Government of Nepal
Ministry of Science, Technology and Environment (MoSTE)

SUMMARY BRIEF

Economic Impact Assessment of Climate Change for Key Risks in Nepal

Current climate variability and extreme events are already causing major impacts and economic costs in Nepal. Continuing climate change will exacerbate these impacts, leading to potentially larger economic costs in the future.

Responding to these climate-related risks involves decision-making in a changing world, due to uncertainty over future climate change. Although adaptation can reduce these impacts, it requires an iterative approach that identifies short-term actions, while learning for the future.

These key findings are from a study entitled the 'Economic Impact Assessment of Climate Change in Key Sectors in Nepal'. Requested by the Government of Nepal, the study estimated the potential impacts and economic costs of climate change for three major risk areas – agriculture (crop productivity), hydroelectricity and water-induced disasters – and identified climate compatible development options to address these.

Current Climate Variability and Extremes in Nepal

Nepal has an extremely complex and variable current climate. Much of this is driven by its terrain, which rises from around 70 metres above sea level in the flat, hot Terai region to the cold, high mountains and Mount Everest at 8,848 metres.

Nepal also experiences complex seasonal weather patterns, which are heavily influenced by the Himalaya and include the annual monsoon. There is very high rainfall variability across the seasons and regions, and from one year to the next.

This is important because the economy of Nepal and the livelihoods of its people are very dependent on the climate: the agricultural sector accounts for around three-quarters of employment and around one-third of Gross Domestic Product (GDP), much of which is rain-fed, small-scale farming. This makes the sector highly sensitive to rainfall extremes: for example, the direct cost of the 2006 and 2009 droughts in terms of lost agriculture output was 1.9% and 0.4%, respectively.

An iterative climate risk-management approach

The study used an iterative climate risk-management approach to identify key climate-related issues in Nepal:

- First, it analysed the 'adaptation deficit', i.e. the impacts and economic costs of climate variability and extreme events today, then considered possible adaptation responses.
- Then, it undertook a risk screening to assess the potential risks of climate change in the next few decades, using an investment and financial flow analysis to identify the additional resources needed to mainstream resilience in Nepal's development plans.
- Finally, it analysed the future impacts and economic costs of climate change in the long-term (2050s), with an analysis of future uncertainty, to identify the early actions needed to start planning for these longer term risks.

Rainfall is also critical for Nepal's hydroelectric plants, which provide around 90% of total electricity. During the dry season, river flows are insufficient to operate all run-of-river plants (i.e. those without reservoirs) compounding existing problems of unmet demand. The impact of rainfall variability on electricity production is estimated to cost the equivalent of 0.1% of GDP/year, and 0.3% in very dry years.

Nepal is currently affected by frequent water-induced disasters, notably floods (in the plains) and landslides (in the hills) associated with the summer monsoon. These frequently lead to loss of life, affect livelihoods, and cause major damage to property, agriculture, infrastructure and commerce. The direct costs of these events is estimated to be equivalent to 1.5% of current GDP/year on average.

The study analysed the current impacts and economic costs of climate variability across these three areas. Overall, it found that the estimated direct costs are equivalent to 1.5–2% of current GDP per year (approximately US$270–360 million/year in 2013 prices), rising to 5% or more in extreme years, with flood-related risks the major driver of these costs.

Future Climate Change in Nepal

Nepal's climate is already changing. Temperatures have increased rapidly over recent decades, at a much faster rate than the global average. In addition, there have been changes in precipitation, but with wide variations in trends across the country. There is also evidence that Nepal's glaciers are retreating and thinning. These trends are anticipated to increase further with climate change.

To analyse what climate change could mean for Nepal in the future, the study used existing downscaled (high resolution) climate model projections. Using the medium-high A1B scenario (which has no mitigation), average temperatures are projected to increase by 3–5°C by the end of this century. Changes in average precipitation are more varied over time and across the regions – though there is a broadly consistent pattern of increasing extreme precipitation. However, large differences exist across future emission scenarios and between different climate models, so a detailed uncertainty analysis was undertaken. This found large differences in future rainfall projections, highlighting the need to recognise uncertainty in planning adaptation.

Overall, the study concluded that the future economic costs of climate change in Nepal (for agriculture, hydroelectricity and water-induced disasters) could be equivalent to an additional 2–3% of current GDP/year by mid-century. The sectoral findings are summarised below.

The sectoral analysis was complemented with a series of local case studies that included new field surveys. These found recent changes in the climate are already leading to impacts on local communities and also indicated differentiated impacts to women for some key risks.

What Does Climate Change Mean for the Agricultural Sector?

The analysis of the future impacts of climate change on the agricultural sector focused on the three main crops grown in Nepal – maize, wheat and rice – using a crop model. The analysis found potentially high

impacts in the Terai (especially for rice and wheat production) but a varied pattern in the hills and mountains, including some potential benefits.

In the longer term (by 2070s), net agricultural losses in Nepal were estimated at around 0.8% of current GDP equivalent per year, or US$140 million/year (current prices, undiscounted); though the impacts were much more severe in years of extreme rainfall variability.

These findings do not take account of irrigation and farm-level adaptation, which would reduce the impacts; but other specific risks were identified that would increase costs, notably increased floods, higher levels of soil erosion and changes in the prevalence of pests and diseases..

What Does Climate Change Mean for the Hydroelectricity Sector?

Nepal has a very large potential for hydroelectricity, and this is a key part of future development plans and export growth. However, this is also a very climate-sensitive sector.

The analysis of the future impacts linked a hydrological model to a power plant and energy-system model, to understand how climate change affected dry season flows and reservoir storage recharge, and thus future electricity generation and plant investment profiles.

To consider uncertainty, two alternative climate models were used. The first of these projected a decrease in dry season flows, increasing the capacity needed on the system to meet demand by an additional 2,800 MW by 2050, which increased sector investment costs by US$2.6 billion from now to 2050 (present value). Critically, this outcome also led to more thermal power plants on the system, increasing greenhouse gas emissions.

However, the second climate model projected an increase in river flows, increasing energy availability and reducing investment costs relative to the baseline by some US$170 million through to 2050 (present value). This highlights that the future effects of climate change on the hydroelectricity sector are potentially large, but uncertain, varying by climate projection, river catchment and over time.

A number of other potential impacts were also identified, including the risks from high flows (floods), sedimention and Glacial Lake Outburst Floods (GLOFs). These were all considered to have potentially important impacts on the sector.

What Does Climate Change Mean for Water-Induced Disasters?

The analysis of the future impacts of climate change on water-induced disasters used climate and hydrological models to analyse two major river catchments. The study looked at how much more frequently high flow events (and associated floods) might occur with climate change, compared to the historical average, as well as how large the increase in magnitude of high flow events might be.

As with the analysis of hydroelectricity, alternative climate model outputs were used to consider uncertainty, and alternative climate model outputs were used. The study found a 20–100% increase in the intensity and frequency of high river flows, across different climate models and river basins, but a general trend of increased risks of flooding in Nepal by mid-century (2050s). With climate change, an event that currently occurs once in every 10 years was estimated to occur once in every five years (or less), with the probability of a very major event (a one-in-100 year event) likely to become much more frequent.

Overall, the direct annual economic costs of climate change on water-induced disasters at the national level were estimated to be an additional US$100–200 million/year by mid-century (current prices, undiscounted), equivalent to 0.6–1.1% of current GDP per year, with an upper estimate of almost 3%.

Adaptation Strategies

In response to these risks, the study developed an iterative adaptation pathway, which starts with current climate variability and then considers future climate change and uncertainty.

The study identified immediate options to address the current adaptation deficit, with a focus on 'low and no regret' options (i.e. which are good to do anyway, even without future climate change, and also build

future resilience). Many of these options are included in existing policies and programmes, or have been identified as priorities for early adaptation, but a priority is to scale these up and address the barriers to wider implementation. To support this, there is a need for enhanced capacity building to provide the enabling environment.

In relation to the medium-term risks, the study undertook a risk screening of current plans and then assessed the additional action and investment costs needed to mainstream adaptation through to 2030.

This identified that a major increase is needed in the three areas assessed, estimated at US$2.4 billion by 2030 (present value). The next step is to build detailed sector investment plans to mainstream implementation.

The study also considered the major long-term challenges of climate change in Nepal and, noting the uncertainty, developed iterative adaptation plans. These identified the short-term actions needed in the next few years to build the evidence base for future decisions and options. A key priority is to implement these early programmatic activities.

Finally, to support all of these areas, there is an urgent need to build capacity, with information and awareness-raising, monitoring, research and institutional strengthening.

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