



# Nepal Health Sector Support Programme III (NHSSP – III)

**A Final Report on  
Climate Change and Health Infrastructure Framework  
30<sup>th</sup> November, 2017**



**Disclaimer**

This material has been funded by UK aid from the UK government; however the views expressed do not necessarily reflect the UK government's official policies.

## ACRONYMS

ADPC	Asian Disaster Preparedness Centre
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AH	Academic Hospital
CBS	Central Bureau of Statistics
CECI	Centre for International Studies and Cooperation
CC	Climate Change
CSSP	Central Specialized Service Hospital
DCC	District Coordination Committees
DDC	District Development Committees
DFID	Department for International Development
DRR	Disaster Risk Reduction
DUDBC	Department of Urban Development and Building Construction
GESI	Gender Equality and Social Inclusion
GIS	Geographical Information System
GLOF	Glacier Lake Outburst Flood
HP	Health Post
HI	Health Infrastructure
HIIS	Health Infrastructure Information System
ICIMOD	International Centre for Integrated Mountain Development
IIED	International Institute for Environment and Development
IPCC	Intergovernmental Panel on Climate Change
K.M	Kilometres
LAPA	National Framework on Local Adaptation Plans for Action
LNOB	Leave No One Behind
M	Metre
mm	Millimetres
MOE	Ministry of Environment
MOFALD	Ministry of Federal Affairs and Local Development
MOH	Ministry of Health
MOHA	Ministry of Home Affairs
MOPE	Ministry of Population and Environment
MOPIT	Ministry of Physical Infrastructure and Transport
MOUD	Ministry of Urban Development
MOWSS	Ministry of Water Supply and Sanitation
NAP	National Plan of Adaptation
NAPA	National Programme of Adaptation
NGI	Norwegian Geotechnical Institute
NHRA	Nepal Hazard Risk Assessment
NHSS	Nepal Health Sector Strategy
NHSSP	National Health Sector Support Programme
NNBC	Nepal National Building Code
PH	Primary Hospital
SH	Secondary Hospital
SSH	Specialized Service Hospital
TH	Tertiary Hospital
TWG	Thematic Working Group
UNFCC	United Nations Framework Convention on Climate Change
WASH	Water, Sanitation and Hygiene
WHO	World Health Organizations

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## EXECUTIVE SUMMARY

This report draws attention to climate change-induced hazard in relation to health infrastructure in Nepal. It is prepared by the Nepal Health Sector Support Programme Health Infrastructure Team, and highlights risks to health facilities and vulnerable groups. While information on climate change impact is not yet fully comprehensive, the reports uses publicly available data to categorize hazards and the number and type of facilities at risk. This data has been combined with Geographical Information System mapping and the Health Infrastructure information System platform.

The Government of Nepal is currently preparing the National Adaptation Plan for the climate change and the Ministry of Health leads the Thematic Working Group on public health. This provides an opportunity to raise the profile of the risks to health infrastructure and service delivery.

This report illustrates examples of hazards to health facilities and raises the need for an improved database and approach to strengthening resilience and sustainability.

In summary the report recommends the following actions:

- Raise the profile of climate change hazards with MOH and the new province and municipal structures through a series of briefings to senior management and politicians on risks to service delivery and health infrastructure investment.
- Undertake a condition and risk survey of health infrastructure.
- Review and consolidate relevant information sources on climate change and hazards scenarios to create an improved database for health infrastructure information and analysis.
- Liaise with the Thematic Working Group on Urban Settlements and Infrastructure of the National Adaptation Plan process to identify health infrastructure as a specific category of infrastructure vulnerable to climate change.
- Develop a Nepal Sustainable and Resilient Health Infrastructure Toolkit (based on the WHO and other relevant international experience) for dissemination of information and good practice in the development, retrofitting, operations and maintenance of health facilities.
- Mainstream GESI and LNOB principles and approaches as part of the sustainability and resilience work stream.

## PURPOSE OF THE REPORT

***The loss of a health care facility is more than a medical issue. It is a larger public health issue, a social and political issue, and an economic issue.***

Source: Safe Hospitals: A Collective Responsibility. Pan American Health Organization. 2005

This report provides an overview of climate change-induced hazard in relation to health infrastructure in Nepal. While the Government of Nepal has investigated high level risks from climate change to vulnerable groups, the environment and key economic sectors, the specific impact on and implications for the country's health infrastructure need to be further investigated. The report draws on publicly available data and identifies specific areas and categories of risk to health facilities. It identifies actions for consideration to improve the Ministry of Health's (MOH) approach to assessing and responding to risk to health infrastructure.

The report concludes with recommendations for action and areas for further investigation as a road map to developing a coherent set of policies and responses to climate change-induced hazards.

## CONSTRAINTS AND LIMITATIONS

- Secondary data from various reports and publications have been used to provide initial state of understating however detailed data production from survey and research on context of health facility and services are needed to portray more accurate findings.
- GLOF related data from ICIMOD has been derived from published document, however raw and full set of digital data could have yielded more specific outcomes.
- Flood inundation data from Nepal hazard risk assessment was derived from published document. The analysis could be more precise by using actual models and data used to create the report.
- Data related to the diseases have been majorly collected from the HMIS however data related to Japanese Encephalitis could not be sourced in its complete form.
- Hazard related data has been sourced from Desinventar and MoHA. Consolidated data to event level could have generated better results.
- Geo-features used in various analysis needs to be updated to reflect current state of existence.
- Study of Health facility in co-relation with climate change has not been carried out or reflected in any major research and government owned publications. Derivation of such a co-relation primarily using the secondary sources of information can only yield surface understanding in absence of concrete data pertaining to specific sector.



# 1 CONTEXT

## 1.1 Physiography

Nepal is particularly vulnerable to natural disasters and climate change-induced hazard. It has terrain that varies in altitude from the Himalaya (over 8 000m asl) to the Terai (less than 100m asl) over a north-south span of 150 kilometres. While the overall climate is categorised as 'sub-tropical monsoon climate' there are significant temperature and rainfall variations across the country.

The southeast monsoon takes place from June to September, and the westerly rainsfall from December to February which contribute to local variations in climate. The average annual rainfall is 1530 millimetres (mm), and rainfall generally increases with elevation up to 3 000m and then declines with elevation and latitude, and from east to west.

The collective impact of topography, variations in elevation, mountain rain shadows and the influence of the monsoon ensures that Nepal's climate is extremely complex and varied, and consequently vulnerable to global change and impacts (IDS et al, 2014)<sup>1</sup>.

The country is broadly divided into five physiographic regions, with a distinct altitude and climatic characteristics (See Table 1 below).

**Table 1 Nepal's Physiographic Regions**

Physiographic Regions	Ecological Belt	Climate	Coverage
High Himalaya	Mountain	Arctic/alpine	Almost always covered with snow: represents 24% of the area
High Mountains			South of the high Himalaya: represents 20% of the area
Middle Mountains	Hill	Cool/warm	Represents 30% of the area
Siwalik (Chure)	Terai	Tropical/sub-tropical	Represents 12% of the area
Terai (low lying plain areas)			The northern extension of the Indo-Gangetic plain: represents 14% of the area

Source: Adopted from MoPE 2017<sup>2</sup> and CBS 2016<sup>3</sup>

<sup>1</sup>IDS-Nepal, PAC and GCAP. (2014). *Economic Impact Assessment of Climate Change in Key Sectors in Nepal*. IDS-Nepal, Kathmandu, Nepal.

<sup>2</sup>MoPE. 2017. Synthesis of Stocktaking Report for National Adaptation Plan (NAP) Formulation process in Nepal. Ministry of Population and Environment, Kathmandu and NAPA, 2011

<sup>3</sup>CBS, 2017. National Climate Change Impact Survey 2016. *A Statistical Report*.

Central Bureau of Statistics, Kathmandu, Nepal

## 1.2 Overview of Climate Change and impact in Nepal

The Government of Nepal's Central Bureau of Statistics (CBS) has emphasised that climate change impacts are becoming increasingly visible, with the poorest and vulnerable people most at risk (CBS, 2016)<sup>4</sup>.

The WHO Climate and Health Country Profile for Nepal (2015) has modelled scenarios across the range of low to high emissions of greenhouse gases, and the impact upon the country's climate (See Box One)<sup>5</sup>.

Research by the Nepal Ministry of Population & Environment (MoPE) has predicted that change in different climatic variables has caused increased frequency of natural disasters, with more than 1.9 million people classified as 'highly vulnerable' and over 10 million people at risk<sup>6</sup>.

The International Institute for Environment & Development (IIED) has also pointed out that it diseases such as typhoid, cholera and other diarrheal disease are increasing in frequency in conditions of drought, flooding, and poor sanitation<sup>7</sup>

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<sup>4</sup>CBS, 2017. *National Climate Change Impact Survey 2016. A Statistical Report*.

Central Bureau of Statistics, Kathmandu, Nepal

<sup>5</sup>Climate Change and Health Country Profile-2015 Nepal, <http://www.who.int/globalchange/en>

<sup>6</sup> MoPE, 2012 IN FULL

<sup>7</sup> International Institute for Environment & Development (IIED), 2008.

### **Box One: WHO Climate & Health Country Profile for Nepal scenarios (2015)**

- **Mean annual temperature:** Under a high emissions scenario, mean annual temperature is projected to rise by about 6°C on average from 1990 to 2100. If emissions decrease rapidly, the temperature rise is limited to about 1.6°C.
- **Days of warm spell ('heat waves'):** Under a high emissions scenario, the number of days of warm spell is projected to increase from less than 20 days in 1990 to almost 245 days on average in 2100. If emissions decrease rapidly, the days of warm spell are limited to about 65 on average.
- **Days with extreme rainfall ('flood risk'):** Under a high emissions scenario, the number of days with very heavy precipitation (20 mm or more) could increase by about 6 days on average from 1990 to 2100, increasing the risk of floods. Some models indicate increases well outside the range of historical variability, implying even greater risk. If emissions decrease rapidly, the increase in risk is much reduced.
- **Consecutive dry days ('drought'):** Under a high emissions scenario, the longest dry spell is indicated to increase by about 14 days from an average of about 80–90 days, with continuing large year-to-year variability. If emissions decrease rapidly, the anticipated changes in the length of dry spells are somewhat less.

## **2 CLIMATE CHANGE POLICY INITIATIVES OF NEPAL**

This section summarises overall GON policy responses to climate change, and concludes with an examination of relevant initiatives on health infrastructure undertaken by the MOH sets out has been divide into two parts. First part is for the government initiatives on climate change in boarder aspect and second one for the health infrastructure related initiatives taken by the MOH.

### **National Level Initiatives**

#### **2.1 National Adaptation Plan of Action (NAPA) 2010**

NAPA is the first comprehensive document that the GON has prepared to respond to the threat of climate change. The MOH coordinated the thematic working group on public health, one of the main focus sectors, and identified a wide range of direct and indirect impacts on health through damage to infrastructure, degradation of water quality, and poor sanitation. The report recommended priority adaptation actions, although these did not include specific initiatives on health infrastructure:

- Strengthening health system
- Awareness raising and capacity building on climate change impacts
- Promotion of appropriate local adaptive knowledge
- Coordination among concerned stakeholders

- Integration of health impacts of climate change into broader development plans and related activities
- Research on climate change and health for evidence based planning

## **2.2 Nepal Climate Change Policy 2011**

The GON has approved the Climate Change Policy in January 2011. The policy puts forward programmes to adverse climate change impacts, improve livelihoods and encourage climate-friendly change. The major areas are as follows<sup>8</sup>:

- Climate adaptation and disaster risk reduction
- Low carbon development and climate resilience
- Access to financial resources and utilisation
- Capacity building, peoples' participation and empowerment
- Study and research on climate change related evidences for health infrastructure
- Technology development, transfer and utilisation
- Climate-friendly natural resources management

The overall goal is to improve livelihoods by mitigating and adapting to the adverse impacts of climate change, adopting a low-carbon emissions socio-economic development path, and to comply with national commitments and international agreements related to climate change.<sup>9</sup>

## **2.3 Climate Resilient Planning 2011**

The National Planning Commission (NPC) developed a climate resilient planning, a tool for long-term climate adaptation in March 2011. This is a framework document which guides the country in implementing development plans for sectors vulnerable to climate change threats, including natural resources, agriculture, biodiversity, infrastructure, water, disaster risks, poverty, environment and public health. The planning framework pays most attention to impacts and risks on infrastructure defined as transport, hydropower, irrigation, water supply and sanitation, housing and communications. Health infrastructure is not specifically identified.

## **2.4 National Framework on Local Adaptation Plans for Action (LAPA) 2011**

The GON endorsed the National Framework on Local Adaptation Plans for Action (LAPA) in order to implement NAPA priorities. The LAPA aims to integrate climate adaptation activities into local and national development planning processes. It promotes the use of vulnerability and adaptations assessment for all levels of governments, with guiding principles of:<sup>10</sup>

- Bottom-up planning process
- Inclusive planning

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<sup>8</sup>Nepal Climate Change Policy, January 2011, Ministry of Environment

<sup>9</sup>MoPE. 2017. Synthesis of Stocktaking Report for National Adaptation Plan (NAP) Formulation process in Nepal. Ministry of Population and Environment, Kathmandu

<sup>10</sup>GoN, 2011. National Framework on Local Adaptation Plans for Action. Government of Nepal, Ministry of Environment, Singhdurbar

- Responsible planning
- Flexibility

This approach has so far being piloted in 10 districts, although its wider roll-out has been stalled by the government restructuring associated with the implementation of the new federal system. The LAPA approach needs to be re-energised and implemented through the structure of new municipalities.

## **2.5 Nepal Development Vision 2030 (concept paper), 2011**

The concept paper developed by the NPC recognises the need for formulating climate-resilient plans, following a low carbon economic development pathway, and equipping policy-makers and practitioners with knowledge, tools, enabling policies and sustained funding to implement climate-resilient plans in order to build a climate-resilient society and economy.<sup>11</sup>

## **2.6 Climate Change Health Adaptation Strategies and Action Plans for Nepal (2016-2020)**

The strategies and action plans have the objectives of raising public awareness and generating evidences on the effects of climate change on health, managing risks of extreme climatic events and protecting human health from adverse effects of climate change.<sup>12</sup>

## **2.7 National Planning Commission Thirteenth Plan (2014-16)**

The 13<sup>th</sup> periodic plan of the Government of Nepal adopts the green development approach to reduce the impact and effect of climate change. It added the strategy in continuation to reduce the disaster risk, poverty alleviation and environmental motivation for climate change resilient development and sustainable conservation of natural resources. It focused on implementation of actions related to green design approach in all sectors of development. It also added the efforts on implementation of environment friendly and climate change resilient infrastructure.<sup>13</sup>

## **2.8 National Planning Commission Fourteenth Plan (2016-2018)**

The 14<sup>th</sup> development plan has focused on fulfilling the objective related to achieve sustainable development by environment protection, to reduce the pollution from rapid urbanization and to achieve climate change resilient development process through green development concept.<sup>14</sup>

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<sup>11</sup>MoPE. 2017. Synthesis of Stocktaking Report for National Adaptation Plan (NAP) Formulation process in Nepal. Ministry of Population and Environment, Kathmandu

<sup>12</sup>MoPE. 2017. Synthesis of Stocktaking Report for National Adaptation Plan (NAP) Formulation process in Nepal. Ministry of Population and Environment, Kathmandu

<sup>13</sup>13<sup>th</sup> development plan (2014-2016), National Planning Commission

<sup>14</sup>14<sup>th</sup> development plan (2016-2018), National Planning Commission



## 2.9 National Adaptation Plan (in development)

The NAPA aims to address the most urgent and immediate adaptations for climate change. It is supplemented by the medium and longer term perspective promoted by the National Adaptation Plan (NAP) which derives from the United Nations Framework Convention on Climate Change (COP-16) October 2016.

The objectives of NAP are as follows.<sup>15</sup>

- To reduce vulnerability to the impacts of climate change, by building adaptive capacity and resilience
- To facilitate the integration of climate change adaptation into relevant new and existing policies, programmes and activities, in particular development planning processes and strategies, within all relevant sectors and at different levels, as appropriate

The process of developing the Nepal NAP is currently underway, with the MOH coordinating a public health working group, which also includes the water, sanitation and health sector (WASH). The group has so far identified key measures to reduce vulnerability:

- Implement and improve basic public health measures such as provision of clean water and sanitation,
- Integrate the processes for making water safe from the planning phase to the implementation phase,
- Secure essential health care including vaccination and child health services
- Increase capacity for disaster preparedness and response, and alleviate poverty

The topic of climate change and health infrastructure has yet to be considered in detail by the group.

### Health and Health Infrastructure Strategy and Standards

The following section examines current standards and practice in Nepal health infrastructure development and maintenance in relation to aspects of climate change

## 2.10 Nepal Health Sector Strategy 2015-2020

The Nepal Health Sector Strategy (NHSS) is the primary instrument to guide the health sector over the period 2015-2020. The NHSS envisions a multi-sectoral response to climate change. It identifies increasing impacts on public health through the reduction in food production, diminishing water supply, and increase in temperature. Over the period to 2020 the NHSS focuses on building MoH's in-house competencies, improving impact data and evidence, and preparing more robust alleviation plans.

The NHSSP is preparing the current report as a contribution to this process, with an intention to strengthen information on climate change impacts and health infrastructure.

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<sup>15</sup>GoN/ Ministry of Population and Environment, Climate Change Management Division, October 2016 NAP approach paper

## 2.11 Nepal Health Infrastructure Development Guidelines 2017

The MoH with the support of NHSSP has adopted standard guidelines for design and construction of health infrastructure. This guideline provides benchmark designs and requirements of the different levels of health facilities. This guideline also provides information on land identification / selection, master planning, site planning and waste management. This guidelines also insist in disaster risk safety, management and preparedness by following the Nepal National Building Code 1994.<sup>16</sup>

The guidelines are comprehensive, and provide also guidance on site selection to avoid natural hazards and promote environmentally sustainable development, accessibility and upgrading.

An increase in climate change-induced hazards is a reality, along with the possibility of frequent extreme weather conditions. Consequently, the guidelines may need to be revisited to ensure that design and structural parameters, construction techniques and materials are within safe margins and performance for projected changes in climatic conditions.

## 3 CLIMATE CHANGE IMPACT AND ENVIRONMENTAL HAZARDS IN NEPAL

### 3.1 Climate change vulnerability mapping for Nepal

The Ministry of Environment (MOE) conducted a climate change vulnerability mapping exercise as part of the development of the NAPA. The exercise produced a breakdown of districts with their vulnerability to natural disasters including rainfall, flood, landslide, drought, Glacial Lake Outburst Flood (GLOF) was carried out (See Table 2 below).

**Table 2 District Ranks-Combined Multiple Risk / Exposure Index**

<b>Combined Risk/Exposure</b>	<b>Districts</b>
Very high	Udayapur, Ramechhap, Lamjung, Saptari, Bhaktapur, Okhaldhunga, Chitwan, Siraha, Dhading
High	Dolakha, Taplejung, Mahottari, Gorkha, Sunsari, Dhanusha, Khotang, Tanahu, Baglung, Solukhumbu, Panchthar, Bhojpur, Sankhuwasabha, Parbat,

<sup>16</sup>Standard guidelines for design and construction of health infrastructure, 2017, DFID-NHSSP/ Ministry of Health, Government of Nepal.

	Kathmandu, Manang, Jajarkot, Makwanpur, Myagdi
Moderate	Sindhuli, Dhankuta, Nawalparasi, Mustang, Parsa, Kaski, Terhathum, Dadeldhura, Rautahat, Dailekh, Darchula, Bara, Kalikot, Morang, Jumla, Bajahang, Achham
Low	Sarlahi, Humla, Kanchanpur, Kavrepalanchowk, Mugu, Baitadi, Jhapa, Nuwakot, Sindhupalchok, Salyan, Doti, Lalitpur, Kapilbastu, Ilam, Syanja, Gulmi, Bajura, Surkhet, Rasuwa, Arghakhanchi, Rolpa, Kailali
Very low	Dang, Banke, Rupandeh, Rukum, Dolpa, Bardiya, Pyuthan, Palpa

Source: Ministry of Environment (2010) Climate Change Vulnerability Mapping for Nepal<sup>17</sup>

The MOE then ranked the various districts in priority order for urgent interventions to address specific risks (see Table 3 below).

**Table 3 Prioritised Districts for adaptation planning**

Risk / Exposure	Prioritised districts for adaptation planning
Ecological	Mugu, Dolpa, Rukum, Achham, Rolpa Jajarkot
Landslide	Udayapur, Mugu, Lamjung, Darchula, Baglung, Rolpa
Flood	Mahottari, Rautahat, Chitwan, Parsa, Saptari, Siraha
Drought	Jajarkot, Mugu, Kalikot, Dailekh, Saptari, Achham, Siraha
GLOF	Dolakha, Solukhumbu, Manang, Mustang, Taplejung, Gorkha

Source: Ministry of Environment (2010) Climate Change Vulnerability Mapping for Nepal<sup>18</sup>

The importance of these vulnerability exercises is that they enable the identification of the number and type of health facilities in the high-risk districts. In turn, this points to priorities for investigation and planning to protect service delivery and public capital investment in these regions.

### 3.2 Nepal Hazard Risk Assessment (NHRA)

In 2010, Asian Disaster Preparedness Centre (ADPC), Norwegian Geotechnical Institute (NGI) and Centre for International Studies and Cooperation (CECI) conducted the Nepal Hazard assessment in support of the World Bank and Global Fund for Disaster Risk Reduction.

This study reviewed existing vulnerability and hazard reports, studies, analyses and assessments at the national and sub-national levels, and presented consolidated findings. It included hazards assessments of health infrastructure at risk from flood in six river valleys: the Kamala, Kankai, Bagmati, Rapti, Tinau, Babai and Narayani rivers considering flood inundations and flood water depth with respect to various return period scenarios.

<sup>17</sup> Ministry of Environment (2010) Climate Change Vulnerability Mapping for Nepal, Kathmandu, Nepal

<sup>18</sup> Ministry of Environment (2010), Climate Change vulnerability mapping for Nepal, Kathmandu Nepal

The exposure vulnerability and risk assessment has identified health sector as primarily affected sector due to flood hazards. The Exposure assessment for frequent (10 years) and extreme return (100 years) periods shows the following conclusions:<sup>19</sup>

### **Scenario for 10 year return period**

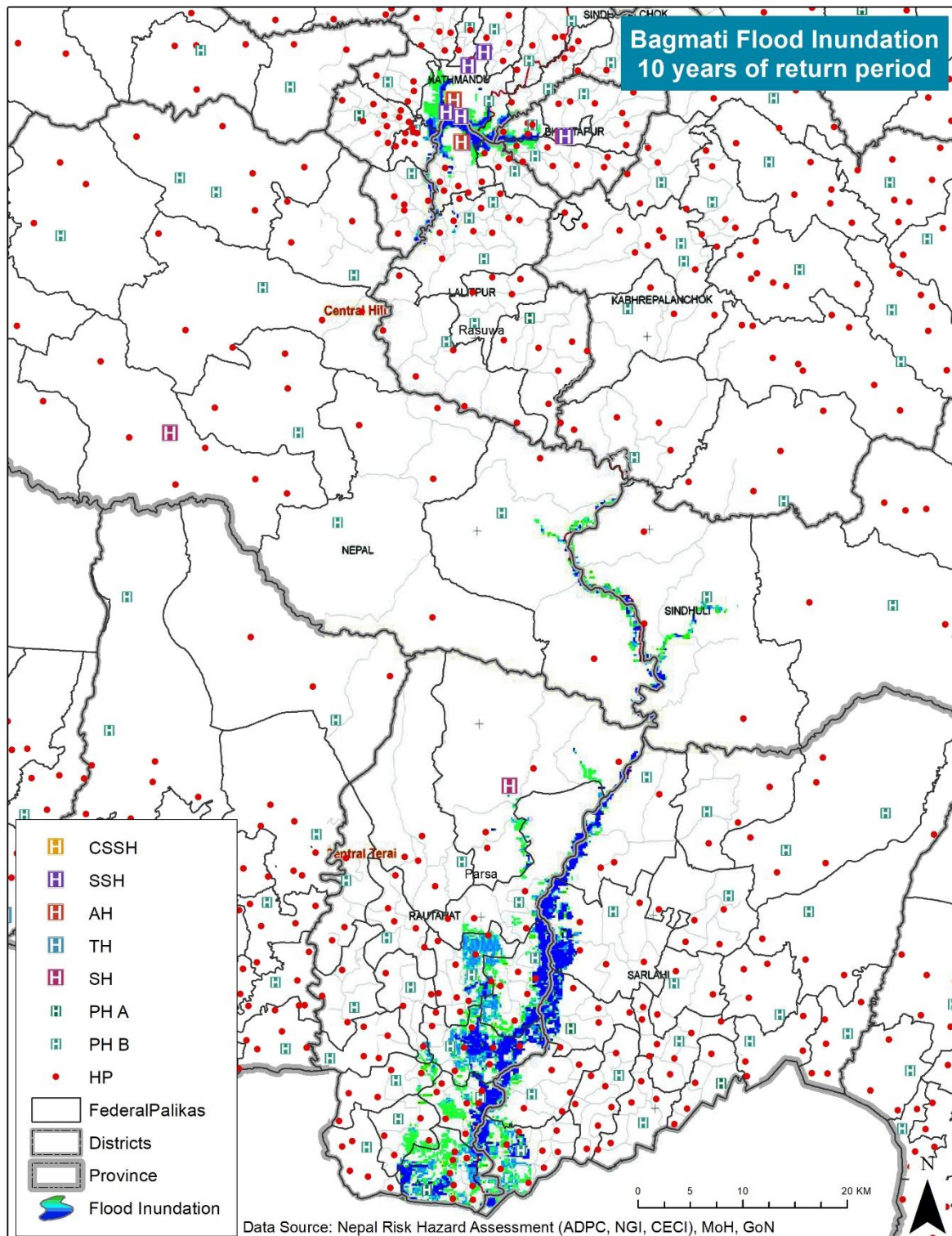
- Latipur, Kathmandu, Bhaktapur and Rautahat districts' health institutions are exposed to flooding from the Bagmati River, The percentage of health posts and hospitals affected by flooding ranges from approximately 13 to 100 percent.
- Health institutions of Jhapa district are exposed to flooding from the Kankai River. Approximately 3 percent of the health posts in this district are affected by flooding. No hospitals in this district are affected by flooding in this return period.
- Health institutions in Nawapalrasi are exposed to flooding from the Narayani River. Approximately 8 percent of the health posts in this district are affected by flooding. Hospitals are not affected by flooding in this district.
- Health institutions in Banke and Dang are exposed to flooding from the Rapti River. The percentage of health posts exposed to flooding is approximately percent. No hospitals are affected in this river basin.
- The health posts and hospitals in Babai, Kamala and Tinau River have hardly been affected by flooding.

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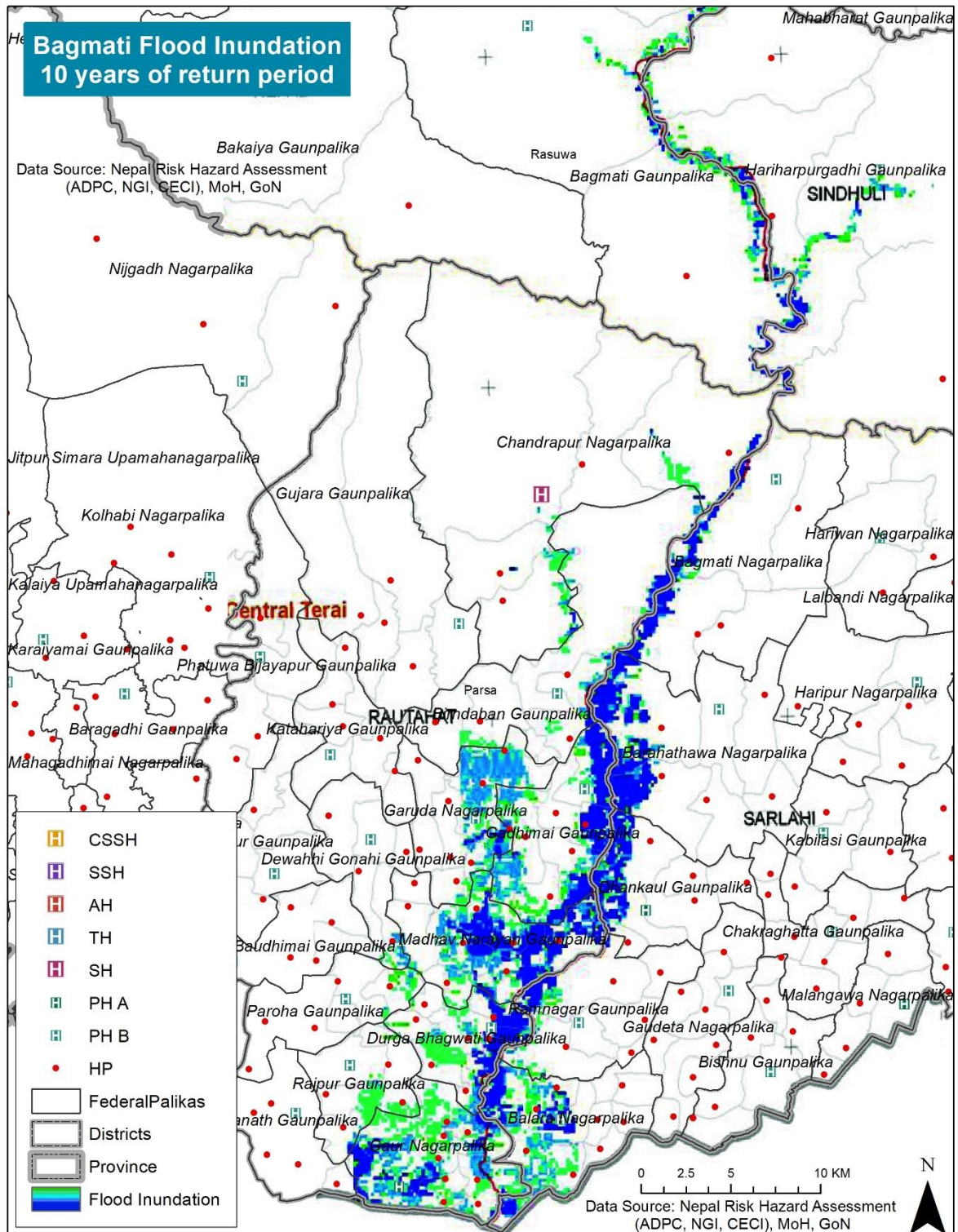
<sup>19</sup>Nepal Hazard Risk Assessment, 2010 ADPC, NGI, CECI.

The 10 years return period scenario of river under the study of NHRA has been mapped and overlaid with current federal structure of Nepal and Health Facility location as shown below:

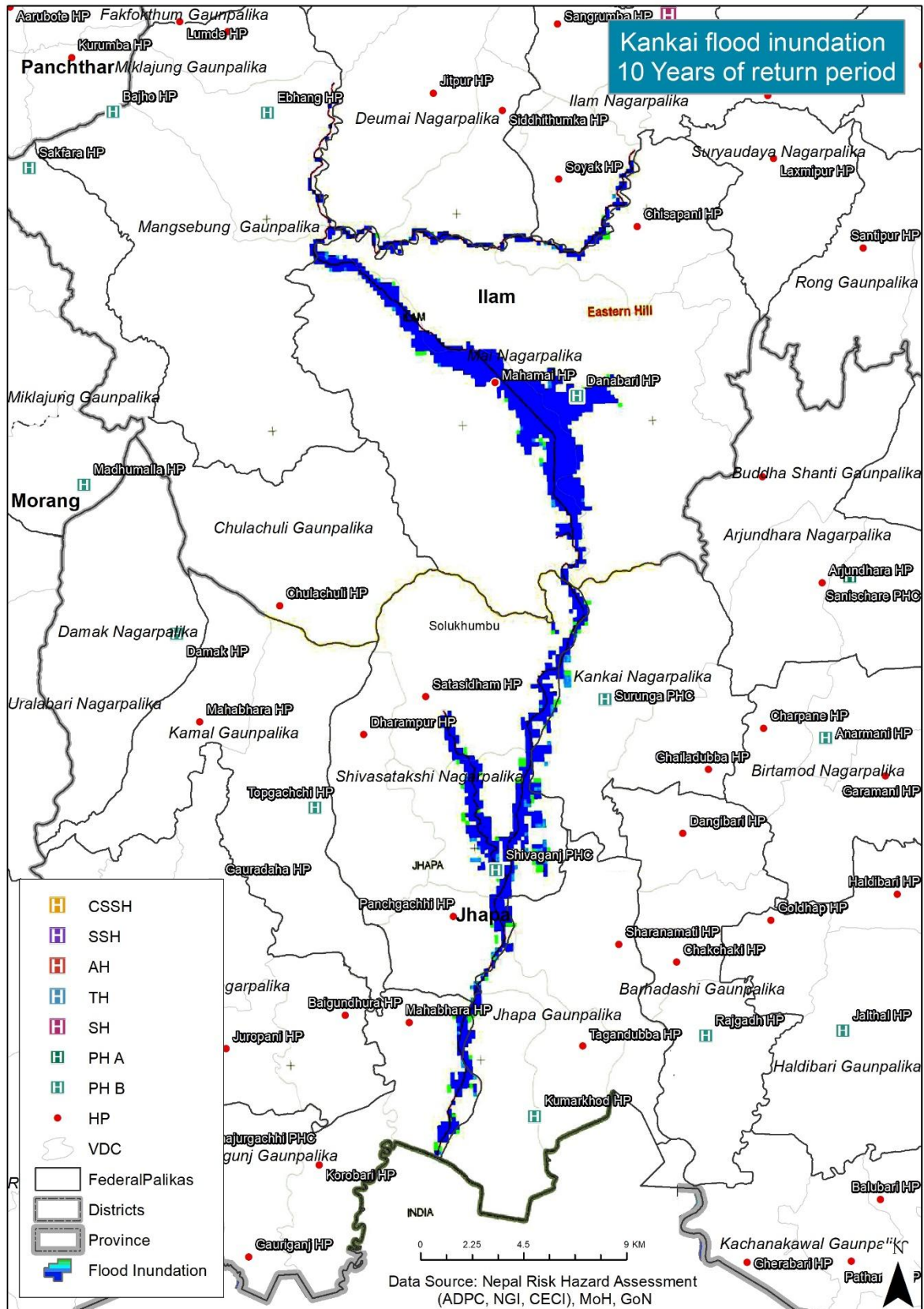
**Map 1: Bagmati River Flood Inundation scenario for 10 years of return period**



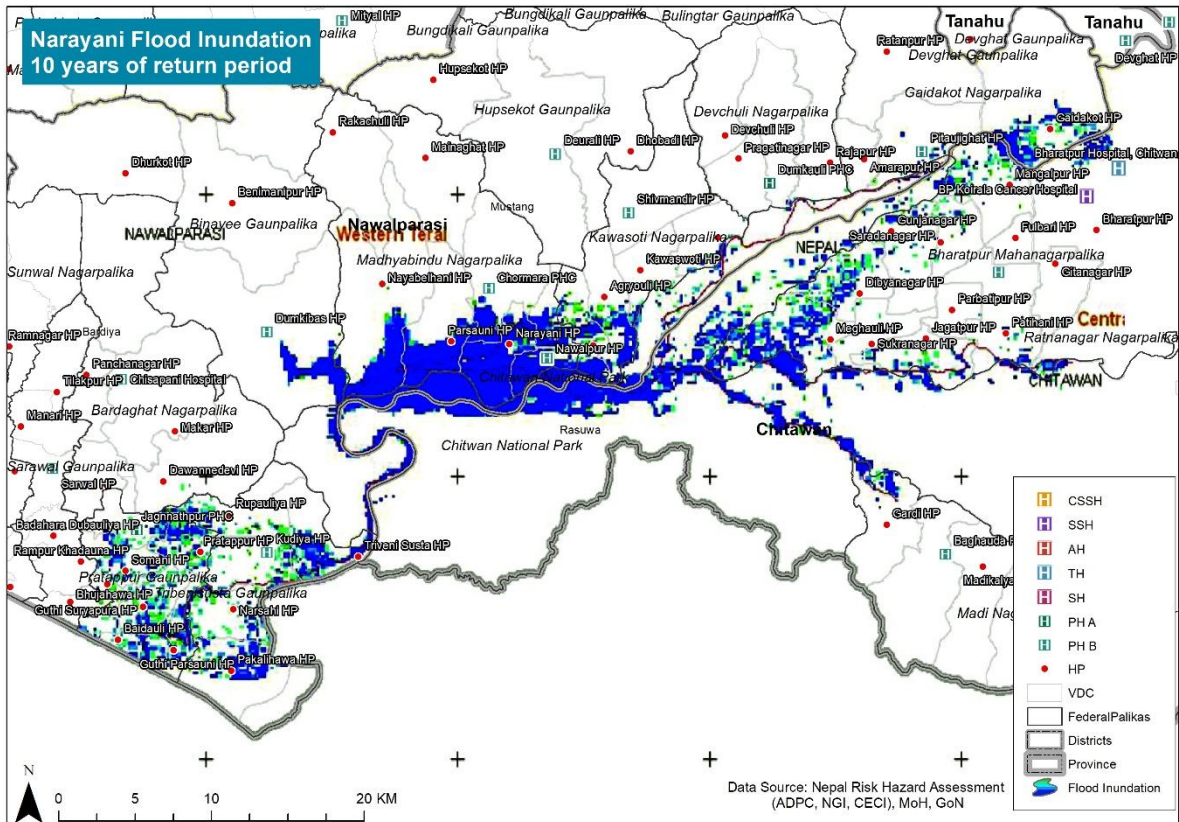
**Map 2: Bagmati River (Lower part) Flood Inundation scenario for 10 years of return period**



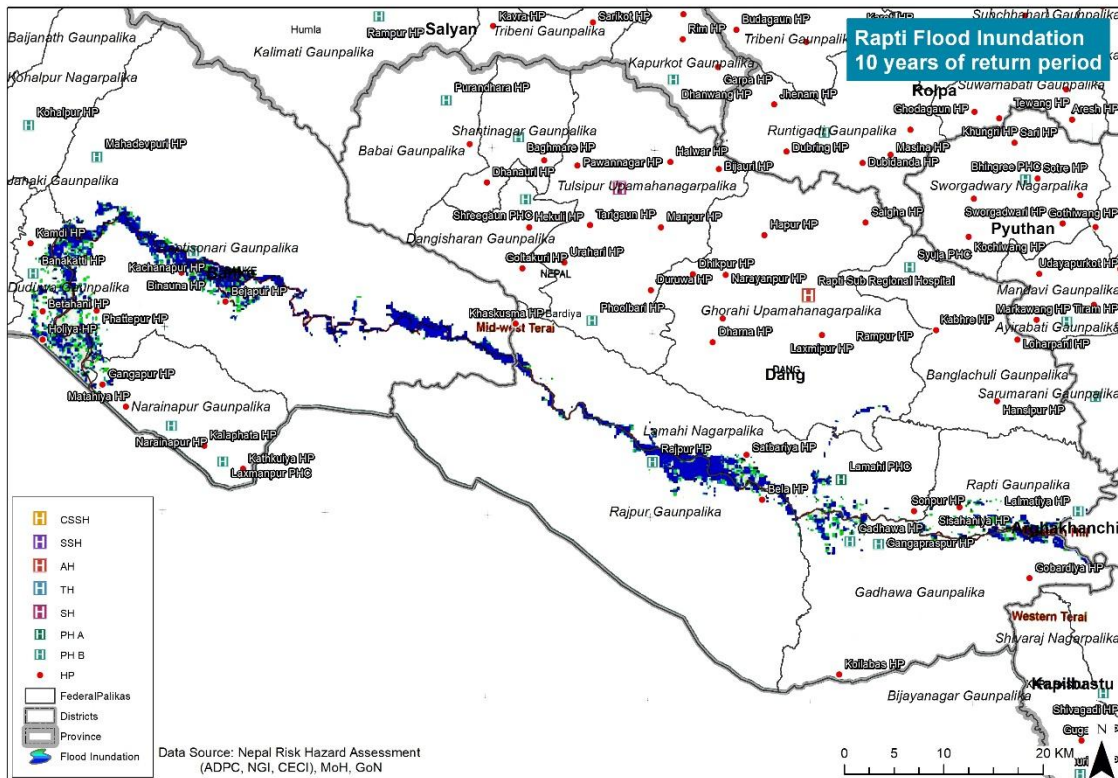
Map 3: Kankai River Flood Inundation scenario for 10 years of return period



**Map 4: Narayani River Flood Inundation scenario for 10 years of return period**

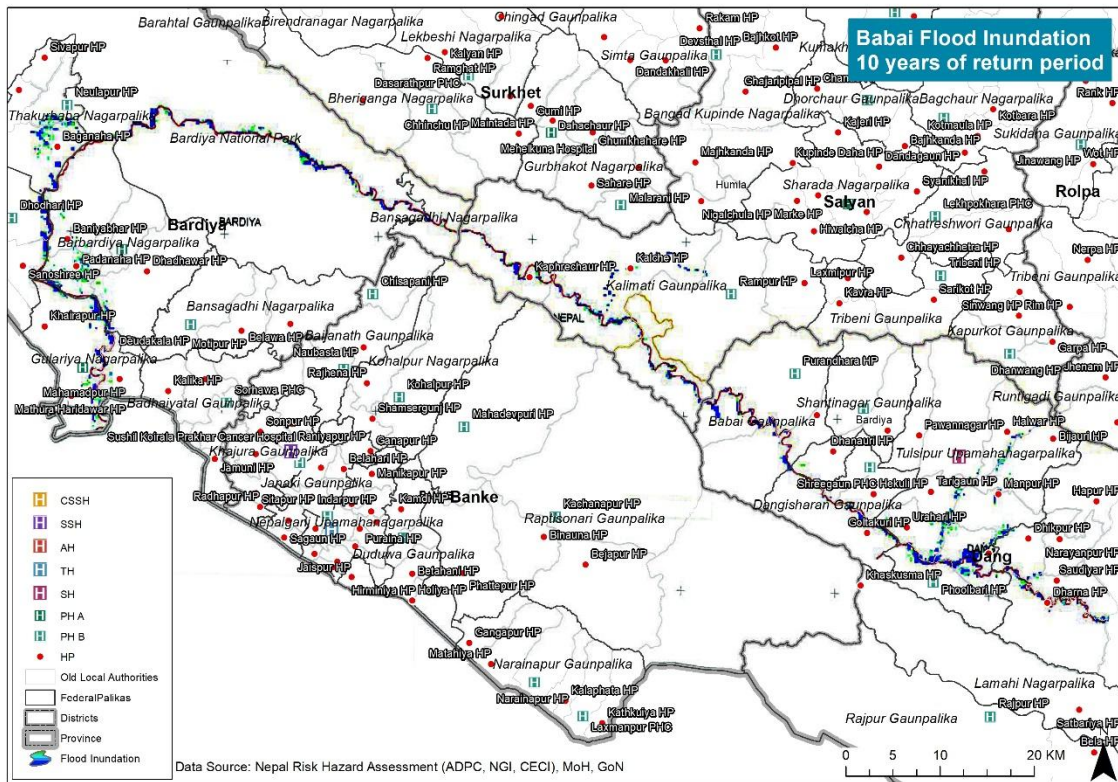


**Map 5: Rapti River Flood Inundation scenario for 10 years of return period**

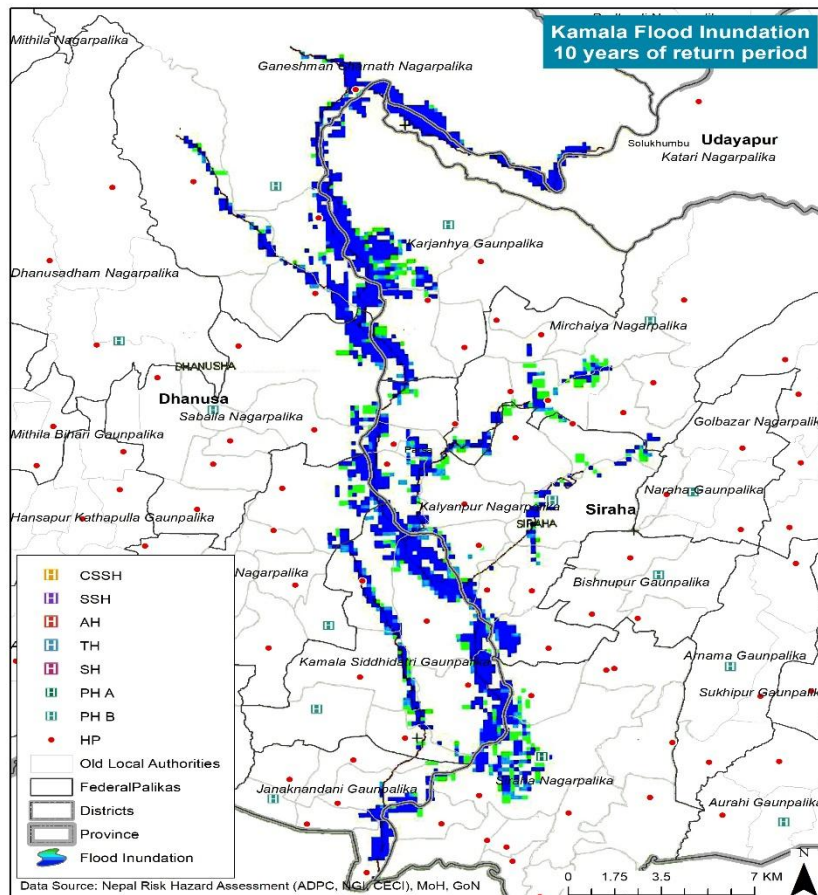




**Map 6: Babai River Flood Inundation scenario for 10 years of return period**



**Map 7: Kamala River Flood Inundation scenario for 10 years of return period**



## Scenario for 100 year return period

- Health institutions in Salyan are exposed to flooding from the Babai River. The percentage of health posts exposed to flooding is approximately 4 percent of the total number of health posts in this river basin.
- Health institutions in Latipur, Kathmandu, Bhaktapur and Rautahat are exposed to flooding from the Bagmati River. The percentage of health posts and hospitals affected by flooding varies from 9 to 100 percent.
- Health institutions in Siraha are exposed to flooding from the Kamala River. The percentage of health posts and hospitals affected by flooding varies from approximately 5 to 50 percent.
- Health institutions in Jhapa district are exposed to flooding from the Kankai River, The percentage of health posts and hospitals exposed to flooding varies from approximately 3 to 4percent.
- Health institutions in Nawapalrasi are exposed to flooding from the Narayani River, with approximately 17 percent of the health posts in this district are affected by flooding. Hospitals are not affected in this district.
- Health institutions in Banke and Dang are exposed to flooding from the Rapti River. Approximately 5 percent of the total number of health posts for this river basin would be affected. There are no hospitals affected in this river basin.
- Health institutions in Rupandehi are exposed to flooding from the Tinau River. 20 percent of the health posts in this district are affected by flooding. Hospitals are not affected by flooding in this district.

### 3.3 Climate Change and Disease Patterns

There is a wide range of evidence to demonstrate cause for concern over changes in pattern of vector-borne, waterborne and other climate sensitive diseases<sup>20</sup>. There are clear relationships between climate variables and spatial distributions of health threats including malaria, dengue fever, and Japanese encephalitis<sup>21</sup>. While changes in disease patterns are not a damage risk per se to health infrastructure, they have implications for service delivery and facility design.

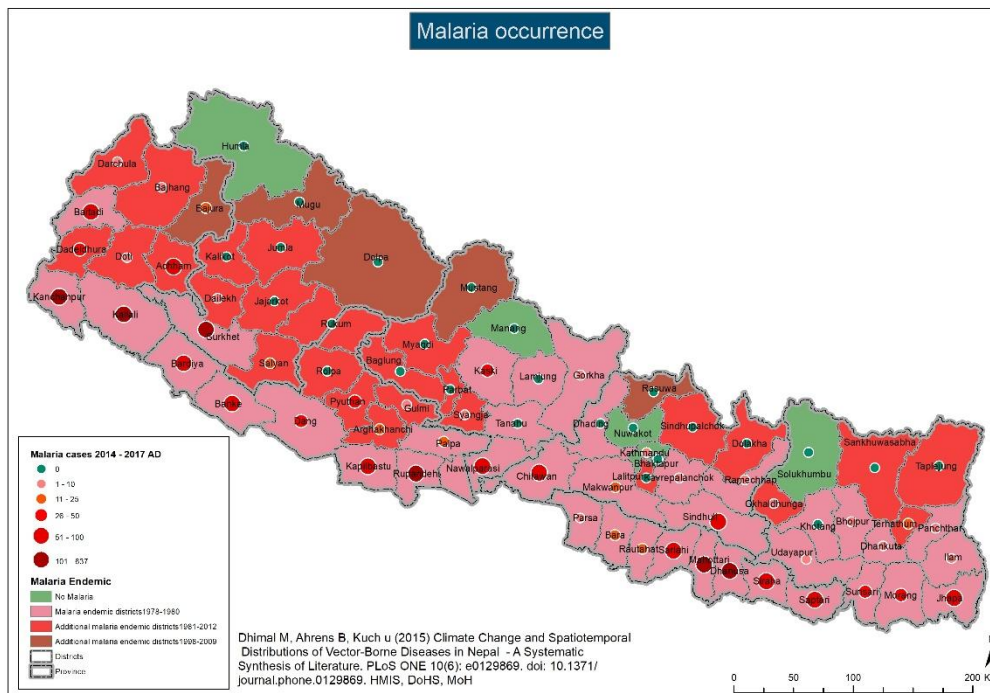
As Map 8 demonstrates, there has been a significant shift in the distribution of malaria. There were 44 malaria endemic districts earlier in 1978 to 1980. In between 1998 and 2009 there were five more districts which had malaria endemic. While during 1981 to 2012 there were 26 malaria endemic districts.

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<sup>20</sup>Dhimal M, Ahrens B, Kuch U (2015) Climate Change and Spatiotemporal Distributions of Vector-Borne Diseases in Nepal – A Systematic Synthesis of Literature. PLoS ONE 10(6): e0129869. doi:10.1371/journal.pone.0129869

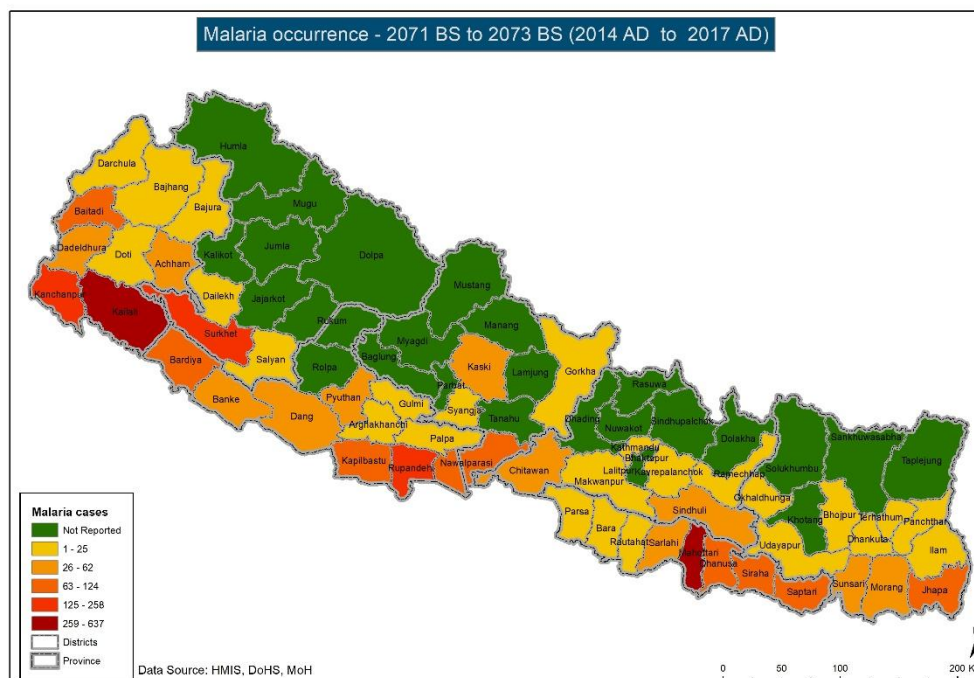
<sup>21</sup>Dhimal M, Dhimal ML, Pote-Shrestha RR, Groneberg DA, Kuch U. Health-sector responses to address the impacts of climate change in Nepal. WHO South-East Asia J Public Health. 2017;6(2):9–14.

**Map 8: Changes in Malaria Distribution 1978 to 2017**



Based on the data from HMIS as shown in map 9, it is seen that there are six districts which have reported more than 100 cases of malaria in between 2014 A.D to 2017 A.D (2071 B.S to 2073 B.S) where in Kailali district, Mahottari district reported maximum number of cases 637 and 534 respectively in between the period.

**Map 9: Malaria Case reported to HMIS from 2014 to 2017 AD**



Further diseases distribution maps are attached in **Annex One**.

#### **4 NHSSP HEALTH INFRASTRUCTURE HAZARD OVERVIEW**

The NHSSP Health Infrastructure team undertook an overview study to develop an initial assessment of districts that are highly vulnerable to climate-change induced hazards, particularly the physical risks to buildings. This information was drawn from four key sources:

- Hazards: the Ministry of Home Affairs Nepal Disaster Risk Reduction Portal
- Hazards: the UN Office for Disaster Risk Reduction (UNISDR) Disaster Information Management System (Desinventar)
- Infrastructure: the NHSSP Health Infrastructure Information System (HIIS)
- Site conditions: the NHSSP Detailed Engineering Assessment (34 districts only)

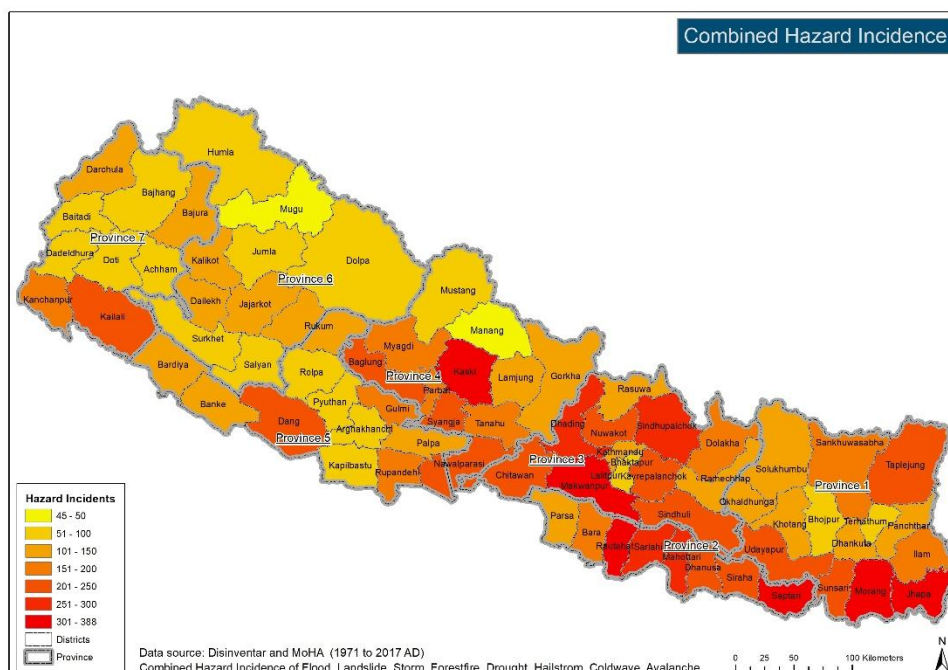
The GIS mapping of districts for different types of disaster has been overlaid with the existing health facilities to identify the exposure and risk level, and collated to provide an overall indication of public health infrastructure at risk.

The overview aims to provide a national picture, broken down into categories of the seven new provinces identified under the federal system. Base data however is still derived from the 75 pre-federal districts. Site conditions information is provided from the NHSSP Detailed Engineering Assessment, but this does not have national coverage.

## 4.1 Combined hazard incident mapping

Map 10 illustrates the combined distribution of natural disasters and extreme weather events that affect health infrastructure - landslides, floods, storm, drought, hailstorm, cold waves and avalanche.

**Map 10: Combined hazard incidence across Nepal**



Source: Hazard incidence from Desinventar and MOHA (DRR Portal), 2017<sup>22</sup> and HI information from HIIS, 2017.<sup>23</sup>

Unsurprisingly, given Nepal's topography and climate, there is a widespread distribution of hazards across all the new provinces, with highest combined incidence as follows:

<b>Province One:</b>	Jhapa, Morang	<b>Province Five:</b>	Dang, Nawalparasi (part)
<b>Province Two:</b>	Rautahat, Saptari	<b>Province Six:</b>	None in highest incidence category (Dialekh having greatest number of incidents)
<b>Province Three:</b>	Dhading, Makawanpur, Sindhupalchowk	<b>Province Seven:</b>	Kailali
<b>Province Four:</b>	Kaski, Syangja		

<sup>22</sup> <http://www.desinventar.net> , Disaster management information system powered by EU, UNSIDR and UNDP, 2017

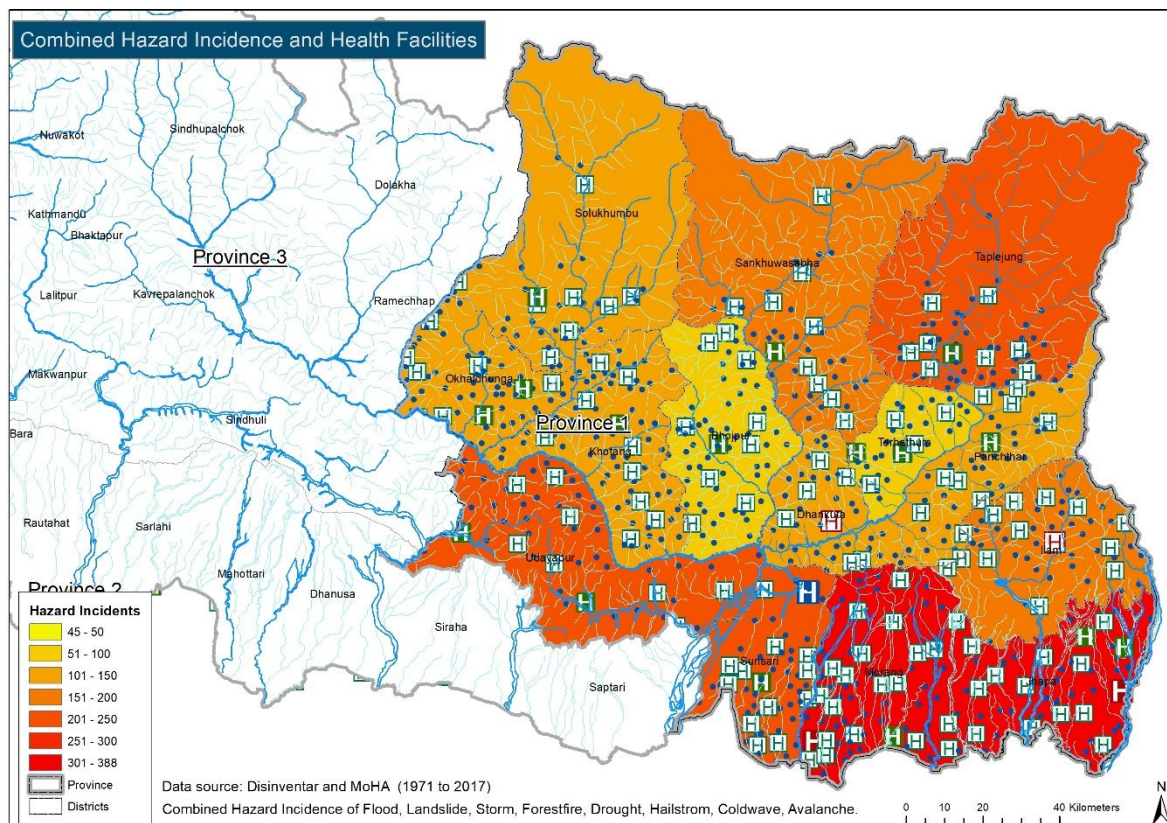
<sup>23</sup> Health Infrastructure information System, NHSSP/MOH, 2017

Note: Nawalparasi district has been divided between Province Four and Five.

## 4.2 Hazard and health facility distribution

The national combined hazard mapping can be further broken down by Province. The following maps depict the concentration of facilities in the highest risk districts.

**Map 11: Province One - combined hazard incidence and health facility overlay**



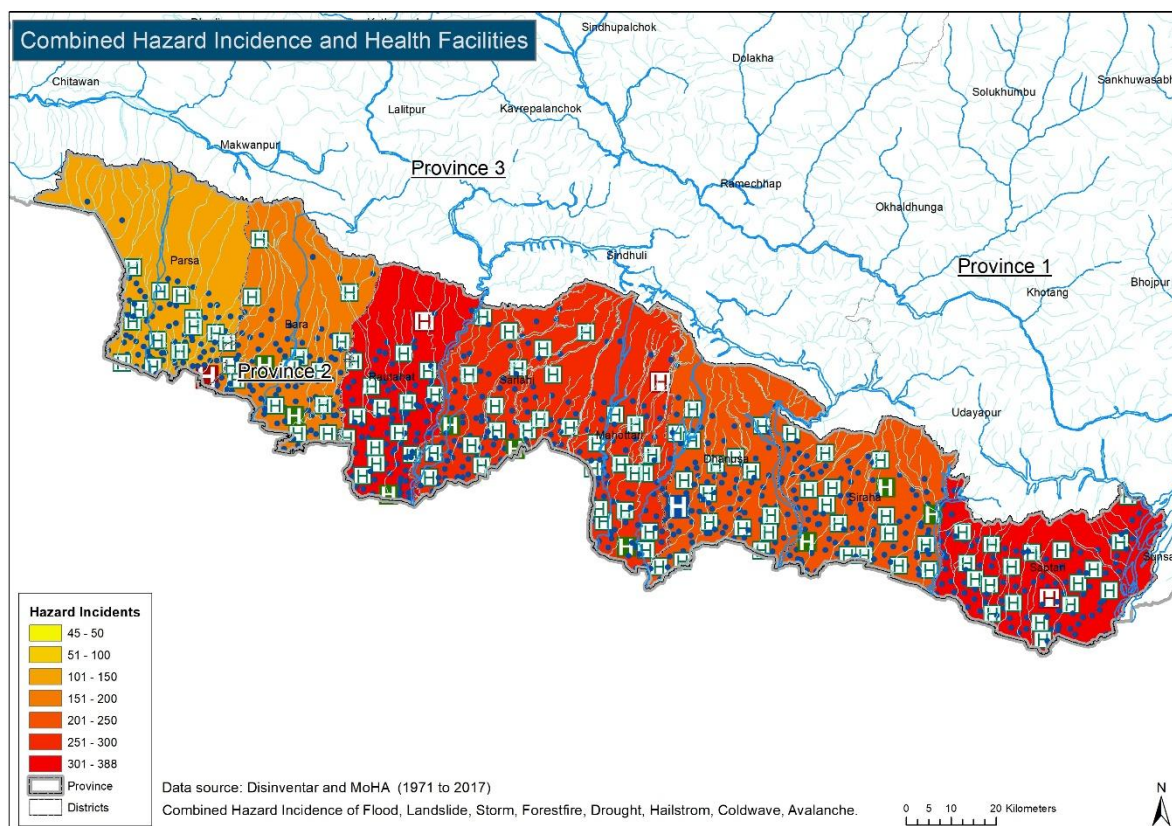
Source: Hazard incidence from Disinventar and MOHA (DRR Portal) 2017<sup>24</sup> and HI information from HIIS, 2017.<sup>25</sup>

There is a total of 704 health facilities in Province One, with flood risk in the Terai, as well as high hazard incidence in the north.

<sup>24</sup> <http://www.desinventar.net> , Disaster management information system powered by EU, UNSIDR and UNDP, 2017

<sup>25</sup> Health Infrastructure information System, NHSSP/MOH, 2017

**Map 12: Province Two - combined hazard incidence and health facility overlay**



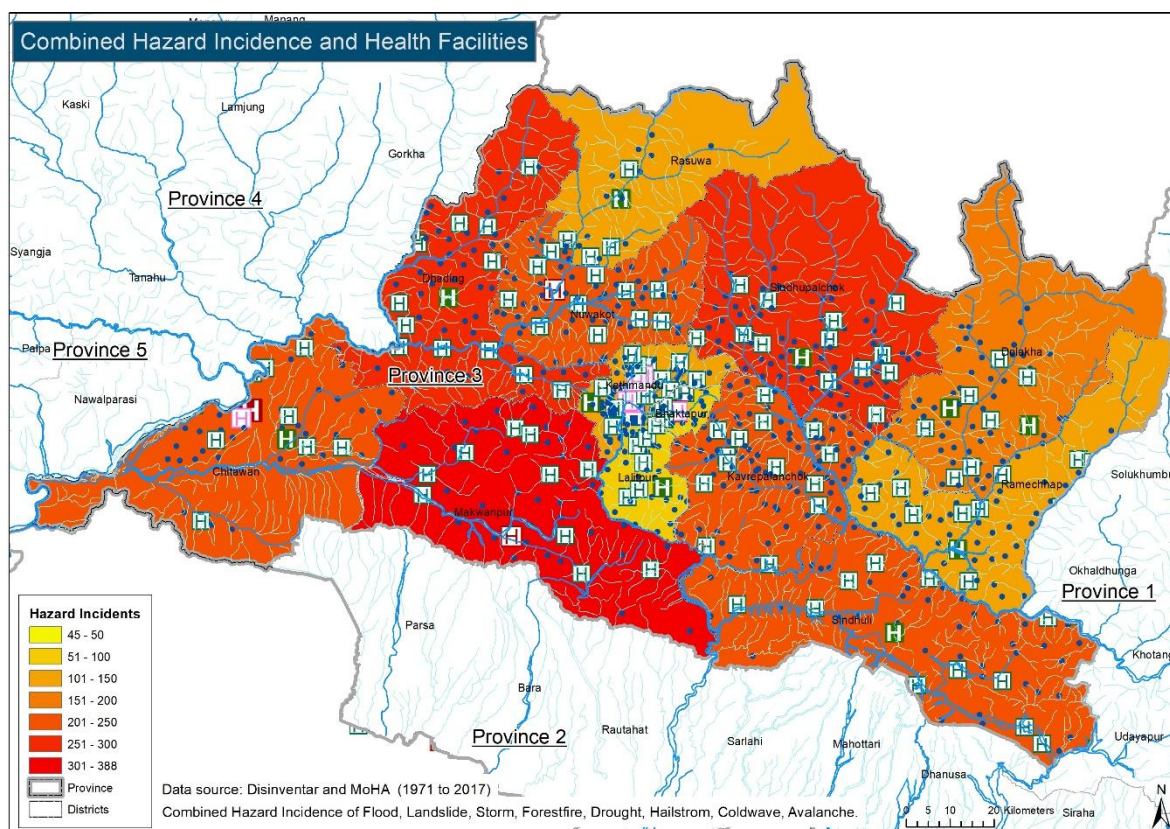
Source: Hazard incidence from Desinventar and MOHA (DRR Portal) 2017<sup>26</sup> and HI information from HIIS, 2017.<sup>27</sup>

Province Two has 799 health facilities – again, note the flood risk in the Terai, as shown by four Districts in the highest risk category.

<sup>26</sup> <http://www.desinventar.net> , Disaster management information system powered by EU, UNSIDR and UNDP, 2017

<sup>27</sup> Health Infrastructure information System, NHSSP/MOH, 2017

**Map 13: Province Three - combined hazard incidence and health facility overlay**



Source: Hazard incidence from Desinventar and MOHA (DRR Portal), 2017<sup>28</sup> and HI information from HIIS, 2017.<sup>29</sup>

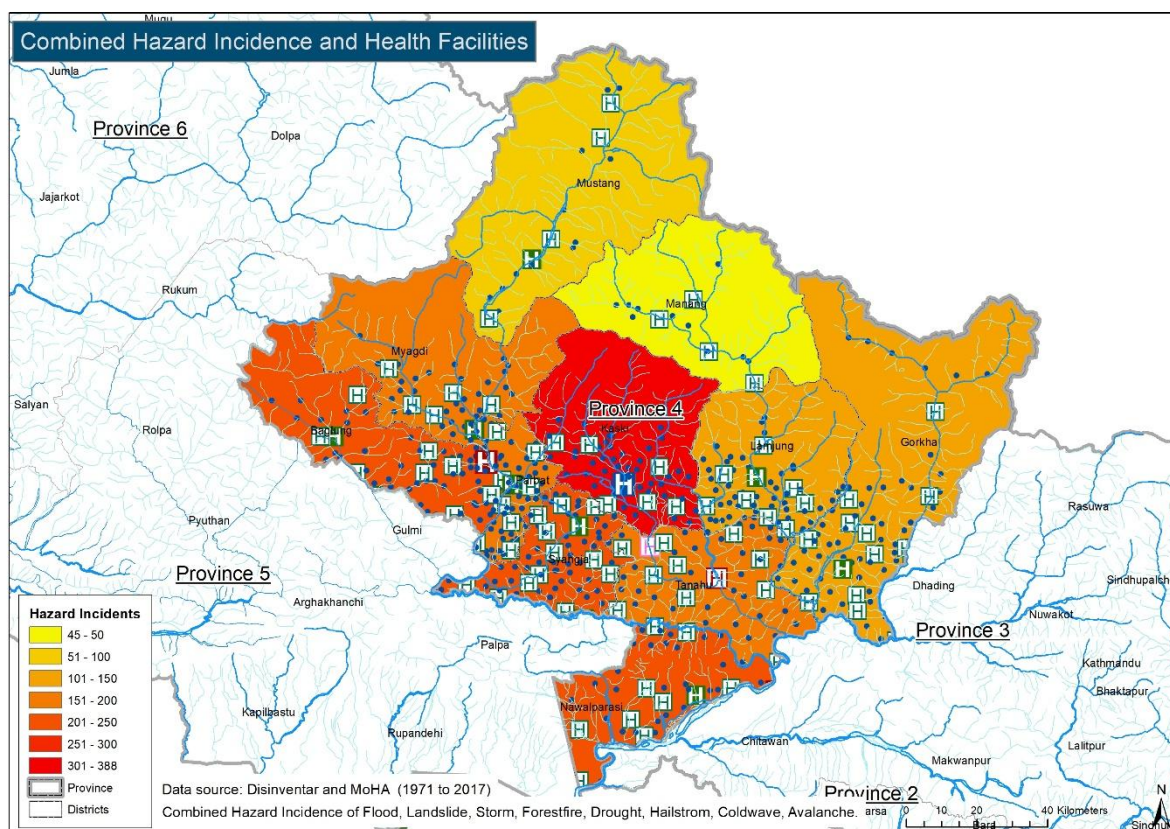
Province Three has a total of 706 health facilities, and three districts in the highest risk category.

<sup>28</sup> <http://www.desinventar.net> , Disaster management information system powered by EU, UNSIDR and UNDP, 2017

<sup>29</sup> Health Infrastructure information System, NHSSP/MOH, 2017



**Map 14: Province Four - combined hazard incidence and health facility overlay**



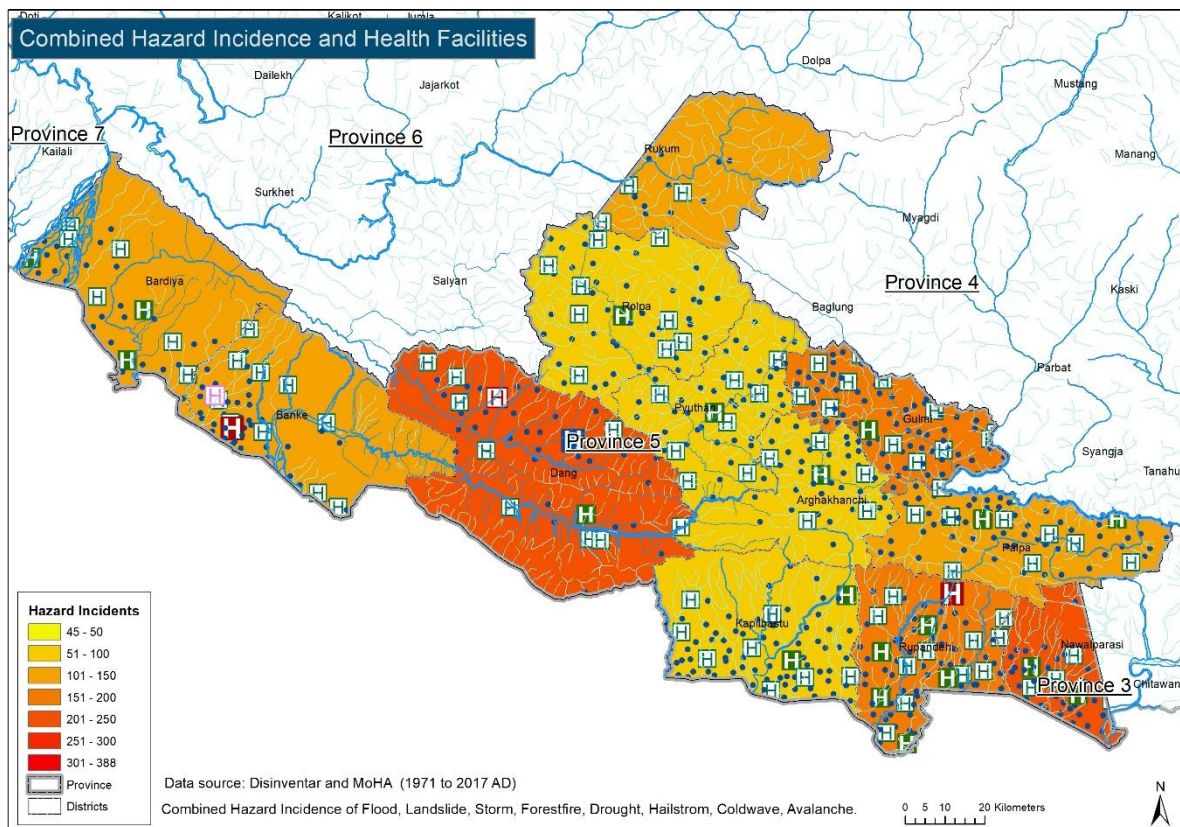
Source: Hazard incidence from Desinventar and MOHA (DRR Portal), 2017<sup>30</sup> and HI information from HIIS, 2017.<sup>31</sup>

There are 525 health facilities in Province Four, with Kaski District in the highest risk category.

<sup>30</sup> <http://www.desinventar.net> , Disaster management information system powered by EU, UNSIDR and UNDP, 2017

<sup>31</sup> Health Infrastructure information System, NHSSP/MOH, 2017

**Map 15: Province Five - combined hazard incidence and health facility overlay**



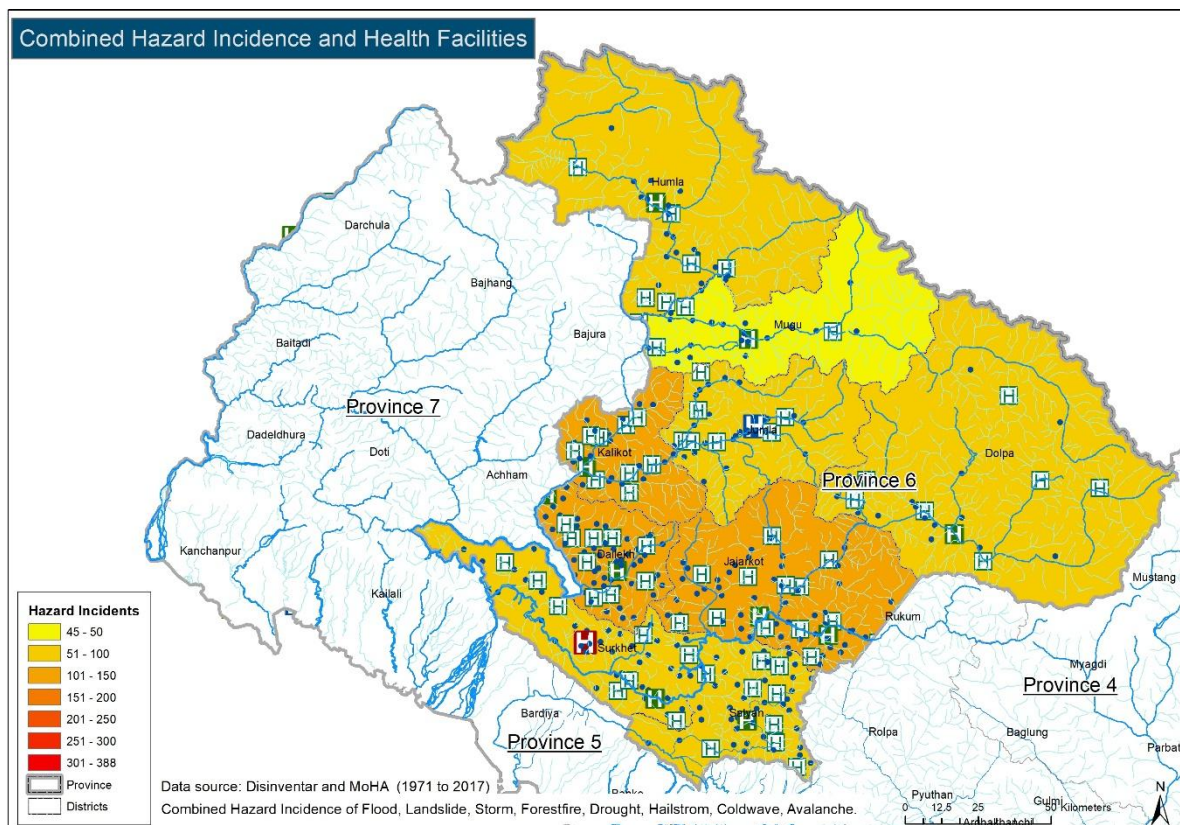
Source: Hazard incidence from Desinventar and MOHA (DRR Portal) 2017<sup>32</sup> and HI information from HIIS, 2017.<sup>33</sup>

There are 615 health facilities in Province Five – note the possibility of flood in the southern parts of the province. Nawalparasi district has been divided between Provinces Five and Six.

<sup>32</sup> <http://www.desinventar.net> , Disaster management information system powered by EU, UNSIDR and UNDP, 2017

<sup>33</sup> Health Infrastructure information System, NHSSP/MOH, 2017

**Map 16: Province Six - combined hazard incidence and health facility overlay**



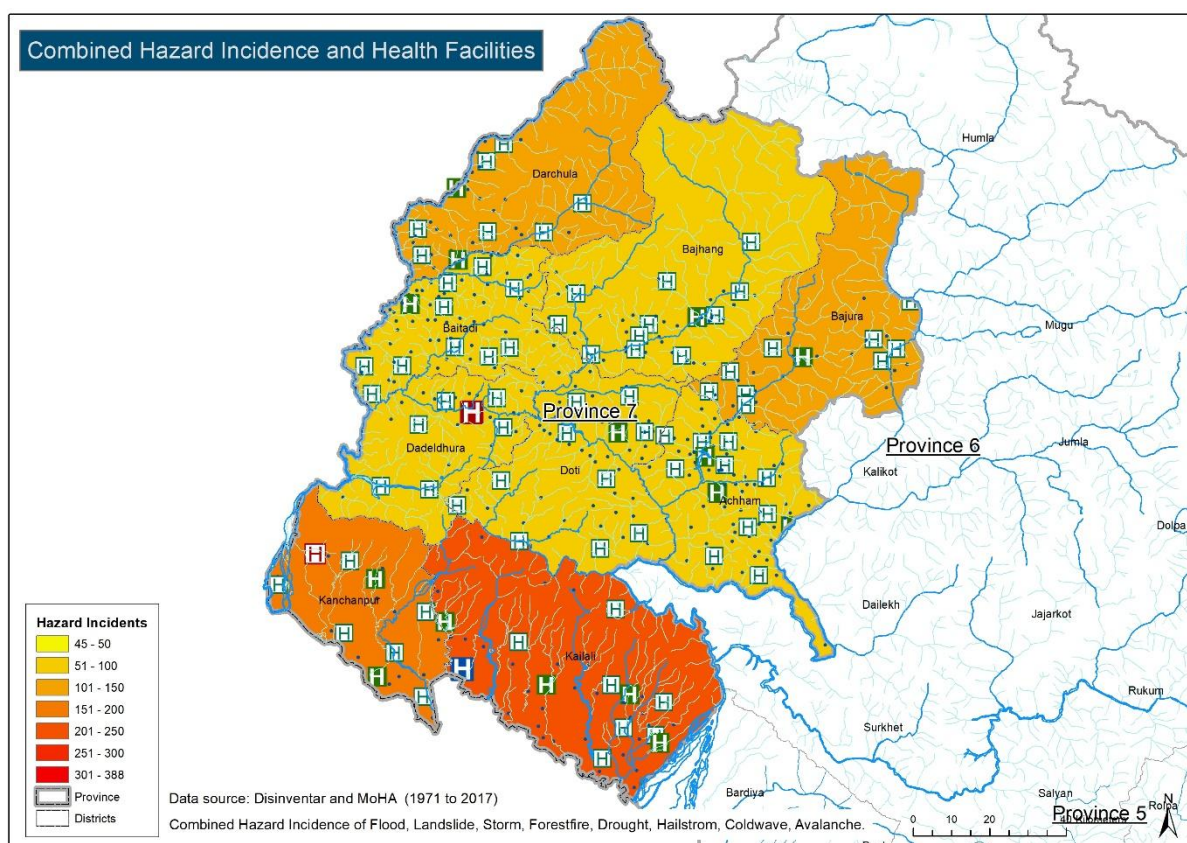
Source: Hazard incidence from Desinventar and MOHA (DRR portal), 2017<sup>34</sup> and HI information from HIIS, 2017.<sup>35</sup>

Province Six has 365 health facilities, and while it may not contain districts in the highest risk category, this analysis indicates that attention should be paid to infrastructure in Rukum and Dailekh districts.

<sup>34</sup> <http://www.desinventar.net> , Disaster management information system powered by EU, UNSIDR and UNDP, 2017

<sup>35</sup> Health Infrastructure information System, NHSSP/MOH, 2017

**Map 17: Province Seven - combined hazard incidence and health facility overlay**



Source: Hazard incidence from Desinventar and MOHA (DRR Portal), 2017<sup>36</sup> and HI information from HIIS, 2017.<sup>37</sup>

Province Seven has 404 health facilities –note the possibility of flood in the southern areas.

## 5 SPECIFIC HAZARDS TO HEALTH INFRASTRUCTURE

### 5.1 Glacial Lake Outburst Floods

Glacial Lakes Outburst Floods (GLOF) are a highly destructive disaster event associated with the build-up and rapid collapse of glacial meltwater dams. Rising temperatures (as described in Section Three above) are accelerating the rate of glacier melt, and the subsequent risk of GLOFs. The drainage lines downstream from the glacial lake are at risk from any GLOF event, which threatens lives, property and infrastructure in its catchment.

There are currently 20 lakes in Nepal identified as high GLOF risks. To illustrate the potential impact on health infrastructure, the following section describes the risk scenario for the Tsho-Rolpa Lake, located in Dolakha district (Province Three) and Imja-Tsho Lake, located in Solukhumbu district (Province One)

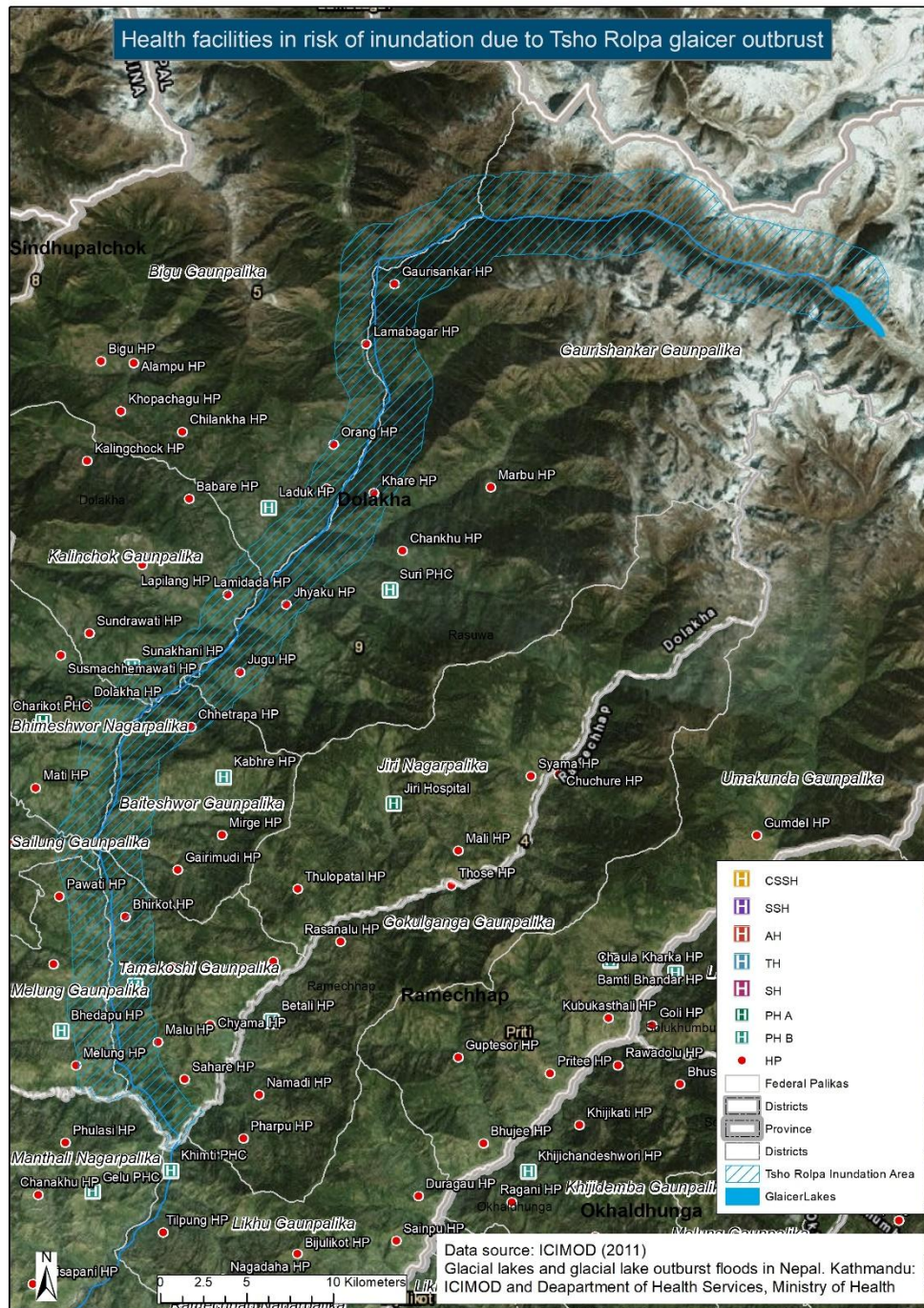
<sup>36</sup> <http://www.desinventar.net> , Disaster management information system powered by EU, UNSIDR and UNDP, 2017

<sup>37</sup> Health Infrastructure information System, NHSSP/MOH

## GLOF case study for Tsho-Rolpa and Imja – Tsho

The International Centre for Integrated Mountain Development (ICIMOD) modelled the potential flood inundation for a GLOF for few critical glaciers lakes in 2011 including Tsho-Rolpa and Imja-Tsho (see Map 18 and 19 below)<sup>38</sup>.

**Map 18: The Tsho-Rolpa GLOF projection and health facilities**



<sup>38</sup> ICIMOD (2011) Glacial lakes and glacial lake outburst floods in Nepal, 2017

Source: ICIMOD (2011) Glacial lakes and glacial lake outburst floods in Nepal<sup>39</sup> health infrastructure overlaid from HIIS, 2017<sup>40</sup>

The graphical outputs of the ICIMOD 2011, Glacial lakes and glacial lake outburst floods in Nepal concerning Tsho-Rolpa outburst inundations as presented in the report has been digitized and overlaid with the HI information from HIIS. This analysis shows that 17 health facilities downstream to Melung Gaunpalika (in the stretch of approximately 80 K.M from the lake to Melung), comprising 15 health posts and two health posts scheduled to be upgraded to public hospitals (See Table 4 below) are in risk of inundation.

Further modelling of the effects of the GLOF would be necessary to assess the risk to facilities downstream from Melung.

Alongside the possible calamity to health service provision to the serviced and catchment populations, the economic consequences if all 17 health posts were to be lost would also be enormous. The replacement construction cost of a Type 4 HP of at least 218 sq m is about NPR 50 000 per sq m. The total cost would be approximately NPR 185 393 500 (around £1.35 million at current rates).

**Table 4:Tsho-Rolpa GLOF projection and health facilities affected in Dolakha**

Health Facility	Total Population	Service Population	Catchment Population
Bhedapu HP	36 242	4 586	8 543
Bhirkot HP	2 788	2 664	2 695
Bulung HP	936	743	807
Chhetrapa HP	2 380	2 225	2 302
Gaurisankar HP	398	398	398
Japhe HP	37 647	3 615	8 477
Jhyaku HP	2 965	2 811	2 888
Jugu HP	2 640	2 484	2 562
Khare HP	938	482	596
Lamabagar HP	680	680	680
Lamidada HP	3 661	3 507	3 584
Malu HP	4 119	1 986	2 519
Melung HP	3 089	3 089	3 089
Namdu HP	3 954	3 612	3 783
Orang HP	1 825	1 659	1 715
Pawati HP	4 524	4 065	4 157

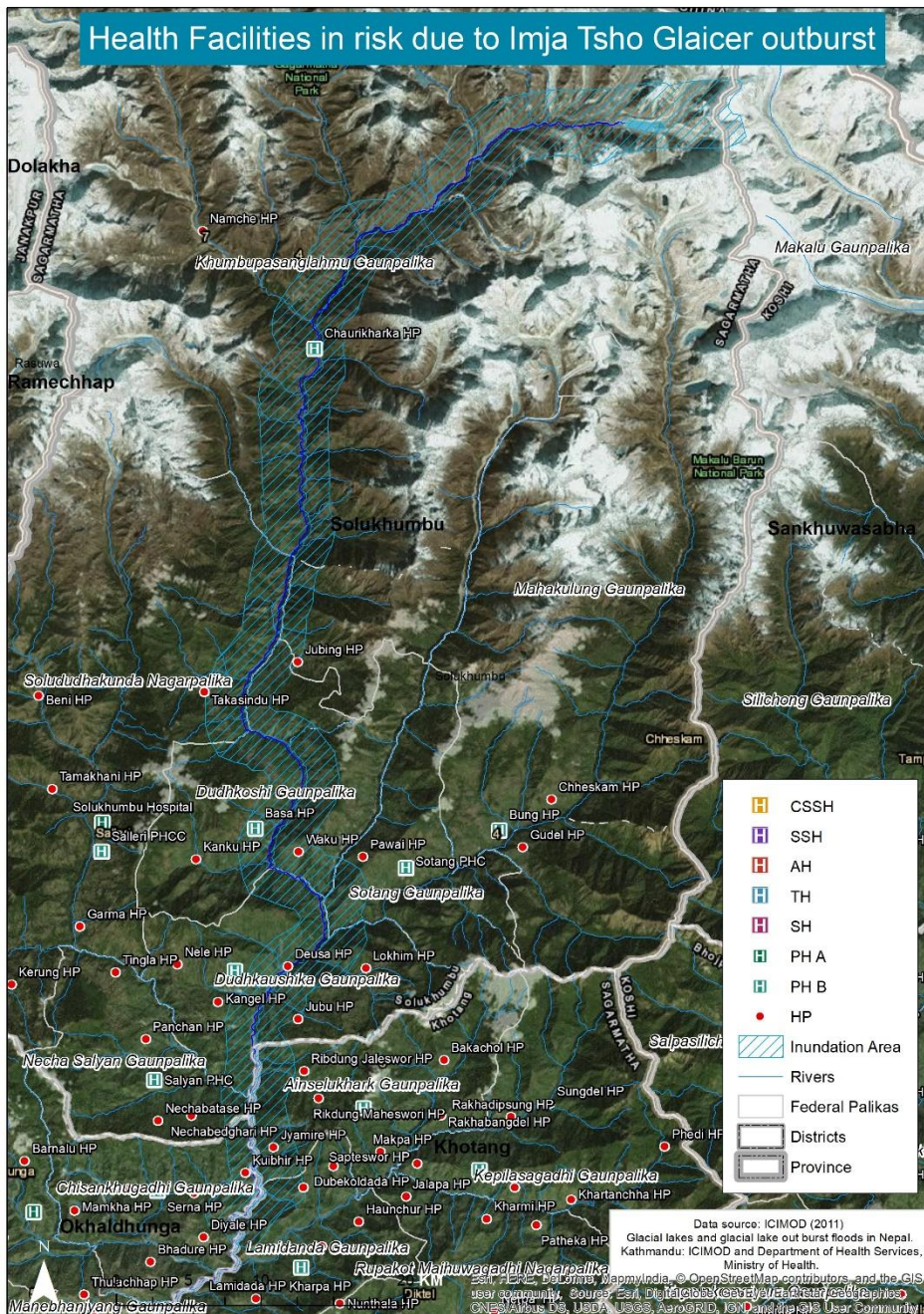
<sup>39</sup> ICIMOD (2011) Glacial lakes and glacial lake outburst floods in Nepal

<sup>40</sup> Health Infrastructure information System, NHSSP/MOH, 2017

Sahare HP	2 934	1 164	1 607
<b>17 Health Posts</b>	<b>111 720</b>	<b>39 770</b>	<b>50 402</b>

Source: Health infrastructure information from HIIS, 2017.<sup>41</sup>

**Map 19: The Imja-Tsho GLOF projection and health facilities**



Source: ICIMOD (2011) Glacial lakes and glacial lake outburst floods in Nepal<sup>42</sup> health infrastructure overlaid from HIIS, 2017<sup>43</sup>

<sup>41</sup> Health Infrastructure information System, NHSSP/MOH, 2017

<sup>42</sup> ICIMOD (2011) Glacial lakes and glacial lake outburst floods in Nepal

The graphical outputs of the ICIMOD 2011, Glacial lakes and glacial lake outburst floods in Nepal concerning Imja-Tsho outburst inundations as presented in the report has been digitized and overlaid with the HI information from HHS. This analysis shows that 14 health facilities downstream to Lamidanda Gaunpalika, Khotang(in the stretch of approximately 100 K.M from the lake to Lamidanda ), comprising 12 health posts and Two health posts scheduled to be upgraded to public hospitals (See Table 5 below) are in risk of inundation.

Further modelling of the effects of the GLOF would be necessary to assess the risk to facilities downstream from Lamidanda Gaunpalika.

Alongside the possible calamity to health service provision to the serviced and catchment populations, the economic consequences if all 14 health posts were to be lost would also be enormous. The replacement construction cost of a Type 4 HP of at least 218 sq m is about NPR 50 000 per sq m. The total cost would be approximately NPR 152600000 (around £1.1 million at current rates).

**Table 5:Imja-Tsho GLOF projection and health facilities affected in Solukhumbu**

District	Health facility	Palika Name	Category	Total Population	Service Population	Catchment Population
Khotang	Dumre Dharapani HP	Lamidanda Gaunpalika	Type 4 HP	1686	832	1003
Khotang	Jyamire HP	Ainselukhark Gaunpalika	Type 4 HP	1307	747	887
Khotang	Ribdung Jaleswor HP	Ainselukhark Gaunpalika	Type 4 HP	1318	675	889
Okhaldhunga	Kuibhir HP	Chisankhugadhi Gaunpalika	Type 4 HP	1781	1108	1276
Solukhumbu	Basa HP	Dudhkoshi Gaunpalika	PHType B 3	14301	5890	7573
Solukhumbu	Chaurikharka HP	Khumbupasanglahmu Gaunpalika	PH Type B 3	2368	2368	2368
Solukhumbu	Deusa HP	Dudhkaushika Gaunpalika	Type 4 HP	2275	2135	2205
Solukhumbu	Jubing HP	Khumbupasanglahmu Gaunpalika	Type 4 HP	1588	1588	1588
Solukhumbu	Jubu HP	Dudhkaushika Gaunpalika	Type 4 HP	1544	1404	1451
Solukhumbu	Khumjung HP	Khumbupasanglahmu Gaunpalika	Type 4 HP	160	160	160
Solukhumbu	Lokhim HP	Dudhkaushika Gaunpalika	Type 4 HP	2534	2534	2534
Solukhumbu	Pawai HP	Sotang Gaunpalika	Type 4 HP	1311	1311	1311
Solukhumbu	Takasindu HP	Solududhakunda Nagarpalika	Type 4 HP	768	768	768

<sup>43</sup> Health Infrastructure information System, NHSSP/MOH, 2017



Solukhumbu	Waku HP	Dudhkoshi Gaunpalika	Type 4 HP	897	897	897
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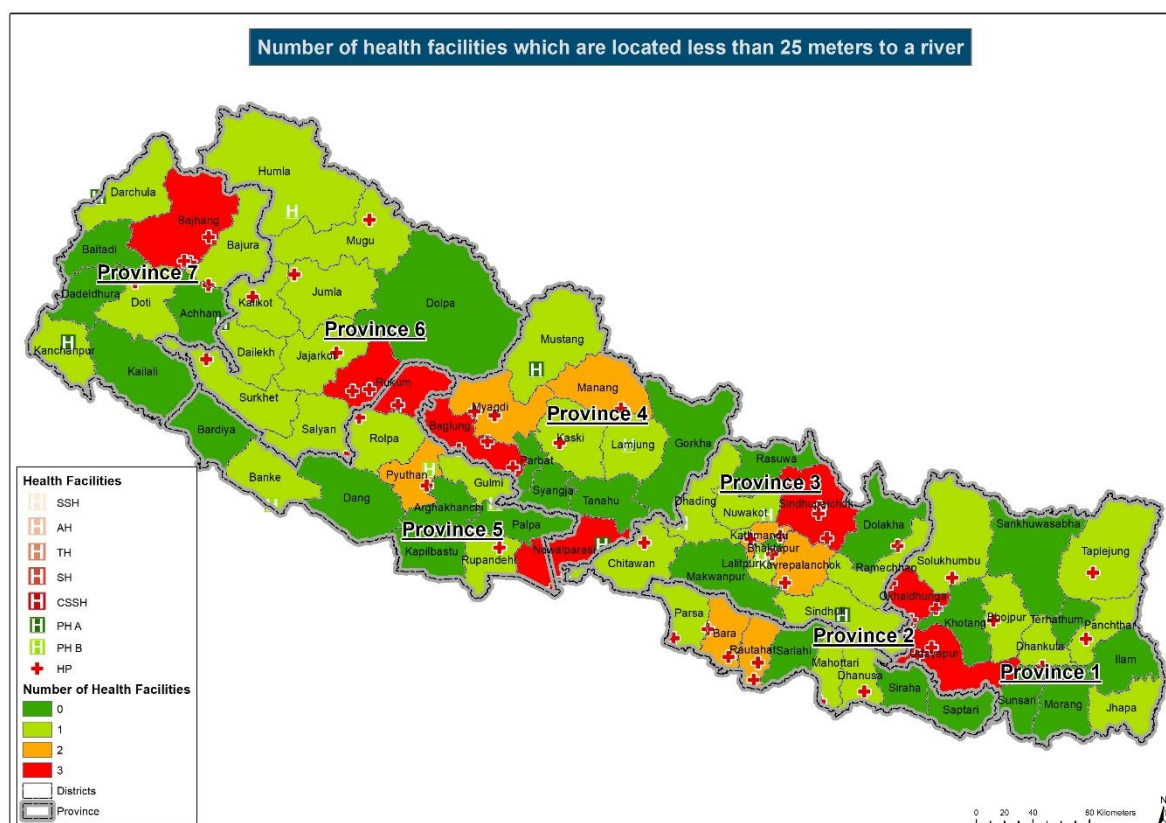
Source: Health infrastructure information from HIIS, 2017.<sup>44</sup>

## 5.2 Floods

The NHSSP Health Infrastructure team has identified health facilities within 25m of rivers as a first filter to discover infrastructure that may be subject to floods. The rivers used for this analysis are order 3 and order 2 rivers (big rivers). The HIIS provides geo-locations of facilities within the 25m catchment, although site elevations above the river levels have not yet been analysed (see Map 20 below).

Further overlays – for example, at smaller or greater distances – could be run for different sections of the river course.

**Map 20: Health facilities within 25m of a river**



Source: Hazard incidence from Desinventar and MOHA (DRR Portal), 2017<sup>45</sup> and HI information from HIIS, 2017.<sup>46</sup>

<sup>44</sup> Health Infrastructure information System, NHSSP/MOH, 2017

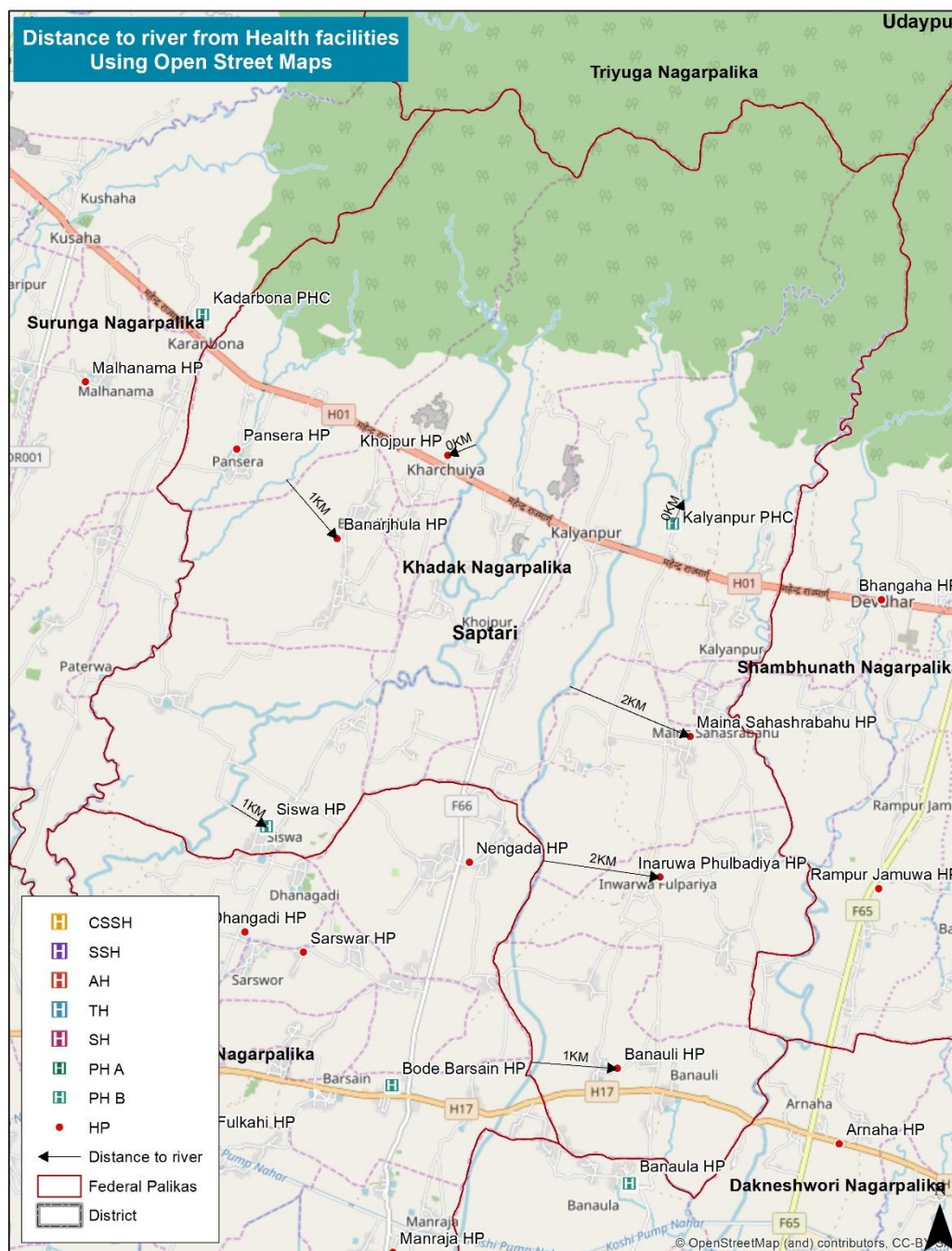
<sup>45</sup> <http://www.desinventar.net>, Disaster management information system powered by EU, UNSIDR and UNDP, 2017

<sup>46</sup> Health Infrastructure information System, NHSSP/MOH, 2017

This simple analysis identifies 69 health facilities within 25m (horizontal distance without considering elevation differences) of a river, comprising 54 health posts and 15 hospitals - seven districts have three health facilities within the study zone: Udayapur and Okhaldhunga (Province One) Sindupalchowk (Province Three), Nawalparasi and Baglung (Province Four), Rukum (across Province Five and Six) and Bhajang (Province Seven). For more details see table in **Annex Two**.

A sample study of Khadak Municipality in Saptari district has been carried out as a reference to further detailed analysis necessity as shown in map 21 and table 6.

**Map 21: Analysis of Health facilities location in Khadak Municipality, Saptari**



Source: HI information from HIIS, 2017<sup>47</sup> , Open Street Maps (OSM)

**Table 6:Distance from health facility to river in Khadak Nagarpalika in Saptari district**

Health Facility Name	Distance to River	River Name
Pansera HP	15 M	Amaha Khola
Banarjhula HP	1216 M	Neraha Khola
Siswa HP	641 M	Chapin Dhar
Kalyanpur PHC	411 M	Kharak Nadi
Khojpur HP	464 M	Chapin Khola
Mainal Sahashrabahu HP	2004 M	Kharak Nadi
Inaruwa Phulbadiya HP	1822 M	Kharak Nadi
Banauli HP	1331 M	Kharak Nadi

Source: Health infrastructure information from HIIS, 2017.<sup>48</sup>

As shown in Map and Table above, such an analysis will generate detailed descriptions location suitability of health facilities as lower order rivers and other infrastructures can be taken into consideration.

This HIIS analysis could also be taken further by examining the alignment with flood hazard districts identified under the World Bank and Global Fund for Disaster Risk Reduction Nepal Hazard study 2010.

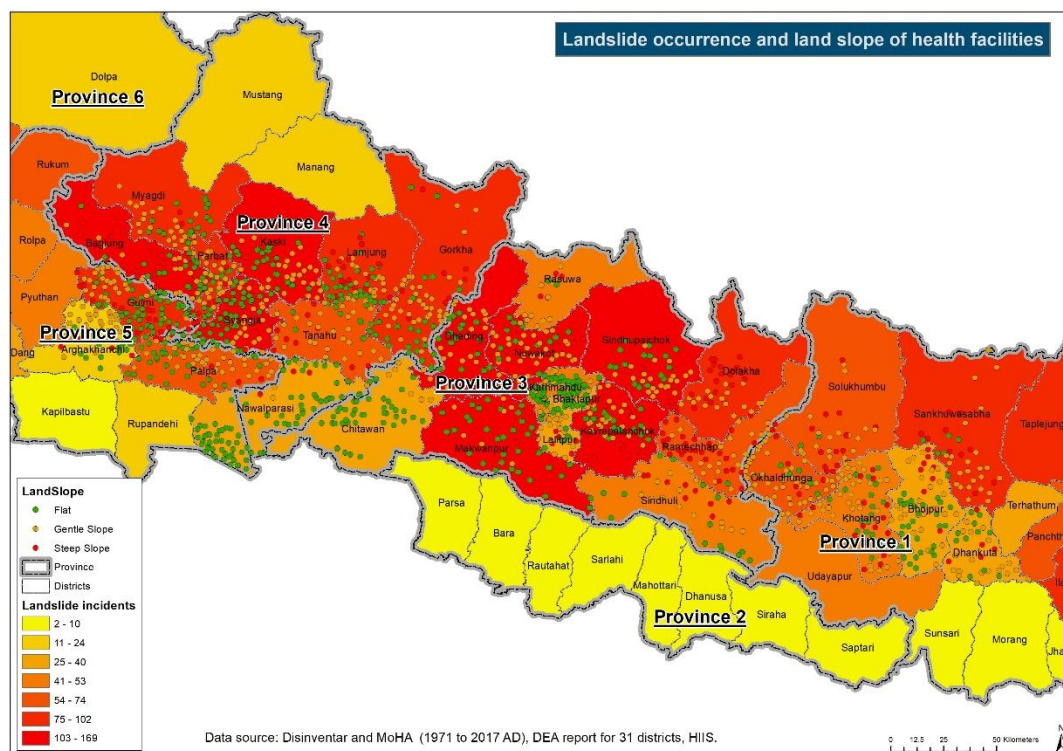
### 5.3 Landslides

Using the HIIS, the NHSSP Health Infrastructure team combined landslide incidence data, location of health facilities and site slope data to provide an overview of infrastructure at possible risk of landslides (see Map 22 below). Because of resource constraints, the slope analysis - carried out as part of the NHSSP Detailed Engineering Assessment (DEA) - is only available at present for 31 districts. However, this information already begins to paint a picture of the amount of infrastructure at risk.

<sup>47</sup> Health Infrastructure information System, NHSSP/MOH, 2017

<sup>48</sup> Health Infrastructure information System, NHSSP/MOH, 2017

## Map 22: Health facilities and potential landslide risk



Source: Hazard incidence from Desinventar and MOHA (DRR Portal) 2017<sup>49</sup>, Facility location from DEA report of 31 district and HI information from HIIS, 2017.<sup>50</sup>

There are districts in high incident landslide areas that have large numbers / proportions of their health facilities located on steep slopes. For example:

- Ramechhap – 30 out of a total 51 facilities (59%)
- Baglung – 28 out of a total 70 facilities (40%)
- Kavrepalanchok – 25 out of a total 68 facilities (37%)
- Dolhaka - 21 out of a total 38 facilities (55%)

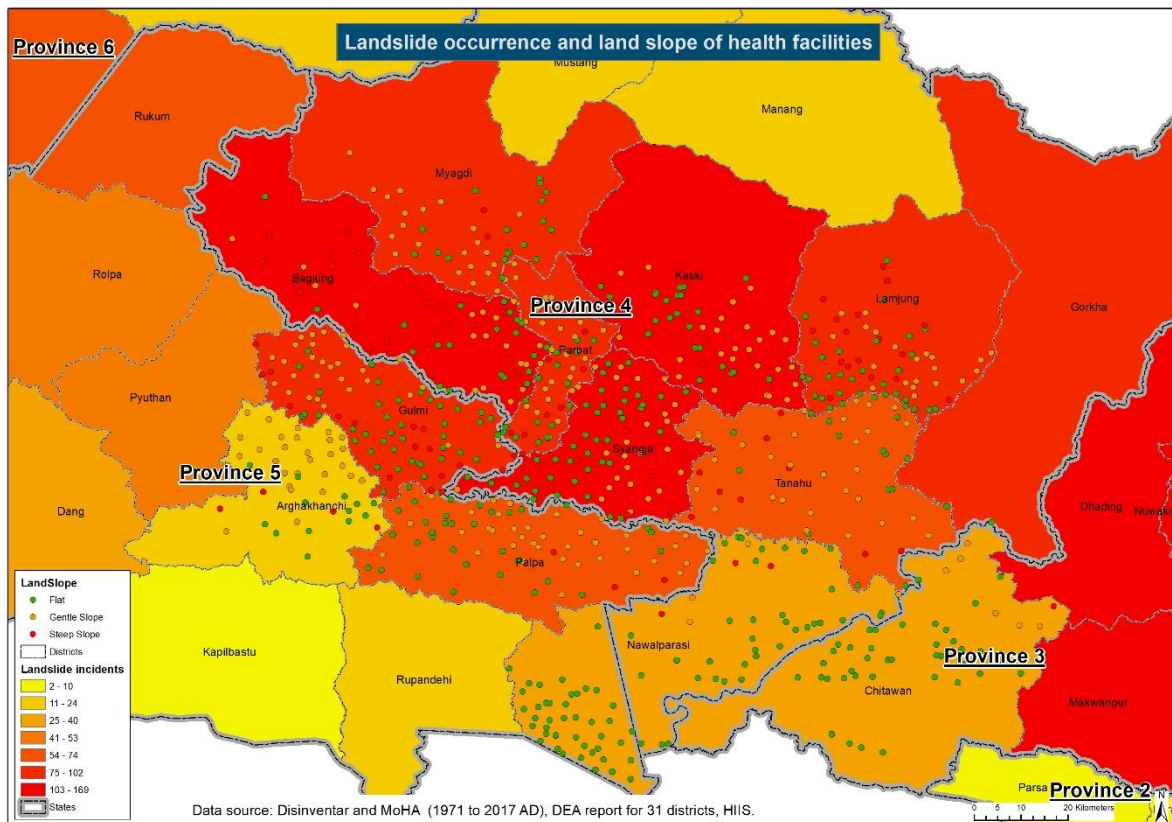
The potential capital cost to the public purse should these facilities need to be replaced due to catastrophic events would be enormous.

More reassuringly, although Syangia district falls within a high incident landslide area, only seven of its 75 health facilities have been constructed on steep slopes (for more details see Map 23 below).

<sup>49</sup> <http://www.desinventar.net>, Disaster management information system powered by EU, UNSIDR and UNDP, 2017

<sup>50</sup> Detailed Engineering Assessment report, NHSSP/DFID and Health Infrastructure information System, NHSSP/MOH, 2017

**Map 23: Health facilities and potential landslide risk – Baglung and Syangia Districts, Province Four**

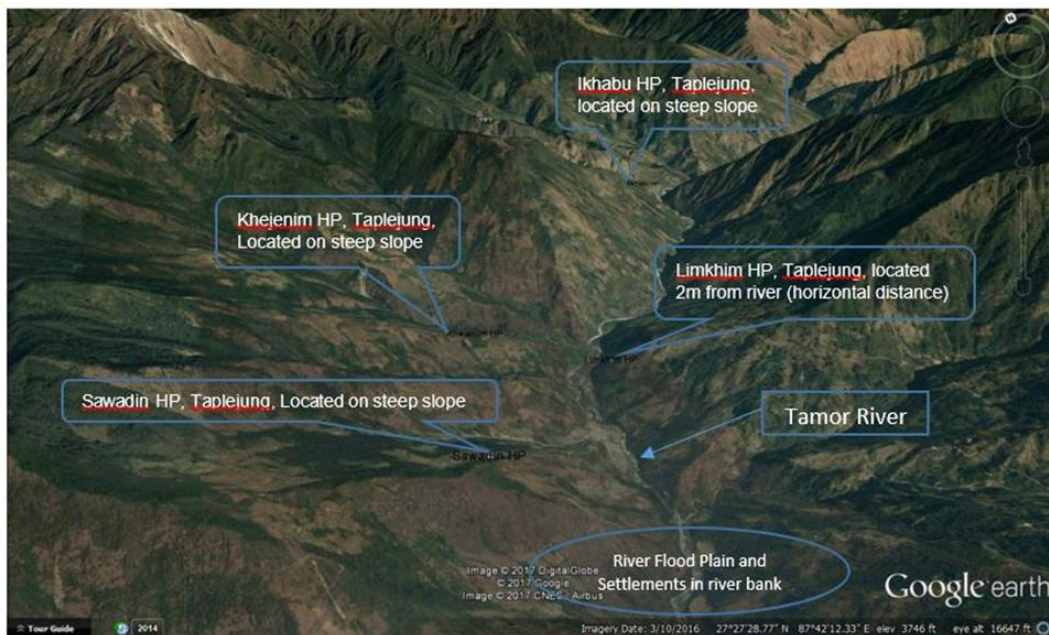


Source: Hazard incidence from Desinventar and MOHA (DRR Portal) 2017<sup>51</sup>, Facility location from DEA report of 31 district and HI information from HIIS, 2017.<sup>52</sup>

<sup>51</sup> <http://www.desinventar.net>, Disaster management information system powered by EU, UNSIDR and UNDP 2017

<sup>52</sup> Detailed Engineering Assessment report, NHSSP/DFID and Health Infrastructure information System, NHSSP/MOH 2017

**Figure 1: Health posts at risk in Taplejung District, Province One**



Source: Based on Google Earth map and HIIS information 2017

The combination of risks to health infrastructure is illustrated by a sample of health facilities from Taplejung district in a 4km radius of each other. Ikhabu, Khejinim and Sawadin health posts are all located on steep slopes (landslide risk) while Limkhim health post is situated immediately adjacent to the Tamor River (see Figure 1 above). For a map of this location see Map 31 in Annex One.

## 5.4 Summary

The NHSSP's HIIIS platform has enabled the Health Infrastructure team to begin to identify types and locations of health infrastructure at risk. The HIIIS foundation layers can be cross-tabulated with data from other sources, and build a picture of facilities that should be prioritised for further investigation.

The DEA is an ideal tool for collecting information on health facilities, as it combines site analysis with a condition survey for each building block. It can be applied across districts to identify risk priorities, remedial and replacement costs. It will provide national government essential information to inform budget allocations and fiscal transfers as appropriate.

Management, maintenance and operational responsibility for the majority of health facilities will be transferred to the new provinces and municipalities under the federal system. Good governance practice should dictate that these new entities are given as complete as possible of the state of the facilities they will inherit – a robust risk assessment should be part of this picture. As DEA data is currently only available for 31 districts, it is strongly recommended that it be extended to cover the remaining areas in support of this climate change-induced hazard assessment.

## 6 OPERATING FRAMEWORK AND TOOLKIT

The NHSSP Health Infrastructure Team preliminary investigation has been pragmatic and focused on disaster risk reduction. Given the shortage of health infrastructure in Nepal this is important, and the exercise should be refined and extended across the country.

It also need to be positioned within a more strategic context to ensure that findings are properly focused and directed to supporting the achievement of national sustainability and resilience goals.

### 6.1 Building a climate resilient health system

The WHO (supported by DFID) prepared an operational framework for building climate resilient health systems in 2015. The framework uses the following operational definition:

*A climate resilient health system is one that is capable to anticipate, respond to, cope with, recover from and adapt to climate-related shocks and stress, so as to bring sustained improvements in population health, despite an unstable climate.*

The framework defines 10 components that together provide a comprehensive approach to integrating climate resilience into existing health systems (see Figure One below). Component 10 focuses on emergency preparedness and risk management and reflects the work done by the NHSSP Health Infrastructure in this study. Component 6 is complementary, as it directs efforts towards developing sustainable facilities as well as those that are resistant to hazards. The NHSSP's work on sustainable technology in new construction or retrofitting could then be aligned with the framework.

- 1 Leadership and governance
- 2 Health workforce
- 3 Vulnerability, capacity and adaptation assessment
- 4 Integrated risk monitoring and early warning system
- 5 Health and climate research
- 6 Climate resilient and sustainable technologies and infrastructure
- 7 Management of environmental determinants of health
- 8 Climate-informed health programmes
- 9 Emergency preparedness and management
- 10 Climate and health financing

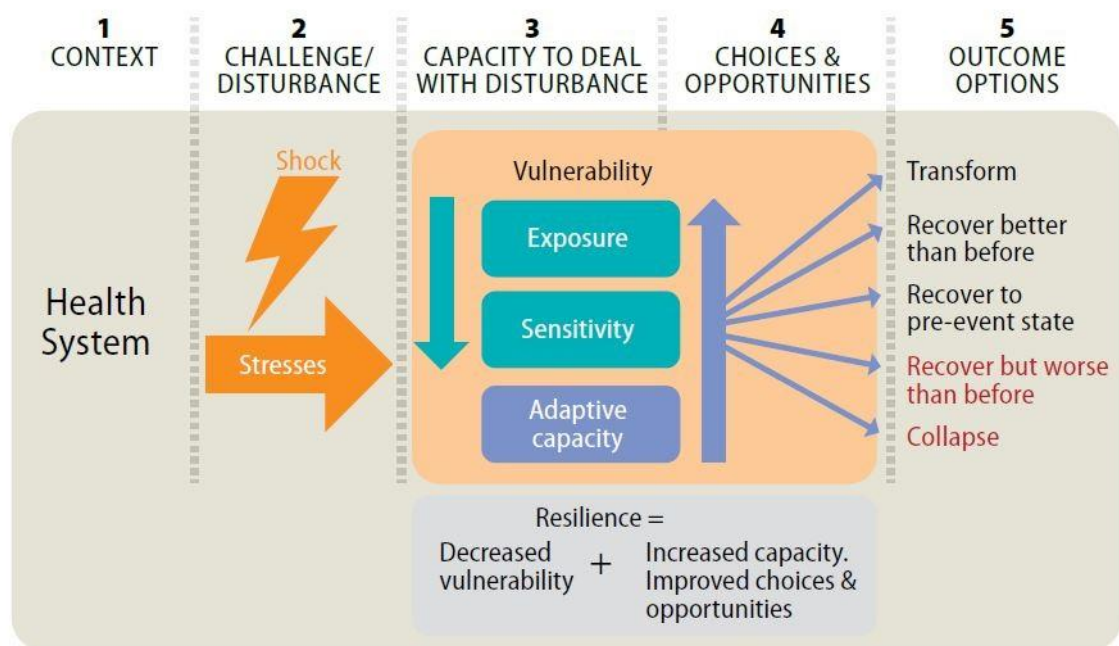


**Figure 2: The WHO operational framework for building climate resilient health systems, and the main connections to the building blocks of health systems<sup>53</sup>**

The WHO operational framework also puts forward a structured process of identifying threats and developing responses which can be adopted for the NHSSP health infrastructure programme

<sup>53</sup>Operational framework for building climate resilient health systems, World Health Organisation, 2015





Model Adopted from Conceptual framework for resilience, Operational framework for building climate resilient health systems. (WHO)

**Figure 3: Process for developing a resilient health system<sup>54</sup>**

## 6.2 Resources for resilient planning of health infrastructure

The transfer of health infrastructure to province and municipal structures under the new federal arrangements brings its own challenges in ensuring consistency in implementing approaches to resilience and sustainability.

At this stage of the creation of the federal dispensation, robust and clear guidelines to sub-national facilities will be essential to promote engagement and compliance, and encourage the development of local responsive solutions and infrastructure.

The Smart Hospital Toolkit<sup>55</sup> produced by the WHO and Pan American Health Organisation and WHO in 2017 provides a recent relevant example of these kind of guidelines. The guidance and instruments set out in the toolkit can be applied to health facility new construction or retrofitting to promote resilience.

The document serves as a practical guide to the development of smart, safe and green health facilities. These facilities will:

- Protect the lives of patients and health workers

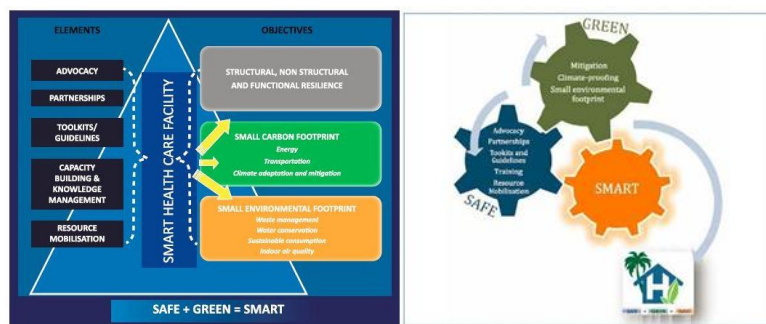
<sup>54</sup>Operational framework for building climate resilient health systems, World Health Organisation, 2015

<sup>55</sup> Smart Hospitals Toolkit. Washington, D.C.: PAHO; 2017 ([www.paho.org](http://www.paho.org))

- Reduce damage to the hospital infrastructure and equipment as well as the surrounding environment
- Continue to function as part of the health network, providing services under emergency conditions to those affected by a disaster
- Use scarce resources more efficiently, thereby generating cost savings
- Improve their strategies to adjust to and cope better with future hazards and climate change

The NHSSP will develop a similar health infrastructure toolkit adopted for the Nepal developmental context paying attention to current and prospective climate changed induced risks, as promoting approaches and recommendations for improving sustainability and resilience. The WHO Toolkit provides a solid starting point and model for this exercise, but suitable comparative international experiences and materials will also be examined.

**Figure 4: WHO Toolkit – health facilities that are safe, green and smart**



Source: Smart Hospitals Toolkit. Washington, D.C.: PAHO; 2017 ([www.paho.org](http://www.paho.org))

## 7 GENDER AND SOCIAL INCLUSION / LEAVE NO ONE BEHIND PERSPECTIVE

There is no specific GESI / LNOB perspective on climate change-induced hazard and health infrastructure. However, guidelines on the impact of climate change on women, children and disadvantaged groups provide a basis for the exploration and development of a more focused approach (see for example, the Lancet Commission framework on climate change and health 2015). The development of a GESI and LNOB for health infrastructure and climate change will be a priority for this programme.

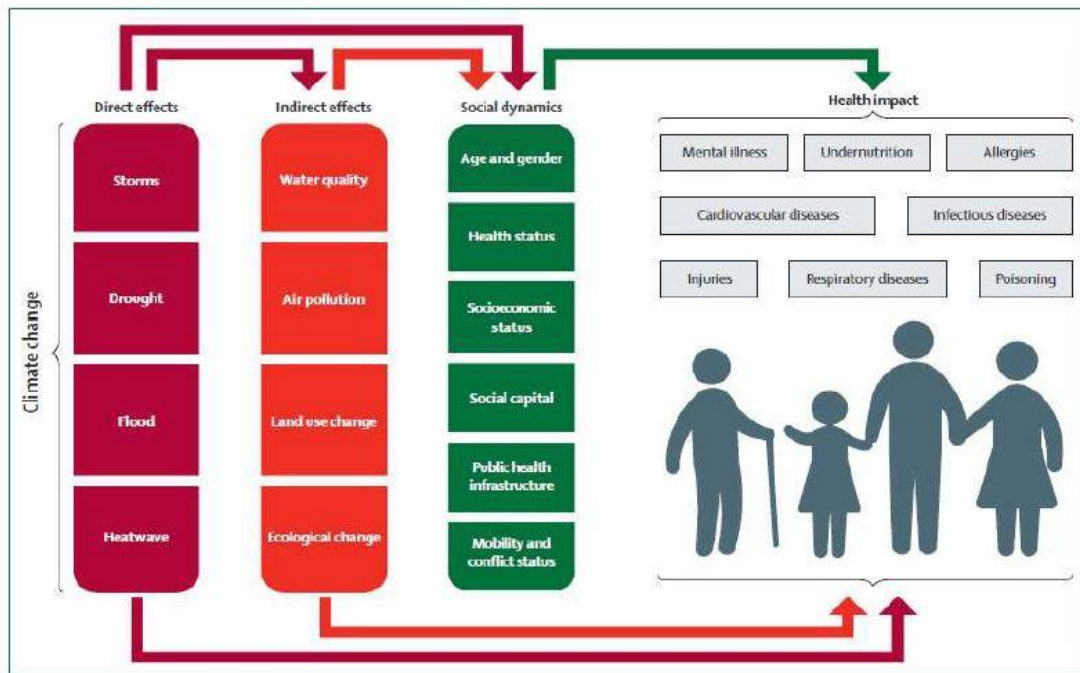


Figure 5: Climate Change and Gender and Social Inclusion

Source: Lancet Commission framework on climate change and health 2015<sup>56</sup>

<sup>56</sup>Lancet Commission framework on climate change and health 2015

## 8 ACTION FOR NEPAL HEALTH INFRASTRUCTURE

This section draws out conclusions from the study and the analysis and make recommendations for strengthening and mainstreaming analysis of and responses to climate change-induced hazard in the development and operation of health infrastructure.

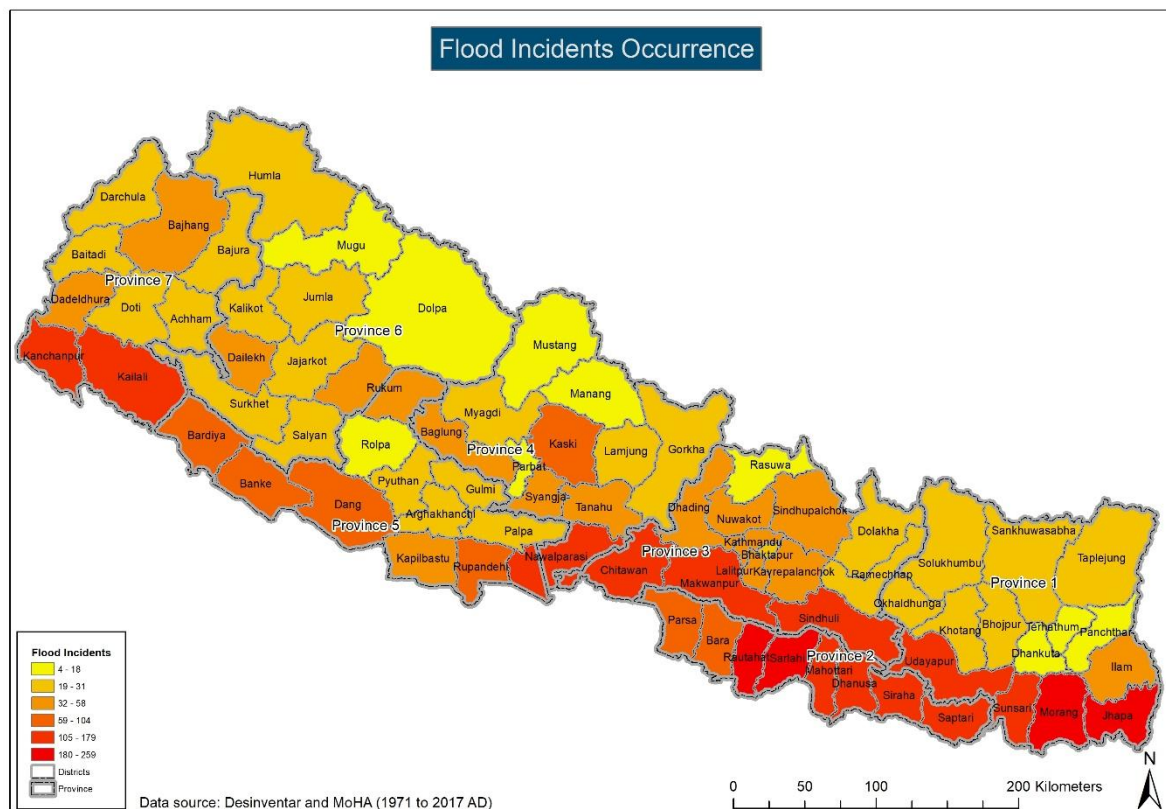
- Raise the profile of climate change hazards with MOH and the new province and municipal structures through a series of briefings to senior management and politicians on risks to service delivery and health infrastructure investment. This would also be in line with the promotion of climate resilient local level planning as part of LAPA implementation.
- Carry out a condition and risk survey of health infrastructure, based on the DEA, to supplement existing information. This should extend the existing database to cover all remaining districts in the country.
- Review and where appropriate consolidate relevant information sources on climate change and hazards scenarios to create an improved database for health infrastructure information and analysis.
- Liaise with the Thematic Working Group on Urban Settlements and Infrastructure of the National Adaptation Plan process to identify health infrastructure as a specific category of infrastructure vulnerable to climate change
- Provide inputs on climate change hazard and health infrastructure to the MOH-led Thematic Working Group on public health (WASH) for the preparation of the health sector adaptation plan.
- Develop the Nepal Sustainable and Resilient Health Infrastructure Toolkit (based on the WHO and other relevant international experience) for dissemination of information and good practice in the development, retrofitting, operations and maintenance of health facilities. The toolkit will also address the issue of supplementary standards and guidelines to support current Nepal practice.
- Mainstreaming GESI and LNOB principles and approaches as part of the sustainability and resilience work stream.
- Incorporate these activities into the NHSSP Health Infrastructure work stream and activity, with clear timeframe, deliverables, and indicators to allow regular monitoring and evaluation of progress.

## ANNEX ONE: MAPS SHOWING HAZARD INCIDENCE AND DISEASE SPREADING

### Flooding incident mapping

Flood hazard incident mapping is based on the open source data available from Desinventar and the GON DRR portal for the period 1971 to 2017. As per the number of incident occurrence, the mapping has been done for districts as shown below.

**Map 24: Flood incident occurrence map**

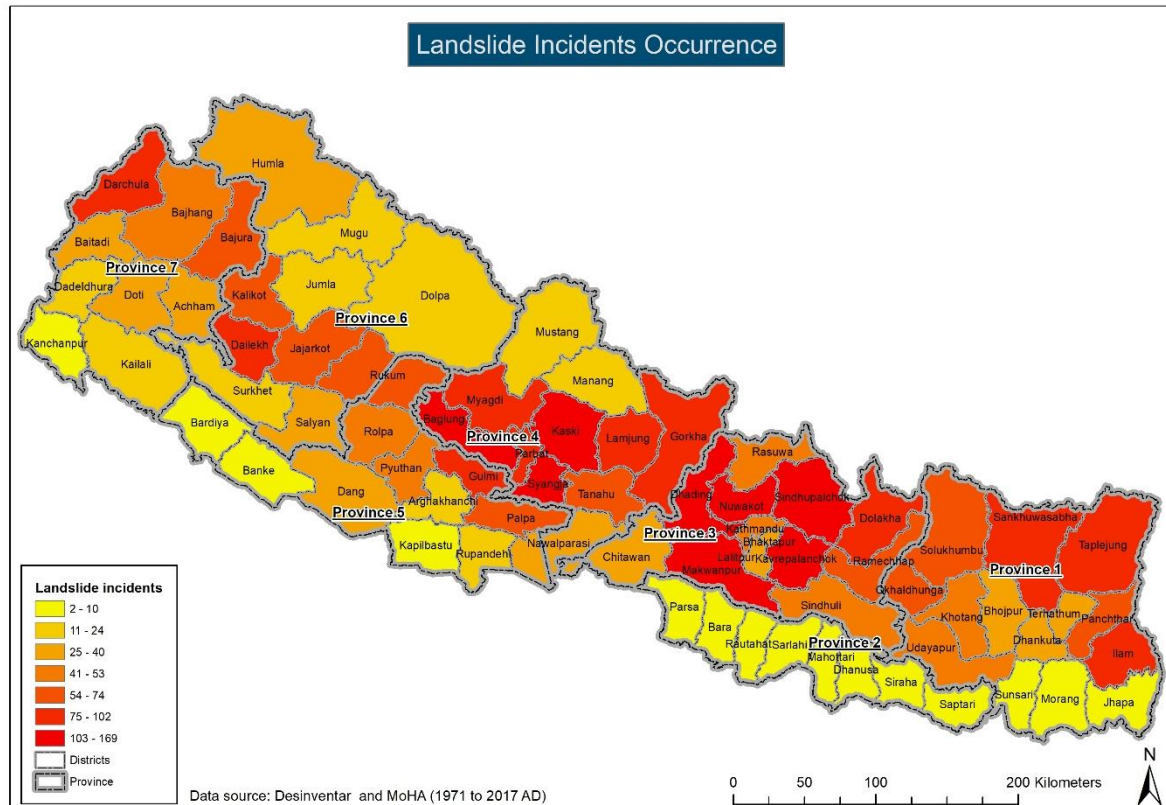


The flood incident occurrence map above shows that three districts Jhapa, Sarlahi and Rautahat has maximum numbers of flood incidents in past. In total there are 249 health facilities including all types within these three districts.

## Landslide incident mapping

Landslide incident mapping has been carried out considering the landslides occurrence in between 1971 to 2017.

**Map 25: Landslide incident occurrence**

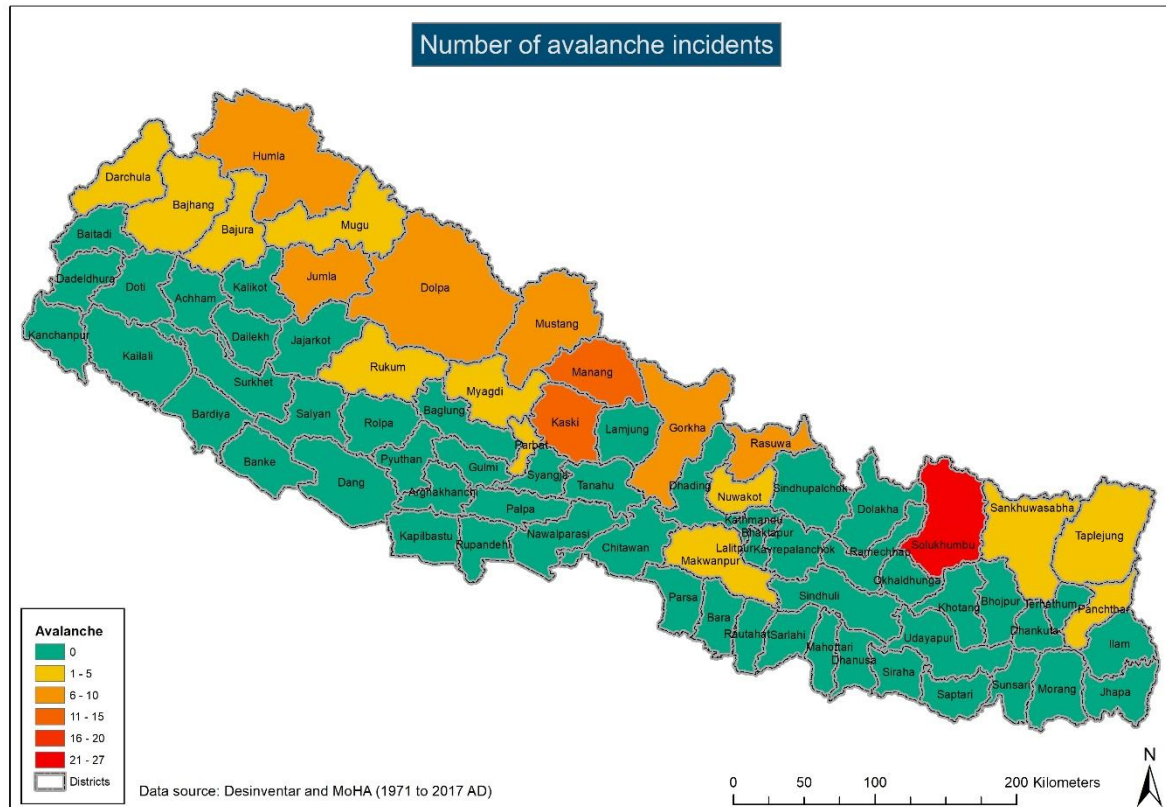


From Map 25, it is seen that the landslides has occurred mostly in the district Dhading. Similarly, district like Baglung, Kaski, Sindupalchowk, Kavrepalanchowk, Makawanpur and Syanjha have also significant numbers of landslides incidents.

## Avalanche incident mapping

Avalanche incident mapping has been carried out considering the landslides occurrence in between 1971 to 2017.

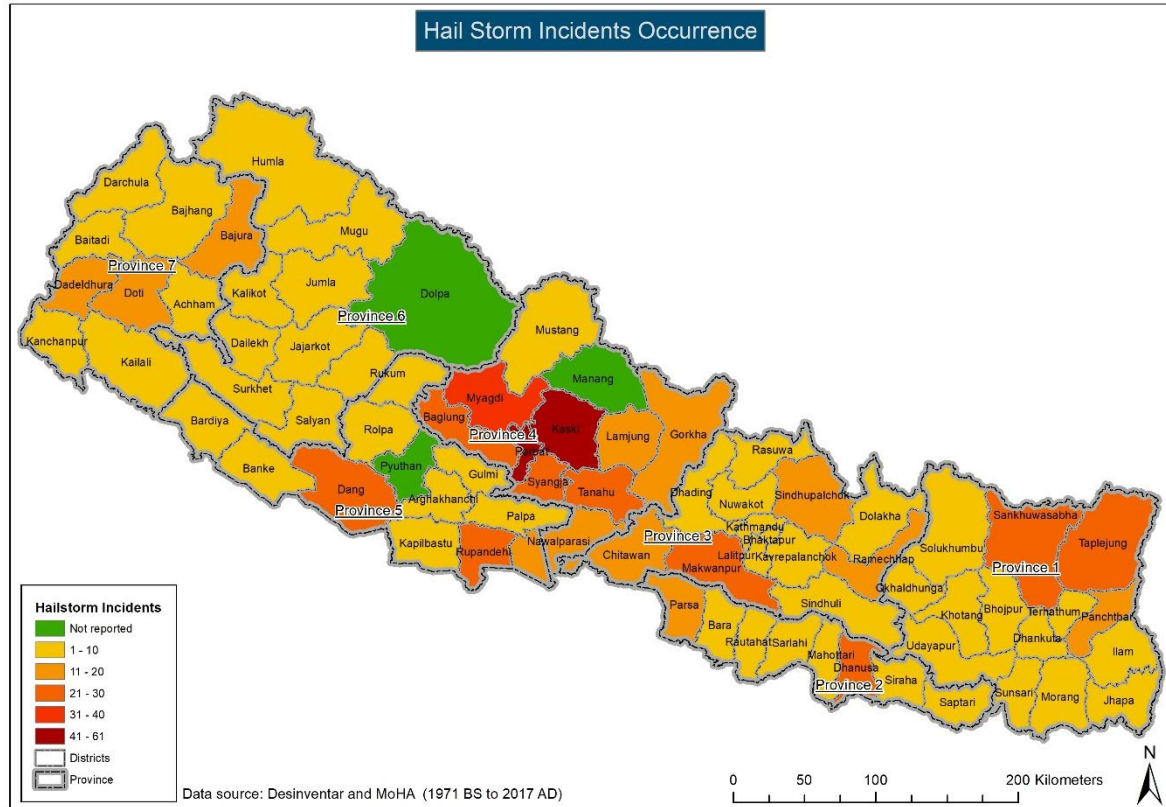
**Map 26: Avalanche incident occurrence map**



The avalanche has been seen in high Himalayan and high mountains. Solukhumbu and Kaski have high avalanche occurrence incident. Whereas, Dolpa, Mustang, Manang and Rasuwa have also significant numbers of avalanche incidents occurrence.

## Hail storm incident mapping

Map 27: Hailstorm incident occurrence mapping

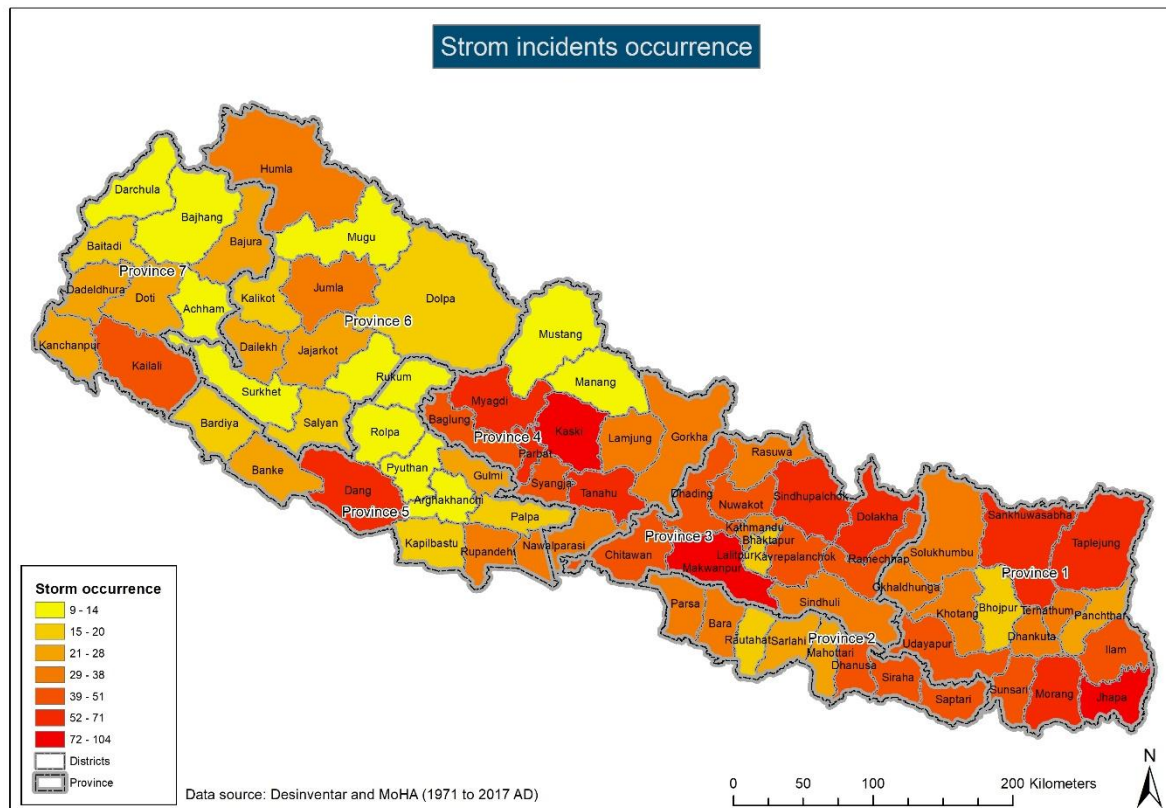


From map 27, it is seen that hailstorm related incident has been occurred maximum in Kaski and Parbat. Rupandehi, Makwanpur, Dhanusa, Dang, Sankhuwasabha, Taplejung, Myagdi, Baglung, Syangja and Tanahu have also significant hailstorm occurrence related incidents.



## Storm incident mapping

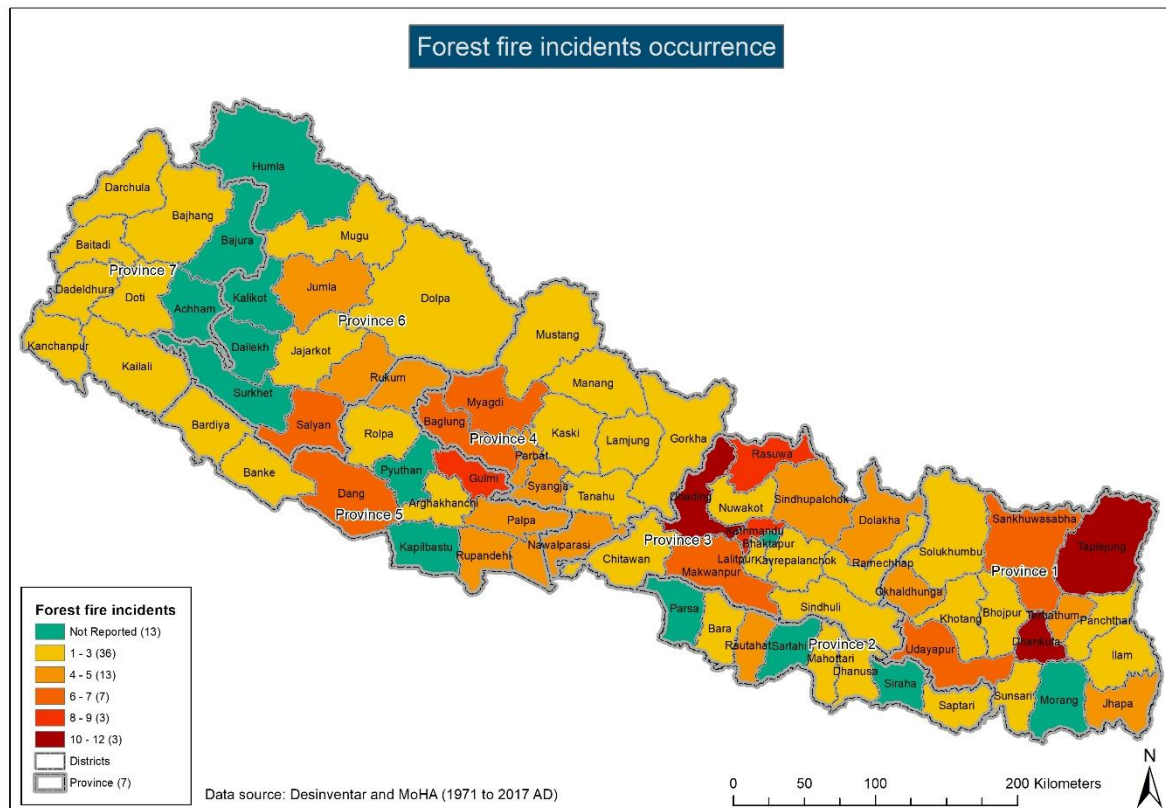
Map 28: Storm incident occurrence mapping



From map 28, Jhapa, Morang, and Makwanpur district have greater number of storm occurrence incidents.

## Forest fire incident mapping

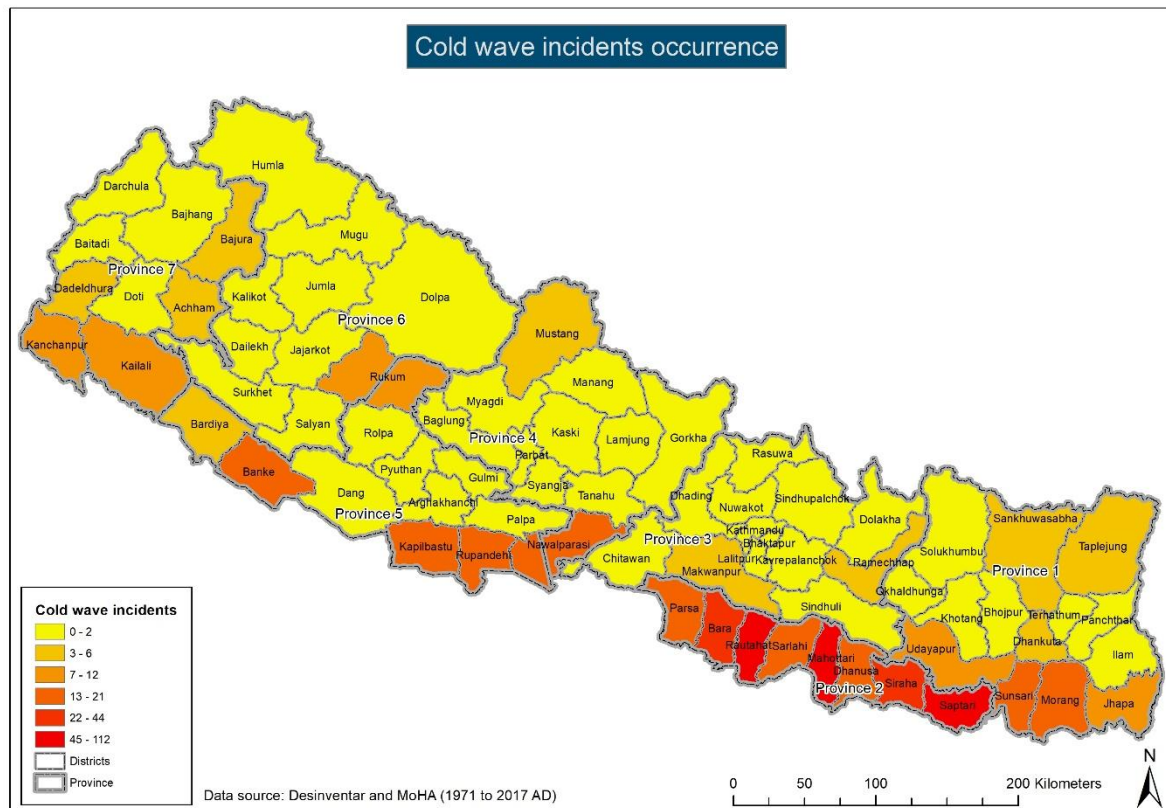
Map 29: Forest fire incidents occurrence map



From map 29, it is seen that Dhading, Taplejung and Dhankuta districts have higher number of forest fire occurrence incidents in past. Similarly, district like Gulmi and Rasuwa have also significant forest fire occurrence.

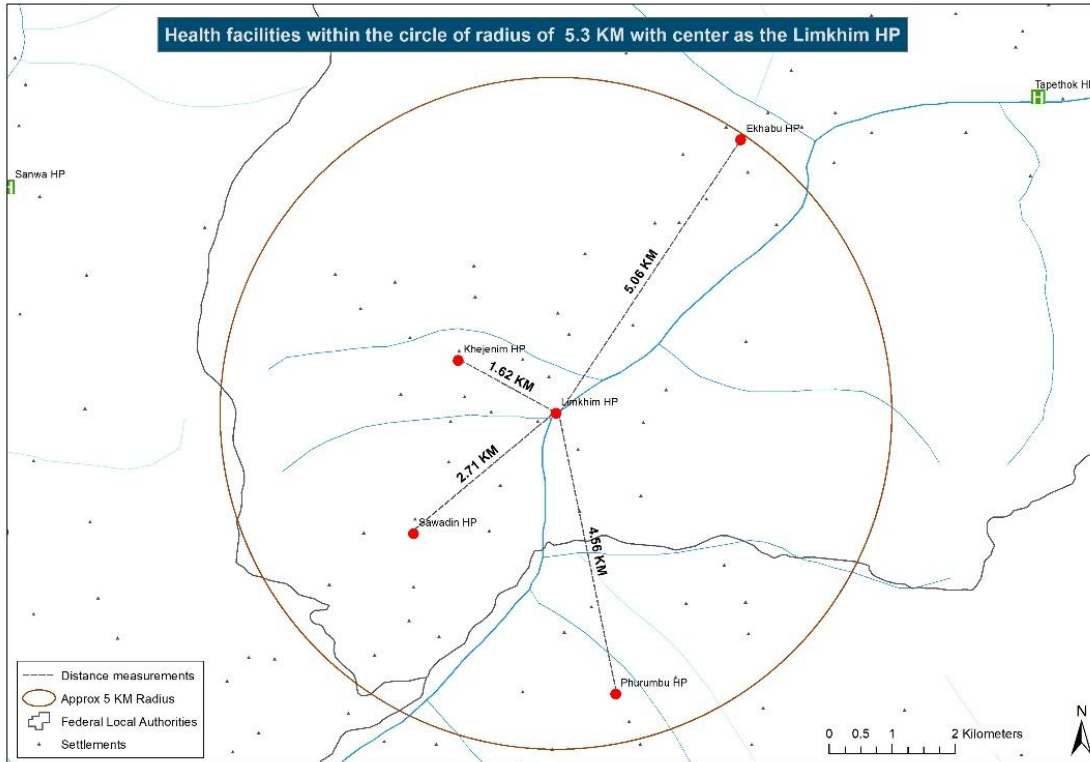
## Cold Wave incident mapping

Map 30: Cold wave incident occurrence map



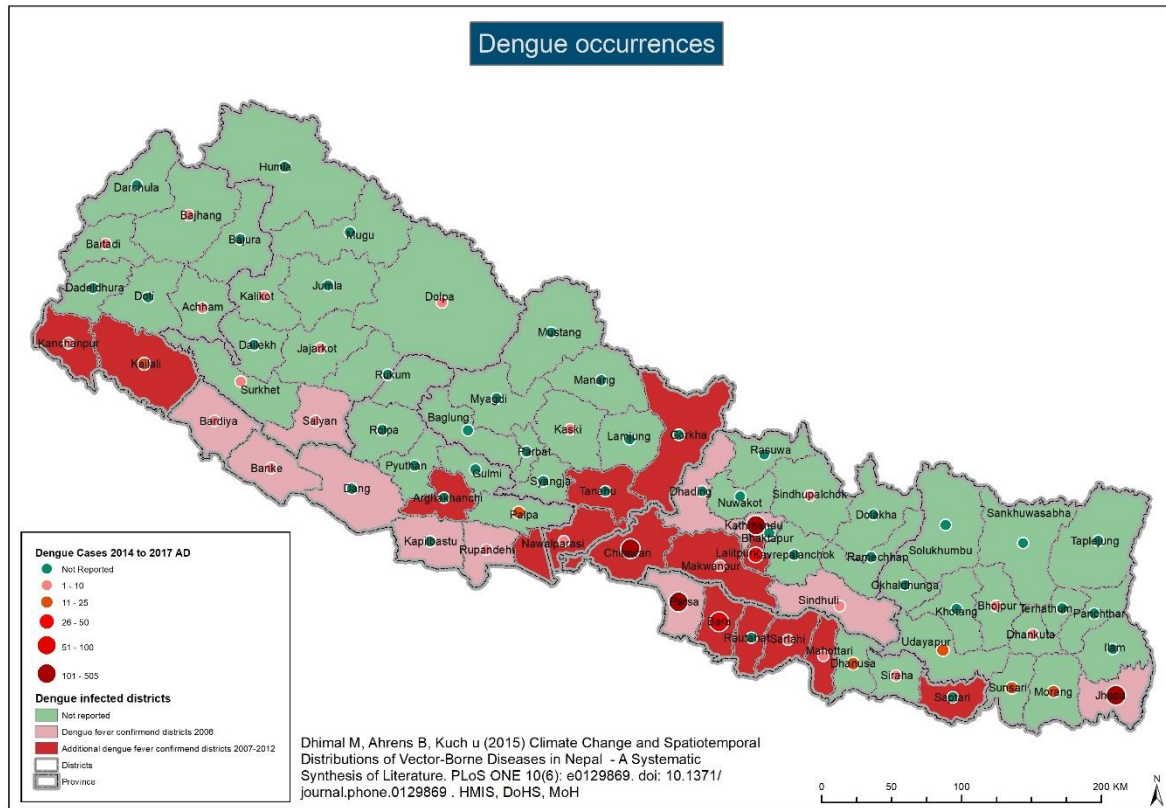
From map 30, a cold wave incident occurrence is maximum in Terai belt with greater numbers in districts like Rautahat, Mahotari and Saptari. However, other districts in Terai have also significant numbers of reporting in cold wave occurrences.

**Map 31: Health Facilities located within the 4 K.M nearer to each other and are at risk of flooding and landslides**

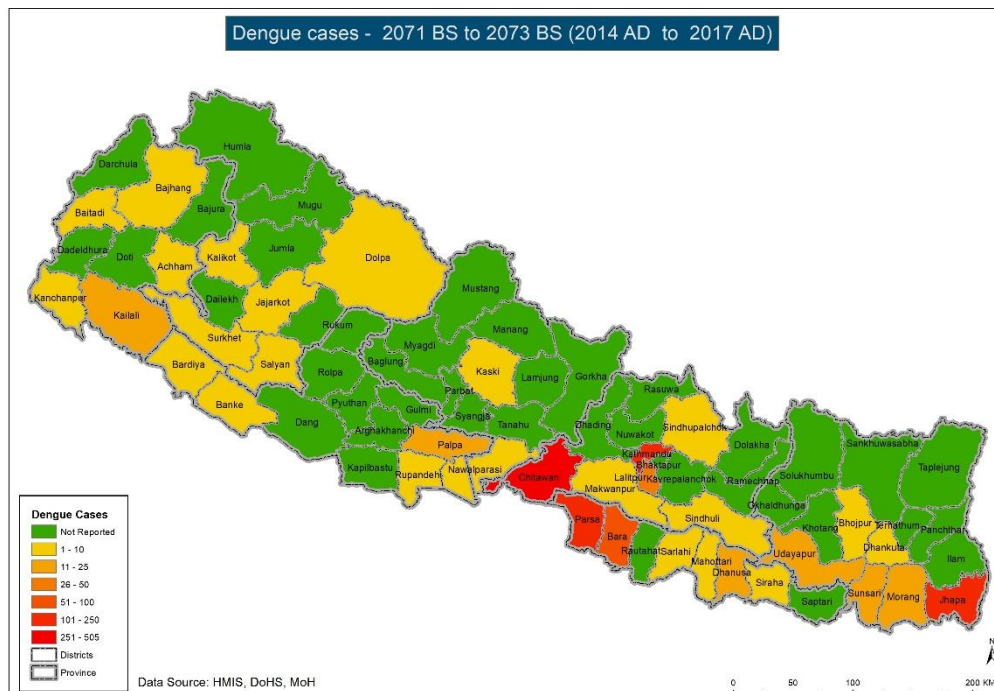


## Changes in distribution of different vector borne diseases

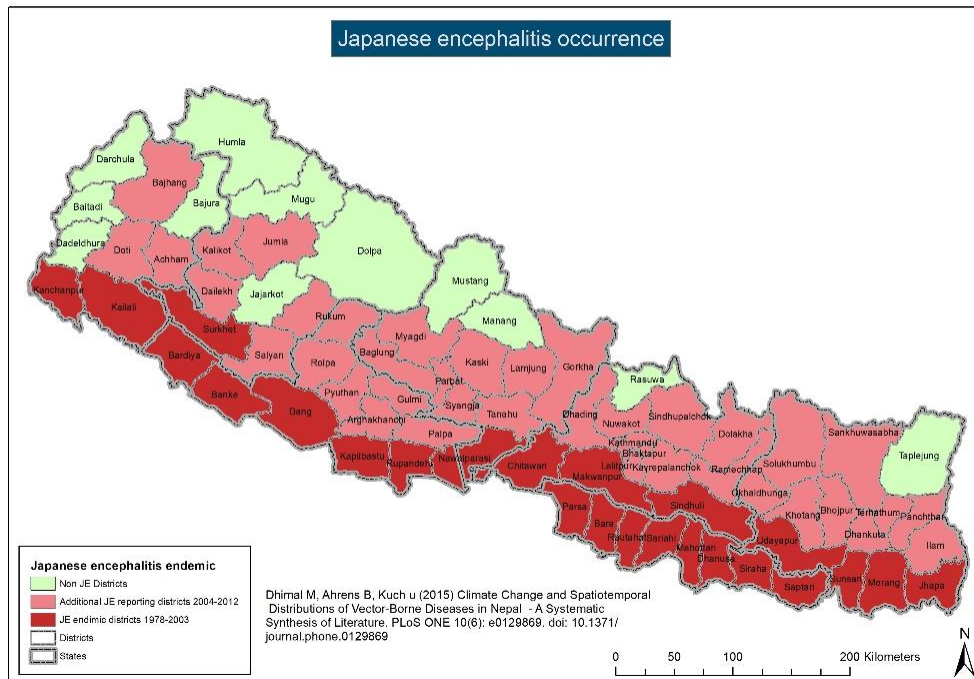
Map 32: Changes in Dengue Distribution from 2006 to 2017



Map 33: Changes in Dengue Distribution from 2014 to 2017

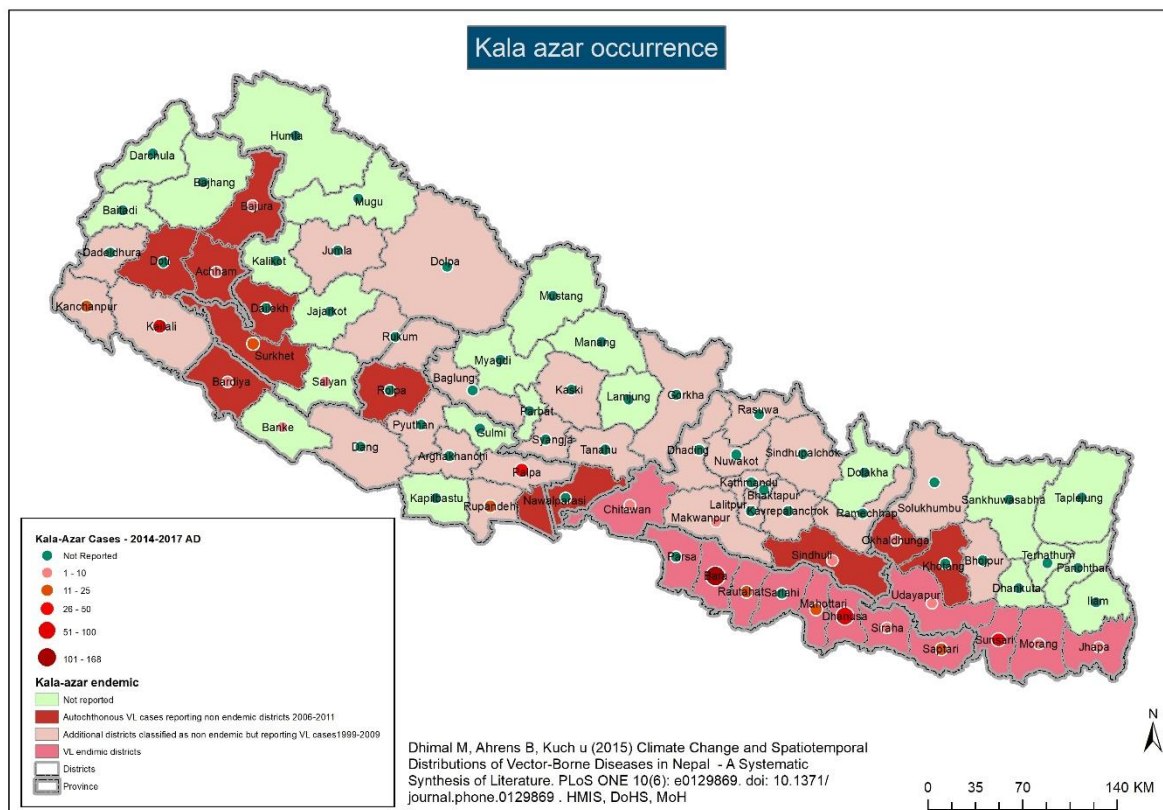


**Map 34: Changes in Japanese Encephalitis Distribution from 2013 to 2016**

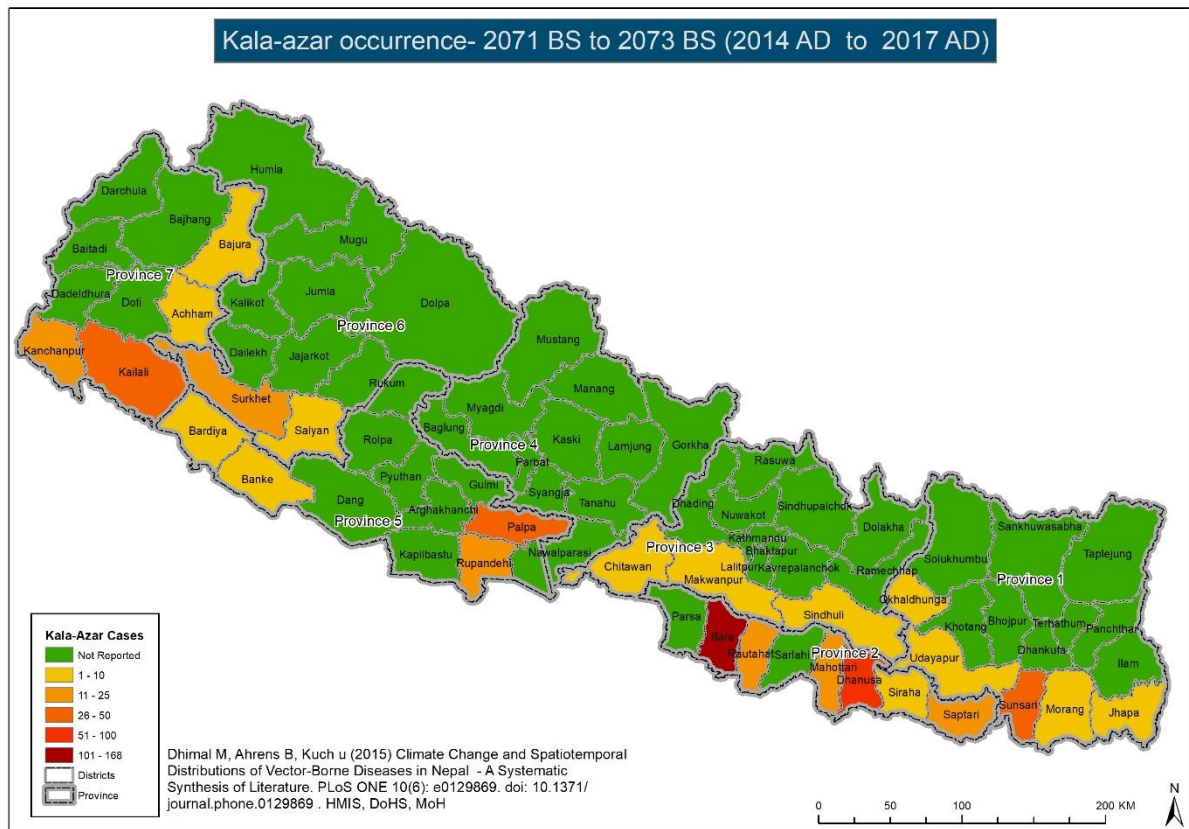


**Changes in Kala azar from 1999 to 2017**

**Map 35: Changes in Kala azar Distribution from 1999 to 2017**



**Map 36: Changes in Kala azar Distribution from 2014 to 2017**



From map 32 to 36, it can be observed that there is an increasing trend in vector borne diseases and is spreading from warm climatic zone to relatively cold climatic zone.

## ANNEX TWO: POSSIBLE FLOOD RISK TO HEALTH FACILITIES

**Table 7: Health Facilities located near to the possible flood zones (within 25 m horizontally)**

District	Total Health Facilities	Primary Hospitals (all types)	Health Post (all types)
Baglung	3	0	3
Bajhang	3	0	3
Bajura	1	0	1
Banke	1	1	0
Bara	2	0	2
Bhojpur	1	0	1
Chitawan	1	0	1
Dailekh	1	1	0
Darchula	1	1	0
Dhading	1	1	0
Dhankuta	1	0	1
Dhanusa	1	0	1
Dolpa	1	1	0
Doti	1	0	1
Gulmi	1	1	0
Humla	1	1	0
Jajarkot	1	0	1
Jumla	1	0	1
Kalikot	1	0	1
Kanchanpur	1	1	0
Kaski	1	0	1
Kathmandu	2	0	2
Kavrepalanchok	2	0	2
Lalitpur	1	1	0
Lamjung	1	1	0
Mahottari	1	0	1



Manang	2	0	2
Mugu	1	0	1
Mustang	1	1	0
Myagdi	2	0	2
Nawalparasi	3	1	2
Nuwakot	1	1	0
Okhaldhunga	3	0	3
Panchthar	1	0	1
Parsa	1	0	1
Pyuthan	2	1	1
Ramechhap	1	0	1
Rautahat	2	0	2
Rolpa	1	0	1
Rukum	3	0	3
Rupandehi	1	0	1
Salyan	1	0	1
Sindhuli	1	1	0
Sindhupalchok	3	0	3
Solukhumbu	1	0	1
Surkhet	1	0	1
Taplejung	1	0	1
Udayapur	3	0	3
<b>Total</b>	<b>69</b>	<b>15</b>	<b>54</b>

These health facilities might be at risk due to flood and a similar projection regarding loss of property in terms of money can be traced as of previously done in case of GLOF.

### ANNEX THREE: DISTRIBUTION OF HEALTH FACILITIES BY PROVINCE & DISTRICT COMPARED TO DISASTER INCIDENTS

Table 8: Province One- Number of HF and Past Hazard incidence

Districts	Storm	Land Slide	Forest Fire	Cold Wave	Drought	Avalanche	Flood	Total Hazard Incidents	Total Health Facility	Hospital	Health Post
Bhojpur	20	33	1	1	2	0	19	76	64	10	54
Dhankuta	32	40	10	3	2	0	17	104	38	7	31
Ilam	44	87	3	2	4	0	36	176	48	12	36
Jhapa	97	9	4	12	7	0	259	388	51	15	36
Khotang	35	47	1	2	2	0	28	115	76	10	66
Morang	61	6	0	21	16	0	198	302	68	22	46
Okhaldhunga	37	60	5	0	0	0	20	122	56	8	48
Panchthar	24	66	2	2	2	2	13	111	43	11	32
Sankhuwasabha	58	82	7	4	1	3	22	177	39	10	29
Solukhumbu	32	66	1	2	0	27	22	150	35	9	26
Sunsari	48	5	2	20	3	0	169	247	54	14	40
Taplejung	65	102	10	3	3	4	21	208	53	9	44
Terhathum	31	32	5	1	1	0	4	74	32	6	26
Udayapur	44	45	7	7	1	0	121	225	47	9	38
<b>Total</b>	<b>628</b>	<b>680</b>	<b>58</b>	<b>80</b>	<b>44</b>	<b>36</b>	<b>949</b>	<b>2475</b>	<b>704</b>	<b>152</b>	<b>552</b>

**Table 9:Province Two- Number of HF and Past Hazard incidence**

Districts	Storm	Land Slide	Forest Fire	Cold Wave	Drought	Flood	Total Hazard Incidents	Total Health Facility	Hospital	Health Post
Bara	33	4	2	44	3	82	168	100	16	84
Dhanusa	50	3	2	19	6	154	234	104	17	87
Mahottari	28	2	3	112	3	135	283	77	15	62
Parsa	34	2	0	20	2	91	149	84	13	71
Rautahat	17	3	4	74	6	253	357	98	16	82
Saptari	42	2	2	86	4	179	315	117	19	98
Sarlahi	22	3	0	21	4	212	262	100	18	82
Siraha	41	4	0	44	3	128	220	110	17	93
<b>Total</b>	<b>267</b>	<b>23</b>	<b>13</b>	<b>420</b>	<b>31</b>	<b>1234</b>	<b>1988</b>	<b>790</b>	<b>131</b>	<b>659</b>

**Table 10:Province Three-Number of HF and Past Hazard incidence**

Districts	Storm	Land Slide	Forest Fire	Cold Wave	Drought	Avalanche	Flood	Total Hazard Incidents	Hospitals	Health Posts
Bhaktapur	16	32	0	2	0	0	19	69	5	18
Chitawan	39	39	1	2	3	0	141	225	10	33
Dhading	51	169	12	0	1	0	38	271	13	39
Dolakha	55	86	5	0	1	0	26	173	9	46
Kathmandu	31	45	8	2	0	0	56	142	18	54
Kavrepalanchok	45	122	3	2	0	0	40	212	14	81
Lalitpur	17	29	2	0	0	0	39	87	9	35
Makwanpur	97	110	6	3	5	1	127	349	11	35
Nuwakot	47	124	3	0	1	1	49	225	12	55
Ramechhap	43	59	2	6	8	0	22	140	9	46
Rasuwa	30	49	8	1	1	9	17	115	5	14
Sindhuli	32	46	2	1	2	0	152	235	12	44
Sindhupalchok	59	143	5	2	2	0	58	269	14	65
<b>Total</b>	<b>562</b>	<b>1053</b>	<b>57</b>	<b>21</b>	<b>24</b>	<b>11</b>	<b>784</b>	<b>2512</b>	<b>141</b>	<b>565</b>

**Table 11:Province Four-Number of HF and Past Hazard incidence**

Districts	Storm	Land Slide	Forest Fire	Cold Wave	Drought	Avalanche	Flood	Total Hazard Incidents	Hospitals	Health Posts
Baglung	46	127	6	0	1	0	42	222	11	52
Gorkha	35	84	2	0	0	7	21	149	11	59
Kaski	104	112	2	0	1	14	70	303	7	42
Lamjung	38	82	3	0	1	0	26	150	9	51
Manang	12	14	2	1	0	11	9	49	4	10
Mustang	10	18	1	5	0	10	14	58	5	12

Myagdi	58	83	6	0	0	5	24	176	6	35
Nawalparas i P1	15	14	2	7	2	0	77	116	10	28
Parbat	71	88	5	2	0	1	18	185	8	47
Syangja	40	138	4	0	2	0	51	235	13	56
Tanahu	59	74	3	2	2	0	52	192	13	36
<b>Total</b>	<b>488</b>	<b>834</b>	<b>36</b>	<b>17</b>	<b>9</b>	<b>48</b>	<b>404</b>	<b>1835</b>	<b>97</b>	<b>428</b>

**Table 12:Province Five-Number of HF and Past Hazard incidence**

Districts	Storm	Land Slide	Forest Fire	Cold Wave	Drought	Avalanche	Flood	Total Hazard Incidents	Hospital	Health Post
Arghakhanchi	11	24	3	0	0	0	20	58	6	36
Banke	23	10	1	15	6	0	86	141	12	36
Bardiya	19	4	1	4	3	0	94	125	9	25
Dang	71	30	7	0	5	0	104	217	12	30
Gulmi	28	84	9	1	2	0	27	151	12	69
Kapilbastu	15	4	0	17	1	0	40	77	10	68
Nawalparasi P2	15	13	2	7	1	0	76	115	6	34
Palpa	16	70	4	2	2	0	23	117	10	56
Pyuthan	12	53	0	0	0	0	20	85	9	40
Rolpa	14	44	2	0	2	0	15	77	10	42
Rukum P2	12	30	2	4	0	0	22	66	3	10
Rupandehi	34	19	4	15	4	0	96	172	16	54
<b>Total</b>	<b>270</b>	<b>385</b>	<b>35</b>	<b>65</b>	<b>26</b>	<b>0</b>	<b>623</b>	<b>1401</b>	<b>115</b>	<b>500</b>

**Table 13:Province Six-Number of HF and Past Hazard incidence**

Districts	Storm	Land Slide	Forest Fire	Cold Wave	Drought	Avalanche	Flood	Total Hazard Incidents	Hospitals	Health Posts
Dailekh	23	85	0	0	4	0	35	147	11	48
Dolpa	18	24	1	0	1	9	10	63	8	16
Humla	31	33	0	2	0	7	26	99	7	20
Jajarkot	25	60	1	2	0	0	24	112	8	27
Jumla	34	19	4	1	1	6	22	87	8	23
Kalikot	20	59	0	1	3	0	21	104	10	20
Mugu	9	19	1	1	0	1	14	45	4	22
Rukum	12	31	2	4	1	1	22	67	6	22
Salyan	15	38	6	1	1	0	24	85	10	38
Surkhet	11	15	0	1	1	0	31	59	10	42
<b>Total</b>	<b>198</b>	<b>383</b>	<b>15</b>	<b>13</b>	<b>12</b>	<b>24</b>	<b>229</b>	<b>868</b>	<b>82</b>	<b>278</b>

**Table 14:Province Seven-Number of HF and Past Hazard incidence**

Districts	Storm	Land Slide	Forest Fire	Cold Wave	Drought	Avalanche	Flood	Total Hazard Incidents	Hospitals	Health Post
Achham	11	39	0	4	1	0	26	81	12	64
Baitadi	17	39	1	1	0	0	30	88	11	56
Bajhang	11	42	1	0	1	2	41	98	12	36
Bajura	26	66	0	6	0	1	28	127	10	18
Dadeldhura	24	18	2	3	2	0	39	88	7	19
Darchula	14	87	2	1	0	2	24	130	9	33
Doti	23	39	1	0	2	0	21	86	10	42
Kailali	40	12	2	10	5	0	134	203	13	31
Kanchanpur	25	8	1	7	3	0	121	165	9	12
<b>Total</b>	<b>191</b>	<b>350</b>	<b>10</b>	<b>32</b>	<b>14</b>	<b>5</b>	<b>464</b>	<b>1066</b>	<b>93</b>	<b>311</b>

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*VIOLENCE AGAINST WOMEN AND CLIMATE CHANGE: WHAT DOES THE EVIDENCE SAY?* Conference: HUMAN SIDE OF CLIMATE CHANGE. Gaby Ortiz-Barreda Department of Health Promotion, Gender and Development –HEMIL Senteret- Multicultural Venues in Health, Gender and Social Justice Research Group University of Bergen, Norway Email: [Gaby.barreda@uib.no](mailto:Gaby.barreda@uib.no)

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