ENVIRONMENTAL HEALTH IN EMERGING MARKETS

SUMMARY AND REPORT
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This report is the product of sustained efforts by many people, including:

The Principal of Green Templeton College, University of Oxford, Professor Denise Lievesley; The Steering Committee of the Emerging Markets Symposium, including its Chairman H.E. Shaukat Aziz and its members: Sir George Alleyne, Suman Bery, Peter Bourne, Tsung Mei Cheng, Michael Earl, Saul Estrin, Alexandre Kalache, Serra Kirdar, Sania Nishtar and Srinath Reddy; the EMS Administrators, Ruth Loseby and Yoland Johnson; Anna Carlqvist who researched and created the images; the Graduate Assistant Team led by Mihika Chatterjee that included Noon Altijani, Sarah Borg, Anna Carlqvist, Michaela Dolk, Irina Fedorenko, Catherine Gresty, Muriel Levy, Christina Maags, Louis Metcalfe, Nikhita Nadkarni, Vasileios Nittas, Johanna Renz, Genevieve Richardson, and Audrey Tan; the designer of this report Richard Boxall; and our Communications Team Anne Winter and Felicity Porritt.

The success of any symposium depends far less on designs, plans or execution than, on first, participants who give their time and donate their world-class expertise to the conversations reflected in this report and second to those who gave extra time to labour through the draft, correct errors of fact and judgement and offer authoritative advice: Rifat Atun, Frans Berkhourt, Suman Bery, John Boardman, Peter Bourne, Jeffery Burley, Anna Carlqvist, Mikhita Chatterjee, Abrar Choudhury, Michael Earl, Saul Estrin, Irina Fedorenko, Yanzhong Huang, Alexandre Kalache, Ana Langer, David Molyneux, Ali Naghieh, Tim O’Riordan, Johanna Renz, Genevieve Richardson, Rainer Sauerborn, Lise van Susteren, Vladimir Zakharov, and Junfeng (Jim) Zhang.

Finally, whilst participants and reviewers are responsible for any merit the report may have, it does not necessarily reflect their views or opinions; I am accountable for errors of omission, commission or interpretation.

Ian Scott
Executive Director
Emerging Markets Symposium
This report distills the outcomes of the eighth in a series of symposia on human welfare in emerging markets at Green Templeton College, Oxford. This symposium like its seven predecessors was made possible by the vision and very generous sponsorship of the C&C Alpha Group, for which the College is deeply grateful.

The report is published at a turbulent and troubling moment in the history of international efforts to meet and manage the challenges of environmental change. In light of recent denials of overwhelming scientific evidence, there is now widespread concern about the lack of commitment in some quarters to take urgent action. Indeed, those who are suffering the direct and indirect consequences of toxic smog, creeping desertification and other threats in parts of Asia and Latin America, are already aware of the impact of air pollution, ocean and freshwater contamination, reduced biodiversity and soil degradation.

No aspects of environmental change are more critical than those that affect health and well-being; none are more urgent than those that affect the poor and disadvantaged; none can be managed without global cooperation that puts the welfare of the world above that of individual countries; and nowhere are the consequences more threatening and evolving faster or on a larger scale than in emerging markets.

The report accepts that environmental threats pose a clear and increasingly acute danger to human health in emerging markets and the world at large. It recognizes that the current trajectory of environmental damage, depletion and degradation is unsustainable. It argues that planetary health, sustainable growth, social cohesion and political stability demand wise stewardship of our limited planetary resources. It acknowledges the need for measured but significant changes in attitudes, lifestyles, modalities and priorities to reconcile economic ambitions with the capacity of the earth’s natural systems. It urges greater global emphases on public health and disease prevention, waste-reducing cyclical economies and the adoption of satisficing objectives. And it suggests that plausible solutions will require a transformation of the approaches which underlie decision-making away from the substantial degrees of corporate and individual environmental autonomy that currently prevail in much of the world towards a sustainable blend of realistic environmental controls and enhanced cooperation.

I welcome this report as a serious and thought-provoking contribution to the debate on the future of our planet, the most important issue facing mankind.

Professor Denise Lievesley
Principal, Green Templeton College, Oxford
INTRODUCTION

The Emerging Markets Symposium (EMS) is an academic initiative of Green Templeton College, Oxford that expresses the College’s commitment to enhance the management of human welfare in the modern world.

The EMS was created in 2008 because: (i) The prosperity of emerging markets is critically important to the world of the 21st century; (ii) Complex and urgent issues of human welfare and well-being, if not resolved, would constrain their growth, cohesion and stability; (iii) No existing forum was dedicated to these issues and; (iv) Green Templeton College had the convening power to gather leading authorities from national governments, international institutions, business and civil society organizations to consider issues and recommend practical changes in policies and practices that could help resolve them.


For more information about the Emerging Markets Symposium please see: ems.gtc.ox.ac.uk

For more information about Green Templeton College please see: www.gtc.ox.ac.uk

SPONSORSHIP

The work of the EMS has been made possible by generous grants from the C&C Alpha Group, a London based venture capital company with strong commitments to human welfare in emerging markets and worldwide interests in healthcare, aviation, real estate, hospitality and utilities.
This is a summary* of the findings, conclusions and recommendations of a 2017 symposium at Green Templeton College, Oxford. The symposium was predicated on the assumptions that problems of environmental health in emerging markets must be: considered in the context of planetary health; viewed through the prisms of environmental and health sciences, economics, politics, anthropology, sociology, geography, history, and philosophy; and addressed in the nexus of the human life-course and the policies, practices, initiatives and interventions of government, business and civil society.
EMERGING MARKET PERSPECTIVES

WHAT ARE EMERGING MARKETS?

Since the term was coined in 1981 some middle income countries in Africa, Asia, Europe and the Americas have been described as ‘emerging markets’. The set of emerging market countries recognized by the EMS, while not immutable, has remained unchanged since 2008. It includes: Argentina, Brazil, Chile, China, Colombia, Egypt, India, Indonesia, Jordan, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Russia, South Africa, Thailand, Tunisia and Turkey.

Emerging markets are in many ways diverse but from a high-altitude perspective have enough in common to allow us to consider them as a distinctive group and to speak of them in the same breath. Their defining generic accomplishments include:

- The capacity to manage demographic transitions attributable to declining fertility and increasing longevity that (with exceptions) are reflected in broadly similar population pyramids;
- The capacity to manage economic, social, cultural, technological and spatial change;
- Moderate to strong (in some instances very strong) economic growth driven by domestic and foreign fixed and financial investment;
- Sustained economic and social development measured (inter alia) by moderate to sharp reductions in infant mortality, illiteracy and communicable diseases;
- Distinctive but relatively stable polities with relatively effective governance and judicial and financial systems;

Figure 1: Map of Emerging Markets and other countries
Source: EMS 2017 Analytical Framework

Figure 1 and other figures in this report, compare emerging markets with small sets of High Income Countries (HICs) and Low Income Countries (LICs) for reference purposes (see Figure Sources).
Comparatively adequate but unevenly accessible primary education systems and partially adequate secondary and tertiary education systems;

Sharply stratified (excellent to very weak) healthcare and public health services;

Sufficient economic power and external influence to become significant players in regional and in some cases global geopolitics.

From the same (high altitude) perspective, their generic *challenges* include:

- Unresolved problems of national, local and corporate governance, including systemic abuses of power and authority, uneven leadership and managerial competence;
- Eroding competitive advantages in trade, manufacturing and other economic activity reflecting rising factor prices;
- Unresolved problems of income, education and health poverty, economic inequality, social inequity and other determinants of human welfare and well-being; and (crucially for this report) unresolved problems of cumulative environmental damage.

**EMERGING MARKETS IN THE WORLD**

In the last quarter century, the benefits and costs of economic globalization (i.e. integration, standardization, digitization, specialization, technological and organizational change, factor mobility) and associated processes of cultural and political globalization have been disproportionately concentrated in emerging markets. The benefits have been transformational, the speed of change unprecedented, the cost unsustainable. Surging
Figure 3: Life expectancy at birth, 1990 and 2014
Source: EMS 2017 Analytical Framework
HIC: High Income Countries (sample), LIC: Low Income Countries (sample)

Figure 4: Children under 5 mortality ratio (deaths per 1,000 live births), 1990 and 2015
Source: EMS 2017 Analytical Framework
globalization after c.1980 was roughly correlated with progressive poverty reduction and increased inequality in emerging markets. Good news for some, not so good for others; not because all those left behind were materially worse off but because they fell relatively further behind. Never before have the lives of so many people been so quickly advantaged or, because the tide of prosperity has left many behind, so thoroughly and comparatively disadvantaged. And never before has so much damage been done in such little time to the earth’s natural systems.

In emerging markets, as in rich countries, accelerated growth and development has widened gaps between haves and have-nots. Not because they sought them (although policies may have made them inevitable) but because they were unintended consequences of rapid growth. Just as rising tides may not lift all boats, economic growth in nation-states is unlikely to lift all people, not least because some people think equitable outcomes are unfair, unattainable or unachievable even if government, business and civil society are nominally and/or actually committed to them.

Leaders and representatives of emerging markets have argued for years that their countries face bigger challenges and harder choices than others because they are simultaneously expected to:

- Promote economic growth;
- Improve the welfare and wellbeing of whole populations;
- Foster social and economic mobility for the disadvantaged;
- Address the specific needs of vulnerable populations including the youngest and oldest;
- Improve the availability and quality of health and education; and
- Manage ecosystem risks.

Yet these challenges are essentially similar to those faced by rich countries in the 19th and early 20th centuries some of which, in some degree, continue to face them. The difference is that emerging markets must face them with fewer resources, less infrastructure, less administrative, legal and financial capacity and weaker governance. Although current trends in some rich countries point to diminishing protection for the poor, more emphasis on autarchy and less on global collaboration, poor emerging market populations are, in almost all respects, worse off than their rich country counterparts.
A GLOBAL PERSPECTIVE

This report reflects the symposium’s answers to four questions:

- What has happened to the global environment?
- Why did it happen?
- How has environmental change affected human health in emerging markets?
- What can be done about it?

WHAT HAS HAPPENED
(OR WHAT HAVE WE DONE WRONG)?

Essentially three things. First, we have failed to adequately protect the earth’s natural systems. Second while our knowledge of the environment has greatly increased, particularly since the late 20th century, we do not yet fully understand some aspects of those systems. Third, those who understand the systems well have not persuaded those who understand and treat them less well to treat them better.

Doing

The Anthropocene Epoch began in August 1945 with nuclear explosions that ended World War II. Post-war recovery was followed by consumption-driven growth that brought unevenly distributed prosperity to much of the world but also degraded, depleted and destroyed natural systems at unprecedented speeds on unmatched scales.55

Economic growth since the mid-20th century (particularly in the last 25 years) has brought unprecedented improvements in health, nutrition, education, social mobility, DALYs and other measures of human welfare and well-being to much of the world. Humanity is healthier, better educated, better housed and has better access to utility and human services than ever before. Partly because the benefits of growth have been spread through rising household and personal incomes and partly because investments and other interventions by government, business and civil society have generated numerous benefits. But while the world as a whole has never had it so good the bottom billion has been left behind.58

If that is the mostly good news consider also the price of progress, in the name of which we have: converted (see Rockefeller(2015)) about a third of the earth’s ice and desert-free surface to cropland or pasture; appropriated half the world’s annual supply of freshwater for human use; cut down more than 2.3 million km² of primary forest since 2000; harvested about 90% of the world’s monitored fisheries at or beyond maximum sustainable limits; dammed more than 60% of the world’s rivers; eliminated species at a 100 times faster rate than that revealed in the fossil record; halved vertebrate populations since 1970;59 contributed to the highest concentrations of carbon dioxide, methane, and nitrous oxide in at least 800,000 years; used more than 100,000 chemicals (many untested and with unknown health effects) to produce pharmaceuticals; abetted solid waste mismanagement to blight urban peripheries across the world; allowed recyclable materials to spoil the soil for future generations; and celebrated our achievements as agents of biophysical change by naming the Anthropocene Epoch for ourselves. (see BOX 6, page 31).
On April 22, 1970, before conservation was popular anywhere, an American cartoonist boldly suggested that, whereas most people thought environmental change was a function of evolving natural systems, it was actually attributable to human interventions (Figure 5). Forty five years later, many of those who understand the issues are convinced that man is his own worst enemy and the game clock is running down.

Knowing

In 1990, the US National Academy of Sciences observed: “for many of the human activities that are transforming the global environment… data and analyses are fragmentary, scientific understanding is incomplete and long-term implications are unknown.”

In the last quarter century, science has come a long way. Not to a perfect understanding but far enough to persuade many governments, businesses and civil society organizations that multiple environmental threats could lead to the end of life as they know it and, in a Doomsday Scenario, to the end of life on earth.

Persuading

Finally, there is the matter of persuasion. With honourable exceptions, failures to address the health implications of environmental change reflect neither a lack of scientific evidence, nor a lack of effort to show that threats to environmental health are truly existential. Above all, they reflect failures by world, national, regional and local leaders to endorse the value of scientific expertise; evangelize environmental threats to planetary health; and understand that if public opinion resists reasoned arguments, ethos and pathos are legitimate options (BOX 2).

WHY DID IT HAPPEN?

The debate on the recent evolution of the global environment has generated both heat and light. Fingers have been wagged, pointed and curled in to fists. And to the extent they have formed sides, each has judged the other with perhaps less than due allowance for the fact that lack of knowledge, insight and foresight is part of the human condition.
It is easy for some to say (as some have said), that environmental damage is a consequence of greed, impatience and the mistaken belief the world’s resources are infinite. It is easy for those who may have misused the planet to point out that without their willingness to take risks and push boundaries, the world would have made less material progress. Yet even those who may be guilty of causing grievous environmental harm recognize that the environmental movement which originated in the 1960s as a disgusted response to the perception that mankind had fouled its nest, has added value to society. The movement spread in the 1970s and 80s and achieved global reach in 1990 when Earth Day was celebrated in 143 countries. As it grew, it gradually engaged government, business and civil society, began to capture public opinion and began to influence household and individual behaviours.

Air quality was the movement’s first concern. But by the 1980s the focus had shifted to the risks of climate change, the nature and magnitude of which were considered at Rio de Janeiro, Kyoto and Copenhagen. Efforts to agree on cohesive intergovernmental standards were, at best, difficult and were not helped by those who denied the findings of environmental science and often ignored environmental scientists.

December 12, 2015 when the Global Climate Change Agreement was signed in Paris, was an extremely important day in the history of global collaboration. It proved the global community was willing to: play a new development game; replace the adversarial agendas of previous environmental debates with collaborative agendas; believe the time for inaction, prevarication, opposition and asymmetric approaches to environmental threats was over; accept it was time to subordinate national priorities to global imperatives; and, before it was too late, decarbonize the global economy to pre-industrial levels by the middle of the 21st century. The Agreement has yet to be implemented and needs enhancement; emerging markets and, perhaps more so, rich countries, have much to learn from these processes.

HOW HAS IT AFFECTED ENVIRONMENTAL HEALTH?

Stylistic differences aside, high income neighbourhoods with high-end services in Buenos Aires, Marrakesh or Bangkok are not so different from those in Brussels, Madrid or Chicago. Building materials aside, slums in Delhi are much like those in Bogotá. And emerging markets have the non-communicable diseases of the poor and the chronic diseases of the rich.

Problems of environmental health are among the most paradoxical, urgent and challenging of the many ‘wicked’ problems facing emerging markets today (BOX 3). Because specific challenges demand specific strategies, most of them must be resolved by emerging markets themselves. But because many environment-related diseases, like many aspects of environmental damage, are too complex, dispersed and mobile to be addressed by any one country, international action is, in many cases, Hobson’s choice. Environmental health problems, and tactics, strategies and opportunities to resolve them demand both global and local thought and global and local action.

Deficient housing, overcrowding, poor sanitation and polluted air and water are relatively pervasive in poor countries and (mostly on smaller scales) also persist in poor emerging market communities. In both, they create conditions where infectious diseases, including malaria, HIV, pneumonia, tuberculosis, gastro-enteric infections and neglected tropical diseases, spread quickly and can be hard to contain although healthcare and public health services in emerging markets, even in poor communities, are generally better than in poor countries. The epidemiological shift from mainly communicable to mainly non-
communicable diseases that was largely completed in rich countries before 2000 when it had barely begun in poor countries is still underway in emerging markets. They are thus caught betwixt and between.

Nonetheless, non-communicable diseases account for growing shares of morbidities and mortalities, many of them attributable to environmental causes. As in the rich world, cardio-vascular and respiratory diseases, cancers and diabetes are all linked to air and water pollution while mental and neurological diseases are directly or indirectly tied to urban stress, cultural dislocation and isolation particularly in emerging market megacities where it is hardest to identify and manage them.

The distinguishing features of environmental health in emerging markets are that:

- Environmental health challenges are larger and are evolving faster than in other countries.
- Some problems are derived from rich countries.
- Some aspects are not well understood including zoonotic diseases (e.g. ebola, malaria, zika) that account for 75% of new and emerging infectious diseases.
- Environmental health in emerging markets reflects welfare disparities, skewed distributions of wealth and incomes, limited economic opportunities and disadvantaged access to health, education, infrastructure, housing and services.
- Environmental health conditions vary enormously between and within emerging markets and in some cases, are worse than in poor countries.
- Response capacity is weaker than in richer countries because institutions are generally less established, skills and technical knowledge are less available and funds are scarcer.
- Political environments, especially at local levels, may not be amenable to decisive action because there is intense competition for leadership attention and less interest in addressing long term problems.

**WHAT CAN BE DONE ABOUT IT?**

Disputes aside and no matter who is responsible, the reality is that the global community cannot continue to use the planet as though, when it no longer serves, they could migrate to another. So what can be done about it?

One option is to recognize that neo-liberalism has made it possible to nourish, house and clothe more people, create jobs and incomes and permit rising living standards for much of (but by no means all) the global population and to assume it will continue to work. Another option is to adopt an alternative model such as the so-called ‘Boundaries Model’ developed by Rockström et al., Raworth and Steffens et al.

Raworth suggests that if the 21st century is to meet the needs for food, water, energy, shelter and material goods of almost 10 billion people without adverse effects on air quality, climate, soils, biodiversity, freshwater and a protective ozone layer, it must inhabit a ‘doughnut’-like safety zone between social and planetary boundaries (see Figure 6) in which the twelve dimensions of the social foundation correspond to standards identified in the Sustainable Development Goals and nine planetary boundaries represent the limits beyond which the earth’s natural systems will not go...
on giving. Indeed, Steffens et al suggest that some boundaries (climate change, biosphere integrity, land-system change and phosphorus and nitrogen use) have already been crossed and that the consequences are potentially devastating.

None of those potential consequences are more important than those considered in this report because human fertility, productivity, educability, creativity, ingenuity, adaptability and destructive capacity fundamentally depend on human health and well-being that, in turn, depends on symbiotic relationships between men, women, children and their natural and built environments.

And they are nowhere more important than in emerging markets which are among the leading perpetrators and major victims of environmental harm.

Figure 6: The Doughnut of social and planetary boundaries
Source: Raworth (2017)
THE GOLDEN EGG

Environmental degradation, destruction and depletion in emerging markets are collateral consequences of rapid economic growth and social development that has been achieved by consuming natural resources at rates that, if continued, would exhaust them. As Haines points out, “We... have mortgaged the future in order to sustain our current level of health and development”.

That does not mean past relationships between economies and environments offer blueprints for the future. Future demand for energy for example, will not increase pari passu with economic growth because technologies will change, production and distribution systems will become more efficient, lessons of past experience will be learned and Santayana’s aphorism – “Those who cannot remember the past are condemned to repeat it” – will be heeded.

The critical and exceedingly difficult question for emerging markets is how to reconcile the urgent need to spread and increase prosperity while diminishing and eventually eliminating environmental threats that, unchallenged, will undermine economic growth. There will be an overwhelming temptation to ignore the longer term, focus on the short term and kill the injured goose that laid golden environmental eggs by dismissing Aesop’s warning, “Much wants more and loses all.”

Because natural systems – air, water, oceans, land, biodiversity, climate – are not confined within national boundaries, growth-driven threats to natural and built environments are universal. But the need for radical changes in priorities and behaviours is disproportionately greater in emerging markets than in other countries and the risks of financial, social and economic disruption are greater there than elsewhere. While the nature of environmental damage in emerging markets is essentially similar to environmental damage in rich countries, its scale has generally been larger and its rate faster in emerging markets than elsewhere.

AIR

Air pollution was a global environmental priority until it was eclipsed by climate change. Since c.1980 air quality in cities and – more than often supposed – rural areas, has deteriorated worldwide. Both urban and rural air pollution is worse in emerging markets than anywhere else. Partly because the world’s megacities (except London, Los Angeles, New York, Paris and Tokyo) are mostly in emerging markets; partly because problems of rural air quality are highlighted by pollution associated with the destruction of the Amazon rainforest; and partly because there have been substantial increases in SO₂ and NOx emissions. Emerging markets have also suffered increases in premature deaths linked to urban air pollution (particulates and ground-level ozone) and high burdens of disease from exposure to hazardous chemicals.
ENVIRONMENTAL HEALTH IN EMERGING MARKETS – SUMMARY

WATER

The pollution and toxification of freshwater and ocean water is greater in emerging markets than in richer countries. Partly as a function of behavioural norms: where else to bathe or wash clothes; why should cows not defecate in rivers; what is wrong with dumping solid wastes and plastic bottles in oceans? And partly because waste management infrastructure and services are weaker. Many emerging markets have high levels of groundwater pollution and depletion; growing populations living in river basins under severe water stress; deterioration of surface water quality; increases in nutrient loading and risk of eutrophication; relatively large rural and urban populations without access to safe water (partly because urban populations have grown faster than water service connections); and increases in untreated wastewater.

BIODIVERSITY

Science has described only a fraction of the world’s estimated 15 million to 100 million species. And because the global distribution of biodiversity is geographically uneven and because emerging markets enjoy species richness and species endemism, they also enjoy economic privileges and (in principle) globally significant custodial obligations. As a result, emerging markets face intensifying internal pressures to prioritize growth and increasing external pressure to prioritize biodiversity.

Emerging markets have experienced a continued loss of biodiversity from growing pressures of land use and climate change and a decrease in primary (virgin) forest area. Biodiversity is also eroding faster, on a larger scale and with greater long term implications in emerging markets than in rich countries as pressures to increase returns on capital and expand economic activities in the context of weak environmental protection, have depleted biodiversity and exploited natural resources with disproportionate impacts on the welfare and livelihoods of the rural poor, particularly those most reliant on the natural world.
SOIL
Limited access to education, extension services and productivity enhancing techniques and the abusive use of pesticides, herbicides and fertilizers and weak regulation of farming practises in emerging markets mean many of their vast acreages of agricultural and livestock farming land yield comparatively poorer returns and faster rates of soil depletion and degradation (with multiple knock-on effects) than in rich countries. Rising pressures will raise the spectre of further deforestation, soil exhaustion and severe consequences for food production, nutrition and health in emerging markets and, to the extent it depends on them, the rest of the world.

CLIMATE
Growing greenhouse gas (GHG) emissions (especially energy-related CO₂) and growing atmospheric concentrations of GHGs mean the impact of climate change will be greater in emerging markets than in rich countries (although not necessarily greater than in poor countries).

Some rich countries (notably Japan, Netherlands) are vulnerable to sea-level rise but world attention is mainly focussed on threats of coastal erosion, coastal flooding and population displacement in poor countries (e.g. Bangladesh, Myanmar, Vietnam). Many emerging markets, particularly in east and south Asia (e.g. China, Indonesia, Malaysia, Thailand, Philippines) are also at risk of predicted coastal flooding.

Other emerging markets (in Latin America and Asia) are threatened by predicted increases in the frequency and severity of extreme weather events, including river flooding, soil erosion and damage to housing, urban infrastructure, irrigation systems and dams from hurricanes, cyclones and intense rainfall. And given their geographic locations, parts of many other emerging markets (e.g. Chile, China, Morocco, Egypt) are exposed to the effects of rising temperatures, high insolation levels, drought and desertification, although – subject to breakthrough transmission and storage technologies – most of them could, in due course, become major producers of solar energy.

BUILT ENVIRONMENTS
By comparison with rich countries, built environments in emerging markets have poorer housing and infrastructure, larger transmission and distribution leakages and losses, less efficient transport, fossil-fuelled electric power, more untreated solid and liquid waste and damaged infrastructure. As a result, their cities are more polluted, have poorer drainage and weaker environment education programmes than cities in richer countries.
SCENARIOS

So, which do you prefer... the end of the world as we know it or the end of the world? Anon

The outlook for environmental health in emerging markets largely depends on the impact of the global economy on the global environment in the last and next 35 years. It can be argued that errors of omission and commission since c.1990 have already settled the outcomes and that environmental damage done cannot be repaired. The burden of evidence suggests the damage is significant but not determinant.

There are two plausible scenarios for 2050. Both exclude wars, epidemics, asteroid strikes, volcanic eruptions and environmental calamities beyond those embedded in recent and current trends. Both focus on tensions between growth and development and the environment (Figure 8).

![Figure 8: Tensions](image)

**THE ‘PARTY ON’ SCENARIO**

Blending the buoyant optimism of Voltaire’s *Candide* with the dystopian realism of Sartre’s *Huis Clos*, the ‘Party On’ scenario would feature increasing tensions between economic growth (and social development) and collateral environmental damage.

**Upside**

In the upside of this scenario, followers of Voltaire’s ultimate optimist, Dr. Pangloss, would assume the unprecedented growth and development of the last 35 years in emerging markets (and to a generally smaller extent) elsewhere, would be sustained or accelerated; that damage to natural systems would not have to be paid for; and that further environmental damage would be avoided.
A recent analysis suggests that in these conditions, world population would grow from ±7.0 billion to ±9.0 billion, largely driven by ageing and largely concentrated in towns and cities. The size of the world economy would nearly quadruple. Demand for energy, food, water and agricultural land would increase as consumption preferences changed with rising incomes.

In 2015, the largest emerging economies (Brazil, China, India, Indonesia, Mexico, Russia and Turkey, a.k.a. the ‘E7’), were about half the size of the G7 economies (having been roughly a third the size in 1995). The analysis suggests that by 2030, China would become the world’s largest economy and India the second largest. By 2050, the E7 would be twice as large as the G7 economies and would account for around half the global economy and six of the world’s seven largest economies, displacing all but one member (the USA) of what is now the G7.

The long term economic prospects of the world would be intensely and increasingly relevant to emerging markets, not least because the reversal of fortunes that, in the recent past, has made some rich country investments hostage to the availability of emerging market capital (mainly from China and India) could continue. Whereas the prosperity of today’s leading economic powers hinges on continued growth in emerging markets, by 2050 the tables would be partially turned and emerging markets would be looking for sustained growth in the now richest countries.

**Downside**

The downside of the Party On scenario is that continued efforts to achieve growth and development in emerging markets (and the world-at-large) would be increasingly constrained by problems of environmental health and human welfare (Figure 9). The goose would stop laying golden eggs and efforts to pursue growth and development without significant changes in economic and environmental policies would be stymied by their environmental and health consequences.

![Figure 9: 'Party On'](source: EMS Original 2017)
Because unprecedented economic and demographic growth since the 1940s has delivered enormous (but far from universal) human benefits at the cost of severe environmental damage, more of the same would lead to irreparable environmental harm. A ± 30% larger (and, except in Africa, significantly older) population, pursuing unrestricted growth without deliberate changes in technology, organization or consumption patterns would probably do more environmental harm than past growth, put natural systems under unsustainable pressure and exacerbate problems of air and water pollution, waste management, biodiversity loss and climate change. The OECD has described the result as “irreversible changes that would endanger two centuries of rising living standards”, and also suggests that:

● Without changes in consumer food preferences (including much reduced demand for red meat), growing demand for food would expand cultivation, degrade soils, increase deforestation, deplete fish stocks, increase waste and increase demand for energy, mainly in emerging markets, by 2050.

● The urbanization of ± 70% of world population (at a rate 200,000 people a day) would increase problems of air and water pollution, transport congestion and waste management, mainly in emerging markets.

● World energy demand would increase by 80% most of which (± 85%) would be met with fossil fuels. Emerging economies, particularly the largest, would become more energy-intensive.

● Disruptive climate change would accelerate. Global greenhouse gas (GHG) emissions would increase by 50% as CO\textsubscript{2} emissions rose. By 2050, atmospheric concentrations would reach almost 700ppm; rising global average temperatures would lead to an increase of at least 3\textdegreeC over pre-industrial levels; and extreme weather events and higher heat, insolation, rainfall, glacial melt and sea-levels would present intolerable threats.

Figure 10: Global water demand: Baseline scenario, 2000 and 2050
Source: OECD (2012)
BRIICS: Brazil, Russia, India, Indonesia, China and South Africa, RoW: Rest of the World
Changing land uses, expanding commercial forestry, infrastructure development, encroaching human settlements, fragmenting habitats, pollution and climate change, would diminish biodiversity especially in Asia, Europe and Southern Africa. Further losses in freshwater biodiversity could also threaten human well-being, especially for the rural poor.\textsuperscript{540}

Freshwater availability would diminish and water-related tensions would rise in many parts of the world, including emerging markets in North and South Africa and South and Central Asia. Growing demand for water from manufacturing, power generation and domestic use would increase global water demand by ± 55%, limiting scope for increased irrigation. Groundwater depletion could become a major threat to agriculture and urban water supplies. Nutrient pollution from urban wastewater and agriculture would worsen in most areas, intensifying eutrophication and damaging aquatic biodiversity.

Access to improved but not necessarily safe water would continue to increase, particularly in emerging markets but not in much of sub-Saharan Africa. By 2050 at least 15% of the world population would still lack basic sanitation.

Environmental and demographic changes in this scenario would present new challenges to environmental health in emerging markets. Communicable disease issues would include:

- Child health would continue to be threatened by environment-related perinatal illnesses (low birthweight, stillbirths, congenital anomalies); respiratory diseases (pneumonia, tuberculosis, asthma); diarrhoeal diseases (rotavirus, E.coli infections and cholera); and vector-borne diseases (especially malaria);
- Population ageing would increase the prevalence of age-related morbidities; pose acute cost-benefit questions to society; and increase threats from ground-level ozone;\textsuperscript{541}
- Although some infectious diseases (e.g. zika) are imperfectly understood, environment-related communicable diseases would continue to confront scientists, doctors and patients;
- As emerging market cities continued to grow, deficient and overcrowded housing and poor sanitation would foster the spread of known and neglected tropical diseases in poor urban communities;
- Drug-resistant infections could wreak more economic damage than the 2008 financial crisis;\textsuperscript{542}
- \(\text{PM}_{2.5}\) exposure would become the leading cause of premature environment-related death, particularly in Asia where concentrations already exceed safe levels;\textsuperscript{543} and
- Exposure to hazardous chemicals would increase as emerging markets captured growing shares of chemicals markets.

Among other downside aspects of this scenario many non-communicable diseases, mainly or partly attributable to environmental causes, would account for growing shares of morbidities and mortalities in emerging markets:

- Cardio-vascular and respiratory diseases, cancers and diabetes would increase as air and water pollution persisted.
- Mental and neurological diseases linked to urban and rural stress, dislocation and isolation would increase, particularly in emerging market megacities.
- Environmental health in emerging markets would continue to reflect skewed distributions of wealth and incomes, limited economic opportunities and disadvantaged access to health, education, infrastructure, housing and services.
Environment-related disease would continue to be unevenly distributed. The worst-off would continue to bear the brunt of socially determined morbidity and mortality. Depending on the speed of environmental degradation the response capacity of emerging markets would diminish and would continue to lag richer countries.

And it could be worse, because:

- The world will have \( \pm 2.0 \) Billion more people in 2050 than it has now. While much of the growth will be in Africa, some will be in poorer communities in emerging markets. Wherever it occurs, more people would put more pressure on natural systems.

- The Global Climate Change Agreement of December 2015 was an extraordinarily important achievement. In light of the fact that failure to meet the Agreement’s obligations by any of the major countries threatens the targeted global warming cap of 2.0°C by 2100, the US decision to withdraw could have catastrophic implications. Uncertainty in the interim could see global warming veer upwards with unknown consequences for natural systems and planetary and environmental health.

- The environmental health implications of rapid environmental change could be more severe and more complex than in the past. For example, Margaret Chan has suggested that the growing global problem of antibiotic resistance could be disastrous for human and animal health, food production and global economies; penalize the poor; bring the end of modern medicine as we know it... and make ‘sophisticated interventions, like organ transplantation, joint replacements, cancer chemotherapy, and care of pre-term infants more difficult or even too dangerous to undertake’.

- While we know natural systems have tipping points beyond which damaging change (e.g. species loss, climate change, groundwater depletion, land degradation) becomes irreversible, many of those tipping points remain undefined and their potential consequences remain poorly understood.

Postures adopted and actions taken by rich and poor countries as well as emerging markets will continue to shape environmental outcomes in emerging markets. And as in the past, political and economic pressures could overwhelm efforts to consider choices in light of long term implications.

**THE ‘NEW DEAL’ SCENARIO**

The second scenario assumes potentially radical changes in economic systems, structures, incentives, rewards and lifestyles and policies and practises that promote (circular) waste-saving economies, satisficing behaviour and the protection of natural systems to minimize the economic, social and political threats of progressive environmental damage (Figure 11). Growth would be slower but sustainable, and with appropriate policies would service continued social development.

There would be huge challenges.

One would be to balance unambiguous policies with the need to adapt to changing circumstances. Another would be to persuade decision-makers to act with all deliberate speed to halt processes of environmental decay that have been underway for decades. A third is that decision-makers would find it exceedingly difficult (particularly in Presidential or parliamentary democracies) to persuade publics-at-large to favour the interests of future generations over those of present generations and to convince them that the weight of evidence on GHG emissions, deteriorating air and water quality, the loss of biodiversity and the environmental health implications of rural and urban economies justified drastic and immediate action.
These challenges are not new. Not so long ago, political, business and civil society leaders agreed to deliver water through lead pipes, permitted tobacco smoking in public places and sanctioned the use of asbestos in new construction until confronted with proof they were toxic. Once they learned the truth many countries banned them but until that proof became available, decision makers could reasonably claim they knew no better, see Nilsson et al (2009).

Their successors cannot reasonably claim to be ignorant of the adverse health consequences of environmental damage. Yet there is not a scintilla of doubt that norms, standards and sanctions designed to stabilize, protect and resuscitate natural systems would be vigorously resisted. Scientists and communicators would be confronted with the gargantuan tasks of: (i) persuading leaders action was a mandatory option; and (ii) giving them sufficiently powerful arguments to face down those who wanted to carry on regardless just as, in the past, they faced down opposition from manufacturers, sellers and consumers of lead, tobacco and asbestos (BOX 4). The difference between the past and the future is that the sands of time will be running faster.

The operational question is how governments, businesses, civil societies (including academe and households) can be convinced to accept radical changes in policies and behaviours – while there is still time.

If Option ‘A’ in Figure 12 (The ‘Party On’ Scenario) is dismissed as unrealistic (because it would mean business as usual and its consequences), the ‘New Deal’ Scenario could, in theory, be executed in one of two ways.

Box 4:

The True Believer

“It is the true believer’s ability to shut his eyes and stop his ears to facts that do not deserve to be either seen or heard which is the source of his unequalled fortitude…. He cannot be frightened by danger, disheartened by obstacles or baffled by contradictions because he denies their existence”

Hoffer, The True Believer, 1951
Option 'B' would limit corporate and personal freedoms to damage or neglect the environment through a combination of inducements, sanctions and regulations. Democratic regimes would find this approach unmanageable unless they could persuade voters the cause of environmental protection was the moral equivalent of war and there were no alternatives. Authoritarian regimes would also have difficulties, not least because most such regimes are in countries (including some emerging markets) with large poor populations whose livelihoods depend on access to natural systems.

That leaves Option 'C' which would feature a balanced mix of control and cooperation. Before December 2015, few people thought the world could unite to protect the planet from the consequences of climate change. Now it is just possible to imagine cooperation as the new normal. The world would have to adopt collaborative values, partially replace the politics of individualism with the politics of collectivism and shift from an emphasis on ‘me’ to an emphasis on ‘we’ while also accepting significant controls and diminished autonomy. A ‘New Deal’ that traded slower growth for planetary survival, health and well-being may seem implausible. But it will look increasingly better as time goes by.

Action to address outstanding issues of environmental health in emerging markets depends on four things. First, broader and deeper knowledge of environment-driven diseases and preventative and therapeutic interventions. Second, public support for policies to manage the impact of human activity on natural systems. Third, the extent to which efforts to build public support are grounded in evidence and embrace all known forms of persuasion. Fourth, whether emerging markets can respond to challenges of environmental health at earlier stages of socio-economic development than today’s rich countries did in the past.

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**Box 5:**

**SDG Target 3.9**  
By 2030, substantially reduce deaths/illnesses from hazardous chemicals and air, water and soil pollution and contamination.
RECOMMENDATIONS

In shaping its recommendations on environmental health in emerging markets the symposium took account of and broadly endorsed the conclusions described in the Sustainable Development Goals (see BOX 5), The Rockefeller-Lancet Commission on Planetary Health (see BOX 6) and the OECD (see BOX 7). Many of these conclusions are reflected in the following recommendations (which are amplified in the full report).

GLOBAL LEADERSHIP

● The Climate Change Agreement at the COP21 conference in Paris in December 2015 opened the door to a green health revolution. If implemented and built on, it is likely to be remembered as one of the most important public health treaties in history. The public health community should now join forces with the environment community to take the lead in ensuring it is implemented.

● The Paris Agreement should also inspire additional agreements to address threats to global health and well-being, including threats from air and water pollution, waste mismanagement, soil degradation and diminished biodiversity. In the absence of such agreements, environmental threats to health and well-being in emerging markets are unlikely to be contained.

● To take such cooperative efforts forward, a new global coalition of government, business, civil society and individuals should be created. This could take the form of a new multilateral organization, an intergovernmental panel similar to the Intergovernmental Panel on Climate Change, or a high-level global alliance as called for in the Ministerial Declaration on Health, Environment and Climate Change issued in Marrakech on November 15, 2016. The alliance should be charged with developing a strategic vision of a long-term equilibrium between economic activities and natural systems, and to lay the groundwork for binding global agreements that will ensure better management of immediate environmental threats to people’s health and well-being.

FINANCING AND INNOVATION

● As concluded under the Paris Agreement, rich countries should provide “climate finance” to help emerging markets and other countries adapt to climate change and support the upfront investments needed to switch to renewable energy. Bilateral aid agencies should also mainstream environmental health and climate objectives into official development assistance and public procurement policies.

● In addition, new sources of financing will be needed. The business and investment communities, together with institutions such as the World Bank and regional development banks, should explore innovative ways of jointly investing in country transitions to low-carbon and health-friendly economies as a matter of urgency.
Box 7: The OECD View

Having concluded that: environmental issues are complex and inter-related (e.g. climate change can affect hydrological cycles and exacerbate pressures on biodiversity; human health and biodiversity and ecosystem services are intimately linked to water, climate and human health) the OECD report* recommended “a mix of policies… carefully designed to account for these cross-cutting environmental functions and their wider economic and social implications”. It pointed out that: making reform happen will depend on political leadership and widespread public acceptance that changes are both necessary and affordable; that not all the solutions will be cheap (which means cost-effective solutions are critical); and that improved understanding of challenges and trade-offs will be essential. OECD also concluded:

- Integrating environmental objectives in economic and sectoral policies (e.g. energy, agriculture, transport) is vital because, collectively, those policies have greater impacts than environmental policies alone. Environmental challenges should be assessed in the context of other global challenges such as food and energy security and poverty alleviation.

- Well-designed policies can maximise synergies and co-benefits (e.g. by tackling local air pollution to cut GHG emissions while reducing the economic burden of health problems; and climate policy can foster biodiversity if emissions are reduced by avoiding deforestation).

- Contradictory policies must be addressed (e.g. dams that are intended to improve water and energy security can disrupt ecosystems; increased use of biofuels to meet climate goals could have a negative impact on biodiversity by requiring more land for bioenergy crops).

- Because many environmental problems are global (e.g. biodiversity loss, climate change) or linked to the trans-boundary effects of globalization (e.g. trade, international investment), international co-operation is indispensable to ensure effective action and an equitable sharing of the cost of action.

- The economic valuation of environmental impacts (e.g. the full benefits of biodiversity and ecosystem services and health costs associated with exposure to chemicals) must be improved.

In light of these conclusions, OECD recommended that:

- Market-based instruments such as environmental taxes and emissions trading schemes should be used to ensure the costs of pollution exceed those of greener alternatives;

- Prices of natural assets and ecosystem services (e.g. for household and irrigation water should reflect true value (with due allowances for cross-subsidies);

- Environmentally harmful (e.g. fossil)fuels should not be subsidized (here too making allowances for selective subsidies);

- Effective regulations and standards should be used to (inter alia) promote energy efficiency and safeguard human health;

- Encourage green innovation to promote non-polluting production and consumption through public support for basic research and development.

*Environmental Outlook to 2050 OECD, 2012
NATIONAL GOVERNMENTS

- Emerging markets governments should take on leadership roles in addressing environmental health concerns: China and India, which have already committed substantial resources to environmental improvement, could lead the world (particularly if the USA is unwilling or unable to do so). Many emerging market countries are better equipped to anticipate and respond to problems of environmental health. To the extent that they have managed economic, social, cultural and political change for decades, change management has become their stock in trade.

- Governments need to reassess their support for investments in greenhouse gas-intensive activities. For example, in order to reduce environmental impacts from farming, agricultural and forest protection policies and research efforts should be targeted to developing methods that produce high yields with low negative environmental impacts, drawing on techniques from both organic and conventional systems. Relationships between nutrition and environmental health, including the contribution of livestock farming to greenhouse gas and toxic chemical emissions should also be reviewed.

- There is increasing evidence of catalytic and multiple benefits of investing in environmental improvements. For example, it is estimated that doubling the share of renewable energy by 2030 would not only reduce air pollution-related disease but would also create 24 million jobs and bring a global GDP increase of 1.1%. Improving water and sanitation services benefits public health, increases labour productivity and brings an estimated return of between US$ 5-28 per dollar invested. These linkages provide a strong basis for improving policy coherence on a national scale and for governments to adopt integrated policies to improve the quality of the environment, with all sectors taking their share of responsibility.

- Governments also need to reconsider their levels of investment in environmental health and prevention strategies. Even in wealthy OECD countries, only 3% of health budgets is spent on prevention. There is an urgent need to adopt a wider view of risk factors for death and disease in health systems that includes both the social and environmental determinants of health. In the immediate future, the upcoming 2018 summit on non-communicable diseases (NCDs) should provide a platform for considering a new agenda for a broad ‘one health’ system, as part of efforts to achieve the WHO-proposed goal of reducing NCDs by 25% by 2025.

- Legislation and systems of incentives and disincentives should also play a greater role. Far too often, tax and subsidy systems work against health improvements, for example favouring the production of animal fat rather than fruit and vegetables. The history of tobacco control has clearly demonstrated the need to invest in legislation as well as public education programmes in order to change behaviour.

LOCAL AUTHORITIES

- Local leaders are vital for local change as they are closer to communities and understand their problems better. For example, mayors were among the loudest voices lobbying in favour of the Paris Agreement. Many cities and associations of mayors are now playing very significant roles in the implementation of innovative solutions to improve their environments and the well-being of citizens. These actions should become a source of inspiration for other district and local authorities.
BUSINESS

- In recent years, in economic circles, there has been a broad consensus that environmental initiatives harm economic growth and business. This view is now changing. New attitudes, priorities and practices in the private sector are essential to improved environmental health. Corporate capabilities in areas such as finance, technology, and advertising must be mobilised to fix existing problems and to help change behaviours.

- Openness to innovation can give businesses competitive edges. For example, new research in Europe shows that companies that focus on eco-innovation are growing at an annual rate of 15% at a time when many competitors remain flat. In some emerging market contexts, these advantages may be offset by relative weaknesses in corporate governance and regulatory regimes which means the latter will require greater attention if businesses are to achieve their full potential and social impact.

CIVIL SOCIETY

- Civil society organizations group powerful forces for changing the environmental attitudes and actions of citizens, companies and governments through lobbying, publishing, broadcasting, protesting and the use of social media. International NGOs should explore further ways of collaborating with domestic NGOs and with universities and research institutions in emerging markets with a view to exchanging knowledge and developing scientifically-grounded arguments that can be persuasive in local contexts, i.e. exchanging in the double sense of linguistic adaptation and transformation into policies.

MEDIA

- Mainstream and social media companies should consider taking on more pro-active roles as gatekeepers in the face of campaigns led by particular vested interests that aim to undermine facts or disseminate ‘alternative facts’. While the principle of ‘fairness’ and of giving equal weight, time or space in media outlets to different perspectives may make sense in political debates, it makes no sense when it comes to promoting mis- or dis-information rather than independent scientific knowledge. For example, it is now well documented that the media continued to present the scientific debate over tobacco as unsettled long after scientists had concluded otherwise.560
ENDNOTES FOR SUMMARY

S1. Organized by the Emerging Markets Symposium (EMS) at Green Templeton College

S2. Planetary Health is defined as the health of human civilizations and the state of natural systems on which health depends

S3. By Antoine van Agtmael, then working at the International Finance Corporation (IFC)

S4. Examples: Cuba, Tanzania, China, Taiwan, Singapore

S5. Richard Hardman, past-President of the Geological Society of London commented: "In my lifetime, humanity has become a geological force but the Anthropocene could be a very thin layer of geological time”.

S6. DALY: Disability Adjusted Life-Year


S9. On average

S10. April 22, 1970 was the first Earth Day

S11. A clock denoting time remaining until the end of game in some sports played in the USA and other countries

S12. National Academy of Sciences

S13. Periodic adjustments to the Doomsday Clock have been published in The Bulletin of the Atomic Scientists since 1947. The latest update was published in January 2017

S14. Most notably, the 2015 Paris Agreement and some national and city government initiatives.

S15. There is scientific uncertainty about the relationships between some environmental change and human health outcomes (e.g. the causes of some cancers) but the scientific evidence is generally overwhelming

S16. e.g. Household waste recycling, largely unheard of in most emerging markets in 1970, had become part of daily life, mainly in higher income groups, in many emerging markets by 2000.

S17. Driven by such events as the Great Smog in London (1952)

S18. Venues of precursor meetings to the Paris Agreement of December 2015

S19. Some countries trying to manage them while others played development catch-up

S20. ‘Wicked problems’ are complex issues that defy definition and resist final solutions

S21. Named for the owner of a livery stable in Cambridge (England) whose customers could not choose their horses

S22. ‘Think global, act local’ was a slogan coined for Friends of the Earth by David Brower, its founder


S26. Raworth op cit


S28. See Haines (2013)

S30. A Man and his Wife had the good fortune to possess a Goose which laid a Golden Egg every day. Lucky though they were, they soon began to think they were not getting rich fast enough, and, imagining the bird must be made of gold, they decided to kill it to secure its precious metal at once. When they cut it open they found it was just like any other goose. They neither got rich all at once nor enjoyed daily additions to their wealth. Much wants more and loses all. ‘The Goose that Laid the Golden Egg’, Aesop, 620-564 BC

S31. i.e. species that are unique to one area

S32. As the rest of the world is well aware, emerging markets are custodians of unique ecosystems.

S33. Voltaire (1759)

S34. Sartre (1944)

S35. Except in Africa

S36. Measured in Purchasing Power Parity (PPP) which yields higher numbers than calculations based on market exchange rates

S37. 20% of the total in terms of Market Exchange Rates (MERS) (as well as PPP)

S38. The projections are based on a model in which GDP is driven by four main supply-side factors using a Cobb-Douglas production function. Source: PWC (2017)


S40. The Economics of Ecosystems and Biodiversity (TEEB) is an international study led by Pavan Sukhdev that suggests the aggregate loss of global biodiversity associated with forest loss worldwide, is between US$ 2 and 5 trillion per year.

S41. To which older people are particularly susceptible.


S43. As defined by WHO (2016)

S44. Margaret Chan, Director-General of WHO (2006-2017)

S45. Changes in lifestyles

S46. Regenerative economic systems that rebuild natural capital and other forms of capital by eliminating waste

S47. Maximizing objectives are replaced by satisficing objectives

S48. An historical example was the Dominican Republic government’s decision to control wood collection for domestic cooking by putting forests under the direct control of the army in the late 1960s

S49. UNEP (2016)

None of the topics considered by the Emerging Markets Symposium (EMS) at Green Templeton College, Oxford since 2008 have been more provocative, urgent or paradoxical than those addressed in the 2017 symposium on *Health and the Environment in Emerging Markets*. Whereas the ‘wicked’ problems¹ examined in previous symposia (healthcare, maternal and child health, education, urbanization, gender, ageing, young people) must, for the most part, be resolved by emerging markets themselves, environmental challenges to human health are too complex, dispersed, mobile and global to be addressed by any one country. International action is Hobson’s choice.²

The symposium was anchored in the assumptions that environmental health in emerging markets must be understood in the contexts of environmental and health sciences, economics, management, politics, anthropology, sociology, geography, history, and philosophy; addressed in the nexus of the human life-course and the policies, practises, initiatives and interventions of government, business and civil society; and interpreted in light of the actions and interests of other countries that affect those of emerging markets.

This report describes the symposium’s findings on environmental health issues in emerging markets; suggests what government, business and civil society could and should do to manage them; and adds the voice of the EMS to those of scholars, statesmen, business leaders and concerned citizens in emerging markets and elsewhere who have spoken about the need for decisive, bold, radical and courageous action to address them.

¹ ‘Wicked’ problems are complex issues that defy definition and resist final solutions
² The owner of a livery stable in Cambridge (England) who did not allow customers to choose their horses
ENVIRONMENTAL CHANGE

When WHO announced, in March 2016, that almost a quarter of annual global deaths were directly or indirectly attributable to environmental causes, much of the world was shocked.³ Although environment-related deaths are blunt measures, they confirm the fact that changes in natural systems have major impacts on human health; they challenge the notion that improvements in health and longevity can be indefinitely sustained notwithstanding the effects of environmental change; they suggest the extraordinary economic and social progress of the last two centuries has been purchased at exorbitant cost; and support Haines’s judgement that “We… have mortgaged the future in order to sustain our current level of health and development”⁴.

Hazards to planetary health include the direct and indirect effects of climate change, stratospheric ozone depletion, changes in ecosystems due to loss of biodiversity, changes in hydrological systems and supplies of freshwater, ocean contamination, land degradation, urbanization, and challenges to food production. The impact of these changes ranges from primary (e.g. heat stress associated with climate change), to secondary (e.g. the consequences of changing ocean systems), to tertiary (e.g. through social disruption provoked by deteriorating environmental conditions).

Although some aspects of the global environment – air, water and climate – are more damaging than others, every aspect is associated with primary or secondary causes of communicable and/or non-communicable disease (including mental and neurological diseases).⁵

Worldwide, environmental factors are estimated to account for 42% of strokes, 35% of ischemic heart diseases, 57% of diarrhoeal diseases, 35% of lower respiratory diseases and 20% of cancers.⁶ Linkages between environmental factors and diseases include those between:

- Water, sanitation and hygiene and diarrhoeal, intestinal nematode disease, trachoma, schistosomiasis, lymphatic filariasis and protein energy malnutrition;
- Indoor fuel combustion and respiratory and cardio-vascular diseases, COPD⁷ and asthma;
- Second-hand smoke, fires and asthma;
- Air pollution and respiratory infections and cardiovascular diseases;

³ Not least because WHO had published an almost identical figure in 2006 and some people wondered if time had stood still. The second figure would have been higher but for scientific advances.
⁴ Sir Andy Haines, Chairman of the Rockefeller Foundation-Lancet Commission on Planetary Health, reported in Business Insider, July 17, 2013.
⁵ The apparently modest impact of climate change is explained by two things: (i) although there is ample evidence of global warming and of random weather events, the main impact of climate change will occur in the future; and (ii) the health effects of rising temperatures, fresh water deficits and surpluses, higher sea levels, threats to plant and animal species and greater frequency of random catastrophic events are largely indirect.
⁶ WHO (2016).
⁷ Chronic Obstructive Pulmonary Disease.

Once, we thought we could use our wealth and technology to make ourselves independent of nature. Now, we are more dependent on it than ever and recognize we need to protect it in order to survive.

Bhanu Choudhrie, 2017
- Water management and malaria, onchocerciasis, Japanese encephalitis, schistosomiasis and food borne trematode infections and lymphatic filariasis; and

- Housing and Chagas disease, dengue, leishmaniasis and tuberculosis.

These associations feature multi-causal relationships and multi-morbidities. Water pollution, the mismanagement of water resources and inadequate housing are linked to a variety of mainly communicable diseases. Indoor fuel combustion, second-hand smoke and ambient air pollution are linked to a variety of mainly non-communicable diseases. Respiratory infections, malaria, lymphatic filariasis, tuberculosis, cancer, cardio-vascular disease, COPD, asthma and neuropsychiatric disorders have multiple environmental causes.

Changes in environmental health in emerging markets (and everywhere else) are attributable to tensions between environmental change and anticipatory and countervailing developments in preventive and diagnostic medicine. In the recent past, natural, rural and urban environments may have changed faster than at any time in recorded history. Sometimes when science has responded to unforeseen events. Sometimes when science has successfully read environmental tea leaves (e.g. when prophylactic vaccinations prevented epidemic events). The tension can be compared to the race between the hare and the tortoise. Suppose the science that has enabled the world to produce foods, goods and services at increasing rates of productivity at the cost of environmental damage is the hare. Suppose the science that has enabled mankind to deal with its consequences is the tortoise. Which will evolve faster or will they evolve at about the same speed? 

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8 i.e. since the end of the Cretaceous-Paleogenic period 66 million years ago.
9 Aesop, Fables.
AIR

AIR POLLUTION

Because pure air is (almost) transparent, most people take it for granted until stories about fog appear on the inside pages of newspapers, stories about pollution make the front pages and stories about health are headlines.\(^\text{10}\) The one good thing about dirty air from a policy perspective is that, unlike less obvious environmental threats, it gets attention.

Many emerging market cities have become victims of their own success because, as engines of economic growth, they have been plagued by fumes from inefficient transport, manufacturing and power emissions, indoor and outdoor cooking and burning waste. The most critical policy questions are about changing the density and composition of urban transport and addressing the fact that cities generate overwhelming volumes of wastes that directly or indirectly contribute to local, national and global air pollution (as well as water pollution and climate change). As demographic and economic growth has rocketed and industrial and commercial businesses have taken off, household and personal incomes have risen; consumption patterns have changed; car ownership has (in many cases rapidly) increased; discarded packaging has proliferated and national and city governments have found themselves running in place or falling behind.

\(^{10}\) e.g. Winter 2016/17 in northern China.
Household air pollution from solid fuels and ambient particulate matter contributes to disease burdens in emerging markets, primarily in cities. Fuel sources include coal, wood, dung, peat, and refuse, much of it toxic, none of it healthy. The need for ambient heat is a function of latitude, elevation and seasonality but heat for indoor and outdoor cooking is a universal need. Hardware varies with culture, tradition, affordability and attitudes towards technology. New technologies have been developed but, for both cultural and economic reasons, take up has generally been slow.

A recent study (Lelieveld et al (2015)) confirms that whilst cities account for 70% of greenhouse gas emissions (GHG), air pollution is not an exclusively urban phenomenon. Volcanic eruptions in remote locations have worldwide effects. Agricultural emissions, mainly in the form of ammonia from nitrogen-rich fertilizers and animal waste, outweighs other human sources of fine-particulate air pollution in China, India, Russia and other emerging markets. In the last 65 years, worldwide production of artificial fertilizer (about a third nitrogen-based) has risen almost tenfold. The question now is whether global food output can continue to increase without a corresponding rise in rural air pollution. That may happen if urban air pollution can be contained by cuts in industrial, vehicular and power emissions but even if it is contained, excess fertilizers washed off fields could continue to pollute watersheds.

“Although China has been increasingly investing in the production of renewable and cleaner energy, this winter’s severe haze problem sends a strong signal that the pace for replacing dirty energy is not fast enough. If all the efforts were targeted to large industrial facilities whilst leaving numerous small sources unchecked, one could only just sit and wait for Mother Nature’s power to blow away or wash out the dirty stuff pumped into the atmosphere by burning dirty fuels. China’s haze is truly a burning ‘burning issue.’ Every effort should be made to reduce the burning of dirty fuels.”

Junfeng (Jim) Zhang, Fortune January 2017
AIR POLLUTION AND HEALTH

These pollutants combine with nitrogen oxides and sulfates from vehicles, power plants and manufacturing industry to create PM$_{2.5}$. There are particularly high concentrations of PM 2.5 in India and in China where 1.2m annual deaths (compared to 0.1m in the USA) are attributed to air pollution.

On the basis of current trends, urban air quality will become the leading environmental cause of premature mortality by 2050. In 2012, damage to health from poor air quality was valued at about 4% of GDP in the 15 countries that had the highest greenhouse gas emissions.

Fine particulate matter with a diameter equal to or smaller than 2.5 micro-meters that can deposit in the deep lung (alveoli) also includes ultrafine particles (smaller than 0.1 micro-meters in diameter) that can penetrate the lung-blood barrier. PM$_{2.5}$ has long been known as a major cause of ischemic heart disease, stroke, lung infections, low birth weights and black carbon (BC). Recent studies show a link between ultrafine particles and dementia and a link between PM$_{2.5}$ and autism.

The effect of air quality on human health is, in large part, a function of weather conditions that promote or depress the formation, concentration, deposition, dispersion, and transport of pollutants. Changing climates mean changes in the location, timing and intensity of air pollution events. Ground-level ozone, the most noxious constituent of photochemical smog, is associated with a host of health problems and is strongly and positively correlated with temperature and solar radiation, increases in temperature and longer summer seasons that correspond to increases in general ozone concentrations and the number of days when air quality standards are violated. The photochemical processes that generate ozone simultaneously generate secondary ultrafine particulate matter. Moreover, forest fires, which are increasing worldwide and are expected to escalate dramatically, release many particulate air pollutants and toxic gases that affect health.

ANSWERS

Diminution of air pollution in emerging market cities depends on; (i) new and/or improved mass transit systems; (ii) incentives and disincentives that encourage people to use them; (iii) cycling and walking that also captures the health benefits of exercise and reduces traffic injuries; (iv) discouraging the use of diesel vehicles and encouraging the use of electric vehicles; (v) converting urban roads and parking areas to green and public spaces; and (vi) promoting the use of clean fuels and new technologies in the industry and energy sectors.

The use of diesel fuels in some rich countries has been or is now being restricted. However, few emerging markets have followed suit and diesel emissions from buses, trucks and other commercial vehicles (and in cities like Bangkok, waterbuses), have continued to increase, often at dramatic speeds. Conversely, cities in Brazil, China and Colombia (amongst others) have become exemplars of innovations to limit vehicular emissions by controlling traffic volume, building new infrastructure, and investing in low-carbon transit systems.

11 Air pollutants increased, on average, by 34% between 2002 and 2010 in Bangalore and economic losses (98% health-related) from haze in Beijing in January 2013 cost an estimated 23 billion RMB ($3.7 billion).
12 Finely divided particles of elemental carbon created by incomplete combustion of hydrocarbons.
13 Several European countries have announced bans on diesel power vehicles by (or soon after) 2020.
14 Congestion charges were pioneered in Brazil.
15 e.g. Innovative above ground rapid transit systems Medellin, Bogotá (Colombia), Curitiba and Fortaleza (Brazil).
The immediate and longer term benefits of reduced urban air pollution may be huge, particularly in high altitude mega-cities where the problems are most severe and the need for action most urgent. The fact that pollution caused by Black Carbon is short-lived means reducing traffic emissions can yield fast results although vehicular traffic also produces ground-level ozone pollution that takes longer to dissipate.

Fossil fuel fired power stations, gas plants, cement plants, brick kilns, manufacturing industries and incinerators are highly visible sources of urban air pollution in most emerging markets. Most rich countries have reduced or outlawed coal fired energy but progress towards clean(er) energy and industry in emerging markets facing bigger financial, economic and institutional hurdles, has been slow, not least because regulations are widely ignored, enforcement is ineffective, governments are often in two minds about trade-offs, and success stories remain rare.

Whilst problems of urban air pollution demand country and culturally specific solutions, the largest air clean-up effort in history could have implications for other emerging markets. Recognizing the need to improve air quality for the 2008 Beijing Olympics, Chinese authorities planned and executed a comprehensive temporary shut-down of the sources of air pollution in and around the city. Studies showed that improved air quality during the Olympics, compared to before and after the Games, was associated with improved cardio-respiratory health indicators in young and healthy adults. Studies also showed that Beijing women whose 8th month of pregnancy happened to be during the Olympics gave birth to larger babies (by an average of 23g increase in birth weight).

Although air quality conditions reverted to previous levels after the Games ended, experiments have continued, the Air Pollution Control Law was amended in 2015 and strict emission limits with penalties for violators were introduced with the aim of reducing PM_{2.5} concentrations to 20% by 2020. The results are not yet known but the Beijing experiment offers compelling evidence that air quality and environmental health can be quickly improved with political will and effective enforcement.

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16 Particularly in cities (e.g. Bogotá, La Paz, Mexico City, Quito) that are located in high inter-montane basins subject to thermal inversion.

17 Including: Tests to determine whether mechanical ventilation + filtration or natural ventilation + air cleaners did more to improve indoor air quality; and randomized cross-over studies to check the efficiency of face masks.
WATER

Water covers 71% of the earth’s surface. It is essential for human life and health, bio-systems, plant and animal populations, agriculture and industry, feedstuffs and foodstuffs. There is more than enough of it to meet human needs but it is often in the wrong place at the wrong time in the wrong quantities. As a result, water systems in many emerging markets are under stress.

Whereas questions about air are about quality, questions about water are about quality and quantity. Air – good, bad or indifferent, heavy or light – is everywhere. Water may be abundant, scarce or absent. Its spatial distribution and quality shapes human geography. Its presence or absence determines patterns of human settlement. Its seasonal availability constrains agriculture and animal husbandry. And whereas most people think about air only when they can see it, most people think about water only when they can’t.

OCEAN WATER

The cyclical global water system is dominated by oceans. Relationships between human health and ocean health are bi-directional: oceans affect human health and humans affect ocean health. Ocean benefits include seafood, nutraceuticals, pharmaceuticals, agricultural additives, pesticides and fungicides, materials, and the ‘blue gym’ (for exercise and health benefits). However the world’s oceans are polluted by industrial, municipal, agricultural and electronic waste.

Hazards include pathogens, algal toxins, toxic chemicals, plastics and excess nutrients (i.e. agricultural nutrients washed through rivers into oceans). Emerging markets and poorer countries are disproportionately affected by domestic and international deposits of wastes, and by the fact that most of them have limited capacities for safe disposal.

There is growing evidence that low-dose chronic exposure to chemicals and harmful algal blooms has cumulative neurobehavioral effects on developmental processes in vertebrates. Contaminants cycle globally, but may be concentrated in coastal areas. Some agents of bacterial pathogens and viruses are local, others are carried by ocean currents and tides. Vibrios are common causes of gastric, dermal, hepatic, and respiratory diseases. Contamination is transmitted by seafood or direct contact. The effects may be immediate but can lead to chronic conditions. Many species of algal toxins are transmitted by seafood consumption or aerosols. Outcomes include paralysis, seizure, amnesia, diarrhoea, respiratory diseases and death. Sources are generally local but occur worldwide.

Technological solutions to problems caused by algal toxins include environmental sample processors to identify their presence, estimate their abundance, understand their life cycle and predict blooms. A goal is to develop less technologically advanced and cheaper methods that would be particularly useful in emerging markets and poorer countries; methods developed in those countries could also aid richer countries.

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18 An aerosol is a colloid of fine solid particles or liquid droplets, in air or another gas. Aerosols can be natural or artificial. Examples of natural aerosols are fog, forest exudates and geyser steam. Examples of artificial aerosols are haze, dust, particulate air pollutants and smoke.
The impact of chemicals has increased dramatically as science has created or modified them. Morbidities include cancers, endocrine and reproductive diseases, damage to immune systems and a range of neurological diseases. The agents are numerous. Transmission is through seafood or water. In many cases the effects are gradual and may be cumulative or delayed. Harmful Algal Blooms (HAB) and contaminants cycle globally, but may be concentrated in some areas. Temporal trends are evident. Waste disposal can create disproportionate risk for poor countries and for poor communities in emerging markets. Many pollutants are implicated. Some of those that influence neurological and cognitive outcomes in later life (and possibly trans-generationally) are distributed to emerging markets in imported waste. Low dose chronic exposures to chemicals and HABs are common but the long term effects are unknown.\textsuperscript{19}

There is an evident need to balance the risks and benefits of seafood consumption. Technology can provide some answers but limited resilience and institutional capacities in vulnerable – particularly densely concentrated coastal – populations in emerging markets and poor countries, means there are implicit issues of environmental justice.

These issues can only be addressed through global collaboration, particularly between Asia, North America and Europe.\textsuperscript{20} Multi-disciplinary approaches (from physics to epidemiology) are essential. There is scope for public-private partnerships. There is need for effective communications in order to influence strategies to persuade policy makers and the world at large that: (i) action is urgent; (ii) the responsibilities of agencies and governments must be defined; and (iii) new inter-agency partnerships are essential.

**FRESH WATER**

Declining river flows affect farming, industry, energy and rural and urban life in emerging markets. When drought and heat reduce river flows, reservoirs empty and water scarcity hits farms, industries, hydro plants and households. Combinations of drought and rising sea levels allow saltwater to travel inland making water undrinkable and also affect agriculture in coastal regions.

Global demand for water is partly related to population size, although most water is used for industry and agriculture, and relatively little is consumed domestically. In emerging markets most water is used for irrigation, but industrial demand (including power generation) will grow. Aggregate demand in the BRIC countries\textsuperscript{21} alone is expected to rise by 70% between 2015 and 2050.

Water scarcity is a ‘constructed’ problem because problems of scarcity – inadequate access to safe drinking water, groundwater over drafting, overuse and ground water pollution – are functions of economic and political constraints.

\textsuperscript{19} As atmospheric concentrations of CO\textsubscript{2} increase, the surplus is taken up by the oceans, causing acidification. This is turn causes multiple stressors on marine life including the breakdown of coral reefs.

\textsuperscript{20} The Stockholm Convention on Persistent Organic Pollutants (2001) specifies that “developed countries provide technical assistance and capacity building to help developing countries and countries with economies in transition meet their obligations.”

\textsuperscript{21} Brazil, China, India, Russia.
Demand for food will be an important source of demand for water as incomes rise and consumer preferences and capacities shift to superior goods. However SDG 1 (‘End poverty in all its forms everywhere’) cannot be met without changes in production and consumption patterns; energy production will include withdrawals for sugarcane ethanol; and, in the short term, emerging markets will lack sufficient waste water treatment capacity to shift to cyclical water treatment systems.

Those systems must, however, be part of emerging market water management strategies. Linear water systems that use energy to abstract and clean drinking water, and to treat industrial waste-water before returning it to the environment will become increasingly inefficient and ultimately unsustainable. Treated industrial waste water must therefore become drinking water to maximise energy and water efficiency and to promote environmental health in metabolic frameworks.

Most urban populations in most emerging markets now have access to improved water supplies, although, in many cases, reliability, availability and delivery systems (ranging from high pressure pipes to standpipes) remain variable. Access to sewerage is generally lower than access to water and there are larger discrepancies between countries (e.g. 79% Brazil, 64% India, 34% China) and between urban and rural areas.

22 e.g. 2400 litres of water are needed to produce one hamburger but the production process also emits methane which contributes to climate change.

23 This system is used in Namibia, Singapore and Orange County, California.
Fig IV - Improved water source (% of population with access), 1990 and 2015
Improved water source: includes piped water on premises (piped household water connection located inside the user’s dwelling, plot or yard), and other improved drinking water sources (public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection).
Source: EMS 2017 Analytical Framework

Fig V - Improved sanitation facilities (% of population with access), 1990 and 2015.
Improved sanitation: includes flush/pour flush (to piped sewer system, septic tank, pit latrine), ventilated improved pit (VIP) latrine, pit latrine with slab, and composting toilet.
Source: EMS 2017 Analytical Framework
WASTE

Demographics, rising incomes and changing consumer preferences are associated with the growth of domestic and industrial waste. In many emerging markets, as in poorer countries, domestic garbage is augmented by imported waste (sometimes mislabelled 'recyclable material') from richer countries, much of it hazardous.\(^{24}\) Burning waste contributes to toxic air pollution. Other environmental health hazards are derived from exposure to heavy metals from e-waste, radiation, water, soil and food contamination and accidents and injuries to children and adults engaged in waste picking.

CLIMATE CHANGE

Climate change is life or death. It is the new global battlefield. Wangari Maathai\(^ {25} \)

The Global Agreement on Climate Change\(^ {26} \) was anchored in evidence that anthropogenic emissions of greenhouse gases had never been higher; human influence on global climate was unequivocal; climate change had widespread impacts on human and natural systems; and continued emissions of greenhouse gases would cause further warming, long-lasting climate changes and increase the likelihood of severe, pervasive and irreversible impacts on people and ecosystems.

The agreement recognized that:

- Mitigation and adaptation were complementary strategies for reducing and managing the risks of climate change. Short and medium term reductions in greenhouse gas emissions would mitigate their longer term impact, increase prospects for effective adaptation, reduce the costs and challenges of long term mitigation and facilitate sustainable, climate-resilient development.

- Whilst mitigation and adaptation could help address the consequences of climate change, the fact there were no simple solutions means success will depend on comprehensive global strategies, including integrated policies at all levels of governance and linkages between mitigation and adaptation.

Since the 1990s, climate change in emerging markets has been paralleled by demographic, economic, urban and social transitions that have been faster, larger and more challenging than any that have occurred elsewhere. Today, as growing pains continue, most emerging markets are, in varying degrees, eager to learn more about climate change, keenly interested in best-in-class science, open to experimental methods and increasingly committed to action\(^ {27} \).

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\(^ {24} \) The UN Step initiative has identified growing volumes of e-waste being shipped to emerging markets and poorer countries.

\(^ {25} \) See Wangari Maathai, 2009.


\(^ {27} \) Mitigation and adaptation are related. Investment in mitigation can reduce the cost of adaptation in the future. There are long term economic benefits too. However, even if countries completely stop emitting, there is a lag in the system and temperatures will continue to rise. Hence, the need to adopt adaptive measure, along with mitigation efforts.

Ali Naghieh, 2017
After 1990, as emerging markets pursued rapid growth to satisfy the rising expectations of large and increasingly concentrated urban populations, many of them (notably China and India) became major emitters of CO\textsubscript{2}, SO\textsubscript{x}, NO\textsubscript{x}, NH\textsubscript{3}, VOC and CFCs.\textsuperscript{28} None were unaware of the possible consequences, but few, at the time, saw how to reconcile growth and environmental protection. More recently, emerging markets have increasingly understood the economic and social hazards associated with climate change and the fact that, contrary to popular belief, economic growth is compatible with environmental protection.

Fig VI - Change in total greenhouse gas emissions (%), between 1990-2012
Source: EMS 2017 Analytical Framework

Fig VII – India PM2.5 variation over time. 99% of districts above WHO annual exposure guidelines. 60% above National Ambient Air Quality Standards
Source: Urbanemmissions.info

\textsuperscript{28} CO\textsubscript{2} (Carbon Dioxide); SO\textsubscript{x} (Sulphur Oxide); NO\textsubscript{x}, (Nitrogen Oxides); NH\textsubscript{3} (Ammonia); VOC (Volatile Organic Compounds); CFCs (Chlorofluorocarbons).
In the 18 months since the Paris Agreement, three things have become increasingly clear. First, climate change could disproportionately disrupt economic growth in emerging markets and poorer, tropical countries, particularly in South and East Asia. Second, greenhouse gas emissions could hit emerging markets even sooner than had been thought. Third, the impact of climate change on economic growth and human welfare could be even larger than expected.

When the Kyoto Protocol was framed in 1997, the burden of adjustment fell on rich countries because emerging markets and poor countries successfully argued they had not been primarily responsible for historical environmental damage and could not afford to share the burden of adaptation. When the Paris Agreement was framed 18 years later, country responsibilities were assigned on the basis of “nationally determined contributions”.

Clear and credible commitment to ambitious core climate policy instruments by emerging market governments could spur low-carbon innovations and parallel shifts in skill mixes and labour forces. Innovation means: creating new businesses; restructuring or phasing out old ones; promoting nascent technologies and business models; developing support frameworks that allow innovations to be widely adopted; and addressing skill gaps through education, training and labour market policies.

The international trade regime does not stop governments pursuing ambitious climate policies, but international trade barriers can undermine climate objectives. Import tariffs could penalise trade in some of the technologies needed for the transition. The Environmental Goods Agreement, currently being negotiated could reduce mitigation costs. But emerging markets should think carefully about promoting greener growth by favouring domestic manufacturers of low-carbon technologies, because, if such measures restrict international trade, they could undermine overall investment and the uptake of sustainable technologies.

Electricity generation typically accounts for just a fifth of energy consumption, even in rich countries. But because deregulated electricity markets do not deliver the long-term price signals needed for investment in high capital-cost, low-carbon technologies, competitive and timely investment in low-carbon solutions will require new market arrangements such as long-term supply agreements, and robust and stable CO₂ price signals. Jurisdictions with regulated systems that consider introducing more competition must therefore adopt market arrangements that encourage low-carbon investment.

Fossil fuelled transport has very high environmental costs (climate change, noise, air pollution), particularly in cities. Policies must therefore promote energy-efficient and less carbon-intensive transport solutions. Co-ordinated land-use and transport planning at all levels of government must take the fossils out of fuels, build new rapid transit systems and encourage people to use them – or to work from home.

First, there is a massive gap in information, an astonishing lack of knowledge about how we should respond to the negative health effects of climate change.

Second, since the effects of climate change will hit the poor hardest, we have an immense task before us to address the inadequacies of health systems to protect people in countries most at risk.

Third, there is a technology challenge. Technologies do have the potential to help us adapt to changes in climate. But these technologies have to be developed out of greater research investments into climate change science, better understanding about how to deliver those technologies in the field, and a more complete appreciation of the social and cultural dimensions into which those technologies might be implanted.

A fourth challenge is political: creating the conditions for low-carbon living. And finally there is the question of how we adapt our institutions to make climate change the priority it needs to be.

Lancet/UCL Commission on Climate Change 2009

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29 Under the Kyoto Protocol, rich countries were legally obliged to cut greenhouse gas emissions by 5% on 1990 levels by 2008-2012. Emissions in emerging markets and poor countries (which were not then major polluters) were unrestricted but they were encouraged to adopt green growth policies. The exclusion of China and the USA (which did not ratify the Protocol) meant the two largest carbon polluting countries were ultimately not included.

30 Negotiations are being conducted outside the mandate of the Doha Mandate of the WTO.
Climate policy is generally more effective if all departments, branches and levels of government collaborate to identify significant misalignments with low-carbon objectives in their policies, programmes and projects. A climate action plan requires joined-up management and government.

Since 2010, as emerging markets have faced rapidly increasing demands for clean power, investments in wind, solar, geothermal and hydro generation have grown quickly and some emerging markets have led richer countries in renewable energy investments: Brazil has unveiled a 10 year plan to replace new fossil fuel plants with biomass and wind power; India has announced an additional 35 GW of renewable power by 2015; China, outspending the world on renewable energy, has installed 15.9 GW of onshore turbines (more than a third of new worldwide capacity); Thailand has established a green energy target of 20% by 2020; Jordan has set a target of 10% and Argentina introduced new policies emphasizing renewables in 2014.

National leaders in Beijing, Delhi and other major emerging market capitals that also happen to be large cities, are well aware of the consequences of climate change. They are also increasingly aware that some emerging markets could lead the world in climate mitigation and adaptation. They have expertise in change management. They have explored the benefits of sufficiency and circularity. They are under intense pressure from vocal, informed and committed young people concerned about the implications of environmental change for health, education and employability. They (and some nearly-but-not-quite emerging markets) are on the bleeding edge of environmental change. And in the absence of firm leadership from the US and the EU, some are asking ‘if not us who…?’

If they are to lead effectively, emerging markets will need to scale up sustainable low-carbon investment and finance by ensuring new infrastructure investment supports the climate agenda whilst fostering growth. The short-term costs of shifting to low carbon would be a fraction of the finance needed for infrastructure overall. There is no shortage of capital, but new sources of financing are needed. Financial stability is a prerequisite to any kind of investment, including low-carbon but it is important to evaluate the potential unintended impact of financial sector rules (accounting, prudential, market) on the supply of long-term finance. Public finance and investment can also catalyse the low-carbon transition. Governments need to reconsider their support for investments in greenhouse gas-intensive activities and mainstream climate objectives into public procurement and official development assistance. Emerging market governments should also seek opportunities to eliminate subsidies and tax expenditures that favour fossil fuels, taxes and tax provisions (property taxes, corporate income tax provisions) that encourage carbon-intensive choices whilst anticipating the revenue impact of transition to a low-carbon economy.

31 Thailand advertises itself as a ‘sufficiency economy’, Bhutan talks of ‘gross national happiness’ and China has embedded a new narrative of ‘ecological happiness’ in public policy and in its Five-Year Plan.
32 Following the lead of rich countries (Denmark, Japan, Netherlands, Scotland, Sweden) China has embraced and Brazil is considering the virtues of circular economies.
33 e.g. Kenya is committed to generating at least 75% of its electricity from renewables by 2030.
LAND USE AND ABUSE

The symposium focused on three aspects of rural environments that, directly or indirectly, are associated with environmental health in emerging markets: biodiversity; soil erosion; and nutrition.

Sustainable land-management that curbs deforestation, restores degraded land, protects wetlands, promotes low-carbon agricultural practices and increases carbon sequestration in soils and forests can reduce emissions whilst responding to growing food demands. It also improves resilience to climate change by protecting ecosystems and consequently maintains biodiversity. But sustainable land-management requires an integrated approach that breaks down silos between mitigation, adaptation, agriculture, food security, forestry, wildlife and environment policies. Emerging markets, like other countries, could pursue efforts to remove environmentally harmful agricultural subsidies, value ecosystem services, protect forests and minimise food waste.

BIODIVERSITY

The world-at-large may be less aware of the implications of human interference in ecosystems than those of climate change and air and water pollution. Emerging markets need science-based frameworks, laws, rules and sanctions that protect ecosystems (particularly if regulations can be readily ignored, avoided or circumvented).

Because there are missing links between what laws say and the public-at-large understands, and because responsible environmental behaviour must be grounded in environmental enlightenment, there are also urgent needs for better evidence-based communications and for programmes to educate children and adults. Scientists must acquire skills to get their messages across, be bolder in what they say, put more emphasis on disseminating e-knowledge, and devote more energy to engaging with communities.

There are urgent needs for more research, not least because science must deal with the fact that only two million species are fully known; it does not know everything it needs to know about actual and potential interactions; and it cannot be sure about the implications of human interventions in natural systems if it does not fully understand them.

Science must also recognize the need for interdisciplinary research on such topics as: the impact of dietary changes on land and water use; the need to consider diet in the context of larger biodiversity systems; whether the use of antibiotics on humans, animals and plants leads to resistance; whether, (if the paradigm for large-scale mechanized commercialized farming is mono-cropping), technology can be used to develop labour-intensive, technology-dependent farming systems; if meat is a driver of climate change and the first 1000 days of life require animal protein whether there are alternatives to meat in emerging markets. (Klein 2003).

Successful conservation demands the creation of habitat corridors (for honey bees and wild bees) as integral parts of land management. In emerging markets there are few financial incentives or compensation schemes to support bee habitat corridors and balance the trades-off between conservation and agricultural production.

Bees and Agriculture

The loss of 58% of the world's bee population has immense negative effects on plant reproduction. Pollination is needed for 70% of the plant population, 35% of which are food crops. Fruits and vegetables such as apples, watermelons and almonds are highly dependent (and Brazil nuts obligatorily dependent) on bee pollination. In Indonesia for example, there is a strong positive correlation between the fruit set of coffee and the number of bee species. (Klein 2003).

The decline in bee populations has been driven by the loss of natural habitat and increased mortality attributable to pesticide use and (in Europe) the importation of diseased foreign bee populations.

Successful conservation demands the creation of habitat corridors (for honey bees and wild bees) as integral parts of land management. In emerging markets there are few financial incentives or compensation schemes to support bee habitat corridors and balance the trades-off between conservation and agricultural production.

Catherine Gresty 2016

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34 I.e. The variability within and between species among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. Convention on Biological Diversity (1992).

35 Some harmful interventions, even if permitted, are serious offenses. Consider possible distinctions between a smallholder who burns trees and scrub to clear land in Thailand for subsistence agriculture, a commercial enterprise that (with the necessary permits), clear-cuts an Amazon forest, and a community of small farmers who did what the individual smallholder did? It can be asked if motives matter if the result is similar?

36 The International Union of Forest Research Organizations includes 15,000 scientists in 700 institutions who form collaborative research groups.

37 Seckbach and Dubinsky (2011).
market diets; the implications of the potential loss of traditional herding for emerging market agriculture and soil nutrition; and how interdisciplinary research on biodiversity can be incentivised.

**SOIL DEGRADATION, PRODUCTIVITY AND POVERTY**

Land degradation in emerging markets has more to do with population growth and migration, poverty, politics and socio-economic factors than with changes in rain, wind or other aspects of climate. Yet nothing has shaped the face of the earth more than the expansion and intensification of agriculture as a driving force in the decline of biodiversity and the source of 40% of greenhouse gas emissions. Like biodiversity, soil erosion is a neglected aspect of environmental change: partly because there is a paucity of data; and partly because soil science has not been well-explained to the public.

Although soil degradation encompasses acidification and salinization, its most important aspect is the erosion of upper layers of soil where nutrients are concentrated and captured. As a rule of thumb, soil erosion reduces crop yields by 4% for every 10cm of erosion which helps explain disparities in yields between rich countries and emerging markets.

Soil degradation is also influenced by fiscal policies. For example, in South Africa in the 1930s and 40s, widespread erosion was encouraged by tax regimes that promoted wheat cultivation on steep slopes. That issue continues. First, because agriculture and the environment rank low on Government priorities despite high levels of poverty and food insecurity. Second, because a growing water crisis is linked to the facts that: 98% of South Africa’s water is allocated; the last river without a dam will soon have one; and reservoirs fail when sediment accumulates. Third, South African agriculture is highly sensitive to climate change which means investment in adaptation is vital, particularly because it will impact small farms more than large ones (80% of smallholder crops are rain fed) and the impact on the poor will be disproportionate. Fourth, because crop advisory services have been withdrawn but farmers desperately need advice on supporting ecosystems and conserving biodiversity.

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38 See Food Production (page 55).
39 Chivian and Bernstein (2008).
40 The only comprehensive global data base on soil degradation is more than 25 years old.
41 Allowing for poor global data it is estimated that 2014 cereal yields ranged from 7.7 t/ha in the United Kingdom to 5.8 in China, to 4.3 in South Africa to 2.9 in India.
42 In 1936 General Smuts observed land degradation was an even bigger issue than politics.
FOOD PRODUCTION

Having reached a low of around 830 million in the 1990s, the number of people suffering from protein-calorie malnutrition worldwide in 2009 exceeded 1 billion. Malnutrition is a factor in roughly one-third of morbidities in poor countries and in poor communities in emerging markets. Between two and three billion people (almost half the human population) suffer from micronutrient deficiencies.

Whilst previous EMS symposia considered indirect links between agricultural production, food security, nutrition, cognitive and physical development, lifetime health and well-being, productivity and longevity, they did not consider relationships between nutrition and environmental health or the contribution of livestock farming to greenhouse gas and toxic chemical emissions.

Producing, processing and distributing meat involves pesticides, fertilizer, fuel, feed and water, and accounts for up to 40 times more toxic gas emissions (including nitrous oxide and methane) than vegetables or grains. Nearly 80% of deforestation in emerging markets in South America is linked to the development of cattle farming in the Amazon Basin. Traditional methods prevail but concentrated feed operations that produce vast quantities of sewage waste (and derived health hazards) and other technology-intensive techniques are gaining favour. The increasing use of antibiotics has also led to the development of antibiotic-resistant strains of bacteria that threaten human health and the environment in their own right.

Over-consumption of beef and lamb is a personal health hazard but in terms of environmental health, the important fact is that demand is income-elastic. Between 1971 and 2010, whilst the global population grew by 81 percent, meat production tripled. If global meat production doubles by 2050, pressure on the environment and environmental will increase disproportionately.

The threats can be partially mitigated by soil carbon sequestration but there are significant (implementation and management) costs. Other solutions could include improved feedstock production, waste reduction, improved manure management and changes in human diets, including switches to less “climate-harmful” meats, which as the United Nations Environment Programme (UNEP) points out, could mean that “what’s good for people could be good for the planet”.

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44 Lifecycle analysis by the Environmental Working Group (EWG) that took into account the production and distribution of 20 common agricultural products.
45 Over-consumption has been linked to increasing rates of heart disease, bowel cancer and obesity.
47 Although pigs are more dependent on grains.
48 UNEP (2012).
A healthy person has a thousand wishes, but a sick person has only one

Because there is a common tendency to conflate climate change and environmental change, it is sometimes thought climate change is the direct or proximate cause of (all or most) environment-related morbidity and mortality in emerging markets. But other factors, particularly polluted air and water, play larger direct roles.

The direct impact of climate change, mainly through the effects of heat, cold, changing hydrological cycles, floods, extreme weather events, increased ground-level ozone, enhanced pollen production, fires and radiation is nonetheless significant. Rising temperatures are associated with respiratory diseases, dehydration, hyperthermia, renal diseases and cerebrovascular infections; cold temperatures are associated with cardiovascular, respiratory and multiple cerebrovascular diseases; floods are associated with cardiovascular accidents, drowning, electrocution and physical and psychological trauma; wildfires are associated with death and physical and psychological trauma; radiation is associated with cancer.

Myers and Bernstein argue that, “in terms of human suffering”, the indirect impacts may be orders of magnitude more important than direct impacts. Disrupted climate systems and high concentrations of PM$_{2.5}$ are associated with cancers, cardiovascular, respiratory and other non-communicable diseases, seasonal allergen distributions, infectious disease vector distributions, water-borne disease outbreaks, food-borne disease outbreaks, decreased food security, poor air quality and neuro-inflammation linked to neuro-degenerative (Parkinson’s, Amyotrophic Lateral Sclerosis, dementia) and psychiatric disorders. The authors add that:

- In recent decades, Spring has come earlier and Autumn has ended later in the Northern Hemisphere, increasing the length of the allergy season in emerging markets that are wholly or partly in it; changing distributions of plants and moulds are spreading allergens into new areas; and fertilizing allergen-rich species (e.g. ragweed) with high CO$_2$ concentrations.

- Disease vectors, such as mosquitos and ticks, are moving into new areas as warmer, wetter climates push poleward and upslope. For example, the spread of malaria and dengue fever is thought to be at least partly due to mosquitos expanding their range with changing climates. Rodents are also changing their distributions in response to climate and diseases borne by their fleas are on the move in some emerging markets in Europe.

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49 Indian proverb.
50 Myers and Bernstein (2011).
51 But are neither causes nor consequences of concentrations of CO$_2$, SO$_x$, NO$_x$, CO, VOC, CFCs or NH$_3$ that directly contribute to climate change.
52 Ultrafine PM (less than 1 micron) not measured in air pollution studies, are particularly ominous. These particulates have been shown to cross the nasal mucosa via the olfactory nerve, facilitating direct entry into brain tissue.
Climate change is causing more intense yet more variable rainfall in many parts of the world and drought in others. Water-borne illness is a growing problem in areas with extreme changes. Cholera, cryptosporidiosis, and several other diseases spread by fecal contamination of water supplies are often closely associated with floods and heavy downpours. Drought can concentrate disease pathogens in pools and low river flows.53

Several foodborne pathogens are spreading as a result of climate change. Drought and excess moisture encourage crop pests and spread moulds. Climate-driven rusts, blights, and rots are devastating already stressed crops and thereby indirectly affecting human health through decreased food security which is, and will continue to be, one of the major indirect consequences of climate change. Starvation kills and malnutrition weakens the poorest, youngest and oldest populations (mainly in Sub-Saharan Africa, but also in some emerging markets in Asia).

These issues will be accentuated by future climate change. Allergens will spread in time and space; disease vectors will expand their ranges; water-borne diseases will spread as floods and intense rainfall events increase; food-borne diseases will get worse in emerging markets as places get wetter or drier; food security is likely to deteriorate; and air quality will degrade as temperatures rise and forest fires spread.

The distinguishing features of environmental health in emerging markets are that:

- The challenges are evolving faster than in most other countries
- Some problems of environmental health in emerging markets are derived from rich countries.54,55
- Some aspects of environmental health in emerging markets are not well understood including zoonotic diseases (e.g. animal derived viruses such as Nippah, Zika, Ebola) as 75% of human infectious agents are derived from animal sources.
- Environmental health in emerging markets reflects welfare disparities, skewed distributions of wealth and incomes, limited economic opportunities and disadvantaged access to health, education, infrastructure, housing and services.
- Environmental health conditions between and within emerging markets vary enormously and in some cases are worse than in poor countries.
- Response capacity is weaker than in richer countries because institutions are generally less established, skills and technical knowledge less available and funds scarcer.
- Political environments, especially at local levels, may not be amenable to decisive action because there is intense competition for leadership attention and less interest in long term problems.

53 Significant changes in rainfall are also associated with a rise in aggression – true for all regions and ethnicities of the world. See Raj, Ajai (2014).
54 For example, huge volumes of rich-world waste from Europe and North America is legally or illegally added to domestic waste that grows as incomes and access to consumer goods in emerging markets (and poorer countries) rise. Waste dumps, including imported refuse, have a direct impact on the health of people living near them.
55 (e.g. in Nairobi waste dumps, blood serum Cd levels in children are 3-15 times the WHO limits). The 2015 film Trash is a story of the lives of trash pickers in Rio de Janeiro.

For Whom the Bell Tolls
In light of growing recognition that the global health consequences of local actions are aspects of globalization, Donne’s advice – “… never send to know for whom the bell tolls; it tolls for thee” – means that whilst damage to natural systems may not affect decision-makers or their families, friends or neighbours, it may affect human health on the far side of the world: Noxious waste from Spain poisons a child scavenger in Pakistan; an oil spill in China kills fish in Alaska; a zoonotic disease from North Africa infects an Italian mother; organic and inorganic waste dumped in the Upper Mekong causes an epidemic in Vietnam.
COMPARISONS

Problems of environmental health in emerging markets (nationally but not in all cases locally) are increasingly like those of richer countries and (in many cases locally but not in all cases nationally) increasingly unlike those of poorer countries.

The main differences between emerging markets and richer countries are the relative faster speeds at which emerging market disease profiles are evolving, the relatively larger scale of consequent challenges and the relative paucity of financial, human and institutional resources to manage them.

The main differences between emerging markets and poorer countries: are that, by virtue of their relatively greater financial, human and institutional resources, emerging markets are better equipped to anticipate and manage environmental threats.

In fact, some emerging markets are better equipped to anticipate, calibrate and respond to problems of environmental health than any other country group because, since the 1970s, they have had to manage tumultuous demographic, economic, social, cultural and political change. They have made change management their stock in trade and, in light of this experience, are nimble, faster and generally more open to new ideas, more inclined to experiment, more likely to take risks (e.g. India and Pakistan have played leading roles in the adaptation and adoption of digital economies) and less encrusted by tradition, rules, conventions, standards, norms and procedures than countries that are more set in their ways. These differences constitute a comparative advantage for emerging markets and help explain why some of them are now playing leading roles in global adaptation to environmental change. Those contrasts are borne out by comparisons between emerging markets, poor countries and rich countries. Environment-related deaths and Disability Adjusted Life Years (DALYs) (as proportions of all deaths and DALYs) in emerging markets ranged from 30% (deaths) and 25% (DALYs) in India, to 30% and 26% in China, 15% and 16% in Brazil and 12% and 13% in Chile. The average figures for poor and rich countries were 23% and 23% and 11% and 13% respectively. Other highlights:

- Deaths attributable to ambient air pollution range from 110 per 100,000 in Russia to 89 in Pakistan and 22 in Jordan as compared with 80 in poor countries and 16 in rich countries.
- Deaths attributable to water and sanitation range from 0.3 per 100,000 in China, to 1.2 in Peru, to 4.9 in Philippines to 7.1 in India to 23 in poor countries.\(^\text{56}\)
- Mortality attributable to household and ambient air pollution range from 163 ppm in China to 130 ppm in India to 110 ppm in poor countries. The corresponding figure for rich countries is under 25 ppm.
- CO\(_2\) emissions (primarily associated with non-communicable diseases) ranged from 0.3 per 100,000 in Tunisia, to 8 in Malaysia, to 12.5 in Russia, compared with 0.3 in poor countries and 10.9 in rich countries.
- Access to water supply ranged from 36% of the population in India to 59% in Indonesia and 65% in Peru. The figure for poor countries is 12% and for rich countries and a significant number of emerging markets (e.g. Argentina, Egypt, Poland), 100%.

\(^{56}\) None recorded in rich countries.
Fig VIII - Deaths and disability-adjusted life years (DALYs) attributable to the environment (% of total deaths or DALYs), 2012. (Dashed line: global average)
Source: EMS 2017 Analytical Framework

Fig IX - Deaths attributable to the environment (per 100,000 population), 2012
Source: EMS 2017 Analytical Framework

Fig X - Water, sanitation and hygiene attributable deaths (per 100,000 population), 2012
Source: EMS 2017 Analytical Framework
There are also contrasts between the financial, human, administrative and institutional capabilities of emerging markets to address environmental threats to health and – for as long as those threats exist – to provide preventative and remedial healthcare. National averages mask urban-rural and regional differences which, whilst by no means uniform, generally favour urban over rural communities and primate cities over others.

57 i.e. A national system of cities dominated by one (primate) city. Many emerging markets have skewed urban systems.
Environmental Health in Emerging Markets – Report

<table>
<thead>
<tr>
<th>Disease or injury</th>
<th>Environmental risk factor</th>
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<tr>
<td>Infectious and parasitic diseases</td>
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<td>Respiratory infections</td>
<td>Water, sanitation and hygiene</td>
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<td>Diarrhoeal diseases</td>
<td>Indoor fuel combustion</td>
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<td>Intestinal nematode infections</td>
<td>Second-hand tobacco smoke</td>
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<td>Malaria</td>
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<td>Trachoma</td>
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<td>Schistosomiasis</td>
<td>Other housing risks</td>
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<td>Chagas disease</td>
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<td>Lymphatic filariasis</td>
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<td>Onchocerciasis</td>
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<td>Leishmaniasis</td>
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<td>Dengue</td>
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<td>Japanese encephalitis</td>
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<td>Noncommunicable diseases</td>
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<td>Cancers</td>
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<td>Neuropsychiatric disorders</td>
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<td>Cardiovascular diseases</td>
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<td>Chronic obstructive pulmonary disease</td>
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<td>Asthma</td>
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<td>Other respiratory diseases</td>
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<td>Chronic kidney diseases</td>
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<td>Congenital anomalies</td>
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<td>Violence</td>
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<td>Self-harm</td>
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Notes: *Limited to industrial and agricultural chemicals and chemicals involved in acute poisonings.*

Fig XIII - Indicative linkages between environmental risk factor and disease or injury
The environmental population attributable fractions are indicative values, based on CRA or expert opinion. The ranges of the population attributable fractions are: ● &lt; 5%; ● 5–25%; ● &gt; 25%.
CRA: comparative risk assessment. Population attributable fraction: “the proportional reduction in death or disease that would occur if exposure to a risk were removed or reduced to an alternative (or counterfactual) exposure distribution”
Source: Reprinted with permission from World Health Organisation: “Preventing disease through healthy environments”, 2016 publication.
COMMUNICABLE AND NEGLECTED TROPICAL DISEASES

Environmental change affects health directly (e.g. through increased temperatures, deforestation, urbanization, fires and floods), indirectly (e.g. as consequences of the loss of livelihoods) and through ecosystem mediation (e.g. reduced food yields). Although the precise effects of the environment on human-microbe interactions are not well known, it is known that environmental changes are affecting new infections, re-emergent infections (e.g. tuberculosis) and emerging infections (e.g. SARS, Avian Flu, Nipah).

Re-emerging and emerging infections are concentrated in emerging markets and poorer countries. They are strongly associated with socio-economic factors. Their impact is often rapid and unpredictable and outpaces the response capacities of fragile health systems. Recent epidemics in the Mekong Valley, Brazil and Mexico were closely linked to changes in the agriculture-environment nexus, deforestation, conflict, population growth, urbanization and migration. Antimicrobial resistance is an important emergent problem. New infections that are likely to emerge in Africa, Asia and Latin America are major threats. Ebola was associated with multiple factors – weak or non-existent health systems, with no surveillance capacity, social factors specific to the area and the failure of WHO to respond appropriately.

Neglected tropical diseases (NTDs), recently described as a "chronic pandemic", are strongly affected by climate change, strongly associated with extreme poverty and strongly concentrated in the poorest emerging markets populations, particularly in India, China and Pakistan.

Current healthcare systems in affected emerging markets have the capacity to deal with NTDs and to anticipate potential threats (e.g. from the Aedes mosquito) but are not regarded as a priority despite the availability of donated drugs, historic successes in control and evidence that interventions are cost effective. Evidence shows successful interventions to control and eliminate NTDs are possible and some NTDs have been eliminated in several settings in recent years.

It is difficult to deliver effective care to patients inflicted with communicable diseases without reliable diagnostics (e.g. malaria is largely diagnosed symptomatically but more than 50% of all cases are misdiagnosed). There is thus an urgent need to improve access to competent, quality assured laboratory and pathology services in emerging markets that have too few technicians and pathologists to cope with demand and provide suboptimal standards of care resulting in misdiagnoses, prolonged illnesses, avoidable suffering and economic waste.

In the last year WHO has started to design recommendations on laboratory systems that if implemented, would help reduce delays in surveying for and managing future epidemics, many of which are vector borne and rainfall driven. Aedes aegypti had been almost controlled in some urban areas but, mainly in emerging markets, is re-emerging as a function of increased urbanisation and the increase in larval breeding sites such as containers and used tyres which contain clean water – the necessary oviposition sites for Aedes.

58 Antimicrobial resistance (AMR) is the ability of a micro-organism (bacteria, viruses, and some parasites) to stop an antimicrobial (antibiotics, antivirals, antimalarials) from working against it.
61 e.g. only 1% of laboratories in India are accredited.
NON-COMMUNICABLE DISEASES

As emerging market economies grow, lifestyles change and disease patterns increasingly resemble those of richer countries. The symposium focussed on cancers, cardio-vascular, respiratory and mental and neurological diseases and disorders.

Fig XIV - Mortality attributable to non-communicable diseases (per 100,000 population), 2012
Source: EMS 2017 Analytical Framework
CANCER

Cancer is a leading cause of death in BRIC countries and other emerging markets. Links between breast cancer (the most common form of female cancer in Brazil and China) and exposures to environmental chemicals that mimic estrogen and contaminants such as alkylphenols have been posited but not proved.62 Prostate cancer, the world’s second most common cancer in men, accounts for 12% of cancer morbidities and 19% of cancer-related male deaths in BRIC countries. Research on links between the environment and other cancers is inconclusive. Because many cancers can be prevented through lifestyle changes there is some resistance to interventions. In emerging markets, as in rich countries, there is continuing debate about the environmental causes of cancer. Many scientists believe existing data63 should be revised to take account of life-style and other differences between emerging markets and richer countries such as high levels of (smoking related) lung cancer and (aflatoxin related) liver cancer in China.

CARDIOVASCULAR DISEASES

The heart and vascular system are vulnerable to ambient air pollution, arsenic, cadmium, lead and heat. Like traditional risk factors (e.g. smoking and diabetes mellitus), these exposures cause disease and mortality by augmenting or initiating pathophysiological processes, including blood-pressure control, carbohydrate and lipid metabolism, vascular function and atherogenesis. Although highly polluted areas are associated with high cardiovascular risks, adverse effects occur at levels below current regulatory standards in most emerging markets and even modest risks can have substantial health effects. Clinical and public-health strategies aimed at reducing environmental exposures from current levels could substantially reduce related deaths and disabilities. Some cardiovascular health impacts of air pollution (e.g. vascular inflammation) may be reversible but plaque formation is not.

Although, historically, the adverse effects of air pollution have focused on respiratory health, it now accounts for a majority of deaths from cardiovascular diseases worldwide. These effects (including inflammation, hypertension, atherosclerosis, vascular function leading to heart failure, ischemic heart disease and arrhythmias) are mediated by metals (lead, arsenic, cadmium). They occur at multiple levels (molecular, sub-clinical, clinical) and may be inter-generational and/or exacerbated by pre-natal and early life exposure.64

Continuous moderate exposure to polluted air is more damaging than sporadic high exposure (stroke-risk doubles and the risk of ischemic heart disease is 1.5 times higher at annual levels of exposure in Delhi or Beijing). Substantial and sustained reductions in exposure would be needed to significantly reduce the health burden.

Heat exposure through water loss, dehydration, hyper viscosity, thrombosis, ischemic stroke, increased core temperature, vascular endothelium injury and cardiovascular dysfunction also contribute to heart diseases, particularly in equatorial latitudes in emerging markets.

62 Other suspected contaminants include bisphenol A (BPA), parabens, perfluoralkyl substances (PFASs), phthalates, polybrominated diphenyl ethers (PBDEs), synthetic musks and triclosan.

63 See Doll and Peto (1976).

64 Some parts of the Indo-Gangetic have groundwater arsenic levels greater than five times the WHO safe guidelines. Phasing out lead from gasoline was major public health success in the 20th century but emerging markets now need to focus on informal lead recycling and lead in paints.
RESPIRATORY DISEASES

Environmental risk factors for respiratory health in emerging markets include air pollution, active and passive smoking and obesity. The respiratory health-impacts of heat exposure resemble those of moderate air pollution on cardiovascular health (i.e. long term exposure to moderate air pollution has a larger impact than sporadic exposure to high levels of pollution). Socioeconomic factors (e.g. access to effective masks and air filters) are, in principle, easy to measure but systematic measurement is uncommon. Primary sources of air pollution (e.g. vehicular emissions, coal burning, construction dust) vary geographically and by country. Air pollution traverses boundaries (e.g. haze in Singapore originates from burning in surrounding countries).

MENTAL/NEUROLOGICAL DISEASES

There is growing pressure on WHO to call a public health crisis on the impact of the environment on mental health. But that is unlikely to happen in the absence of evidence-based analysis of links between environmental change and mental and neurological disease, particularly in poor emerging market communities. Demand for evidence is driven as much by the need for credible data as by the need to plan, design and eventually evaluate realistic interventions and by the fact that mental and neurological diseases and disorders often result in disability rather than mortality.

Debate about links between climate change (higher temperatures, rising sea levels and catastrophic weather events), stress and mental and neurological illness continues. It is hypothesized that: (i) these impacts will be increasingly apparent, profound and geographically differentiated; (ii) national, regional and political differences will intensify; (iii) self-interest will dominate; and (iv) future international agreements on climate change will become more elusive.

![Fig XV - Population living in areas where elevation is below 5 meters (% of total population), 2010](source: EMS 2017 Analytical Framework)
It is nonetheless clear that coastal threats menace very large and mostly poor populations in emerging markets (e.g. India, Malaysia, Thailand) and poorer countries (e.g. Bangladesh). More than a third of the world population lives on small islands and in areas within 100 km of an ocean and less than 50 m above sea level. The combination of sea-level rise, increasingly intense storms, and the destruction of coastal barriers (mangroves, wetlands, vegetated dunes, and coral reefs) leaves these populations extremely exposed. By 2050 it is estimated that between 200 million and one billion people may be displaced by climate change, many of them in emerging markets (mainly in East and South Asia) although some of the biophysical changes that may contribute to displacement are hard to quantify.

Massive urbanization in some emerging markets has been associated with disrupted personal relationships, financial insecurity and difficulties of acculturation, often resulting in cognitive dysfunction, emotional illness and neurological disease. For migrants and natives alike, life on the physical, social and economic margins of cities and megacities is harsh, most visibly in the slums of China (191 million) and India (90 million). By one estimate, as much as 10% of the mental health burden in emerging markets is attributable to poor urban housing and sanitation, noxious air, noise and physical insecurity that create optimal conditions for mental illness in places where help is rarely available. More and better data and more and better studies of mental health issues based on them are needed. As are ex-post analyses of the mental health benefits of: (i) slum upgrading, sites and services and other interventions; (ii) recreational and green spaces and common areas within cities; (iii) improved housing standards; and (iv) lessons that can be learned from such initiatives as the “half house” programme in Chile (see page 70).

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**Fig XVI – Urban population living in slums (% of urban population), 1990 - 2014**

*Source: EMS 2017 Analytical Framework*

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65 e.g. in Dhaka. See Khan et al. (2013).
Research suggests that: (i) rising temperatures may be associated with public trauma, aggression, depression, violence, alienation, substance abuse, suicide, psychotic episodes and post-traumatic stress disorders; (ii) relationships between higher temperatures and aggression are linear; and (iii) global warming will make matters worse because the production of adrenaline (the key substance fueling “fight or flight” mechanisms) increases as temperatures rise.

Other evidence suggests that urban and rural air pollution damages the central nervous system and may increase the incidence of dementia and other neurological diseases. Exposure to carbon particles has long been known (from experiments on animals) to provoke inflammation of the central nervous system. A recent study has identified an increased incidence of dementia among people living near busy roads. Chaotic traffic, unregulated noise and high levels of air pollution in emerging market cities have comparable, if not more serious, effects.

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67 The heat hypothesis states that hot temperatures can increase aggressive motives and behaviors. Although alternative explanations occasionally account for some portion of the observed increases in aggression when temperatures are high, none are sufficient to account for most such heat effects. Hot temperatures increase aggression by directly increasing feelings of hostility and indirectly increasing aggressive thoughts. Results show that global warming trends may well increase violent crime rates. Better climate controls in many institutional settings (e.g., prisons, schools, the workplace) may reduce aggression-related problems in those settings, Anderson, C.A. (2001).
BUSINESS PERSPECTIVES

Since the 1980s, effective policies and public and private investment have allowed hundreds of millions of people in emerging markets to abandon pasts of relative deprivation and embrace futures of relative prosperity. But the economic growth that has enabled social development has often come at the expense of environmental damage and to the detriment of environmental health. Market, policy and institutional failures in many emerging markets have led to inefficient and wasteful uses of natural capital, neglect of the social costs of resource depletion and failures to reinvest in other forms of wealth. These failures threaten sustainable growth. The values and priorities embedded in these behaviours are reflected in the World Bank's posture on the environmental impact of an urban development project in the 1980s (see BOX p69).

The world and the World Bank have come a long way since the 1980s. The jury is still out on the Environmental Kuznets Curve but a more recent World Bank report proposes that inclusive green growth strategies must (i) fit country priorities, and circumstances (including institutional capacity, transparency and accountability); (ii) promote efficient and sustainable decision-making by policymakers, consumers, and the private sector; (iii) feature pollution charges and other market-based instruments that incentivize efficiency and spur innovation, and (iv) meet up-front capital requirements by using innovative financing tools to encourage private green investment, private-public partnerships and increase access to financing for small and medium enterprises.

The report cautions, however, that: (i) whilst “green growth is good growth”, green growth policies “are not panaceas for structural shortcomings”; (ii) environmental measures cannot offset macroeconomic instability, distorted labor markets, poorly regulated financial systems, or hostile business environments; (iii) the ultimate choice is either to do nothing in the short term and accept catastrophic long run implications or accept slower short term growth to avoid brutal long term outcomes and (iv) there is a strong incentive to start now.

Emerging market (domestic and multinational) enterprises in the agricultural, animal husbandry, mining, manufacturing and (some) service sectors are major (and often sole) sources of air, water and ocean pollution, degraded soils and biodiversity, climate change and consequent environment-related diseases.

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69 Which posits that as national incomes rise environmental degradation diminishes.
70 World Bank (2012).
71 The report suggests that “An array of complementary approaches will be needed to nudge individuals toward better behaviors and to unleash the power of the private sector... Natural assets should be systematically incorporated into national accounts. The UN Statistical Commission adopted the System of Environmental and Economic Accounting as an international standard in February 2012, providing a broadly agreed methodology. Neglecting natural capital, like neglecting human and physical capital, is bad economics and bad for growth.”
Changes in business attitudes, priorities and practises are therefore essential to improved environmental health. Openness to innovation and exposure to environment-related diseases, may give emerging market businesses an edge over rich and poor country competitors. However, those advantages are offset by (i) relative weaknesses in corporate governance, (ii) regulatory regimes, (iii) enforcement capacity, and (iv) negative attitudes towards private business in light of perceived crony capitalism and corruption. Outcomes are also tempered by the fact that business opinion is split as to whether domestic and/or global businesses can or should play leading roles in addressing environmental issues in emerging markets.

Some argue that social responsibility rests with society rather than business and that private enterprises should pursue their interests as legal entities\textsuperscript{72} Others believe social responsibility is an opportunity rather than a cost and that firms should: (i) create shared value by acknowledging the social consequences of their actions; (ii) recover products and markets; (iii) redefine productivity within the value chain; and (iv) build supportive clusters.

It is also argued that: (i) corporate growth and social welfare are not a zero-sum game; (ii) businesses and governments should have the same long-term objectives as society; (iii) firms do well by doing good (citing clear evidence of better financial performance and better access to capital); and that (iv) sustainability enhances firms’ differentiation and competitiveness.\textsuperscript{73} There is evidence that companies that take a long view and adopt environmentally sustainable business practises have better long-run performance.

The implications of these contrasting views are illustrated by the facts that: (i) half the Chinese companies in a recent survey\textsuperscript{74} had never heard of corporate social responsibility (CSR) whilst other respondents thought it simply meant following laws and conventions by operating in good faith, creating employment and using natural capital responsibly; and (ii) a survey of Chinese MBA students suggests the current generation is committed to environmental protection.

Other obstacles, that vary from one emerging market to another, include: severe restrictions on land resettlement and acquisition; complex bureaucratic and legislative procedures; the high cost of recycling (which means recycling will not gain ground unless recycling is cheaper than waste disposal); and the fact that, until recently, many emerging markets have focused on domestic markets and, because of that, are not under pressure to address CSR.

\textsuperscript{72} Friedman (1970).
\textsuperscript{73} Porter and Kramer (2011).
\textsuperscript{74} Yiming Wu (2013).
SOCIAL PERSPECTIVES

*Social justice is a matter of life and death. It affects the way people live, their consequent chances of illness and their risk of premature death.*

**WHO Commission on Social Determinants of Health, 2010**

The health impacts of environmental change in emerging markets reflect contrasting economic and social conditions.

The contrasts are nowhere clearer than in correlated gradients of life expectancy and socio-economic conditions in emerging market cities. In Bogotá, for example, average life expectancy in leafy, wealthy, high-income northwest neighbourhoods with excellent housing, reliable public services and good schools and healthcare is 20 years higher than in the densely populated, makeshift *barrios* of the southeast and southwest. There are similar correlations in Cairo, Karachi, Manila, Rio de Janeiro and many other emerging market cities, with the partial exceptions of those that have benefitted from large scale sites and services and slum upgrading programmes such as Chile's 'half house' programme that improves housing and well-being for low income populations cheaply and effectively.

LIFE COURSE PERSPECTIVES

Some aspects of environmental health are gender and age neutral. Most are not. That is partly because the burdens of environmentally-related health conditions for men and women in emerging markets are (in some cases starkly) different. And it is partly because some age groups, particularly the very old and very young, are more vulnerable than others.

CHILDREN AND YOUNG PEOPLE

Reflecting on what their generation has done to the global environment, many older people ask what their children and grandchildren will say when they look back in anger at the 20th and 21st centuries. However, younger generations need not actually wait for the future because they are surrounded by evidence that environmental change presents major hazards for the youngest and oldest.

Children are most conspicuously at-risk. Pre-natal inequalities and inequities set the scene for health and other outcomes through the human life course. The impact of environmental shocks on the mental health of mothers and children can be devastatingly severe, especially in the contexts of forced migration and natural disasters.

A recent report reveals that (worldwide), 26% of nearly six million deaths of children under five in 2015 were environment-related and implies that in emerging markets with large under-five populations the proportion was higher. Respiratory infections, lung disease, cancers, diarrhoeal diseases, vector borne diseases, exposure to chemicals, e-waste and the consequences of climate change, all have larger impacts in emerging markets than in

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75 See www.archdaily.com/half-a-house.
76 The UN has reported that 80% of all disasters are climate-related and that particularly in Africa and Asia 50-60% of the victims are children.
77 WHO (2017).
richer countries although in some respects (e.g. exposure to vector borne diseases) smaller impacts than in poorer countries.

**OLDER PEOPLE**

The young have always been vulnerable to environmental threats, but population ageing – in emerging markets as in richer countries – is creating a second apex of vulnerability to environment-related morbidity and mortality. Although ageing rates vary, emerging market population pyramids have been transformed by population ageing. Whereas rich countries got rich before they grew old, most emerging markets are growing old before they get rich.

Studies show the defences of older people against environmental stress are weakened by physiological, biochemical, immunological and homeostatic deterioration, reduced xenobiotic metabolism, increased oxidative stress and cumulative exposure to toxicants. Separately, and in combination, these changes increase cardiovascular and pulmonary risks as lifetime exposures add up. Exposures to carcinogens lead to cancers. Exposures to lead can be linked with cognitive impairment. Exposure to traffic fumes and high concentrations of PM2.5 are associated with strokes and cardiovascular disease.

**Fig XVII - Population pyramids, 1980-2015-2050 (projection)**

Source: EMS 2017 Analytical Framework

78 See EMS (2015).
The physical and cognitive frailties of older people and their vulnerability to environmental change are also transforming morbidity and mortality profiles in emerging markets. The economic and social challenges created by ageing are greater in emerging markets than in other countries, not least those attributable to climate change (heat in particular), flood and severe weather threats.

**GENDER PERSPECTIVES**

Poverty weighs heavily on males and females of all ages but the evidence for emerging markets shows that poor women tend to bear larger burdens than poor men, and that, in some cultures, girls are worse-off than boys.

In the household, women undertake more (in some cases most) domestic responsibilities. Particularly in rural areas, these often include water and wood collection tasks that weaken physical health and take time away from children, education and income generation. Drought and deforestation mean women travel longer distances to access water and fuel. They make up the majorities of agricultural workforces. They are disproportionately impacted by heat waves (70% of deaths in the 2003 European heat wave were women). Natural disasters exacerbate previously existing patterns of discrimination. Women and children are 14 times more likely than men to die in or after disasters as a function of limited mobility, lack of empowerment to make decisions, and limited access to relief supplies. 70% of the urban poor are women. Many women and girls move to urban areas in search of better economic opportunities, health care and education but the “urban advantage” is eroding and women in slums are at increased risk of trafficking, violence and harassment.

Mothers and infant children are uncommonly vulnerable to environmental change, the effects of which may be long or short term and/or inter-generational. Environmental hazards include exposures to: polluted air (indoor smoke, tobacco smoking that affects pregnant women and, through second hand smoke, children); metals (e.g. lead); chemicals; gasoline; and polluted water. Many harmful elements cross the placenta by passive diffusion and because the elements may be released from a mothers’ bones during breastfeeding may be a preconception risk. High lead levels in pregnancy increase the risk of hypertension, spontaneous abortion, and low birth weight. Children’s lead exposure can cause impaired neurodevelopment. Infectious and insect transmitted diseases constitute perfect storms of environmental hazards: the Zika epidemic was compounded by the abundance of the widespread *Aedes aegypti* mosquitos in urban centres in the Americas; Chagas was associated with poor housing and exposure to infected triatomine bugs and subsequent infection with *T. cruzi* parasites; and Leptospirosis was associated with urban flooding, poor infrastructure and abnormally high rainfall.
CONCLUSIONS

PINNING THE TAIL ON THE DONKEY

It is not hard to understand why many people tend to attribute environmental damage to financial greed, impatience and the belief that the world’s resources are infinite. It is not hard to appreciate their anger when plastic bottles are hurled in rivers, battery acid is thrown in streams, garbage is dumped beyond three mile limits, and trash is fly-tipped in fields. Nor is it hard to understand why those charged with abusing the planet, respond by saying that if they had not taken risks, grown businesses, created jobs and pushed environmental, technological and other boundaries, the world would have made less material progress in reducing poverty, enhancing longevity and improving the quality of many lives. Much of this discourse is a blame-game that ignores two distinctions.

First, the distinction between the owner of a waste producing petrochemical plant that destroys a wetland and an architect who specified asbestos for a building before it was known that asbestos is a carcinogen. Depending on whether, in a given emerging market, the legal system is, or is not, fault-based, the plant-owner may be legally and ethically culpable whereas the architect might be held legally liable but no more ethically culpable than a gynaecologist who, in good faith, prescribed thalidomide before it was known to cause birth defects. The issue in these cases is whether relevant knowledge existed.

Second, take the more general case where knowledge (and laws) exist but alleged offenders are ignorant, because: (i) they have not bothered to find out; (ii) the knowledge was not readily accessible; or (iii) they had not been told about it. The issue in this case is ignorance.

Although some cases of environmental and social justice may be more ambiguous than others, there is an evident need to close the knowledge gap between those who know about the environmental (and health) implications of their decisions and relevant laws and regulations and those who don’t. Not, primarily, to block “I didn’t know” arguments but to raise environmental consciousness, awareness and understanding in individuals, households, businesses, governments and civil society organizations.

The implications vary depending on legal systems. In fault based systems, the overwhelming majority of criminal cases require proof that a defendant intentionally committed the prohibited act (although gross negligence may, in some instances be a substitute for intent). There may also be limited instances where criminal liability may exist absent intent.
THE MEANING OF THE PARIS AGREEMENT

The Paris Agreement had four deep meanings, three of them not climate-related. First and self-evidently, it meant the world could agree on solutions to the most critical item on the global environmental agenda. Second, having resisted for several decades, the world proved it could, when pushed, collaborate to achieve an objective no nation could pursue autonomously. Third, it could inspire future agreements on other threats to global health and well-being including: air and water pollution, waste mismanagement, soil degradation and diminished biodiversity (in the absence of which threats to environmental health in emerging markets cannot be contained). Fourth, it meant the world community embraced the fundamental meanings of environmental stewardship and intergenerational responsibility.

WHAT NEXT?

So which is better… the end of the world as we know it or the end of the world?

The answer to the question of what emerging markets should do to improve environmental health has two parts. First, whatever else they do, emerging markets should act with all deliberate speed to prioritize and improve public health. Second, they should decide on complementary actions.

WHAT NEXT I: PUBLIC HEALTH

Public health needs a “Moon Shot”

Action to stem the tide of environmental damage to human health in emerging markets must include urgent measures to improve public health. This is partly because public health is the key to disease prevention and partly because other initiatives would almost certainly be more difficult and would take longer to implement.

Having told the symposium that public health is “one of the most successful disciplines of humanity”, Jeffrey Sachs argued that many public health programmes in emerging markets (and elsewhere) are disconnected from budgets and capabilities and hampered by weak links between discourse and action. He suggested that their future success will depend on clear goals, specific time-bound commitments and mission driven programmes like those which all but eradicated Guinea Worm, Polio and Smallpox. Since the adoption of the MDGs in 2000, the value of mission driven programmes has been further demonstrated by vast increases in funding and emphatic global commitments to reducing child mortality, improving maternal health, and combatting HIV/AIDS and malaria.

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80 i.e. Metaphorically, an ambitious, exploratory and ground-breaking project undertaken without any expectation of near-term profitability, see footnote 80.
81 Jeffrey Sachs, speaking at a Special Session (with invited guests) of the EMS symposium, January 2017.
82 Yellow fever elimination was motivated by the US purchase of the Panama canal; Polio vaccination was spurred by Roosevelt through the creation of an NGO to treat polio and develop a vaccine to be distributed throughout the world; Smallpox eradication was led by WHO in campaign mode, including mission, quarantine, and contact tracing.
83 UN (2000).
84 Spending vastly increased from 2000-2010, followed by a plateau in 2010-2015 when international financing for malaria and HIV was stopped or reduced.
85 The goals helped to focus world attention on the issues; to promote action leading to the reduction of global malaria deaths by 70% (compared to the peak year, 2004); the delivery of anti-retroviral treatments for HIV; and the reduction of deaths of children under five from 12.7 million in 1990 to 5.9 million in 2015.
Like richer countries, most emerging markets spend far less on preventive than therapeutic healthcare. In 2012 only 3.0% of health expenditures in OECD countries were on public health and primary and secondary prevention. Because emerging markets are no better, and in most cases worse, it seems futile to expect significant improvements in environmental health (particularly in fast growing megacities) unless and until public health gets the priority it needs.

The major constraints to change are:

- Resistance to upsetting the status quo.
- Difficulties co-ordinating action across branches of local, national and international governance that affect public health outcomes.
- Difficulties building effective public health institutions and services

**Acuity vs. Continuity**

Acute care paradigms embedded in healthcare cultures, technologies, incentives, research and commerce have reduced morbidity and mortality across the life course and, to lesser but significant extents, in emerging markets. Healthcare professionals depend on patients to tell them they are sick and in some cases may treat them as passive recipients of episodic care rather than active partners in monitoring potential morbidities. With the exception of widespread vaccination programmes, healthcare systems in emerging markets, and throughout the world, are designed to diagnose and treat urgent issues and manage chronic illness rather than prevent disease.

Whilst few experts favour massive expenditure shifts from personal to public health, the fact that public health expenditures in most emerging markets (and the rest of the world) are so low creates huge opportunities for growth. Even large proportionate increases in public health (of say, 50%) would not necessarily imply implausible increases in total health expenditures.

The symposium agreed that if emerging markets are to manage the challenges of environmental health they must partially realign their priorities to focus on health rather than disease, prevention rather than therapy and keeping people healthy rather than curing them when sick. This would mean emphasising the social and environmental determinants of health and transitions to holistic ‘one health systems’.

The odds against changing the existing paradigm in rich countries are high because alliances between healthcare providers, institutions, insurance and pharmaceutical businesses and complicit patients are seemingly impregnable. But in emerging markets, the case could be strengthened by examples of remarkably successful public health initiatives over the last 70 years including: measures against worms and parasitic diseases in many emerging markets; deworming and filariasis control in China, Korea and Japan after World War II; and interventions in India like the National Deworming Day (270 million patients were treated in a single day), the elimination of yaws and guinea worm and the world’s largest national filariasis programme.\(^{86}\) All of these programmes were affordable, replicable and reduced physical and mental health and economic burdens.

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\(^{86}\) NTDs are directly addressed by SDG 3, but are indirectly addressed by most SDGs. See Bangert (2017).
Shifts towards public health would be resisted but less so in emerging markets where many people lack access to health care (and would not resist withdrawal of something they don't have) whereas they, and many others would benefit from improved and redistributive public health initiatives that would disproportionately benefit the poor. But at least one challenge would persist. Health expenditures can be precisely measured but the costs of ignoring clear and increasingly present dangers of environmental change for human health are incalculable. Whereas the costs and benefits of a shift from reactive to proactive healthcare can be modelled, the costs and benefits of saving mankind from itself are only partly knowable.

Every Minister is a Minister of (Public) Health

Despite general acceptance of the principles that “every Minister is a Minister of Health” and that the purpose of public health is to prevent disease, public health in most emerging markets is an orphan. Almost every operational ministry or department in national and local government owns a piece of the public health action. Most obviously in cities, where responsibility for public infrastructure (water supply, sanitation, waste management) is vested (with usually minimal national/federal control or regulation) in utility enterprises. And also most relevantly because these enterprises and agencies are the primary executors of environmental policy and, in many cases, its de facto creators, subject (where it exists), to oversight from environmental protection agencies (or the equivalent). Similarly, because air quality is largely a function of local conditions (transport, industrial pollution) responsibility for air quality control normally rests with local public or private enterprises.

Although the health of emerging market cities is directly or indirectly affected by actions taken or not taken in almost every branch of national and local governments, few emerging market countries or cities coordinate health-related policies and programmes either horizontally (within national or city governments) or vertically (between national and city governments). The consequences include duplication, competition, contradiction and lower returns on health-related expenditures and a smaller impact on public health than could be achieved if policies and programmes were coordinated.

Because (i) public health outcomes in emerging markets cannot be optimized by delivering programmes through autonomous jurisdictions in national or local governments, and (ii) bureaucracies invariably resist coordination that diminishes their autonomy, public health strategies must be coordinated, prioritized and sequenced at the highest levels of federal, national and local governments rather than by ministries or departments.

Some emerging markets (e.g. Colombia) have taken inter-ministerial coordination of health policies and services very seriously. Although its scope is not formally confined to environmental health that is the focus. There is less evidence of formal coordination in local jurisdictions although, in practise, many mayoral systems are comparatively tight and relatively intimate. At all scales, however, the critical issue is that whereas most managers are happy to be coordinators, they are less happy to be coordinated. That is why, in what could be a promising model for emerging markets, President Santos took the reins himself.

More broadly, emerging markets must recognize that:

- The time has come to recognize that environmental health is a higher priority than economic growth when health is not integrated within the growth and market paradigms.

87 Sir Michael Marmot at the 2012 EMS symposium on Urbanization, Human Security and Health.
Continued failures in addressing public health, especially for young people, will have very considerable economic and social outcomes with severe effects on economic growth, social cohesion and trust in political arrangements.

Improved public health is a key to improving environmental health and social wellbeing.

Global action to improve environmental health (supported and/or led by emerging markets) must be complemented by (i) national environmental health strategies designed to attenuate (and eventually eliminate) air, water and ocean pollution, soil degradation, biodiversity depletion, waste reduction, and the negative environmental attributes of built environments; (ii) Attitudinal, behavioural and legislative changes that embody the principles of circularity and satisficing\(^88\) in a framework of social justice; and (iii) Sustainable balances between the relative weights of control, autonomy and cooperation in civil, public and private sector decision-making.

National and local initiatives to attack domestic sources of communicable and non-communicable diseases are essential.

All nation states, including all emerging markets, must develop capabilities to plan, coordinate and communicate public health actions by state and non-state actors that complement global agreements.

Investments in water, sewerage, electricity and waste management are generally excluded from public health accounts but play critical roles in enhancing environmental health.

Because health-based inequalities reflect social and economic inequalities, improved health and extended life expectancies in emerging markets will be contingent on improved environmental protection and improved socio-economic and living conditions, including housing, infrastructure, services, schools and healthcare.

Efforts to reduce disparities in environmental health should be grounded in ‘proportionate universalism’\(^89\) and intimately connected to SDGs.

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\(^{88}\) Whereas classical economics assumes maximizing behaviour, Simon’s theory of “satisficing” behaviour reconciles outcomes with the “cognitive limits” of the human mind. In a ‘satisficing economy’ maximizing objectives would be replaced by satisficing objectives and less stress on natural systems. See Simon (1979).

\(^{89}\) Proportionate universalism is the resourcing and delivering of universal services at a scale and intensity proportionate to the degree of need.
WHAT NEXT II: OPTIONS

Besides improving public health, emerging must decide what more, if anything should and could be done to address problems of environmental health. The main choices (there could be many hybrids) are: (i) Keep calm and carry on; (ii) Take radical action; (iii) Take decisive but non-radical action.

The Inaction Option

The risks of inaction to halt or reverse the health consequences of environmental change in emerging markets are mainly long term. They could include but would not be limited to:

- Potential deterioration of natural environments to the point at which parts of some emerging markets could become uninhabitable due to the combined effects of rising temperatures, more disruptive weather events, coastal and river flooding, drought, desertification, soil degradation, diminished biodiversity and air and water pollution;
- Gradual deterioration in the quality of life, particularly for poor people with few options or resources to cope with the problems or adapt to changing environments;
- Large scale forced migration and population displacement; and
- Losing battles against environmental health threats as communicable diseases mutate.

![Fig XVIII - Droughts, floods, extreme temperatures (% of population exposed), average 1990-2009](Source: EMS 2017 Analytical Framework)
The Radical Action Option

Transformational changes in lifestyles, habits, customs, industrial and agricultural processes and practises, economic systems, social structures, cultural norms and political systems would, in theory, create life sustaining conditions, including improved environmental health, in emerging markets and on the planet at large. But in the short term, creating these conditions would cause massive economic, social, cultural and political disruption and discontinuity. Implementing a comprehensive and radical strategy to create environmental conditions that would change the current course of climate change, reduce air and water pollution to tolerable levels, recycle waste, restore biodiversity, halt soil degradation and create habitable built environments would turn the world upside down, inside out and back to front.

There is an almost infinite variety of strategies but the more fundamental the changes, the more bitterly and perhaps violently they would be contested in democratic polities. That is because they would abrogate individual liberties, demand basic changes in values, prioritize control and cooperation over autonomy and create a social contract equivalent to that in a country at war. They would be ridiculed as unnecessary and unworkable. They would be presented as punishment for the environmental crimes and misdemeanours of previous generations or (if clichés were allowed) as the last best hope of mankind. They could be seen as essential weapons in an increasingly hot world that survived the Cold War but might not indefinitely survive at all without recognizing that environmental change, like nuclear weapons, could threaten mutually assured destruction. Although this vision appeals to some people it must, as a matter of realpolitik, be set aside.

The Non-Radical (But Nonetheless Quite Transformational) Option

Here too, the character of changes could vary from relatively weak to relatively strong (though less strong than in the radical option). If the radical option is seen as a bridge too far\(^90\) the question is how much change would be tolerable, manageable and sufficiently radical to create a sustainable balance that enabled human beings and natural systems to share the planet?

Three conditions stand out:

- The knowledge gap must be narrowed.
- Allowances must be made for the zeitgeist.
- Enforceable environmental protection regulations must be developed.

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\(^{90}\) i.e. An over-reach. Also title of book by Cornelius Ryan (1974).
Closing the Knowledge Gap

Ignorance may or may not be an admissible defence against environmental crimes and misdemeanours but is nonetheless a powerful driver of environmental damage, not least in emerging markets with limited educational opportunities.

Emerging markets must recognize that:

- Prospects for coordinated global and local action on environmental health are predicated on support from environmentally aware and engaged populations who understand the need for sustainability.
- Education and interactive learning about the environment and about the responsibilities of citizens must be provided for all ages.
- Past efforts to inform populations about the long term health consequences of environmental change and to build popular support for urgent and radical countervailing action have had limited success. This is not because the messages have been wrong, but because the messengers have been less than fully effective. This is partly due to conflicting signals about the primacy of economic growth and distributive inequalities and partly (in varying degrees) to limited public trust in management and leadership.
- Environmental enlightenment depends on the skilled use of ethical, rhetorical and rational communications that: (i) are age, gender and culturally sensitive and specific; (ii) are supported by appropriate training in communications for scientists and others with decision-making responsibilities; (iii) are grounded in socially supported evidence-based knowledge; (iv) avoid counterproductive confrontational language and postures; and (v) prioritize the strategic use of time, attention, skills, money and other resources to achieve results. Learning about sustainability should be an integral part of management training for government, business, and civil society organizations.
- Education and communications efforts are being challenged by trends in global and national zeitgeists that make it harder today than in the (very recent) past to spread environmental awareness and engagement. This is why creative partnerships are needed between academia, business, government, civil society and community organizations.

Sound science, political skills and powerful arguments produced the game-changing Paris Agreement. But conservationists won a battle, not a war and science-deniers, for whom Paris was a defeat, not a disaster, can seek refuge in the knowledge that environmental enlightenment has not (yet) swept the world. In some emerging markets, there has been rapid and real progress towards environmental enlightenment. In others, progress has been slower than the ice-melt on Perito Moreno.91

It is therefore essential to persuade emerging market populations of all ages in all socio-economic categories, that natural systems can be damaged by seemingly innocent as well as overtly hostile behaviours; that environmental stewardship can be introduced at young ages; and that environmentally friendly behaviour can be promoted with carrots as well as sticks.

91 A glacier in Patagonia.
Scientists and their associates have done remarkable work disseminating knowledge of the environmental consequences of economic decisions, but may not have fully absorbed Aristotle’s advice that three kinds of persuasion (ethos, pathos, logos) are “furnished by the spoken word”. They may have placed undue reliance on evidence-based argument and/or overlooked the fact that the public-at-large can be persuaded to act in bizarre ways, to vote against their own environmental interests and, particularly if their own ethical compasses are wobbly, to support irresponsible actions.\textsuperscript{92}

For many who endorsed it, the Paris consensus confirmed that “a man’s reach should exceed his grasp”;\textsuperscript{93} that everything possible (and seemingly impossible) should be done to win hearts as well as minds; and that the Agreement could and should be a precursor to other agreements. Other supporters, contemplating forthcoming agreements, have reservations about the style, tone, language and deportment of some past environmental campaigns and campaigners. They argue that rhetoric can be an asset and a liability and suggest that whilst emotive appeals and moral suasion are relevant, advocacy must be grounded in science, economics, sociology, anthropology and law and that, as in all negotiations, advocates must confront opponents with empathy and mutuality as well as integrity.

\textbf{Zeitgeist}

Whilst the Paris Agreement reflected a mood of empathetic global cooperation there is increasing but inconsistent evidence – in some European countries, the USA, Japan, Australia – and some emerging markets, of: (i) a shift from communitarian values towards greater reliance on business and civil society as agents of change; (ii) diminished belief in the value of global and regional cooperation and less enthusiasm for instruments of global governance; and (iii) global mood-swings away from the post-1945 consensus that embraced multilateralism, cooperation and long-termism towards short-term autonomous nationalism. In varying degrees, these trends have been inspired by leaders who, at precisely the wrong moment in history,\textsuperscript{94} have chosen to deny scientific evidence about the origins, implications and existence of environmental change and its impact on human health. The challenge presented by naysayers is getting harder, not easier, to deal with in light of an associated and growing trend towards populist authoritarian governance.

From an environmental perspective, the salient trends are that, even as China and some other emerging markets are showing more concern for environmental protection, developing renewable energy and fomenting environmental consciousness, some rich countries are evincing less interest in protecting and enhancing natural capital,\textsuperscript{95} air and water quality, ocean protection, environmental education and the impact of the environment on human health.

In these circumstances, efforts to promote environmental awareness, global cooperation, concern, compassion, communitarianism and commitment run against the current global mood of individualism, materialism and shifts from the mutuality of we towards the Darwinian logic of me; from co-operation to a blend of autonomy and control. The fact that the current mood suggests ‘we’ has not penetrated the hearts and minds of those who believe in ‘me’, does not mean the message is wrong. It means the recipient is cognitively deaf or the messenger can’t shoot straight.

\textsuperscript{92} Recent political events in Europe and the USA may offer evidence.

\textsuperscript{93} Browning (1855).

\textsuperscript{94} And often ‘pointoutable’ (from Greek deiktos) benefits.

\textsuperscript{95} i.e. the stock of the earth’s environmental resources that support human life.
So messengers must raise their games, burnish their evidence and speak with a more convincing mix of control and passion. The challenge is to speak truth to power, deny the deniers and outwit the forces of manipulative self-interest; that task is not made easier by the reminder that “the long run is a misleading guide to current affairs.”

The case may be altered if short run imperatives are driven by long run concerns particularly if the world approaches environmental tipping points beyond which challenges to existential threats resemble Quixote’s plans to assault innocent windmills.

Recent changes in the global *zeitgeist* make it harder today than it was a very few years ago to persuade hearts and minds of the urgent need to address the impact of environmental change on human health. The *Zeitgeist* Problem can be seen as a battle between good and evil, the bright side and the dark side. But it must also be seen in the context of global, regional and national mood-swings. Every *zeitgeist* features values, attitudes, priorities and behaviours that make it hard to sell antithetical ideas. If mutuality and empathy are ascendant it is hard to sell social Darwinism, regressive fiscal policy or beggar-thy-neighbour protectionism. If the *zeitgeist* favours nativism, mistrust and short-termism it may be impossible to pursue initiatives anchored in collective action to address long term issues.

**Rules and Regulations**

Environmental knowledge is a necessary but insufficient condition of environmental protection in emerging markets which must also create (or, where they have them improve) comprehensive and enforceable regulations, recognizing that in some cases, enforcement may be thwarted by corrupt practises. The longer action is delayed, the steeper the gradient and the more disruptive the changes in government, business, civil society and individual behaviour.

There is no shortage of targets. Besides knowing that the maximum allowable increase in global temperatures to avoid catastrophic global warming is 2.0°C. (and that 1.5°C. would be better), we also know that: WHO air quality guidelines include limits of 25 μg/m³ for 24-hour PM$_{2.5}$ and 10 μg/m³ for annual mean PM$_{2.5}$, 100 μg/m³ for maximum 8-hour ozone (O$_3$), 40 μg/m³ for annual mean nitrogen dioxide (NO$_2$), and 20 μg/m³ for annual sulphur dioxide (SO$_2$).

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96 A commentator said: “Particularly when we are faced with politicians who are creationists then we will have serious problems. We have an uphill battle which will be harder to overcome than climate change deniers”

97 Cervantes (1605).

98 Literally “spirit of the age,” from Zeit “time” and Geist “spirit” meaning the general moral, intellectual, and cultural climate of an era.

99 The maximum figure agreed in the Paris Agreement

100 WHO (2005).


102 The London Convention (1972) for the protection of the marine environment from human activities.

103 UN Habitat, 2015.
We know too that there are at least 83 laws, conventions, agreements and guidelines on human uses of natural systems and that they constitute a patchwork of binding and non-binding legislation and guidelines. From an environmental health perspective (and in most cases from a global perspective as well) the problem is that they are incomplete, largely unenforceable and widely ignored. For as long (we assume indefinitely) as the global economic system is anchored in returns on capital, enterprise, labour and land there will be overwhelming incentives to break rules, disregard sanctions and trash guidelines. This is partly because the risk of getting caught is low, partly because sanctions are often honoured in the breach, \(^{104}\) and partly because many governments are inclined to look at violators with blind eyes on the grounds that short term environmental harm is an acceptable price for jobs and growth.

\(^{104}\) Shakespeare (1602).
RECOMMENDATIONS

Apart from ancient Greeks, Swiss citizens, and voters in modern plebiscites few people have been direct participants in epoch-making national decisions. But everyone can help protect the earth from our collective impulses: a child in Santiago, Chile putting a candy wrapper in a bin; a department head at WMO collaborating with her counterpart in another multilateral institution; the manager of an Ankara factory asking colleagues in Bangkok and São Paolo for advice on water recovery processes; a farmer in the Eastern Cape reducing her use of pesticides on the advice of an extension agent; the Governor of Tianjin enforcing an air pollution regulation; a fisherman in Canada returning an under-size fish to the ocean; a young man in Buenos Aires resisting the urge to burn rubber at a stop light.

The purpose of these recommendations is to suggest how emerging markets and the world-at-large could prevent a gratuitous collision with nature. They are addressed to governments, businesses, civil societies and individuals in emerging markets and elsewhere.

RECOMMENDATIONS ON GOVERNANCE

GLOBAL GOVERNANCE

“If you want to go fast, go alone. If you want to go far, go together.”

It took more than 10 years to negotiate what became the Paris Agreement which, if implemented, will become one of the most important conventions in history. It took more than 50 years to negotiate what became the Minamata Convention. The environmental protection game is now in extra time.

Because most aspects of the global environment are in a state of constant, frontier-vaulting flux, few problems of environmental health can be successfully addressed without international action. Because multilateral institutions function within policy frameworks mandated by nation states, those states play critical roles in setting priorities and guiding outcomes. But, subject to governing body approvals, these institutions must enjoy sufficient autonomy to launch initiatives, investigate issues and define objectives.

The support of emerging market governments for the Paris Agreement, the Marrakesh Agreement and, in due time, other conventions and agreements will be critical because: (i) agreements are easy, implementation is difficult; (ii) successful implementation of the Paris Agreement will be critical in shaping the prospects for other agreements; and (iii) emerging markets must play leadership roles in implementation.

105 African proverb.
106 Minamata Convention (2013).
107 Some multilateral institutions have longer leashes than others (e.g. World Bank, IMF vs. IMO, WTO).
Recommendation 1
To improve planetary and environmental health in the absence of a system of global governance, the global community should create a viable, durable coalition of governments, businesses and civil society organizations which could be: (i) a meta-multilateral organization; (ii) a coordinating mechanism based on the Marrakesh Agreement between UNEP/WHO/WMO; or (iii) an intergovernmental panel similar to the IPCC. The coalition should:

A. Coordinate: (i) a strategic vision of a sustainable long term equilibrium between economic activities and natural systems; and (ii) binding global agreements on air and water pollution, ocean contamination, soil degradation, biodiversity and standards for built environments.

B. Rely on principled pragmatism; have agreed objectives, priorities and modalities; embrace the Pareto Principle; and make transparent decisions using an ethical compass.

C. Be inclusive, whilst recognizing that tasks that (i) belong to everybody belong to nobody and (ii) uncoordinated initiatives may be counterproductive

D. Focus on implementing the Paris Agreement because: (i) it is critical to prospects for human life and health; and (ii), if it were not implemented, other environmental initiatives could be stymied or doomed.

E. Develop frameworks for other international agreements, prioritizing seemingly intractable problems starting with air, water and ocean pollution.

Recommendation 2
The world community should exploit its extraordinary environmental knowledge and understanding (much of which now sits in unconnected silos) on which evidence-based decisions on environmental health depends.

NATIONAL GOVERNANCE
Active support for and compliance with regulations designed to protect emerging markets against damage from agricultural, industrial, commercial and other economic activity must be at the heart of global and national environmental health strategies.

Recommendation 3
National governments in emerging markets should:

A. Develop principles and frameworks for national agendas and their contributions to global action on the environment that embody commitments to attitudinal, regulatory and behavioural changes and the principles of circularity and recycling, satisficing and sustainable balances between control, autonomy and cooperation

B. Recognize that prospects for effective action on environmental health are weakened by the fact that expertise in different aspects of health and natural systems cannot be exploited. There is an urgent need for a comprehensive conceptual framework and an opportunity to combine these knowledge bases – in regional / national / global hubs.

108 In due course this coalition should expand to include UN-Habitat, FAO, IMCO, WTO and other multilateral agencies whose policies and programmes affect environmental health.

109 i.e. for many events, roughly 80% of the effects come from 20% of the causes.
C. Devise and implement Environmental Impact Assessments for all public and private investment proposals subject to official approval.

D. Support innovative, robust and resilient infrastructure based on integrated holistic plans and strategies developed with community participation for low-carbon energy generation, digital energy networks, transformed transport systems and circular waste management systems and an explosion in green finance and low carbon capital markets to fund the transformation of infrastructure, including transport systems and digitised energy.

E. Create national standards and institutions to regulate and control the contamination, degradation and depletion of natural systems including enforceable incentives, disincentives and sanctions.

F. Create national education programmes to sensitize children of all ages to current challenges of environmental health, the implications of failure to correct current trends, the need for children to sensitize parents and family members and empower them with an understanding of what, individually and collectively, they can do.

G. Support the development of communications to create awareness and understanding of threats to environmental health and how changes in corporate, institutional, household and individual behaviours can contribute to national and global solutions.

H. Develop public health using innovative methods such as the use of smartphones for remote monitoring, emergency transport, diagnostics and protocols.\(^{110}\)

I. Demonstrate that climate change mitigation must be paralleled by adaptation and that global adaptation strategies must be complemented by national strategies.

J. Explore the potential strengths and disadvantages of the ‘One Health System’, which is a nexus of health services, public health, social and environmental determinants, in which investment decisions take account of risk, response and health system resilience. It could offer a valuable and viable biosocial model for emerging markets.

K. Develop incentives and disincentives that favour green energy

L. Create disincentives to persuade businesses to reduce the production of and increase recycling or reuse of waste. Circular business models should be encouraged.

M. Recognizing that businesses produce large quantities of waste (from excess packaging to uneaten food which extracts huge environmental tolls through increased deforestation, greater use of energy and filling up landfills) create incentives and disincentives that persuade businesses to recycle waste.

\(^{110}\) e.g. 90-90-90 to fight HIV/AIDS: 90% of infected people to know their status, 90% of those to be on ARTs, 90% of those on treatment to suppress viral load.
LOCAL GOVERNANCE

The commonest environmental roles of local governments in emerging markets are directly or indirectly linked to public health: solid waste collection and management, water supply and drainage, sewerage, rodent and pest control, air quality management, traffic management; parks and recreation. Depending on how roles are allocated between local and national governments, many local jurisdictions – states, provinces, departments, counties – are also responsible for regulating and (at least partially) funding other activities.

Many of the most fundamental public health functions (solid waste, water, sewerage utilities) are excluded from public health expenditures because they are self-financing (public or private) enterprises. The spread, density and quality of these services are nonetheless keys to environmental health. Although service standards vary\(^\text{111}\) between and within local jurisdictions, the fact that most emerging markets have achieved relatively high levels of at least basic provision helps explain significant recent reductions in communicable diseases.

Recommendation 4
Local governments in emerging markets should enhance the efficiency and effectiveness of public health policies and programmes by:

A. Developing technological and organizational solutions grounded in local realities rather than models imported from wealthier countries.

B. Coordinating health policies and programmes within city governments and between national and city governments

C. Coordinating improved health and healthcare planning with improved city planning

D. Reforming health and healthcare education to cover (i) urban health, (ii) the social determinants of health and (iii) collaboration between public health and clinical practitioners, by building urban health and healthcare knowledge networks to promote mutual learning between cities.

\(^{111}\) i.e. from wells, to stand-pipes to running water.
RECOMMENDATIONS ON BUSINESS

Recommendation 5
All emerging market businesses should:
A. Respect environmental laws (e.g. on waste deposits in water systems, approvals for onshore and offshore oil and gas wells, coal mining and use of hazardous materials, such as asbestos, in construction).
B. Press for rigorous and even-handed enforcement of environmental regulations

RECOMMENDATIONS ON CIVIL SOCIETY

Civil societies in emerging markets play larger roles in environmental health than in other aspects of human welfare ranging from the roles of individuals of all ages and households to Non-Government Organizations (NGOs); International NGOs (INGOs); Government Organized NGOs (GONGOs); universities and research institutions; the press and media; and social and political organizations and movements. Some (particularly in semi-authoritarian states) have distinctive identities, some lack legal protection, some (e.g. ‘embedded activism’ in China) exist on blurred boundaries between state and civil society. Together, they represent powerful forces for changing the environmental attitudes and actions of citizens, companies and governments through lobbying, publishing, broadcasting, protesting and social media. They have made numerous differences and will make more. It is, however, difficult to address specific recommendations to civil societies-at-large other than INGOs that have the dual advantages of global reach and supranational identities.

Recommendation 6
Recognizing that emerging markets have distinctive polities in which domestic civil society organizations play many roles, they should:
A. Develop scientifically grounded arguments for action to resolve country specific problems of environmental health
B. Explore options for collaborating with other domestic civil society organizations working on related problems
C. Explore options for sharing knowledge and coordinating activities with civil society organizations working on related problems in other emerging markets and non-emerging market countries
D. Consider the value of non-confrontational approaches to government and business decision-makers
E. Build on progress made in integrating the work of domestic NGOs on National Climate Change Adaptation Strategies (NAPAs) with action on health/health co-benefits.

112 Ho and Edmonds (2008).
Recommendation 7
International NGOs (INGOs) should:
A. Explore options for exchanging knowledge and coordinating activities with other INGOs and domestic NGOs working on related problems.
B. Develop working relations with domestic and international universities and research institutions working on related problems.

Recommendation 8
Domestic and International NGOs should improve their communication and persuasion skills through press and media training schemes focussed on environmental health issues.

RECOMMENDATIONS ON RESEARCH

Recommendation 9
With support from government, business and civil society, universities and research institutions in emerging markets should:
A. Focus on generating local evidence on the environmental causes and consequences of diseases.
B. Continue to collaborate with counterpart institutions in other emerging markets and richer countries.
C. Focus on the effectiveness of different forms and styles of communications on environmental health including social media.
D. Develop programmes to help scientists communicate effectively with non-scientists, acquire the skills they need to get their messages across, put more emphasis on communication and the dissemination of e-knowledge, be bolder in what they say and put more energy in to engagement with the community at large.
E. Consider collaboration between schools/departments of journalism and communications and environmental and public health scientists.
F. Investigate the cost-effectiveness of education programmes for children and adults that enhance understanding and change behaviours.
G. Focus on lacunae in existing knowledge including the fact that only two million of an estimated ten million species are fully known.
H. Recognize the need for interdisciplinary research on complex systems and topics.
I. Consider affiliating with the Planetary Health Alliance (PHA).

113 The International Union of Forest Research Organizations (IUFRO) includes 15,000 scientists in 700 institutions who form collaborative research groups.
114 e.g. The impact of changes in human diets on land and water uses and the need to consider diet in the context of larger biodiversity systems; the impact of the loss of traditional herding on soil nutrition; the use of antibiotics on humans, animals and plants leads to resistance; can technology be used to develop highly labour-intensive, technology-dependent farming systems; alternatives to meat in emerging market diets.
115 The Planetary Health Alliance (PHA) is a consortium of universities, NGOs and other partners with a shared mission—supporting the growth of a rigorous, policy-focused, transdisciplinary field of applied research aimed at understanding and addressing the human health implications of accelerating anthropogenic change in the structure and function of Earth’s natural systems.
APPENDIX A

URBAN ENVIRONMENTS

Cities generate around 80% of global economic output, and around 70% of global energy use and energy-related emissions. The proportions are lower in emerging markets where farming is still a major sector. But the future of emerging market economies will largely depend on the performance of their cities and megacities.

Emerging markets have urbanized at unprecedented speeds on unmatched scales since the 1980s. As they have done so, the geographic balance of the global economy has shifted east and south. Long established cities have become megacities. Asian cities that many people in Europe and the USA have never heard of are economic powerhouses that will account for nearly half the world’s expected GDP growth between 2010 and 2025. Although they account for small fractions of emerging markets territories, the economic health of emerging markets depend disproportionately on their urban economies that depend in turn on their environmental health.

More than by anything else, emerging market cities are set apart from other cities by spatial segmentation between: wealthy urban areas with superior housing, infrastructure and services (usually including world class healthcare); neighbourhoods with adequate housing, infrastructure and services and: slums with primitive housing, pirated, if any, infrastructure, and services that often exclude most aspects of education, public health and healthcare. The socio-economic gradients between them confirm that urban health and absolute and relative urban poverty are two sides of the same coin. This endorses the contention that poverty is about more than a lack of money, although, perhaps, no worse than their industrial predecessors at a similar stage of development.

The health of emerging market cities is directly or indirectly affected by actions taken or not taken in almost every branch of national and local governments. Few emerging market countries or cities coordinate health-related policies and programmes either horizontally (within national or city governments) or vertically (between national and city governments). The consequences include duplication, competition, contradiction and lower returns on health related expenditures and a smaller impact on public health than could be achieved if policies and programmes were coordinated.
Health and healthcare planning is an essential condition of cost-effective urban public health and healthcare in emerging markets. Current practices and results vary. Some cities do an outstanding job, employing advanced information management, scenario planning and other techniques to address potentially overwhelming problems arising from rapidly growing demands for housing, water supply, sanitation, solid waste management, education and public health and healthcare services. Others seem to believe that if problems are ignored they will go away. Yet even emerging market cities that have squared up to these unprecedented challenges have failed to integrate health and healthcare planning with comprehensive city planning. All too often health planners and city planners work in separate spheres, use different assumptions and pursue different objectives. Here too the opportunity costs are measured in lower levels of health and healthcare than could have been achieved through cooperation.

The segregation of education and training in public health and medicine – in emerging markets and virtually everywhere else – means that public health professionals and medical doctors lack mutual understanding and respect and are poorly equipped to work collaboratively to deliver cost-effective health and healthcare. The consequences are aggravated by the fact that very few public health or healthcare education programmes offer specialized courses in urban health and healthcare (although schools of public health usually pay more attention to urban health than medical schools) and the fact that very few schools of public health or medical schools offer courses on the social determinants of urban health. Pending the alleviation of absolute and relative poverty in EMC cities, improved urban health depends on compensatory public health and healthcare policies and programmes.

With few exceptions, managers and practitioners in urban public health and healthcare are mutually ignorant of what has been learned in other cities. In most emerging markets this applies to other cities in the same country and (in spades) to other cities in other countries. The consequences are as inevitable as they are obvious. Problems that have been resolved in one city are not resolved in others because the other city does not know about the solution. Different cities devote time and resources to addressing identical problems when they could have developed joint solutions. Language barriers impede the flow of explicit knowledge between cultures. Tacit knowledge remains inaccessible. The opportunity costs are incalculable. And the losers are urban populations, particularly the poor, whose environments could be improved and whose health problems could be addressed if only health and healthcare providers knew what others already know.

Without countervailing action, breakneck urbanization in emerging markets will continue and things will get worse. The world will be 60% urbanized by 2030, 70% by 2050. It took 150 years for European towns and cities to house 50% of national populations (1% in 1800). Many emerging markets have done that in 50 years and have surprised themselves and the world by managing growth better than anyone predicted.116 They have broken some moulds: Beijing does not look like Paris, Mexico City does not resemble Berlin. But traditional and recent paradigms of market driven, unplanned, uncontrolled urban growth are not blueprints for a sustainable future; neither emerging markets nor the world can afford their environmental and economic costs.

116 In the mid-1970s there was a common tendency to believe megacities would eventually be overwhelmed by diseconomies of agglomeration. See Scott (1980).
Because urban development in emerging markets is largely unplanned and unregulated and features infrastructure with high economic, social and environmental costs, there is an evident need for better connected, more compact, more efficient and economically and environmentally healthier cities. New paradigms for urbanisation could reduce capital requirements for urban infrastructure worldwide by more than US$3 trillion over the next 15 years.\textsuperscript{117}

Emerging markets could enhance the efficiency and effectiveness of urban public health and healthcare policies and programmes by: (i) developing technological and organizational solutions grounded in local realities rather than models imported from wealthier countries; (ii) coordinating health policies and programmes within city governments and between national and city governments; (iii) coordinating improved health and healthcare planning with improved city planning; (iv) reforming health and healthcare education to cover urban health, the social determinants of health and collaboration between public health and healthcare practitioners; and (v) building urban health and healthcare knowledge networks to promote mutual learning between cities.

Demographic and economic concentration makes emerging market cities vulnerable to epidemics, social disorders and natural disasters, particularly in primate urban systems\textsuperscript{118}. The risks of concentration are real. Planners must manage them, learning wherever possible from countries with more resources and stronger institutions and experience that can be adapted to local conditions. From a health and healthcare perspective, these disadvantages are heavily outweighed by the inherent advantages of urban agglomeration: economies of scale, operation and specialization for building low income housing; constructing and maintaining water supply, sewerage, and other health related infrastructure; and developing and running hospitals, clinics, health centres and other facilities. The city is the problem, it is also the solution.

\textsuperscript{117} Stern (2006).

\textsuperscript{118} A national urban system dominated by one city (e.g. Bangkok, Buenos Aires, Jakarta, Mexico City).
APPENDIX B

THE DIVERSE FACES OF ENVIRONMENTAL CHANGE

In 1990 the US National Academy of Sciences wrote as follows:

Human activities are transforming the global environment… have many faces: ozone depletion, tropical deforestation, acid deposition, and increased atmospheric concentrations of gases that trap heat and may warm the global climate. For many of these troubling transformations, data and analyses are fragmentary, scientific understanding is incomplete, and long-term implications are unknown. Yet, even against a continuing background of uncertainty, it is abundantly clear that human activities now match or even surpass natural processes as agents of change in the planetary environment…

Global environmental change is interwoven with a complex web of social, economic, political, and scientific implications. Recent natural fluctuations in weather and climate, whilst not necessarily attributable to climate change due to human activities, nevertheless illustrate the magnitude and broad scope of environmental impacts on our intricately intertwined global economy…

The diverse faces of global environmental change are linked both scientifically and politically. Scientifically, the ability to predict future changes in the environment requires an understanding of the physical, chemical, biological, and social processes that govern the earth, and of the interaction of these processes throughout the earth system. Politically, policy options to address these problems highlight the need for coordinated international policies relating to energy, technology, land use, and economic development.

Thus difficult policy decisions must be made on the basis of judgments between dimly perceived future risks and possible economic or other consequences that may be more immediate. Whilst these decisions must be based on the best information that science has to offer, scientists are no better qualified than other individuals to hammer out these difficult judgments.”

*Source: One Earth, One Future: Our Changing Global Environment, National Academy of Science*
APPENDIX C

ALPHABETICAL LIST OF INTERNATIONAL ENVIRONMENTAL AGREEMENTS


2. Agreement on the Conservation of African-Eurasian Migratory Waterbirds

3. Alpine Convention together with its nine protocols

4. Anti-Ballistic Missile Treaty (ABM Treaty) (ABMT)

5. ASEAN Agreement on Transboundary Haze Pollution

6. Asia-Pacific Partnership on Clean Development and Climate

7. Barcelona Convention for Protection against Pollution in the Mediterranean Sea, 1976


10. Bonn Agreement


12. Cartagena Protocol on Biosafety

13. Chemical Weapons Convention

14. China Australia Migratory Bird Agreement

15. Comprehensive Test Ban Treaty (CTBT), 1996


22. Convention for the Protection of the Natural Resources and Environment of the South Pacific Region, Nouméa, 1986
23. Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (Assistance Convention), Vienna, 1986


25. Convention on Biological Diversity (CBD), Nairobi, 1992


28. Convention on Cluster Munitions

29. Convention on the Conservation of European Wildlife and Natural Habitats


32. Convention on Fishing and Conservation of Living Resources of the High Seas


34. Convention on Long-Range Transboundary Air Pollution

35. Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere, Washington DC, 1940


   EMEP Protocol
   Heavy Metals Protocol
   Multi-effect Protocol (Gothenburg protocol) [S]
   Nitrogen Oxide Protocol
   POP Air Pollution Protocol

   Sulphur Emissions Reduction Protocols 1985 and 1994
   Volatile Organic Compounds Protocol


38. Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques


42. Convention on the Transboundary Effects of Industrial Accidents, Helsinki, 1992

43. Convention on Wetlands of International Importance Especially As Waterfowl Habitat (notably not a Multilateral Environmental Agreement)

44. Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Transboundary Movement and Management of Hazardous Wastes within the South Pacific Region, Waigani, 1995

45. Convention to Combat Desertification (CCD), Paris, 1994

46. Conventions within the UNEP Regional Seas Programme

47. Directive on the legal protection of biotechnological inventions

48. Energy Community (Energy Community South East Europe Treaty) (ECSEE)

51. European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR), Geneva, 1957
53. Framework Convention for the Protection of the Marine Environment of the Caspian Sea
54. Framework Convention on Climate Change (UNFCCC), New York, 1992
55. Geneva Protocol (Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or other Gases, and of Bacteriological Methods of Warfare)
57. International Convention for the Prevention of Pollution from Ships
60. International Treaty on Plant Genetic Resources for Food and Agriculture
63. Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution, Kuwait, 1978
64. Kyoto Protocol – greenhouse gas emission reductions
65. Migratory Bird Treaty Act of 1918
67. Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal, 1989
68. North American Agreement on Environmental Cooperation
69. Protocol on Environmental Protection to the Antarctic Treaty
70. Putrajaya Declaration of Regional Cooperation for the Sustainable Development of the Seas of East Asia, Malaysia, 2003
71. Ramsar Convention Convention on Wetlands of International Importance, especially as Waterfowl Habitat, Ramsar, 1971
75. Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space, and Under Water
77. United Nations Convention to Combat Desertification
78. United Nations Framework Convention on Climate Change
80. Vienna Convention on Civil Liability for Nuclear Damage, Vienna, 1963
81. Western Regional Climate Action Initiative
82. Working Environment (Air Pollution, Noise and Vibration) Convention
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SUMMARY

Figure 1: “Source: EMS 2017 Analytical Framework” (Reference: Carlqvist, A. (2016). Health and the Environment in Emerging Markets: An Analytical Framework, Green Templeton College. Figure 1.1. Map of countries. Sample High Income Countries (HIC) are Australia, Japan, Switzerland, United Kingdom, United States. Sample Low Income Countries (LIC) are Bangladesh, Cambodia, Ethiopia, Haiti, Nigeria.


Figure 5: “Source: Copyright Okefenokee Glee & Perloo, Inc. Used by permission. Contact permissions@pogocomics.com.” (Reference: PogoComics.com is the official home of Okefenokee Glee & Perloo, Inc. (OGPI), owners and sole controlling entity of the copyrighted and trademarked works of Walt Kelly, including the text and comic characters that make up the Pogo comic strips, and all other published text and artwork by Walt Kelly.)

Figure 6: “Source: Raworth (2017)” (Reference: Raworth, Kate (2017) Doughnut Economics, Cornerstone, 2017.)

Figure 7: “Source: allianz.com”. (Reference: The megacity of the future is smart available at https://www.allianz.com/en/press/news/studies/151130_the-megacity-of-the-future-is-smart/)

Figure 8: “Source: EMS Original 2017”

Figure 9: “Source: EMS Original 2017”


Figure 11: “Source: EMS Original 2017”

Figure 12: “Source: EMS Original 2017”
REPORT


Figure VII: “Source: Urbanemissions.info” (Reference: http://www.urbanemissions.info/india-satpm25/)


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