4 Development first

What is covered in this chapter?

Development drives greenhouse gas emissions through increased consumption of fossil energy, increasing populations, industrial production, and increasing consumption. It also shapes the way societies are able to respond to climate change and other challenges. Climate change as caused by greenhouse gases emitted as a result of development can undermine that same development. This chapter looks at how to get out of this vicious circle. The solution can only be found if development objectives are seen as the starting point. Alleviating poverty and providing people with decent living conditions has to remain central. The way to get there can and must be changed. Integrating climate change into development decisions and making development more sustainable is the way to go. But what does that mean in practice and how easy is it to reconcile conflicting priorities? These are some of the issues that this chapter will investigate.

Development and climate change

Chapter 2 pointed out that greenhouse gas emissions are driven by development: population growth, economic development, technology choices, consumption patterns, and energy and land use. Building a society around unlimited availability of cheap fossil fuels, leading to poorly insulated buildings, gas-guzzling cars, and inefficient industries (what most countries have done so far), makes it very hard to adjust to a situation that requires efficient use of energy and low greenhouse gas emissions. A transport infrastructure centred on the car and urban sprawl can only be changed over a long period of time. Every day a wide array of investments in energy systems, buildings, factories, and infrastructure further shape a society and its greenhouse gas emissions.

Vulnerability to climate change also depends on development. As explained in Chapter 1, poor countries and poor people are the most vulnerable. They are more dependent on agriculture, which is most sensitive to changes in rainfall patterns and temperatures. Irrigation is not available in many places. Drinking water is scarce in large areas. There is

little protection against flooding. Health services are inadequate. And worse, development is often making societies more vulnerable by building houses in flood plains, destroying mangrove forests that used to protect coasts against storm surges and hurricanes, and cutting down forests that retain water.

Rich countries can take measures to protect people against drought by building irrigation systems, against flooding by building dikes, and against hurricanes by building strong houses and providing shelter. They can also provide good health services to counter increased exposure to infectious diseases. That can be costly however. And that does not mean rich countries are not vulnerable. The enormous damage done to New Orleans by hurricane Katrina in 2005 shows that neglect of appropriate investments to deal with the risk of hurricanes and storm surges can have dire consequences.

So the relationship between development and climate change is a 'two-way street' (see Figure 4.1). Development is the driver and also the recipient of climate change.

Can or even should development policy be used in controlling climate change? Is dealing with climate change not distracting from or even endangering development? Industrialized countries developed without taking care of the environment and cleaned up when they could afford it. So why would developing countries develop differently?

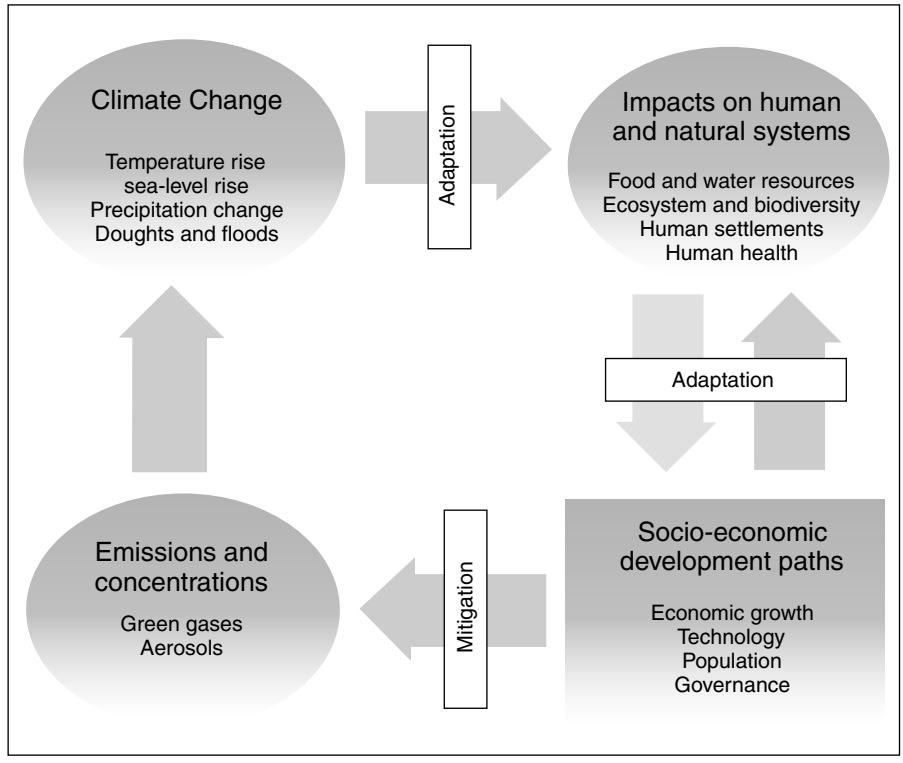


Figure 4.1 **Interrelationship between development and climate change. Development is both the driver and the recipient of climate change.**

Source: IPCC Third Assessment report, Synthesis Report, 2001.

What does climate change mean for development?

In Chapter 1 the impacts of climate change were discussed extensively. Water, ecosystems, food production, coastal areas, and human health all face impacts of climate change, leading to increasingly negative consequences as climate change progresses. Africa, Asia, and small island states are particularly vulnerable. These impacts affect development. In countries that rely heavily on agriculture changing rainfall patterns, higher temperatures, heat waves, droughts, and floods present a great threat to agricultural production and can negatively affect economic growth. Availability of drinking water, already problematic in some regions, will be further threatened, directly affecting the livelihoods of rural people. Sea level rise and increasing frequency of heavy rainfall will lead to more flooding, particularly in densely populated river deltas, negatively affecting social and economic development.

The basic elements of poverty eradication, as summarized in the Millennium Development Goals (see Table 4.1), will be much harder to reach with the climate change projected, particularly in the period beyond 2015 when the eradication of poverty should be finally achieved.

Impacts of climate change can go beyond specific damages that are repairable. It can become impossible for people to survive extreme drought or repeated flooding in which case abandoning their lands and migrating to safer grounds is the only way out. There are several potentially explosive areas in the world where that may happen, increasing the risk of violent conflict (see Figure 4.2). That brings climate change into the realm of international security concerns.

Development assistance given to poor countries is targeted to a considerable extent at sectors that are vulnerable to climate change. For instance, in Tanzania the percentage of all aid going to vulnerable sectors is about 20%, in Bangladesh 30%, and in Nepal about 60%[1]. Overall, the World Bank estimates that about one quarter of its loans portfolio is subject to significant risk from climate change[2].

Costs of climate change damages were discussed in Chapters 1 and 3, leading to the conclusion that extreme events like hurricanes or floods can have a disastrous impact on the economy of poor countries. Looking at the overall impact of gradual climate change it was concluded that losses of income of 5–20% in poor countries can be expected for 7–9ºC of warming, something that is well within the range of uncontrolled warming if we look beyond the year 2100. The conclusion must be that climate change can really undermine development, so it cannot be neglected when making the main socio-economic decisions.

As far as controlling emissions of greenhouse gases is concerned developing countries cannot afford to wait either. It is true that industrialized countries have been responsible for about 70% of all greenhouse gas emissions since 1850 and therefore are responsible for most of the climate change we are seeing today[3]. It is also true that per capita emissions in developing countries are still much lower than in industrialized countries. But without a policy on climate change two-thirds to three-quarters of all additional emissions for the period until 2030 will come from developing countries and for the period thereafter the share will be even higher. Or, to put it in different terms, even if industrialized countries were to reduce their emissions to zero, emissions from developing countries would be too high to keep climate change to tolerable levels.

Table 4.1. Potential impacts of climate change on Millennium Development Goals

Millennium Development Goals: Climate Changes as a Cross-Cutting Issue	
Millennium Development Goal	Examples of Links with Climate Change
Eradicate extreme poverty and hunger **(Goal 1)**	• Climate change is projected to reduce poor people's livelihood assets, for example, health, access to water, homes, and infrastructure • Climate change is expected to alter the path and rate of economic growth due to changes in natural systems and resources, infrastructure, and labour productivity. A reduction in economic growth directly impacts poverty through reduced income opportunities • Climate change is projected to alter regional food security. In particular in Africa, food security is expected to worsen
Health related goals: • combat major diseases • reduce infant mortality • improve maternal health **(Goals 4, 5, and 6)**	• Direct effects of climate change include increases in heat related mortality and illness associated with heat waves (which may be balanced by less winter cold related deaths in some regions) • Climate change may increase the prevalence of some vector borne diseases (for example malaria and dengue fever), and vulnerability to water, food, or person-to-person borne diseases (for example cholera and dysentery) • Children and pregnant women are particularly susceptible to vector and water borne diseases. Anemia – resulting from malaria – is responsible for a quarter of maternal mortality • Climate change will likely result in declining quantity and quality of drinking water, which is a prerequisite for good health, and exacerbate malnutrition – an important source of ill health among children – by reducing natural resource productivity and threatening food security, particularly in Sub-Saharan Africa
Achieve universal primary education **(Goal 2)**	• Links to climate change are less direct, but loss of livelihood assets (social, natural, physical, human, and financial capital) may reduce opportunities for full-time education in numerous ways. Natural disasters and drought reduce children's available time (which may be diverted to household tasks), while displacement and migration can reduce access to education opportunities
Promote gender equality and empower women **(Goal 3)**	• Climate change is expected to exacerbate current gender inequalities. Depletion of natural resources and decreasing agricultural productivity may place additional burdens on women's health and reduce time available to participate in decision making processes and income generating activities • Climate related disasters have been found to impact more severely on female-headed households, particularly where they have fewer assets to start with

Table 4.1. (*cont.*)
Millennium Development Goals: Climate Changes as a Cross-Cutting Issue

Millennium Development Goal	Examples of Links with Climate Change
Ensure environmental sustain ability **(Goal 7)**	• Climate change will alter the quality and productivity of natural resources and ecosystems, some of which may be irreversibly damaged, and these changes may also decrease biological diversity and compound existing environmental degradation
Global partnerships	• Global climate change is a global issue and response requires global cooperation, especially to help developing countries to adapt to the adverse impacts of climate change

Source: African Development Bank Asian Development Bank, Department of International Development, UK; Directorate-General for Development, European Commission; Federal Ministry of Economic Cooperation and Development, Germany; Ministry of Foreign Affairs, Development Cooperation, The Netherlands; OECD; UNDP; UNEP, World Bank. Poverty and Climate Change – Reducing the Vulnerability of the Poor through Adaptation, 2004.

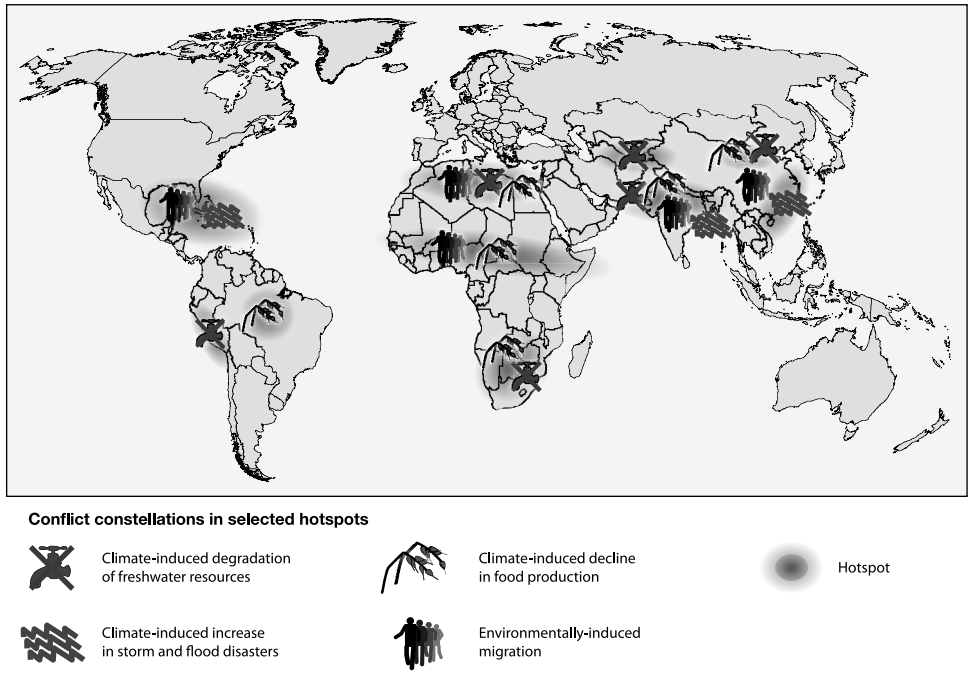


Figure 4.2 **Potential areas where violent conflicts could emerge as a result of climate change.**
Source: German Advisory Council on Global Change, World in Transition: Climate Change as a Security Risk. Summary for Policy-makers. Berlin, 2007. See Plate 9 for colour version.

Making development more sustainable

The answer to the threat of climate change and to many other threats, such as losing biodiversity, natural resource depletion, and extreme poverty, is to make development more sustainable. The notion of sustainable development was put on the political agenda by the Brundlandt Commission in its report 'Our Common Future' in 1987. They defined sustainable development as *'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'*. But how can this be made operational? The most common interpretation is that there are three dimensions of development, i.e. economic, social, and environmental, that need to be in harmony. Often the institutional dimension (governance structures, democratic institutions, etc.) is added as 'cement' between the three pillars (see Figure 4.3).

This conceptual description of sustainable development does not answer the question of how much of each dimension needs to be there to be sustainable. Can progress on one dimension compensate lack of progress in another? Or are there minimum levels of progress for each of the dimensions to make development sustainable? And how do you measure sustainability? No unequivocal answers to these questions exist. There are different schools of thought: different definitions of 'sustainable' and different sets of sustainability indicators have been developed[4]. For the purposes of this book a practical approach is chosen that has three elements:

1. *Relation between the sustainability dimensions*: each dimension of sustainable development needs to be satisfied to such an extent that undermining the other dimensions is avoided. For example, climate change impacts need to be limited to a level that allows preservation of a healthy environment (look at the discussion in Chapter 3 and the section above on climate change impacts). It should also not endanger eradication of poverty and should guarantee a positive economic development (defined in a broad sense,

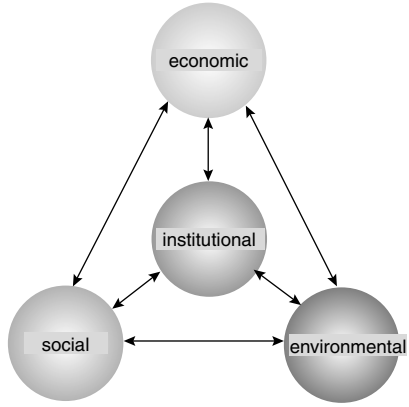


Figure 4.3 **The dimensions of sustainable development. The three main dimensions are shown as the corners of the triangle. Institutions form the 'cement' between the three pillars.**
Source: Munasinghe M. Making development more sustainable: sustainomics framework and practical applications, MIND Press, Munasinghe Institute for Development, Colombo, 2007.

including the value of natural resources). This means there are minimum demands for each of the three main dimensions for a sustainable situation. Compensation can only happen over and above this minimum standard. The determination of the minimum standard for each dimension is a political, not a scientific issue.

2. *Indicators and metrics*: these are chosen so that they are appropriate for each particular sustainability dimension. For climate change impacts that could for instance be the number of people with access to sufficient water or the number of people affected by floods. No attempt is made to translate everything into monetary terms (so-called cost–benefit analysis, although this approach is discussed in Chapter 3).
3. *Operational approach*: the best practical way to make development more sustainable is through integration of all relevant elements of sustainability into development decisions. This is called 'mainstreaming'.

Sustainable development is of course not only connected to climate change. There are many other global problems that tend to undermine development: poverty, lack of social security, loss of biodiversity, overexploitation of oceans, loss of tropical forests, large scale air pollution, damage to the ozone layer, etc. In fact, many of these problems have causes similar to those of climate change. They are the result of an inherently unsustainable pattern of production and consumption. Taken together, they are a huge threat to our planet. Trying to make development more sustainable can therefore help address a whole series of problems if a broad and integrated policy approach is chosen.

An important notion is that meaningful discussions about the direction of development can only be held at a local level, i.e. at the scale of a city, region, or country. That is where decisions are taken and impacts are felt. And making such development decisions more sustainable brings climate change (and other global problems) to the heart of the political process. International progress towards more sustainable development is by definition the sum of local actions.

Mainstreaming climate change in development policies

How would mainstreaming work when it comes to specific development issues? Are there real synergies to be found between economic and social development goals and dealing with climate change? Or are there serious tradeoffs to be made? To find that out we will consider a number of development issues in more detail. In doing so we will look at the two aspects of climate change: possibilities for development towards a low carbon economy and possibilities for development of a society that is more resilient (i.e. less vulnerable) to climate change.

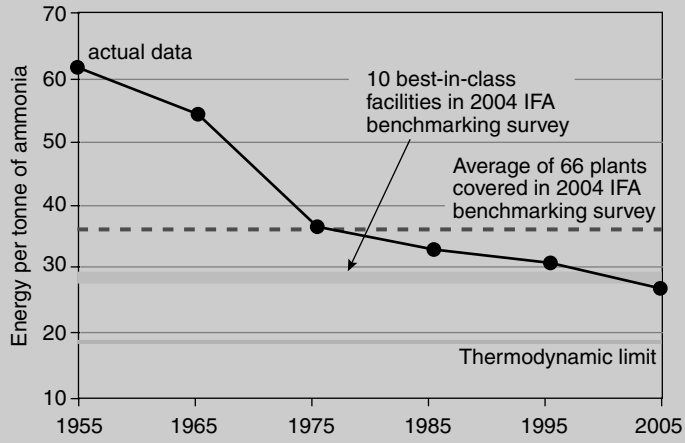
Modernizing industry to become competitive

For the manufacture of steel, aluminium, fertilizer, chemicals, paper, cement, glass, and ceramics and the refining of oil, large amounts of energy are needed. For example, an oil

refinery uses about 15–20% of the crude oil in the process of producing oil products. Energy is responsible for about 15% of the costs of a tonne of steel[5]. So energy is an important component of production costs. With oil prices above US$100 per barrel and gas and coal prices sharply increased, energy costs have gone up enormously. Since these industries are generally competing on the world market, cost matters a lot. Energy efficiency improvement is thus a vital strategy for these industries to become or remain competitive (see Box 4.1).

Box 4.1 Energy efficiency in the fertilizer industry

Ammonia is the most important component of nitrogen fertilizers. Its production requires large amounts of fossil fuels. The majority of ammonia plants in the world use natural gas as the raw material. The production costs of ammonia are very sensitive to the costs of natural gas. An increase of the natural gas price by a factor of 2.5, which happened over the past few years, doubles the production costs. That makes energy efficiency a very important issue, and is why energy use per tonne of ammonia produced has gone down substantially over the years. A plant designed in 2005 uses less than half the energy per tonneof ammonia produced as one designed around 1960 (see figure). The newest plants therefore have the best efficiency and many of those are located in developing countries.



Energy consumption per tonne of ammonia for manufacturing plants around the world, designed in a particular year. The figure shows a continuous improvement of energy efficiency over time. The thermodynamic limit is the lowest theoretical energy consumption for this process.

(Source: IPCC Fourth Assessment Report, Working Group III, Chapter 7.4.3.2)

This is not just an issue for industries in industrialized countries, on the contrary. In 2003 42% of steel, 50% of aluminium, 57% of fertilizer production, and 78% of the cement industry was located in developing countries[6]. To be honest, these industries have moved there not only to serve the growing domestic markets in developing countries, but also because of closeness to raw materials and availability of cheap energy and labour. For

example, after the 1980s oil crisis Japanese industries moved many of their energy intensive production processes overseas in order to escape high energy costs, supply security problems, and environmental legislation. In the current globalized economy relocation of plants is a common phenomenon. And energy costs are an important consideration. When greenhouse gas emission controls are added to these energy costs it could become attractive to move to countries where energy costs are lower and emission controls less stringent. This industrial relocation could thus lead to a deterioration of overall energy use and CO_2 emissions and act as a possible countermovement to modernization and energy efficiency improvement.

Improving energy security and reducing oil imports

Security of energy supply is a major concern of many countries these days. Oil imports are an increasing burden for the economy of many nations. Conflicts between Russia and neighbouring countries on contracts for gas supply have made importing countries realize their vulnerability when they are dependent on one country for a major part of their energy sources. There are in principle three different responses to this problem of energy security: more efficient use of energy, shifting to domestic energy resources, and diversification of imported energy.

Energy efficiency is always a win–win option. The lower the use of energy, the lower the dependence on energy imports and vulnerability to interruptions in supply and price increases. This is in fact in perfect synergy with reduction of CO_2 emissions, because energy efficiency improvement has low or even negative costs (i.e. is profitable). (See also the discussion on energy efficiency in the transport, buildings, and industry sector in Chapters 6, 7, and 8.)

Shifting to domestic energy sources, the second response strategy, becomes particularly interesting when these are renewable energy sources that have immediate advantages from a climate change point of view. Availability of renewable resources varies of course considerably between countries, but most countries have the potential to replace a large part of their fossil fuel use with renewable energy, given enough time and given cost reductions of some of the more advanced renewable energy technologies. Developing a domestic renewable energy industry can also create new jobs[7]. The Brazilian alcohol programme is a good example of a successful implementation of this strategy (see Box 4.2).

Box 4.2 Fuel alcohol in Brazil

The oil crisis of 1973 had a bad economic impact on Brazil: oil imports were rising to about half the value of all exports. In addition to launching a big exploration programme for oil and gas, the Brazilian government started an ambitious programme of producing alcohol from sugar cane. This was made relatively easy by low sugar prices on the

world market at the time. Alcohol was sold in two forms: as a mandatory 20–25% blend in all regular gasoline and as pure alcohol. The blended product could be used by all cars with only minor modification. For pure alcohol use, engines needed more radical adjustment.

Through a combination of (gradually declining) subsidies to sugar cane growers, ethanol ready cars, and gas stations, a large scale ethanol supply system was built. Due to low gasoline prices after the oil crisis was over and fluctuations in the supply of alcohol, consumption of pure alcohol had its ups and downs. Only after the automobile manufacturers offered so-called Flex Fuel Vehicles (FFVs, with engines that automatically adjust to the gasoline–ethanol mixture available) in the late 1990s, did the market stabilize. In 2006 more than 80% of vehicles sold in Brazil were FFVs at an additional cost of about US$100 per vehicle. At the same time production costs of alcohol had gone down from about US $100/barrel of oil equivalent to about US$40 and in 2005 costs had further fallen to about US$30. Alcohol is now cheaper than gasoline.

The alcohol programme generated a large number of jobs in the sugar cane industry and the processing and distribution of alcohol. Oil import savings over the period 1975–2002 amounted to more than US$50 billion, while additional investments and subsidies are only a fraction of that. All of this was done without considering the reductions in CO_2 emissions.

(Source: IPCC Fourth Assessment Report, Working Group III, chapter 5.3.1.3; Goldemberg J. The ethanol programme in Brazil. Environmental Research Letters, vol 1 (October–December 2006) 014008; Kahn Ribeiro S, Andrade de Abreu A. Climate Policy, vol 8 (2008), pp 220–240)

In several countries, such as India, China, and the USA, coal resources are abundant and energy security concerns can easily lead (and actually have already led) to a shift to domestic coal, away from imported oil or gas. Coal is a cheap source for electricity production, but can also be used to produce gasoline based on the so-called Fisher Tropsch processes[8]. This coal-to-liquid process doubles the CO_2 emission per unit of fuel. The use of domestic coal thus provides a difficult trade-off problem with climate change and air pollution. The only way to reconcile such an energy security decision with controlling greenhouse gas emissions is to rely heavily on CO_2 capture and storage[9].

Diversification of energy imports has been a long-standing strategy of many countries to enhance energy security. Again, this often leads to considerable use of coal for reasons of costs (coal prices have gone up but are substantially lower than gas prices) and spreading the suppliers. A shift to nuclear power, also beneficial from a CO_2 point of view[10], would help to diversify energy sources, but there are only a few countries that have uranium resources. The more domestic or imported renewable energy can be developed the better the possibilities to implement diversification policies in synergy with CO_2 reduction strategies.

The response of China to deal with energy security, industrial competitiveness, and air pollution is shown in Box 4.3.

Box 4.3 China's sustainable development policies on energy

China has an extensive set of policies in place to deal with energy security, industrial competitiveness, air pollution, and greenhouse gas emissions:

- Shift to a less energy intensive economy: by promoting the growth of high tech manufacturing and services
- Energy efficiency improvement: in power supply (a 12% reduction in carbon intensity of electricity between 1990 and 2004; see note 1) by closing small inefficient coal fired power plants; in energy intensive industries (a 30% reduction in energy per tonne of steel and 20% per tonne of cement between 1990 and 2004; in buildings (energy efficiency standards for new buildings)
- Over the period 1991–2005 energy use per unit of GDP was reduced by 45%, double the improvement of the world on average*
- Expansion of energy efficiency programmes, such as technology modernization in the iron and steel, metals, oil and petrochemical, and building materials industries; stronger efficiency standards for buildings (Green lighting programmes, government buildings programme); introduction of fuel efficiency standards for new vehicles and removal of old inefficient ones
- Expansion of renewable energy capacity: by the end of 2005 there was 117GW hydropower capacity (23% of electric power capacity), 2GW biomass based power, 1.3GW wind power, 70MW solar photovoltaic (in remote regions), 1 million tonne per year in fuel alcohol, about 40 million solar water heaters, and 17 million households with biogas units (in addition to 1500 larger ones). Targets for expansion of renewable energy are: 10% of primary energy from renewable sources by 2010, 15% by 2020; 20GW wind power by 2010, and strong increase in number of biogas units and solar water heaters, solar PV, and biofuels
- Expansion of nuclear power and coal bed methane recovery
- Expansion of forest area: increase of forest cover from 14 to 18% between 1990 and 2005. Planned extension to 20% in 2010
- Banning of coal burning in a number of urban areas to address air pollution
- The overall target for improved energy efficiency of the economy is a 20% reduction of energy use per unit of GDP between 2005 and 2010.

The estimate of the Chinese government is that these programmes together will reduce CO_2 emissions by more than 1Gtonne per year (1000 million tonnes) in 2010, compared to the business as usual projection of around 7Gtonne per year. This is still a big increase compared to 2000, but also about a 15% reduction compared to business as usual.

* Energy and carbon intensity of electricity has increased between 2004 and 2007.

(Source: China National Climate Change Programme, National Development and Reform Commission, June 2007; 11th 5-year Plan, National Development and Reform Commission, Gao Guangsheng, Policies and measures of China under the framework of sustainable development, presentation at 2nd Dialogue Session, UNFCCC COP-12, Nairobi, 2006)

Table 4.2. Ranking of cities according to their liveability (December 2006)

Best			Worst		
Rank		Liveability (%)*	Rank		Liveability (%)*
1	Vancouver	1.3	132	Algiers	64.7
2	Melbourne	1.8	131	Dhaka	60.4
3	Vienna	2.3	130	Lagos	60.1
4	Perth	2.5	129	Karachi	58.6
5	Toronto	3.0	128	Kathmandu	54.7
6	Adelaide	3.0	127	Abidjan	53.9
7	Sydney	3.2	126	Dakar	53.2
8	Copenhagen	3.7	125	Phnom Penh	53.0
9	Geneva	3.9	124	Tehran	52.6
10	Zurich	3.9	123	Bogota	48.3

* Weighted index rating whereby 0% = exceptional quality of life and 100% = intolerable.
Source: Economist, August 22, 2007.

Providing efficient transport for people

Adequate transport is a basic need of modern societies and a prerequisite for development. Traffic congestion, health impacts from air pollution, and rising oil imports are however inherent to transport in many countries. Making transport more energy efficient, replacing fossil fuels, and shifting from private to public transport are effective ways to address these problems and at the same time reduce CO_2 emissions. Building more roads, a popular response to traffic congestion, is the only strategy that is not synergistic with CO_2 reduction, and even in terms of combating congestion it is not effective because it generally increases traffic and results in congestion in other places.

At the city level providing efficient public transport, careful urban planning, limiting car access, and creating safe walking and bicycling spaces and facilities can go a long way to create a 'liveable city', something that is highly appreciated by people. In the real world there are forces driving cities in the opposite direction. Think of the ever increasing tendency to locate large shopping centres in the outskirts of cities, generating a large transportation demand; freight transport and warehouse hubs for the distribution of industrial goods and retail products; and suburban (often uncontrolled) residential development in search of affordable housing, with inadequate public transport infrastructure. Controlling such developments requires strong municipal governments and adequate land use planning legislation. Huge differences exist in liveability of cities in developed and developing countries (see Table 4.2). With the fast growth in many cities in developing countries investments in urban planning and good public transport facilities will allow these cities to become more liveable and low carbon in the future.

Improving air quality to protect health

Air pollution in many countries and particularly in urban and industrialized areas is a growing problem in developing countries, with important health consequences and negative impacts on food production. More than 700000 people die prematurely every year as a result of urban air pollution (see Figure 4.4). Cities with small particle air pollution at least 50% above the World Health Organization guidelines are listed in Figure 4.5. Most of these cities are in developing countries. Successful abatement of air pollution in many industrialized countries was the result of eliminating pollution from coal fired power plants (sulphur oxides, nitrogen oxides, soot, and other small particles) and reducing traffic related emissions (nitrogen oxides, soot, and small particles from diesel fuel). So there are ample opportunities for achieving synergies between improving health by reducing air pollution and reducing CO_2 emissions from cleaner fuels and more energy efficiency.

A good example of a win–win strategy for reducing air pollution and CO_2 emissions is the Delhi natural gas-for-transport programme. The main cause of air pollution in Delhi is traffic. Since the early 1990s measures were taken to tighten emission standards for vehicles and improving fuel quality. But in 1998, as a result of a court case filed by an environmental activist, the Supreme Court ordered a complete replacement of diesel and gasoline by compressed natural gas for motorized rickshaws, taxis, and buses. This resulted in a significant improvement of air quality, in particular in terms of fine particles, one of the most dangerous components of polluted air. It also resulted, as a co-benefit, in reduced emissions of CO_2[11]. Other examples of win–win strategies in the transport sector are so-called Bus Rapid Transit Systems that have successfully changed the liveability of several South American and other cities (see Chapter 6).

Air pollution is affecting crop productivity (see Figure 4.6), which is also negatively influenced by climate change. So there is also a synergy between abatement of air pollution, food security, and addressing climate change.

Ensuring a strong agriculture and forestry sector

The forestry and agriculture sector are economically very important in many developing countries, in terms of food, fodder, and forest products as well as for the livelihoods of the people dependent on it. They also provide essential ecological functions through nature and biodiversity protection and water management. Policies aimed at these core development issues can have positive or negative impacts on greenhouse gas emissions and will determine vulnerability to future climate change.

Food security is one of the most important concerns of governments. Existing poverty in many countries means that many people are vulnerable to food scarcity and increasing food prices. Social unrest and even riots in times of rising food prices have happened frequently. Policies to enhance food security are manifold. Extending cropland and grassland, increasing crop productivity, efficient irrigation methods, erosion control, improved pest and fertilizer management, and creating incentives for farmers are all

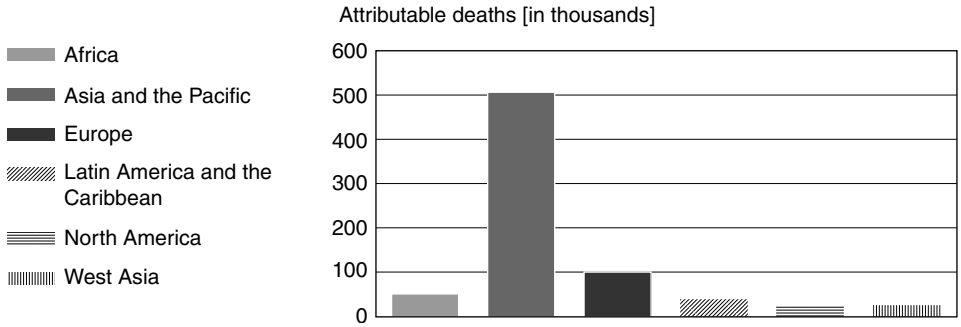


Figure 4.4 **Premature deaths due to outdoor urban exposure to small particle air pollution in the year 2000.**
Source: UNEP, Global Environmental Outlook, 2007, ch 2.

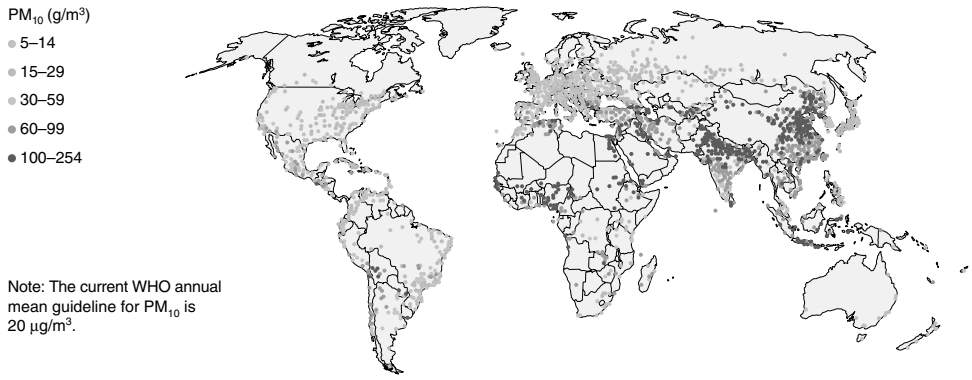


Figure 4.5 **Cities with annual mean concentrations of small particles (PM10) at least 50% above the current WHO air quality guideline.**
Source: Cohen, A. J., Anderson H. R., Ostro B. *et al*., Mortality impacts of urban air pollution. In: Comparative Quantification of Health Risks: Global and Regional Burden of Disease Due to Selected Major Risk Factors, eds. M. Ezzati, AD Lopez, A. Rodgers, CJL Murray, vol. 2. World Health Organization, Geneva, 2004. p. 1374. See Plate 11 for colour version.

important policy objectives. Most but not all of these policies have synergies with reducing greenhouse gas emissions: higher crop productivity reduces the need for land and reduces deforestation, minimizing erosion through low tillage methods, retention of crop residues and agro forestry help to accumulate carbon in soils, and lower fertilizer use reduces emissions of nitrous oxide.

Several of these policies also help to reduce vulnerability to climate change, a very important issue for countries heavily dependent on agriculture. Increased soil carbon and agro forestry improve the water holding capacity of farmland, making it less vulnerable to droughts. Efficient irrigation makes it possible to continue farming if the climate gets dryer. Better erosion control helps to deal with extreme rainfall, something that is going to happen more often in a changed climate.

However, there are also conflicting policy objectives. Increasing populations and shifts to diets with more meat as incomes rise increase the need for cropland and grassland,

Figure 4.6 **The impact of local air pollution on the growth of wheat in suburban areas of Lahore, Pakistan.** *Source*: photo by A. Wahid. Published in *Global Environment Outlook-4: Environment for Development,* UNEP, 2007.

leading to land conversion and increased CO_2 emissions. Reducing subsidies for farmers (abundant in many industrialized countries) would reduce greenhouse gas emissions, but could also lead to a decrease in food exports, which might harm global food security. Creating new income for farmers through bioenergy crops is attractive, but could easily create tensions with food production and biodiversity protection[12].

Reducing deforestation and planting new forests to preserve ecological functions and water management have large positive impacts on retaining the stocks of CO_2 in trees and soil. They are also important in making forests resilient to climate change, by retaining groundwater and generating rain. A sustainable forestry industry also benefits from maintaining healthy forests. The pressure to convert forests to cropland or pastures is high however and the short term economic benefits of turning forests into cropland or grassland are big. In addition, there are often unexpected connections with other social and economic policies. An example is the devaluation of the Brazilian currency in 1999 by 50% against the US dollar. Together with the increase in soybean prices on the world market, it made it so attractive to convert forests into land for soybeans and meat production for export that this led to massive deforestation in the state of Mato Grosso (about one third of all deforestation in Brazil between 1999 and 2003[13]).

So potential synergies between development and sustainable development policies and climate protection in forestry and agriculture are abundant, but trade-offs between different policy objectives are inevitable[14].

General macro-economic policy

Taxes, subsidies, currency exchange rates, policies to stimulate economic growth, and trade policies seemingly have little to do with greenhouse gas emissions. This is not the

case. On the contrary, taxes and subsidies determine energy, raw materials, and pollution costs and the cost of labour. 'Greening' taxes, i.e. shifting taxes to polluting activities and lowering them on labour and environmentally friendly activities, is being pursued in many countries now, maintaining the necessary tax base but helping to reduce greenhouse gas emissions. Eliminating energy subsidies, 95% of which are for fossil or nuclear energy (worth about US$250 billion per year globally) would lead to stronger economic growth of 0.1% on average per year and a reduction of CO_2 emissions of more than 6%[15]. Of course, caution is needed to avoid unwanted side effects and compensating measures for poor people may be needed when removing subsidies.

Trade policies have important implications for greenhouse gas emissions as well. In a globalizing economy production moves to the place where it is cheapest. Trade laws allow countries to ban harmful products as long as these rules also apply to domestically made products. Trade rules however make it difficult for importing countries to demand clean (i.e. low carbon emitting) production processes for the products they import. So-called border tax adjustments (for instance adding a tax to a product made with cheap energy because no CO_2 abatement is applied in the exporting country) are therefore currently not applied. This means that large scale shifts of export oriented production to developing countries, such as China, where production facilities are less energy efficient and the electricity fuel mix has a higher share of coal, increases global greenhouse gas emissions. For example, the current USA–China trade pattern (much greater import from China than export to China) has led to an increase of CO_2 emissions for the two countries together of about 100 million tonnes CO_2 per year[16] (equivalent to the total annual emissions of a country like the Philippines).

Existing import duties on climate friendly products are a barrier to wider use of low carbon technologies. A good example is the import duties on Brazilian sugar cane alcohol in the USA and Europe to protect domestic production of biofuels, even though Brazilian alcohol has a much greater benefit in terms of CO_2 emissions than the biofuels produced in the USA and Europe and is lower in price. Changes in trade laws can create incentives for low carbon products.

What about providing people with modern energy?

There are still 2.4 billion people that rely on wood, crop residues, charcoal, and animal dung for their energy needs and 1.6 billion people do not have access to electricity. Most of these people live in rural areas of developing countries. As a consequence they suffer from serious indoor air pollution caused by smoke, leading to acute respiratory infections in children and chronic lung disease in adults. These health problems are responsible for nearly all of the 1.6 million deaths each year from indoor air pollution[17], 98% of which happens in developing countries[18].

Providing these people with modern energy in the form of liquefied petroleum gas (LPG), kerosene, biogas, and electricity would reduce indoor air pollution by 95% and clearly has huge advantages. In doing so CO_2 emissions will inevitably go up (modestly), but that cannot be an argument not to improve the health conditions of course. If 2 billion

people were provided with LPG for cooking, lighting, and heating global CO_2 emissions would go up by about 2%[19]. In practice the increase can be much lower. Biogas is an option in many rural areas to reduce CO_2 emissions considerably without adding to net CO_2 emissions (see Chapter 5). And since part of the wood and charcoal used currently is not produced sustainably, traditional biomass energy does have net CO_2 emissions. Experience from an LPG programme in Senegal showed a considerable drop in charcoal production that counters the CO_2 emissions from the LPG.

As far as electricity supply is concerned, it is possible to extend the grid so that it reaches many of the 1.6 billion people currently without electricity. But in many rural areas grid extension may take a very long time to materialize. Developing local mini grids, using a combination of renewable energy sources (small hydro, wind, biomass, solar), is a viable alternative in such areas. It is a better option than individual home solar systems, which limit the owners to small amounts of electricity and may make the village less attractive for grid extension (see Chapter 5 for more details).

Developing coastal regions while retaining natural coastal protection and ecologically valuable areas

Mangrove forests provide a natural protection against storm surges and hurricanes. In addition, they are hugely important as breeding grounds and shelter areas for fish and other sea life. So retaining them will make the system much more resilient against climate change and the resulting increase in sea level rise, hurricane intensities, and storm surges. They will also make fish populations less vulnerable and help ecosystems to survive under very different climatic conditions. Retaining or replanting mangrove forests will also contribute to maintaining or increasing reservoirs of carbon.

Building a good public health system

A good public health system is of course of prime importance for better living conditions and it is a prerequisite for sound social and economic development. Climate change will bring new threats from contagious diseases. A good health system, good sanitary systems, and controlling disease vectors (e.g. mosquitoes transmitting malaria) are extremely important to adapt to a new climate.

Nature and biodiversity protection

Nature and biodiversity protection has become an integral part of development. Ecological goods and services are an essential input in sound social and economic development. They are already under enormous stress due to the strong reduction in suitable areas for important ecosystems (see Figure 4.7). Species and ecosystems will be subject to increasing stresses in

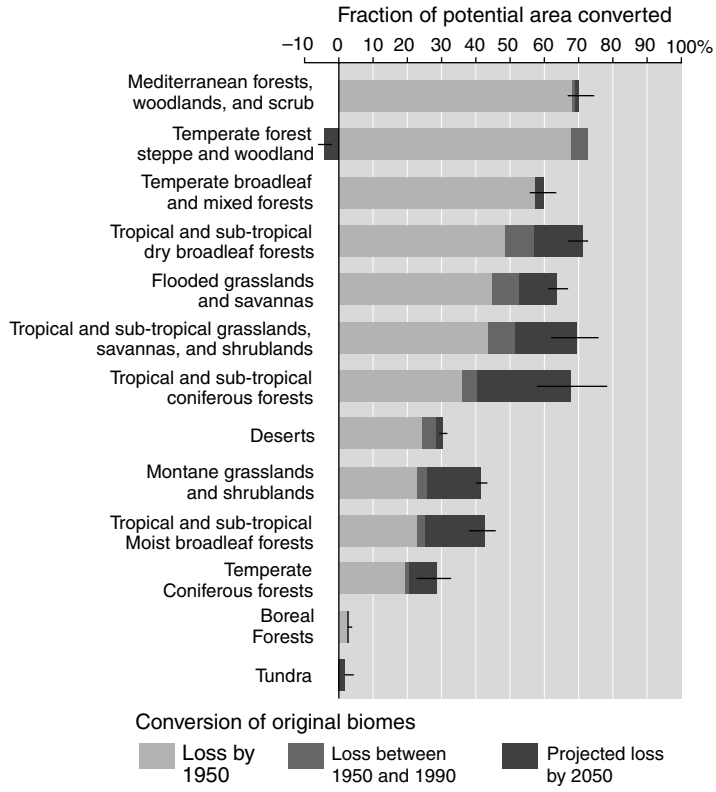


Figure 4.7 **Reduction in area covered by important ecosystems between 1950 and 1990 and projected further loss till 2050.**
Source: Millennium Ecosystem Assessment, 2005.

a changed climate and large numbers of species are threatened with extinction with further climate change. Conditions with respect to temperature and precipitation will no longer support species in a specific location. In practice many species are locked in certain locations by their required habitats and natural and man-made obstacles. Protected areas are often surrounded by cultivated and populated lands and cannot easily be moved. Different concepts and approaches are needed for nature and biodiversity protection in light of climate change. One of the most important is merging smaller ecologically valuable areas with larger ones and providing corridors between protected areas, so that species can more easily find appropriate conditions for survival. Protecting natural vegetation from decay will also help to retain carbon reservoirs.

Socio-economic development

The potential for sustainable development to deliver a significant contribution to controlling greenhouse gas emissions and controlling climate change can be illustrated

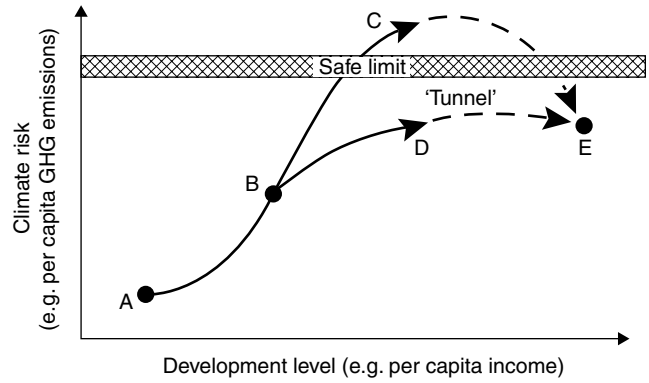


Figure 4.8 **Schematic drawing of development paths and resulting greenhouse gas emissions. The industrialized country trajectory A-B-C-E is not the model for currently developing countries that can follow trajectory A-B-D-E.**
Source: Munasinghe M. Making growth more sustainable, *Ecological Economics*, 1995, 15:121–124.

with the IPCC scenarios for socio-economic development and expected climate change over this century. As Figure 1.8 shows, the difference in temperature at the end of the century between the highest and the lowest scenario is about 2°C. And that is the difference between a sustainable development scenario (IPCC SRES B1) and a high growth fossil fuel based scenario (IPCC SRES A1FI). Both scenarios do not assume any specific climate policy. So the 2°C difference is purely the result of different development paths. It is as much or even more than what can be achieved with specific climate policy.

When you compare the way countries have developed in the past, a strong increase in emissions with increasing development is the dominant picture. However, that does not mean countries whose development has taken off only recently will have to follow the same path. Knowledge is now available of how to avoid serious social and environmental problems. Modern technologies are now widely available to produce goods and services with much lower greenhouse gas emissions. So newly developing countries should be able to skip the stage of high emissions and serious environmental problems by finding a 'short cut' or 'tunnel' to a modern low carbon society. Figure 4.8 shows this schematically.

Does this harm economic growth?

There is a generally held belief that sustainable development policies lower economic growth. This is often used as an argument to continue development in an unsustainable way. Short term economic growth means more jobs, more goods, improvement of living conditions for those participating in the market economy, and generally more money for governments to invest in education, health care, and infrastructure. The long term effects are often not taken into account.

Climate change damages as a result of unsustainable development have negative effects on economic growth, particularly in the long term. As discussed in Chapter 3 they

can become so large (of the order of 5–20% of GDP) that they can really undermine development. So a somewhat slower economic growth in the short term caused by investments in a low carbon and climate resilient economy is more than compensated by the gains in the long term.

What do we know about the economic impacts of climate change mitigation action? The general findings are that average global economic growth rates, even allowing for an ambitious climate policy to control global average temperature change to something like 2°C above the pre-industrial period, are only marginally affected. It means lowering annual economic growth rates by no more than 0.1–0.2 percentage points, but often less, depending on the specific policies applied. We also know that new industries, such as those for producing wind turbines, solar panels, energy efficient machines, and equipment can bring many new jobs. In Germany about 250000 jobs in the renewable energy industry have been created in about 10 years. This number is already higher than that for all of the jobs in the coal mining sector. A study of the Confederation of European Trade Unions[20] shows that implementing the ambitious EU climate policies in the period to 2030 will lead to shifts in sector employment, but overall creates many opportunities for new jobs. There are many other co-benefits as well, not the least being the creation of a healthy environment for people to live in. (See more elaborate discussion in Chapter 11.)

Changing development paths is not so simple

Mainstreaming climate change into development decisions and making development more sustainable, the main thrust of this chapter, means changing development paths. So what do we know about these processes of change? What are the conditions to make it easier? And what are the obstacles to social and economic change?

The conditions that determine how well societies respond to the need for change are manifold. They can be grouped together under the term ‘response capacity’. Drawing on studies of social change in general and adaptation to and mitigation of climate change in particular, a number of important factors related to the economy, institutions, resources, and governance can be identified. Before going into those in more detail, it must be emphasized that the response capacity of a society is both influenced by development paths (in other words it is path dependent) and helps shape development paths. This interaction is responsible for so-called ‘lock-in’ effects, i.e. creating such infrastructures, governance and institutions that are strongly geared towards the current development path, creating vested interest in the status quo, and making change more difficult.

Another important notion is that development paths do not emerge as a result of a set of conscious decisions by government[21]. They emerge as the result of interactions between governments, the private sector, civil society (citizens and non-governmental organizations – NGOs) and also to some extent due to international developments and pressures. So changing development paths is not just a matter of changing government policy,

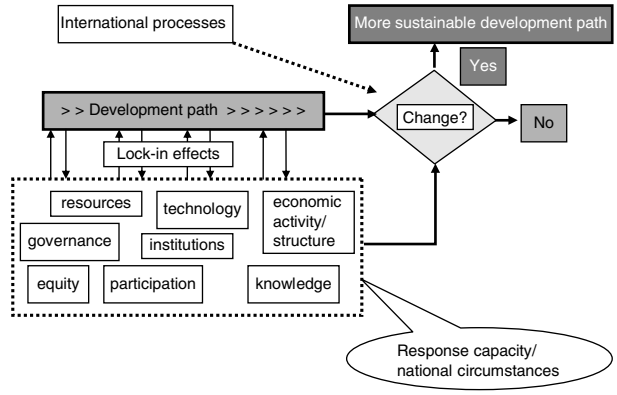


Figure 4.9 **Schematic representation of the interaction of response capacity with development paths and the influence of response capacity and other factors on changing development paths.**

although that is eventually a necessary condition to realize change. NGOs and business have shown to be able in many countries to initiate fundamental changes[22]. Figure 4.9 summarizes in a schematic way these interrelationships.

The main elements of response capacity are as follows.

Economic activity and structure

In a dynamic, growing economy change is easier to make. New activities can be taken up; older, less profitable activities can be stopped. If the labour market is flexible, i.e. skilled labour is available and employees can switch to new jobs easily, economic growth can be shifted to new activities. Moving to a service based economy with lower energy intensity requires the right skills in the labour force. Adapting agricultural practices to a new climate requires farmers to have the necessary skills. In a situation of economic stagnation, unfortunately the case in many developing countries, reorientation to new economic activities is much more difficult. Economic stability is a major determinant of attractiveness of a country for foreign investments that can help to make changes in the economy.

Resources

Natural resources vary from country to country. An abundance of natural resources allows a country to diversify the economy and to undertake new economic activities. On the other hand many countries are dependent on a limited set of natural resources. Abundant coal reserves and lack of natural gas will make it more difficult for a country to reduce the carbon intensity of the economy if it wants to preserve energy security at the same time. Strong winds will allow the development of wind energy. Abundant sunshine positions a

country well for the development of solar energy. Financial resources are another crucial factor in determining response capacity. The possibility of attracting finance from abroad is strongly connected to political and monetary stability.

Technology

Availability of modern technology and capacity to use and maintain this technology is also important to respond to the need for change. This applies to efficient use of energy, renewable energy sources, efficient use of water, modern agricultural practices, health care systems, and many other practices that are needed to adapt to or prevent climate change. And this is strongly connected to the research, development, and innovation structure in a country as well as the ability to attract foreign investments in modern technologies. International arrangements and mechanisms can play an important role as well.

Knowledge

Availability of and access to state of the art information is another factor determining response capacity. This requires trained professionals in all sectors of the economy, up to date information management systems, and sharing knowledge amongst key institutions, not just government institutions. When it comes to adjusting existing practices to deal with climate change or to apply new technologies for renewable energy generation in specific locations, the use of local knowledge is crucial.

Institutions

Social and economic development depends on the availability of strong institutions in the field of security and justice, banking, insurance, research and development, education, power and water supply, business and professional associations, trade unions, and many others. They form the backbone of a stable society with predictable rules and enforcement of contracts and legislation. Without this network of institutions new economic and social initiatives are hard to establish. On the other hand some institutions may resist change, because it is perceived as going against their interests.

Equity

Widespread poverty and large differences in income or wealth create social unrest. Increases in food prices can create immediate problems for poor people and food riots have been shown to be a huge threat to political and economic stability.

Governance and participation

Government cannot realize social and economic change through legislation alone. It needs the cooperation and participation of the business community, civil society, and a wide range of institutions. In short: 'governance' instead of 'government'. It is a matter of getting the support of these groups, using their insights in workable solutions, and mobilizing power and motivating them to be instrumental in creating change. This allows for sharing information, bringing in better knowledge, improving the likelihood of successful changes in development paths, and motivating people to be part of the change. NGOs, including philanthropic foundations, have been particularly active on the issue of development and climate change[23].

How to make it happen?

As emphasized above, changing development paths is not just a matter of government decisions. When societies are facing important challenges, such as dealing with climate change, it matters how the necessary transitions are managed, i.e. how the coherence between different actions is maintained in overcoming barriers and getting the desired change.

There are many barriers to mainstreaming climate change into development policies. They range from lack of awareness about climate change risks, the complications and lack of 'media appeal' of integrated approaches, lack of cooperation between various ministries and institutions, lack of trained people, and last, but not least, an overload of issues for which integration with development is on the agenda.

Some experience in a number of countries has been gathered with strategies and approaches that have shown to be effective in overcoming these barriers.

Start at the top

One of the most critical things is to have all relevant ministries and government bodies share a common strategy and to have key ministries of planning, finance, and development take climate change as a serious and relevant issue. That will only happen if there is sufficient attention amongst the country's leaders to make integration of climate change into development policy a success. Only then will the government budget, the economic strategy, and the country's Poverty Reduction Strategy Plan – a precondition for getting international financial support – reflect mainstreaming of climate change. And only then will climate change get enough political attention to have a chance of changing the country's development path. This sounds self-evident. In practice however only very few countries have managed to achieve this so far. Tanzania (see Box 4.4) is a good example of successful application of this principle. In countries like Nepal or Bangladesh the main policy documents are silent about climate change, while there are serious threats of climate change undermining development[24].

Box 4.4 The example of Tanzania

Tanzania's vulnerability to the impacts of climate change is increasingly becoming a national concern. Extreme weather events impact negatively on agriculture. Infrastructure such as roads, railways, and bridges is destroyed by floods and cyclones. The economy, which grew by 6.9% in the year 2005, is expected to grow by 5.9% in 2006. The decline is mainly a result of drought, a climate related phenomenon.

The economy and the very survival of the majority of communities, like in many Least Developed Countries (LDCs), depend on such climate sensitive sectors. Tanzania's economy can aptly be described as a Climate-Sensitive Economy. It is because of this dependency and the current and projected impacts of climate change on such sectors that climate is a national priority and now, a national preoccupation.

Mainstreaming the environment and hence climate in the national development process is a prerequisite, with or without any international treaty. Mainstreaming entails integration of sustainability principles into a development strategy and, for most poor countries, building capacities at national and local levels for better identification of environmental concerns and opportunities.

This implies properly integrating actions into plans and budgets. Factoring environmental actions into the budgets of the key sector of the economy is an essential attribute of environmental mainstreaming. Tanzania's national budget for the fiscal year 2006/2007 has been dubbed as a 'green budget'. Environment now features prominently, with an increasing level of emphasis in the different national and sectoral policies and strategies. A number of initiatives have been undertaken, and policies, strategies, and programmes put in place to achieve environmental concerns. These include the National Environmental Policy; the Environment Management Act, 2004; Rural Development Policy; the Agricultural Sector Development Strategy (ASDS); the Tanzania Assistance Strategy (TAS); the National Strategy for Growth and Reduction of Poverty; and the Tanzania Development Vision 2025.

(Source: speech of Professor M. J. Mwandosya (MP), Minister of State (Environment), Vice President's Office, Tanzania at the Development and Climate Workshop, Paris Sept 2006, http://www.mnp.nl/en/publications/2006/IntegratedDevelopmentandClimatePolicies_howtorealizebenefitsatnationalandinternationallevel_.html)

Prepare a long term low carbon development plan

South Africa did a remarkable thing recently. It developed a Vision and Strategic Framework on long term low carbon development for the country[25]. It was based on a nationally coordinated long term scenario exercise that explored how the gap between current development plans and a sustainable long term society could be bridged[26]. The basic consideration for this strategic vision was the risk of serious climate change impacts in South Africa with respect to water and food security. It accepted the need for drastic emission reductions along the lines of the lowest IPCC stabilization scenarios that would lead to a limit of mean global mean temperatures to about 2°C above pre-industrial times.

It then looked at options in energy supply, industry, transport, buildings, agriculture, and other economic sectors on how development ambitions can be satisfied, while drastically reducing greenhouse gas emissions. It shows positive effects on poor people because of lower energy bills, increased employment, and overall a negligible or even slightly positive effect on GDP for the country. The strategic plan has been translated into specific policy directions aimed at building a strong renewable energy industry, drastically improving fuel efficiency standards for vehicles, and strengthening R&D, environmental education and policy coordination. It also contains plans to identify vulnerability and develop appropriate adaptation measures, which are to be included in the key performance standards for affected government departments.

Coordinated actions

Changing development paths is generally the result of a multitude of actions, as was explained above. Often these actions are not coordinated or even spontaneous as business and civil society take initiatives that are not in line with government policy. The more coherent individual actions are, the higher the probability that changes will lead to a more sustainable development path. One important element in such a transition management is coherence in government policy, something that is not at all self-evident. To be more effective, transition management should be extended to the role of business and civil society by creating dialogue, networks, and public-private partnerships and encouraging local action and experimentation to find promising approaches The capacity to manage transitions is thus an important condition for effective mainstreaming of climate change in development policy.

An example of such deliberate and coordinated transitions can be found in the way industrialized countries responded to the 1973 oil crisis. France, Germany, and Japan all faced the same problem. They chose different strategies to cope with it. France heavily invested in nuclear power and energy efficiency in buildings, reducing the dependence on fossil fuel. Germany built a strong export industry, compensating the trade balance deficit from the increasing cost of energy imports. Japan invested in making its industrial activities less energy intensive through energy efficiency and moving energy intensive production facilities overseas. All three managed to adjust to the new realities of expensive energy and maintained their economic growth, but in very different ways[27].

Climate proofing

This started as a way to check how well Danish development assistance projects were taking climate change risks into account. It was called ‘climate proofing’, i.e. systematically assessing how climate change was dealt with in these projects. It has now become a more widely applied practice by development assistance agencies and governments of developing countries to assess development policies, programs, and

projects on their consistency with the goal of developing a low carbon economy (low emissions of greenhouse gases) and a society that is resilient to the impacts of climate change. DANIDA, the Danish Development Assistance Agency, has continued to champion this approach in collaboration with the governments of countries where they operate[28]. The approach is gaining ground now. It has been adopted by a variety of organizations such as the Asian Development Bank, United Nations Development Program (UNDP), and United Nations Environment Program (UNEP) (in the context of their climate change vulnerability management programmes), the UK Development Assistance Programme to assist African countries in dealing with climate change[29], and the Netherlands government to assess challenges to manage sea level rise and river flooding.

The key points from this chapter

The main message from this chapter is that a low carbon/high climate resilient society is the appropriate answer to the challenges of improving the living conditions of people around the world. It creates jobs, it improves energy security, it reduces health problems due to air pollution, and it avoids the most important damages from climate change. Even from a purely economic point of view it is the right thing to do. Changing development paths from the current fossil fuel/high greenhouse gas emission trajectory towards a low carbon, 'climate proof' one is a difficult process that requires close cooperation between governments, the private sector, NGOs, and civil society.

Notes

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5. http://www.eia.doe.gov/emeu/mecs/iab/steel/page2d.html.
6. IPCC Fourth Assessment Report, Working Group III, ch 7.1.2; for a further discussion of industrial mitigation options see Chapter 8 of this book.
7. See section on co-benefits of climate policy in Chapter 10.
8. A Fisher Tropsch process is based on chemical reactions of gasified coal in the presence of water at high pressure, leading to the synthesis of gasoline or other chemicals.
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12. See also Chapter 9.

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