The Royal Society of Edinburgh

Environmental Choices Lecture

The technology–policy challenges to address climate changes and biodiversity loss

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With impeccable timing, as world leaders gathered in Copenhagen to address the critical issue of dangerous climate change, Professor Bob Watson arrived at the Royal Society of Edinburgh to give his prescription for halting global warming and protecting the planet's population from its worst effects. As Chairman Stephen Blackmore, Regius Keeper of the Royal Botanic Garden Edinburgh (RGBE), pointed out in his introduction, the RSE is exploring the options for tackling this major new environmental threat, and few people are more qualified than Professor Watson, who has, in his long career, worked for the National Aeronautics and Space Administration (NASA), the World Bank, the Tyndall Centre at the University of East Anglia (UEA), the Intergovernmental Panel on Climate Change (IPCC) and now DEFRA, all at senior levels, to provide advice.

From the start of his talk, Professor Watson was at pains to make clear that climate change is not just an environmental issue. Climate change threatens world security in many different ways, including the smooth functioning of economies and the fight against poverty, and has adverse implications for human health. What is already accepted by most scientists is that humans have changed the composition of the atmosphere through increasing emissions of greenhouse gases and that developing countries are the most vulnerable to the emerging consequences.

So what is the evidence of climate change? Professor Watson took as his starting point the rise in global temperatures since the late 1800s, but primarily focused on the last half of the 20th Century. The statistics show that the last 17 years have been the hottest and that the 1990s had collectively been warmer than any other earlier decade in a pattern repeated across every continent. The warming could have occurred naturally but, Professor Watson argued computer simulations show this is highly unlikely. In fact, the upward trend of rising temperatures reveals a close correlation with increases in the atmospheric concentration of greenhouse gases, as expected based on simple physics. The vast majority of scientists are in agreement that the warming is due to human activity, not to natural forces such as a change in solar output.

This gives rise to three scenarios of temperature changes, based on whether future greenhouse gas emissions are low, medium or high, with the prediction that the higher the emissions the warmer the planet will get. If no action is taken to curb emissions, then under the most extreme scenario, each decade will get progressively warmer, with the possibility of global temperatures rising 7^{o} C by the end of the 21st Century relative to pre-industrial levels.

The effect on rainfall could be severe, with sub-tropical areas becoming progressively drier and present-day 'food bowls', such as in the Mediterranean and the USA, drying up and becoming less suitable for agriculture. But, equally, the UK would be affected. The south of England could warm by more than 6–7^{o} C and northern Scotland by more than 3–4^{o} C, even under a medium emissions scenario.

What effects would that have? In the UK, summers would be drier and winters wetter, leading to major challenges to water resource management and agriculture. There would be health effects too. The heat wave in 2003 in Europe led to many deaths from heat stress, and this would be repeated on a more regular basis in the future. This could be even more of a problem in the UK than in areas such as California – where Professor Watson had lived – as our homes and workplaces are not equipped with air-conditioning. Serious health problems would also emerge in developing countries, where diseases such as malaria and cholera, and conditions such as heat stress and malnutrition, would become more common.

Food production could be badly hit. Professor Watson pointed out that the amount of food produced and consumed per person has been on the increase since the 1960s. Yet while demand is growing, environmental degradation of habitats, in part caused by climate change, has already started to have an impact on production. Prices have already been pushed up by poor harvests, higher demand, use of food crops for energy production, export restrictions and higher energy prices, at a time when demand is increasing in developing countries. Climate-induced food loss is projected to decrease rice and wheat production in the coming decades in both rain-fed and irrigated systems. Therefore, governments' goal of doubling food availability to meet demand will be challenged by climate change. Bringing down child malnutrition is one goal that would be significantly hampered.

"Climate change has serious implications for hunger and poverty, as it is projected to have a significant impact on food prices," Professor Watson said. "They will go up anyway, but climate change exacerbates it."

Scientists face a major challenge in understanding all aspects of climate change, Professor Watson insisted, but there do not necessarily need to be significant increases in knowledge when deciding how to mitigate climate change. But there is a need for increased knowledge in how to tackle the effects of global warming, ie, the impacts of climate change on ecological and socio-economic sectors. Addressing human-induced climate change, loss of biodiversity and natural resources requires the development of policies at regional, national and international levels, choosing the right technologies, getting the price right and understanding human behaviour.

Projected water shortages will have to be addressed, soil fertility will have to be improved and crops have to be made temperature-, drought-, pest-, disease- and salinity-tolerant. Post-harvest losses of food – 40% of food in the UK is wasted – have to be decreased significantly. There are challenges in both developed and developing countries, where the key in developing countries is rural development (eg, micro-financing, roads and access to markets) and the education of women, who do most of the work in rural economies. But even if that happens, there have to be changes in international food trading systems, as developing countries cannot compete with dumped food from industrialised countries where production is subsidised. "Business as usual will not feed the world", said Professor Watson.

Other problems need to be tackled. Water scarcity is growing, yet 70% of the water supply is used for irrigation, so better pricing mechanisms are needed to give water its true value. Biodiversity loss is gathering pace with, for example, mangrove swamps being turned into shrimp farms and savannah and tropical forests being turned over to agricultural production.

Governments around the world have to be made aware that ecosystems have both economic and environmental values. But even within countries, government agencies often do not talk to each other and this is replicated on an international scale, where work programmes and regulatory protocols of the Multilateral Environmental Conventions, eg, the United Nations Framework Convention on Climate Change (UNFCCC), the Convention of Biological Diversity (CBD), the Convention of Wetlands of International Importance (the Ramsar Convention), the Convention on International Trade in Endangered Species (CITES), the Convention on Migratory Species (CMS) and the Convention to combat Desertification (CCD), need to be better coordinated.

Who will pay for this lack of co-operation? Developing countries will suffer, with tens of millions of citizens displaced. A one-metre rise in sea levels prompted by global warming could displace one third of the population of Bangladesh, primarily from rice-growing areas. There will be conflict and a stream of environmental refugees for the world to cope with.

That is why it is imperative for world leaders to commit to keep temperature rises to 2^{o} C relative to pre-industrial levels by cutting back greenhouse emissions. But while striving to achieve that, governments must plan for a 4^{o} C world rise. In the pre-industrial age, CO_2 levels in the atmosphere stood at 280 parts-per-million (ppm). Now they are 385ppm, and with all greenhouse gases included, more like 450–500ppm. That means a 50% reduction in global emissions relative to 1990 levels by 2050 is needed to achieve stabilisation at 2^{o} C. Fortunately, some of the current warming due to the increased atmospheric levels of greenhouse gases is being masked by sulphate aerosols in the lower atmosphere (ie, troposphere).

But governmental action is not the whole story. Individuals would have to change their behaviour too, Professor Watson argued. Surveys have shown that most people say they want to do what they can on an individual basis, but in reality they are unwilling to act if it hits their pockets. Around half of the homes in Britain do not yet have adequate attic insulation to stem heat loss. With so many disengaged from taking action, regulation is necessary.

“We need a global policy and we need this to start at Copenhagen,” Professor Watson concluded. “We need political will and leadership and for politicians and business to look to the 50-year horizon. We also need scientists to communicate these messages better.”

After the conclusion of the talk, Professor Watson was asked, perhaps inevitably, what he thought of the arguments being put forward by climate change sceptics. “We need sceptics to challenge us,” he replied. “but what they say needs to be based on scientific evidence, not ideology.”