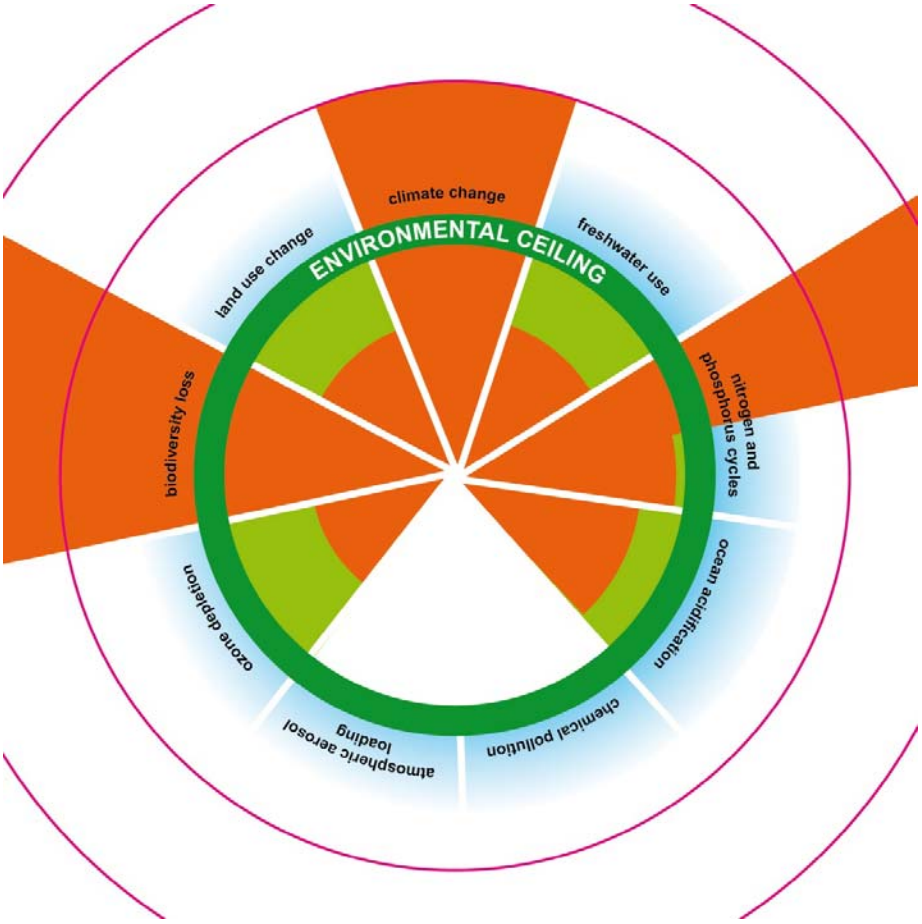
Table 2. How close to the environmental ceiling are we? A first assessment based on the nine planetary boundaries

Earth-system process	Parameters	Proposed boundary	Current status (as of 2009)	Pre-industrial value
Climate change	Atmospheric carbon dioxide concentration (parts per million by volume)	350	387	280
	Change in radiative forcing (watts per metre squared)	1	1.5	0
Rate of biodiversity loss	Extinction rate (number of species per million species per year)	10	>100	0.1–1
Nitrogen cycle	Amount of nitrogen removed from the atmosphere for human use (millions of tonnes per year)	35	121	0
Phosphorus cycle	Quantity of phosphorus flowing into the oceans (millions of tonnes per year)	11	8.5-9.5	-1
Stratospheric ozone depletion	Concentration of ozone (Dobson unit)	276	283	290
Ocean acidification	Global mean saturation state of aragonite in surface sea water	2.75	2.90	3.44
Global freshwater use	Consumption of freshwater by humans (km^3 per year)	4,000	2,600	415
Change in land use	Percentage of global land cover converted to crop land	15	11.7	low
Atmospheric aerosol loading	Overall particulate concentration in the atmosphere, on a regional basis	To be determined		
Chemical pollution	E.g. amount emitted to, or concentration of persistent organic pollutants, plastics, endocrine disrupters, heavy metals and nuclear waste in, the global environment, or the effects on ecosystem and functioning of Earth system thereof	To be determined		

Source: Rockström et al (2009b). Shaded areas show boundaries that have been crossed.

Figure 3 below charts these data within the framework of the doughnut, indicating how close each Earth-system process is to the environmental ceiling, and showing that at least three of the boundaries – climate change, biodiversity loss, and nitrogen use – have already been crossed.

Figure 3. Breaching planetary boundaries



Source: Rockström et al (2009b), based on Table 2 above.

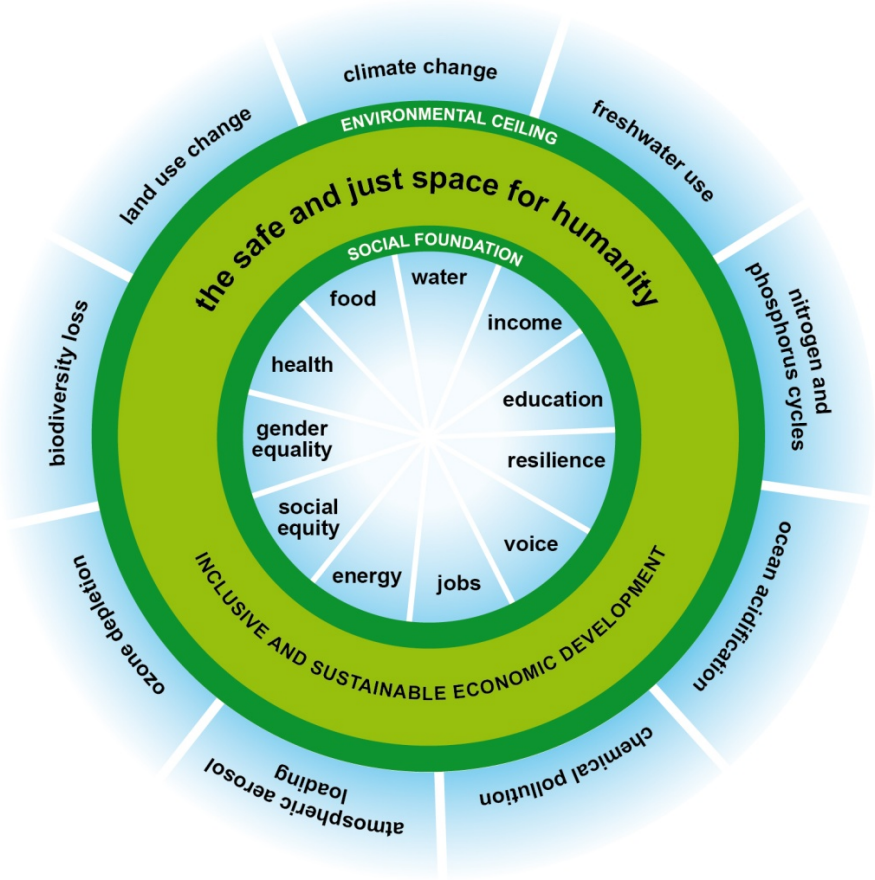
An important challenge to the political feasibility of respecting planetary boundaries is their implications for national policy-making and international negotiations. Climate change may be widely recognised as a global challenge that demands global governance in response, but Earth-system processes with critical local and regional thresholds – such as freshwater use and land-use change – make reaching international agreement more complex. The diversity of natural resource endowments between countries (in terms of their land mass, forests, biodiversity, freshwater, marine resources, and oil and minerals), their very different histories of resource use, and their contrasting levels of economic development, add further dimensions of complexity. Given this context, the question of how to agree on fair shares of effort for staying within planetary boundaries – e.g. through 'common but differentiated responsibilities and respective capabilities'[23] – is clearly a crucial but complex one.

The political complexity is very real, but so too are the biophysical realities of the planet. If these critical Earth-system processes are to be protected from dangerous levels of degradation, then agreeing how to manage them at regional and planetary scales is one of the most important issues of international law and governance that the international community must grapple with this century.

5 BETWEEN THE BOUNDARIES

Combining the social foundation with the environmental ceiling creates a doughnut-shaped area between these social and planetary boundaries. It is an illustrative depiction of a safe and just space for humanity (see Figure 4).

Figure 4. A safe and just space for humanity to thrive in: a first illustration



Source: Oxfam. The 11 dimensions of the social foundation are illustrative and are based on governments' priorities for Rio+20. The nine dimensions of the environmental ceiling are based on the planetary boundaries set out by Rockström et al (2009b)

This framework brings out a new perspective on sustainable development. Human-rights advocates have long focused on the imperative of ensuring every person's claim to life's essentials, while ecological economists have highlighted the need to situate the economy within environmental limits. The framework brings the two approaches together in a simple, visual way, creating a closed system that is bounded by human rights on the inside and environmental sustainability on the outside. The resulting space – the doughnut – is where inclusive and sustainable economic development takes place.[24] It implies no limit on increasing human well-being; indeed, it is within this safe and just space that humanity has the best chance to thrive.

Quantifying both the planetary and social boundaries (Figures 2 and 3 above) turns the framework into a global-scale compass, giving an indication of the current state of human and planetary well-being in relation to the boundaries of sustainable development.

The framework can also be used to explore interactions between the boundaries. These interactions are complex and multi-layered, as illustrated below.

1. Environmental stress can exacerbate poverty

Crossing planetary boundaries, or their regional thresholds, can push people back below the social foundation, or prevent them from ever achieving it. The current and potential impacts of climate change, for example – including rising temperatures, shifting seasons, sea-level rise, and increasing droughts and floods – seriously undermine poor people's ability to ensure their food security, health, and access to safe water and sanitation, and further exacerbate gender inequalities.[25] Indeed, for all nine Earth-system processes, the repercussions of crossing planetary boundaries, or their regional thresholds, threaten to severely undermine human development, first and foremost for women and men living in poverty (see Table 3).

2. Poverty can exacerbate environmental stress

People living below the social foundation may be forced to resort to using resources in an unsustainable way in order to meet their most essential needs. Globally, 2.7 billion people have no access to clean cooking facilities (such as gas stoves) and so rely on traditional biomass (including wood, dung, charcoal and crop residues) and coal for cooking. Women and children spend hours each week collecting the fuels, then inhaling their fumes over smoky fires – leading to an estimated 1.5 million premature deaths each year due to lung disease. Burning biomass also produces black soot aerosols and CO_2 emissions, and the use of wood as a fuel can lead to local deforestation and biodiversity loss, further deepening poverty.[26]

3. Policies aiming for sustainability can exacerbate poverty

Bringing global resource use back within planetary boundaries is critical for sustainability, but this must not be done in ways that push people further below the social foundation. Yet, due to poor policy design and implementation, and in the face of extreme inequalities of power and income, this is happening, as the following two examples show:

- **Carbon markets: driving land and water grabs.** International carbon-offsetting schemes have been set up to enable high-emissions companies and individuals to buy carbon credits by financing investments, often in developing countries, which reduce net CO_2 emissions. Tree plantations can earn these credits, but the forestry companies behind them are often given licence to take over land which has, for decades, been farmed by low-income communities, particularly women farmers. These marginalised communities are often evicted without consent or compensation – losing their land and water supply, their food security and livelihoods, and their homes and communities.[27]

- **Biofuels: fuelling food-price crisis and land grabs.** Rapid growth in the use of biofuels, especially in the US, Canada, and the EU, has been promoted to cut fossil-fuel use for transport, in order to reduce carbon emissions. But biofuel production has been achieved at the cost of exacerbating deprivation for millions of people living in poverty. During the food price crisis of 2007-09, biofuel production diverted food crops for use as fuel, significantly pushing up food prices.[28] Planting crops to produce biofuels has also been a major driver of large-scale land acquisitions in developing countries. In many cases, biofuels companies have taken control of the land and water that marginalised agricultural communities, particularly women farmers, depend upon for their livelihoods.[29]

The impacts of such policies that aim to reduce pressure on planetary boundaries highlight the risk of doing so through inadequately regulated market mechanisms that bring powerful international actors together with local communities whose rights to land, water, and political participation are deeply insecure.

Table 3. Breaching planetary boundaries: human causes and impacts

Planetary boundary	Human causes of Earth-system stress	Expected consequences of crossing planetary boundaries
Climate change	Releasing greenhouse gases through: burning coal, oil, and gas; fertilizer and cement production; deforestation; livestock management; agriculture; and producing soot and black carbon.	Global temperature rise; loss of polar ice sheets and glacial freshwater supplies; rapid sea-level rise; bleaching and mortality in coral reefs; increases in large floods; abrupt shifts in forest and agricultural systems; potentially challenging the viability of contemporary human societies.
Biodiversity loss	Destroying habitats; expanding urban land use; agriculture and aquaculture; introducing invasive species; mining, building dams and transport routes.	Reduced resilience of land and marine ecosystems, especially in the face of climate change and increasing ocean acidity; large-scale biodiversity loss may lead to sudden and irreversible consequences for ecosystems.
Nitrogen use	Producing fertilizers for crops and animal feed; manure and human sewage management; burning fossil fuels and biomass; and growing leguminous crops.	Raised acidity of soils, and algal blooms in coastal and freshwater systems that deplete oxygen levels, pollute waterways and kill aquatic life – so threatening the quality of air, soil and water, and eroding the resilience of other Earth systems.
Phosphorus use	Putting excessive phosphorus into the environment by producing fertilizers, manures, detergents, and pesticides.	Depleted oxygen levels in freshwater bodies and coastal waters, risking abrupt shifts in lake and marine ecosystems.
Freshwater use	Altering river flow and extracting water for irrigation; capturing rainfall for use on crops; extracting water from water tables, for agriculture, industry and household use.	Shifts in regional rainfall and climate (e.g. the monsoon); reduced biomass production and biodiversity, decreasing the resilience of land and marine ecosystems, and undermining human water supply, food security, and health.
Land use change	Converting natural forests and other ecosystems into agricultural land, plantations, and urban settlements.	Serious threat to biodiversity and to the regulatory capacities of the Earth system, by affecting the climate system and the freshwater cycle.
Ocean acidification	Producing CO_2 (which becomes dissolved in sea water) primarily through burning fossil fuels and through land use change.	Loss of calcifying marine organisms; serious impacts on the productivity of coral reefs with likely ripple effects up the food chain.
Stratospheric ozone depletion	Producing chlorofluorocarbons for use in refrigerators, air conditioners and aerosol cans.	Severe and irreversible ultra-violet radiation with especially damaging effects on marine ecosystems, and on the health of humans exposed to radiation.
Atmospheric aerosol pollution	Releasing fine particles into the air, primarily through burning fossil fuels and biomass.	Changing global rainfall patterns including monsoon systems; damaging crops and forests, and killing fish with acid rain; human health impacts and premature death due to respiratory disease.
Chemical pollution	Releasing and spreading radioactive compounds, organic compounds (such as DDT), and heavy metals (such as mercury and lead), through industrial production and waste disposal.	Reduced abundance of species, likely to create bioaccumulation of effects up food chains, with impacts on human immune systems and neuro-development; likely to increase vulnerability of organisms to stresses such as climate change.

Source: Rockström et al (2009a and 2009b) and Sutton (2011)

4. Policies aimed at tackling poverty can exacerbate resource stress

Eradicating poverty is a priority, but poorly designed policies to achieve it can inadvertently lead to environmental degradation at the same time – with dire consequences for human well-being. Subsidies for fertilizer use, for example, aim to increase food production and as a result reduce food prices for low-income consumers. But if those subsidies encourage excessive amounts of fertilizer to be applied, they may bring no improvement in crop yields but a significant cost to the environment. Researchers in China, for example, found farmers using up to three times the required amount of nitrogen fertilizer, bringing no increase in their harvests, but resulting in 20 to 50 per cent of the nitrogen applied leaking into the air and polluting the groundwater.[30]

5. Policies can promote both poverty eradication and sustainability

There are many possible policies that can both help to achieve the social foundation for all – in rich and poor countries – while reducing stresses on the environmental ceiling at the same time, as the following three examples show:

- **Reproductive rights:** Ensuring every woman's right of access to sexual and reproductive health care empowers women in their households and in society, yet 11 per cent of adult women have an unmet need for family planning services. Meeting that need will also empower women to manage the size of their own families, slowing population growth, and reducing the resources required to enable every person to prosper above the social foundation – potentially a crucial difference, given that UN forecasts for the global population by 2100 range between 6.2bn and 15bn people.[31]
- **Insulating homes:** In many industrialised countries, housing is poorly insulated, exacerbating 'fuel poverty' among people with low incomes who have to spend more than 10 per cent of their incomes to heat their homes. Research in the UK, for example, has found that people living in fuel poverty also tend to live in the least efficiently insulated homes. By providing subsidies to householders for insulating their homes, governments can help to cut fuel bills, reducing fuel poverty and improving social equity, while simultaneously cutting national carbon emissions.[32]
- **Reducing food losses:** Every year, roughly one third of all food produced – 1.3bn tonnes – is lost in harvest or storage, or wasted by consumers. Policy initiatives to improve harvesting techniques, storage facilities, and processing in developing countries translate into higher incomes for small farmers, and into lower prices and greater food security for poor consumers. Reducing such food losses also reduces pressure for increasing food production, thereby saving on land, water, fertilizer use, and carbon emissions.[33]

These diverse interactions and examples highlight the importance of understanding the many complex relationships between social and planetary boundaries, and of taking both into account when designing policy interventions.

6 DISTRIBUTION DYNAMICS

The framework of social and planetary boundaries provokes the question of where the responsibility lies for pushing humanity's use of natural resources beyond sustainable limits. Four insights:

1. Ending poverty for all today: no need for stress

The first imperative of sustainable development is poverty eradication, and achieving that need not be a source of stress on planetary boundaries. Data available for some critical dimensions of deprivation indicate that bringing every person alive today above the social foundation could be achieved with strikingly little additional demand on resources:

- **Food:** Providing the additional calories needed by the 13 per cent of the world's population facing hunger (850m people) would require just 1 per cent of the current global food supply.[34]
- **Energy:** Bringing electricity to the 19 per cent of the world's population (1.3bn people) who currently lack it could be achieved with less than a 1 per cent increase in global CO_2 emissions.[35]
- **Income:** Ending income poverty for the 21 per cent of the global population who live on less than $1.25 a day (1.4bn people) would require just 0.2 per cent of global income.[36]

More analysis of this kind is needed to understand the relationship between all the dimensions of the social foundation and the nine planetary boundaries, but these statistics indicate that addressing poverty need not be a cause of stress on planetary boundaries.

2. The wealthy few stress the planet

The biggest source of planetary boundary stress today is the excessive consumption levels of roughly the wealthiest 10 per cent of people in the world, and the production patterns of the companies producing the goods and services that they buy:

- **Carbon emissions:** Just 11 per cent of the global population generate around 50 per cent of global carbon emissions, while 50 per cent of people create only 11 per cent.[37]
- **Incomes:** The richest 10 per cent of people in the world hold 57 per cent of global income. The poorest 20 per cent of people hold just 2 per cent.[38]
- **Purchasing power and electric power:** High-income countries – home to 16 per cent of the world's population – account for 64 per cent of the world's spending on consumer products and use 57 per cent of the world's electricity.[39]
- **Nitrogen:** Humanity is using nitrogen at four times the globally sustainable rate. The European Union – home to just 7 per cent of the world's population – uses up 33 per cent of the globally sustainable nitrogen budget simply to grow and import animal feed, while many Europeans eat far more meat and dairy products than is suitable for a healthy diet.[40]

This excessive resource use by the world's richest 10 per cent of consumers crowds out much-needed resource use by billions of other people aiming to meet far more modest consumption needs, within planetary boundaries.

3. The aspirations of many will keep raising the pressure

Adding to the excessive resource-use of the well-off are the aspirations of a growing number of consumers seeking to emulate today's high-income lifestyles. Over the next 20 years, global population is expected to grow by 1.3bn people, while the global 'middle class' is expected to grow from under 2bn consumers today to nearly 5bn by 2030, increasing particularly in India and China.[41] For people moving into the lower-income end

of this group, rising consumption may mean being able to afford meat, electricity, and transport for the first time – transforming their lives and life-long prospects. But for those at the higher-income end, it may mean adopting lifestyles that are deeply unsustainable. Demand for many resource-intensive consumer products is expected to rise: the global car fleet is predicted to double, for example, and China's per capita consumption of meat could increase by 40 per cent (while still being well below US levels). New and expanding cities could displace 30m hectares of high-quality agricultural land by 2030, equivalent to 2 per cent of land currently under cultivation.[42] Global demand for water is expected to rise by 30 per cent, and demand for food and energy both by 50 per cent.[43] As international competition for these resources grows, women and men living in poverty will be worst hit, particularly through high and volatile food prices, and land and water grabs. Securing their rights to the resources they depend upon is a top priority.

4. Inefficient use of natural resources adds to the planetary pressure

In addition to these vast inequalities of resource use are significant inefficiencies in how natural resources are transformed, recycled, and restored to meet human needs – particularly for food, transport, and energy. Examples include:

- **Food waste:** Every year, the average consumer in Europe and North America throws away 95–115kg of edible food. Food wasted by consumers in industrialised countries each year (222m tons) is almost as high as the total net food production of sub-Saharan Africa (230m tons).[44]
- **Irrigation water:** Surface water irrigation efficiency (the proportion of irrigation water that actually reaches the plant) is around 50–60 per cent in Japan and Taiwan, only 40–50 per cent in Malaysia and Morocco, and as low as 25–40 per cent in India, Mexico, Pakistan, the Philippines, and Thailand.[45]
- **Transport:** Making incremental changes to the engines and aerodynamics of new cars could result in a 50 per cent improvement in the average fuel economy of all cars on the road worldwide by 2050.[46]

Efficiency improvements alone are not enough (they can lead to lower prices, which may increase total resource use – an irony known as 'the rebound effect'), so measures to reduce total resource use are often needed to accompany them. One study identifies available resource productivity improvements which could meet nearly 30 per cent of the increase in demand for resources in 2030, if they were widely disseminated and put to use.[47] But any such interventions must be designed and implemented in ways that respect both human rights and planetary boundaries, so that while increasing efficient resource use, they also serve to make economic activity more inclusive and sustainable.

Living within the doughnut

These four insights above make it clear that moving into the safe and just space for humanity demands far greater equity in the distribution of incomes and resource use, within and between countries, as well as far greater efficiency in how resources are used.

The over-riding aim of global economic development must be to enable humanity to thrive in the safe and just space, ending deprivation and keeping within sustainable limits of natural resource use. Traditional economic growth policies have largely failed to deliver on both accounts: far too few benefits of economic growth have gone to people living in poverty, and far too much of GDP's rise has been at the cost of degrading natural resources. The critical economic question is whether or not global GDP growth can be harnessed as a tool for moving into the doughnut – or whether a different approach to economic development is needed.

The policies now needed to make this unprecedented social and economic transition cover a vast agenda, beyond the scope of this discussion paper. But the framework of social and planetary boundaries provides a global-scale compass for getting there.

7 INTO DEBATE

This discussion paper has outlined a visual conceptual framework of planetary and social boundaries as a new perspective on sustainable development. It has attempted to quantify those boundaries, explored some of their interactions, and highlighted the vast inequalities and inefficiencies of resource use that are causing humanity to live far outside of the doughnut.

If this framework is to be useful in taking forward debates about sustainable development, then it raises a number of questions:

1. Who should determine the dimensions and boundaries of an internationally agreed social foundation and an environmental ceiling, and how?
2. What are the implications of this framework for drawing up new global development goals beyond 2015, as part of the MDG and Rio+20 processes?
3. How could the framework be adapted regionally or nationally to reflect the importance of regional thresholds for many planetary boundaries?
4. How could inequalities in global resource use be represented graphically within the framework?
5. How could this framework be extended to explore the fair shares of effort needed, between and within countries, to bring humanity into the safe and just space?
6. What are the major policy shifts required to achieve economic development that brings humanity within social and planetary boundaries?

ANNEX 1

Social and environmental concerns raised in governments' submissions to Rio+20 (out of a total of 80 submissions)

Social issue	No. of submission mentions	Environmental issue	No. of submission mentions
Access to energy	68	Climate change	72
Food security	65	Biodiversity	64
Income poverty	64	Water resources	62
Water and sanitation	60	Land and forest management	56
Jobs / decent work	56	Soil degradation, including nitrogen and phosphorus use	47
Health care	53	Marine resources, including ocean acidification	40
Education	50	Chemical pollution	39
Resilience	48	Waste management	35
Gender equality	43	Desertification	32
Voice and participation	43	Mineral and oil resources	18
Social inequity	41	Air pollution (aerosols)	15
Access to transport	30	Ozone depletion	8
Culture and indigenous rights	23		
Adequate housing	19		
Social protection	14		

Source: Oxfam, based on http://www.uncsd2012.org/Rio+20/index.php?menu=115. The shaded social issues in bold are those mentioned in at least half of the submissions, thereby forming the set of 11 social priorities for Rio+20.

NOTES

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[8] This is reinforced by Principle 5 of the Rio Declaration on Environment and Development, which states, 'All states and all people shall cooperate in the essential task of eradicating poverty as an indispensable requirement for sustainable development, in order to decrease the disparities in standards of living and better meet the needs of the majority of the people of the world' (see Note 4 for source).

[9] Food security is based on the prevalence of undernourishment. Data from the FAO, available at http://www.fao.org/economic/ess/ess-fs/fs-data/ess-fadata/en/ (last accessed January 2012)

[10] Income poverty is based on the population living on less than $1.25 (PPP) per day. Data from S. Chen and M. Ravallion (2008) 'The developing world is poorer than we thought but no less successful in the fight against poverty', World Bank Policy Research Working Paper No. 4703. Available at: http://econ.worldbank.org/external/default/main?pagePK=64165259&piPK=64165421&theSitePK=469382&menuPK=64216926&entityID=000158349_20100121133109 (last accessed January 2012). Primary education is based on total net primary enrollment rate. Data from World Databank, available at: http://databank.worldbank.org/ddp/home.do (last accessed January 2012)

[11] Water deprivation is based on the proportion of the population using an improved water source. Sanitation deprivation is based on the proportion of the population using an improved sanitation facility. Adult education deprivation is based on literacy rate of 15–24 year olds. Gender inequality is based on the gap between women's and men's share in non-agricultural wage employment, and on the gap between women and men holding seats in national parliaments. All data from UNStat (2011) 'The Millenium Development Goals Report 2011', available at: http://unstats.un.org/unsd/mdg/Resources/Static/Data/2011%20Stat%20Annex.pdf (last accessed January 2012).

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[23] This principle is enshrined in the United Nations Framework Convention on Climate Change (1992), available at: http://unfccc.int/resource/docs/convkp/conveng.pdf (last accessed January 2012)

[24] This concept of combining planetary and social boundaries echoes the concept of 'environmental space', developed by Friends of the Earth in 1992, which defines upper and lower limits of sustainable resource use, based on nature's capacity and social need. An illustration of the concept is available at: http://www.foeeurope.org/sustainability/foeapproach/espace/t-content-espace.htm (last accessed January 2012)

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Food deficit and undernourished population: http://www.fao.org/economic/ess/ess-fs/fs-data/ess-fadata/en

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