REPORT

Climate & Development Knowledge Network

DEVELOPING A DISASTER RISK INSURANCE FRAMEWORK FOR VULNERABLE COMMUNITIES IN PAKISTAN:
PAKISTAN DISASTER RISK PROFILE

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Pakistan Disaster Risk Profile

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Executive Summary

Pakistan is vulnerable and prone to numerous hazards, both natural and man-made. The multiplicity of natural hazards is a direct consequence of the country's high variability in terms of geology, topography and meteorology. Pakistan is primarily affected by earthquakes, floods, hill torrents, monsoons and cyclones. More than 50 million people have been affected by disasters and damages totalling more than US$ 24 billion over the past 10 years. These disasters have had devastating consequences on socio-economic systems and human development.

In response, new institutional structures were created with the mandate to develop disaster risk management strategies. These strategies are not generally selected by methods and tools for cost-effective and sustainable interventions. Within disaster management agencies in Pakistan, there is a shortage of information about and understanding of risk assessment and management as well as the linkages between livelihoods and disaster risk reduction.

While disaster risk management in Pakistan has primarily focused on rescue and relief, initiatives have been undertaken by the Government to increase resilience and minimize hazard impacts by investigating financial risk sharing options. A risk-based approach is recognized today as an integrated and cost-effective method for disaster prevention and reduction, which relies on the purposeful and adequate assessment of various components of risk.

This report first describes the current disaster landscape in Pakistan and, then, re-examines the components of risk, their purpose and their measurement in risk assessment processes. In this light, disaster risk assessment initiatives in Pakistan are analysed and recommendations are provided for strengthening risk assessment practices to support informed risk reduction strategies and to formulate a specific risk insurance fund for the most vulnerable communities.

The central findings of this report show that considerable efforts have been made to develop hazard monitoring networks and to consolidate hazard, exposure and vulnerability information from different data sources and technical agencies. However, the resulting risk assessment efforts have mostly focused on identifying hazards and consequences and have not sufficiently assessed the relative significance of risks in a livelihood context. Ongoing initiatives aim to bridge this gap by developing methodologies and information platforms at the micro level, but such efforts appear fragmented and uncoordinated at the national level.

The key recommendations for future improvements to disaster risk assessments in Pakistan include:

1. Efforts to consolidate, unify and share data, methods and information management platforms should be strengthened at the national level.

2. Hazard assessments should be derived in probabilistic terms and should ideally be based on stochastic event sets.

3. Quantitative and qualitative models of exposure and vulnerabilities need to be developed and fully integrated into risk assessments.

4. Governmental bodies and institutions working on vulnerability assessments and risk reduction programmes (e.g., poverty reduction, natural resources management, etc.) should engage in disaster risk assessment activities.

5. A national-level quantitative analysis and assessment of risk based on consolidated methodologies is required in order to orient national policies and funds in the most cost-effective way. Ongoing micro-level studies in pilot areas should ideally be replicated in all districts and provinces of Pakistan applying consolidated and approved models and methodologies.

6. In order to account for climate change, it is necessary to consider changes in the climate and extend the risk assessment framework to longer time frames using hazard and vulnerability trend forecasts.

7. A flexible information system is required in order to centralize all hazard and risk-related information. Such a system must be capable of integrating updated and new datasets, supporting scenario simulations for testing as well as comparing options for mitigation and adaptation.

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1 Hazard risk landscape

Many studies have been completed to assess and map hazards and risks in Pakistan (e.g., National Disaster Management Agency (NDMA), 2012). This section compiles data and facts regarding hazards, population exposure and the most vulnerable groups in order to support the information needs required for the development of a risk insurance fund to benefit the poorest. This section does not intend to produce new information.

1.1 Context: Pakistan and natural hazards

Pakistan is vulnerable and prone to numerous hazards, both natural and man-made. The multiplicity of natural hazards impacting Pakistan is a direct consequence of the country's high variability in terms of geology, topography and meteorology.

The Indus Plain, which flows through Pakistan from north to south, occupies more than 60 per cent of the country. The Baluchistan and Khyber Pakhtunkhwa provinces are mountainous. Northern Pakistan has some of the highest peaks in the world, including K2, the second highest peak in the world at 8,616 m. Baluchistan is classified as a semi-desert ecosystem with only the Indus Valley and lowlands providing irrigated rice and wheat crops found in some northern forests. Pakistan is comprised of high-contrast regions, characterized by extreme temperature changes between seasons and places.

With 11 distinct as well as overlapping climatic zones, Pakistan is still predominantly a dry land country. Eighty per cent of the land is arid or semi-arid and vulnerable to desertification, about 12 per cent is dry sub-humid and the remaining 8 per cent is humid. In the plains, temperatures range from 4° C to 15° C in January and 30° C to 45° C in June and July. In the south, scorching droughts

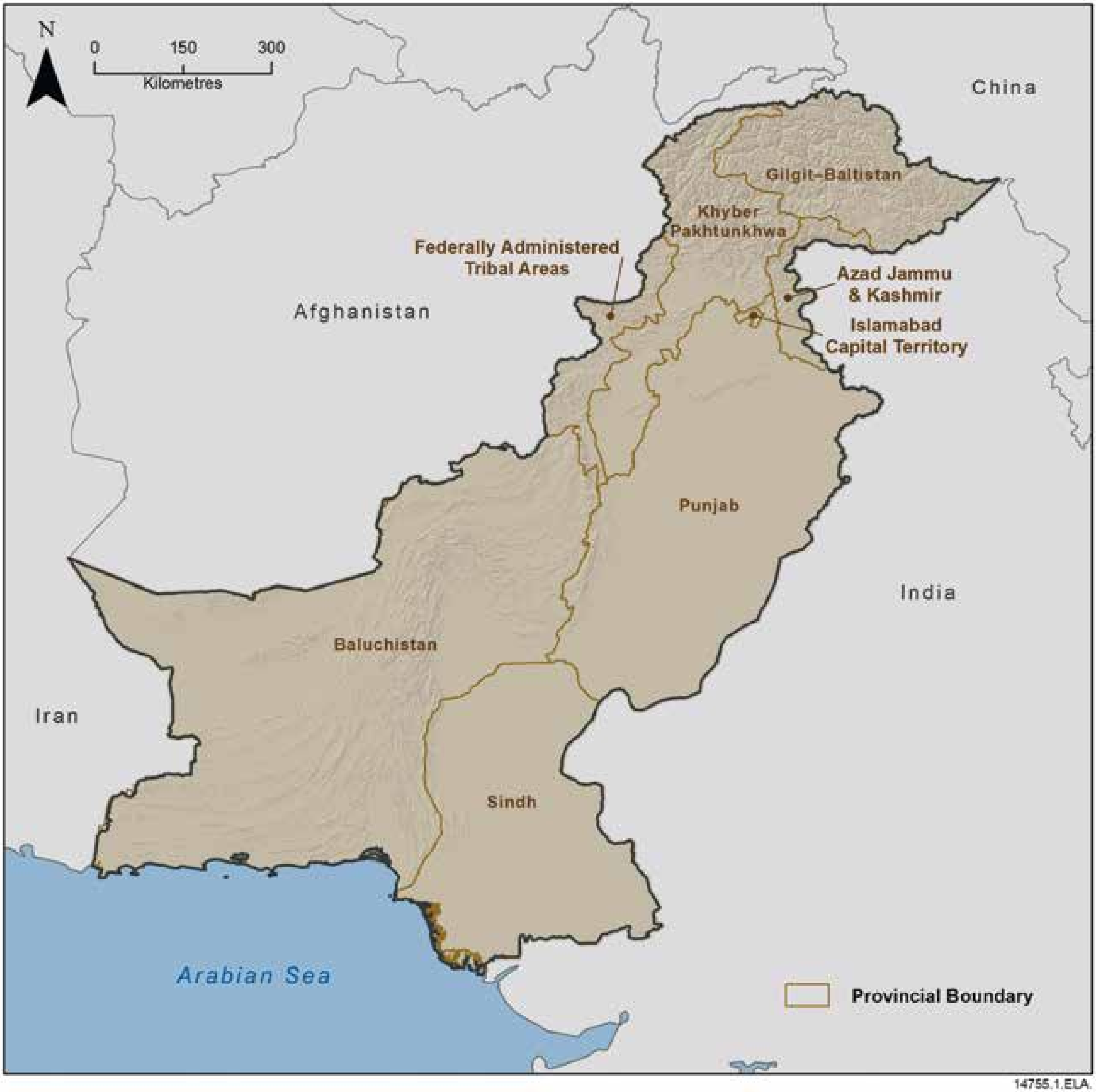


Figure 1: Geographical setting and provincial boundaries of Pakistan
Source: Author's own.

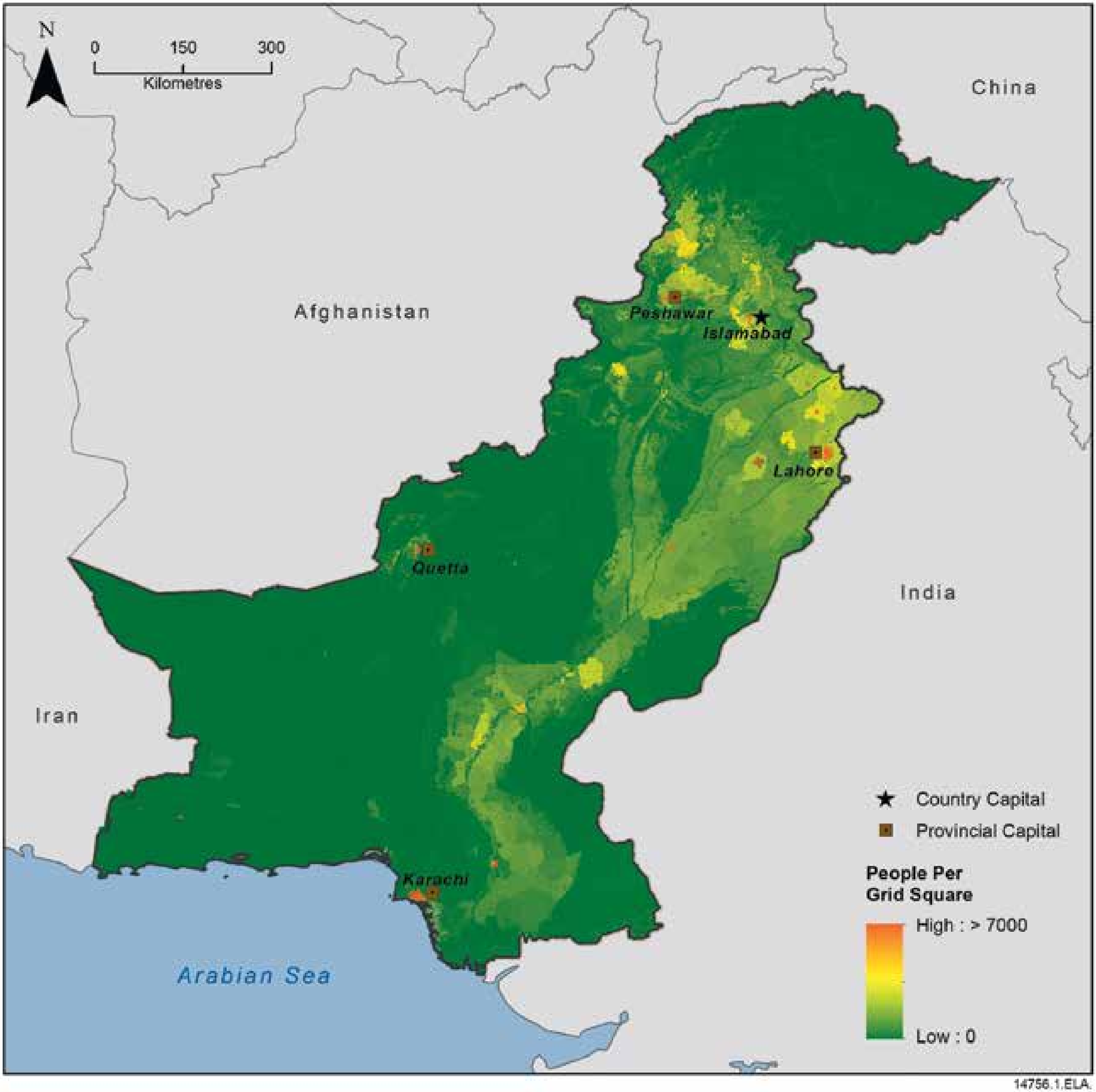


Figure 2: Population distribution in Pakistan.
Source: PopAsia.

prevail along the coast of Makran. Jacobabad is one of the hottest places on the planet (with temperatures climbing above 50° C). Despite the influence of the summer monsoons, the country is arid and vegetation and crops depend on rainfall intensity and irrigation. Of the 79.6 million hectares (ha) in the country, only about 20 million ha are suitable for agricultural production (16 million ha for irrigated farming and 4 million for rain-fed, or barani, agriculture). About 4.2 million ha are forested, while a sizeable chunk (28 million ha) are rangelands.

The agricultural sector is the mainstay of Pakistan's economy, representing a 20 per cent contribution to the country's gross domestic product (GDP) and employing 45 per cent of the workforce. The main crops are wheat, rice, cotton, sugarcane, fruits and vegetables and tobacco. Livestock production is also very important. Pakistan is the fourth largest producer of cotton in the world and has abundant natural resources, mainly, copper, oil and gas. The industrial sector represented 26 per cent of GDP in 2013. The primary industries include textile production (representing the largest source of foreign exchange earnings), petroleum refining, metal processing and the production of cement and fertilizer. Maritime transportation is also an important activity. This tertiary sector represents more than half of GDP (54 per cent in 2013) and employs about 35 per cent of the workforce. Remittances from Pakistanis working abroad also constitute a significant financial windfall for the country.

With more than 185 million inhabitants in 2014, Pakistan is the sixth most populous country in the world. The majority of southern Pakistan's population lives along the Indus River and about one third live in urban centres. Karachi is the most populous city in Pakistan. In the northern half of the country, most of the population lives along an arc formed by the cities of Faisalabad, Gujranwala, Islamabad, Lahore, Mardan, Multan, Nowshera, Peshawar, Rawalpindi, Sialkot and Swabi.

1.2 Hazards and physical exposure

1.2.1 Flood

Pakistan is one of the most flood-prone countries in South Asia. Floods that hit Pakistan regularly are classified into four main categories: riverine flooding concentrated in the Indus River basin, flash floods, glacial lake outburst floods (GLOFs) and coastal flooding associated with cyclone activity.

River-related floods occur mostly in the Indus River basin and broadly inundate floodplains along the major rivers (Indus, Jhelum, Chenab, Ravi, Sutlej and Kabul). Such riverine floods are the most severe in the Punjab and Sindh provinces and have recently caused extremely high damages on an almost annual basis. In this area, damages to agriculture primarily affect standing kharif crops. However, in some cases, the inundated lands do not dry up in time and ultimately affect sowing rabi crops. Specifically, in the lower part of the Indus River (Sindh province), which flows at a higher elevation than the adjoining lands, water spills do not return to the main river channel and may extend beyond the extent and period of inundation, resulting in a more significant impact. For example, the 2010 flood event was massive, affecting almost all of Pakistan. It caused an estimated US$ 9.7 billion in damage. Agriculture and livestock were particularly hard hit, while the flooding also destroyed a large number of houses and damaged roads and irrigation facilities. According to Pakistani authorities, more than 1700 people died due to the flooding, while more than 20 million individuals were displaced. The number of individuals affected by the flooding exceeded the combined total of individuals affected by the 2004 Indian Ocean tsunami, the 2005 Kashmir earthquake and the 2010 Haiti earthquake. The 2011 flood affected another 8.9 million people and destroyed 1.5 million homes in 37,000 villages in the Sindh province alone.

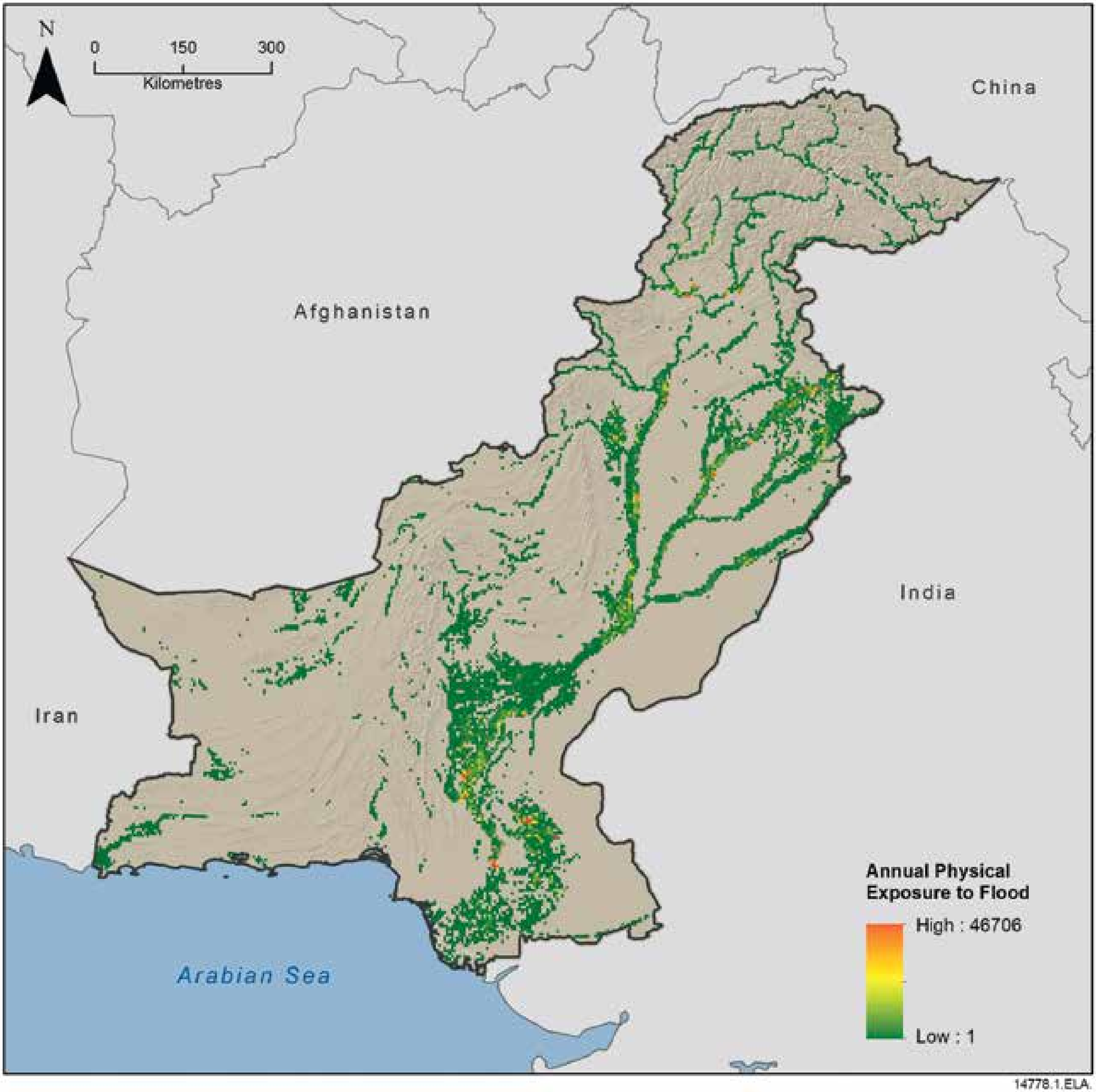


Figure 3: Expected average annual population exposed to floods.
Source: UNEP-GRID PREVIEW.

Flash floods originate from highly localized convective rainfall or cloudbursts over small to medium-sized basins in hilly terrains and along the foot of mountains and hills. Such events, prevalent in Baluchistan, Khyber Pakhtunkhwa and the northern areas, can severely damage farmlands and livestock and dramatically impact urban centres. For example, in July 2001, due to continuous heavy downpours, the Nullah Lai flooded and inundated nearby houses, bridges and roads. According to official figures, at least 10 people died, 800 houses were destroyed and 1069 houses were damaged in Islamabad. In 2009 in Karachi, 26 people were killed and hundreds of homes were also damaged.

1.2.2 Drought

Pakistan is characterized by low rainfall, extreme temperature variations and as much as 60 per cent of the country is classified as semi-arid to arid (particularly in Baluchistan, Sindh and the southern part of Punjab). Arid regions receive less than 200 mm of rain per annum and are extremely vulnerable to minimal changes in rainfall regimes or the usage of the limited amount of water available. The most susceptible regions experience a drought lasting over 2 or 3 years from each decade. Regions with no surface water and low or brackish groundwater are most vulnerable to climate variation. Drought is also a complex phenomenon that is closely linked to its socio-economic context and is usually closely related to poverty and non-adaptive land, water and agricultural practices leading to the overexploitation of groundwater, deforestation and the depletion of grazing pastures.

Droughts were so severe in 2000 and 2002 that the livelihoods of individuals were destroyed. More than 3.3 million people were affected in the Baluchistan and Sindh provinces, thousands of people were forced to migrate and millions of livestock were killed. According to one estimate, 15 million cattle died and economic losses totalled US$ 2.5 billion. The 2001 drought was so severe that the economic growth rate was reduced from an average of 6 per cent to only 2.6 per cent (Global Facility for Disaster Risk Reduction (GFDRR, 2012).

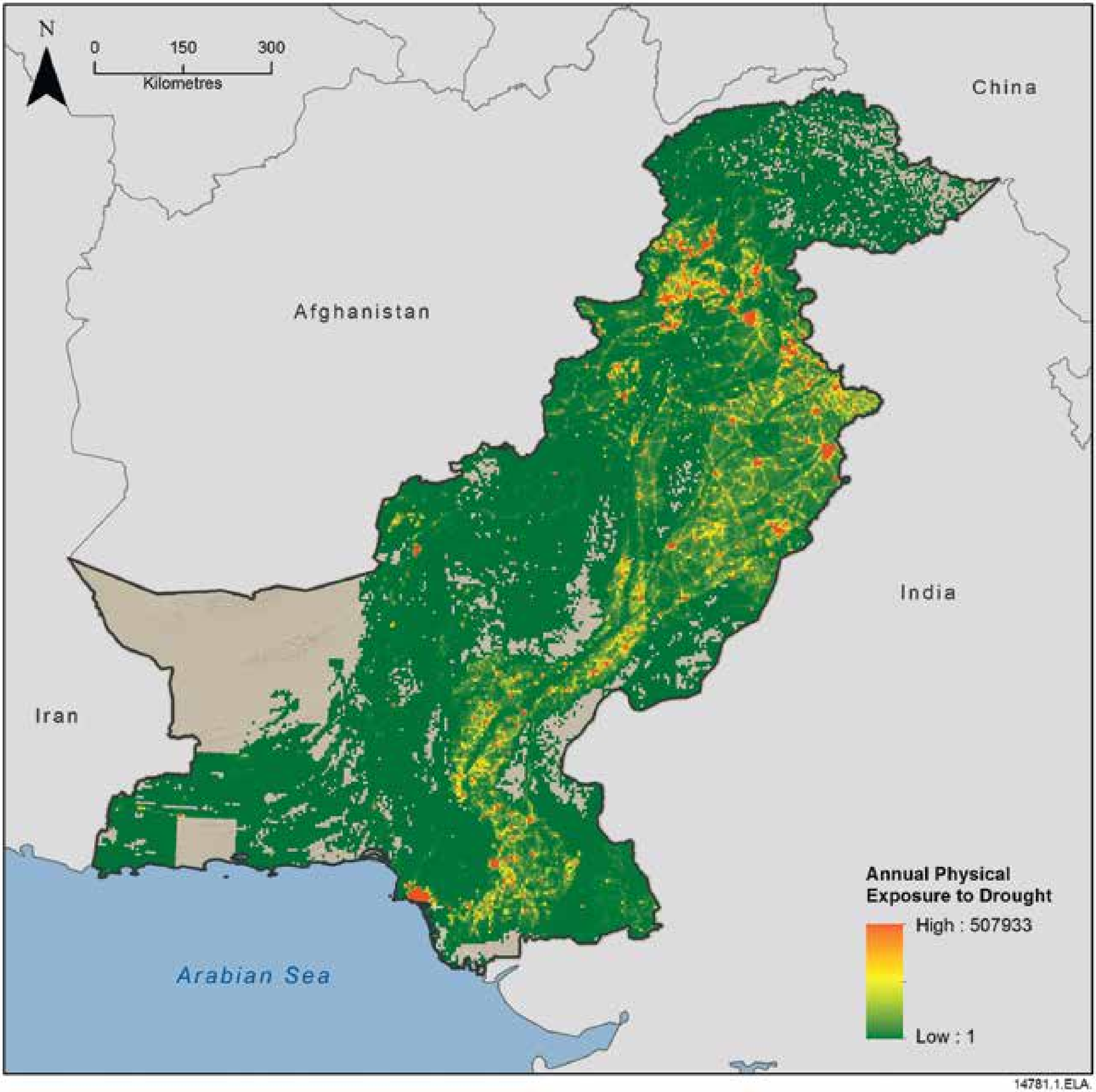


Figure 4: Expected average annual population exposed to drought.
Source: UNEP-GRID PREVIEW.

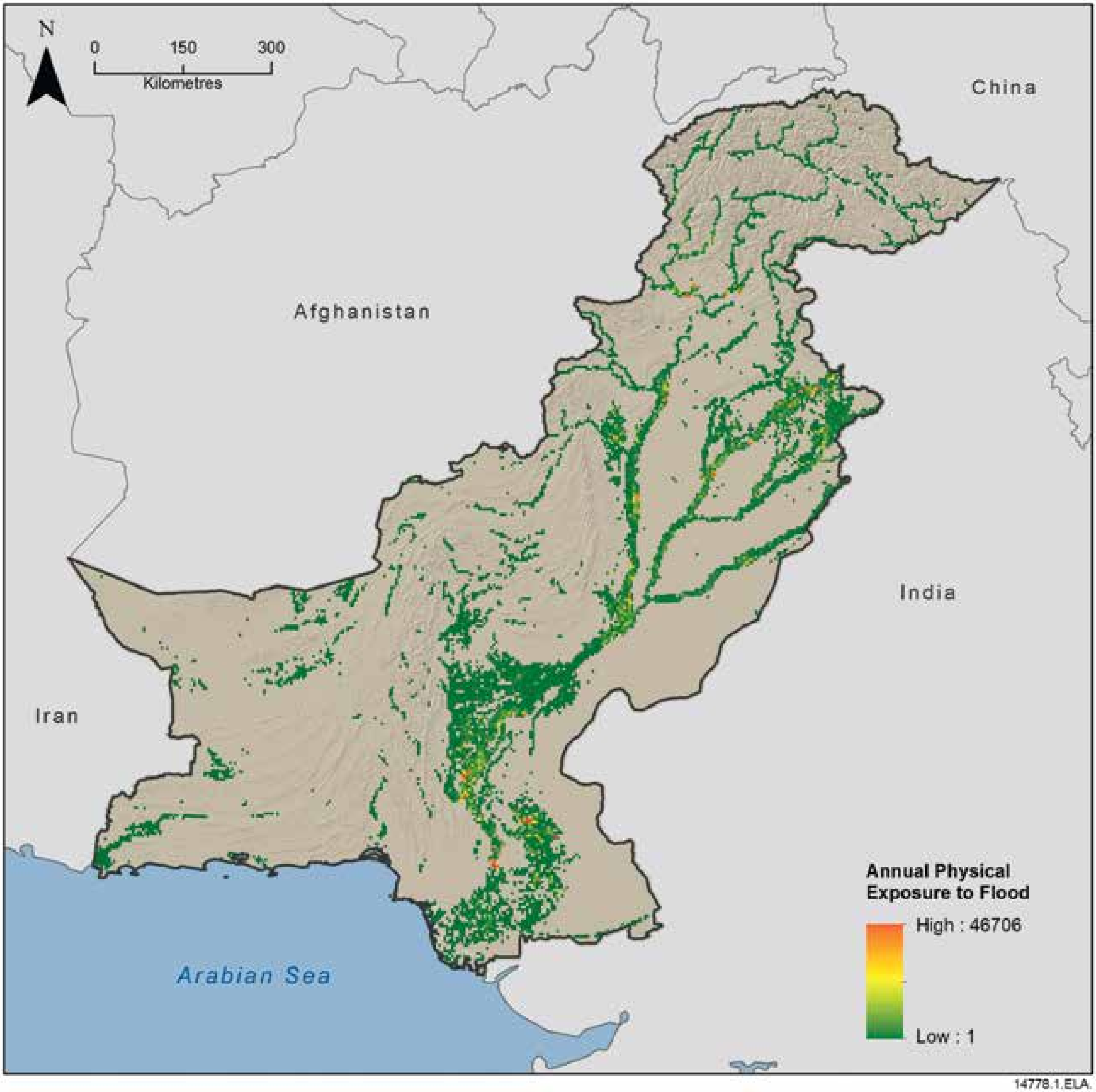


Figure 5: Expected average annual population exposed to earthquakes (MMI = 5). Source: UNEP-GRID PREVIEW.

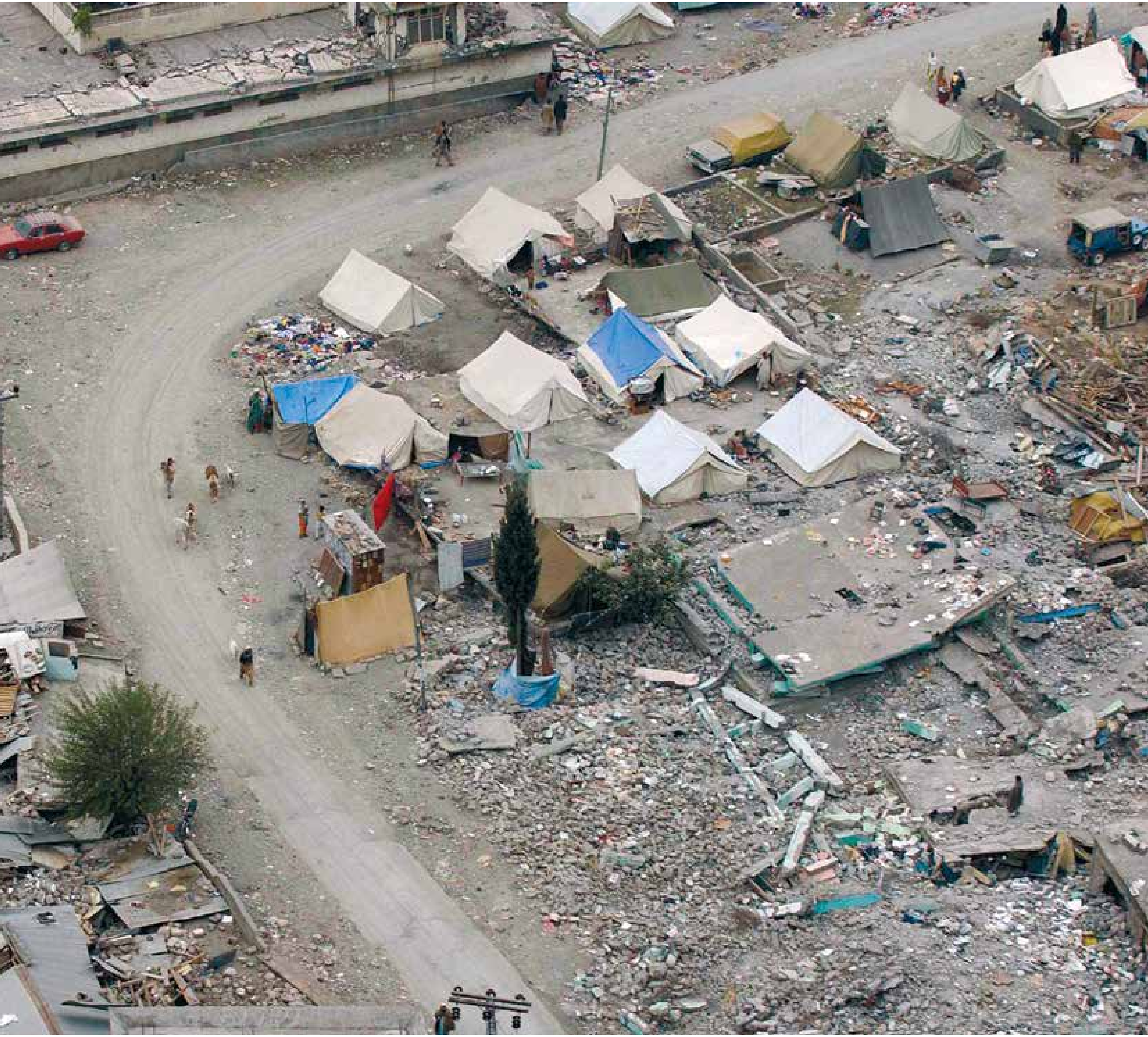
Since the beginning of March 2014, severe shortages of food and water have been reported in the Tharparkar district in Pakistan's south-eastern province of Sindh. A number of children have reportedly died of malnutrition and a state of emergency was declared by the provincial government. Between March 2013 and February 2014, rainfall was 30 per cent below normal. Yet, some observers have suggested that the drought is not the only reason for the recent deaths, but that the extreme situation resulted from an ensemble of factors originating from endemic poverty exacerbated by the drought and an outbreak of disease which killed livestock (Reliefweb, 2014).

1.2.3 Earthquakes

Earthquakes in Pakistan occur along various fault lines transecting the country, which are caused by the stress and release of energy originating from movements of the Indo-Australian Plate colliding with the Eurasian Plate. The Hindu Kush, Karakorum and Koh-e-Suleiman mountain ranges are particularly vulnerable and the resulting devastation can be immense due to the poor construction of buildings. The most recent devastating earthquake took place in 2005. More than 75,000 people died, 138,000 were injured and 3.5 million people were displaced. Hospitals, schools and rescue services including police and armed forces were paralyzed. There was virtually no infrastructure and communications were badly affected. Small and frequent earthquakes also cause considerable damage due to the low quality and weak quake resilience of buildings (e.g., mud houses).

1.2.4 Tsunamis

The history of large earthquakes along the Makran subduction zone is suggestive of the potential vulnerability of Pakistan's coastline to tsunamis. In 1935, an earthquake measuring 8.5 on the Richter scale triggered a tsunami along the Baluchistan coastline, killing nearly 4,000 people in the fishing town of Pasni. Gwadar and Karachi were also threatened.



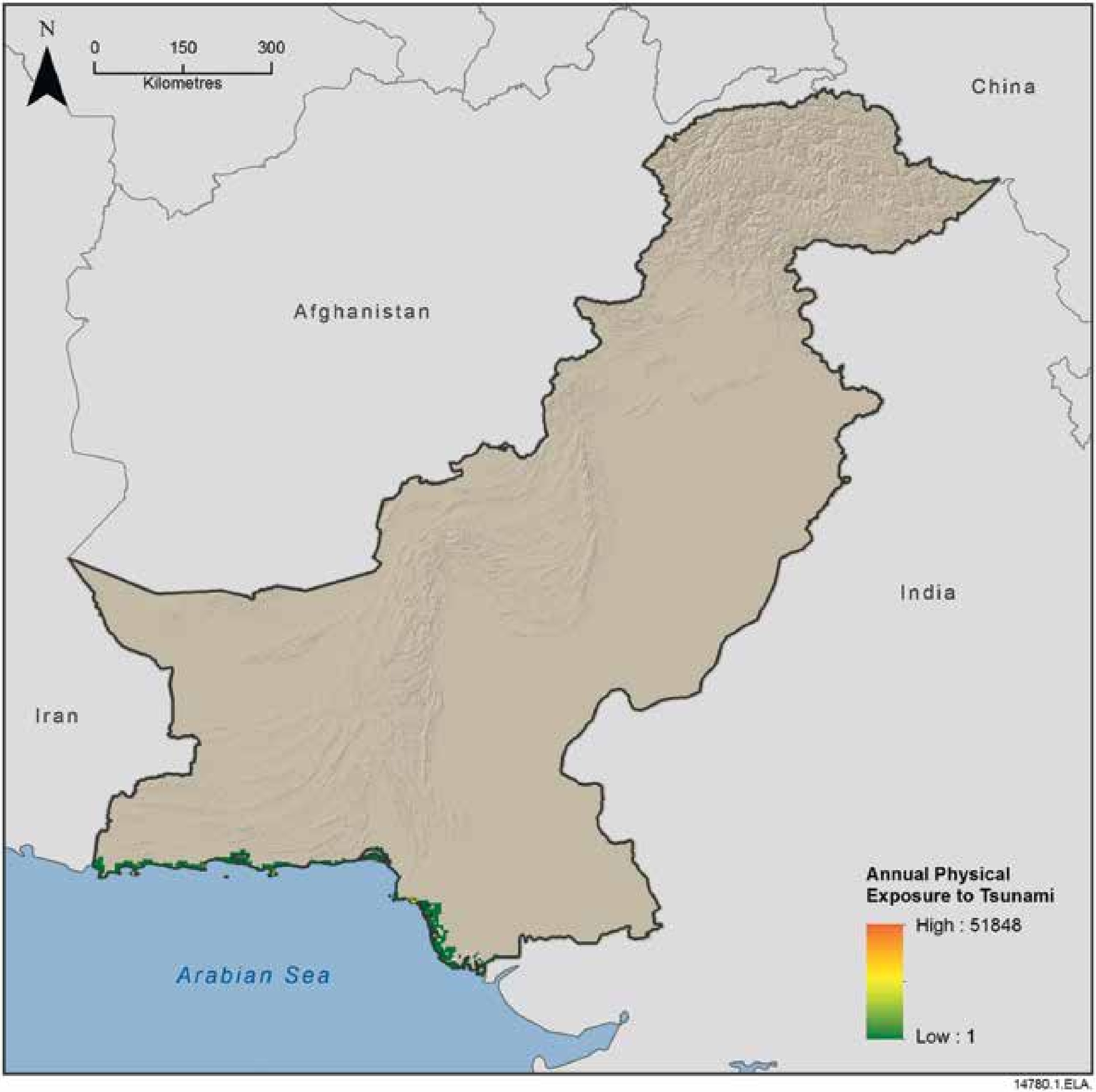


Figure 6: Expected average annual population exposed to tsunami.
Source: UNEP-GRID PREVIEW.

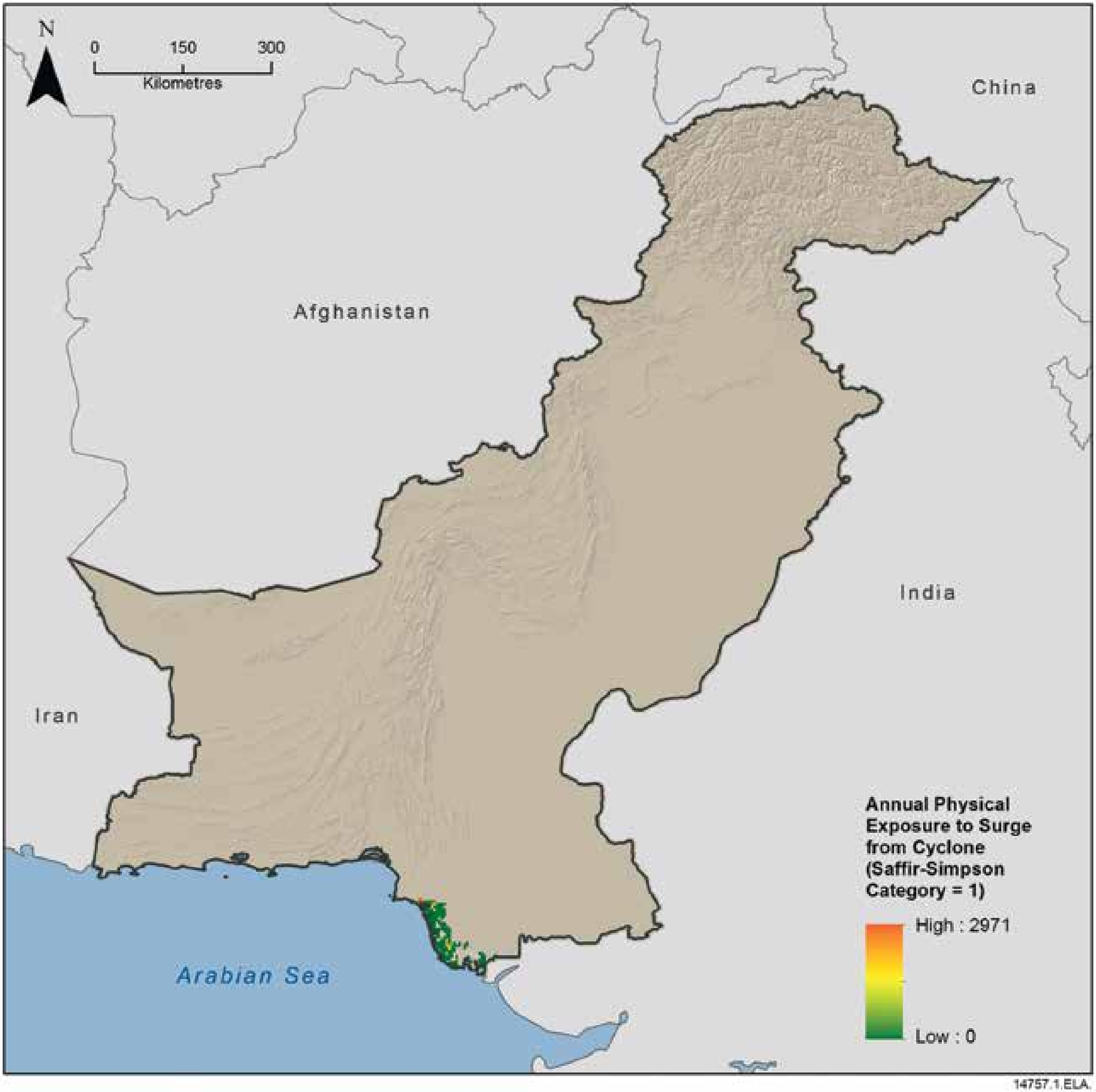


Figure 7: Expected average annual population exposed to cyclone.
Source: UNEP-GRID PREVIEW.

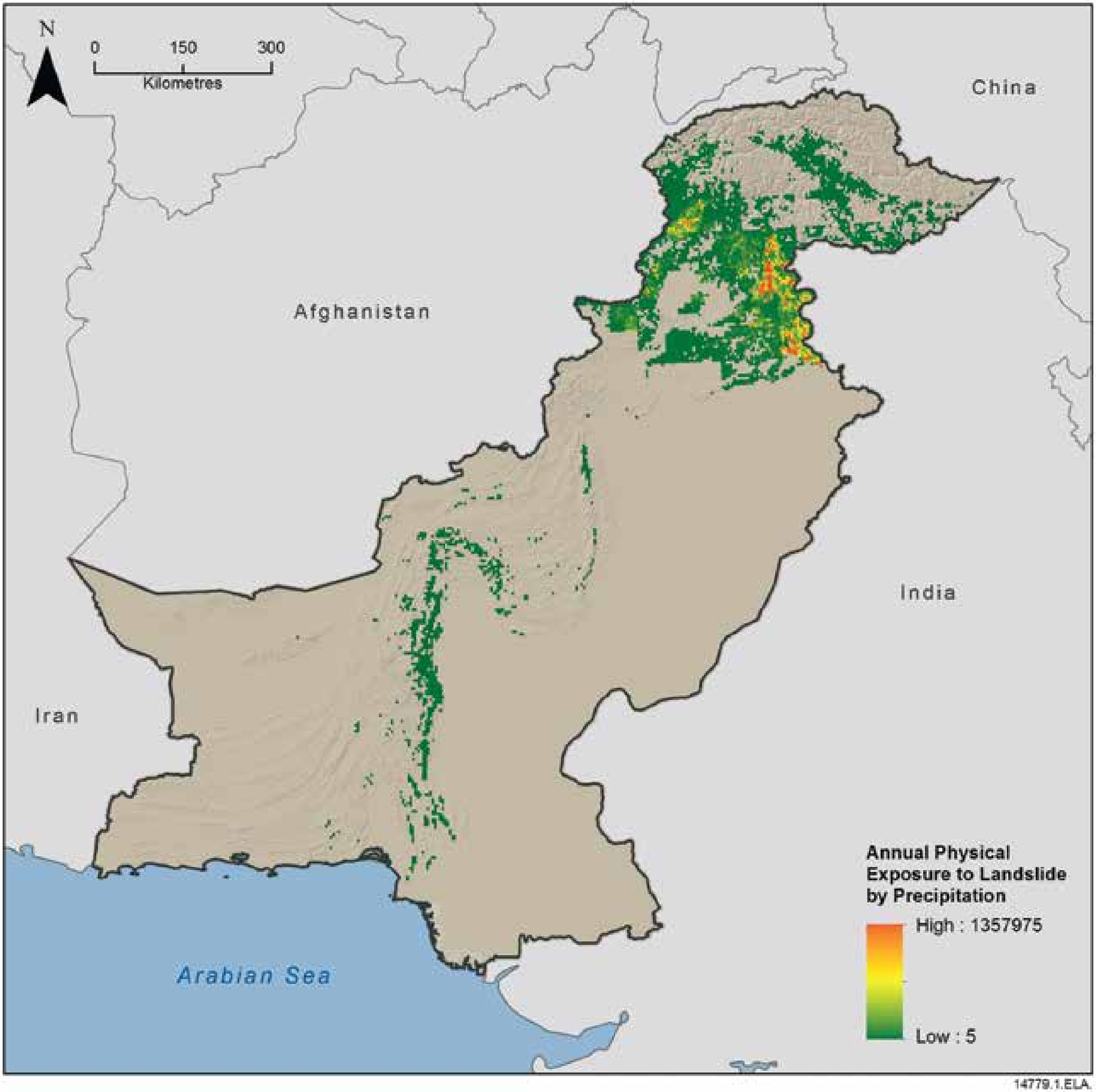


Figure 8: Expected average annual population exposed to precipitation triggered landslides. Source: UNEP-GRID PREVIEW.

1.2.5 Cyclones

In the period between 1971 and 2001, 14 cyclones were recorded. While cyclones are rare in the Arabian Sea, the low-lying coastal belts may suffer significant damages from the occasional cyclone. Cyclones mostly hit the Sindh coast rather than the Baluchistan coast. In 1999, cyclone 2A – a category 3 hurricane – ravaged large tracts along the coastal districts of Badin and Thatta, wiping out 73 settlements and affecting nearly 600,000 people. Extensive property and agricultural damages of up to US$ 12.5 million were also recorded.

1.2.6 Landslides

The regions of Kashmir, Northern Areas and parts of the NWFP province are highly exposed towards landslides. Aside from the young geology and fragile soil type of mountain ranges, accelerated deforestation, cultivation and construction are also major causes behind the increased incidences of landslides. Small scale isolated landslide hazards happen frequently in the above mentioned regions. A total of 13 landslide events have been recorded since 1926 causing the death of 413 people.

1.3 Hazard impacts and trends

Natural hazards in Pakistan originate mostly from meteorological phenomena (NDMA, 2012). Weather-related hazards account for approximately 76 per cent of the total number of natural disasters recorded between 1980 and 2013 (Figure 9), with floods (riverine flooding and flash floods) accounting for 46 per cent of all hazards. Negative impacts associated with all types of hazards excluding droughts are expected to occur nearly every second year (Figure 10). Earthquakes and floods (all types) occur more frequently and are respectively expected to hit annually and up to three times a year. It must be mentioned that only one drought event was recorded in the International Disaster Database (EM-DAT) for the 1980–2013 period, but it lasted for more than 2 years.

In terms of impact, 85 per cent of the population affected by hazards from 1980 to 2013 were affected by flood events, with 74 per cent (Figure 11) corresponding to riverine floods concentrated along the Indus River floodplain, of which more than 35 per cent can be attributed to a 2010 flood event. Earthquakes and droughts affected respectively only 9 per cent and 3 per cent of the total population during the same period. Despite the lower frequency of occurrence, droughts can affect a larger proportion of the population compared to earthquakes.

In terms of overall economic damages, the proportional impact of riverine flooding is still larger, representing 69 per cent of the total economic damages from all hazards during the same period (Figure 12), with the 2010 flood event representing more than 50 per cent of this share. The earthquake share in terms of the total damages reaches 21 per cent, including a significant contribution from the 2005 earthquake.

Historical trends related to the impact on the population and economic damages from all hazards and the proportion of damages associated with general flooding (originating from the Indus River and its main tributaries) and earthquakes are presented in Figures 13 and 14. A considerable increase in the amount of damage and the affected population is noticeable beginning in 2005 when an earthquake generated a considerable amount of damage and death, at the same time floods also affected a large portion of the population. More specifically, in the past 4 years, riverine flood events have been predominant and accounted for nearly 100 per cent of the total damages and affected population.

From this analysis, floods and earthquakes appear to be the most prevalent hazards in Pakistan followed by droughts and storms. The impact of flooding is dominated by general riverine flooding along the Indus River, which has resulted in the largest impact on human and economic activities. More importantly, such hazards have occured almost annually since 2010. It should be noted that drought is a peculiar hazard to capture in statistical analyses. Because of its slow-onset characteristics and the lack of any structural impact, drought is often disregarded (and not reported) unless serious problems appear (Svoboda and others, 2002; Mishra and Singh, 2010). In addition, due to the complex nature of droughts, the collection of objective field information on drought events (e.g., geographical extent and timing) and its direct or indirect impact is a real challenge (Horion and others, 2012). In such circumstances, the true impact of drought on the ground and particularly on the poorest segment of the population is likely to be underestimated in the figures above.

Due to its diversity in terms of climate and topography, every province and region faces a diverse range of hazard threats. For example, the coastal areas of Pakistan are prone to cyclones and tsunamis. Southern Punjab is mostly affected by the threat of droughts and flooding, while Baluchistan is at risk for droughts, earthquakes and flash floods. Furthermore, the Sindh province faces the possibility of droughts and flooding, while Khyber Pakhtunkhwa is affected by earthquakes, landslides, avalanches and flooding.

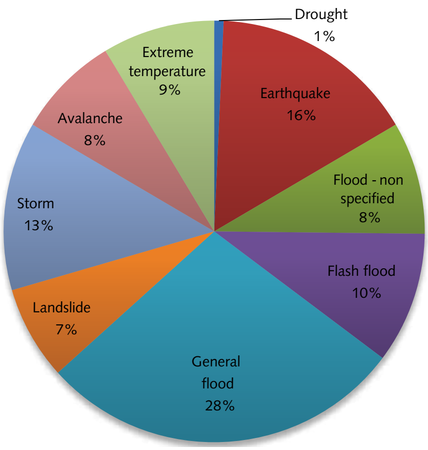


Figure 9: Proportion of hazards number between 1980–2013 (total 139 events). Source: EM-DAT.

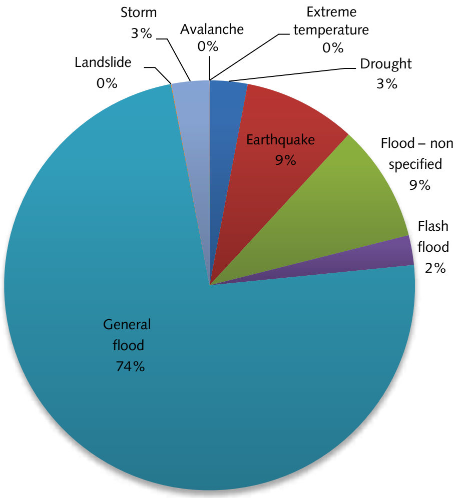


Figure 11: Proportion of affected population by hazard type, 1980–2013 (total for 73.8 million people). Source: adapted from EM-DAT, 2014.

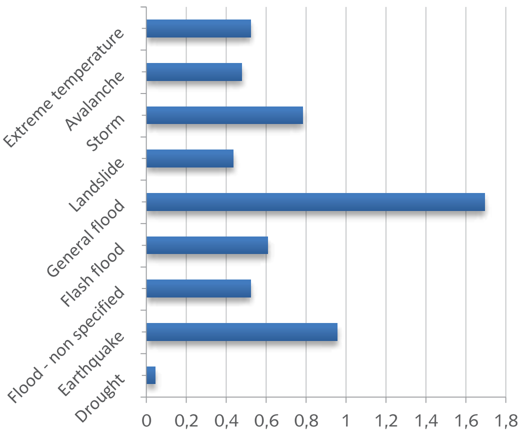


Figure 10: Yearly frequency of hazards, 1980–2013. Source: EM-DAT, 2014

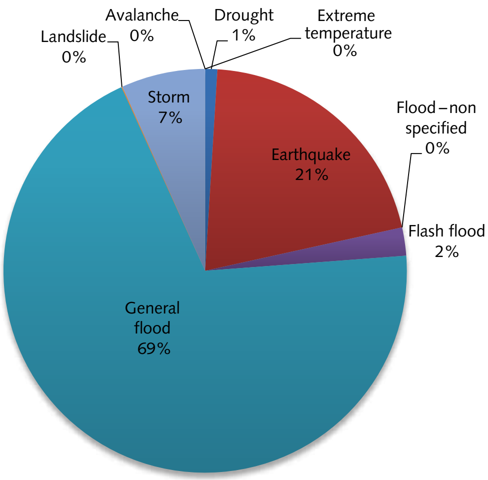


Figure 12: Proportion of economic damages by hazard type, 1980–2013 (total of US$ 25.4 billion). Source: adapted from EM-DAT, 2014.

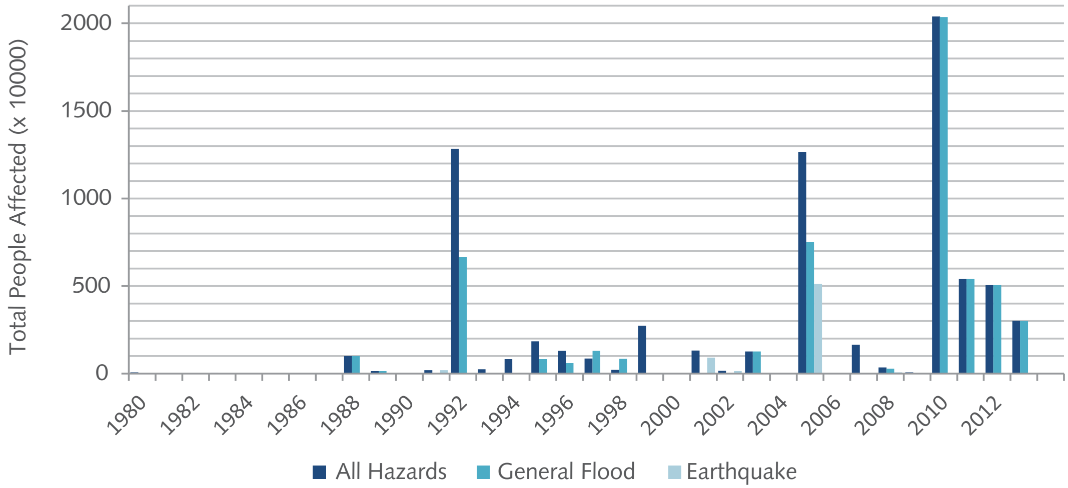


Figure 13: Population affected by natural hazards in Pakistan between 1980 and 2013. Source: EM-DAT, 2014.

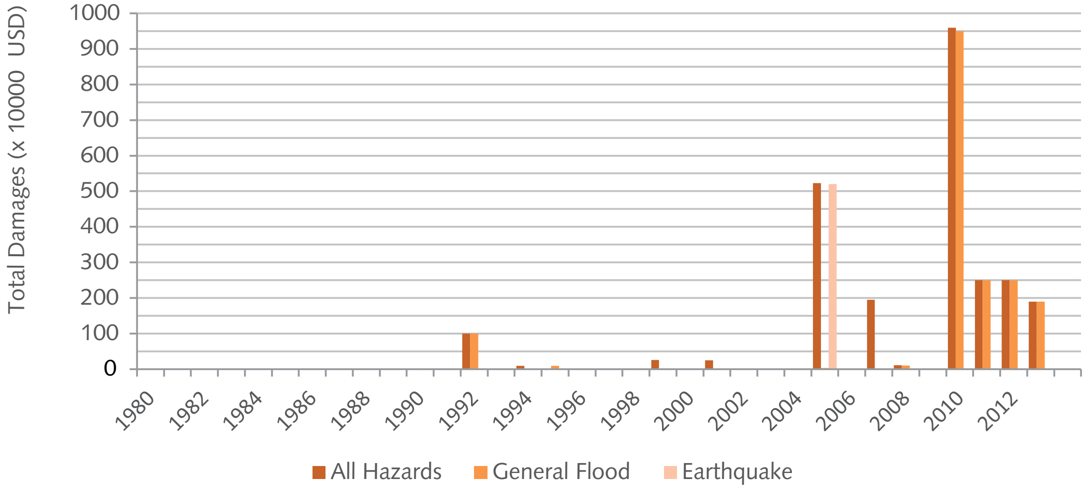


Figure 14: Economic damages from natural hazards in Pakistan between 1980 and 2013. Source: EM-DAT, 2014.

1.4 Exposure and vulnerabilities of the poorest

1.4.1 Identification of the poorest

In order to develop the proposed disaster insurance fund, there is a need to identify and map the poorest and understand their vulnerabilities to different hazards. Many studies have also attempted to identify, rank and map poverty at the provincial and district levels using different classification techniques and socio-economic indices. Arif & Farooq (2011) and Cheema & Sial (2012) previously reviewed the extensive literature available. Some studies have focused on agricultural and agro-climatic zone classifications. In 1989, Pinckney proposed the first classification of poverty based on kharif crops. Malik (2005) and Irfan (2007) derived poverty incidence on the basis of 2004–05 Household Income and Expenditures Survey (HIES), agro-climatic zones and differentiated between urban and rural zones at the provincial level. Although poverty patterns emerged, Irfan (2007) suggested that differences in land distribution and ownership structures within provinces and districts were also significant factors in the incidence of poverty. Those studies identified poor regions in Punjab which are reliant on cotton and wheat and low-intensity zones consisting of seven districts, namely, Bahawalnagar, Bahawalpur, Bhakkar, Dera Ghazi Khan, Layyah, Lodhran, Muzaffargarh, Rahim Yar Khan, Rajanpur and Vehari situated in south and south-west Punjab. In Sindh, the cotton and wheat zone has commonly been identified as the poor region. Rural areas of the remaining two provinces, Baluchistan and Khyber Pakhtunkhwa, are considered two separate zones and are also among Pakistan's poor regions. Under this regional or zonal classification of rural areas, South and West Punjab, the cotton and wheat belt of Sindh and the rural areas of the Baluchistan and Khyber Pakhtunkhwa provinces represent Pakistan's poorest and most vulnerable regions.

Cheema (2010) used a poverty mapping technique to rank districts. The findings are not different from those based on the zonal and regional classification. Districts located in the southern part of Punjab are identified as the poorest districts, including Bahawalpur, Lodhran, Muzaffargarh, Rahim Yar Khan, Rajanpur and Vehari. In Sindh province, Badin, Dadu, Larkana, Shikarpur and Thatta are identified as the poorest districts. In the Khyber Pakhtunkhwa province, Batgram, Bonair, Kohistan, Malakand, Shangla and Upper Dir were identified as the poorest districts, while the poorest districts identified in the Baluchistan province were Chagi, Jhal Magsi, Lasbella, Pishin and Sibbi.

Jamal and others (2003) developed a Multiple Deprivation Index (MDI) for each district based on the combined education, health, housing quality, housing services and employment sector indices. Similarly, Said and others (2011) developed a basic need index and an asset index using the Pakistan Social and Living Standards Measurement Survey (2008–2009) data set. Arif and others (2011) suggested that most studies identify similar poverty patterns at the district level independent from the approach chosen.

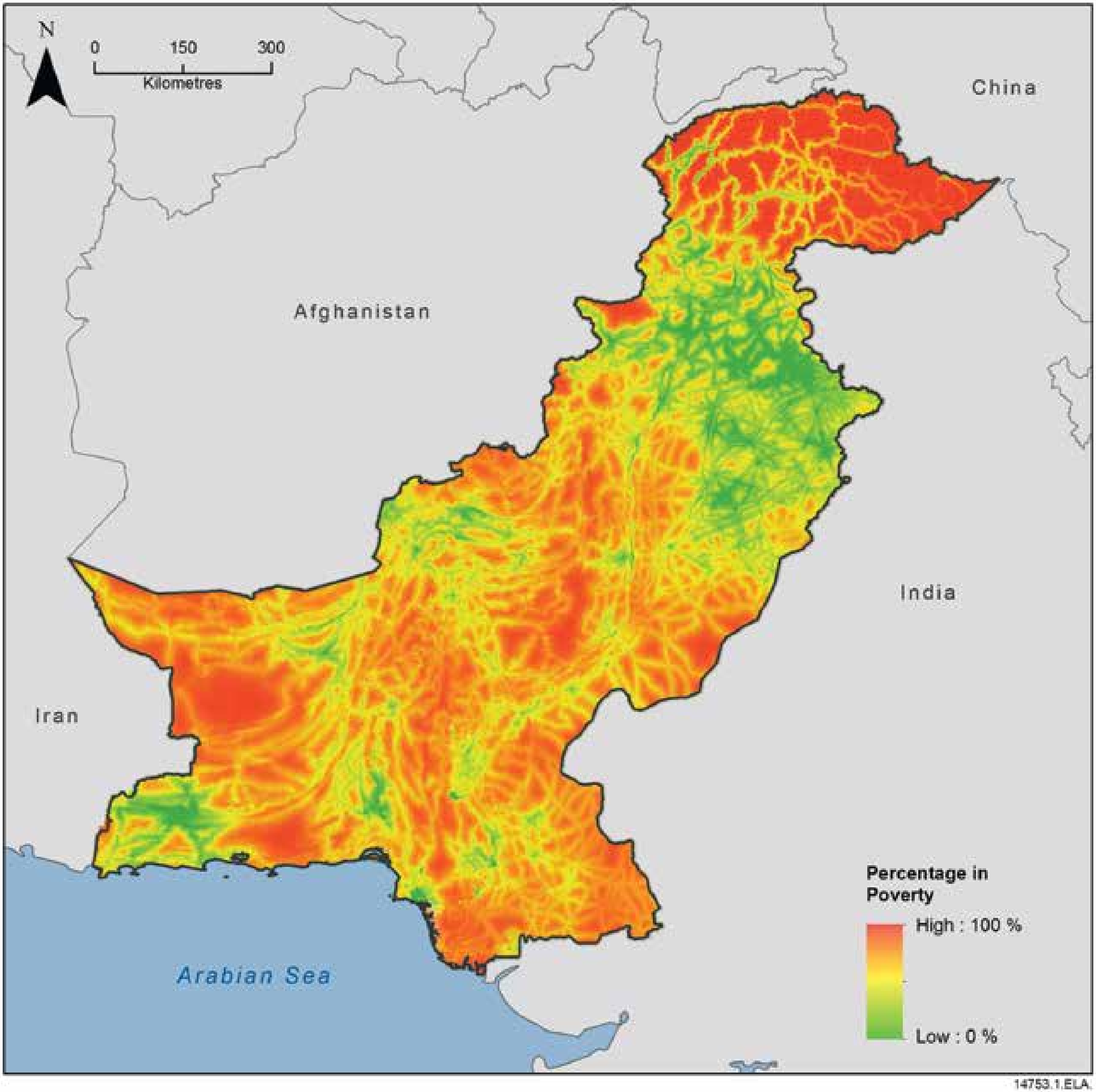


Figure 14: Percentage of population living in poverty as defined by the multidimensional poverty index (Oxford Poverty & Human Development Initiative). Source: WorldPop, 2013.

1.4.2 Vulnerabilities among the poorest

In order to understand and capture the potential impact of different hazards on the poorest populations, it is necessary to establish the vulnerabilities to physical assets and the dependency of the poorest populations on those physical assets (e.g., crops).

A considerable body of literature exists in Pakistan that has identified the poorest segment of the population based on both quantitative and qualitative research. This literature has identified the following rural groups as the poorest: landless households, sharecroppers and small landowners, agricultural workers, construction workers, female-headed households, large households and zakat recipients (Arif and Farooq, 2011).

Through field surveys in the Punjab province, Mustafa (1998) noted that a lack of structures (e.g., schools, hospital and irrigation systems) is a contributing factor to vulnerability at the macro level. However, exposure and vulnerabilities were unequal within a community and were primarily a function of powerlessness and poverty. The spatial pattern of settlements favours the wealthiest. The poorest sharecroppers and landless tend to have homes in the low-lying fringes of the main village and large landlords and affluent individuals are usually situated on higher ground beyond the main inundation zones.

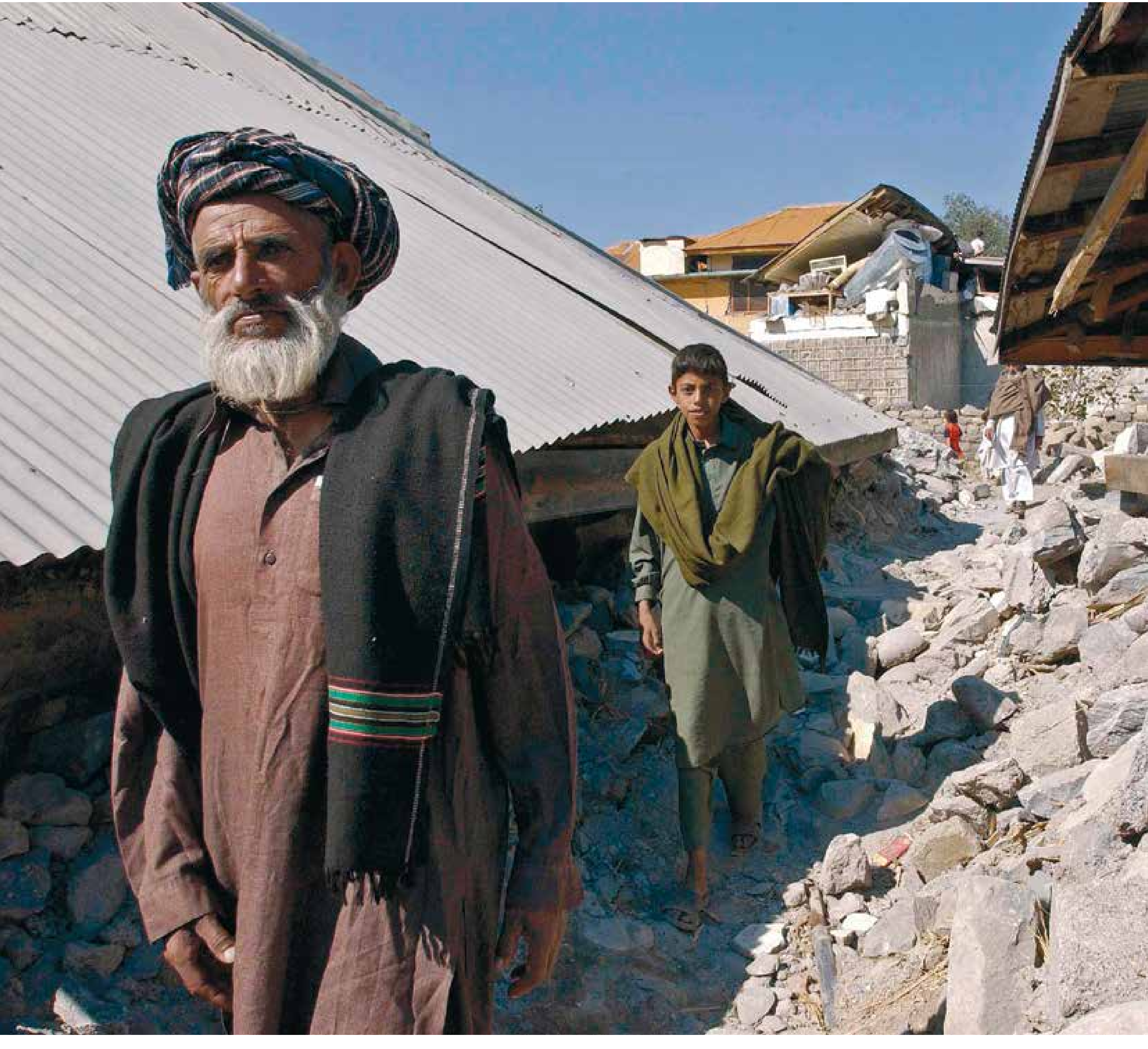
In Pakistan, rural housing and particularly the housing of the poorest is traditionally made of adobe structures classified as pacca (solid structures made of stone, brick or cement) or katcha (timber frame), which have a low construction cost and raw materials that are widely available and cheap. The vulnerability of such structures to meteorological and geological hazards has been documented in many studies in Pakistan and different regions of the world (Shah and others, 2013; Maheri and others, 2005; Macuabag and others, 2008). Most recently, Rafi and others (2012) developed comprehensive fragility curves associated with different grades of damage.

Understanding the source of income among the most vulnerable is also an important factor in identifying dependencies on other vulnerable physical features such as crops. Large landowners and small farmers report a significantly larger percentage of loss of income (67 per cent and 77 per cent, respectively) during flooding than the landless (41 per cent). Small farmers and landless households have a proportionately higher number of people with non-farming sources of income (Mustafa, 1998). They report seeking off-farm employment as insurance against a total loss of income in the event of flooding.

Irfan (2007) analysed the dependence of households on different sources of income. Analyses confirmed the dependence of the poor on wages and the diversification of income sources. The role of wages is larger among the landless and gradually declines as the size of one's land holdings increases. The share of non-farming (or enterprise) income is highest (33 per cent) for the landless followed by small landholders (0.5–12.5 hectare, 22 per cent). For the remaining landowners, enterprise income accounts for less than 15 per cent of the total earnings. Income from crops and livestock accounts on average for more than 40 per cent of the total income for those who own more than 2 hectare and over 57 per cent for the largest landowners (10 or more hectare). In conclusion, extra-village and off-farm labour market participation represents a response to lower levels of income from crops and livestock either due to the paucity of land resources or land ownership concentration among a fewer number of inhabitants as is the case in Southern Punjab and rural Sindh. Non-farming (or enterprise) emerges as more important for the landless and small landholders who supplement their income through engagement mostly in the low productivity informal sector most likely in a deliberate manner to increase their resilience in the event of a hazard.

Indicator	Landless	Small farmer	Large landowner
Average income (US$ 1 994 / year)	282	2 880	23 800
Income loss during a flood year (%)	41	67	77
Average landholding (ha)	0	6.9	84
Percentage of population reporting non-farming sources of income	71	77	33
Primary means of recovery	Sale of livestock; loans from friends and relatives	Non-farming labour ; sale of livestock; loans from friends and relatives	Loans from lending institutions

Table 1: Intra-community vulnerability to flood hazards in Pindi and Qatalpur. Source: Mustafa, 1998.



2. Understanding and assessing risks

Understanding and measuring risk adequately and frequently are at the core of the disaster risk management process. Modern disaster risk management started in the 1990s with the development of risk management approaches within the contexts of financing and insurance, then expanded to the health sector. The risk-based approach lead to the introduction of concepts such as tolerable and unacceptable risks, which are used to quantify the necessary efforts aimed at mitigating hazards. In addition, this approach does not simply identify hazards and consequences, but also seeks to assess the relative significance of a risk. As an approach, it is now widely accepted as the most integrated and cost-effective method for disaster prevention, reduction and transfer.

2.1 Defining risk

Disaster risk can be captured through two major components: the probability of an event occurring and its intensity and the reach of an event (which is encompassed in the Hazard (H) term) and its consequences. Diverse frameworks propose using a variety of nomenclature and disaggregation into further constituents to characterize the hazard's consequences. The consequences are influenced by the relative vulnerability of the receptors and their actual value (exposure):

→ Exposure quantifies the value of property, goods and other valuables that may be exposed to a given event. Exposure can also capture the population that is physically exposed to hazards.

- Vulnerability captures the susceptibility of the receptor. It describes the propensity of a particular receptor to experience harm during a given event and describes its relative loss. In some cases, a resilience component is introduced into the overall vulnerability estimation. Resilience describes the ability of the receptor that has been harmed by an event to recover without aid.

Different concept formulae (see Table 2 below) linking the different components of risk can be derived depending on the needs and interests of the study groups. Traditional risk management approaches normally focus primarily on structural work and associate risk only with hazard. The modern approach to risk management calculates risk by including quantifiable aspects of exposure and vulnerability and is currently enjoying widespread acceptance among financial institutions and in risk assessment for development purposes. Finally, additional components (e.g., resilience) can be introduced and more complex interactions can be investigated between various components of risk. Such approaches aim to capture the intrinsic relationships between hazards and consequences and propose more complex methodologies to assess non-quantifiable aspects of risk management (e.g., policies and social cohesion).

The impact of risks and hazards must be understood not only as dependent on the occurrence and intensity of hazards, but also as closely linked to anthropogenic activities and development (Figure 2). Quantifying the hazard remains a critical exercise for risk management, especially in the context of climate change. But, an understanding of the likely effects of our quickly developing and constantly changing societies (e.g., urbanization as well as water and land resource use) should become a priority in order to achieve efficient risk reduction strategies.

Concept formulae	Focus on	Application
R = H	Hazards	Structural mitigation work
R = H * E	Exposure	Zoning and spatial planning
R = H * E * V	Quantifies economic losses in probabilistic terms	MCA, CBA and insurance
R = H * E * V / R	Exposure, vulnerability and resilience	Community-based disaster reduction
R = H(v,e,r) * E(h,v,r) * V(h,e, r)/ R(h,e,r)	Complex interactions between the hazard, vulnerability and resilience	Institutions, policies and academic research

R = risk, H = hazard, V = vulnerability, R = resilience and E = exposure

Table 2: Examples of concept formulae applied to flood risk management. Source: adapted from Van Westen, 2001.

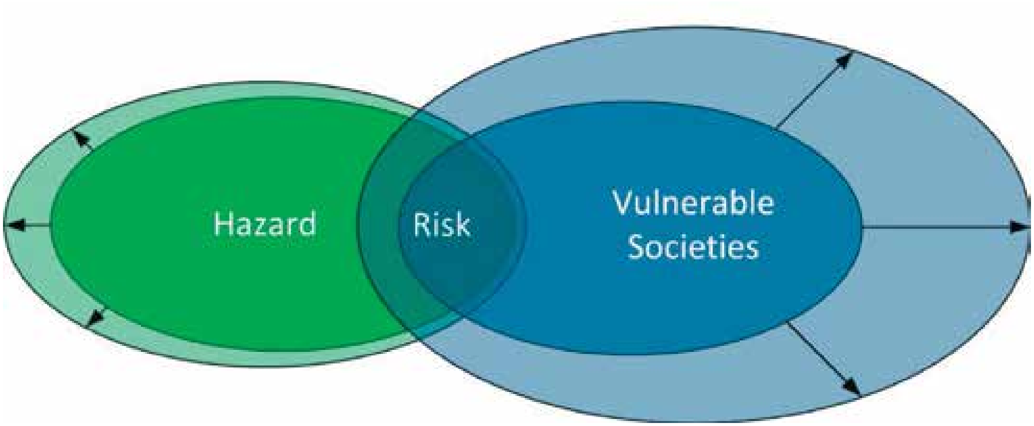


Figure 15: Schematization of the dynamics of the main risk components. (Source: adapted from van Westen, 2001).

2.2 Assessing hazards and uncertainties

Understanding natural hazards is at the core of understanding, mitigating and managing risks related to natural disasters. Various techniques can be applied to assess natural hazards ranging from the analysis of historical events captured by ground and remote sensing information to advanced numerical simulations using detailed models. A multitude of modelling methods exist for each hazard (e.g., one-dimensional, quasi-two-dimensional, three-dimensional and coupled above- and below-ground models for flooding). If used correctly and well calibrated, state-of-the-art models are capable of representing complex geological, climatic and hydraulic processes very well. Combined with detailed data capturing physical features at ground level, such as terrain elevation or soil properties, increases in computational speed now mean such models are able to provide accurate results relatively quickly for large swaths of land.

With the increase in the available computational power, so-called probabilistic flood models can now be developed for large areas. Probabilistic flood models are different from normal deterministic flood models in that they take the probability of certain events into account. This may involve consideration of the following:

- A range of source-loading conditions (e.g., inflow, sea water level and weather events);
- Performance of control and mitigation measures (e.g., embankments and gates);
- The probability that the control measures will fail and;
- Other not easily quantifiable variables.

Through a thorough consideration of the entire complex system, the probability of a hazard's occurrence can be robustly established. The information derived from probabilistic studies is considerably more powerful than traditional (deterministic) hazard maps.

Changes in climate are likely to affect the frequency and severity of future extreme weather events. However, ongoing immense societal changes, particularly those developing in Asia, have a much larger impact on the overall risks compared to the climate change effect alone. This stresses the need to understand the changes in vulnerability and exposure and the need for governmental agencies and the insurance industry to increase their focus on vulnerability.

2.3 Defining and measuring vulnerability

Vulnerability is the most complicated component of risk assessment because of its wide range of interpretations. In 2004, the United Nations Office for Disaster Risk Reduction (UNISDR) defined vulnerability as the conditions determined by the physical, social, economic and environmental factors or processes which increase the susceptibility of a community to the impact of hazards. This definition illustrates that vulnerability is multidimensional (physical, social, economic, environmental, institutional and human factors define vulnerability), dynamic (it changes over time), scale-dependent (it can be expressed at different scales from individuals to countries) and site-specific (each location might need its own approach).

Vulnerability can be captured using qualitative and quantitative methods. Quantitative methods focus primarily on physical vulnerability as the potential to physically impact assets (e.g., infrastructure, buildings and crops) and population. It is defined as the degree of loss to a given element at risk or the set of elements at risk resulting from the occurrence of a natural phenomenon of a specific magnitude. Quantitative methods for assessing vulnerability are either empirical (e.g., historical damages or expert judgements) or based on analytical methods. Empirical methods for vulnerability assessments are most often based on damage data from historical events which are used to establish a correlation between the hazard intensity and the degree of damage. The result is either a damage probability matrix or a vulnerability curve. In many situations, however, expert opinion is the most feasible option for obtaining vulnerability information, either because there is no prior damage information or because the building stock and social context changed markedly since the last event.

Social vulnerability is defined as the potential impact of events on groups within a society (such as the poor or single-parent households) and the institutional structures designed to help them cope. Qualitative methods based on indices and weighting and ranking are generally used to capture the diverse dimensions and complex interactions characteristic of social vulnerability.

2.4 Risk assessment for risk transfer

Insurance is a major and legitimate activity in managing disaster risks. For the beneficiaries, insurance provides the necessary funds for the repair or replacement of assets or other economic losses. As such, it provides a mechanism for them to transfer part of their risk to the insurer and reduce their vulnerability to natural hazards through reimbursement and incentives to adopt 'better behaviour'. For those providing the insurance (and reinsurance), it provides a commercially viable means of generating income.
To be viable, the insurance needs to meet the following five principles of insurability:

- → Mutuality: A large number of people who are at risk must combine to form a risk community;
- → Assessibility: The expected loss burden must be assessable;
- → Randomness: The time at which the insured event occurs must not be predictable, and the occurrence itself must be independent of the will of the insured;
- → Economic viability: The community organized by the insured individuals must be able to cover its future, loss-related financial needs on a planned basis;

- → Similarity of threat: The insured community must be exposed to the same threat, and the occurrence of the anticipated event must meet the need for funds in the same way for all those concerned.

Therefore, adequate information (e.g., hazard maps and probabilities, exposure and vulnerability data including property types or assets and damage curves) is critical for deriving premiums. Such data require specific probabilistic and quantitative risk studies that are able to capture economic risk through probable maximum losses, average annual losses or loss exceedance curves. In addition, periodically re-assessing individual and total cumulative risks (e.g., changes in exposure and total premiums to be paid) is compulsory for a sustainable insurance scheme.

3. Disaster risk assessment initiatives in Pakistan

Many studies have been carried out to map and assess hazards and risks in Pakistan since 2007 and the establishment of the National Disaster Management Authority (NDMA). Considerable effort has since focused on improved disaster risk assessment at various levels. A comprehensive list of disaster risk-related studies that have been completed or are ongoing in Pakistan is provided in Appendix A. The most notable among these are summarized below.

3.1 National Disaster Risk Management Plan 2012

In 2012, a macro-scale risk assessment initiative under NDMA and the Ministry of Climate Change was completed with support from the Japan International Cooperation Agency (JICA) as a part of activities aimed at strengthening the National Disaster Management Plan (NDMP). The overall NDMP had a total investment cost of US$ 1,040.9 million (NDMA, 2012) and is to date the only risk assessment related document approved by the National Disaster Management Committee (NDMC) in January 2013. The overall NDMP identifies macro-level hazards and risks in qualitative terms for floods, landslides, earthquakes, tsunamis, cyclones, droughts, avalanches and glacial lake outburst floods (GLOFs). Hazards and vulnerabilities have been classified into five categories at the district level, where the hazard classification is derived from indices capturing historical records or relevant physical features (e.g., slope, ground elevation, mean rainfall, etc.). Vulnerability indices have been derived from population density and principal crop yields. It should be noted here that the term 'vulnerability' used in the macro-scale risk assessment actually corresponds to the term 'exposure' as defined in section 1.1 of this document. Risk maps have also been generated using the following concept formula: *Risk = Hazard x Exposure.*

In addition to identifying risks, the project drafted plans for the development of an enhanced multi-hazard early warning system and defined the roles and responsibilities at the national, regional and community levels for risk management activities.

3.2 A United Nations joint programme on disaster risk management

An ongoing multi-hazard vulnerability and risk assessment initiative from the United Nations World Food Programme (WFP), under the United Nations Delivering as One programme and supported by NDMA. This initiative is being implemented at the subprovincial level for the districts of Badin, Mirpur Khas, Tando Allah Yar, Tando Mohammad Khan and Thatta in the Sindh province. The project is aimed at developing methodologies and providing a dynamic planning tool for disaster risk management officials to assess the degree of risk to humans and physical elements (e.g., buildings, infrastructure and crops). It has been proposed that the hazard assessments rely on a probabilistic approach by using different modelling techniques (e.g., Weather Research and Forecasting (WRF), Standardized Precipitation Index (SPI), etc.) and a frequency analysis of hazard-related parameters (e.g., rainfall, river discharge, etc.). Risk is estimated in quantitative terms using the following concept formula: *Risk = Hazard * Exposure * Vulnerability.*

Population density, infrastructure, building and crop maps are recommended for the mapping of physical exposure. Vulnerability functions are also suggested in order to capture physical damages in economic terms for different hazard parameters (e.g., wind speed, flood elevation, ground shaking, etc.). Localized earthquake risk assessments are also ongoing under the same programme in five locations including Citral, Murry and Qwajah.

3.3 The World Bank and Global Facility for Disaster Reduction and Recovery initiatives

The World Bank and GFDRR are currently engaged in various disaster risk management programmes with the Provincial Disaster Management Authority (PDMA) and other local authorities. The projects target two pillars of disaster risk management: 1) institutional arrangements and capacity building and 2) hazard and vulnerability assessment. The latter category includes the following projects (Forni and others, 2013; GFDRR, 2012):

→ Baluchistan Disaster Management Project (2012–2015): This project strengthens the capacity of the Baluchistan PDMA to prepare and respond to natural disasters. It has four main components: institutional strengthening, hazard and risk assessment in the provincial capital, a community-based disaster risk management programme and a contingency emergency response programme

→ Innovation in Risk Assessment and Financing (2012–2015): This project aims to support the government in advancing the understanding of risk and developing financial protection strategies. The programme supports the development of the country's data gathering, risk modelling and risk financing capacities. As a starting point, a National Working Group (NWG) on risk assessments was established in November 2012 under NDMA leadership and includes technical agencies such as the Pakistan Meteorological Department (PMD), the Geological Survey of Pakistan, the Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) and other stakeholders. One of the primary objectives of NWG is to map, assimilate and consolidate information and models related to existing risk assessment initiatives and to identify and fill gaps.

- → Development of a programme for hazard and risk assessment in urban areas (2012–2013): The objective of this activity is to increase the capacity for hazard and risk assessment in Pakistan. It has been implemented in two pilot cities and was designed to contribute to the creation of a replicable risk assessment framework for the country.

3.4 Strengths and weaknesses

The strengths and weaknesses of past and current disaster risk assessment initiatives are summarized below. The analysis focuses mostly on disaster risk assessment and does not specifically address institutional and capacity issues nor does it focus on mitigation, preparedness and response activities.

Strengths

- → A considerable amount of data and information is being collected and generated across the country. The information consists of hazard monitoring and forecasting systems, hazard and risk maps and socio-economic data from a variety of technical agencies and research institutes (e.g., Benazir Income Support Programme (BISP), Leadership for Environment and Development (LEAD), NDMA, Pakistan Agricultural Research Council (PARC), Pakistan Bureau of Statistics (FBS), Pakistan Institute of Development Economics (PIDE), PMD, SUPARCO and Water Resources and Power Development Authority (WAPDA)).

- → The credibility of any hazard or risk assessment study depends on the data upon which it is based. Through NWG, ongoing efforts are aimed at consolidating hazard, exposure and vulnerability information from different data sources and monitoring networks (e.g., remote sensing, rainfall, river discharges, etc.) from diverse agencies. The consolidated database, which is shared between agencies, will help to avoid the duplication of data and to identify gaps. This has significant savings advantages and promotes the concept of 'collect once, use many times' across all governmental and private organizations that have an interest in disaster or environmental management.

- → In terms of methodologies, a shift toward probabilistic and quantitative risk assessment at the micro scale has been initiated in pilot projects across the country. Such approaches are prerequisites to orienting risk reduction and transfer efforts in a more cost-efficient manner.

- → Data sharing and decision support systems have been developed to support micro-scale risk assessment studies across the country. Risk assessment and management is a continuous process in which a flexible information system is critical for periodic updates to datasets, scenario testing and the integration of new datasets.

Weaknesses

- → The macro-scale risk assessment carried out to support the NDMP addresses hazard and exposure in qualitative and deterministic terms. Such an assessment allows for the screening of disaster risks, but cannot provide clear guidance for cost-effective disaster risk management strategies.

- → Quantitative risk assessment studies are highly localized and isolated. Diverse methodologies based on diverse information platforms have been developed under various donor initiatives.

- → The assessment of vulnerabilities needs to be developed through the creation of uniform and nationwide quantitative and qualitative methods and models.

- → Dynamics and trends related to climate change, environmental degradation and socio-economic factors need to be integrated.

3.5 Way forward

The detailed tasks required for assessing the economic risks associated with the insurance fund are listed in section 3.5.1. Section 3.5.2 then provides recommendations for a series of activities to strengthen the current disaster risk assessment initiatives for generic disaster risk management and risk reduction purposes in Pakistan.

3.5.1 Risk assessment activities for the insurance fund

A consultant has recommended the following activities for implementation in order to assess the risks of losses associated with the proposed insurance fund.

1. Data acquisition and processing: All data necessary to assess, model and monitor hazards; identify, classify and model exposure and vulnerabilities of the beneficiaries; and establish potential economic losses will be acquired, processed and quality checked. Such datasets will be based on remote sensing and ground data sources and meet the specific requirements of coverage, continuity, availability (near-real time for fast payout release) and independency. During this stage, automated processes required to correct historical and near-real time datasets will be identified and developed.

2. Probabilistic hazard modelling: The hazard proposed to be insured will need to be assessed in the pilot areas and then at the national scale in probabilistic terms. In the case of a weather-based index such as rainfall, an extreme value analysis will be performed over the pilot areas. More advanced modelling tools are also available for stochastic modelling of hazards such as earthquakes. Models and intensity parameters will be selected and their spatial distribution and probability of occurrence will be mapped.

3. Exposure and qualitative vulnerabilities analysis and modelling: In order to estimate insurance payout, it is necessary to relate hazard magnitude and frequency to economic impact on specific population groups. A prerequisite of the insurance system is that it is able to identify and categorize those groups and their vulnerabilities to the insured hazards according to a series of socio-economic indicators acquired from previous studies (e.g., different vulnerability studies conducted in Pakistan, such as the Human Development Index (HDI) or MDI) or by reprocessing and cross-referencing different census and survey data (e.g. FBS, BISP, etc.). If judged necessary, site visits and surveys will be conducted in the pilot areas. The literature review initiated during this stage will be extended to include additional data produced to deliver a robust model of the exposure of the beneficiaries. At this stage, it is expected that specific demographic models and datasets such as LandScan (see Bhaduri and others, 2007)) or WorldPop (2013) will be used to disaggregate census information to a spatial resolution able to meet or exceed the resolution of the hazard models.

4. Quantitative vulnerabilities and loss functions modelling: The quantification of losses can be completed using damage curves and historical damage information. The use of damage curves is normally preferred when damages to physical assets (e.g., housing, infrastructure and crops) need to be assessed especially when stochastic hazard models are used. However, such an approach might not always be possible particularly when weather-based indices are used. In this case, losses can be established either by developing damage curves through correlations of historical damages with the index chosen or by identifying the exact number of beneficiaries (available from the exposure model) when the payout is uniformly distributed among beneficiaries.

5. Risk modelling and scenario testing: Following the development of the loss models, the risk model can be used to produce a probability distribution of losses and exceedance probability curves. Exceedance probability curves reveal the probability that a certain level of loss will be surpassed within a given period of time. Based on the historic or stochastic hazard analysis and impacts performed, a simulation of 'what if scenarios' can be completed for different insurance schemes to see how payout, data quality and the 'sharpness' of triggered events would enable the client to define and select the best scheme for different insurance products in the pilot test areas.

6. Information system development and operation: A dedicated information platform is required to host all spatial information required for the risk modelling, to acquire and process real-time hazard-related information and to estimate payout in real-time on a scenario basis (for a periodic re-evaluation of the insurance index values due to changes in hazard trends or exposure). The platform will be developed in parallel during the development of the models mentioned previously and should preferably be hosted by a third-party organization.

3.5.2 Strengthening disaster risk management

The most recent disaster risk assessment efforts (e.g., the Sindh province multi-hazard risk assessment) are important for improving disaster risk information and knowledge in Pakistan. Such efforts could be further supported through the following activities:

- → The work of NWP to consolidate, unify and share data, methods and information system platforms at the national level is critical and must be pursued. Detailed technical specifications on data acquisition, processing, storing, as well as analyses of identified data gaps, should be made available to all interested internal and external parties. A key principle of good data management is also to maintain the ownership of the data used, including the responsibility for its quality and updating, among those organizations best able to manage and maintain those datasets.

- → Probabilistic hazard modelling is required for all types of hazards. The mapping of historical data should be complemented by geo-referenced frequency analysis of the hazard parameters considered important for each type of hazard (e.g., water levels for floods, wind intensity for cyclones, etc.). Ideally, stochastic event sets should be generated to improve the accuracy of the hazard assessment. In the specific case of flooding along the Indus River basin, simplified approaches to generate flood zone maps using river discharge extremes extracted from an analysis of extreme values from historical discharge measurements can be conducted. It is believed that such an analysis has been performed in the Upper and Middle Indus River using the Integrated Flood Analysis System (IFAS), and possibly in the Sindh province where a multi-hazard micro-scale risk assessment was recently conducted. However, such an approach is somewhat limited and less applicable to larger catchments, such as the full Indus River, where gauging is limited and flood plain areas are largely developed given that man-made structures have been erected over time to divert and control flood waters. In such cases, more advanced probabilistic flood modelling approaches that take rainfall and spatial and temporal variability at the full catchment scale as the input data and the probabilities of the failure of dykes and flood protection systems are advised.

- → Quantitative and qualitative exposure and vulnerability assessments are required. Quantitative vulnerability models have already been developed for building structural vulnerability to earthquake hazards or to measure crop vulnerabilities to water depth in the event of flooding. Additional vulnerability and damage functions need to be developed to provide for a wider range of hazard parameters and physical assets. Existing models should be reviewed and approved under activities included in item 1 above. Current qualitative vulnerability models can be helpful in understanding the linkages between vulnerabilities and to develop and analyse policies at different scales and different purposes. Many socio-economic studies as well as poverty reduction and environmental management programmes are ongoing in Pakistan. The information and knowledge originating from such programmes could be extremely valuable for assessing vulnerabilities. Collaboration and data-sharing initiatives between the organizations implementing them (e.g., PIDE, Sustainable Land Management Project (SLMP)) and the technical organizations working on disaster risk management should be developed.

- A national scale quantitative risk assessment is required to orient national policies and funds in the most cost-effective way. Ongoing micro-scale studies in pilot areas should ideally be replicated in all districts and provinces of Pakistan as is or by applying improved hazard and vulnerability methodologies.

- Disaster risk reduction and climate change adaptation should share the same risk-based approach. In order to account for changes to the climate, it is necessary to extend the risk assessment to a longer time frame. For example, this could be achieved by using climate change projections and providing estimates of future trends in hazard occurrences and frequencies using different time scales. Similarly, it is important to take into consideration changes in vulnerabilities and capacities and explore non-traditional hazards and risks from a long-term perspective.

- As for the insurance fund, a flexible information system is required to centralize all hazard and risk-related information. Such a system must be capable of integrating updated and new datasets and support scenario simulations for the testing and comparison of options for mitigation and adaptation. One approach that would be quite suitable for this project is the Comprehensive Approach for Probabilistic Risk Assessment (CAPRA). CAPRA is a geographic information system (GIS)–based platform for risk analysis, where probabilistic techniques are applied to analyse earthquakes, tsunamis, floods, cyclones, landslides and volcanoes. CAPRA is an open-source tool and is fundamentally designed to be modular and extendable. As such, it allows for the gradual building of a comprehensive risk assessment model, starting small (for example, one type of natural hazard in one specific region), which is expanded over time based on the most urgent needs and available resources (e.g., expanding geographically to cover other regions or an entire nation or by adding other types of hazards into the assessment framework). A modular platform also generates flexibility, such that the risk assessment can be adapted according to changes in needs and priorities, changes to the climate and the related frequency and magnitude of hazards, changing vulnerabilities due to changing land use and demography, etc. Hazard information is combined with exposure and vulnerability data allowing the user to determine risk simultaneously on an inter-related multi-hazard basis. This distinguishes the platform from traditional single-hazard analyses. Thus, CAPRA is a flexible model for comprehensive risk management, providing a risk mapping tool and a cost-benefit analysis tool for risk prevention, mitigation and management. CAPRA is also a useful tool in developing risk financing strategies and plans.

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Appendix A

Name	Type of assessment	Funded by	Technical assistance	Year	Remarks
Mansehra	Seismic microzonation	United Nations Development Programme (UNDP)	NDMA	2009	Scientific
Quetta	Seismic microzonation	UNDP	NDMA	2009	Scientific
Bagh	Hazard, livelihood and vulnerability assessment	Food and Agriculture Organization of the United Nations (FAO) and WFP	NDMA, Himalayan Rural Support Programme (HRSP) and AJK	2009	Scientific
Mansehra	Seismic microzonation	National Society for Earthquake Technology (NSET) (National Engineering Services Pakistan (NESPAK))	NDMA	2009	Scientific
Badin	Hazard, livelihood and vulnerability assessment	FAO and WFP	NDMA and the Provincial Government of Sindh	2009	Scientific
Haripur	Hazard, livelihood and vulnerability assessment	FAO and WFP	NDMA and the District Government of Haripur	2010	Scientific
Chitral	Seismic microzonation	UNDP	NDMA, PDMA and PaRRSA	2010	Scientific
Quetta	Seismic microzonation	UNDP	NESPAK	2011	Scientific
Murree	Seismic microzonation	UNDP	NESPAK	2011	Scientific
Chitral	Seismic microzonation	UNDP	NESPAK	2011	Scientific
Sindh	Multi Hazard Assessment	WFP and the Asia Pacific Development Centre (APDC)		2012	Scientific

Name	Type of assessment	Funded by	Technical assistance	Year	Remarks
Abbottabad	Enabling governance and institutions for earthquake response (hazard, vulnerability and capacity building)	UNDP	UNISDR	2007	Non-Scientific
Bagh	Enabling governance and institutions for earthquake response (hazard, vulner-ability and capacity building)	UNDP	UNISDR	2007	Non-Scientific
Battagram	Enabling governance and i nstitutions for earthquake response (hazard, vulnera-bility and capacity building)	UNDP	UNISDR	2007	Non-Scientific
Mansehra	District disaster risk management plan (hazard, vulnerability and assessment)	UNDP	UNISDR	2007	Non-Scientific
Bhimber	District hazard and vulnerability assessment	UNDP	NDMA		Non-Scientific
Charsadda	District risk management plan (district hazard and assessment)	UNDP	NDMA	2009	Non-Scientific
Dadu	District risk management plan (district hazard and vulnerability)	UNDP	NDMA	2009	Non-Scientific
Gwadar	District risk management plan (hazard and vulnerability assessment)	UNDP	NDMA	2008	Non-Scientific
Gujrat	District disaster risk management plan (risk hazard and assessment)	UNDP	NDMA	2009	Non-Scientific

Name	Type of assessment	Funded by	Technical assistance	Year	Remarks
Haripur	District hazard and earthquake vulnerability	UNDP	NDMA		Non-Scientific
Jhal Magsi	District disaster risk management plan (hazards in the district)	UNDP	NDMA	2009	Non-Scientific
Jhang	District disaster risk management plan (hazards in the district)	UNDP	NDMA	2009	Non-Scientific
Kachhi	District disaster risk management plan (hazards in the district)	UNDP	NDMA	2009	Non-Scientific
Kamber Shahdadkot	District disaster risk management plan (hazards in the district)	UNDP	NDMA		Non-Scientific
Lasbela	District disaster risk management plan (hazards in the district)	UNDP	NDMA	2009	Non-Scientific
Mansehra	District disaster risk management plan (hazard, vulnerability and assessment)	UNDP	UNISDR	2007	Non-Scientific
Muzzaffarabad	District disaster risk management plan (risk assessment and current responses)	UNDP	UNISDR	2007	Non-Scientific
Neelum	Building enabling governance and institutions for earthquake response	UNDP	NDMA	2007	Non-Scientific

Name	Type of assessment	Funded by	Technical assistance	Year	Remarks
Rawlakot	Risk assessments and current responses	UNDP	UNISDR	2007	Non-Scientific
Shangla	Building enabling governance and institutions for earthquake response	UNDP	UNISDR	2007	Non-Scientific
Sialkot	Disaster risks and vulnerability in the district	UNDP	NDMA	2008	Non-Scientific
Muzzaffargarh	District disaster risk management plan (hazards in the district)	UNDP	NDMA	2009	Non-Scientific
Nasirabad	District disaster risk management plan (hazards in the district)	UNDP	NDMA	2009	Non-Scientific
Rajanpur	District disaster risk management plan (hazards in the district)	UNDP	NDMA	2009	Non-Scientific
Sanghar	District disaster risk management plan (hazards in the district)	UNDP	NDMA		Non-Scientific
Tharparkar	Disaster risk in the district of Tharparkar	UNDP	NDMA	2009	Non-Scientific
Ziarat	District disaster risk management plan (hazards in the district)	UNDP	NDMA	2009	Non-Scientific
Pakistan	GLOF hazard assessment data	Climate Change Adaptation Programme (CCAP) Climate Change Division	PMD and the International Centre for Integrated Mountain Development (ICIMOD)	2013	In progress

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About MCII

The Munich Climate Insurance Initiative (MCII) was launched in April 2005 in response to the growing realization that insurance-related solutions can play a role in adaptation to climate change, as advocated in the Framework Convention and the Kyoto Protocol. This initiative brings together insurers, experts on climate change and adaptation, NGOs, and policy researchers intend on finding solutions to the risks posed by climate change. MCII provides a forum and gathering point for insurance-related expertise on climate change impact issues. MCII is hosted at the United Nations University Institute for Environment and Human Security (UNU-EHS) in Bonn, Germany.

About UNU-EHS

The United Nations University (UNU) – the academic arm of the United Nations system – implements research and educational programmes in the area of sustainable development, with the particular aim of assisting developing countries. The United Nations University Institute for Environment and Human Security (UNU-EHS) addresses risk and vulnerability aspects of

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