A general view of the leading edge of Perito Moreno glacier in the southern Patagonia region near El Calafate. While most of the world's glaciers are melting away because of warmer temperatures, scientists say the Perito Moreno ice field, known as "The White Giant," is gaining as much as 3 meters (10 feet) a day in some parts, pushed forward by heavy snowfalls in the Patagonia region. This picture was taken Jan. 3, 2009. / Reuters-Yonhap

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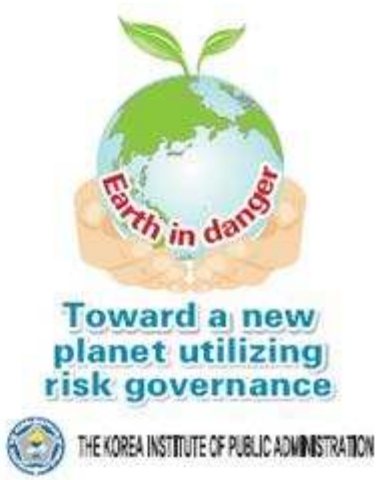
By Geoff O'Brien



From a climate change perspective, adaptation is precautionary or anticipatory adjustments to shifts already happening or likely to happen in the near future.

Accelerated climate change and increasing variability is one of the greatest challenges we face. The Intergovernmental Panel on Climate Change (IPCC) has determined that there is clear evidence that human actions are exacerbating the natural variability of the climate system; we are responsible for producing changes. Though there is general agreement that there is an urgent need to reduce greenhouse gas emissions, there is also recognition that we will have to adapt to the changes that will be driven by the emissions already loaded into the atmosphere.

There seems little likelihood of an international agreement to reduce emissions before 2020, meaning that climate change could be further accelerated. There is a possibility that we will enter an era of dangerous climate change where extreme events could severely threaten communities and livelihoods throughout the world or even cause irreversible damage to ecosystems. Adaptation is an urgent need.

Climate change risks

Broadly speaking accelerated climate change risks are meteorological in nature, for example temperatures will rise and droughts and floods are likely to be more severe and less predictable. Table 1 highlights some of the possible risks that we will face.

The lack of an international agreement to limit emissions means that many of the impacts listed in Table 1 are likely to be exacerbated.

This will make adaptation even more challenging. It is very probable that we will have to adapt to significant changes. We may have already reached tipping points that could lead to irreversible change.

A tipping point is where warming, for example, of the tundra releases methane into the atmosphere. Methane is a powerful greenhouse gas and this would further accelerate the warming trend. It is clear that adaptation is needed urgently.

Adaptation is a process of adjustment to disruptive events. It is not a new concept. Societies have adjusted continually throughout history. From a climate change perspective, adaptation is precautionary or anticipatory adjustment(s) to shifts already happening or likely to happen in the near future. It is defined by IPCC in its Third Assessment Report as:

"Adjustment in natural or human systems is in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation." (IPCC, 2001)

Adaptation is not just adjustment to an average climate condition but is a response to reduce vulnerability to extremes, variability, and rates of change at all scales.

Though the aim of adaptation is to reduce or mitigate vulnerability, its focus is on adaptive capacity, which is the ability of our societies to adjust to climate disruptions. Vulnerability is the degree to which societies are unable to cope with the adverse effects of climate change, including climate variability and extremes.

Adaptive capacity refers to the potential or ability of communities to adapt to the effects or impacts of climate change and is the ability of societies to adjust to actual or expected climate stresses, or to cope with the consequences. The determinants of adaptive capacity comprise factors such as wealth, technology, education, information, skills, infrastructure, access to resources, government and stability and management capabilities.

Wealthier nations have greater adaptive capacity than poorer nations. A term increasingly used in adaptation is resilience, which is the ability of communities to respond and cope with disruptive events. This means building up the capacity of communities to be more self-reliant.

Resilience is a function of learning from experience and using the determinants of adaptive capacity to better prepare for future. In this sense resilience is an on-going process.

This is an important aspect of adaptation to climate change as we will have constantly assess climate hazards and make judgements about the risks that they will produce.

Adaptation strategies

Adaptation strategies will differ from place to place. There is no single solution. Adaptation strategies should aim at reducing risks to communities, promoting food and water security, protecting critical infrastructure and ensuring that people are prepared.

The types of measures that can be used can be characterized in two ways. The first are structural measures which comprise any physical construction to reduce or avoid possible impacts of hazards, or application of engineering techniques to achieve hazard-resistance and resilience in structures or systems such as flood levies, ocean wave barriers and evacuation shelters.

The second are non-structural measures which comprise any measure that does not involve physical construction but uses knowledge, practice or agreement to reduce risks and impacts, in particular through policies and laws, public awareness raising, training and education. Common non-structural measures include building codes, land-use planning laws and their enforcement, research and assessment, information resources, and public awareness programs.

Local knowledge, climate science

Short measures can range from the building of flood defences through to the introduction of drought resistant crops. It is important that adaptation measures should build on local knowledge as well as good climate science.

There needs to be an interchange of information of what works best and why. It will be through learning that adaptation measures will build resilience.

But there are likely to be some very difficult decisions to make. Many of our cities and critical infrastructure are in coastal areas and highly vulnerable to sea level rise and storms. New Orleans is a graphic example of what may happen.

Even today there is discussion of whether some of the low-lying areas of the city should be re-developed. In the future we will have to consider whether or not to abandon some areas, as the costs of defending are likely to be prohibitive.

In Asia there are many cities that will be threatened by rising sea levels and extreme storms. Countries such as Bangladesh will lose land and many will be displaced. This raises the prospect of climate refugees. How will we deal with such problems?

Costs of Adaptation

This is a contentious area. A study by Stern in 2006 on the economics of climate change concluded that it would more cost effective to act now as opposed to dealing the consequences. Stern suggests that a spending of roughly 3-5 percent of GDP would avoid the some 15-20 percent of GDP if we did nothing (Stern, 2006). Studies in 2007 from UNDP (UN Development Programme) and Oxfam estimated costs between $50 and $109 billion per annum (Oxfam, 2007; UNDP, 2007).

The UN Framework Convention on Climate Change (UNFCCC) estimated that total funding need for adaptation by 2030 could amount to between $49 and $171 billion per annum globally, of which $27 and $66 billion would accrue in developing countries (UNFCCC, 2007). More recent analysis suggests that these figures underestimate the costs.

Adaptation is complex and studies need to include a number of sectors, such as agriculture, water, ecosystems, coastal systems, human health and infrastructure. An analysis by Parry et al (2009) of the UNFCCC study, suggest that in some sectors estimates may need to be 2 or 3 times higher.A 2010 study by the World Bank into the infrastructure costs alone suggests an annual spend between $75 and $100 billion (World Bank 2010).

One of the problems is deciding on what areas and sectors to protect. This implies that a concerted effort is likely to be much higher that current published estimates.

Given that the recent World Bank study only focuses on infrastructure then it is not unreasonable to assume that a comprehensive approach is likely to exceed $100 billion per annum.

Cost and lives

According to The Global Humanitarian Forum (2010) the costs of climate related losses amount to $125 billion per annum and some 300,000 lives are lost every year along with countless numbers of lives that have been degraded because of climate change. It is impossible to put a value on such losses and suffering. But whatever the costs we should note that the IMF estimates that the costs of the global credit crunch are some $10 trillion.

Through UNFCCC the global community has established the Green Climate Fund which has identified that developed countries should commit to providing $30 billion in fast-start finance for developing countries in 2010-12 and to mobilize $100 billion a year in public and private finance by 2020 for adaptation and low carbon initiatives. Don't hold your breath as the global economic slowdown may mean that this commitment will not be fully met.

Climate adaptation is urgent. However there does seem to be a lack of action. This is odd as adaptation is about protecting people and the assets we need. Many of the measure will require innovation, a move to a greener economy.

This will have benefits as new products will be needed. This can have long term benefits, particularly if we decide to adapt the global energy system to new and alternative energy resources. What is clear is that many of the options are realisable.

The question remains: do we have the political will? It seems that many of our leaders are transfixed Giddens Paradox (2009); they will not act until something goes wrong.

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Table 1: Examples of possible Impacts of climate change

Phenomena and direction of trend	Agriculture, forestry and ecosystems	Water resources	Human health	Industry, settlement and society
Over most land areas, warmer and fewer cold days and nights, warmer and more frequent hot days and nights	Increased yields in colder environments; decreased yields in warmer environments; increased insect outbreaks	Effects on water resources relying on snow melt; effects on some water supplies	Reduced human mortality from decreased cold exposure	Reduced energy demand for heating; increased demand for cooling; declining air quality in cities; reduced disruption to transport due to snow, ice; effects on winter tourism
Warm spells/heat waves. Frequency increases over most land areas	Reduced yields in warmer regions due to heat stress; increased danger of wildfire	Increased water demand; water quality problems, e.g., algal blooms	Increased risk of heat-related mortality, especially for the elderly, chronically sick, very young and socially-isolated	Reduction in quality of life for people in warm areas without appropriate housing; impacts on the elderly, very young and poor
Heavy precipitation events. Frequency increases over most areas	Damage to crops; soil erosion, inability to cultivate land due to waterlogging of soils	Adverse effects on quality of surface and groundwater; contamination of water supply; water scarcity may be relieved	Increased risk of deaths, injuries and infectious, respiratory and skin diseases	Disruption of settlements, commerce, transport and societies due to flooding; pressures on urban and rural infrastructures; loss of property
Area affected by drought increases	Land degradation; lower yields/crop damage and failure; increased livestock deaths; increased risk of wildfire	More widespread water stress	Increased risk of food and water shortage; increased risk of malnutrition; increased risk of water- and food-borne diseases	Water shortages for settlements, industry and societies; reduced hydropower generation potentials; potential for population migration
Intense tropical cyclone activity increases	Damage to crops; windthrow (uprooting) of trees; damage to coral reefs	Power outages causing disruption of public water supply	Increased risk of deaths, injuries, water- and food-borne diseases; post-traumatic stress disorders	Disruption by flood and high winds; withdrawal of risk coverage in vulnerable areas by private insurers, potential for population migrations, loss of property
Increased incidence of extreme high sea level (excludes tsunamis)	Salinisation of irrigation water, estuaries and freshwater systems	Decreased freshwater availability due to saltwater intrusion	Increased risk of deaths and injuries by drowning in floods; migration related health effects	Costs of coastal protection versus costs of land-use relocation; potential for movement of populations and infrastructure; also see tropical cyclones above

Adapted from Table, Summary of Policymakers (SPM), 1 (IPCC, 2007)