1.Background*

Steep terrain, vulnerable soils, heavy rainfall and earthquake activity make large parts of Asia highly susceptible to landslides.[18] With population growth, expansion of infrastructure and increased forestry and agricultural activity in sloping areas, the significance of landslides is set to increase in coming years. In temperate and tropical Asia, projected climate change-related impacts, including increased frequency of extreme rainfall events, and heightened risk of forest die-back and wildfires, are likely to increase the number and severity of landslides.[40]

In Asia, as natural disasters have become more frequent, major natural resource-related policy realignments have been triggered. In the 1990s, Asia suffered 75 percent of global fatalities from natural disasters.[38] Water-related issues – floods, landslides and droughts – have been perhaps the most significant driver of forestry-related policy change. For example, logging bans in Thailand, the Philippines and China were largely the result of perceptions that landslides, floods and droughts were consequences of deforestation. However, there is a lack of precise understanding of the role of forests in relation to these disasters and in watershed management in general.[66, 93] In this context, it is clear that reference to accurate technical information is essential if policy prescriptions are to provide benefits in economic, social and environmental terms and avoid unnecessary costs.

As well as causing fatalities and damaging residential and commercial areas and infrastructure, landslides cause environmental problems. For example, they may also damage or destroy forest and agricultural resources, remove topsoil and reduce land productivity, block rivers and increase downstream sedimentation.[169,131,17] Bursting of rivers blocked by landslides has also caused downstream disasters.

By understanding the factors that influence landslide incidence, damage can often be avoided by relocating settlements or activities away from high risk areas or, by adopting precautionary measures. The prevalence of landslide deaths in poorer countries and regional experience in successfully reducing landslide risks suggest that much can be done to limit future losses associated with landslides.[18,103]

*Citations indicated by numbers in superscript are referenced at the end of the publication.

The objective of this publication is to describe the extent to which:

(i) The preservation of forests or planting of forests can reduce the incidence of landslides; and

(ii) Forestation projects can assist in land rehabilitation and stabilization after landslides have occurred.

This section includes a review of trends in landslide frequency and the distribution of landslides in Asia as well as an assessment of policy responses to natural disasters in Asia. Sections 2 and 3 detail how trees and forests are useful in landslide reduction and why landslides are a growing hazard. Section 4 outlines the implications of climate change on landslide incidence and Section 5 reviews practices for managing landslide risk, including rehabilitation of landslide-affected areas. Sections 6 and 7 contain conclusions and recommendations for policy-makers.

1.1 Landslide trends in Asia

Assessing trends in landslide incidence is hindered because accurate records are rarely collected. Damage due to landslides is also often recorded as damage due to other natural disasters with which landslides are commonly associated, such as earthquakes, floods or cyclones.[18, 150]

Available statistics nonetheless imply that the frequency of landslides causing death or affecting people in Asia has increased more than five-fold since the 1970s; between 2000 and 2009, 88 recorded landslides resulted in the deaths of 5 367 people (Figure 1.1).[51] The increasing trend is supported by independent data held in the Durham Fatal Landslides Database, which also demonstrate an increase in smaller landslide events. Some of the increase in recorded data is likely to be due to better communication and reporting in more recent decades but also results from increased human development of sloping areas and observations of climatic changes (Box 1).

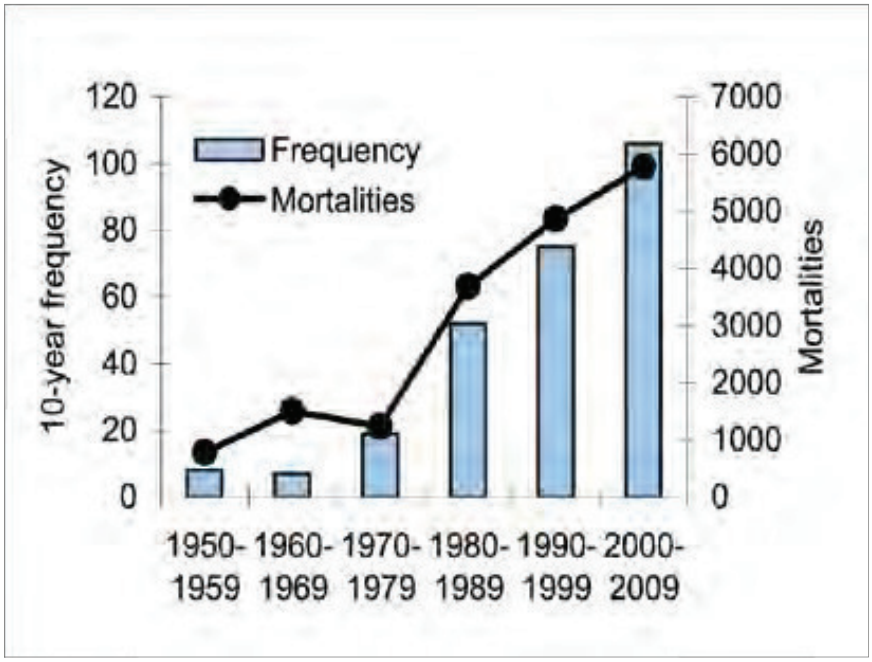

Figure 1.1. Decadal frequency of landslides and mortality rates in Asia
Source: International Disasters Database <http://www.emdat.be> [51].

The occurrence of fatal landslides is heavily influenced by tectonic processes, monsoon rainfall and the presence of a vulnerable population.[149] In some countries such as Indonesia and the Philippines exposure to landslides resulting from heavy rainfall is proportionately greater than in others where earthquakes are of greater significance, for example Japan and Taiwan, Province of China. Regardless of the triggering mechanism, however, poor countries have significantly higher numbers of landslide deaths than wealthier countries due to lower levels of human development.[103]

Risks of mortality through landslides triggered by precipitation can be estimated by combining information on hazard type and destructivity, population exposure and vulnerability. Assessments demonstrate relatively high levels of risk in many parts of Asia (Figure 1.2). In particular, five key landslide locations in Asia have been identified, all of them associated with high seismic risks:[148]

(i) The southern edge of the Himalayan arc;

(ii) Central and southeastern China;

(iii) The Philippines and Taiwan, Province of China;

(iv) Indonesia/Java; and

(v) Southern India and Sri Lanka.

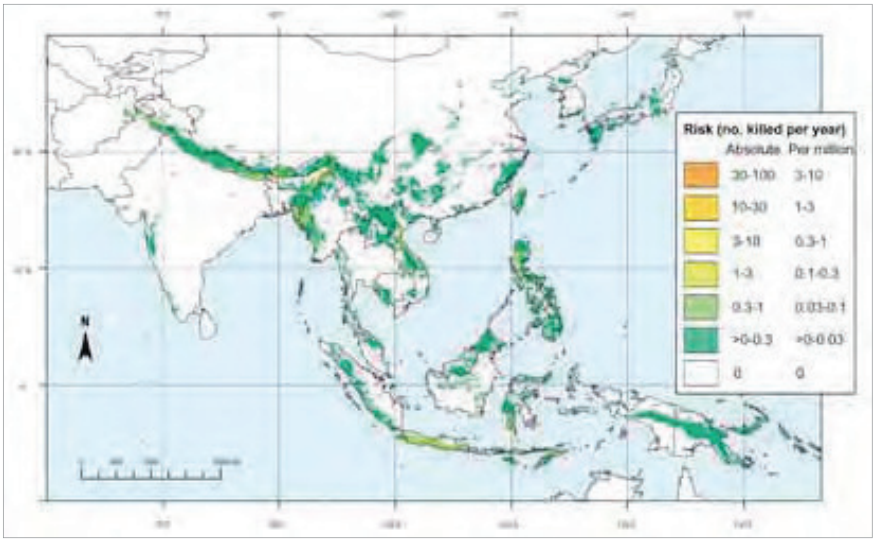

Figure 1.2. Mortality risk distribution for landslides triggered by precipitation
Source: ISDR, 2009. (103)

Between 1950 and 2009, the frequency of fatal landslides in Asia was highest in China, followed by Indonesia, India, the Philippines, Japan, Pakistan and Nepal. These seven countries accounted for 82 percent of the 267 landslides and 87 percent of the 17 830 landslide-related fatalities reported in Asia during the period. Relative to population in 2000, landslide fatalities between 1950 and 2009 were highest in Nepal (71.1 per million), followed by the Philippines (35.4), Indonesia (10.6), Republic of Korea (7.4), Malaysia (6.5), Sri Lanka (6.4) and Japan (6.3).

With the population in Asia set to expand by 10 percent, from 3.8 to 4.1 billion between 2010 and 2020, the impacts of landslides are likely to increase. The experience of Hong Kong Special Administrative Region (S.A.R.) provides an example, where landslides increased when the territory became more densely populated and hillside cutting increased.[18] In this context there is a clear and increasing need to address landslide risk in Asia and also the roles that forests and forestry can play in risk reduction.

BOX 1 - The Durham Fatal Landslides Database

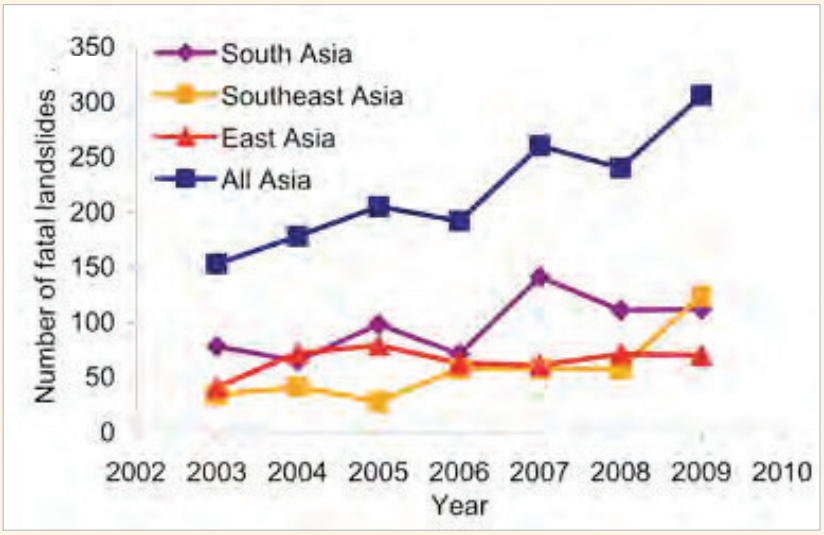

Figure 1.3. Number of fatal landslides in Asia by subregion 2003-2009 (excluding earthquake damage)
Source: Petley, 2010. (148)

The increasing incidence of fatal landslides in Asia is corroborated by data from the Durham Fatal Landslides Database (DFLD),[149] which independently shows rising numbers of fatal landslides over the past decade, particularly in Southeast Asia (Figure 1.3). Some of this increase is likely to be due to improvements in communications and reporting, but increasing precipitation frequency, intensity and/or duration; deforestation; population growth; urbanization; and infrastructure development are also likely to have played a role.[148]

With respect to the overall frequency and severity of landslides, the DFLD indicates an average of 219 fatal landslides per year between 2003 and 2009 (2 585 fatalities per year) – more than three times the number recorded in the International Disasters Database for the same period (68 landslides with 538 fatalities).[148,82] The difference results from the inclusion of landslides with fewer than ten fatalities in the DFLD and indicates the greater significance of smaller events.

1.2 Policy responses to natural disasters

In several countries in Asia, natural disasters have prompted fundamental realignments of policy. In China, following water shortages in the Yellow River catchment in 1997 and catastrophic flooding of the Yangtze River in 1998, two major national programmes were implemented. The Natural Forest Protection Program (NFPP) and the Sloping Land Conversion Program (SLCP) included logging bans and quotas, conversion of sloping croplands to forest and reforestation activities in several provinces.[30] The logging ban is controversial, however, with authorities accused of making excessive claims in relation to the downstream impacts of deforestation in northwest Yunnan.[105] The drought and flooding periods also coincided with strong El Niño and subsequent La Niña events, the effects of which may not have been adequately taken into account.

In the Philippines, recurrent devastating floods and landslides were attributed to illegal logging and land conversion and led to the introduction of a series of logging bans, most recently in 2011.[98,123,13] The poor location of settlements and lack of flood adaptation, however, accounted for some of the most devastating effects. In relation to deep-seated landslides that occurred within the affected area, reforestation, although proposed as a major response, was probably inappropriate.

In Thailand, landslides in the south of the country following heavy rains in 1988 were linked to deforestation of steep slopes and, as most of the damage was on land cleared for cropping, a logging ban was subsequently implemented (Figure 1.4). However, some reports suggested that landslides had tended to occur regardless of the type of vegetation cover and that rainfall intensity had overwhelmed the stabilizing properties of vegetation.[151] Forest clearance and replacement with vegetation less capable of securing the soil – rubber in particular – were also suggested to have been of greater significance than logging.[158,32]

In most cases where radical policy changes have been adopted in response to natural disasters the technical basis for change has been challenged. Knowledge on the nature of relationships between disasters and human activities – road building, deforestation, logging, agriculture, etc. – is still being refined.[66,93] Predicted increases in extreme weather events and natural disasters in the coming years can be expected to further influence policies related to forests and the environment. To avoid unnecessary costs it is important that future policy responses should be based on sound technical understanding.

Figure 1.4. Landslide scars in Southern Thailand following heavy rains in 1988
Courtesy: Masakazu Kashio.