# 2010

# Blue Planet Prize

## Dr. James Hansen (USA)

Director at Goddard Institute for Space Studies ( NASA )
Adjunct professor in the Department of Earth and Environmental Sciences at Columbia University

## Sir Bob Watson (UK)

Chief Scientific Adviser of the UK Department for Environment, Food and Rural Affairs (DEFRA)
Chair of Environmental Science and Science Director at Tyndall Centre for Climate Change Research, the University of East Anglia

***PRAY:***
*This blue planet where we live*
*Does not belong to us only*

*All the children to be born on this planet,*
*All living beings on the planet,*
*All have the holy right*
*To rejoice in the happiness*
*Of being born on this planet*
*We as one of those given life on this planet,*
*By rendering thoughts to all the life rejoicing in their lives*
*In the future of this planet,*
*Can recreate our linkage*
*Between all of those lives and us.*

*If the film helps to allow you*
*To refresh you to rejoice in the happiness*
*Of passing this blue planet to the future generations,*
*By rendering thoughts to the blessings of the Earth,*
*The Planet of Life*
*We are more than delighted*



Selected from the Slide Show Presented at the Opening of the Awards Ceremony


His Imperial Highness Prince Akishino congratulates the laureates

Their Imperial Highnesses Prince and Princess Akishino at the Awards Ceremony

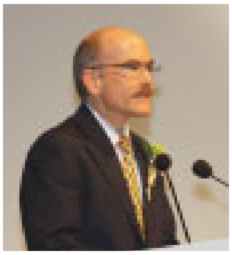
Tetsuji Tanaka, Chairman of the Foundation delivers the opening address

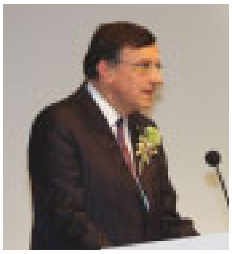
The prizewinners receive their trophies from Chairman Tanaka

Dr. James Hansen

Sir Bob Watson

Dr. Hiroyuki Yoshikawa, Chairman of the Selection Committee explains the rationale for the determination of the year's winners





Mr. James P. Zumwalt, Deputy Chief of Mission of the United States of America (left) and Mr. David Warren, United Kingdom Ambassador to Japan, congratulate the laureates

Blue Planet Prize Commemorative Lectures

## Profile

# Sir Bob Watson

Chief Scientific Adviser of the UK Department for Environment, Food and Rural Affairs (DEFRA)
Chair of Environmental Science and Science Director at Tyndall Centre for Climate Change Research, the University of East Anglia

**Education and Academic and Professional Activities**

| | |
|---|---|
| 1948 | Born in UK |
| 1969 | Receives a bachelor's degree in chemistry at Queen Mary College, University of London |
| 1973 | Receives a doctorate in reaction kinetics at Queen Mary College, University of London |
| 1976-1987 | Appointed as a scientist at NASA Jet Propulsion Laboratory |
| 1980-1987 | Acts as Deputy Program Scientist at NASA |
| 1980-2006 | Co-chairs scientific assessments of the Ozone Layer for World Meteorological Organization (WMO)/United Nations Environment Programme (UNEP) |
| 1987-1990 | Serves as Branch Chief for Upper Atmospheric Research and Stratospheric Chemistry Program of NASA's Earth Science and Applications Division |
| 1989 | Designated member of UNEP's "The Global 500: The Roll of Honor for Environmental Achievement" |
| 1991-1994 | Chairs the U.N. Global Environment Facility (GEF) Scientific and Technical Advisory Panel |
| 1991 | American Geophysical Union's Edward A. Flinn, III Award established to recognize individuals who personify the American Geophysical Union's motto of unselfish cooperation in research through their facilitating coordination and implementing activities (first recipient) |
| 1992 | US National Academy of Sciences Award for Scientific Reviewing |
| 1993-1995 | Chairs the Global Biodiversity Assessment for United Nations Environment Program |
| 1993-1996 | Associate Director for the Environment in the Office of Science and Technology Policy of the Executive Office of the President of the United States (under the Clinton Administration) |
| 1993-1997 | Co-chairs the IPCC Working Group II |
| 1993 | American Meteorological Society Special Award "for notable efforts in organizing and conducting international assessments in ozone depletion and global change" |
| | American Association for the Advancement of Science Award for Scientific Freedom and Responsibility |

| | |
|---|---|
| 1996 | Joins the World Bank as Senior Scientific Adviser in the Environmental Department |
| 1997 | Becomes Head of the Environment Sector Board of the World Bank and later Chief Scientist and Director for Environmentally and Socially Sustainable Development |
| 1997-2002 | Chairs IPCC |
| 2000-2005 | Co-chairs Millennium Ecosystem Assessment |
| 2003-2008 | Directs the International assessment of Agricultural Science and Technology for Development |
| 2003 | Global Green Award for International Environmental Leadership – US chapter of the Green Cross International formed by Mikhail Gorbachev<br>Honorary "Companion of the Order of Saint Michael and Saint George" from the United Kingdom |
| 2006 | Zayed science award for the Millennium Ecosystem Assessment |
| 2007 | Appointed Chief Scientific Adviser of the UK Department for Environment, Food and Rural Affairs (DEFRA)<br>Becomes Chair of Environmental Science and Science Director at Tyndall Centre for Climate Change Research, the University of East Anglia (England) |
| 2007 | Nobel Peace Prize for the IPCC, chaired from 1997-2001 |
| 2008 | American Association for the Advancement of Science Award for International Scientific Cooperation |

Sir Watson worked on the study of the creation and depletion of the Ozone Layer at the National Aeronautics and Space Administration (NASA). Leading numerous scientists, he produced scientific evidence of human-induced depletion of the Ozone Layer which led to the Montreal Protocol which incorporated the reduction of ozone depleting substances. In this way, Sir Watson has made a significant contribution to the enactment of the Protocol. Later, as Chair of the Intergovernmental Panel on Climate Change (IPCC), he took the initiative in developing the Synthesis Report of the Third Assessment Report. In particular, he played a significant role in successfully completing the detailed review by national governments from around the world of the Synthesis Report, coordinating and bridging science and policy and achieving an international consensus on the need to ratify the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC). He also served as the first Chair of the Science and Technical Advisory Panel to the Global Environmental Facility (GEF), and held other important positions at the World Bank and other organizations. As Associate Director for the Environment in the Office of Science and Technology Policy under the Clinton Administration, he testified dozens of times before committees and subcommittees of the US Senate and House of Representatives on conservation issues. He emphasized the importance of environmental issues. Devoted to the facilitation of cooperation between science and government policy, he has communicated with related government officials and has helped them make policy decisions. The amount of contribution he has made to policy-making by national governments and international frameworks, a necessity and the foundation for the conservation of the global environment, is tremendous.

**Depletion of the Ozone Layer and Preventive Actions**

Sir Watson received a bachelor's degree and a doctorate in chemistry at Queen Mary College, University of London (England) in 1969 and 1973, respectively. Later, he worked as a postdoctoral fellow at the University of Maryland and the University of California, Berkeley (United States) before establishing a research group at the Jet Propulsion Laboratory (JPL) of the National Aeronautics and Space Administration (NASA). He was purely academic by nature. As a result of the reputation he gained with his doctoral thesis on halogen chemistry research, however, he began to work on a more realistic issue, "depletion of the ozone layer resultant from the use of chlorofluorocarbons (CFCs)." It was already a known fact that depletion of the ozone layer would increase harmful ultraviolet rays reaching the earth's surface, which could increase the occurrences of dermal cancer, conjunctivitis and other serious diseases. In this way he grew motivated to work on the important issue of the global environment.

In 1980 he moved to the headquarters of NASA located in Washington, D.C., as a manager of the upper atmosphere research program and had the opportunity to work with leading numerous scientists studying the depletion of the Ozone Layer. He developed skills and strategies to control and manage the NASA program which was growing more enormous and complex. The most important part of the strategies was the way he adeptly ran the organization by acknowledging the unique values and abilities of scientists and motivating them to a higher goal irrespective of differences in their organization or affiliation. He appealed to the pride of researchers and successfully encouraged them to deepen their involvement in the program. This approach to running the organization gained the support of numerous researchers.

To proceed with a big program aimed at the scientific elucidation of ozone layer depletion, he developed a relationship of trust with Dr. Dan Albritton, Director of the National Oceanic and Atmospheric Administration (NOAA), and helped realize the cooperation of former rivals: NASA and NOAA. The two organizations cooperated with each other and made significant achievements by communicating to policymakers the importance of scientific actions against the crisis and threat posed by a hole in the ozone layer. In cooperation with Dr. Albritton, he sent a team of scientists to the Antarctic in 1986. Dr. Susan Solomon, then an NOAA-affiliated scientist, was appointed the chief of the team. Dr. Solomon's team performed balloon observations and sample analysis experiments near the ground, and strongly suggested that the ozone layer depletion could be attributable to an artificial cause, namely chlorofluorocarbons (CFCs), rather than a natural weather phenomenon. The validity of the report was demonstrated the following year, by an analysis of upper air atmosphere performed in the stratosphere using a high-altitude plane (ER2). Their suggestion became a scientifically undeniable fact. With the latest scientific data, he joined Dr. Albritton in attending meetings for the ratification of the Montreal Protocol, which was negotiated in 1987. They explained to government officials from participating nations the fact that the cause of the Ozone Layer depletion was chlorofluorocarbons (CFCs), and endorsed ratification of the Montreal Protocol which incorporated a 50% reduction of chlorofluorocarbons (CFCs) by 2000. Then-President Reagan signed the Montreal Protocol and said it would boost the development of new technologies. He tackled ozone layer depletion, the biggest environmental issue at that time, and influenced the whole world toward the pursuit of solutions.

**IPCC Third Assessment Report**

From 1997 to 2002, Sir Watson chaired the IPCC and led the review of scientific, technical and socio-economic studies on global warming. In 2001, the IPCC published its Third Assessment Report. The Bush Administration ordered the US National Research Council (NRC) to review the report. The NRC said the IPCC Third Assessment Report (especially Working Group I[1] and technical summary) deserved a lot of praise as a study on climate science[2]. This statement enhanced confidence in the IPCC report.

The Third Assessment Report is important in that it included a Synthesis Report, which said there was strong evidence that the progression of global warming was undeniable and was due to human activities; that the human-induced climate change was expected to persist for centuries; and that the prevention of global warming would require comprehensive actions: continued technical development and overcoming of socio-economic difficulties. The introduction to the Synthesis Report defines the essence of the report as “integration and summarization of information that is policy-relevant and is not policy-prescriptive.” The definition means that the Synthesis Report aims to cover all policy-relevant matters and to continually inform them by using expressions that contribute to policy-making, and that the Synthesis Report represents advice from the scientists’ view and is not meant to tell policymakers what to do. This strongly conveys the attitude of Sir Watson toward realistically solving climate issues without deviating from his position as a scientist or limiting the role of the Synthesis Report to mere scientific remarks.

The basic details of the report were decided by scientists. The line by line wording of the report required consent by government officials from around the world. The coordination activities needed between scientists and government officials was all about putting scientific remarks into the most appropriate language for policymakers. Discussions for coordination were focused on a relationship between “accuracy, balance and clarity of message” in wording and “policies and interpretations.” The approval of the Synthesis Report of the IPCC Third Assessment Report, led by Sir Watson, involved many people consisting of delegations from 100 countries, 10 non-governmental organizations and 42 scientists. Assuming leadership of this large organization, he summarized important points and submitted them to the IPCC plenary. By facilitating close exchange between science and policy, he contributed to making important policies, set an exemplary precedent for collaboration and coordination between scientists and policymakers and is now referred to as the master of uniting government officials and scientists.

Most remarkably, he drastically changed the whole world’s view on climate change through the IPCC report which led to important changes of policy designed for the reduction of greenhouse gases at regional, national and international levels.

**Facilitation of Environmental Policies**

Sir Watson chaired the Scientific and Technical Advisory Panel of the U.N. Global Environment Facility (GEF) and the international Global Biodiversity Assessment and Millennium Ecosystem Assessment of the United Nations Environment Programme (UNEP) and has held important positions at many other international organizations. His administrative and managerial abilities were thoroughly exhibited in his commitments to the conservation of the global environment. From 1996 to 2007, he acted as Chief Scientist and Director for Environmentally and Socially Sustainable Development at the World Bank. He was devoted to revitalizing scientific programs at the World Bank. In line with the aim of the World Bank, namely relief from poverty and development of a sustainable society, he facilitated international exchanges of scientists and endeavored to help developing nations improve their scientific abilities. As Associate Director for the Environment in the Office of Science and Technology Policy under the Clinton Administration, he testified dozens of times before committees and subcommittees of the US Senate and House of Representatives on conservation issues. He explained the causal relationship among human economic activities, depletion of the ozone layer and global warming as well as the impact and damage that could result as a consequence, explaining to the whole world the graveness of environmental issues. Mr. Al Gore, former US Vice President, described Sir Watson as a “Hero of the Planet” in a letter written to a senior US government official.

The Sir Watson has devoted himself to the facilitation of cooperation between science and government policy, disseminated important information and views on science and helped government officials make policy decisions by keeping in contact with them. The size of the contribution he has made to policymaking by national governments and international frameworks, a necessity and the foundation for conservation of the global environment, is tremendous.

**Notes**

1. IPCC Working Group I (designed for scientific, technical and social-scientific assessment of climate change)
2. Committee on the Science of Climate Change, NRC (2001)

## Essay

# Current and Projected State of the Global and Regional Environment: Implications for Environmental, Economic and Social Sustainability

**Sir Bob Watson**

Most countries are attempting to achieve environmentally and socially sustainable economic growth, coupled with food, water, energy and human security at a time of enormous global changes, including environmental degradation at the local, regional and global scale. Key issues include climate change, loss of biodiversity and ecosystem services (provisioning, regulating, cultural and supporting), local and regional air pollution, and land and water degradation.

There is no doubt that the Earth's environment is changing on all scales from local to global, in large measure due to human activities,. The stratospheric ozone layer has been depleted, the climate is warming at a rate faster than at any time during the last 10,000 years, biodiversity is being lost at an unprecedented rate, fisheries are in decline in most of the world's oceans, air pollution is an increasing problem in and around many of the major cities in the world, large numbers of people live in water stressed or water scarce areas, and large areas of land are being degraded. Much of this environmental degradation is due to the unsustainable production and use of energy, water, food and other biological resources and is already undermining efforts to alleviate poverty and stimulate sustainable development, and worse, the future projected changes in the environment are likely to have even more severe consequences.

Understanding the interconnections among these environmental issues is essential in order to develop and implement informed cost-effective and socially acceptable policies, practices and technologies at the local, regional and global scale. Given these environmental issues are closely inter-linked we must ensure that policies and technologies to address one environmental issue, positively, and not negatively, impact on other aspects of the environment or human well-being, i.e., it is important to identify climate change response measures that are also beneficial to biodiversity and do not adversely affect biodiversity. Cost-effective and equitable approaches to address these issues exist or can be developed, but will require political will and moral leadership. While the substantial measures needed to prevent environmental degradation from undermining growth and poverty alleviation are not yet in place, a combination of technological and behavioral changes, coupled with pricing and effective policies (including regulatory policies), are needed to address these global challenges at all spatial scales, and across all sectors.

The major indirect drivers of change are primarily demographic, economic, socio-political, technological, and cultural and religious. These drivers are clearly changing: the world's population and the global economy are growing, the world is becoming more interdependent, and there are major changes in information technology and biotechnology. The world's population will likely increase from about 6.5 billion people today to 9 to10 billion people by 2050. This increase in population will be accompanied by an increase in GDP globally of a factor of 3-4, with developing countries increasingly driving global economic growth. By 2030, about half or more of the purchasing power of the global economy will stem from developing countries. Broad-based growth in developing countries sustained over the next 25 years could significantly reduce global poverty. At the same time, it must be recognized that the benefits from growth and globalization could be undermined by a failure to properly manage global environmental issues, especially mitigating and adapting to climate change, and reducing the loss of biodiversity and degradation of ecosystem services.

**Climate Change**

There is no doubt that the composition of the atmosphere and the Earth's climate have changed since the industrial revolution predominantly due to human activities, and it is inevitable that these changes will continue regionally and globally. The atmospheric concentration of carbon dioxide has increased by over 30% since the pre-industrial era primarily due to the combustion of fossil fuels and deforestation. Global mean surface temperatures have already increased by about 0.75°C, an additional 0.5°C to 1.0°C is inevitable due to past emissions, and are projected to increase by an additional 1.2-6.4°C between 2000 and 2100, with land areas warming more than the oceans and high latitudes warming more than the tropics. Precipitation is more difficult to predict, but is likely to increase at high latitudes and in the tropics, and decrease significantly in the sub-tropics, with an increase in heavy precipitation events and a decrease in light precipitation events, leading to more floods and droughts.

Changes in temperature and precipitation are causing, and will continue to cause, other environmental changes, including, rising sea levels, retreating mountain glaciers, melting of the Greenland ice cap, shrinking Arctic Sea ice, especially in summer, increasing frequency of extreme weather events, such as heat waves, floods, and droughts, and intensification of cyclonic events, such as hurricanes in the Atlantic.

The Earth's climate, which is projected to change at a faster rate than during the last century, is projected to adversely affect freshwater, food and fiber, natural ecosystems, coastal systems and low-lying areas, human health and social systems. The impacts of climate change are likely to be extensive, primarily negative, and cut across many sectors. Temperature increases, which will increase the thermal growing season at temperate latitudes, including in the US and Europe, are likely lead to increased agricultural productivity for temperature changes below 2-3°C, but decrease with larger changes. However, agricultural productivity will likely be negatively impacted for almost any changes in climate throughout the tropics and sub-tropics, areas with high levels of hunger and malnutrition. Water quality and availability in many arid- and semi-arid regions will likely decrease, while the risk of floods and droughts in many regions of the world will increase. Vector- and water-borne diseases, heat stress mortality and extreme weather-event deaths, and threats to nutrition in developing countries, will likely increase. Millions of people could be trapped in areas of abject poverty or displaced due to sea-level rise and flooding. These climate change impacts are most likely to adversely affect populations in developing countries. Climate change, coupled with other stresses, can lead to local and regional conflict and migration depending on the social, economic, and political circumstances.

The goal, agreed at the Ministerial session of the UNFCCC in Copenhagen in 2009, and endorsed in Cancun and Durban, to limit global temperature changes to 2°C above pre-industrial levels is appropriate if the most severe consequences of human-induced climate change are to be avoided, but it must be recognized to be a stretch target and, unless political will changes drastically in the near future, it will not be met. Therefore, we should be prepared to adapt to global temperature changes of 4-5°C. In addition, we must recognize that we cannot address mitigation and adaptation separately.

Mitigating climate change will require getting the price right, an evolution of low-carbon technologies (production and use of energy), and behavior change by individuals, communities, private sector and the public sectors (see paper by Goldemberg and Lovins). In addition to transitioning to a low carbon energy system, it is critical to reduce emissions from forests by reducing forest degradation and deforestation; and sequestering carbon through reforestation; afforestation; and agroforestry, and from agricultural systems through conservation tillage, reducing emissions from the use of fertilizers, and from livestock and rice production.

In addition, to mitigating the emissions of greenhouse gases, it will be essential to adapt to climate change. However, mitigation is essential because there are physical, technological, behavioural and financial limits to the amount of adaptation that we can achieve: there are physical limits to adaptation on small, low-lying islands, technological limits to flood defences, behavioural limits to where people live and why, and financial limits for adaptation activities. The more we mitigate, the less we will have to adapt. Nevertheless, we know that adaptation is essential and must be mainstreamed, particularly into sectoral and national economic planning in developing countries due to their heightened vulnerability to climate change impacts.

**Loss of Biodiversity and Degradation of Ecosystem Services**

Throughout the world, biodiversity at the genetic, species and landscape level is being lost, and ecosystems and their services are being degraded, because of conversion of natural habitats, over-exploitation, pollution, introduction of exotic species and climate change, which are in many instances causing tremendous harm to both people and the environment. In particular, the emphasis placed on provisioning services to meet the increased need for food (crops and livestock), and to a lesser extent fibre, water and energy, for an increasing population has resulted in a decline in biodiversity and degradation of many ecosystems. The Millennium Ecosystem Assessment reported that 15 of the 24 services evaluated were in decline, 4 were improving and 5 were improving in some regions of the world and declining in other regions. The UK National Ecosystem Assessment reported that between 30-35% of the ecosystem services evaluated were in decline, 20% were improving and 45-50% were relatively stable. While climate change has not been a major cause of biodiversity loss over the last 100 years it is likely to be a major threat in all biomes during the next 100 years. Climate change will likely exacerbate biodiversity loss and adversely affect most ecological systems, especially coral reefs, mountainous and polar ecosystems, potentially resulting in significant adverse changes in ecosystem goods and services. A recent assessment estimated that every 1°C increase in global mean surface temperature up to 5°C would eventually result in a 10% loss of species.

Biodiversity is central to human well-being, providing a variety of ecosystem services that humankind relies on, including: provisioning (e.g. food, freshwater, wood and fiber, and fuel); regulating (e.g. of climate, flood, diseases); culture (e.g. aesthetic, spiritual, educational, and recreational), and supporting (e.g. nutrient cycling, soil formation, and primary production). These ecosystem services, which contribute to human well-being, including our security, health, social relations, and freedom of choice and action, are being diminished.

The benefits that we derive from the natural world and its constituent ecosystems are critically important to human well-being and economic prosperity, but are consistently undervalued in economic analysis and decision-making. Effective conservation and sustainable use of ecosystems are critical for human well-being and a future thriving and sustainable green economy. Failure to include the valuation of non-market values in decision-making results in a less efficient resource allocation; however, a major challenge is to develop systems to appropriate the values of non-market ecosystem services to land managers.

Therefore, addressing the issue of biodiversity and ecosystem services requires changing the economic background to decision-making. There is a need to: (i) make sure that the value of all ecosystem services, not just those bought and sold in the market, are taken into account when making decisions; (ii) remove subsidies to agriculture, fisheries, and energy that cause harm to people and the environment; (iii) introduce payments to landowners in return for managing their lands in ways that protect ecosystem services, such as water quality and carbon storage, that are of value to society; and (iv) establish market mechanisms to reduce nutrient releases and carbon emissions in the most cost-effective way.

There is also a need to improve policy, planning, and management by integrating decision-making between different departments and sectors, as well as international institutions, to ensure that policies are focused on protection and sustainable use of ecosystems. It will require: (i) empowering marginalized groups to influence decisions affecting ecosystem services, and recognize in law local communities' ownership of natural resources; (ii) restoring degraded ecosystems and establishing additional protected areas, particularly in marine systems and providing greater financial and management support to those that already exist; and (iii) using all relevant forms of knowledge and information about ecosystems in decision-making, including the knowledge of local and indigenous groups.

Success will also require influencing individual and community behavior. Thus it will be critical to provide access to information about ecosystems and decisions affecting their services, provide public education on why and how to reduce consumption of threatened ecosystem services, and by establishing reliable certification systems to give people the choice to buy sustainably harvested products. It will also be important to develop and use environment-friendly technologies, thus requiring investments in agricultural science and technology aimed at increasing food production with minimal harmful trade-offs.

## Lecture

# Ozone Depletion, Climate Change and Loss of Biodiversity: Implications for Food, Water and Human Security

**Sir Bob Watson**

**Slide 1*** - There is no doubt that the Earth's environment is changing on all scales from local to global, in large measure due to human activities. The stratospheric ozone layer has been depleted, the climate is warming at a rate faster than at any time during the last 10,000 years, biodiversity is being lost at an unprecedented rate, fisheries are in decline in most of the world's oceans, air pollution is an increasing problem in and around many of the major cities in the world, large numbers of people live in water stressed or water scarce areas, and large areas of land are being degraded. Much of this environmental degradation is due to the unsustainable production and use of energy, water, food and other biological resources and is already undermining efforts to alleviate poverty and stimulate sustainable development, and worse, the future projected changes in the environment are likely to have even more severe consequences.

The issues of stratospheric ozone depletion, climate change, loss of biodiversity and degradation of ecosystem services, local and regional air pollution, and land and water degradation are inter-connected and are undermining:

- Economic growth, poverty alleviation, and the livelihoods of the poor;
- Human health; and
- Personal, national, and regional security.

Understanding the interconnections among these environmental issues is essential in order to develop and implement informed cost-effective and socially acceptable policies, practices and technologies at the local, regional and global scale. Given these environmental issues are closely inter-linked we must ensure that policies and technologies to address one environmental issue, positively, and not negatively, impact on other aspects of the environment or human well-being, i.e., it is important to identify climate change response measures that are also beneficial to biodiversity and do not adversely affect biodiversity. Cost-effective and equitable approaches to address these issues exist or can be developed, but will require political will and moral leadership. While the substantial measures needed to prevent environmental degradation from undermining growth and poverty alleviation are not yet in place, a combination of technological and behavioral changes, coupled with pricing and effective policies (including regulatory policies), are needed to address these global challenges at all spatial scales, and across all sectors.

The major indirect drivers of change are primarily demographic, economic, socio-



* There are supplement slides *at the back of* the section.

political, technological, and cultural and religious. These drivers are clearly changing: the world's population and the global economy are growing, the world is becoming more interdependent, and there are major changes in information technology and biotechnology. The world's population will likely increase from about 6.5 billion people today to 9-10 billion people by 2050. This increase in population will be accompanied by an increase in GDP globally of a factor of 3-4, with developing countries increasingly driving global economic growth. By 2030, about half or more of the purchasing power of the global economy will stem from developing countries. Broad-based growth in developing countries sustained over the next 25 years could significantly reduce global poverty. At the same time, it must be recognized that the benefits from growth and globalization could be undermined by a failure to properly manage global environmental issues, especially mitigating and adapting to climate change, and reducing the loss of biodiversity and degradation of ecosystem services.

**Slide 2 - Stratospheric Ozone Depletion**

The layer of ozone in the stratosphere protects the Earth from damaging ultraviolet radiation, which can cause melanoma and non melanoma skin cancer in humans and adversely affect ecological systems. Scientific research in the 1970s, 1980s and 1990s demonstrated that anthropogenic emissions of chlorine, e.g., chlorofluorocarbons, and bromine containing chemicals that reached the stratosphere are photo-dissociated. The resulting halogen atoms and halogen free radicals catalytically destroy ozone at all latitudes, except the tropics, with the greatest depletions being at high latitudes in winter. Of particular importance was the discovery of the spring-time Antarctic ozone hole and the subsequent ground, balloon and aircraft campaigns that showed that human activities were responsible and not natural phenomena. A series of international ozone assessments provided the scientific, technical and economic information needed to inform national and international policy formulation. In 1985 an International Convention to protect the ozone layer was successfully negotiated, followed by the historic Montreal Protocol in 1987, which mandated emission reductions in ozone-depleting chemicals from industrialized countries. The Montreal Protocol was quickly followed by a series of adjustments and amendments, which resulted in the elimination of emissions of nearly all short- and long-lived halogenated chemicals from both developed and developing countries, thus protecting the ozone layer from significant loss. Observational evidence shows that the Montreal Protocol is working with the atmospheric concentrations of the ozone-depleting chemicals peaking and now decreasing. The Montreal Protocol should result in the ozone layer recovering by the middle of the century.

This is clearly a success story, where national and internationally coordinated research led to an understanding of the processes controlling the abundance of stratospheric ozone. The international assessments provided decision-makers in government with a single source of information upon which to base national and international policies and the private sector information upon which to develop environmentally-friendly alternatives.

**Slide 3 - Climate Change**

There is no doubt that the composition of the atmosphere and the Earth's climate have changed since the industrial revolution predominantly due to human activities, and it is inevitable that these changes will continue regionally and globally. Global mean surface temperatures have already increased by about 0.75°C, and are projected to increase by an additional 1.2-6.4°C between 2000 and 2100, with land areas in the high northern latitudes increasing by 4-5°C by 2090 even under low greenhouse gas emission scenarios, and by 10°C on average under high greenhouse gas emission scenarios. Precipitation is more difficult to predict, however is likely to increase at high latitudes and in the tropics, and decrease significantly in the sub-tropics.

Changes in temperature and precipitation are causing, and will continue to cause, other environmental changes, including, rising sea levels, retreating mountain glaciers, melting of the Greenland ice cap, shrinking Arctic Sea ice, especially in summer, increasing frequency of extreme weather events, such as heat waves, floods, and droughts, and intensification of cyclonic events, such as hurricanes in the Atlantic.

The Earth's climate, which is projected to change at a faster rate than during the last century, is projected to adversely affect freshwater, food and fiber, natural ecosystems, coastal systems and low-lying areas, human health and social systems. The impacts of climate change are likely to be extensive, primarily negative, and cut across many sectors. Temperature increases, which will increase the thermal growing season at temperate latitudes, including in the US and Europe, are likely lead to increased agricultural productivity for temperature changes below 2-3°C, but decrease with larger changes. However, agricultural productivity will likely be negatively impacted for almost any changes in climate throughout the tropics and sub-tropics, areas with high levels of hunger and malnutrition. Climate change will likely exacerbate biodiversity loss and adversely affect most ecological systems, especially coral reefs, potentially resulting in significant adverse changes in ecosystem goods and services. A recent assessment estimated that every 1°C increase in global mean surface temperature up to 5°C would eventually result in a 10% loss of species. Water availability and quality in many arid and semi-arid regions will likely decrease, while the risk of floods and droughts in many regions will increase. Vector- and water-borne diseases, heat stress mortality and extreme weather-event deaths, and threats to nutrition in developing countries, will likely increase. Tens of millions of people could be displaced due to sea-level rise. These climate change impacts are most likely to adversely affect populations in developing countries. Climate change, coupled with other stresses, can lead to local and regional conflict and migration depending on the social, economic, and political circumstances.

Poverty alleviation requires climate change-resilient development, which must consist of strategies to cost-effectively mitigate human-induced climate change and adapt to the projected impacts. While developed countries remain the largest per-capita emitters of greenhouse gases today, the growth of carbon emissions in the next decades will come primarily from developing countries, especially China and India, which are following the same energy and carbon intensive development path as did their rich counterparts. Consequently, to mitigate climate change we must minimize the emissions of greenhouse gases and transition to a low-carbon economy while recognizing that access to affordable energy in developing countries is a pre-requisite for poverty alleviation and economic growth. To adapt, we must integrate current climate variability and projected climatic changes into sector and national economic planning while taking into consideration the aspirations of local communities.

Climate change-resilient development must be equitable. Climate change, like biodiversity loss and ecosystem degradation, is an inter- and intra-generational equity issue. Whereas the historical greenhouse gas emissions have come from developed countries, developing countries and poor people in developing countries are most vulnerable to the impacts of climate change. Furthermore, the actions of today will affect future generations. Mitigation and adaptation strategies must take these equity issues into account.

**Slide 4 - Mitigating Climate Change**

The goal, agreed at the Ministerial session of the UNFCCC in Copenhagen in 2009, to limit global temperature changes to 2°C above pre-industrial levels is appropriate if the most severe consequences of human-induced climate change are to be avoided, but it must be recognized to be a stretch target and, unless political will changes drastically in the near future, it will not be met. Therefore, we should be prepared to adapt to global temperature changes of 4-5°C. In addition, we must recognize that we cannot address mitigation and adaptation separately.

The current level of greenhouse gases in the atmosphere, accounting for the offsetting effect of aerosols, is approximately 385ppm $CO_2$eq*. If we succeed at stabilizing between 400 and 450ppm $CO_2$eq, there is a 50% chance that global temperature changes will be limited to 2°C above pre-industrial levels, with a 5% probability of 2.8°C. However, the likelihood of stabilizing at this level is low. If we stabilize at 550ppm $CO_2$eq, there is a 50% chance that global temperature changes will be limited to 3°C above pre-industrial levels, with a 5% chance of a 4.8°C, and if we allow the atmosphere to reach 650ppm $CO_2$eq then there is a 50% chance that global temperature changes will be limited to 4°C above pre-industrial levels, with a 5% chance of a 6.0°C.

To stabilize at 500ppm $CO_2$eq or lower, OECD countries would need to reduce their carbon emissions by at least 80% by 2050. Developing countries would also need to decrease their projected carbon emissions significantly over the same time period. Clearly a range of tools (policies, technologies and practices) are needed to stabilize greenhouse gases in the atmosphere at 500ppm $CO_2$eq or less.

It is often assumed that an appropriate combination of technology and policy options could provide the basis to meet our stabilization goals and mitigate climate change. However, mitigation will require a combination of pricing and technological mechanisms, as well as good policies and behavioural change, i.e., pricing carbon emissions and understanding behavioural changes is critical.

The IPCC Fourth Assessment Report shows that putting a price on carbon can lead to significant emission reductions. Pricing mechanisms include emissions trading, taxation, and regulations across national, regional, and global scales and across all sectors.

Note * ppm $CO_2$eq: parts per million of carbon dioxide equivalent

Technology use and transformation is needed to reduce emissions. Better use of available low-carbon technologies coupled with improved development, commercialization and market penetration of emerging technologies is required. Examples include:

- **Efficient production and use of energy:** power generation (e.g. re-powering inefficient coal plants and developing integrated gasification combined cycle (IGCC)); efficient transport (e.g., developing electric and fuel cell cars; developing mass transit; and improving urban planning), buildings, and industries;
- **Fuel shift:** coal to gas;
- **Renewable energy and fuels:** wind, wave and tidal power; solar PV and solar thermal; small- and large-scale hydropower; and bio-energy;
- **Carbon capture and storage (CCS):** capture and geological storage of $CO_2$ produced during electricity generation (e.g., IGCC – CCS); and
- **Nuclear fission:** nuclear power

In addition to transitioning to a low carbon energy system, it is critical to reduce emissions from forests by reducing forest degradation and deforestation; and sequestering carbon through reforestation; afforestation; and agroforestry, and from agricultural systems through conservation tillage, reducing emissions from the use of fertilizers, and from livestock and rice production.

Key mitigation technologies projected to be commercialized before 2030 include, carbon capture and storage, advanced nuclear power, and renewable energy (e.g., tidal and wave energy), second generation biofuels, advanced electric and hybrid vehicles, and integrated design of commercial buildings. However, governments and the private sector must invest more in energy RD&D to deliver these low greenhouse gas technologies. At least US$20 trillion is required globally for energy infrastructure investments between now and 2030. Investment decisions will determine emissions from the energy sector. Returning global energy-related $CO_2$ emissions to 2005 levels by 2030 would require a major shift in investment patterns, but initial estimates suggest that the net additional investments range from negligible to 5-10%

A suitable policy framework is needed to facilitate the emergence of appropriate pricing and technological mechanisms, as voluntary agreements alone will not work. Policies that provide a real or implicit price of carbon could create incentives for producers and consumers to significantly invest in low-greenhouse gas products, technologies and processes, including economic instruments, regulations (e.g., standards) and government funding and tax credits. The costs of reducing greenhouse gas emissions are reduced through international trading and adopting a multi gas / multi sector strategy, hence reducing the financing needed to transition to a low-carbon economy.

A long-term (e.g. 2030–2050), legally binding global regulatory framework is needed that involves all major emitters, including the US, EU, Russia, China, Brazil, and India. The agreement should allocate responsibilities in an equitable manner and should include immediate and intermediate targets. This would stimulate a viable carbon market with a flow of funds to developing countries of tens of billions of dollars per year. The framework should expand the range of eligible Clean Development Mechanism (CDM) activities to include reduced deforestation and forest degradation (REDD), green investment schemes, and energy efficiency standards. Sectoral and programmatic approaches should be considered.

In order to stabilize the concentration of greenhouse gases in the atmosphere, emissions would have to peak and decline thereafter – the lower the stabilization level the more quickly this peak and decline would need to occur. Delaying action to reduce greenhouse gas emissions will be costly by locking in high carbon pathways, thus making it more difficult and expensive to reduce emissions in the future, as well as creating higher risks of severe climate change impacts.

**Adaptation**

In addition, to mitigating the emissions of greenhouse gases, it will be essential to adapt to climate change. However, mitigation is essential because there are physical, technological, behavioural and financial limits to the amount of adaptation that we can achieve: there are physical limits to adaptation on small, low-lying islands, technological limits to flood defences, behavioural limits to where people live and why, and financial limits to integrate adaptation to climate change. The more we mitigate, the less we will have to adapt. Nevertheless, we know that adaptation is essential and must be mainstreamed, particularly into sectoral and national economic planning in developing countries due to their heightened vulnerability to climate change impacts.

The estimated annual costs of inaction related to climate change cover a huge range, but are expected to fall between tens and hundreds of billions of dollars in developing countries by 2050. Furthermore, a preliminary assessment shows that tens of billions of dollars per year of Overseas Development Assistance (ODA) and concessional finance investments are exposed to climate risks. Comprehensive project planning and additional investments to climate-proof development projects will require additional funding.

While current financial instruments are technically adequate to respond to the challenge of achieving climate resilient development, the amounts of money flowing through these instruments need to be substantially increased. Issues requiring immediate work include an analysis of institutional barriers to mainstreaming adaptation into development planning and the need for new standards for infrastructure and procedures for planning. New insurance related instruments are likely to play a major role in this, including weather index insurance for activities by farmers, and risk pooling arrangements such as the Global Index Insurance Facility.

Failure to adapt adequately to current climate variability is already a major impediment to poverty reduction. Most sectors are maladapted to current climate variability. Failure to effectively mainstream adaptation to increasingly severe weather patterns and climate variability into development activities is a major threat to poverty alleviation. This requires a climate risk management approach that takes account of the threats and opportunities arising from both current and future climate variability in project design. This process must be country-driven and focus on national needs and local priorities. Delivery of adaptive responses depends on effective governance mechanisms.

**Slide 5 - Loss of Biodiversity and Degradation of Ecosystem Services**

Biodiversity is central to human wellbeing, providing a variety of ecosystem services that humankind relies on, including: provisioning (e.g. food, freshwater, wood and fiber, and fuel); regulating (e.g. of climate, flood, diseases); culture (e.g. aesthetic, spiritual, educational, and recreational), and supporting (e.g. nutrient cycling, soil formation, and primary produ-ction). These ecosystem services contribute to human wellbeing, including our security, health, social relations, and freedom of choice and action.

Enhancement of the goods and services provided by ecosystems tend to have multiple and synergistic benefits, but little of this potential is being used today. Indeed, throughout the world, the capability of many ecosystems to provide a range of services is being diminished, because of conversion of natural habitats, over-exploitation, pollution, introduction of exotic species and climate change, which are in some instances causing tremendous harm to both people and the environment. While climate change has not been a major cause of biodiversity loss over the last 100 years it is likely to be a major threat in all biomes in the next 100 years.

Addressing the issue of biodiversity and ecosystem services requires changing the economic background to decision-making. There is a need to: (i) make sure that the value of all ecosystem services, not just those bought and sold in the market, are taken into account when making decisions; (ii) remove subsidies to agriculture, fisheries, and energy that cause harm to people and the environment; (iii) introduce payments to landowners in return for managing their lands in ways that protect ecosystem services, such as water quality and carbon storage, that are of value to society; and (iv) establish market mechanisms to reduce nutrient releases and carbon emissions in the most cost-effective way.

There is also a need to improve policy, planning, and management by integrating decision-making between different departments and sectors, as well as international institu-tions, to ensure that policies are focused on protection and sustainable use of ecosystems. It will require: (i) empowering marginalized groups to influence decisions affecting ecosystem services, and recognize in law local communities' ownership of natural resources; (ii) restoring degraded ecosystems and establishing additional protected areas, particularly in marine systems and providing greater financial and management support to those that already exist; and (iii) using all relevant forms of knowledge and information about ecosystems in decision-making, including the knowledge of local and indigenous groups.

Success will depend on influencing individual behavior, thus it will be critical to provide access to information about ecosystems and decisions affecting their services, provide public education on why and how to reduce consumption of threatened ecosystem services, and by establishing reliable certification systems to give people the choice to buy sustainably harvested products. It will also be important to develop and use environment-friendly technologies, thus requiring investments in agricultural science and technology aimed at increasing food production with minimal harmful trade-offs.

**Slide 6 - Food Security and Agricultural Production**
Total food production has nearly trebled since 1960, per capita production has increased by 30%, and food prices and the percent of undernourished people have fallen, but the benefits have been uneven and more than one billion people still go to bed hungry each night. Furthermore, intensive and extensive food production has caused environmental degradation.

Food prices increased during the last two-three years for a variety of reasons that are unlikely to disappear in the coming decades, including:

- Poor harvests due to variable weather – possibly related to human-induced climate change;
- Increased biofuels use, e.g., maize in the USA;
- Increased demand, in rapidly growing economies;
- High energy prices, increasing the cost of mechanization and fertilizers;
- Speculation on the commodity markets at a time of low stocks; and
- Export bans from some large exporting countries to protect domestic supplies.

The demand for food will likely double in the next 25-50 years, primarily in developing countries. Furthermore, the type and nutritional quality of food demanded will change, e.g., increased demand for meat. We need sustained growth in the agricultural sector to feed the world, enhance rural livelihoods, and stimulate economic growth. Yet these new demands are arising at a time when – in addition to the challenges highlighted above – the world has less labour due to disease and rural-urban migration, less water due to competition from other sectors, distorted trade policies due to OECD subsidies, land policy conflicts, loss of genetic, species, and ecosystem biodiversity, and increasing levels of air and water pollution.

Agriculture affects the environment; for example, tillage and irrigation methods can lead to salinisation and soil erosion, and fertilisers and other forms of agricultural production (e.g. rice production and livestock) contribute to greenhouse gas emissions, and extensification into grasslands and forests leads to loss of biodiversity at the genetic, species and landscape level. Environmental degradation in turns reduces agricultural productivity.

We can no longer think of agriculture in terms of production alone. We must acknowledge the multi-functionality of agriculture, and place agriculture within a broad economic, social, and environmental framework.

We can feed the world with affordable food while providing a viable income for the farmer, but business-as-usual will not work. Most of today's hunger problems can be addressed with the appropriate use of current technologies, particularly appropriate agro-ecological practices (e.g. no/low till, integrated pest management, and integrated natural resource management). These must be coupled with decreased post-harvest losses.

Emerging issues such as climate change and new plant and animal pests may increase our future need for higher productivity and may require advanced biotechnologies, including genetic modification, to address future food demands. However, the risks and benefits of these tools must be fully understood on a case-by-case basis. The public and private sectors should increase their investments in research and development, extension services, and weather and market information.

Farmers must be central to all initiatives taken; local and traditional knowledge must be integrated with agricultural knowledge, science, and technology developed in universities and government laboratories. Innovation that involves all relevant stakeholders along the complete food chain is essential. As such, we must recognize the critical role of women and empower them (e.g. through education, property rights, and access to financing).

We will also need to employ global-scale policy reforms. This will include eliminating both OECD production subsidies and tariff escalation on processed products, and recognizing the special needs of the least developed countries through non-reciprocal market access. Governments should pay farmers to maintain and enhance ecosystem services.

**Slide 7 - Water Security**

Projections show that by 2025 over half of the world's population will live in places that are subject to severe water stress. This is irrespective of climate change, which will exacerbate the situation. Water quality is declining in many parts of the world, and 50-60% of wetlands have been lost. Human-induced climate change is projected to decrease water quality and availability in many arid and semi-arid regions and increase the threats posed by floods and droughts in most parts of the world. This will have far-reaching implications, including for agriculture: 70% of all freshwater is currently used for irrigation. 15-35% of irrigation water use already exceeds supply and is thus unsustainable.

Freshwater availability is spatially variable and scarce, particularly in many regions of Africa and Asia. Numerous dry regions, including many of the world's major "food bowls," will likely become much drier even under medium levels of climate change. Glacier melt, which provides water for many developing countries, will likely exacerbate this problem over the long term. Runoff will decrease in many places due to increased evapotranspiration. In contrast, more precipitation is likely to fall in many of the world's wetter regions. Developed regions and countries will also be affected. For example, winters will likely become hotter and wetter in the UK, and summers hotter and drier; southeast England may receive 50% less rainfall during the summer by the 2080s.

Cost recovery for water – at only 20% – poses a major problem for water management. Crucially, and controversially, we must get water pricing right. The Dublin Principles should be implemented to help address the challenges associated with water scarcity. These include the:

- **Ecological Principle:** river basin management (often transnational); multi-sectoral management (e.g. agriculture, industry, and households); and coupled land-and-water management
- **Institutional Principle:** Comprehensive stakeholder involvement (e.g. state, private sector, and civil society – especially women) in management action at the lowest level
- **Instrument Principle:** Improved allocation and quality enhancement via incentives and economic principles

**Science-policy Interface**

Strengthening the science-policy interface for many environmental issues is also critical. National and international, coordinated, and interdisciplinary research is the critical underpinning of informed policy formulation and implementation. There is an urgent need for strengthening the scientific and technological infrastructure in most developing countries. Independent, global expert assessments that encompass risk assessment and risk management have proven to be a critical component of the science-policy interface. These include the International Stratospheric Ozone Assessments, the Intergovernmental Panel on Climate Change, the Millennium Ecosystem Assessment, and the International Agricultural Assessment of Science and Technology for Development. Such assessments must be policy-relevant rather than policy-prescriptive. Furthermore, we need a more integrated assessment process that encompasses all environmental issues within the construct of economic growth and poverty alleviation.

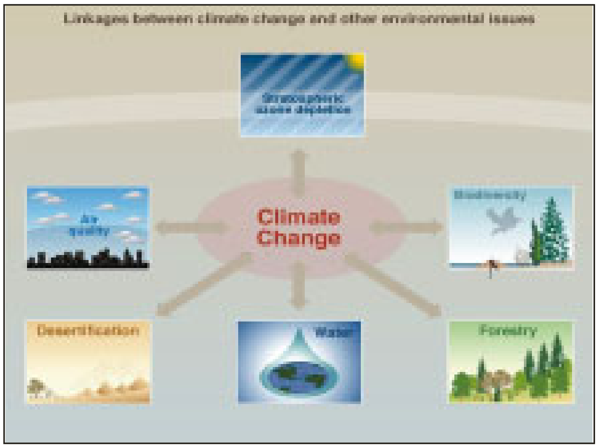
**Slide 8 - Conclusion**

In summary, we are changing the Earth's climate, losing biodiversity and spending Earth's natural capital, putting such strain on the natural functions of Earth that the ability of the planet's ecosystems to sustain future generations can no longer be taken for granted. However, the future is not pre-ordained. Business as usual will lead to an unsustainable world with significant changes in the Earth's climate and a loss of critical ecosystem services. Cost-effective technologies, supported by an appropriate policy framework, can lead to more sustainable practices. Effective action needs stable and credible environmental policies that support the long-term shift to a low-carbon economy and the sustainable use of natural resources. We need not just a small improvement in resource efficiency, but a radical shift. Public and private sector decision-makers need to take a longer-term perspective. We must make advances in science and technology, with the emphasis on interdisciplinary research. We must get the economics right; this includes eliminating perverse subsidies by valuing ecosystem services and internalizing externalities.

Progress requires political will and moral leadership in the public and private sectors. The actions of today's generation will profoundly affect the Earth inherited by our children and future generations. Policymakers should recognize that there is no dichotomy between economic growth and environmental protection, and that addressing issues such as climate change provides economic opportunities to restructure and make a more efficient energy system, and can provide additional benefits such as reducing local and regional air pollution, with positive implications for human health. The benefits of limiting climate change and sustainably managing ecosystems far exceed the costs of inaction, and delaying action can significantly increase costs. Efficient resource use saves money for businesses and households, and a green economy will be a source of future employment and innovation. Similarly the conservation and sustainable use of biodiversity can have significant economic and social benefits.

Unless we act now to limit human-induced environmental degradation, history will judge us as having been complacent in the face of compelling scientific evidence that humans are changing the Earth's environment with predominantly adverse effects on human health, ecological systems and socio-economic sectors. Do we really want our heritage to be that of sacrificing the Earth's biodiversity for cheap fossil fuel energy, ignoring the needs of future generations, and failing to the meet the challenge of providing energy in an environmentally and socially sustainable manner when so many choices were available? Leaders from government and industry must stand shoulder to shoulder to ensure that the future of the Earth is not needlessly sacrificed.

## Slide 1-1




## Slide 1-2

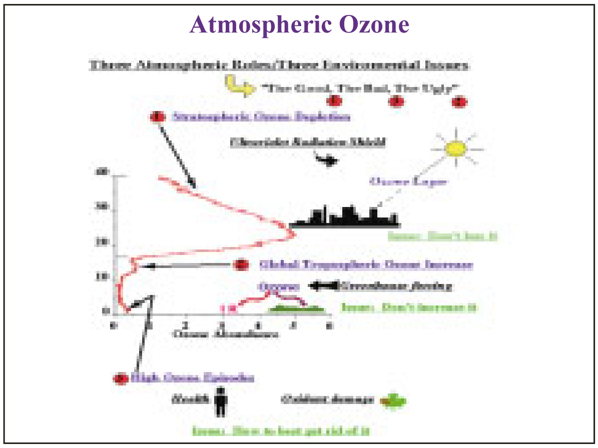
### Climate change, loss of biodiversity and ecosystem degradation

- Climate change, loss of biodiversity and ecosystem degradation are environment, development and security issues, i.e., they undermine:
  - food, water and human security
  - the economy (loss of natural capital)
  - poverty alleviation and the livelihoods of the poor
  - human health
  - personal, national and regional security

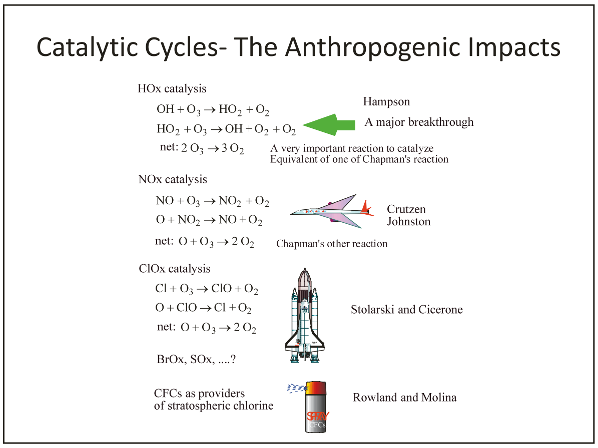
- Climate change and ecosystem degradation are inter- and intra-generational equity issues:
  - developing countries and poor people in developing countries are the most vulnerable
  - the actions of today will affect future generations

## Slide 2

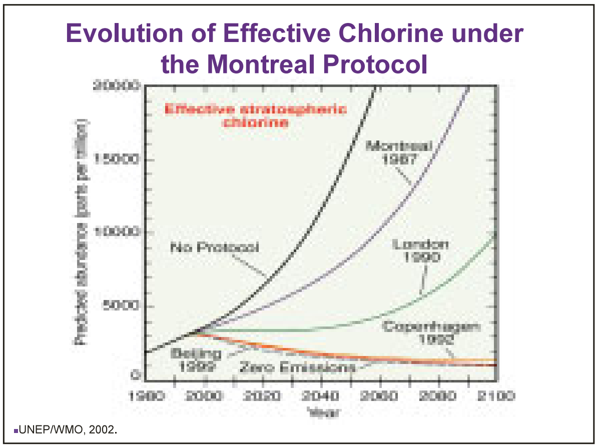
## Stratospheric Ozone Depletion 1



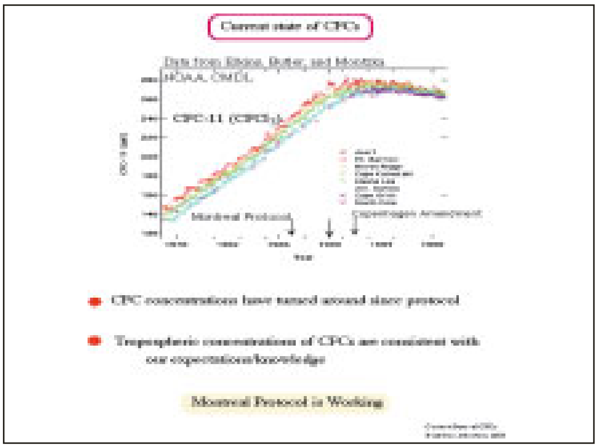
## Slide 2
### Stratospheric Ozone Depletion 2



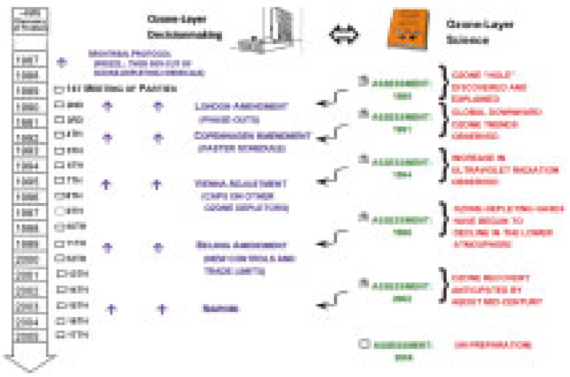

## Slide 2
### Stratospheric Ozone Depletion 3




## Slide 2
### Stratospheric Ozone Depletion 4



## Slide 2
### Stratospheric Ozone Depletion 5



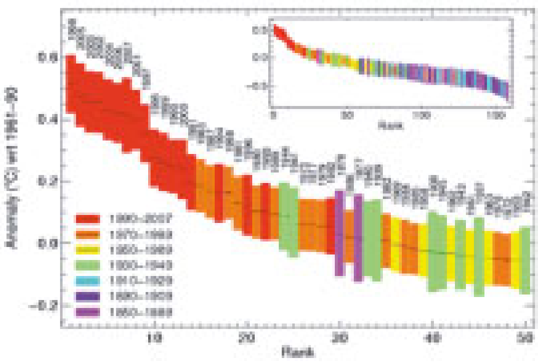

## Slide 3
### Climate Change 1

**Climate Change**

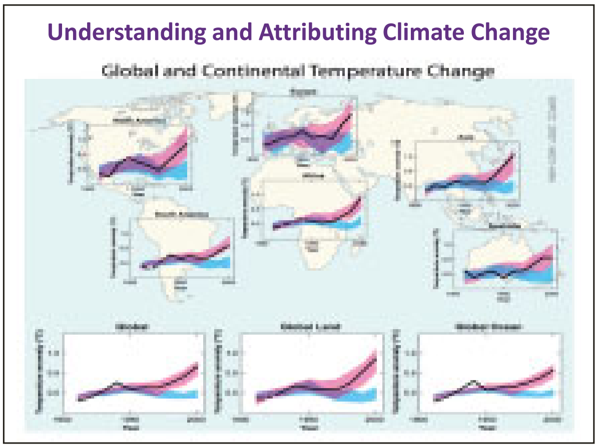
- The composition of the atmosphere, and the Earth's climate has changed, mostly due to human activities (highly certain), and is projected to continue to change, globally and regionally:
  - Increased greenhouse gases and aerosols
  - Warmer temperatures
  - Changing precipitation patterns – spatially and temporally
  - Higher sea levels – higher storm surges
  - Retreating mountain glaciers
  - Melting of the Greenland ice cap
  - Reduced arctic sea ice
  - More frequent extreme weather events
    - heat waves, floods and droughts
  - More intense cyclonic events, e,g., hurricanes in the Atlantic

## Slide 3
### Climate Change 2

**Climate is Warming**



**Slide 3**
Climate Change 3

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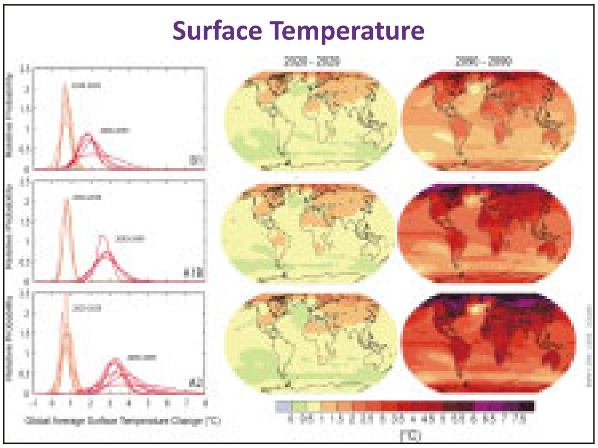
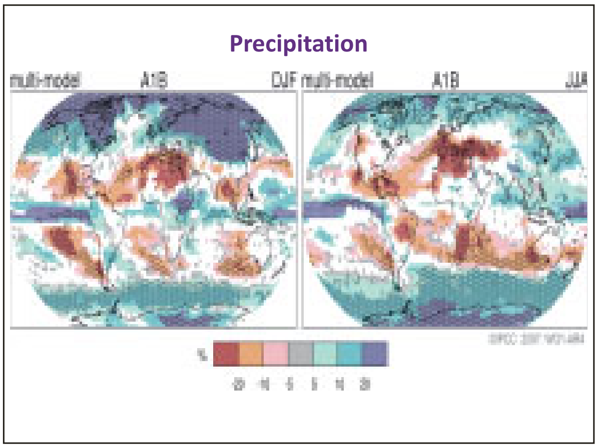
Climate Change 4




**Slide 3**
Climate Change 5



## Slide 3
## Climate Change 6

### Projected Impacts of Human-induced Climate Change

•Adversely effect ecological systems, especially coral reefs, and exacerbate the loss of biodiversity

•Decrease agricultural productivity for almost any warming in the tropics and sub-tropics and adverse impacts on fisheries – food security

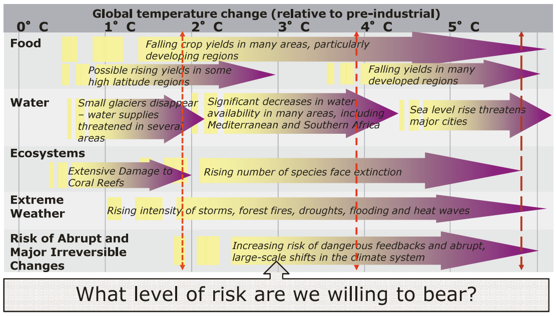
•Decrease water availability and water quality in many arid- and semi-arid regions – increased risk of floods and droughts in many regions – water security

•Increase the incidence of vector- (e.g., malaria and dengue) and water-borne (e.g., cholera) diseases, heat stress mortality, threats nutrition in developing countries, increase in extreme weather event deaths

•Adverse effects on human settlements due to flooding, coastal erosion and sea level rise

## Slide 4
## Mitigating Climate Change 1

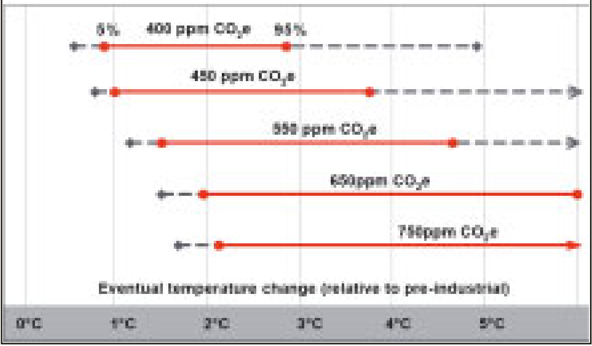
### Dealing with impacts is about managing risk - economic, environmental and social economy




▪ **Stern Review (2006)**

## Slide 4
## Mitigating Climate Change 2

### Emissions Paths to Stabilization



## Slide 4
### Mitigating Climate Change 3

# Mitigation Strategy

- Putting a price on carbon through
  - emissions trading
  - taxation
  - regulation - national, regional and global
- Technology transformation
  - Carbon capture and storage
  - Future generation biofuels
- Mobilising behaviour change
  - Citizens
  - Business
  - Public sector

## Slide 4
### Mitigating Climate Change 4

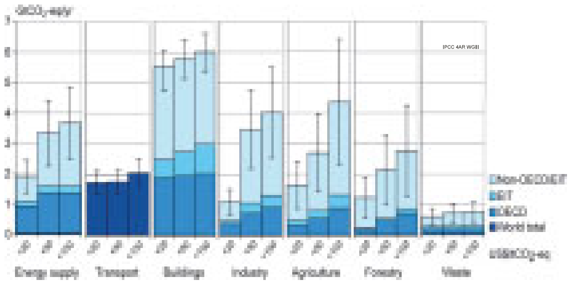
# Potential technological options

- **Efficient production and use of energy:** coal plants (e.g., re-powering old inefficient plants and developing IGCC); vehicles (e.g., fuel cell cars) and reduced use of vehicles (e.g., mass transit and urban planning), buildings, and industries
- **Fuel shift:** coal to gas
- **Renewable Energy and Fuels:** Wind power; solar PV and solar thermal; small and large-scale hydropower; bio-energy
- **$CO_2$ Capture and Storage:** Capture $CO_2$ in the production of electricity followed by geological storage (e.g., IGCC – CCS)
- **Nuclear fission:** Nuclear power
- **Forests and Agricultural Soils:** Reduced deforestation; reforestation; afforestation; and conservation tillage

## Slide 4
### Mitigating Climate Change 5

# Mitigation Potential Exists For All Sectors & Regions

*At least* a 50% reduction global greenhouse gas emissions by 2050 is needed for a chance of meeting the EU 2ºC target



## Slide 4
## Mitigating Climate Change 6

### Policy Instruments

- Policies, which may need regional or international agreement, include:
  - Energy pricing strategies and taxes
  - Removing subsidies that increase GHG emissions
  - Internalizing the social costs of environmental degradation
  - Tradable emissions permits--domestic and global
  - Voluntary programs
  - Regulatory programs including energy-efficiency standards
  - Incentives for use of new technologies during market build-up
  - Education and training such as product advisories and labels
- Accelerated development of technologies requires intensified R&D by governments and the private sector

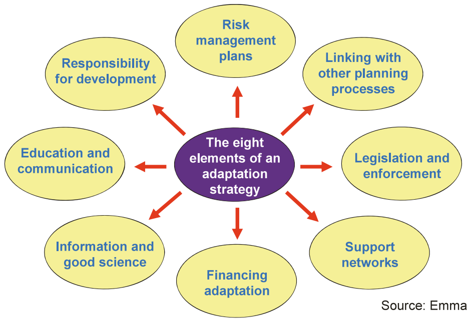
## Slide 4
## Mitigating Climate Change 7

### Summary of the Major Mitigation Challenges

- International policy
  - A long-term (2030 – 2050) global regulatory framework, involving all major emitters, with an equitable allocation of responsibilities – with intermediate targets
  - Kyoto plus 5 years will not provide the right signals to the private sector or national governments
  - Expand range of eligible CDM activities, including avoided deforestation, green investment schemes, energy efficiency standards, and exploring sectoral and programmatic approach
  - Key challenges include engaging USA, China and India

## Slide 4
## Mitigating Climate Change 8

### Elements of an adaptation strategy




Source: Emma Tompkins

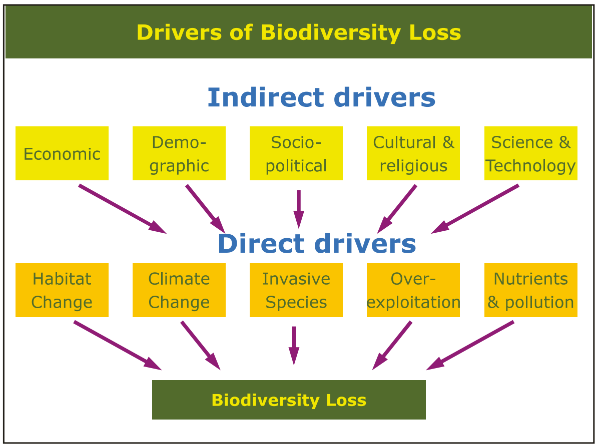
- Delivery of adaptive responses depends on **governance** mechanisms
- Adaptive capacity and society's self-organisation is determined by **governance**
- Distribution of costs and benefits in society is determined by **governance**

## Slide 4
### Mitigating Climate Change 9

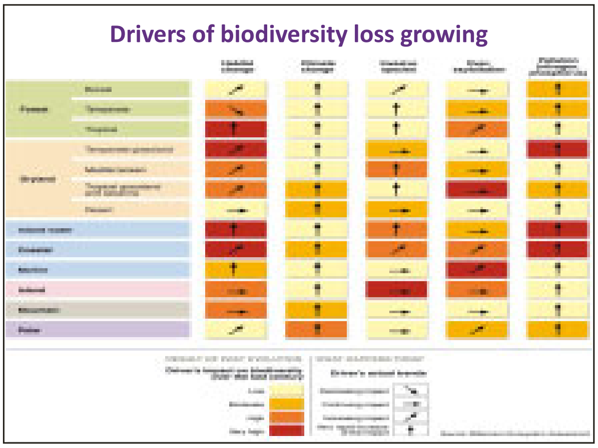
**Elements of a Post-2012 framework**

| | |
|---|---|
| 1. Long-term goal | (2C) 50% cut by 2050 on 1990 level |
| 2. Developed country targets | 30% cut by 2020 and 60-80 by 2050 for developed countries |
| 3. Developing countries | Graduated approach to commitments |
| 4. Carbon market | Broader, deeper, longer carbon market |
| 5. Technology | Technology Protocols, IFI financing, R&D, energy ffiiciency |
| 6. Adaptation | Adaptation integrated into development and finance strategies |
| 7. LULUCF inc Deforestation | LULUCF integrated in post-2012 framework. Incentives to tackle deforestation |
| 8. Aviation & maritime | Global sectoral approach |

## Slide 5
### Loss of Biodiversity and Degradation of Ecosystem Services 1

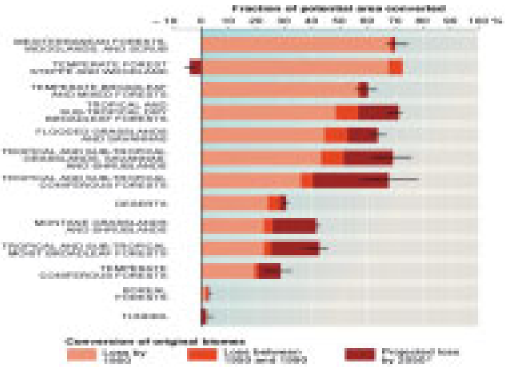



## Slide 5
### Loss of Biodiversity and Degradation of Ecosystem Services 2



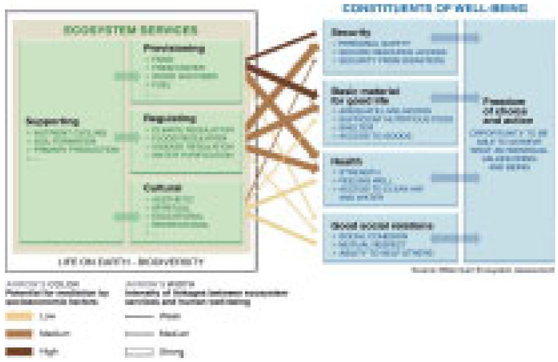
## Slide 5
### Loss of Biodiversity and Degradation of Ecosystem Services 3

**Unprecedented change: Ecosystems**



## Slide 5
### Loss of Biodiversity and Degradation of Ecosystem Services 4

**Consequences of Ecosystem Change for Human Well-being**




## Slide 5
### Loss of Biodiversity and Degradation of Ecosystem Services 5

**Climate change impacts on biodiversity and ecosystems are unavoidable**

–an increasing number of ecosystems, including areas of high biodiversity, are likely to be further disrupted by a temperature rise of 2° C or more above pre-industrial levels.

–10 per cent of species will face an increasingly high risk of extinction for every 1° C rise in global mean surface temperature (up to an increase of about 5° C).

–Wetlands, mangroves, coral reefs, Arctic ecosystems and cloud forests are particularly vulnerable to climate change.

–Without strong mitigation action, some cloud forests and coral reefs would may cease to function within a few decades.

## Slide 5

## Loss of Biodiversity and Degradation of Ecosystem Services 6

### Change the economic background to decision-making to implement ecosystem-based activities

– Make sure the value of all ecosystem services, not just those bought and sold in the market, are taken into account when making decisions

– Remove subsidies to agriculture, fisheries, and energy

– Payments to landowners in return for managing their lands in ways that protect and enhance ecosystem services

– Appropriate pricing policies for natural resources, e.g., water

– Apply fees, taxes, levees and tariffs to discourage activities that degrade biodiversity and ecosystem services

– Establish market mechanisms to reduce nutrient releases and carbon emissions in the most cost-effective way

## Slide 5

## Loss of Biodiversity and Degradation of Ecosystem Services 7

### Non-financial incentives to implement ecosystem-based activities

- Laws and regulations
- Promote individual and community property or land rights
- Improve access rights and restrictions
- New governance structures to improve policy, planning, and management
  - Integrate decision-making between different departments and sectors, as well as international institutions
  - Include sound management of ecosystem services in all planning decisions
- Develop and use environment-friendly technologies
- Influence individual behavior

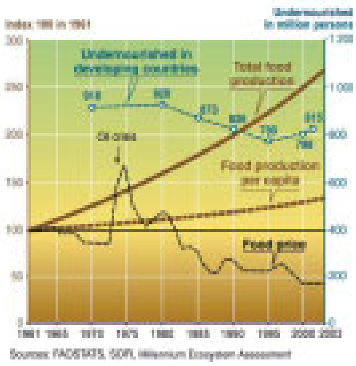
## Slide 6

## Food Security and Agricultural Production 1

### Food Production

– Uneven benefits:
- One billion people still hungry
- Hunger has increased in several parts of the world – SSA
- Institutional and policy environments

– Significant environmental degradation
- GHG emissions
- loss of biodiversity
- land and water degradation



## Slide 6
### Food Security and Agricultural Production 2

**Food Security**

**Drivers of the recent increase in food prices**

- Poor harvests due to variable weather - possibly related to human-induced climate change
- Increased use of biofuels
- Increased demand , especially for meat
- High energy prices, hence higher fertilizer prices
- Speculation on the commodity markets
- Export bans from some large exporting countries

**The future Challenge**

- The demand for food will double within the next 25-50 years, primarily in developing countries, **and** the type and nutritional quality of food demanded will change
- We need sustained growth in the agricultural sector to feed the world, enhance rural livelihoods and stimulate economic growth, while meeting food safety standards

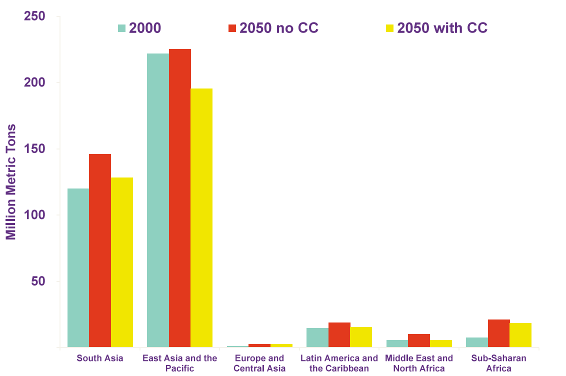
## Slide 6
### Food Security and Agricultural Production 3

**Global Context for Food Security**

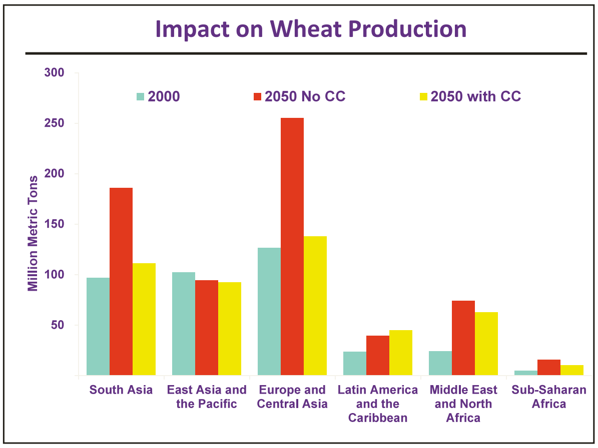
- **Less labor – disease, rural to urban migration**
- **Less water – competition from other sectors**
- **Less arable land – competition from energy crops**
- **High energy prices**
- **Distorted trade policies – OECD subsidies**
- **Land policy conflicts**
- **Loss of biodiversity: genetic, species and ecosystem**
- **Increasing levels of air and water pollution**
- **A changing climate**

## Slide 6
### Food Security and Agricultural Production 4

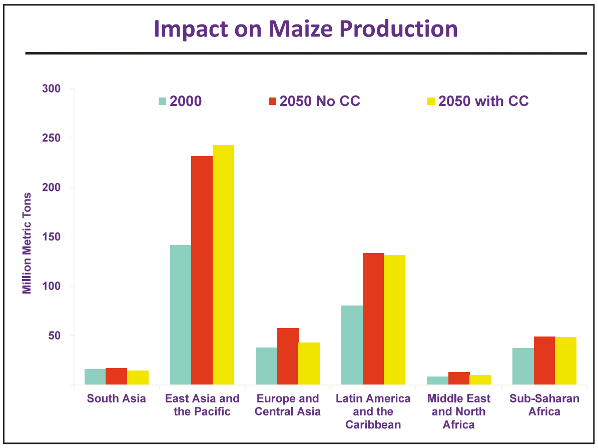
**Impact on Rice Production**



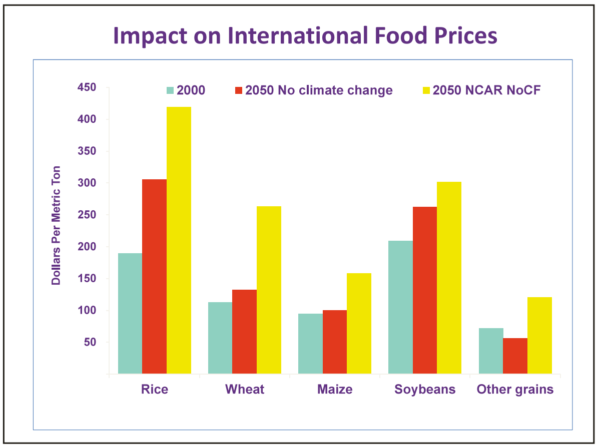
## Slide 6
### Food Security and Agricultural Production 5




## Slide 6
### Food Security and Agricultural Production 6




## Slide 6
### Food Security and Agricultural Production 7



## Slide 6
## Food Security and Agricultural Production 8

### Agricultural S&T Challenges

- to produce, by region, the diversified array of crops, livestock, fish, forests, biomass (for energy) and commodities needed over the next 50 years in an environmentally and socially sustainable manner:
  - address water deficit problems, e.g., through improved drought tolerant crops, irrigation technologies, etc
  - improve the temperature tolerance of crops
  - combat new or emerging agricultural pests or diseases
  - address soil fertility, salinzation of soils and improve nutrient cycling
  - reduce external and energy-intensive inputs
  - reduce GHG emissions while maintaining productivity
  - improve the nutritional quality of food
  - reduce post harvest losses
  - improve food safety

## Slide 6
## Food Security and Agricultural Production 9a

### Food Security: Options for Action

- **Most of today's hunger problems can be addressed with appropriate use of current technologies, emphasizing agro-ecological practices (e.g., no/low till, IPM and INRM), coupled with decreased post-harvest losses**
- **Advanced biotechnologies may be needed to address future demands for increased productivity and emerging issues such as climate change and new plant and animal pests – but the risks and benefits must be fully understood**
- **Place the farmer in the middle – understand their needs and integrate as appropriate their local and traditional knowledge with formal AKSTD – innovation involving all relevant stakeholders along the complete food chain**

## Slide 6
## Food Security and Agricultural Production 9b

### Food Security: Options for Action

- **Recognize the critical role of women and empower them (e.g., education, property rights, access to financing)**
- **Reform international trade, e.g., eliminate OECD production subsidies, eliminate tariff escalation on processed products, recognize the special needs of the least developed countries through non-reciprocal market access**
- **Provide payments to the farmer for maintaining and enhancing ecosystem services**
- **Increase public and private sector investment in research and development, extension services, and weather and market information**

**We can feed the world with affordable food, while providing a viable income for the farmer, but business-as-usual will not work**

## Slide 7
### Water Security 1

**The Global Water Crisis**

- Water scarcity is growing - by 2025 more than half of the world's population is projected to live under conditions of severe water stress
- Water quality is declining in many parts of the world
- 70% of all freshwater is used for irrigation - 15 - 35% of irrigation withdrawals exceed supply rates and are therefore unsustainable
- 50-60% of wetlands have been lost
- Water has the lowest rate of cost recovery among all infrastructure sectors (about 20%)
- Human-induced climate change is projected to decrease water quality and availability in many arid- and semi-arid regions, and increase the threats posed by floods and droughts in most parts of the world

## Slide 7
### Water Security 2

**Options for Action**

- **Implementation of the Dublin Principles**
  - **Ecological Principle:** **River basin management (often transnational); multi-sectoral management, (agriculture, industry, households); land and water must be managed together**
  - **Institutional Principle:** **All stakeholders, state, private sector and civil society, especially women, must be involved in the management – principle of subsidiarity – action at the lowest level**
  - **Instrument Principle:** **Incentives and economic principles to improve allocation and enhance quality - pricing policies**

## Slide 8
### Conclusion

**In Conclusion**

- There is no dichotomy between environmental protection and economic growth
- Get the economics right – eliminate perverse subsidies – value ecosystem services – internalize externalities – recognize the wealth of a nation is dependent on built, human, natural and social capital
- There are cost-effective and equitable solutions to address issues such as climate change and biodiversity loss, but political will and moral leadership is needed, and the changes in policies, practices and technologies required are substantial and not currently underway
- Public and private sector decision-makers need to take a longer-term perspective
- Advances in science and technology are required – investments are needed now to address these issues cost-effectively

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**Book Chapters**

I have contributed to about 10 book chapters but have never kept a record of them.