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# Poverty, climate change, and the economic recession

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## Introduction

In 2008, more than 900 million people in the Asia and Pacific region lived in absolute poverty (defined as less than $1.25 a day in 2005 prices), and an additional 900 million lived in moderate poverty (defined as less than $2 a day). In other words, approximately one of every two individuals—or 1.8 billion people—remains poor in the developing member countries (DMCs) of the Asian Development Bank (ADB) (Bauer et al. 2008). Furthermore, almost half of the world's absolute poor live in South Asia (ADB 2008). If it is true that income is a key determinant of climate resilience,[2] then the Asia and Pacific region is particularly vulnerable to the expected forthcoming onslaught of changes associate with global warming.

Perhaps for the very first time in the history of humankind, issues pertaining to both climate change and economic recession are simultaneously occupying front interest and concerns. It is generally argued that the existing global recession may significantly hamper the achievements of the poverty reduction goals set forth in the Millennium Development Goals (MDGs). Given the poor's vulnerability to climate changes, the global recession, despite being of relative short duration when measured against the long-term impacts of climate change, may thus significantly indent achieving climate resilience in the region.

In this paper, we briefly explore the relationship between economic development and climate resilience, and then assess the potential impacts of the global economic recession on achieving climate resilience for the poor.

Capital investment in adaptive infrastructure will undoubtedly be a source of economic benefits (given the expected climate change projections), which may be targeted to the poor if it is designed with this objective in mind (pro-poor infrastructure): Investment in rural economies and slums upgrading, for example, may contribute to short-term economic growth and to poverty reduction and simultaneously may increase climate resilience. However, we suggest that investment in education, particularly in female education, should become or remain a key budget priority in times of economic recession as more education (especially female) will contribute significantly not only to poverty reduction, improved

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2 Broadly defined as the capacity of a community to withstand the impacts of climate change.

living standards, and sustainable economic growth, but will also contribute to building a climate-resilient Asia.

## Economic development, climate resilience, and the impacts of natural disasters

Over the period 1960–2007, the number of people affected by droughts, floods, storms, and extreme temperatures has increased approximately 10-fold.[3]

**Table 1: Number of people affected by extreme weather events, 1960–2007**

| | 1960–1969 | 1970–1979 | 1980–1989 | 1990–1999 | 2000–2007 |
|---|---|---|---|---|---|
| Drought | 117,899,704 | 263,706,885 | 592,746,376 | 309,913,523 | 631,553,213 |
| Flood | 42,374,639 | 207,877,106 | 468,400,647 | 1,436,005,223 | 845,939,199 |
| Storm | 30,244,783 | 52,539,673 | 141,405,617 | 224,336,097 | 333,244,475 |
| Extreme temp. | - | 600 | 40,202 | 7,134,684 | 5,376,889 |
| **Total** | **190,519,126** | **524,124,264** | **1,202,592,842** | **1,977,389,527** | **1,816,113,776** |

Source: Estimates are based on the International Disaster Database EM-DAT maintained by the Centre for Research on the Epidemiology of Disasters (CRED), available at www.em-dat.net. The database covers 210 countries. See Dasgupta et al. (2009b) for more details.

The Intergovernmental Panel on Climate Change (IPCC) concluded in 2007 that climate change and the warming of the earth is without doubt happening and that in all likelihood (90% probability) this warming is primarily caused by human activity (IPCC 2007). Furthermore, recent observations show that some climate indicators (such as sea level) are near or beyond the upper range of the IPCC projections of 1990 (Rahmstorf et al. 2007).

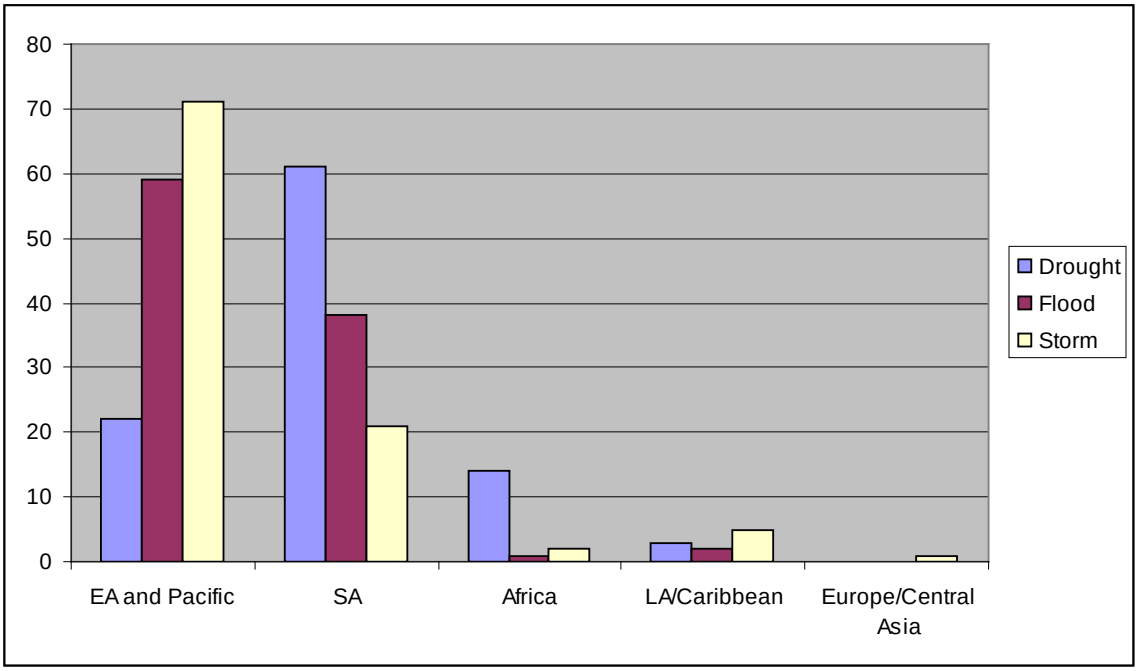
The warming of the earth is expected to result in a wide range of impacts associated with higher temperatures and changes in precipitation patterns leading to both drier and wetter weather, more frequent, and/or more severe extreme weather events (storms, floods, droughts, and heat waves), and rising sea levels.

The East Asia and Pacific and South Asia regions are expected to bear a significant share of the impacts associated with these events (Dasgupta et al. 2009a). Indeed, historically, more people in the Asia and Pacific region have been affected by floods, droughts, and storms than in any other region of the world: 83% of all people affected by droughts, 97% of all people affected by flood, and 92% of all people affected by storms over the period 1960—2007 resided in the East Asia and Pacific and South Asia regions (Figure 1).

While these changes are expected to be a source of significant environmental and social disruption, the equity dimensions associated with these changes are of equal concern: Different groups of people within countries, and different groups of countries, will experience the impacts of climate change differently. In particular, climate change will impact the poor (households and countries) disproportionately.

3 This increase in the number of affected people cannot be accounted solely by an increase in population: Over the same period, the world population approximately doubled, from 3.2 billion to 6.5 billion.

**Figure 1: Distribution (%) of people affected by floods, droughts and storms, 1960–2007**




EA: East Asia; SA: South Asia; LA: Latin America.

Estimates are based on the CRED International Disaster Database EM-DAT.

The actual demonstration of a possible relationship between income (or more generally economic development) and the impacts resulting from natural disasters (some of which being arguably related to global warming) is not necessarily simple, and ranges from anecdotal (yet strongly suggestive) to rigorous empirical testing.

Natural disasters of similar intensities (e.g., earthquakes or cyclones) cause much greater damages and casualties in low-income countries than in high income countries. For example, while the Japan's Great Hanshin earthquake of 1995 resulted in 6,000 deaths, an earthquake of approximately similar intensity in 2005 in Kashmir left 75,000 people dead. The IPCC (2001) has reported that 65% of world deaths from natural disasters between 1985 and 1990 took place in nations with income below $760 per capita. Also, although the 50 poorest countries are exposed on average to only 11% of the annual world's natural hazards, they suffer 53% of deaths from disasters each year. On the other hand, countries with high levels of human development account for only 1.5% of the death from disasters, despite being exposed to 15% of all hazards (UNDP 2004).

While suggestive of a relationship between income and damages, such statistics do not strictly allow for such a conclusion, because the impacts of other variables need to be controlled for when one attempts to establish the relationship between income and weather-related damages. In recent years, various studies have addressed this issue and empirically tested the relationship between income and the impacts of natural disasters.

Using the Centre for Research on the Epidemiology of Disasters (CRED) EM-DAT database comprising 151 countries[4] over the period 1960–2003, Toya and Skidmore (2005) unambiguously find that both the total number of deaths and the extent of economic damages caused by natural disasters decrease as per capita gross domestic product (GDP) increases. Controlling for the impact of income, the study also finds a significant role for education in reducing vulnerability, through better choices in areas ranging from safe construction practices to assessment of potential risks and better location decisions.

Kahn (2005) used a database comprising 73 nations over the period 1990–2002 to test hypotheses concerning the role of income and institutions in mitigating death counts from natural disasters. Controlling for the number and intensity of natural disasters, the study unambiguously finds that richer nations suffer fewer deaths from natural disasters than poorer nations: Statistically, a nation with a population of 100 million would suffer 764 fewer natural-disaster deaths on average per year if it were to experience an increase in GDP per capita from $2,000 to $14,000. The study also finds that the institutional improvement that accompanies economic development also plays a significant role, through enhanced public sector capability to organize disaster prevention and relief.

More recently, Blankespoor et al. (2009) have also identified this relationship and empirically estimated that an increase in GDP per capita results in fewer people killed or affected by floods and droughts.

Both the anecdotal and empirical evidence strongly support the hypothesis that the lower a household's level of income, the greater the likelihood of being adversely impacted by natural disasters.[5] At a country level, the same evidence supports the hypothesis that the lower GDP per capita and economic development (all other things being equal), the greater the number of deaths and the number people affected by natural disasters and extreme weather events.

A number of factors may explain the nature of this relationship.

First, the livelihood of the poor is known to be significantly dependent on natural resources. When natural disasters disrupt the flow of goods and services provided by these resources and more generally by ecosystems, the poor find themselves in a precarious situation. Furthermore, when natural disasters destroy capital (be it machinery, cattle, or otherwise), the poor typically lack access to financial resources to restore the level of capital to its pre-disaster level. Second, increases in income enable individuals and households to respond to increased risk (including risk associated with natural disasters) by employing additional costly precautionary measures.[6] Third, the poor are often located in areas that are more susceptible to high variability in temperature and rainfall, such as hilly and steep slopes, and flood plains.[7] Finally, richer societies are more resilient societies as a result of the positive correlation between income and education, openness, financial development, and greater institutional capacity.

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4 While the CRED EM-DAT database includes 210 countries, for the purpose of their analysis the authors included only those countries which had experienced natural disasters over the period of analysis.

5 The relation between level of income and the impacts of natural disasters has also been empirically observed in developed countries. For example, in the United States Deschenes and Moretti (2007) show that one day of cold temperature increases daily mortality by 0.2174 deaths per 100,000 people in the richest counties (top 10% of the income distribution), and by 0.3696 per 100,000 people in the poorest counties (bottom 10% of the income scale).

6 Both the demand for security and the private capacity to invest in security (through better access to financial capital and private savings) increase as income increases.

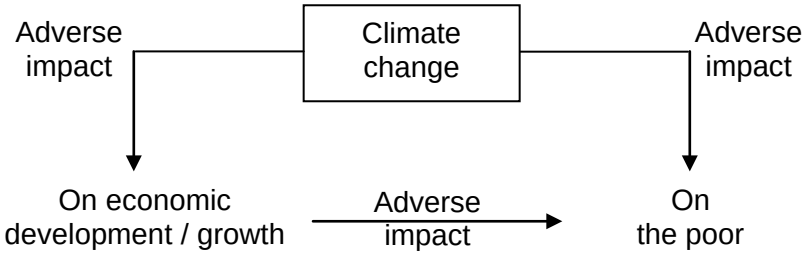
7 "Ninety percent of the disaster victims worldwide live in developing countries where poverty and population pressures force growing numbers of poor people to live in harm's way on flood plains, in earthquake prone zones and on unstable hills. The vulnerability of those living in risk prone areas is perhaps the single most

In other words, wealth and economic development are significant determinants of the climate resilience of households as well as of countries. In simple words, richer households and societies are safer households and societies. This evidence suggests that poverty reduction, among other measures, must be an integral component of an effective climate change adaptation strategy in countries of the region. A region free of poverty will also be a region with enhanced capacity to withstand the impacts of climate change.

## Economic growth, poverty reduction, and climate change

In the above section, it was shown that the existing empirical evidence clearly demonstrates a positive correlation between poverty (or economic development) and the impacts of natural disasters (some of which are related to climate change). In this section, we argue briefly that climate change could also impact the poor indirectly via its adverse impact on economic development (Figure 2).

**Figure 2: Direct and indirect impact of climate change on the poor**




Demonstrating the possible impacts of climate change on economic development or economic growth has followed two different approaches.

A first approach, most notably used by Stern (2007) and more recently by ADB (2009), relies on the use of "integrated assessment models" (IAMs).[8] These models aim to assess the impacts of climate change on specific sectors of the economy (e.g., agriculture, energy, forestry), and then to aggregate these sector-specific effects accounting for the possible interaction that may exist across sectors. Despite the recognized limitations of these models,[9] estimates are that climate change may significantly impact future economic development. This appears to be particularly the case in countries of the region. In a business-as-usual scenario, Indonesia, Philippines, Thailand, and Viet Nam are projected to suffer an average loss of 2.2% of GDP by 2100 on an annual basis, if market impact alone is considered (mostly related to agriculture and coastal zones). This loss could reach an average of 5.7% of GDP each year by 2100 if non-market impact is included (ADB 2009). Other studies of a similar nature are summarized in Table 2.

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important cause of disaster casualties and damage." (Secretary General of the United Nations Kofi Annan, 1999.)

8 The IAM used by both Stern (2007) and ADB (2009) is known as PAGE2002.

9 "Making such estimates is a formidable task in many ways. It is also a computationally demanding exercise, with the result that such models must make drastic, often heroic, simplifications along all stages of the climate-change chain. What is more, large uncertainties are associated with each element in the cycle. Nevertheless, the IAMs remain the best tool available for estimating aggregate quantitative global costs and risks of climate change." (Stern 2007, p. 145).

**Table 2: Estimates of the welfare impact of climate change**

| Study | Warming ($^0$C) | Impact (% of GDP) | Worst-off region | |
|---|---|---|---|---|
| | | | % of GDP | Name |
| Nordhaus (1994) | 3.0 | -1.3 | | |
| Fankhauser (1995) | 2.5 | -1.4 | -4.7 | PRC |
| Tol (1995) | 2.5 | -1.9 | -8.7 | PRC |
| Nordhaus and Yang (1996) | 2.5 | -1.7 | -2.1 | Developing countries |
| Plamberk and Hope (1996) | 2.5 | 2.5 | -8.6 | Asia (excl. PRC) |
| Mendelsohn et al. (2000) | 2.5 | 0.0 | -3.6 | Africa |
| Nordhaus and Boyer (2000) | 2.5 | -1.5 | -4.1 | Africa |
| Tol (2002) | 1.0 | 2.3 | -4.1 | Africa |
| Maddison (2003) | 2.5 | -0.1 | -14.6 | South America |
| Rehdanz and Maddison (2005) | 1.0 | -0.4 | -23.5 | Sub-Saharan Africa |
| Hope (2006) | 2.5 | 0.9 | -2.6 | Asia (excl. PRC) |
| Nordhaus (2006) | 2.5 | -0.9 | | |

Source: Tol (2009).

A second approach relies on estimating the effects of changes in temperature and precipitation directly on economic growth. Dell at al. (2008) show large, negative effects of higher temperatures on growth, *but only in poor countries*. In poorer countries, the authors estimate that a 1 $^0$C rise in temperature in a given year reduces economic growth in that year by about 1.1 percentage points. Extrapolating these results to the long-run under a climate change scenario, Dell et al. find that a permanent 1 $^0$C increase in temperature would reduce aggregate GDP in poor country by 11%.

Though the precise magnitude of the expected impact of climate change on economic development remains a source of investigation, its direction is certain: In a business-as-usual scenario, climate change will reduce economic growth and adversely hamper economic development. This in turn would constrain achieving poverty reduction targets.

The importance of this result is perhaps best illustrated by the impacts of the existing global recession as noted in the recent *Millennium Development Goals* report (UN 2009): Worldwide, the number of people living in extreme poverty in 2009 is expected to be 55 million–90 million higher than expected before the global economic crisis. The global recession may jeopardize or postpone achieving some of the MDGs.[10] More poor implies more households vulnerable to the vagaries of climate change; more poor implies a less climate resilient community, and society.

# Building climate resilience for the poor: The role of education, particularly for females

In the above sections, it was argued that future climate change is likely to adversely impact the poor both directly (by impacting the dominant activities of the poor, threatening livelihoods and negatively affecting natural resources), and indirectly by reducing economic growth and development—when assessed against a no-climate change scenario. Climate change is thus a serious risk to poverty reduction programs and poverty reduction goals.

10 In 2000, leaders of 189 nations agreed on the Millennium Declaration which includes, among seven other goals, reducing by half the proportion of people living in extreme poverty (defined as less than $1.25 a day) by 2015.

Measures to reduce climate change vulnerability and increase climate resilience have been devised at sector levels (ADB 2009), and at a broader level to sustain economic development (Table 3). Capital investment in adaptive infrastructure will undoubtedly be a source of economic benefits (given the expected climate change projections) which may be targeted to the poor if designed with this objective in mind (pro-poor infrastructure). For example, investment in rural economies and slums upgrading may contribute to poverty reduction and simultaneously increase climate resilience.

**Table 3: Adaptation options for selected sectors**

| | Reactive / Responsive | Proactive / Anticipatory |
|---|---|---|
| **Water** | • Protection of groundwater resources;<br>• Improved management and maintenance of existing water supply systems;<br>• Protection of water catchment areas;<br>• Improved water supply;<br>• Groundwater and rainwater harvesting and desalination. | • Better use of recycled water;<br>• Conservation of water catchment areas;<br>• Improved system of water management;<br>• Water policy reform including pricing;<br>• Development of flood controls and drought monitoring. |
| **Agriculture** | • Erosion control;<br>• Dam construction for irrigation;<br>• Changes in fertilizer use and application;<br>• Introduction of new crops;<br>• Soil fertility maintenance;<br>• Changes in planting and harvesting times;<br>• Switching to different cultivars;<br>• Educational and outreach programs. | • Development of tolerant/resistant crops;<br>• Research and development;<br>• Soil and water management;<br>• Diversification and intensification of food and plantation crops;<br>• Policy measures, tax incentives / subsidies;<br>• Development of early warning systems. |
| **Forestry** | • Improvement of management systems;<br>• Promoting agro-forestry;<br>• Development/improvement of forest fire management plans;<br>• Improvement of carbon storage in forests. | • Creation of parks, protected areas and biodiversity corridors;<br>• Identification / development of species resistant to climate change;<br>• Better assessment of ecosystem vulnerability;<br>• Development of seed banks;<br>• Forest fire early warning systems. |
| **Coastal** | • Protection of economic infrastructure;<br>• Public awareness;<br>• Building sea walls and beach reinforcement;<br>• Protection of coral reefs, mangroves, sea grass, and littoral vegetation. | • Integrated coastal zone management;<br>• Better coastal planning and zoning;<br>• Development of legislation for coastal protection;<br>• Research and monitoring of coasts and coastal ecosystems. |
| **Health** | • Public health management reform;<br>• Improved housing and living conditions;<br>• Improved emergency response. | • Development of early warning systems;<br>• Better and/or improved disease/vector surveillance and monitoring;<br>• Improvement of environmental quality;<br>• Changes in urban and housing design. |

Source: ADB (2009).

While numerous analysts have pointed out that low levels of education (and in particular of female education) are a key impediment to adaptation and climate resilience, the implications of it, with a few

exceptions,[11] have not been fully internalized: Investing in education, and particularly in female education, should be a key component of the set of investments aimed at increasing a society's resilience to climate change. This proposition has been empirically estimated by Blankespoor et al. (2009).

In their study, the authors first demonstrate that over the period 1960–2002, female education was a key determinant of the number of people affected by extreme weather events: For a given level of income and extreme weather intensity, the more females are educated, the fewer people affected or killed by extreme weather events. The authors then use this relationship to estimate how many more women in developing countries over the period 2010–2050 would have to be educated in order to offset the impacts of climate change, i.e., to maintain the number people affected or killed by extreme weather events as if there had not been climate change. These numbers are estimated using two Global Circulation Models (GCMs) producing the wettest and driest projections at the global level.[12]

The results indicate that by mid-century, neutralizing the impact of extreme weather events requires educating globally an additional 18 million–23 million young women at a cost of $11 billion–$14 billion annually. For the period 2010–2050 as a whole, both GCM scenarios entail about $110 billion in additional expenditures at the global level.[13] Given the expected population of the Asia and Pacific region and the projections that the region will be most impacted by climate change, a large proportion of these required increases in education and expenditures take place in the region. By mid-century, South Asia would have to educate 6 million–10 million more women (in addition to the projected number of women in primary and secondary schools by mid-century), at an aggregate cost for the period 2010–2050 of $31 billion–$46 billion. For East Asia and the Pacific, the aggregate cost would amount to approximately $22 billion.

Achieving such incremental education (above and beyond what the country would do) will require significant additional commitment of resources. To put the numbers in some perspective, ADB's total amount of education sector loan, technical assistance (TA), grants, and equity approved over the entire period 2000–2008 reached approximately $2.6 billion.

Yet, in times of economic downturn, governments often restructure (reduced) budget allocations to up-front capital investment so as to offset the reduction in private capital investment and consumption. As a result, an economic slowdown typically puts strong pressure on education systems in developing countries. There is indeed empirical evidence (albeit limited) that fiscal adjustment in times of crisis is particularly detrimental to the poor (Ravallion 2004).

Moreover, slower growth or reductions in household incomes reduce the ability of parents to send and keep children in schools. As part of an overall strategy to protect existing living conditions (which may include acquiring more debts, and selling productive assets), children are taken out of school both to save money and then to increase household earnings. There is clear empirical evidence that schooling tends to decline in times of economic crisis in low-income countries (Ferreira and Schady 2008). These adjustments are difficult to reverse: It has been shown that once students drop out of school for longer than 12 months, the return rate is very small (World Bank 2009).

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11 A notable exception is Eriksen et al. (2007), and to some extent ISDR (2009).

12 The driest overall is CSIRO's Mk 3.0 model, which was transmitted to the IPCC's data collection center in 2005. CSIRO is Australia's Commonwealth Scientific and Industrial Research Organization (www.csiro.au/). The wettest is NCAR's Community Climate System Model (CCSM), version 3.0, which was released to the public in 2004. NCAR is the US National Center for Atmospheric Research. For a detailed description of the CCSM program, see http://www.ccsm.ucar.edu/about/.

13 In present value terms, using a 3% discount rate.

Welfare losses resulting from even a short-term economic downturn are not time-framed by the duration of the downturn itself: these losses typically last considerably longer. In this context, the most significant long-term impact of the existing global economic downturn may be that students cannot enroll in school or are forced to drop out from school without prospect of returning—often girls from poor families.

The economic downturn may therefore have unanticipated long-term implications: as shown above, a less educated population is a population that will be less resilient to climate change.

Effective policy instruments to keep children in school (including during economic downturns) are relatively well known and include conditional cash transfer programs, school feeding programs, student fellowships, and block grants to schools. If budget allocation to such programs were determined on the basis of their costs and benefits, adding "enhancing climate change resilience" as a key benefit of education would call for a significant increase in the resources allocated to keeping children at school in times of economic downturn.

# Concluding comments

Given its degree of exposure to natural disasters and extreme weather events, as well as its high population and its large number of poor, the Asia and Pacific region is particularly vulnerable to the expected forthcoming onslaught of changes associate with global warming. Building climate resilience in the region will require a vast amount of resources at national planning level as well as sector and local levels. Some of these resources will target specific capital (infrastructure) investments which in times of economic downturn may accomplish multiple objectives: stimulating short-economic growth, poverty reduction, and climate resilience. However, we have argued in this short paper that education can contribute significantly to the building of a climate resilient region.

As stated in ADB's *Strategy 2020*:

> Research and experience over the last 10 years confirm the importance of gender equity as essential to poverty reduction, improved living standards, and sustainable economic growth. ADB will promote gender equity through operations that deliver specific gender outcomes, such as improved access for females to education and health services, clean water, better sanitation, and basic infrastructure (ADB 2008, p. 15).

Increasing climate resilience would appear as a key benefit of female education and gender equity in addition to the benefits listed above.

We thus conclude by suggesting that investment in education, particularly in female education, should become or remain a key budget priority in times of economic recession as more education—especially for females—will contribute significantly not only to poverty reduction, improved living standards, and sustainable economic growth, but also to building a climate-resilient Asia.

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