UNEQUAL IMPACTS OF CLIMATE HAZARDS: NEEDS FOR BUILDING CLIMATE RESILIENCE FOR SUSTAINABLE DEVELOPMENT

By: Hiroshi Kawamura *

Summary:
This background paper explains the motivation behind the choice of theme for the World Economic and Social Survey 2016 – Climate change resilience: an opportunity to reduce inequalities, as well as the framework used to address the topic. It explains the link between climate change and inequalities in the 2030 Agenda for Sustainable Development, the role of the public sector and international collaboration in climate change mitigation and adaptation, the impacts of climate hazards on the human system and the human interface with climate hazards, and, finally, the difference between incremental and transformative activities for sustainable development.

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I. Threats of Climate Change and Adaptation: Objectives of the Survey

The world has experienced 6,457 climate-related disasters during the period 2005-2015 and they claimed more than 600,000 lives and affected about 4.2 billion people (CREG, 2015). Global total of the economic losses from these disasters was also significant, estimated to be about $1.9 trillion (in the 2014 prices) during the same period. Developing countries suffered disproportionately greater economic losses relative to their national incomes from the disasters than developed countries. Furthermore, the losses of the developing countries, particularly low-income countries, are believed to be even greater if their losses are estimated more rigorously. Climate hazards, if not addressed, are threatening economic growth and the progress in sustainable development of every country and, in particular, lower-income developing countries. In a worst case, they can threat the existence of a country on the surface of the Earth; sea-level rise is known to expose vast areas of land in the world to increasing flood risks and it forces some small island developing States (such as Kiribati and Tuvalu) to face the very realistic risk of their territories submerging under the water.\(^1\)

The World Economic and Social Survey 2016, entitled “Climate change resilience: an opportunity to reduce inequalities”, is about threats of climate change – or technically speaking, climate hazards attributed to climate change with a major or minor contribution of climate change -- to human societies. It will examine the impact of climate change on lives and livelihoods of people through the inter-linkages between inequalities and climate hazards. The Survey aims to show that inequalities already existed in the society make disadvantaged groups suffer disproportionate losses of their products, income and assets from climate hazards, resulting in greater subsequent inequalities at the end, if a set of climate policies are not in place. That is, the society exhibits the vicious circle among initial inequalities, climate hazards and subsequent inequalities. The Survey is also about adaptation to the threats of climate change. It will examine policies and interventions by the public sector, sometimes through partnerships with other stakeholders, to strengthen adaptation to climate change in order to break the vicious circle.\(^2\) The challenge of adaptation is imminent, as recent data suggests that the world has already warmed 0.85 degree centigrade over the period 1880 - 2012 and most aspects of climate change will persist for many centuries even if the emissions are completely halted immediately, due to the cumulative total emissions of CO\(_2\) up to now (IPCC, 2013).

\(^1\) The Government of Kiribati, for example, acknowledges the relocation of its people may be inevitable, due to climate change, threatening survival of the country. It states that “it would be irresponsible to acknowledge this reality and not do anything to prepare out community for eventual migration.” Office of the President of the Republic of Kiribati, “Relocation”, Kiribati Climate Change, available at http://www.climate.gov.ki/category/action/relocation/ (accessed on 25 January 2016).

\(^2\) While mitigation constitutes the other important side of policies against climate change, it will consider mitigation only to the extent that it complements adaption policies.
The magnitude of impacts of climate hazards on people depends on their exposure and vulnerability to the hazards. Exposure and vulnerability are, in turn, functions of long entrenched, structural inequalities that are observed in the distribution of assets and opportunities, including access to political decisions at various levels of government (see box I.1).\(^3\) Furthermore, when actually suffered from a climate hazard, the capacity to recover from the damage caused also differs among people or communities, depending on their accessibility to resources (mainly income and assets) and public policy. Thus, the structural inequalities in assets, opportunities, voice and political participation and the norms that perpetuate discrimination matter when examining differential impacts of climate change among people and communities. The Survey will thus argue that policies to build climate resilience – strengthening the capacity of people to reduce climate risk and to recover from adverse consequences of a climate event – should address not only issues related to the climate per se, but also the socio-economic and political structural factors that perpetuate inequalities in the context of national development strategies; the Survey calls the policies to address the structural factors transformative. The Survey will shed some light on climate change and inequalities, which have not fully examined, except climate change and gender as well as on indigeneity (Olsson et al., 2014).\(^4\)

Needless to say, the only robust way to prevent the adverse consequence of climate change on the human and natural systems in the very long run is through mitigation. The Survey 2016 will, however, pay attention to mitigation only to the extent that it complements adaptation policies. Climate-related policies has long been biased towards mitigation and only a small share of the climate financing has been directed to adaptation, even though the international community has increasingly been incorporated adaptation into development policy discourse more recently.\(^5\) Adaptation policies and interventions are location- or sector-specific and, unlike the case of mitigation, are difficult to measure their progress or achievement with globally agreed yardsticks. The Survey is hoped to direct international attention to adaptation challenges many communities in the world are facing today, and to achieve proper balance in development policy debates between mitigation and adaptation.

Mitigation and adaptation to climate change have also brought about a new challenge in development policy making. There are significant degrees of uncertainties associated with future climate change in the long run and, accordingly, there are several climate scenarios and their impacts on the human and natural systems in the future. These uncertainties make it difficult for policy makers to integrate the environmental dimension into national policy

\(^3\) For the critical concepts and words that are frequently used in the Survey, see Annex at the end of this chapter.

\(^4\) Vincent et al. (2014) examines gender and climate change and stresses that recognizing gender differences in vulnerability and adaptation can lead to gender-sensitive responses that reduce the risk that women and men face.

\(^5\) According to OECD and CPI (2015), only 7 per cent of total global climate finance flows in 2012 was utilized for adaptation.
making processes, along with the economic and social dimensions. Since the Millennium Declaration in 2000, the interactions between the economic and social dimensions of development have been better understood, both in analysis and practice owing to the extensive experience of many countries and the international community, which implemented policies for socially inclusive growth (see, for example, UN/DESA, 2016). There is much less experience, however, about the interactions among economic, social and environmental dimensions when integrating climate-related policies into a sustainable development framework. Understanding such interactions is at the core of implementing the 2030 Agenda, which places the re-balancing of the economic, social and environmental dimensions at the very centre of achieving sustainable development. The Survey 2016 also aims to help understand the interactions in the three dimensions.
II. Climate Change and Inequalities in the 2030 Agenda for Sustainable Development

The Secretary General of the United Nations proposed to the global community, in its report of December 2014, to make the year 2015 a landmark to navigate the world to the direction that ends poverty and to protect the planet Earth, the two greatest challenges and indispensable requirements for sustainable development (United Nations 2014). In 2015, global leaders and people indeed took important steps towards achieving the two greatest challenges. On 25 September 2015, heads of State and Government gathered in the United Nations in New York adopted the agenda that will drive global efforts towards sustainable development by 2030. A few months earlier on 27 July 2015, the General Assembly endorsed the Addis Ababa Action Agenda of the Third International Conference on Financing for Development that put forward a global framework to mobilize resources and facilitate policy implementation for sustainable development. And, before the end of the year, on 12 December 2016, the 21st session of the Conference of the Parties to the United Nations Framework Convention on Climate Change announced quantitative commitments to reduce their greenhouse gas emissions, the major driver for climate change. The Parties recognized that adaptation is a key component of the long-run global response to climate change to protect people, and established “the global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development...” (UNFCCC, 2015, Article 7.1).

In particular, the final outcome document of the 2030 Agenda, “Transforming our world, the 2030 Agenda for Sustainable Development” (UN General Assembly, 2015), adopted by the United Nations General Assembly in September 2015, presents the promise of the international community to re-establish the delicate equilibrium among economies, societies and the environment. It has an unprecedented scope and significance, as it resulted from a broad Member State-led consultation process that produced the common goals applicable to all, while taking into account different national capacities and the realities that each country faces depending on its development level and priorities. At the same time, the Agenda shows the determination of the international community at large to take the bold and transformative steps to shift the world on to a sustainable and resilient path, with the acceptance of the 17 Sustainable Development Goals and 169 targets. These Goals and targets are integrated and indivisible, and signify the importance of a balanced approach to the three dimensions of sustainable development - economic, social and environmental.

Equality has been recognized as one of the “fundamental values to be essential to international relations in the twenty-first century” in the United Nations Millennium Declaration (UN General Assembly 2000) and now explicitly mentioned in the Sustainable Development Goals (SDG10). The great popularity of a rather technical book about the capitalist economy and inequality (Piketty 2014) also suggests the keen interest of the global society at large in the recent trends in income and asset inequality and the role that the capitalist system has played in determining income distribution.
The average person living in Denmark, Norway, Sweden and Qatar earned more in one day than what the average person of some countries in sub-Saharan Africa during an entire year. Within-country income inequality has also been large and increasing; between 1990 and 2010, income inequality increased by 11 per cent in developing countries, taking into account population size, and more than 75 per cent of the population in developing countries are living today in societies where income is more unequal than it was in the 1990s. At present, about 60 per cent of the variation observed in incomes per capita in the world is explained by country nationality and another 20 per cent by parental income class (Milanovic, 2011). This implies that 80 per cent of the total variation in income per capita is already pre-determined by the factors that an individual is endowed at birth. The world is not only a place of large inequality of outcomes, but also great inequality of opportunity (Anderson, 2015).

In fact, the equalities recognized in the SDG10 are not only about income, but also about opportunities for people to access to resource and participate in socio-economic and political activities. That is, the SDG10 aims at reducing both income inequality and structural inequalities (see box I.1). In the context of the opportunities and access, income is a mere outcome of complex socio-economic and political processes (World Bank, 2006). Sustained, inclusive and sustainable economic growth is essential for building strong economic foundations for all people and countries, and this will be possible only if income inequality is addressed, resources are shared, and disparities of opportunity and power are reduced.

The Paris Agreement on climate change adopted in December 2015 (UNFCCC, 2015) recognizes that “deep reductions in global emissions will be required” in order to achieve the ultimate goal of the Framework Convention on Climate Change, which is to stabilize greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system. The same Paris Agreement recognizes that “climate change represents an urgent and potentially irreversible threat to human societies and the planet and thus requires the widest possible cooperation by all countries.” In addition, the World Economic Forum declared in its report on global risks that “the failure of climate change mitigation and adaptation … is perceived in 2016 as the most impactful risk for the years to come.” (World Economic Forum, 2016, p.6) These concerns are equally reflected in Sustainable Development Goal 13 (see box I.2).

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7 Bourguignon (2015) estimates that 66 per cent of global income inequality can be explained by inequality among countries.
III. The Role of the Public Sector and International Collaboration in Climate Change Mitigation and Adaptation

This section considers why collective actions, or public policies as particular forms of collective actions, at both national and international levels, are necessary for addressing climate change. It will consider the need for public actions in the areas of mitigation and adaptation, separately, as the need comes from different sources of the so-called market failure.

Interactions between climate change and inequalities are generally examined in three broad aspects and each one of them requires distinctive approach; (i) unequal climate impacts on different groups of people within and among countries; (ii) inter-generation inequalities; through impacts on the climate, human activities at present affects the welfare of both current future generations, the latter of which does not exist yet and thus has no way to influence current decision making; (iii) unequal impacts on the climate among people or countries due to their (sometimes significantly) different energy consumption levels (thus greenhouse gas emissions). The first and third aspects of climate change and inequalities can also be argued in an inter-generational framework, but are usually discussed in the context of the current generation.

The first aspect of climate-change and inequality relation is about the so-called unequal impacts of climate change,\(^8\) whose underlying mechanisms are to be examined by the present Survey. The world witnessed such unequal distribution of adverse impacts among different people or communities in the countless episodes in natural disasters at the every corner of the globe. As argued above, the Survey does not consider that they were disproportionally affected by the weather events by chance. Rather, they are considered to be systematically more disaster-prone because of the presence of structural inequalities and income inequality as the embodiment of the complex interactions of these determinants.

The inter-generational trade-off has been the major concern since the landmark definition of sustainable development was appeared in 1987 in the World Commission on Environment and Development (also known as, the Brundtland Report, United Nations, 1987). It defines sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations 1987, section 2). This definition recognizes the potential trade-off between the two generations, and casts the question about how far the present generation should be allowed to expand their activities without compromising the welfare of the future generations. This is the basic cause for the second aspects of the interaction between climate change and inequalities. The Stern Report on economics of climate change (UK, 2006) has indeed acknowledged climate change as the greatest market failure ever experienced by the human society; the current generation who is damaging the future generations by emitting greenhouse gases do

\(^8\) See Lowrey (2013).
not pay and compromise the welfare of the future generations. It has brought attention of the global community to the significant benefits of decisive and immediate action on climate change, which is estimated to far exceed the costs that the future generation has to bear, including the potential impact on health, water resources, food production and the environment.\[9\]

The last aspect of climate change and inequalities is the existing large gap between poor and rich countries in term of energy consumption and greenhouse gas emissions per capita. World Bank (2016) contrasts the significant difference in energy consumption and gas emissions per capita between high- and low-income countries; one billion people living in the poorest countries emit less than 1 per cent of global emission and a person in rich countries consume energy as much as ten times of a person in poor country.\[10\] The sense of the unfairness is further strengthened by the fact that those who are least contributing to global warming are those who are most exposed and vulnerable to climate impacts. It should be noted that here is another type of the market failure, in which most of the impacts of the emissions fall on people living in developing countries, and those responsible for the emissions do not pay the cost. Oxfam (2015) states that “climate change is inextricably linked to economic inequality” by pointing that the poorest half of the global population are responsible for only 10% of global emissions yet live overwhelmingly in the counties most vulnerable to climate change.\[11\]

The second and third aspects above demonstrate that a major challenge when confronting mitigation of climate change is the presence of market failure, or specifically, market externalities. The public sector can play a critical role in reduce or even eliminate the market externalities associated with green gas emissions. Without collective actions among people or countries, individual agents are most likely to advance their own interests without paying any social costs associated with their economic activities, and effective mitigation will not be possible. In principle, cooperative mechanisms, largely led by various levels of Government, at the community, national and international levels must be in place to make those responsible for the emissions pay the social costs (including the private costs) and compensate the others who are damaged by the emissions, so that a socially desirable emission level is achieved.

In fact, towards achieving a globally desirable level of the emissions, the Paris Agreement aims at holding the increase in global average temperature to well below 2°C above pre-industrial levels, fostering low greenhouse-gas emissions development, and establishing means of finance to achieve the goal. The following key mechanisms created under the

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\[9\] There have been numerous reactions to the Report – both positive and negative, based on the natural science or economics grounds. See, for example, articles in Journal of Economic Literature (2007). It may be fair to say that the Report has increased public awareness on the dangers of climate change on the present and future generations.

\[10\] Islam (2015), while acknowledging the fact that the rich tends to pollute more, points out possible equality-venues through which the local, national and international communities can reduce the adverse impact of the income inequality.

\[11\] The richest 10 per cent of people in the world, on the other hand, are responsible for around 50 per cent of global emissions.
Agreement for mitigation are in both voluntary and compulsory nature, with the reporting obligations.

(i) National determined contributions (NDCs) requires parties to prepare, maintain and submit NDCs, which are performance benchmark, with parties’ current status, their intended contributions and measures they intend to use to fulfil their contributions;

(ii) Recognizing the need for greenhouse gas absorption from the atmosphere, the Agreement encourages parties to conserve and enhance sinks and reservoirs of greenhouse gases, such as forest, and;

(iii) The Agreement establishes a voluntary cooperation mechanism, so that parties may transfer mitigation outcomes towards NDCs between countries to promote sustainable development.

The Agreement is rather a political landmark, and the mechanisms are prescribed only at a high level and need to be worked out at lower but more operational levels. It is also with limited enforceability. But it has very symbolic significance as 196 parties have agreed to its language and, during the process of negotiations, they have acknowledged that public actions at the global level are required to control climate change mitigation.

 Adaptation to climate change, on the other hand, can be privately funded for individual sake if a person or household is not constrained by financial availability. For example, with her own financing, a structurally sound house can be built, with access to clean water in a well in her land. She can also buy life, health and property insurance for herself and her family against potential damages from natural disasters. So, at least some adaptation measures may not require public interventions for those who are not financially constrained. But, as will be seen in the following chapters, adaptation measures to climate change include various types of policy and institutional arrangements, and physical and social infrastructure building. They range from improved access to educational and health facilities to installation of an early warning system urban planning and land zoning laws, and to participatory political decision processes and establishing national adaptation strategy.

These services, systems and rules and regulations have the characteristics of public goods, both non-excludable and non-rivalrous where individuals cannot be excluded from the use and where use by one individual done not reduce availability to others (Rosen, 1985, chapter 6). It is known that provision of public goods at the community or national level is below a social optimal level if it is left for the market mechanism only based on private incentives. Thus, the public sector is expected to deliver these services by enacting legal provisions and social policies via public funds likes taxes or service charges. The following chapters will examine various policies and mechanisms that aim at increasing supply of public goods at the community and national levels.

It should be quickly added that similar arguments can be made for national-level adaptation; a country can fund and initiate adaptation measures to climate change by itself if it has the financial and technical ability. Needless to say, financially or technically constrained
countries need international assistance to adapt to climate change. However, even for the countries with financial and technical capabilities, international collaboration is necessary to provide a public good up to globally or regionally desirable level. Early warning systems against extreme weathers or international health partnerships against geographical spreading of climate-induced diseases are just two cases in point for the necessity of cooperation beyond national borders. Such international cooperation often involves technical and financial partnerships and assistance, which will be taken up in the last chapter of the present Survey.
IV. Climate Hazards and their Impacts on the Human System

A. Differential impacts among countries

Climate change can occur in the natural processes such as modulations of the solar cycles, volcanic activities and a generic geological period of temperature fluctuations. The international community, however, has come to realize that climate change is caused by human activities, with strong scientific evidence; IPCC reports that “it is extremely likely that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in greenhouse gas concentration and other anthropogenic forcing together. The best estimate of the human-induced contribution to warming is similar to the observed warming over the period.” As mentioned above, the Paris Agreement also recognizes he urgent necessity to deep reduction of global emissions.

Climate change has affected every corner of the world and no country is immune to its impacts. For the 21st century, all climate change scenarios predict continuing slow onset changes, such as higher surface and ocean temperature, ocean acidification and global rise of sea level. The scenarios also predict increased or more intensified extreme weather-related events, such as heat waves and extreme precipitation. This section will present occurrence of weather-related disasters in the past 2 decades and in human cost as results of the disasters. During 2005-2015, climate-related disasters defined above have become more frequent, reaching 6,457 events during the period, 333 disaster events per year. The disasters claimed more than 600,000 lives and affected about 4.2 billion people during the same period (see table I.1). These weather-related events affected every corner of the world and people in both developing and developed countries suffered from loss of human lives (figure I.1).

12 The Ice Age is a period of temperature reduction.
**Table I. 1: Numbers of people killed and affected by disaster type (1995-2015) a/**

<table>
<thead>
<tr>
<th>Disaster</th>
<th>Number killed</th>
<th>Number affected (millions) b/</th>
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<tbody>
<tr>
<td>Flood</td>
<td>242,000</td>
<td>2,300</td>
</tr>
<tr>
<td>Drought</td>
<td>164,000</td>
<td>1,100</td>
</tr>
<tr>
<td>Storm</td>
<td>157,000</td>
<td>660</td>
</tr>
<tr>
<td>Extreme temperature</td>
<td>22,000</td>
<td>94</td>
</tr>
<tr>
<td>Landslide and wildfire</td>
<td>20,000</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>605,000</strong></td>
<td><strong>4,162</strong></td>
</tr>
</tbody>
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Notes:  
  a/ Up to August 2015.
  b/ Those injured, left homeless or in need of emergency assistance. It does not include those who were killed.

**Figure I. 1: Impacts on the human society**  
(a) Number of weather-related disasters, 1995-2015
(b) Number of people killed by weather-related disasters, 1995-2015

Source: UN/DESA, based on CRED (2015)

Their impacts on economic activities were also significant, about $1.9 trillion (in the 2014 prices) during the period 1995-2015, with no countries free from disastrous impacts (figure I.2). Because of their sizes of the economies, developed countries as a whole incurred the largest economic loss; about $1.1 trillion, 58 per cent of the global loss (see figure I.3). But, in terms of the loss relative to GDP, low-income countries as a whole had to incur the highest economic burdens, about 5 per cent of their total GDP. Furthermore, due to the underreporting of economic losses in the developing regions, particularly low-income countries, a true magnitude of the economic costs relative to total income is very likely to be significantly higher for low-income countries, further depleting economic and human resources that could have been channelled to socio-economic progress of these countries. 14

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14 The number of the disasters covered under the economic cost calculation accounts for only 36 per cent of the total disasters recorded during 1995-2015 (CRED, 2015).
Figure I. 2: Economic Impacts on the Human Society

(a) Economic cost of weather-related disasters, millions of US dollars, 1995-2015 a/

(b) Economic cost of weather-related disasters as a percentage of GDP, 1995-2015


Note: a/ Economic cost of disasters refers to the amount of damage value (in United States dollars) to property, crops and livestock at the moment of the event, i.e. true to the year of the event.
B. Interactions between the natural and human systems: vulnerable populations in the coastal area and dry lands

The number of disastrous events during 2005-2015 increased by 14% higher from 1995-2004 and more than doubled from 1980-1989. The significant increase is largely owing to a sustained rise in the number of floods and storms. But a caution is required when attributing the increase to climate change. First, as mentioned earlier, it is not so straightforward to link a wealth-related event to climate change. Second, disastrous outcomes result from interaction of weather/climate and human activities. As seen in box I. 3, significant part of the deforestation is due to the expansion of human settlement into forest areas, largely due to population growth and increasing demands for forest resources. At the global level, despite sea-level rise and coastal erosions in many parts of the world, more people in both developing and developed countries have settled in coastal areas, exposing themselves to greater risks (see figure I.4). In fact, after careful investigation on population increases in US coastal areas from 1960 to the present, a study by the US Census Bureau (Wilson and Fischetti, 2010) concludes that social, economic and environmental factors drew residents to coastline destinations from other areas in the United States and other countries, and predicts that the trends will continue.

According to Neumann et al. (2015), eleven per cent (547 out of 5,029 million) of the population in developing regions was living in a low-elevation coastal zone -- zones less than 10 meters above sea level -- in 2000, of which 28 per cent (156 million) were living in a 100-year flood plain – a plain that has a 1 per cent probability of occurring of a flood event in any
given year (see table I.2). The same study predicts that 798 million people (about 11 per cent of the developing regions population) will live in a low-elevated coastal zone and 245 million in a 100-year flood plain in 2030, suggesting greater exposure to climate hazards and thus larger climate-related human costs in the future if proper climate policies are not in place. As of 2000, eighty-eight per cent of the flood plain population were in Asia. But, the same authors warn that high rates of population growth and rapid urbanization (from 35 per cent in 2000 to 47 per cent urban in 2030) “will exacerbate the already high vulnerability of many African coast countries.” 15

Other vulnerable populations can also be found in dry lands and mountain and remote areas. Populations in these areas largely comprise nomadic, semi-nomadic and sedentary agricultural inhabitants. Large areas of populated dry lands with growing subsistence populations particularly pose challenges to agricultural development and food security in Africa and large parts of central and southern Asia. About an estimated 2 billion inhabitants in the developing region were threatened by desertification and drought in 1995, for which latest data are available (see table I.3) and the number is considered to be increasing due to population growth and migration, as in the case of coastal zones. According to two MDG country reports by Ghana and Kenya, the proportion of the population in extreme poverty declined in many regions in the countries, the direst or most remote parts of the countries witnessed increased poverty rates (Johnston, 2016). Climate change and variability are greatly affecting mountain populations in dry lands, limiting agricultural production productivity and inducing migration from the highest elevation to middle elevation area. According to FAO (2015), the global mountain population in the developing region was estimated to be at 834 million in 2012, with countries with significant mountain populations include Burundi, Ethiopia, Lesotho and Rwanda in African; Bhutan and Nepal in Asia, and; Bolivia and Guatemala in Latin American and the Caribbean. With overall population growth in the world, these mountain areas experienced high population growth since 2000. This was particularly evident in the middle elevation area as a result of high inflows of migrants from the higher elevation area, who were compelled to leave because of a changing climate (Georgis et el., 2010). FAO notes that the migration not only increased the population pressure on the middle elevation area, but also resulted in losses in the higher elevation area in terms of ecosystem services and preservation of cultural agro-biological diversity.

Without proper adaptation policies and better infrastructure in place, more people are likely to expose themselves to climate hazards, particularly to floods, the major cause for deaths, injuries and displacements, even if the climate or weathers do not change. In addition, economic activities, physical assets and wealth will be more concentrated in the coastal area in tandem with the increasing number of residents, leading to more significant economic damages. Of a particular concern is about the high vulnerability of small-island developing

15 See Johnston (2016) for more detail.
States to weather-related events (largely flooding and storm). Largely due to their small land areas, these countries are likely to be hit hard by a single climate event in terms of economic costs and the damage can be predicted to be higher due to the predicted rising sea level in the future.

Figure I. 4: Population living in coastal cities with 300,000 habitants or more on 1 July 2014

(Millions) a/


Note: a/ 540 cities. The coastal areas were defined as areas between 50 meters below mean sea level and 50 meters above the high tide level or extending landward to a distance of 100 kilometres from shore, including coral reefs, intertidal zones, estuaries, coastal aquaculture, and sea grass communities. If a city’s buffered zone was located in a coastal area, the city was considered a coastal city. Otherwise, it was considered an inland city.
Table I.2. Populations of low-elevation coastal zones and 100-year flood plains in developing regions (millions) a/

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>811</td>
<td>1562</td>
<td>54</td>
<td>84</td>
<td>109</td>
<td>13</td>
<td>24</td>
</tr>
<tr>
<td>Asia</td>
<td>3697</td>
<td>4845</td>
<td>461</td>
<td>80</td>
<td>649</td>
<td>37</td>
<td>201</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>521</td>
<td>702</td>
<td>32</td>
<td>71</td>
<td>40</td>
<td>6</td>
<td>68</td>
</tr>
<tr>
<td>Developing Countries total</td>
<td>5029</td>
<td>7109</td>
<td>547</td>
<td>82</td>
<td>798</td>
<td>156</td>
<td>245</td>
</tr>
<tr>
<td>Least developed countries</td>
<td>645</td>
<td>1325</td>
<td>93</td>
<td>93</td>
<td>136</td>
<td>n.a</td>
<td>n.a.</td>
</tr>
<tr>
<td>World b/</td>
<td>6101</td>
<td>8626</td>
<td>625</td>
<td>76</td>
<td>893</td>
<td>169</td>
<td>282</td>
</tr>
</tbody>
</table>

Source: B. Neuman et al., 2015, tables 4 and 5.
Notes: a/ Populations for low-elevation coastal and plain zones are estimated, based on identification of built-up areas in satellite imagery.
b/ Includes developed regions and Oceania, not shown.

Table I.3: Total population and dry-land population by region, 1995

<table>
<thead>
<tr>
<th>Region</th>
<th>Population</th>
<th>Dry lands population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>720</td>
<td>326</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>1093</td>
<td>182</td>
</tr>
<tr>
<td>Asia</td>
<td>3451</td>
<td>1475</td>
</tr>
<tr>
<td>Developing regions</td>
<td>4533</td>
<td>1983</td>
</tr>
<tr>
<td>World</td>
<td>5702</td>
<td>2130</td>
</tr>
</tbody>
</table>

V. Climate Risks at the Human Interface with Climate Hazards

A climate event affects different people and communities in a different ways and magnitudes, as well. This is because consequences of a climate event on them are results of their interface with the climate, and the ways in which they interface with the nature differ among them. To understand that interface, the concept of climate risk plays the key role. According to the Working Groups II and III to the Fifth Assessment Report of the IPCC, the term risk refers to the potential for adverse consequences when the outcome is uncertain and where something of value is at stake in the human and natural systems – such as human lives, livelihoods and health, economic, social and cultural assets and service flows out of them, ecosystems and species.

Risk of climate-related impacts is represented by the interaction of climate-related hazards and the vulnerability and exposure as results from human interface with the natural system (figure I.5). In this framework, vulnerability and exposure are considered to be the consequence of socioeconomic pathways and the existing political, ethical and even cultural conditions in the society. Exposure refers to the presence of people (including their livelihoods), ecosystems and species economic, social, or cultural assets, among other things, in places that could be adversely affected. Vulnerability refers to the propensity or predisposition to be adversely affected by climate change. Vulnerability, like the concept of equality, has two distinctive aspects, outcome and contextual. Outcome vulnerability is a linear result of the projected impacts of climate change on a particular exposure unit, offset by adaptation measures. The main question on outcome vulnerability might be “which groups of population or sectors are likely to be negatively more affected?” On the other hand, contextual vulnerability focuses on the context to determine outcome vulnerability. That is, impacts of a climate event is considered to be experienced in the context of political, institutional, economic and social structures and their changes, all of which interact with each other. Thus, the structural inequalities have the major role when determining the contextual and outcome vulnerability. The typical question on contextual vulnerability might be “why are some regions and groups affected more than others?” The risk thus defined can be examined in the context of the structural inequalities, as well.

Weather-related events in the short term and climate change in the long term modify biophysical conditions of the human and natural systems, altering the context for which people live in or work with. That is, climate change not only directly leads to changes in biophysical conditions (such as global warming, changing precipitation patterns and sea-level rise), but also alters ways in which people undertake food production, trade of goods and services, and energy consumption, for example.

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16 This section is largely based on IPCC (2014).
Impacts caused by changes in climate will exacerbate existing risks and create new risks both for the human and natural systems. IPCC projects that climate change will undermine food security due to (net) adverse impacts on the production of the major grains – wheat and rice – and maize in tropical and temperate zones, decreased productivity of fisheries due to global marine species redistribution and marine biodiversity reduction in some regions, the reduction of surface water and groundwater resources in dry subtropical regions. Figure I.6 shows detailed projected impacts on biophysical and human systems, with varying degrees of confidence about attributing these impacts to climate change.\textsuperscript{17}

IPCC (2014) ranks the degree of confidence with regard to attributing observed impacts for various systems to climate change into five categories from "very high" to "very low". Climate change will also affect human health by exacerbating the already existing health problems. The combination of higher temperature and humidity in some areas for certain periods of the year is expected to compromise regular human activities, such as growing foods and working outdoor with negative impacts on productivity and total volumes of output. With changing climatic conditions and the spread of diseases, impact on human health can be exacerbated due to worsening health problems or due to outbreaks of newly found diseases or existing diseases new to the area.

\textsuperscript{17} For the description of the map, see IPCC (2014), pp. 30-32.
Figure I. 6: Widespread impacts attributed to climate change based on the available scientific literature since the AR4 $^{a/b}$


Notes: $^a$ Based on the available scientific literature since the IPCC Fourth Assessment Report (AR4), there are substantially more impacts in recent decades now attributed to climate change. Attribution requires defined scientific evidence on the role of climate change. Absence from the map of additional impacts attributed to climate change does not imply that such impacts have not occurred. The publications supporting attributed impacts reflect a growing knowledge base, but publications are still limited for many regions, systems and processes, highlighting gaps in data and studies. Symbols indicate categories of attributed impacts, the relative contribution of climate change (major or minor) to the observed impact and confidence in attribution. Each symbol refers to one or more entries in WGII Table SPM.A1, grouping related regional-scale impacts. Numbers in ovals indicate regional totals of climate change publications from 2001 to 2010, based on the Scopus bibliographic database for publications in English with individual countries mentioned in title, abstract or key words (as of July 2011). These numbers provide an overall measure of the available scientific literature on climate change across regions; they do not indicate the number of publications supporting attribution of climate change impacts in each region. Studies for polar regions and small islands are grouped with neighbouring continental regions. The inclusion of publications for assessment of attribution followed IPCC scientific evidence criteria defined in WGII Chapter 18. Publications considered in the attribution analyses come from a broader range of literature assessed in the WGII AR5.

A. Risks at the country level

The IPCC framework represented in figure I.5 is usually applied at the individual or community level. If empirical assessment of the risk is to be performed for an individual or a community, detailed personal information as well as environment and climatic information about the local area surrounding the community is required. This section, instead, examines how the country climate risk can be assessed, based on the IPCC conceptual framework and available country-level information. That is, it is to assess IPCC defined climate risks by combining available information on the vulnerability and exposure to climate impacts and climate hazards at the country. This is to show that many developing countries face high risks to climate impacts, but even developed countries are not free from the climate risk. Climate change is indeed a major global concern, affecting every country.

A country with high risks is likely to face slower economic growth and wider year-to-year economic fluctuations as consequences of disasters than other countries with lower risks, particularly when the agriculture accounts for a significant share in total economic activities. It can lead to higher incidence of poverty or deepening of poverty, making it more difficult to eradicate poverty by 2030, the target year of the SDGs. With higher incidence of poverty, more frequently exposure to weather-related events, or prolonged, deteriorating socio-economic and environmental conditions, people will be likely to be displaced and to induce unplanned within or cross border migration.18

The number of weather-related disasters experienced during the period 1995-2015 that are reported in figure I.1 (a) is used as a proxy for climate hazards. The IPCC defines the climate hazard as the potential (but not actual) occurrence of a natural physical event or trend or physical impact that may incur human costs. The reported number of disasters in figure I.1 is assumed to be reliable a predictor for the number of disastrous events that are expected to occur in the future. The countries are ranked according to the number of weather-related events, from the first (the highest number of events) to 192nd (the fewest).

Vulnerability and exposure ranking is made based on the scores constructed by the Notre Dame-Global Adaptation Index (ND-GAIN).19 The vulnerability of a country of the Notre Dame Index comprises of three components; the exposure to climate-related hazards, the sensitivity to the impacts of the hazard and the adaptive capacity to cope or adapt to these impacts. Each component index is constructed by considering six “life-supporting sectors”, comprising of food, water, health, ecosystem services, human habitat and infrastructure, each of which is, in turn, represented by an indicator. There are thus 18 entries (36 variables) to build the vulnerability index.

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18 For example, see Nawrotzki et al. (2015).
19 Available at [http://index.gain.org/ranking](http://index.gain.org/ranking). For the technical treatments of the index, see University of Notre Dame Global Adaptation Index (2015).
Its definition of vulnerability defers from the one by the IPCC, the latter of which treats the exposure as an independent component when evaluating risks to climate impacts. So a new vulnerability index to be used here is calculated by removing the exposure elements from the Notre Dame vulnerability index, and new exposure index is reported as an independent component for the risk (called it IPCC-vulnerability index). The 192 countries/economies are ranked according to the IPCC-vulnerability and the (new) exposure indexes (see figures I.10 (a) and (b)). Finally, to arrive at risk ranking of a country, all data must be expressed in the same unit, so that they can add. Here it is to simply sum up the rankings of the three components that affect the risk (while there are many approaches to create indexes to set data into the same range of numbers). The result is figure I.7 (c).

Overall, the result shows that poorer developing countries in Africa and South Asia exhibit high vulnerability while countries with high or upper-middle per-capita income enjoy lower vulnerability scores. The vulnerability index reflects several social variables related to the present levels or status of the social infrastructure in the areas of health and sanitation, energy, water management and ecosystem. As a result, developing countries with low levels of financial and management capacity received lower scores.

Turing to the exposure index, the Notre Dame Index looks for projected changes (not levels) of cereal yields, water runoff, warm period and food hazard, some of which are due to projected climate change. Because climate impacts are projected in terms of change, even some high or upper-middle income countries appear to be relatively more exposed to climate impacts. In general, however, countries in the tropical or sub-tropical region appear to be more exposed to climate impacts.

The county risk is the sum of the IPCC-vulnerable and exposure rankings plus the ranking of the number of weather-related events. Countries with the highest risk are concentrated in Africa and South and southern East Asia. The countries in the Americas (except Canada) and two high-income countries outside (Italy and Japan) also exhibit relatively high risk levels. In general, countries with less exposure to climate impacts tend to face lower risks. While some countries, particularly those in the high-income category, can manage to reduce the vulnerability to climate impacts, they still face relatively high risks, owing to their greater exposure to climate impacts and to (projected) higher occurrence of weather-related events. Overall, many countries in the tropical and subtropical areas and countries in the Southern sphere are more likely to face high risks, but even some high-income countries are not to immune to the risk.

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20 One can also argue that countries with history of many episodes of natural disasters are likely to have attempted to reduce their vulnerability to climate impacts by improving economic and social infrastructure as a matter of necessity, but the risk has not been reduced significantly.
Figure I. 7

(a) IPCC-vulnerability index, by quintile, 1995-2014

(b) Exposure index to climate change, by quintile, 1995-2014

(c) Risk of climate change, by quintile, 1995-2014

B. Impacts on Human Livelihood

Within countries, some risks are location specific beyond obvious candidates, such as mountainous areas or agricultural villages with marginal lands. Cities with high population densities can be exposed to higher risks when climate or weather is changing; increasing risks from heat stress, storms and extreme precipitation, inland and coastal flooding, landslides, air pollution and water scarcity will affect people living in the urban area. One should be reminded that even developed countries with stronger and better infrastructure are no escape from these negative impacts; major heat waves in 2003 and 2006 killed more than 72,000 and 3,400 people, respectively, in Western and Southern Europe (CRED, 2015). The urban area in many developing countries will face increasingly amplified risks if essential infrastructure and public services are not in place.

Impacts from changing climate are further differentiated among people due to differences in the vulnerability and exposure that arise from non-climatic factors (Anderson, 2015). People who are in disadvantageous positions in an economic, social, political or institutional sense are further vulnerable to climate impacts and face harder and longer times to cope with and adapt to the impact, leading to greater risks. As an illustration, consider a case in which natural disasters affect the two sexes in different ways and magnitudes. Neumayer and Plümper (2007) distinguish three different causes for gender differences in mortality vulnerability to natural disasters; (i) biological and physiological differences; (ii) social norms and role behaviour (care takers of children and elderly, dress codes, behaviour restrictions), and; (iii) access to resources and a temporary breakdown of social order after disasters. After careful statistical analysis, they conclude that biological and physiological differences between women and men alone cannot account for the systematic gaps between female and male life expectancies that were observed after natural disasters, and the gender differences in the social norms and behaviours contribute to the gap.

There are other cases. Poor households are most vulnerable to climate change as they are inflexible in accessing to resources. But they also have least political power to mobilize public resources for their advantage. Urban slum dwellers tend to face larger climate-change related risks due to the higher exposure to weather-related events and their poor living environment; low-quality, clustered housing and poor social infrastructure. But, insufficient provisions of health care, sanitation facilities and emergency services by the public sector amplify the risk the urban resident faces. Thus, the greater risk can rarely be attributed to a single cause, climatic or non-climatic. It is the product of intersecting climatic and social processes that give rise to higher inequalities (or, equivalently, greater vulnerabilities) in income, access to financial or non-financial assets and other opportunities to climb up the social ladder. The next chapter will examine impacts of the intersecting human and natural processes on different people or groups of people.
VI. Building Resilience to Climate Change: Incremental and Transformative Activities for Sustainable Development

Achieving sustainable development is an ultimate goal of climate policies, and minimizing the impact of climate hazards to livelihoods is a necessary step for sustainable development envisaged in the SDGs. Insufficient mitigation and adaptation responses to changing climate and weather-related events could erode that basis for sustainable development and, left unattended, impacts of climate change could reverse the development progress that many countries have accomplished. Managing the risks of climate change that involves mitigation and adaptation decisions has implications for balancing the needs of both current and future generations, as well. This section depicts adaptation as a means to build resilience to climate impacts. While mitigation activities have been dominant responses to climate change, adaptation is gradually becoming important in climate negotiations and implementation, as discussed in chapter V in relation to the Green Climate Fund (Green Climate Fund, 2016).

Climate resilience, if it is to address the risks that lead to differential impacts on different groups of people, should target at strengthening people’s capacity to cope and adapt not only by reducing direct climate impacts. As seen above, climate risks are determined by the intersecting climatic and social processes. The resilience policy and adaptation activities, thus, should identify the structural inequalities or, equivalently, the contextual vulnerability, that make particular groups of people more vulnerable to climate hazards. Then, resilience policies and adaptation activities should aim at transforming the structural inequalities, consistent with social and economic policies for sustainable development, taking into account the co-benefits, adverse side- or unintended-effects and risks. A package of these policies can be called comprehensive, coherent and transformative.

Such policy package constitutes important part of adaptation recommended by the IPSS, which does not explicitly refer to structural inequalities in the context of adaptation, though. Table I.4, which is based on the table in IPCC (2014, p.27), indicates the current state of an integrated policy framework for adaptation policy actions to climate change. At present, there are different ways to categorize options and there is no universally agreed set of operational definition of adaptation activities, either. The table only illustrates how diversified the adaptation activities can be.

Technological and management adaptation options and interventions related to human development and livelihood security (the upper part in the table) have commonly been mentioned in policy debates about adaptation. But when moving towards the bottom of the table, there is less agreement about a boundary between adaptation activities and beyond. According to IPCC, however, “there is a growing experience of the value for ecosystem-

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21 Olson et al. (2014) in one of the IPCC reports, however, often refers to structural inequality and other forms of inequalities.
based, institutional, and social measures, including the provision of climate-linked safety nets for those who are most vulnerable.”22 Adaptation needs are used to be assessed on the basis of physical hazards but, more recently, their focus has been on the underlying causes of vulnerabilities and exposures. For example, vulnerability and exposure “are affected by geographic location, biophysical conditions, institutional and governance arrangements”23 at the local and country levels, while biophysical and socio-economic conditions are considered to be more prominent determinants. Thus, adaptation measures have increasingly been presented as an integrated package of activities.

Admittedly, it is difficult to be truly comprehensive and transformative. Furthermore, adaptation is location or context specific and, therefore, a one-size-fit-all, or a cook-book, approach may be not appropriate. The first, perhaps immediately implementable, option to be considered is to reduce vulnerability and exposure by implementing policies in the areas of health and education, diversification of income and livelihood diversification, disaster risk and ecosystem management, and infrastructure improvement. Disaster risk management includes, but not limited to, setting up early warning system against weather-related events (plus against tsunami), building shelters against flood and storm surge, infrastructure building or improvement and hazard mapping. Keeping urban green spaces and wetlands, natural resource management and coastal afforestation – all under the ecosystem management -- can be undertaken by the local community with local knowledge and practice and, thus, be implemented sooner. Improving health and education and diversifying income and livelihood should be familiar areas of policy implementation under the era of the Millennium Development Goals.

These options can be implemented by improving the existing institutions, administrative arrangement and rules and regulations, while constraints still do exist as regard to financing and human resources. They can be called incremental as opposed to transformative. These options address issues related to inequalities in income and assets, unequal opportunities in access to social services or weak social and physical infrastructure. These options cluster in the upper part of table I.4. They help the society plan and implement further options in the next stage of adaptation, which may increasingly demand transformative plans and actions.

As moving down the list in table I.4, activities require transformation of rules and regulations or, more generally, governance and culture. Transformational adaptation activities are required to change the fundamental socio-economic, political and institutional attributes of the society in response to climate change. These activities in the area of education, for example, may include equal access to quality education for both women and men and the introduction of awareness raising about adaptation to climate change and ways to implement adaptive actions at home. Behavioural changes can be induced through an evacuation planning and soil and water conservation practices among family members or at the community level. At the local or national level, hazard and vulnerability mapping and early

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22 Noble et al., 2014, p. 836.
23 Noble et al., 2014, p. 840.
warning and response systems, based on the mapping, can be instituted. Transformative options can also include behavioural shifts to sustainable production and consumption, and reforms in political, social, cultural and ecological decision making. Restricting adaptation responses to incremental changes that are sought in the first step of climate resilience building can eventually miss opportunities to tackle the issue of the fundamental attributes of the society to changing climate, i.e., the structural inequalities or contextual vulnerability. Without paying sufficient attention to the need for transformational changes, the society will demand on the institutional structures to reconcile different visions for the future and to address possible equity and ethical consequences of climate change and its impacts on the human and natural systems.

It is further noted that, because these transformative activities are likely to affect other areas of adaptation options, coordination efforts are required among different adaptation actions and a longer time span may be needed to implement such actions. Policy makers need to note that poor planning or implementation, too much emphasizing short-term outcomes, relying too much on the existing institutional arrangement, or completely failing to anticipate consequences could result in mal-adaptation. It can increase, rather than reduce, the vulnerability and exposure of the group targeted. Adaptation to climate change is complex and requires taking account of interactions among land use, food security, water management and fragile environment.

The location specificity prevails, as most effective transformation should be the one that reflects country’s own visions for a sustainable society in the future and own possible pathways to reach the goal, in accordance with national reality and priorities. Building greater climate resilience through the transformational adaptation could lead to sustainable development with more equal outcomes. Conversely, understanding structural determinants of inequality could help identify the transformational adaptation measures that are necessary to achieve sustainable development.

After all, adaptation to reduce the risks from climate impacts comprises of a continuum of policies ranging from incremental to transformative, and a set of the interventions spanned in a wide range of development strategies specific to sectors (see the table approaching climate risks). Adaptation options vary among countries, sectors and geographical locations, with diverse potential risks and benefits, depending on the context of inequalities or vulnerability, disaster risk and ecosystem management, health and education, diversification of income and livelihood diversification and infrastructure improvement.
Table I.4: Approaches for managing the risks of climate change

<table>
<thead>
<tr>
<th>Overlapping Approaches</th>
<th>Category</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Human development</td>
<td>Improved access to education, nutrition, health facilities, energy, safe housing &amp; settlement structures, &amp; social support structures; Reduced gender inequality &amp; marginalization in other forms.</td>
</tr>
<tr>
<td></td>
<td>Poverty alleviation</td>
<td>Improved access to &amp; control of local resources; Land tenure; Disaster risk reduction; Social safety nets &amp; social protection; Insurance schemes.</td>
</tr>
<tr>
<td></td>
<td>Livelihood security</td>
<td>Income, asset &amp; livelihood diversification; Improved infrastructure; Access to technology &amp; decision-making fora; Increased decision-making power; Changed cropping, livestock &amp; aquaculture practices; Reliance on social networks.</td>
</tr>
<tr>
<td></td>
<td>Disaster risk management</td>
<td>Early warning systems; Hazard &amp; vulnerability mapping; Diversifying water resources; Improved drainage; Flood &amp; cyclone shelters; Building codes &amp; practices; Storm &amp; wastewater management; Transport &amp; road infrastructure improvements.</td>
</tr>
<tr>
<td></td>
<td>Ecosystem management</td>
<td>Maintaining wetlands &amp; urban green spaces; Coastal afforestation; Watershed &amp; reservoir management; Reduction of other stressors on ecosystems &amp; of habitat fragmentation; Maintenance of genetic diversity; Manipulation of disturbance regimes; Community-based natural resource management.</td>
</tr>
<tr>
<td></td>
<td>Spatial or land-use planning</td>
<td>Provisioning of adequate housing, infrastructure &amp; services; Managing development in flood prone &amp; other high risk areas; Urban planning &amp; upgrading programs; Land zoning laws; Easements; Protected areas.</td>
</tr>
<tr>
<td></td>
<td>Structural/physical</td>
<td>Engineered &amp; built-environment options: Sea walls &amp; coastal protection structures; Flood levees; Water storage; Improved drainage; Flood &amp; cyclone shelters; Building codes &amp; practices; Storm &amp; wastewater management; Transport &amp; road infrastructure improvements; Floating houses; Power plant &amp; electricity grid adjustments.</td>
</tr>
<tr>
<td></td>
<td>Institutional</td>
<td>Technological options: New crop &amp; animal varieties; Indigenous, traditional &amp; local knowledge, technologies &amp; methods; Efficient irrigation; Water-saving technologies; Desalination; Conservation agriculture; Food storage &amp; preservation facilities; Hazard &amp; vulnerability mapping &amp; monitoring; Early warning systems; Building insulation; Mechanical &amp; passive cooling; Technology development, transfer &amp; diffusion.</td>
</tr>
<tr>
<td></td>
<td>Economic options</td>
<td>Ecosystem-based options: Ecological restoration; Soil conservation; Afforestation &amp; reforestation; Mangrove conservation &amp; replanting; Green infrastructure (e.g., shade trees, green roofs); Controlling overfishing; Fisheries co-management; Assisted species migration &amp; dispersal; Ecological corridors; Seed banks; gene banks &amp; other ex situ conservation; Community-based natural resource management.</td>
</tr>
<tr>
<td></td>
<td>Services</td>
<td>Services: Social safety nets &amp; social protection; Food banks &amp; distribution of food surplus; Municipal services including water &amp; sanitation; Vaccination programs; Essential public health services; Enhanced emergency medical services.</td>
</tr>
<tr>
<td></td>
<td>Legal</td>
<td>National &amp; government policies &amp; programs: National &amp; regional adaptation plans including mainstreaming; Sub-national &amp; local adaptation plans; Economic diversification; Urban upgrading programs; Municipal water management programs; Disaster planning &amp; preparedness; Integrated water resource management; Integrated coastal zone management; Ecosystem-based management; Community-based adaptation.</td>
</tr>
<tr>
<td></td>
<td>Educational options</td>
<td>Educational options: Awareness raising &amp; integrating into education; Gender equity in education; Extension services; Sharing indigenous, traditional &amp; local knowledge; Participatory action research &amp; social learning; Knowledge-sharing &amp; learning platforms.</td>
</tr>
<tr>
<td></td>
<td>Informational options</td>
<td>Informational options: Hazard &amp; vulnerability mapping; Early warning &amp; response systems; Systematic monitoring &amp; remote sensing; Climate services; Use of indigenous climate observations; Participatory scenario development; Integrated assessments.</td>
</tr>
<tr>
<td></td>
<td>Behavioural options</td>
<td>Behavioural options: Household preparation &amp; evacuation planning; Migration; Soil &amp; water conservation; Storm drain clearance; Livelihood diversification; Changed cropping, livestock &amp; aquaculture practices; Reliance on social networks.</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>Practical: Social &amp; technical innovations, behavioural shifts, or institutional &amp; managerial changes that produce substantial shifts in outcomes.</td>
</tr>
<tr>
<td></td>
<td>Political</td>
<td>Political: Political, social, cultural &amp; ecological decisions &amp; actions consistent with reducing vulnerability &amp; risk &amp; supporting adaptation, mitigation &amp; sustainable development.</td>
</tr>
</tbody>
</table>
VII. Concluding remarks: Next steps in the WESS 2016

It would be very difficult, if not impossible, to kick start all the approaches listed in the table I.3 at once in a consistent and integrated manner, even for a Government with large human and financial capacities. All UN member States are now standing at the gate of the new era under the 2030 Agenda for Sustainable Development, and begin to learn the challenge of integrating the environmental dimension into sustainable development policy.

The WESS 2016 identifies the challenges of integrating the environmental dimensions into sustainable development policy. It examines how climate hazards affect human lives and livelihoods through various channels and in different magnitudes, according to socio-economic, geographical, political and other attributes of people or communities. It continues to identify policy challenges when integrating economic, social and environmental interventions into sustainable development. Needless to say, effective decision-making requires analytical approaches and assessment tools for evaluating risks, costs and benefits of the environmental dimension when undertaking climate-resilience policies. The Survey analyzes the assessment tools. Policy implementation and assessments further requires a wide range of information, including available technologies and knowledge, and financial resources. The Survey explores international partnerships in sharing geophysical and environmental information and how to turn the information into actual adaptation policies via various international cooperation, including technical and financial partnerships.
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Annex: Key terms for WESS 2016

- **Adaptation** is the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. Adapting differs from coping in the sense that adaptation is the process of adjusting to change, which takes over longer term (over a decade or longer) (IRIN, 2012). On the other hand, coping is a way of responding to an experienced impact with a short (immediate) to medium term (one season) vision (IRIN, 2012), with the purpose of reestablishing basic capabilities. Furthermore, it is oriented towards survival, it is not continuous in any way, it is reactive and often motivated by crisis.

- **Contextual vulnerability (or starting-point vulnerability)** points to the importance of context to determine vulnerability. In this sense, climate variability and change is just one of several processes of change, including economic liberalization, political decentralization and the spread of epidemics (O’Brien at al. 2007). It affects the context for responding to these processes and, in turn, these processes change the context wherein climate change occurs. Decreasing contextual vulnerability implicates altering the context in which climate change occurs (e.g. by reducing inequalities or reducing poverty) and mitigating climate change due to equity and justice reasons. The main question of a study on contextual vulnerability might be “Why are some regions and social groups affected more than others.

- **Coping** is to address, manage, and overcome adverse conditions, with the aim of achieving basic functioning of people, institutions, organizations, and systems in the short to medium term, by using available skills, resources, and opportunities” (IPCC).

- **Outcome vulnerability (or end-point vulnerability)** is described as “a linear result of the projected impacts of climate change on a particular exposure unit (which can be either biophysical or social), offset by adaptation measures” (ibid). For example, the main question of a study on outcome vulnerability might be “Which sectors are likely to be negatively affected?” Decreasing outcome vulnerability implicates climate change mitigation efforts and/or adaptation measures to limit negative outcomes.

- **Resilience** is the capacity of social, economic, and environmental systems to cope with disturbances, which can push a system pass its tipping point, altering its essential identity. It responds or reorganizes to maintain its essential function, identity and structure of the system, while also maintaining the capacity for adaptation, learning and transformation. Thus, being resilient involves the capacity to adapt and to continuously adjust approaches.

- **Sensitivity** is the degree to which a system or species is affected by climate variability or change, either adversely or beneficially, and either directly (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or
indirectly (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise).

- **Vulnerability**: The IPCC’s interpretation of vulnerability is most often cited (Adger, 2006) though many other interpretations have been presented in the last decades. In IPCC (2014), vulnerability is described as “the propensity or predisposition to be adversely affected”, which “encompasses a variety of concepts and elements”, namely: (i) sensitivity or susceptibility to harm, and (ii) lack of capacity to cope and adapt. More specifically, the IPCC supports the idea of the existence of two alternative views of vulnerability: *outcome vulnerability* and *contextual vulnerability*. Though vulnerability is often denoted the antonym of resilience, but this is not consensual (Miller et al. 2010) and the present Survey distinguishes the two concepts.
Box I.1: Structural Inequalities and the Sustainable Development Goals

SDG 10: Reduce inequality within and among countries. (Only domestic-oriented targets are listed.)

1. By 2030, progressively achieve and sustain income growth of the bottom 40 per cent of the population at a rate higher than the national average
2. By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status
3. Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regards
4. Adopt policies, especially fiscal, wage and social protection policies, and progressively achieve greater equality

Structural inequalities constitute unequal opportunities in the access to health services, education and employment, and unequal distribution of physical and financial assets among individuals, households or communities in the society. They give rise to pervasive inequalities and poverty (target 10.1). The concept of structural determinants focused on the issues that lie beneath the inequalities in outcomes that we observe, and to help us understand the scope of the inequality problem. Understanding the scope, in turn, assists policy makers to device policies or to change legislations to eliminate structural obstacles that prevent the society from realizing an equal society.

Structural inequalities (Dani and de Haan, 2008) are also known as *structural issues of inequalities* (Rist et al. 2015) and are the crucial factors that determine the long-lasting, pervasive inequalities in outcomes that we observe in many societies. Typical questions about structural inequalities is “why an individual or a community is poor” and “why their access to health or educational services is more limited than other groups”. Outcome inequalities, on the other hand, are concerned with “who is the poorest?” or “which group of children has highest stunting ratio.”

In a sociological point of view, structural inequalities are conditions that arise “out of attribution of an inferior or unequal status to a category of people, in relation to one or more categories of people” (Dani and de Haan, 2008). Such unequal relationships are translated into unequal distribution of human and non-human capital, and inequalities in opportunities, including unequal access to health services and education and employment opportunities and, further, unequal representation in decision-making processes in the society.

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24 The concept of structural inequality was first introduced in sociology in the 1970s in the context of social inequality.
The structural inequalities are rooted in social norms or codes that, for example, define gender-based division of labour within and outside households, and in (formal or informal) contracts that establish dependency between tenants and landlords. Unfair (often unwritten) codes against women and girls perpetuate the gender division, and unequal control of assets, with the landlord monopolizing them while the tenants lacking alternatives, cements the relationships. Such perpetuated inequalities can also be found in ethnic, tribal or racial division or geographical segregation. These structural inequalities often prevent those in the disadvantageous status from fully participating in socio-economic and political activities in the society, leading to their social exclusion. SDGs target 10.2 aims at empowering those in the disadvantageous status to gain more equal status with the advantaged, and promoting social inclusion, instead.

**Role of the State and Policies**

Structural inequalities are difficult to change, but not impossible. As Stiglitz notes, inequality in outcomes is not inevitable, but rather a choice the society makes with the rules it creates to structure the economy, politics and the society itself. Thus, a challenge “is to rewrite the rules to work for everyone” (Stiglitz, 2015, p.12). The first step for policy makers to change the structure is to examine how laws, policies and practices, and social norms work against the discriminated, with a view towards creating proper incentives for all to build more equal access to assets and opportunities. They need to determine the balance of power between, for example, women and men, tenants and the landlord, minorities and the majority ethnic groups, or other types of the so-called horizontal inequalities. Then, policy makers and the public at large need to design and implement economic and social policies or interventions to eliminate discriminatory practices and norms that trap the discriminated at the bottom of the economic or social ranks. What is important is to provide the discriminated with a level playing field by guaranteeing equal opportunities to learn, to maintain healthy life and to be gainfully productive. Because the society is built on a socio-economic system in which policies and the institutions interact, it is imperative to achieve various changes simultaneously. For example, to make female farmers as productive and secure as their male counterparts, it is required not only to guarantee female farmers equal access to land, productive assets and financing, but also to provide universal education and public health services to both girls and boys, and to eliminate the traditional practice that girls receive less food than boys at the times of food shortage.

Target 10.3 aims at working with structural of inequality; by eliminating unequal relations through the introduction and promotion of new legislations, policies and practices, those who are discriminated due to age, sex, disability, race, ethnicity, origin, religion or economic or other status are guaranteed equal access to health services, education and employment opportunities that are envisaged in other SDG’s goals and targets. At the same time, the level playing field provides a greater opportunity for the discriminated to accumulate more human, physical and financing assets, which would lead to greater equality in outcomes. Target 10.4 is more concerned directly with income support measures through fiscal policies (i.e., income redistribution via taxes and subsidies), wages policies (minimum wages, wage increases and benchmarking for workers’ compensation, for example) and policies aimed at reducing
poverty and vulnerability of the population. They are complement to the policies for eliminating the structural inequalities sought in target 10.3, as it takes a longer period before their impacts on inequalities become visible.
Box 1.2: Sustainable Development Goal 13: Take urgent action to combat climate change and its impacts*

1. Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
2. Integrate climate change measures into national policies, strategies and planning
3. Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
   13.a Implement the commitment undertaken by developed-country parties to the UFWCC to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible, and
   13.b Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities.
* Acknowledging that the United Nations Framework Convention on Climate Change I the primary international, intergovernmental forum for negotiating the global response to the climate change.
Box 1.3: Deforestation making communities more exposed to climate risks

According to the FAO, the world’s forest cover is about 4 billion hectares, covering about 30 per cent of the Earth’s total land area in 2015. The assessment reveals that deforestation accounted for the loss of approximately 13 million hectares per year between 2000 and 2005, while natural expansion of forests and forest plantations increased 5.7 million hectares per year during the same period. In sum, an annual total net loss of forest cover is estimated 7.3 million hectares per year.

Forests contribute to the livelihoods of at least 1.6 billion people, with some 60 million people, mainly indigenous communities, living within forest and another 350 million highly dependent on forests. The forest industry, both formal and informal, is estimated to employ 50 million people in the world.

Increased global temperatures and drought are also having adverse impacts on forest health and productivity, including forest fires, pest infestations and increasing alternations in the populations of plant and animal species. Indigenous people in particular are under siege as their livelihoods are seriously affected due to altering the ecosystem balances. Local human activities that are being undertaken in and near forests further accelerate deforestation and degradation. They include unsustainable logging, the conversion of forests into agricultural land, forest fires, mining, infrastructure and the expansion of human settlements.

Deforestation increases the risk of communities to disasters, both through higher vulnerability and greater exposure to natural hazards. Forest degradation lowers the capacity of forests to provide the community with livelihood resources to withstand and recover from disasters. Deforestation is known to cause severe floods, rivers to overflow (flash floods), mudslides and landslides (Hammill et al. 2005). Tropical storms often kill thousands of people and leave significant damages in the extensively-deforested new settlement areas. Deforestation is highly likely to lead to the increased number of the disasters as well as the extent of damages when hit by weather-related extreme events.

It should be noted that the UN Forum on Forest has identified the root causes, in addition to these causes identified, that are more complex in nature. Its report to the ECOSOC recognizes that factors causing deforestation and forest degradation are interlinked and many of the factors lie outside the forest sector. It finds that inappropriate and conflicting policies related to natural resource management often clash with policies and practices that aimed at sustainable forest management and that leads to forest loss. Other underlying causes of forest loss include:

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25 This box is largely based on United Nations Economic and Social Council (2009a). “Forest and climate change, Report of the Secretary-General” (E/CN.18/2009/4) (11 February); and (2009b). “Reversing the loss of forest cover, preventing forest degradation in all types of forests and combating desertification, including in low forest cover countries, Report of the Secretary-General” (E/CN.18/2009/5) (26 January).
27 Economic and Social Council (2009a).
28 See footnote above.
a. lack of institutional capacity to manage forests;
b. inadequate enforcement of existing laws;
c. perverse policy instruments, such as certain subsidies;
d. issues of governance such as corruption and human rights abuses;
e. the lack of recognition of the multiple values of forests, leading to other forms of land use such as agriculture, cattle raising, mining and hydropower;
f. decisions outside the forest sector promoting large-scale development projects resulting in deforestation; and
g. the lack of empowerment of local communities in forest management decisions.

The policy conflicts identified in and around the forest sector is a micro-cosmos of the larger issues surrounding the designing and implementation of climate resilience policies to be discussed in the present Survey (see chapter III).