Climate Change and Disaster Risk Management for Sustainable Development

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ABSTRACT

The main purpose of this work is ascertaining the relationship assisting between climate change and disaster management towards sustainable development. Without doubt, the most important environmental issues we face today are climate change. Poorer developing countries are especially vulnerable to climate change because of their geographic exposure, low incomes and greater reliance on climate sensitive sectors, particularly agriculture. People exposed to the most severe climate- related hazards are often those least able to cope with the associated impacts, due to their limited adaptive capacity. This in turns poses multiple threats to economic growth, wider poverty reduction and the achievement of the Millennium Development Goals. Within this context, there is growing recognition of the potential role of social protection as a response to the multiple risks and short and long term shocks and stresses associated with climate change.

Keywords: Climate change, disaster, risk management, sustainability, social protection.

INTRODUCTION

Climate change and disaster risk reduction are closely linked. More extreme weather events in future are likely to increase the number and scale of disasters, while at the same time, the existing methods and tools of disaster risk reduction provide powerful capacities for an adaptation to climate change. For most people, the expression “climate change” means the alteration of the world’s climate that we humans are causing, through fossil fuel burning, clearing forests and other practices that increase the concentration of greenhouse gases (GHG) in the atmosphere. This is in line with the official definition by the United Nations Framework Convention on Climate Change(UNFCCC) that climate change is the change that can be attributed “directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods”.

MEANING AND CAUSES OF CLIMATE CHANGE

Climate change is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. It may be a change in average weather conditions, or in the distribution of weather around the average conditions (i.e., more or fewer extreme weather events). Climate change is caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, and volcanic eruptions. Certain human activities have also been identified as significant causes of recent climate change, often referred to as "global warming". (IPCC, 2007)

In his statement, Kasting (2002) says that Scientists actively work to understand past and future climate by using observations and theoretical models. A climate record — extending deep into the Earth's past — has been assembled, and continues to be built up, based on geological evidence from borehole temperature profiles, cores removed from deep

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accumulations of ice, floral and faunal records, glacial and periglacial processes, stable-isotope and other analyses of sediment layers, and records of past sea levels. More recent data are provided by the instrumental record. General circulation models, based on the physical sciences, are often used in theoretical approaches to match past climate data, make future projections, and link causes and effects in climate change. On the broadest scale, the rate at which energy is received from the sun and the rate at which it is lost to space determine the equilibrium temperature and climate of Earth. This energy is distributed around the globe by winds, ocean currents, and other mechanisms to affect the climates of different regions.

Factors that can shape climate are called climate forcing or "forcing mechanisms" (Kopp, 2005). These include processes such as variations in solar radiation, variations in the Earth's orbit, mountain-building and continental drift and changes in greenhouse gas concentrations. There are a variety of climate change feedbacks that can either amplify or diminish the initial forcing. Some parts of the climate system, such as the oceans and ice caps, respond slowly in reaction to climate forcings, while others respond more quickly.

Forcing mechanisms can be either "internal" or "external". Internal forcing mechanisms are natural processes within the climate system itself (e.g., the thermohaline circulation). External forcing mechanisms can be either natural (e.g., changes in solar output) or anthropogenic (e.g., increased emissions of greenhouse gases).

Whether the initial forcing mechanism is internal or external, the response of the climate system might be fast (e.g., a sudden cooling due to airborne volcanic ash reflecting sunlight), slow (e.g. thermal expansion of warming ocean water), or a combination (e.g., sudden loss of albedo in the arctic ocean as sea ice melts, followed by more gradual thermal expansion of the water). Therefore, the climate system can respond abruptly, but the full response to forcing mechanisms might not be fully developed for centuries or even longer.

WEATHER AND CLIMATE

According to International Strategy for Disaster Reduction (ISDR, 2008) opined that Weather is the set of meteorological conditions – wind, rain, snow, sunshine, temperature, etc. – at a particular time and place. By contrast, the term “climate” describes the overall long-term characteristics of the weather experienced at a place. For example, Singapore, in the tropics, has a hot wet climate, while continental Mongolia always has cold winters. The ecosystems, agriculture, livelihoods and settlements of a region are very dependent on its climate.

The climate therefore can be thought of as a long-term summary of weather conditions, taking account of the average conditions as well as the variability of these conditions. The fluctuations that occur from year to year, and the statistics of extreme conditions such as severe storms or unusually hot seasons, are part of the climatic variability. Some slowly changing climatic phenomena can last for whole seasons or even years; the best known of these is the El Niño phenomenon. Mills and Lecomte (2006).

Colarusso, (1996) observed that since the atmosphere connects all weather systems and all climates, it is sometimes useful to describe the atmosphere, oceans and Earth surface as the “global climate system”. Because the climate system is in a constant state of flux and has always exhibited natural fluctuations and extreme conditions, it is not possible to argue that any single extreme event is attributable to climate change. Only after a sufficient period and with hundreds of extreme events recorded can scientists determine if a specific event is within normal historical variation or is due to some other cause such as climate change.

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RISK AND VULNERABILITY IN THE CONTEXT OF CLIMATE CHANGE

> *"Climate change will make it impossible for the world to achieve the Millennium Development Goals. Poverty is bound to increase. Food security is bound to get worse."*
>
> Professor Richard Odingo, vice-Chairman of the IPCC.

Mark, Katy, and Tom (2008) stated that there is growing evidence that climate change is increasing the frequency and intensity of climate-related hazards, and hence the level and patterns of often inter-related risks, exacerbating levels of vulnerability for poor and excluded people. Poverty and social impacts, though generally not well-understood, are likely to be profound and will impact humans through a variety of direct (changes in climate variables) and indirect pathways (pests and diseases; degradation of natural resources; food price and employment risks; displacement; conflicts, negative spirals) (Heltberg et al., 2008).

For many poor rural people, reliance on subsistence agriculture means that the impact of climate shocks and stresses are likely to have negative implications for their food and livelihood security, human capital and welfare. Risks and uncertainties, often associated with seasonality, are typically embedded in agricultural practices and poor people often have considerable experience of coping and risk management strategies, which need to be built upon in developing more resilient livelihoods.

Climate change also has implications for the urban poor and for rural-urban change. Most informal urban settlements are built illegally and without formal planning. Limited availability of water, high child and infant mortality rates and a very high disease burden (malaria, tuberculosis, diarrhea etc.) are common characteristics of such informal settlements (Satterthwaite et al., 2007). Planning for climate change in such situations will be extremely difficult when governments have limited authority and capacity to address the risks posed by existing hazards.

With climate change negatively impacting rural livelihoods, migration from rural to urban areas is increasingly likely to become the favored adaptation strategy of the mobile, rural poor. This will further exacerbate the problem of people living in urban fringe hazardous environments with potential risks of social unrest. At the same time, the greater concentration of people creates opportunities for more effectively managing climate change risks vis-à-vis people living in remote rural locations. Furthermore, migration should not be viewed as a universally negative impact of climate change; it can serve a positive function. For both the poor and non-poor, migration can be an accumulative strategy (Scott, 2008). For example, rural agricultural laborers may choose voluntary internal migration from rural to urban areas in the aftermath of a shock in order to move from the agricultural to non-agricultural sector. However, migration is not an option for all, especially the chronically poor or specific vulnerable or excluded people, who may face discrimination and severely limited mobility.

Poor people in Africa often face already high risks and use informal and often ineffective means to protect themselves against those risks, in the context of very low coverage of government and market-based instruments (Heltberg, 2008). With climate change likely to result in an increased magnitude and frequency of shocks, innovative approaches to social protection and DRR will be needed to bolster local resilience, support livelihood diversification strategies, and reinforce people's coping strategies.

DISASTER IMPACTS

Globally, the impacts of disasters have risen rapidly over recent decades, affecting almost all sectors and rich countries and poor countries alike. Several hundred million people are affected annually and losses reached a record US$ 371 billion in2012, (Annual Disaster

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Statistical Review, 2012). This figure may underreport the true losses by 50% or more. It does not incorporate knock-on impacts across economies and it undervalues the relative economic impacts on individual and particularly poor households. In some regions numerous smaller-scale and unreported events are a major source of aggregate loss, especially in developing countries and poor communities. Bull-Kamanga, et al. (2003). A particular concern is that disaster-damaged livelihoods and economies can set the preconditions for further rounds of excessive exposure, susceptibility and loss, blocked escapes from poverty and negative spirals of development failure. This may occur at any level, from household to state.

UNDERLYING RISK FACTORS

The United Nations-sponsored Hyogo Framework for Action 2005-2015, (Mark Pelling, 2014) which seeks to build the resilience of nations and communities to disasters, includes the integration of disaster risk considerations into sustainable development processes as a key strategy. One of its five priorities is the reduction of underlying risk factors, involving environmental, social and economic actions, but it is here that least progress has been achieved according to reporting by Governments. Explicit recognition of disaster risk reduction in the Sustainable Development Goals will provide critical weight to help drive the substantive work on underlying disaster risk in the parallel post-2015 framework planned to succeed the Hyogo Framework for Action.

THE DISASTER RISK PROCESS AND RISK MANAGEMENT

According to United Nation Integrated Research on Disaster Risk (UNIRDR, 2009), Disasters can be considered an outcome of an ongoing "risk process", in which the prevailing circumstances of hazards, exposure and vulnerabilities combine to generate disaster risk. The risk may grow and accumulate over time, becoming evident as greater losses only when a hazard event strikes. This is a radical shift from earlier ideas of disasters as acts of God or as natural events. A geophysical hazard event may be natural but its impacts depend on the circumstances of people, households and societies, which in turn arise from diverse micro- to macro-level political, social, economic and environmental processes. Knowledge of the driving factors in disaster risk is the essential basis for pre-emptive policy and action to reduce the risks. Asia Pacific Disaster Report, (2012) revealed that integrated approaches will improve outcomes and opportunities for both disaster risk reduction and sustainable development. A basic requirement in both cases is to systematically monitor disaster risk.

LINKAGES WITH CLIMATE CHANGE

It is well accepted that disaster risk reduction measures will play an important role in responding to the projected increases in weather- and climate-related hazards including sea-level rise. IPCC,(2012) noted that good management of today's existing risks is clearly the starting point for facing tomorrow's changed risks, whether from climate change, globalization or development. These three policy arenas share interests in monitoring changing risks, reducing exposure and vulnerability and advancing the transformation to resilience and sustainability.

TARGETS AND INDICATORS

High-level meetings have identified the need to address resilience and disaster risk reduction in the Sustainable Development Goals. Targets and indicators work can draw on the experience gained in monitoring progress on the Hyogo Framework for Action. Various global and national databases are available for natural hazards, exposure and disaster losses,

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and research are advancing on measures of vulnerability and resilience. Resolution adopted by the General Assembly on 27 July 2012.

DISASTERS AND SUSTAINABLE DEVELOPMENT

Disaster Events Undermine Poverty Eradication

The livelihoods, productive economic activity and public capacities that keep poverty at bay are compromised when the underpinning assets and resources of households and countries are destroyed in disasters (Shepherd, et al. 2013). This can generate new poor as well as deepening existing poverty. For example, a study of 2454 municipalities for a five-year period showed significant impacts from disasters, with a 0.8% decrease in the Human Development Index in affected areas, similar to a two-year setback, and a 3.6% increase in extreme food poverty. Rodriguez-Oreggia, et al. (2010).

Disaster Linked To Unsustainable Growth

In 1998, Central America suffered massive losses associated with Hurricane Mitch, with thousands of deaths, millions of displaced people and estimated losses of about US$ 6 billion. Studies show that the impacts were particularly severe where the development model sought agricultural diversification and export-led growth but at the expense of floodplain exploitation, deforestation and soil degradation and reduced opportunities for small farmers. Ensor, (2009). The social and economic processes involved rendered the environment, infrastructure and population exceptionally vulnerable to the hurricane. In this way, disaster risk was actively created through human action. Similar lessons have been learned in developed countries, for example as a result of major flood loss events in Europe and North America over recent decades.

Disasters and Inequality

On average, disasters disproportionately affect women, children, the aged and disabled. Enarson, (2012).For example, a study of villages affected by the 2004 Indian Ocean tsunami as reported by Guha-Sapir, et al. (2006) showed that the death rate was highest for young children and the elderly and was 40% higher for women than for men. These patterns are related to the prevailing social roles and expectations. Disadvantaged groups also are often excluded or not catered for in disaster response and recovery stages. While disasters can thus amplify social exclusion, economic inequality and poverty, they also provide an opportunity, through risk reduction action and post-disaster recovery, to address such issues as part of the promotion of resilience and sustainable development.

Magnified Impacts for Small Developing Countries

The greatest absolute losses occur in larger and richer countries, but the greatest relative losses occur in small countries and particularly small island countries. In some years, the disaster losses can exceed the annual GDP. One study showed that 26countries have an average annual economic impact of more than 1% of GDP, with seven countries above 2% GDP,(World Bank, 2011). Most of these countries are small-island developing states or small coastal countries. Such high average impacts represent a serious drag on long-term development. The problem arises partly because hazard events such as a storm or earthquake may cover most of a small country leaving the remaining unaffected parts unable to internally fund the recovery (Annual Disaster Statistical Review, 2012).

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Disaster Impacts on Cities

Cities are engines of economic development. Large cities exposed to cyclones and earthquakes will more than double their population by 2050 (from 680 million in 2000 to 1.5 billion in 2050). The resulting growth in exposure will need to be matched by substantial reductions in urban vulnerability if disaster losses are to be restrained in these cities as they grow. Cities struck by major hazards can take years to recover. An economics study of the 1995 Kobe earthquake as reported by DuPont and Noy, (2012) showed that in 2008, thirteen years after the event, the city's per capita GDP was lower by 12%. This impact is persistent, clearly observable, and attributable to the earthquake, and it occurred despite the relative wealth of the country and the considerable recovery support provided to the city. Another study has estimated a nine-fold increase in the global risk of floods in large port cities between now and 2050, as a result of rapid population increases, economic growth, land subsidence and climate change, with a similar increase in losses, rising to US$ 52 billion (Hallegate, et al. 2013). The cost of required flood management for the 136 cities studied is estimated at around US$ 50 billion per year.

Globalization and Cascading Risk

Globalized systems involving highly interactive and optimized production give rise to large-scale vulnerabilities. In some countries, electricity failures arising from minor technical problems have cascaded to affect millions of people for several days. Imbalances in global grain supply and demand in 2008, precipitated by poor harvests in major grain production countries and market speculation led to a severe spike in food prices, with wheat prices rising to more than double the price of the previous five years. The impacts were mainly felt elsewhere, in poorer countries and communities, leading to food crises and urban food riots. The 2011 Tohoku earthquake and tsunami led to a cascade of power outages, radioactive pollution, closure of nuclear plants, reactivation of fossil fuel plants, and disruption of global industrial supply chains.

Disaster Impacts Extend Widely

Disasters bring a range of indirect and secondary impacts in addition to the direct losses (mortality, injury, physical damage and economic loss). Individuals may suffer long term disability, psychological harm, degraded living circumstances, and interrupted education, increased disease occurrence, loss of employment and relocation. Prolonged drought can lead to reduced nutrition and stunting. Expertise, skills and resources will be diverted from growth activities to recovery activities. Businesses and investment may fail and sectors may not reach their production targets and development targets. Government finances are often severely disrupted. A key lesson is that disaster risk is a systemic issue and must be managed on a system-wide basis.

Economic Impacts and Hazard and Development Status

A review of econometric literature has shown that:

I. Disasters have larger relative impacts on developing, than developed countries;

II. The nature of impact varies between types of hazard;

III. Climatological hazards have negative long-term economic impacts, particularly in lower-income countries;

IV. Earthquakes may have positive long-term macroeconomic consequences for middle- and upper-income countries but negative consequences for lower-income states; and

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V. Severe disaster events do not have positive economic impacts under any circumstances. Indirect losses and secondary effects can increase sharply if post disaster contraction and reallocation of government resources delay reconstruction and dampen the pace of capital accumulation. An alternative countercyclical response may be more cost-effective, by spurring recovery and reconstruction, and "building back better", with reduced risk and future losses (Benson, 2012).

Development Opportunities Involve Risks

Taking on risks and proactively managing them is a natural element of development. This includes disaster risk, which is often associated with favorable economic assets such as fertile floodplains and volcanic soils and coastal zones. A key need is for shared action on risks which individuals or enterprises cannot handle alone. Governments have a critical role in managing systemic risks, providing an enabling environment, and channeling support to vulnerable groups. Measures to reduce damages from earthquakes, floods and tropical storms can have median benefit-cost ratios of 2 to 5, while the provision of earlier warnings of disasters in developing countries could yield estimated benefit-cost ratios of 4 to 36. By way of 4 example, a national system that provides flood warnings up to 10 days ahead to millions of Bangladesh villagers and supports community-level planning and household action to preserve assets and livelihoods generates 10-year savings of US$ 40 for each dollar invested, according to one study.

Private Sector Roles

The private sector is responsible for 70 to 85 percent of all investment worldwide in new buildings, industry and small- to medium-size enterprises. The pursuit of short-term gains can be a major factor in disaster risk generation, for example through inappropriate land use or building construction practices. Private sector enterprises are vulnerable to disasters not only through direct effects on plant, equipment and personnel but also through disruption of supporting infrastructure for inputs such as water and electricity and transportation to maintain supply chains and product distribution. When these lifelines are cut, costs rise, competitiveness and reputation suffer, and businesses may close or move elsewhere. The business sector is an important partner in systematic risk reduction action, alongside community and government sectors.

Broad Economic Policy Can Reduce Disaster Risks

One economics study according to World Bank, 2011 suggests that substantial reductions in risk could be achieved through relatively inexpensive interventions in broader policy settings, particularly in respect to information availability, the functioning of markets, the role of public infrastructure and the effectiveness of public institutions. Adequate funding of infrastructure, data gathering, basic services, and early warning and evacuation systems will have high payoffs.

Humanitarian Intervention and Resilience

Large sums are expended on international emergency assistance, approaching US$ 12.4 billion in 2010. This is in effect a risk transfer mechanism, as it helps in smoothing the economic impacts on the affected communities, albeit at a very basic level. Only about 4.2% of official humanitarian aid was invested in disaster risk reduction between 2006 and 2010. However, more timely interventions and sustained multi-year support to risk management and resilience building can pay handsomely. In one case studied, resilience building activities over 20 years cost US$ 21 billion less than the more common late humanitarian response. Good linkages between humanitarian relief, rehabilitation and reconstruction can lead to

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more sustainable, resilient and adaptive outcomes and avoid the common trap of re-creating the original risk profile.

STATUS OF DISASTER-RELATED GOALS, TARGETS AND INDICATORS

Existing Capabilities

The risk process described in the Overview provides the basis for disaster related goals, targets and indicators. The key elements are: (i) the hazard profile; (ii) the exposure (of people and assets); (iii) the vulnerability of people and assets to hazards (including community and institutional capacities and the related concept of resilience); and (iv) the losses that occur, such as mortality, morbidity, livelihood and asset loss, social and macroeconomic impact, etc. The field relies on the physical, environmental and social sciences and relevant sector expertise.

Links to the UN Disaster Reduction Strategy

The Hyogo Framework for Action has stimulated the development of reporting and databases. A process of national self-reporting has been put in place to monitor progress against measures of national achievement on the priorities and tasks6. Most of the measures address inputs and processes, rather than outcomes. The experience to date provides a valuable foundation for the consideration of disaster-related goals and targets in the Sustainable Development Goals process. A post-2015 successor arrangement to the Framework is being developed, in parallel with the Sustainable Development Goals process. Many United Nations member states have called for stronger targets and upgraded accountability in the new framework, (UNISDR, 2013).

Expert Workshop

A meeting of experts on disaster targets and indicators in July 2013 reviewed options for supporting the Sustainable Development Goals process. The meeting welcomed the target proposed by the High-Level Panel to "build resilience and reduce deaths from natural disasters by x%" and it's positioning within the goal to "end poverty." It also welcomed several other Panel-proposed targets that aim at increased resilience. The group reviewed a number of disaster related indicators, and concluded that a range of indicator types should be pursued, including outcome indicators where possible, but also process indicators and input indicators, (Birkmann, 2013).

Hazards, Exposure and Losses

Data gathering, historical databases and data modeling for hazards, exposure and losses are relatively well developed and can readily support indicator development, although the spatial scale rarely reaches down to community level. Hazard modeling is most developed and can be combined with population and asset data to form maps and indexes of exposure. However, disaster loss databases lack consistency in what they measure and in their geographic coverage. Consideration could be given to more informative indicators of disaster loss, such as working days lost, days of school closure, price of seasonal produce, etc.

Vulnerability and Resilience

Vulnerability and resilience are widely used concept, albeit with varied interpretations and with limited systematic collection of data, Birkmann (2013). However, with improved data systems at local and national levels there is good scope to generate data sets and indicators, and to measure long-term changes. Both can be represented by surrogates such as household income or community-level capacities. The establishment of vulnerability lines alongside poverty lines is a possibility. Observation and indexing of vulnerability (and associated

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capacity) is most developed at the community level, but there also exist a number of national and global tools, as well as some common frameworks. Indexes of relative vulnerability, expressed as the proportion of people or assets exposed to hazard types that suffer harm from events (e.g. mortality, homelessness, livelihood loss), or that benefit from protective capacities (e.g. early warnings, building codes, insurance), are simple to generate and communicate. Specific targets for vulnerability reduction and adaptation to extreme events also need to be defined to monitor progress.

Risk Measures Are Least Developed

Risk requires the integration of hazard, exposure, vulnerability and capacity, and while this is difficult, models do exist. Risk management capability is also captured in some models but this relies on self-reporting by country officials. Comparative analysis and analyses of over time within a single unit are possible. Progress in the management and reduction of risk can only be demonstrated from data and longitudinal studies that span a decade or more.

Indicators of Disaster Risk Reduction Action

These include measures of public commitment, such as the availability and effective application of legislation, the level or proportion of annual government spending allocated to disaster risk reduction, and the integration of disaster risk assessment into private sector development projects. Though simple in concept, their implementation requires considerable effort and cooperation among countries and between different administrative levels.

Uncertainty of Loss Events

A particular challenge for the application and communication of disaster relatedindicators lies in the high variability of many hazards. In particular, the losses during a yearmay be substantial, despite major risk reduction efforts, or conversely may be minimal despite high risks and small efforts. This means that monitoring progress on disaster risk reduction cannot rely solely on direct disaster loss information, and that a variety of indicators are necessary to track exposure, vulnerability, risk and risk reduction actions to alternative interventions.

CONCLUSION AND RECOMMENDATIONS

1. Taking a longer term perspective for social protection initiatives that takes into account the changing nature of shocks and stresses
2. Developing Climate Risk Assessments for use in conjunction with sustainable programme design and implementation.
3. Developing practical guidance on the design and implementation of appropriate adaptation methods, taking into account the views of affected groups particularly women, children and the elderly.
4. Designing monitoring and evaluation systems to capture further evidence and feedback on the effectiveness of an adaptive social protection approach.

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