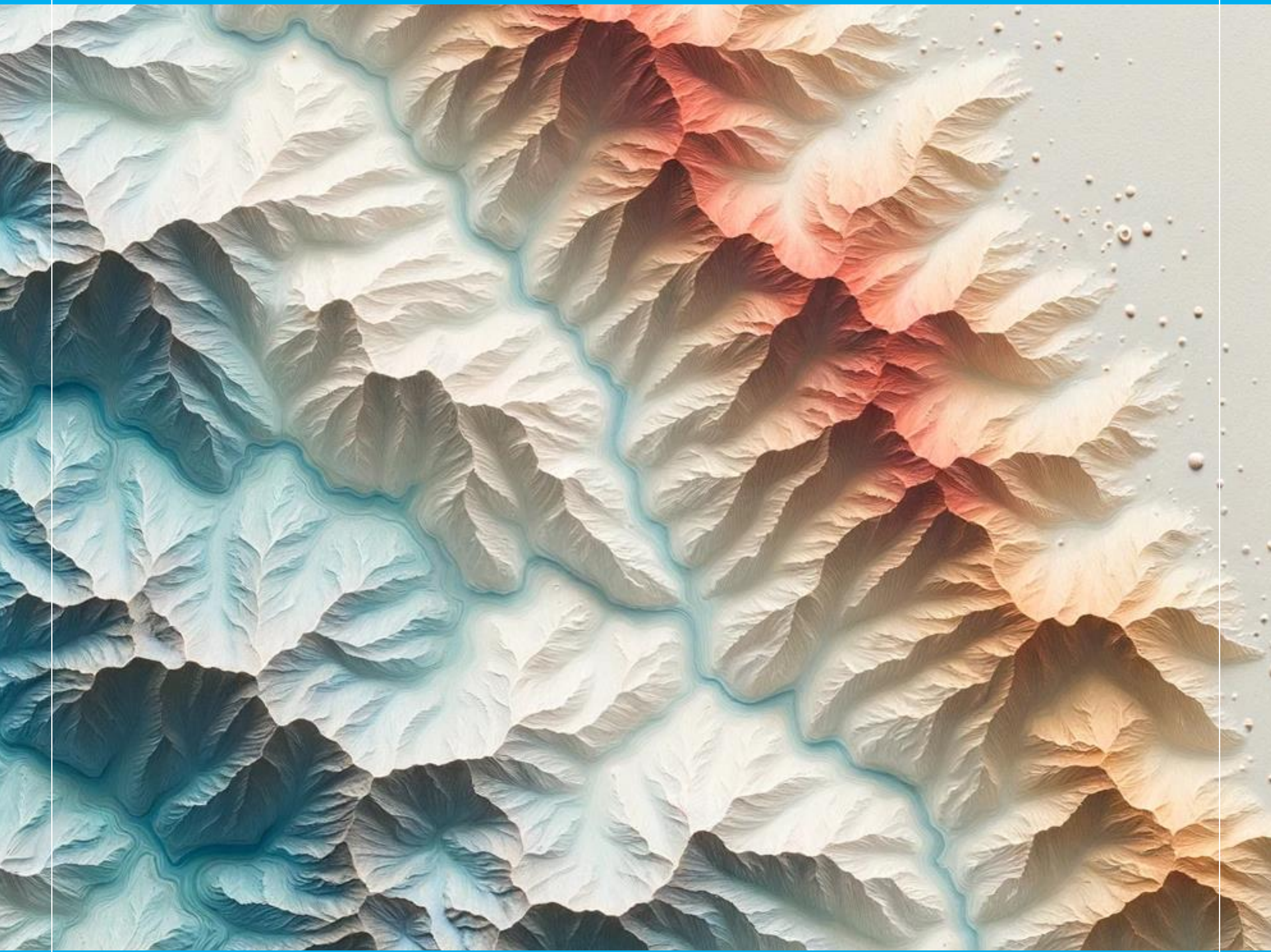

National Assessment of Multi-Hazard Risk to Health Facilities and Critical Infrastructure Under Climate Change

Strengthening Health Facility and Lifeline Infrastructure for Health Emergency Preparedness in Lao PDR

THE WORLD BANK

UN-HABITAT
FOR A BETTER URBAN FUTURE

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Acronyms and Abbreviations

API	Application programming interface
DCDC	Department of Communicable Disease Control
DHHP	Department of Hygiene and Health Promotion
DHO	District Health Office
DHP	Department of Health Personnel
DHR	Department of Healthcare and Rehabilitation
DPC	Department of Planning and Cooperation
DPF	Department of Planning and Finance
FDD	Food and Drug Department
HEPR	Health Emergency Preparedness and Response
IDA	International Development Association
INFORM	Index for Risk Management
Lao PDR	Lao People's Democratic Republic
MOH	Ministry of Health
ND-GAIN	Notre Dame Global Adaptation Initiative
PHO	Provincial Health Office
SPSS	Statistical Package for the Social Sciences
WASH	Water, Sanitation, and Hygiene

Executive Summary

This report presents a comprehensive multi-hazard risk assessment of health facilities in Lao PDR, emphasizing climate-related risks such as floods, droughts, storms, landslides, and wildfires. The study adopts a data-driven methodology, leveraging geospatial data of 1,233 health facilities to assess the periodicity, frequency, and severity of these hazards on health infrastructure.

1. Introduction and Background

Lao PDR's vulnerability to climate risks, underscored by its low rankings in the ND-GAIN and INFORM Risk Indexes, highlights the urgent need to strengthen healthcare facilities. Major floods in recent years have not only caused fatalities and significant economic loss but have also underscored the critical importance of resilient health infrastructure, particularly in the context of Covid-19. The World-Bank funded Lao PDR COVID-19 Response Project, aimed to, among other things, enhance the preparedness and resilience of healthcare facilities. Under this project, UN-Habitat carried out a National Assessment of Multi-Hazard Risk to Health Facilities and Critical Infrastructure under Climate Change.

2. Methodology

The assessment adopted a data-driven methodology, combining paper-based questionnaires at the district level with digital transformation at the provincial level using Kobo Toolbox. This dual approach ensured efficient data collection, monitoring, and accountability across different administrative levels. The methodology includes a detailed analysis of health facilities and critical services, focusing on understanding their exposure and vulnerability to climate hazards. Data management is a critical component, involving both paper-based surveys and digital transformation through Kobo Toolbox. Comprehensive data analysis is conducted using SPSS, integrating hazard risk assessment with critical infrastructure service data to identify high-risk facilities. Additionally, spatial analysis using ArcGIS Pro is utilized to enhance understanding of geographic trends in facility vulnerability.

3. National-Level Findings

The national-level findings indicate a substantial impact of climate hazards on health facilities across Lao PDR. The prevalence of hazard impacts, changes in frequency and severity of hazards, and the overall vulnerability of health facilities are detailed. The report analyses the observed changes in the frequency of climate hazards at the national level, examines their periodicity, and discusses changes in severity. A significant portion of health facilities are affected by storms and floods, with each hazard impacting over 40% of the facilities. Droughts, affecting approximately 39% of health facilities, highlight pressing challenges related to water supply.

4. Provincial-Level Findings

Provincial-level findings offer insights into the specific impacts of various climate hazards in different provinces of Lao PDR. The prevalence and impact of floods, droughts, storms, landslides, and wildfires in various provinces are analysed. The section provides an overview of the occurrence of multiple hazards and their combined impact on health facilities across provinces. Regions like Savannakhet and Champasak are more prone to flooding, while northern provinces such as Oudomxai experience heightened drought conditions. Central provinces report a higher incidence of storms, and landslides are predominantly a concern in the northern hilly terrains, indicating the need for tailored resilience strategies in different areas.

5. Multihazard District Analysis

A detailed analysis of multihazard vulnerability at the district level is presented, offering granular insights into the geographic distribution of risks and vulnerabilities. The district-level analysis uncovers specific clusters of heightened multihazard vulnerability.

6. Infrastructure Impact

The impact of climate hazards on health facility infrastructure is explored, highlighting the need for targeted infrastructure resilience initiatives. The assessment also highlights that critical infrastructures such as roads and electricity supply are notably impacted by landslides and storms, respectively.

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1. Introduction

1.1 Background

Lao PDR is highly exposed to climate and disaster risks such as floods and droughts and, with high vulnerability and low readiness for climate resilience, ranks 121st of 180 countries according to the 2021 ND GAIN index.[1] Significantly, the fact that the readiness ranking (136) is lower than the vulnerability ranking (117) shows a need to build resilience in institutions, systems and processes, infrastructure and the environment. Flooding is particularly problematic, with Lao PDR scoring 9.1 out of 10 for flooding in the 2023 INFORM Risk Index,[2] the 6th highest score of the 191 countries in the index. Major flooding events in the recent years, for example, led to 29 deaths and total damages and losses of over US$270 million in 2013, and 56 fatalities and damage and losses of an estimated US$371.5 million in 2018. Over the next decade, flood-related urban damage alone is estimated to increase from US$49.2 million to US$273 million, and affected GDP from US$373.9 million to US$1.6 billion, according to the World Resources Institute.[3] Flooding and other climate-related hazards have direct and indirect impacts on health facilities throughout the country. In addition to these climate-related events, the COVID-19 pandemic increased the urgency to enhance the national capacity for the preparedness of health facilities including preparedness against multi-hazard and cascading risks.

Disaster and cascading risk pose significant risks to public health in a variety of ways. In addition to deaths and injuries caused by such events as drowning, electrocution, and building collapse, hazards such as floods raise follow-on health risks, including water and vector-borne diseases, infections, and mental health issues. Disasters can also severely disrupt the functioning of health facilities through direct damage to health facilities, as well as through indirect channels such as damage to critical infrastructure, including electricity, water, and transport systems. These can pose cascading risks to the functioning of the country’s health facilities, especially when natural hazard events interact with pandemic risks. Therefore, to strengthen the resilience of healthcare facilities under climate and disaster risk, proper understanding of the current state of hospital safety in Lao PDR is needed.

With the COVID-19 situation in Lao PDR, it has been necessary to improve the country's capacity to respond to health emergency, especially water, sanitation and waste management for health facilities. It is crucial to have the instructions and procedures to guide staff on the operation and maintenance of Water, Sanitation and Hygiene (WASH) facilities, including hospitals and water supply and sanitation, for current and future pandemics and disasters.

The Lao PDR COVID-19 Response Project received financial support of US$ 33 million through the World Bank’s International Development Association (IDA) loan and the Health Emergency Preparedness and Response (HEPR) Trust Fund to respond to the COVID-19 pandemic and improve the preparedness and resilience of healthcare facilities, workers, water, sanitation, and waste management. As part of the HEPR-Trust Fund technical assistance project entitled “Strengthening Health Facility and Lifeline Infrastructure for Health Emergency Preparedness in Lao PDR,” UN-Habitat facilitated a “national assessment of multi-hazard risk to health facilities and critical infrastructure under climate change.”

[1] https://gain.nd.edu/our-work/country-index/rankings/
[2] https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Risk
[3] https://www.wri.org/applications/aqueduct/floods/

1.2 Scope of Assessment

- Exposure Analysis of Critical Services and Health Facilities: Analyse existing geospatial data of ca. 1250 key public health facilities in Lao PDR (i.e., central hospital, provincial hospital, community hospital, and health centre) and basic service provision from the Ministry of Health's (MOH) Health Facility dataset, examining their completeness and relevance to this assessment and identifying gaps, if any, that should be filled with additional data collection. Moreover, design a procedure for vulnerability data collection including the development of an appropriate set of questionnaires on hazard-caused service disruptions. Exposure analysis will further help prioritise factors that may compromise hospital planning, design, construction, repair, retrofit, and operation and their link to critical services under risk of natural disasters in the detailed pilot of a hospital safety index, which will be completed as a complementary activity to this national assessment.
- Natural Hazard and Risk Assessment: Conduct multi-hazard assessments for health facilities and related critical service provision in current and future climates - building on UN-Habitat's experience from previous vulnerability assessments at the provincial level;[4] Develop and apply appropriate method(s)/metrics to evaluate risks to public health facilities and Critical Services, quantifying their interdependencies and cascading consequences of health services disruption.
  - Data Management: Consolidate all newly obtained information on multi-hazard exposure and vulnerability of Critical Services of public health facilities into one centralized, geospatial asset management database system. This system shall ideally build upon and consolidate the existing systems within Lao PDR (i.e., national vulnerability assessment and the Ministry's Health Facility dataset), so that an updated version can be returned to the MOH with a seamless handover for further use.
  - Develop technical reports in Lao, with translation in English and submit to MOH and the World Bank.

Table 1: Health facilities by type within the scope of the natural hazard and risk assessment

Health Facility Type	
Central Hospital	**8**
Provincial Hospital	**20**
Community Hospital	**137**
Community Hospital (DH-A)	34
Community Hospital (DH-B)	103
Health Centre	**1082**
Health Centre (HC-A)	176
Health Centre (HC-B)	906
Grand Total	**1247**

[4] Lao PDR National Climate Change Vulnerability Assessment, 20211. 1 https://fukuoka.unhabitat.org/wp-content/uploads/2021/12/3_Lao_PDR_National_Climate_Change_Vulnerability_Assessment.pdf

2. Methodology

The National Assessment of Multi-Hazard Risk to Health Facilities and Basic Service Provision Under Climate Change assessment comprised several activities.

2.1 Exposure and vulnerability analysis of health facilities and critical services

To provide a comprehensive risk profile for each facility and related infrastructure services, vulnerability data was obtained from a questionnaire designed by UN-Habitat. The questionnaire facilitated the collection of multi-hazard exposure data of health facilities and critical services, quantifying the risks, interdependencies, and cascading consequences of health service disruption.

UN-Habitat adopted a highly effective data collection methodology that has demonstrated impressive results in the past. The success of this methodology is reliant on coordination between the Ministry of Health (MOH) and the provincial and district health offices, with technical assistance from UN-Habitat. The monitoring of progress and accountability at each level was ensured by assigning specific roles and responsibilities during various stages of the procedure. The methodology involved collecting data at the district level and aggregating the information subsequently as it went from the district to the national level (see Figure 1).

The proposed methodology enables local data collection by the national level without the need of travel to the sites thereby reducing costs, saving time, and allowing a great amount of data to be collected from every district in a very limited time.

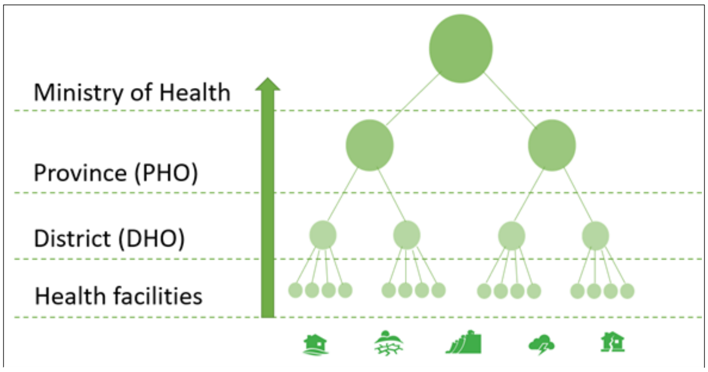


Figure 1: Data collection and aggregation pathway

2.1.1 Data collection tools

The data was collected using paper questionnaires at the district level. Data from the questionnaires was then transformed to a digital format at the provincial level.

1. Paper-based questionnaires at the district level

UN-Habitat developed a draft questionnaire aimed at assessing the impact of climate change hazards on healthcare facilities' critical service provision. The questionnaire examines the direct or indirect exposure of these facilities to climate change hazards, while also exploring the frequency, severity, and regularity of such events, and their potential to disrupt essential services. The goal was to quantify the interdependencies and cascading consequences of health service disruptions resulting from these hazards.

To ensure ease of use and efficiency, the questionnaire was designed in a user-friendly and concise manner, allowing respondents to complete it quickly. Once the draft was finalised, it was circulated amongst relevant departments of MOH and the World Bank for their review and inputs. MOH departments included in the review were:

- Department of Hygiene and Health Promotion (DHHP)
- Department of Communicable Disease Control (DCDC)
- Department of Healthcare and Rehabilitation (DHR)
- Food and Drug Department (FDD)
- Department of Health Personnel (DHP)
- Department of Planning and Finance (DPF)
- Department of Planning and Cooperation (DPC)
- Cabinet (Governance, Management, and Inspection)

Feedback from the reviewers was incorporated into the draft questionnaire to produce the final version.

At the district level, the paper-based questionnaires were administered by staff from the district health offices (DHO) to collect vulnerability data from health facilities and related critical services across each district. The questionnaire focused on two main areas of investigation. The first area involves identifying the occurrence, frequency trends in recent years, and severity of different types of hazards (such as floods, droughts, storms, landslides, wildfires, and heatwaves) to determine the level of hazard risk faced by each health centre. The second area examined how each hazard affects or disrupts the provision of essential services linked to critical services. This comprehensive approach was designed to enable a thorough understanding of the risks associated with hazard-induced service disruptions and the potential consequences for each healthcare facility.

The questionnaire was designed in a straightforward manner to streamline the data collection process. UN-Habitat's prior experience has shown that targeted questions and the collection of specific information are effective in obtaining valuable data with a minimal number of questions. This approach not only saves time for both the enumerators responsible for data collection and the respondents but also enhances the quality of the collected data.

2. Digital data collection at the provincial level

The provincial level digitalisation of the collected data was conducted through a primary data collection platform called Kobo Toolbox. This open-source data collection tool, created by the Harvard Humanitarian Initiative, has a proven track record of efficiently collecting data. The platform enables the aggregation of all district-level data into a centralized database, ensuring organized and easily accessible information. Kobo Toolbox also offers data validation and quality control checks to guarantee the accuracy of the collected data.

Overall, this approach was designed to provide a comprehensive understanding of the risks faced by each health facility, using a high quality, efficient data collection and data management method.

2.1.2 Roles at the district level (DHO)

Staff from the District Health Offices (DHO) were responsible for gathering information from the health facilities in their respective district by completing the paper-based questionnaires. The district focal points had a specific timeframe to complete this task, adding a layer of efficiency and urgency to the data collection process. DHO staff's knowledge of their district was key in overcoming challenges including limited access to information and telecommunication infrastructure in certain parts of the country. The number of health facilities in each district was manageable for the DHOs with an estimated average of eight health facilities per district.

For the facilitation of district-level officials to gather valuable information in a timely and efficient manner, the questionnaires were designed with simple language and conciseness in mind. Besides this, recommended communication channels (e.g., mail, phone, site visit) were determined for each facility based on discussions between national and provincial focal points

Table 2: Provincial and district officials trained in data collection.

Training North (Louangphabang)	Participants
Louangphabang	**2**
Chomphet	1
Louangphabang	1
Nambak	1
Nan	1
Ngoy	1
Pak-ou	1
Pakxeng	1
Phonthong	1
Phonxai	1
Phoukhoun	1
Viangkham	1
Xiangngeun	1
Phongsali	**2**
Bounnua	1
Bountai	1
Khoua	1
Mai	1
Nyot-ou	1
Phongsali	1
Samphan	1
Houaphan	**2**
Et	1
Hiam	1
Houamuang	1
Kouan	1
Sopbao	1
Viangxai	1
Xamnua	1
Xamtai	1
Xiangkhoh	1
Xon	1
Xainyabouli	**2**
Boten	1
Hongsa	1
Kenthao	1
Khop	1
Ngeun	1
Paklay	1
Phiang	1
Thongmixai	1
Xainyabouli	1
Xaisathan	1
Xianghon	1
Bokeo	**2**
Houayxay	1
Meung	1
Paktha	1
Pha-oudom	1
Tonpheung	1
Louangnamtha	**2**
Long	1
Naleh	1
Namtha	1
Sing	1
Viangphoukha	1
Oudomxai	**2**
Beng	1
Houn	1
La	1
Namoh	1
Nga	1
Pakbeng	1
Xai	1
Total Provicial focal Points	**14**
Total District focal Points	**57**
Total Participants	**71**

Training Central (Vientiane	Participants
Bolikhamxai	**2**
Bolikhan	1
Khamkeut	1
Pakkading	1
Pakxan	1
Thaphabat	1
Viangthong	1
Xaichamphon	1
Vientiane Capital	**2**
Chanthabouli	1
Hatxayfong	1
Naxaythong	1
Pakngum	1
Sangthong	1
Sikhottabong	1
Sisattanak	1
Xaisettha	1
Xaithani	1
Khammouan	**2**
Boualapha	1
Hinboun	1
Khounkham	1
Mahaxai	1
Nakay	1
Nongbok	1
Nyommalat	1
Thakhek	1
Xaibouathong	1
Xebangfai	1
Xaisomboun	**2**
Anouvong	1
Hom	1
Longcheng	1
Longxan	1
Thathom	1
Vientiane	**2**
Fuang	1
Hinheup	1
Kasi	1
Keo-oudom	1
Met	1
Mun	1
Phonhong	1
Thoulakhom	1
Vangviang	1
Viangkham	1
Xanakham	1
Xiangkhouang	**2**
Kham	1
Khoun	1
Mok	1
Nonghet	1
Pek	1
Phaxai	1
Phoukout	1
Total Provicial focal Points	**12**
Total District focal Points	**49**
Total Participants	**61**

Training South (Pakse)	Participants
Savannakhet	**2**
Atsaphangthong	1
Atsaphon	1
Champhon	1
Kaysone Phomvihane	1
Nong	1
Outhoumphon	1
Phalanxai	1
Phin	1
Songkhon	1
Thapangthong	1
Vilabouli	1
Xaibouli	1
Xaiphouthong	1
Xepon	1
Xonbouli	1
Champasak	**2**
Bachiangchaleunsouk	1
Champasak	1
Khong	1
Mounlapamok	1
Pakxe	1
Pakxong	1
Pathoumphon	1
Phonthong	1
Soukhouma	1
Xanasomboun	1
Xekong	**2**
Dakchung	1
Kalum	1
Lamam	1
Thateng	1
Attapu	**2**
Phouvong	1
Samakhixai	1
Sanamxai	1
Sanxai	1
Xaisettha	1
Salavan	**2**
Khongxedon	1
Lakhonpheng	1
Lao-ngam	1
Salavan	1
Samouay	1
Ta-oy	1
Toumlan	1
Vapi	1
Total Provicial focal Points	**8**
Total District focal Points	**42**
Total Participants	**50**

beforehand. To further support the DHO staff, detailed information on role and communication channels was shared during two training sessions on data collection planning. Table 2 shows the number of health officials from each district and province that were trained in data collection.

2.1.3 Role at the provincial level

The Provincial Health Offices (PHO) played a critical role in the data collection process. Initially, the Ministry of Health identified two provincial focal points in each province, inviting them to a capacity-building workshop in Vientiane. Here, they received training on the data collection process and were given sets of paper questionnaires, which were designed to capture a range of metrics including occurrence, periodicity, frequency, and severity for each climate hazard. These questionnaires were grouped by district and further sorted by individual health facilities.

After the workshop, provincial focal points returned to their provinces and distributed the questionnaires to district focal points, who were then responsible for collecting data from the health facilities in their respective jurisdictions.

Once the paper questionnaires were completed, the PHO entered the completed questionnaire data from each facility in their province into the centralized database using the Kobo Toolbox platform.

Once all data was collected, the provincial focal points were responsible for entering it into the Kobo Toolbox digital platform.

2.1.4 Role at the national level

The national level, with technical assistance from UN-Habitat, had the primary responsibility of coordinating, facilitating, and supervising the provincial level data collection process. A team was therefore set up to monitor the provincial teams. Each team member was responsible for overseeing the progress of specific provinces and maintaining close communication with the provincial focal points.

To monitor the data collection process, a PowerBI dashboard was linked to the central Kobo Toolbox database. This dashboard offered a real-time visual representation of the progress, enabling the MOH at the central level to track the advancement, verifying which provinces and districts were meeting their assigned targets or experiencing delays within a specified timeframe. This approach helped ensure that any potential delays or issues in data submission were identified and addressed promptly.

To ensure effective communication between national staff and provincial focal points, as well as to aid at the national level throughout the entire process, UN-Habitat actively participated in the training sessions. The monitoring and evaluation strategy, supported by UN-Habitat, enabled efficient and effective monitoring of the data collection process, thereby providing valuable insights to the project team, and ensuring the project remained on track.

2.2 Data management

2.2.1 Data collection

To ensure comprehensive and accurate data collection for this project, a mixed-method approach was employed, encompassing various techniques and tools to gather the necessary information. Building upon the previous subchapter's discussion, this section will delve deeper into the specific methodologies and technologies utilized in the data collection process.

The primary method utilized in the data collection process involved conducting paper-based surveys. This approach enables the collection of detailed information directly from health facilities. DHO officials visited, contacted the designated sites, or applied their knowledge of the health facilities within their districts to capture key data on climate change exposure and the linkages between climate change and the provision of basic services to the health centres. By utilizing paper-based surveys, the project ensures a systematic and structured approach to data collection, allowing for consistency and comparability across different health facilities and catchment areas. This method provides an opportunity to gather first-hand information from health facilities, ensuring that the data collected reflected the unique challenges and circumstances faced in each site.

Once the surveys were completed, the collected data underwent a digital transformation process. This involves the conversion of paper-based responses into electronic format for ease of management, analysis, and storage. To facilitate this process, the project employed Kobo Toolbox as the designated data management platform. Kobo Toolbox is an open-source data collection and management tool that provides a user-friendly interface for survey design, data collection, and data analysis. It allows for the creation of customized digital forms based on the paper-based questionnaires, which can be easily deployed to surveyors' mobile devices for data entry.

The digitization process involves carefully inputting the responses from the paper-based surveys into the Kobo Toolbox platform. This may be performed by trained data entry personnel. The platform offers features such as data validation checks, skip logic, and real-time data synchronization, ensuring the accuracy and integrity of the digitized data.

Once the data was successfully entered the Kobo Toolbox platform, it was automatically consolidated in a centralized database. This centralized database serves as a repository for all the collected data, allowing for efficient data management and analysis. The project team could access the database in real-time, ensuring timely availability of the latest data for monitoring and decision-making purposes.

Furthermore, the use of Kobo Toolbox enables enhanced data quality control measures. The platform supports built-in checks and validations to minimize errors and inconsistencies during data entry. It also allows for real-time monitoring of the data collection progress, enabling the project team to identify and address any issues or discrepancies in a timely manner. These quality control measures ensure the reliability and accuracy of the collected data, enhancing the overall validity of the project's findings and conclusions.

2.2.2 Data analysis

The resulting dataset underwent comprehensive analysis using the Statistical Package for the Social Sciences (SPSS) software platform, following internationally recognized standards. The primary objective of this analysis was to determine the level of exposure that different hazards pose to health facilities and their subsequent impact on the accessibility of basic services. To achieve a comprehensive understanding of the actual threats faced by health facilities, a hazard risk assessment was incorporated into the analysis. This assessment shed light on the potential limitations in health service provision resulting from these hazards.

Moving forward, an integration process was carried out, merging the obtained dataset with critical infrastructure service data. The aim here was to identify the health facilities that are most vulnerable to cascading consequences, which can lead to significant disruptions in health service delivery during emergencies. By considering the interconnectedness between health facilities and critical infrastructure services, this analysis allowed for the identification of high-risk facilities requiring special attention.

Incorporating a spatial component into the analysis, the ArcGIS Pro software was utilized. This spatial analysis enabled the identification of potential geographical trends related to the vulnerability of health facilities. By precisely locating the most vulnerable health facilities, the analysis provided valuable insights into their specific geographic contexts.

2.2.3 Data verification and monitoring

Data monitoring played a crucial role in overseeing the progress of the data collection process. To ensure effective monitoring, specific application programming interfaces (APIs) were utilized, establishing a seamless connection between the central database and Power BI. This integration enabled the creation of a dynamic and real-time dashboard, providing an accurate reflection of the status of data collection. Through this dashboard, stakeholders, and project teams had immediate access to key metrics and indicators, facilitating timely decision-making and ensuring the completion of data collection within the desired timeframe.

Furthermore, all resulting products and outputs from the data collection process adhere to national and international standards. This adherence will ensure the compatibility and interoperability of the collected data with existing systems within Lao PDR. By following these standards, project aims to seamlessly integrate the collected data into the country's health infrastructure, enabling efficient data sharing, analysis, and utilization by relevant stakeholders and institutions.

The combination of a multi-hazard risk assessment approach and comprehensive data management practices established a robust framework for understanding and addressing vulnerabilities in the health sector. By systematically assessing risks associated with multiple hazards, such as natural disasters, disease outbreaks, and other emergencies, this approach provides a holistic perspective on the vulnerabilities faced by health facilities and the broader health system. This comprehensive understanding will guide the development of targeted interventions and strategies to strengthen the resilience and response capacity of the health sector in Lao PDR.

In summary, the implementation of robust data monitoring mechanisms, adherence to national and international standards, and the integration of multi-hazard risk assessment ensured the reliability and quality of the collected data. This, in turn, will enable informed decision-making, effective planning, and the implementation of appropriate measures to mitigate vulnerabilities and enhance the overall preparedness and response capabilities of the health sector in Lao PDR.

2.3 Data Analysis: Periodicity, Frequency and Severity

In the context of assessing vulnerabilities of health facilities to climate hazards in Lao PDR, understanding the key risk factors of Periodicity, Severity, and Frequency is crucial. These factors form the cornerstone of our vulnerability assessment methodology, each representing a distinct dimension of the risks posed by various climate hazards.

Periodicity refers to the regular occurrence of a climate hazard over a given time frame. It is categorized into four distinct levels: "1 every 10 Years," indicating rare events; "1 every 3-5 years," denoting occasional occurrences; "1 per year," suggesting annual regularity; and "More than 1 per year," which signifies hazards that occur multiple times within a single year. This factor is critical in vulnerability assessment as it helps in identifying the regularity and predictability of hazards, thereby enabling better planning and preparedness. Understanding the periodicity of climate hazards allows for the allocation of resources and the implementation of mitigation strategies in a manner that is proportionate to the frequency of these events.

Severity and **Frequency** are equally important in contributing to vulnerability. **Severity** is classified into three categories to show the change in severity over time: "less severe," for hazards that have relatively minor impacts and are decreasing in severity; "not changing," indicating no significant alteration in the impact level over time; and "more severe," for hazards that have increasingly significant impacts. This categorization allows for an understanding of the intensity and potential damage of each hazard, guiding prioritization, and response efforts. Similarly, **Frequency** refers to the change in frequency over time and is categorized as "less frequent," for hazards that are reducing in occurrence; "not changing," indicating a stable pattern of occurrence; and "more frequent," for hazards that are occurring with increasing regularity. Frequency provides insight into the changing patterns of hazards, which is essential for long-term planning and adaptation strategies.

These three factors – Periodicity, Severity, and Frequency – are interrelated and collectively provide a comprehensive understanding of the risks associated with climate hazards. Their assessment forms the basis for calculating the Individual Hazard Vulnerability Index and the Multi-Hazard Vulnerability Score, critical components in our methodology for evaluating the resilience of health facilities in Lao PDR against climate-induced risks.

2.3.1 Individual Hazard Vulnerability Index Calculation

In assessing the vulnerabilities of health facilities to climate hazards in Lao PDR, a sophisticated methodology was employed for the Individual Hazard Vulnerability Index. This methodology is designed to capture the complex interplay between the different risk factors of periodicity, severity, and frequency, and to reflect their compound impact on vulnerability. The following formula was utilized:

2.3.1.1 Vulnerability Index

$$\frac{3\times(Periodicity-1)}{3}+\frac{3\times(Severity-1)}{2}+\frac{(Frequency-1)}{2}+\frac{2\times\left((Periodicity-1)\times(Severity-1)\right)}{6}+\frac{\left((Periodicity-1)\times(Frequency-1)\right)}{6}+\frac{\left((Severity-1)\times(Frequency-1)\right)}{6}\div\left(10+\frac{4}{6}\right)$$

Periodicity (3/3 weight): This factor is weighted heavily as it indicates the regularity of a hazard occurrence. Higher periodicity means more frequent exposure to the risk, necessitating stronger resilience measures.

Severity (3/2 weight): The severity of a hazard plays a crucial role in assessing vulnerability. A higher severity score, indicating more devastating impacts, warrants greater attention and resource allocation.

Frequency (1/2 weight): Although important, frequency is weighted less than periodicity and severity, as the focus is more on how often the event could occur rather than the regularity or intensity of its impact.

The inclusion of interaction terms in the formula:

$$(Periodicity * Severity), \quad (Periodicity * Frequency), \quad (Severity * Frequency)$$

allows for a deeper understanding of how these factors compound each other, thus offering a more comprehensive view of the vulnerability. The simultaneous consideration of how often a hazard occurs (Periodicity) and the intensity of its impact (Severity) allows for a more realistic assessment of the risk. For example, a hazard that occurs with high periodicity and with high severity poses a significantly greater risk than one that is either less periodic or less severe. Therefore, the interaction of Periodicity and Severity is weighted higher.

2.3.2 Multi-Hazard Vulnerability Score Calculation

The Multi-Hazard Vulnerability Score provides a balanced composite score reflecting the overall risk profile of health facilities against multiple climate hazards. This score is derived using the following approach:

2.3.2.1 Multi-Hazard Vulnerability Index

$$\text{Multi} - \text{Hazard Vulnerability Score} = SUMPRODUCT(Normalized\ Scores, Weights)$$

The normalized scores[5] for each hazard vulnerability index are first computed, and then a weighted sum[6] is calculated using the SUMPRODUCT function[7]. The weights are set based on the normalization of the vulnerability indexes for each location. For example, in a location with high flood and drought risks but no wildfire risk, the weights for flood and drought would be 1 (one), while the weight for wildfire would be 0 (zero). This method ensures that the overall score accurately reflects the relative importance of each hazard in the context of specific locations.

2.4 Understanding the Timing and Impact

While the previous sections provide a snapshot of the climate hazards affecting health facilities in Lao PDR, it is crucial to dig deeper to understand what makes some facilities more vulnerable than others. However, to understand the scope of these vulnerabilities, we delve deeper into four specific metrics available in our dataset: Periodicity, Frequency, Severity, and the calculated Vulnerability Index.

Starting with Periodicity, the dataset categorizes this into four groups: '1 every 10 years,' 'every 5 to 3 years,' 'Once a year,' and 'More than once a year.' Knowing the periodicity of each hazard helps us in several ways. For instance, a health facility affected by floods 'more than once a year' would require far more stringent and frequent preparedness measures compared to one that experiences floods '1 every 10 years.'

Frequency is the next crucial metric, divided into 'less frequent,' 'no change,' and 'more frequent.' A facility experiencing 'more frequent' storms within a year, for example, would require different preparation levels compared to one where the frequency is 'less frequent' or shows 'no change.' This information is vital for resource allocation and emergency planning.

The third metric is Severity, also categorized as 'less severe,' 'no change,' and 'more severe.' The potential impact of a 'more severe' hazard is much higher compared to a 'less severe' one. This distinction helps in tailoring the response plans. For instance, a 'more severe' event may require immediate evacuation and long-term recovery efforts, whereas a 'less severe' event might only necessitate minor repairs.

Our dataset combines these three metrics into a Vulnerability Index, calculated through normalization formulas as explained in Section 2.3.1. This index gives an overall picture of how

[5] "Normalized Scores" refer to individual hazard scores adjusted to a common scale, ensuring comparability.
[6] "Weights" are numerical values assigned to each hazard score, reflecting its relative importance in the overall vulnerability assessment.
[7] "SUMPRODUCT" is a mathematical function that multiplies corresponding elements in two arrays and returns the sum of those products. In this context, it combines individual hazard scores and their respective weights to calculate an overall score.

susceptible each health facility is to specific hazards. A high Vulnerability Index calls for immediate action and resource allocation, identifying those health centres that are most at risk.

Considering periodicity, severity, and frequency allows us to move from a general understanding of vulnerability to a more nuanced, targeted analysis. For example, a facility affected 'more than once a year' by 'more severe' storms would naturally have a higher Vulnerability Index and should be a priority for interventions.

With this detailed understanding, decision-makers are better equipped to create nuanced strategies that cater to the specific needs and vulnerabilities of each health facility. Whether it is through reinforced infrastructure, emergency training programs, or resource pre-positioning, interventions can be precisely tailored. The objective, therefore, is to turn complex data into actionable insights that can safeguard the health facilities and, by extension, the communities that rely on them

3. National-Level Findings

3.1 Prevalence of Hazard Impacts

This overview draws on the assessment data to show the number of health facilities impacted by each of the hazards that were assessed, namely storms, floods, droughts, landslides, and wildfires. All these hazards can disrupt essential infrastructure, making it difficult for people in surrounding villages to access health services, especially in emergencies. Figure 2 shows the percentage of health facilities affected by each of the five hazards which were assessed.

The hazard which affects the highest number of health facilities is storms. Of 1,233 health facilities, 569 are affected by storms or 46%. Two hazards which sometimes occur because of storms are floods and landslides.

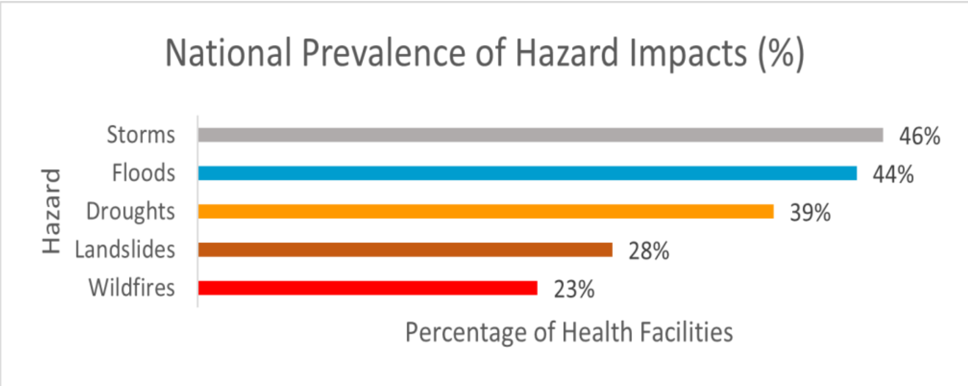


Figure 2: Percentage of health facilities affected by each hazard.

The number of health facilities affected by floods is 547, 44% of the total number of health facilities. Of all the health facilities, 69% were affected by both storms and floods.

Landslides impact 344 health facilities, accounting for 28% of the total. The prevalence of landslides highlights the geographic challenges some facilities face, emphasizing the complex terrain in which they operate.

While storms, floods and landslides can be linked to sudden, extreme weather events, there is also a significant impact from droughts, with 478 facilities, or 39% of the total, being affected. The impact of droughts is especially felt in the disruption of essential services such as water supply.

Finally, wildfires introduce a different kind of challenge, affecting 282 facilities or 23% of the total. Though they may occur less frequently than storms or floods, their disruptive potential, especially in rural settings, should not be underestimated.

This quantitative data gives a picture of the multi-layered vulnerabilities facing health facilities in Lao PDR. Storms and floods are the most pressing, closely followed by droughts, landslides, and wildfires. Each of these hazards has broader implications, affecting not just the health facilities but also the communities that rely on them.

The following sections provide a more comprehensive understanding of the data and its implications for both the health facilities and the communities they serve.

3.2 Change in Frequency at the National Level.

Aggregated data shows that a significant number (20%) of hazards have been observed to be increasing in frequency. This aligns with trends observed because of climate change. Hazards for which no change in frequency has been observed accounted for 44% of hazards. Figure 3 shows the change in frequency for each hazard. It can be observed that droughts are increasing more than any other hazard, followed by storms and then landslides, floods and wildfires respectively.

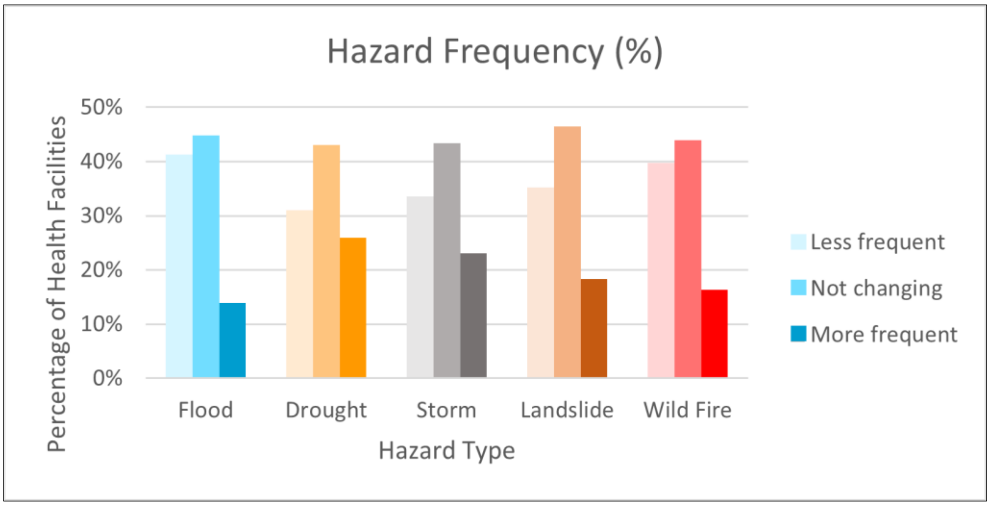


Figure 3: Change in frequency of each hazard nationally, as a percentage of health facilities

3.3 Periodicity at the National Level

There was a wide variation in the periodicity of the different hazards. Wildfires had the highest percentage of rare occurrences with 26% of health facilities reporting that wildfires occur only once every 10 years while only 7% of health facilities reported wildfires occur more than once a year. However, wildfires, as well as storms, droughts and landslides were reported as occurring once a year or more in 50% or more of the health facilities. In contrast, floods were not reported as occurring so often, with 50% of health facilities observing that floods occur once every 3-5 years. The periodicity of the different hazards is shown in Figure 4.

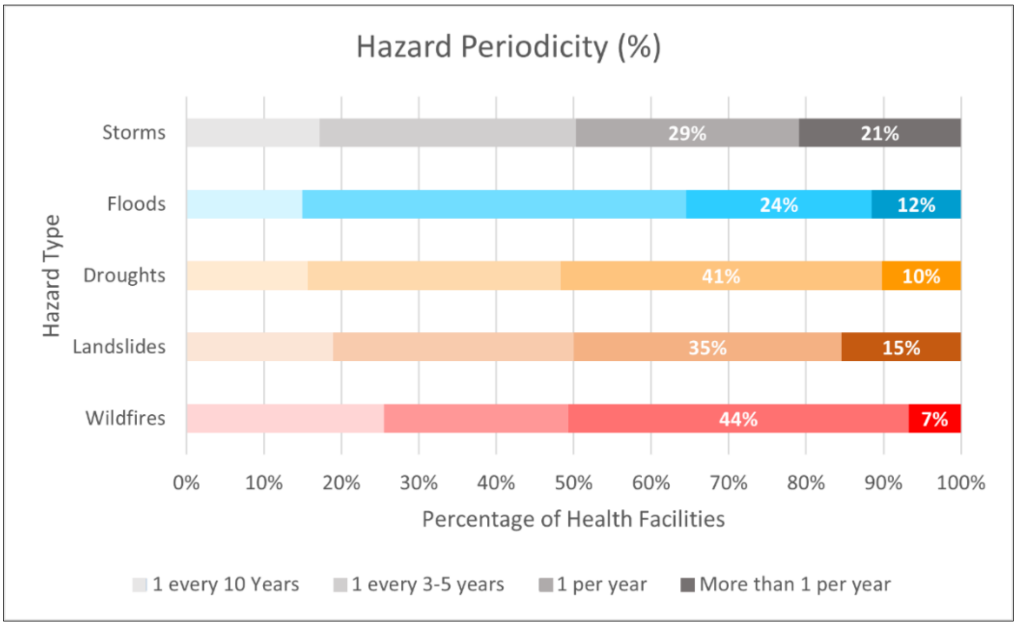


Figure 4: Periodicity of each hazard nationally, shown as percentage of health facilities.

3.4 Change in Severity at the National Level

Changes in severity were more pronounced than changes in frequency. Overall, 26% of hazards were observed to be increasing in severity, 40% are not changing in severity and 36% are decreasing in severity. Storms are increasing the most in severity, followed by droughts, floods, landslides and wildfires as shown in Figure 5.

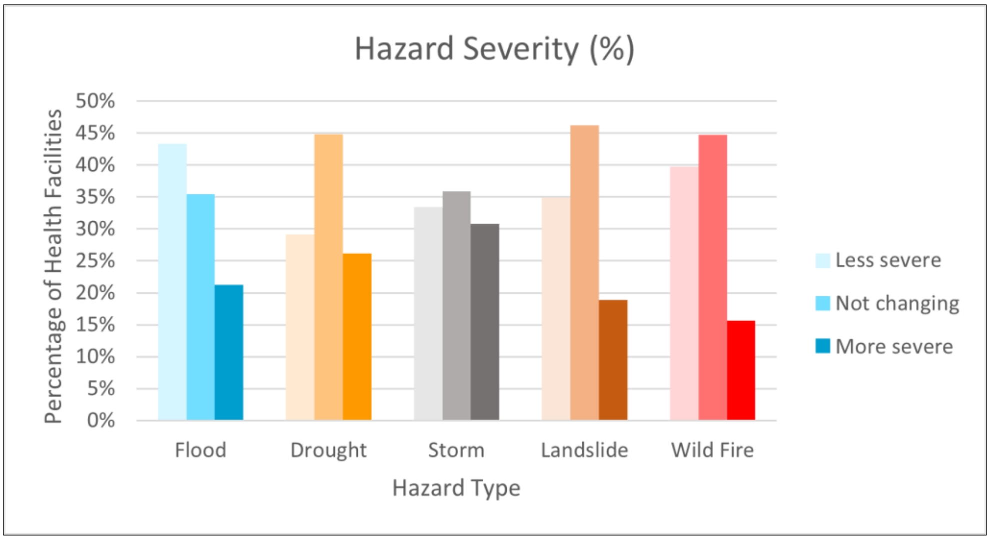


Figure 5: Changes in severity at the national level, shown as percentage of health facilities

3.5 Vulnerability at the National Level

As previously explained, the data on each of the hazards was combined according to a specified formula to show the vulnerability to each of the hazards. Overall, 5% of the health facilities are shown to be extremely vulnerable to hazards. The percentage of health facilities at each of the five categorised vulnerability levels is shown in Figure 6.

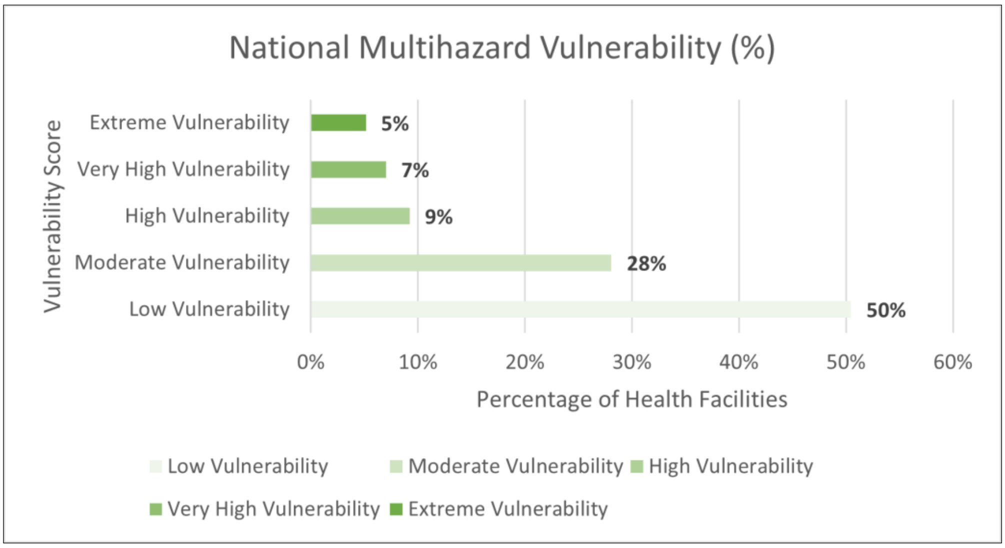


Figure 6: Level of vulnerability shown by percentage of health facilities.

In the extreme vulnerability category, the hazard creating the highest vulnerability is storms, followed by droughts and then landslides. Droughts are the most prominent hazard in the very high vulnerability category, highlighting the critical need for resilient water supply and sanitation facilities. The percentage of health facilities at the different level of vulnerability to specific hazards is shown in Figure 7.

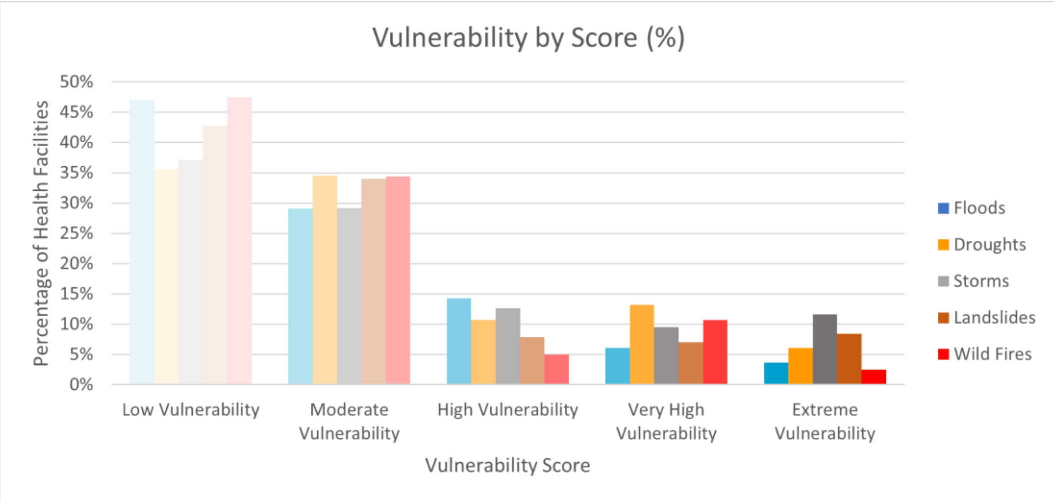


Figure 7: Level of vulnerability to each hazard, shown as percentage of health facilities.

4. Provincial-Level Findings

This section shows the percentage of health facilities in each province which are affected by each hazard, and the distribution of affected health facilities over the country. When analysing the data, it is noteworthy that the population and health facilities are not evenly distributed over the country, as shown in Figure 8. With 15 districts and a population of 969,697, according to the 2015 census, Savannakhet is the most populous province. To serve its large population, Savannakhet has the 174 health facilities, the largest number of any province. In contrast, Xaysomboun has five districts and a population of 85,168 according to the 2015 census. This is the lowest population of any province. Correspondingly, Xaysomboun has 22 health facilities, the lowest number of any province.

Figure 8: Location of health facilities

When displaying the findings of the assessment at the provincial level, two graphs are shown. The first shows the number of impacted health facilities in the province as a percentage of the total number of facilities in the country. These graphs show that the more populous provinces often have a greater number of affected facilities. The second graph shows the number of affected facilities as a percentage of the total number of facilities in the province. These graphs show that there are less populous provinces with a higher rate of impacted health facilities than that of some of the more populous provinces. Both the graphs are shown since they both have implications for health service delivery.

Graphs of provincial-level data on periodicity, severity and frequency are available in Annex 0, starting on page A.

4.1 Occurrence of Floods in Provinces

Figure 9 shows the number of flood-impacted health facilities in each province as a percentage of the total number of health facilities in Lao PDR. Nearly 7% of health facilities are impacted by floods and located in Savannakhet province, where there are 82 impacted facilities, with almost 6% located in Khammouane. The provinces with the smallest number of flood-affected health facilities are Xaysomboun and Xayaboury, which each have four facilities impacted by floods.

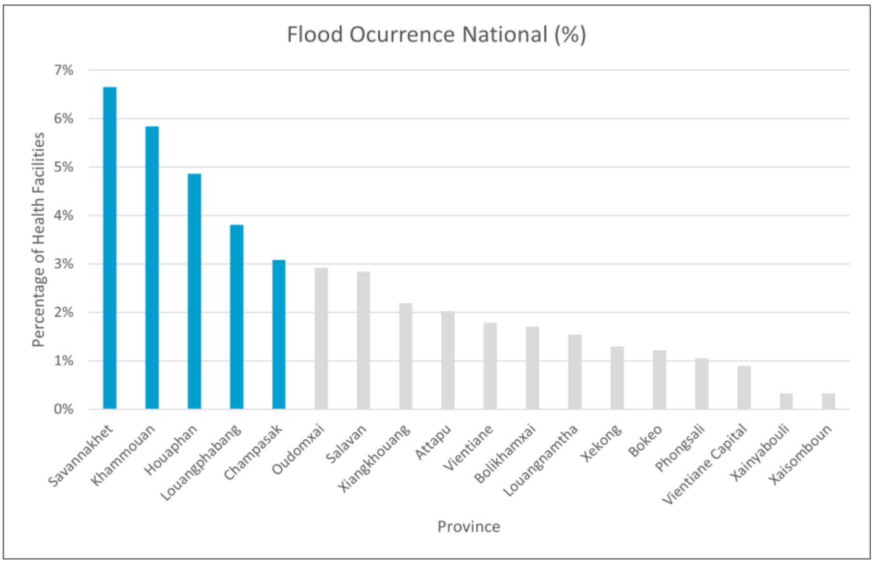


Figure 9: Flood-affected health facilities as a percentage of total health facilities in Lao PDR

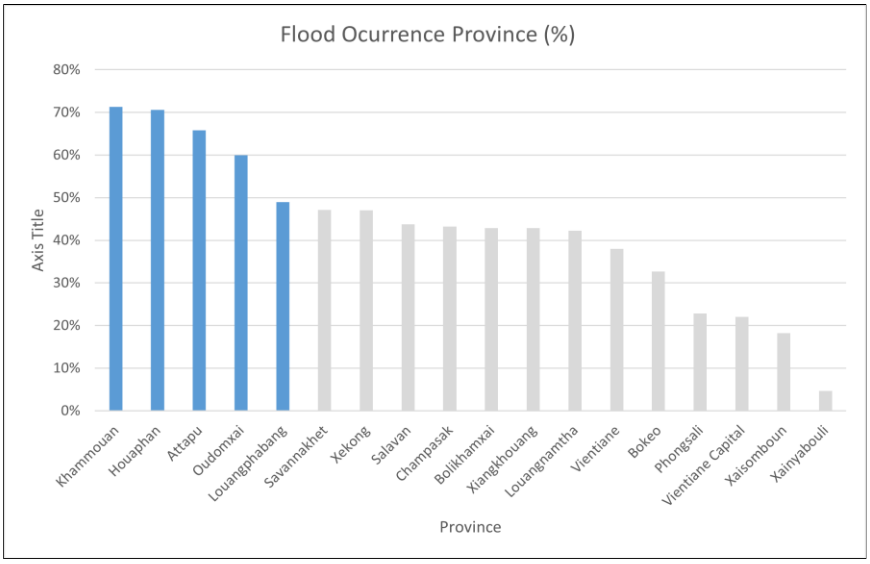


Figure 10: Percentage of total health facilities in province which are affected by flooding

To show the rate of flooding in each province, Figure 10 shows the percentage of each provinces' health facilities which are affected by flooding. Although Savannakhet has the highest number of flood-impacted health facilities, Khammouane and Huaphanh have the highest rates of flooding with 71% of their health facilities impacted. In contrast, Savannakhet has only 47% of its health facilities affected by floods.

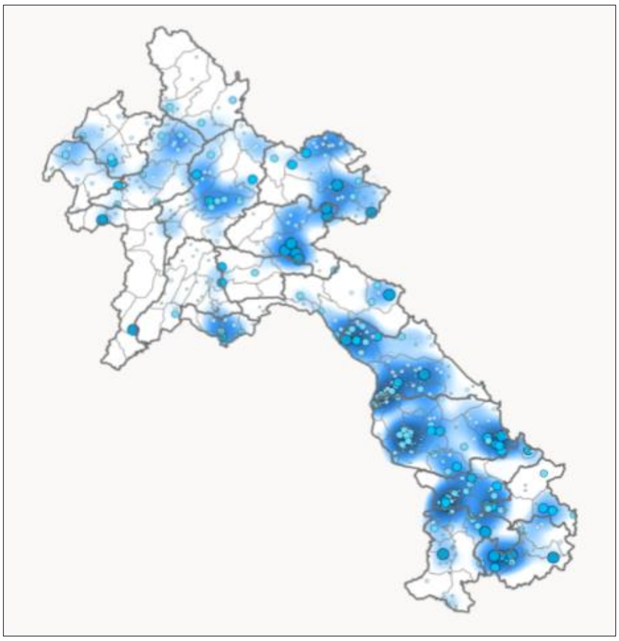


Figure 11: Heatmap of flood-affected facilities of Lao PDR

Figure 11 shows the most flood-affected regions of the country. The shading is a heat map showing the density of flood-affected health centres and the circles represent individual health centres, with the size and shading of the circles representing the health centres' degree of vulnerability to flooding. **Error! Reference source not found.** shows there are several areas with high vulnerability to flooding. The two districts with the highest number of affected facilities in Savannakhet are Champhone District and Nong District. Other districts with a high number of affected facilities are Sanamxay District in Attapeu, Khongxedone District in Saravane, and Xebangfay, Nongbok, Khounkham and Hinboon Districts in Khammouane. In Huaphanh, which has the highest equal rate of flooding, the most affected districts are Add, Xiengkhor, southern Xamneua and western Xam tay.

4.2 Occurrence of Droughts in Provinces

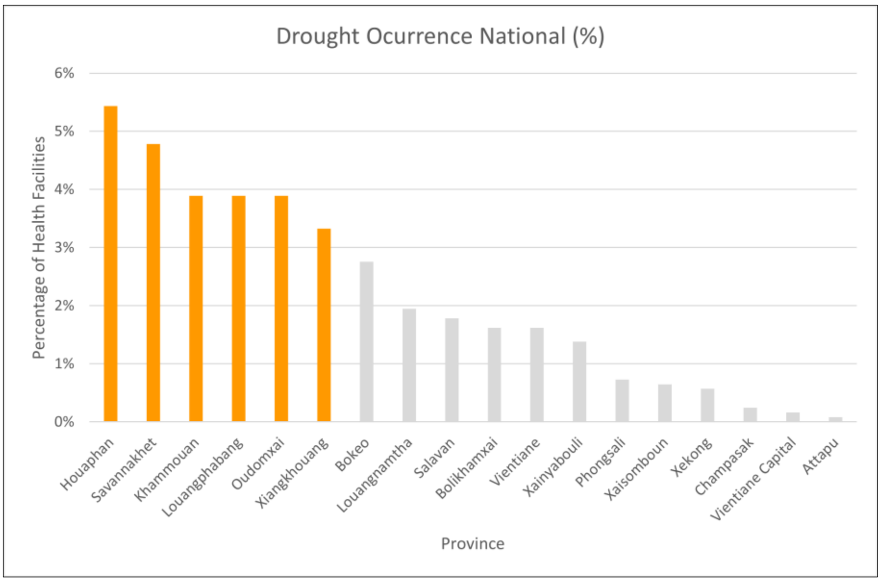


Figure 12: Drought-affected health facilities as a percentage of total health facilities in Lao PDR

Although Huaphanh is the province with only the sixth highest number of health facilities, it still had the highest number of facilities which are impacted by drought, with 67 facilities affected. Three provinces had very low numbers of drought-affected facilities so that they approximated 0% of the total number of facilities throughout the country. These provinces were Attapeu, Champasak and Vientiane Capital.

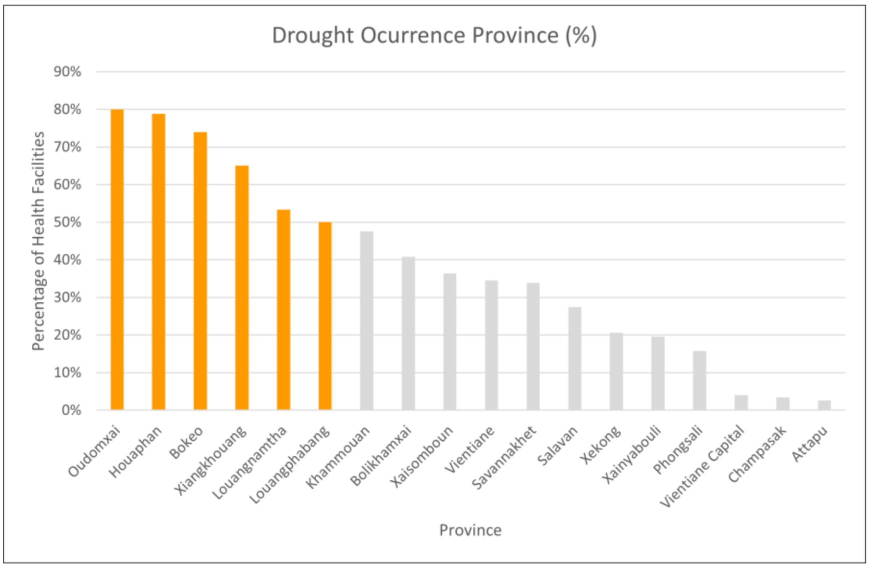


Figure 13: Percentage of total health facilities in province which are affected by droughts.

Oudomxay and Huaphanh had the highest rates of drought-affected health facilities, with 80% and 79% respectively of their facilities affected. There was a wide range of drought effects, with Attapeu and Champasak having only 3% of their health facilities affected.

Unlike flooding, the most drought-affected provinces are clustered in the north, with the provinces with the six highest rates all being in the northern region. Drought-affected areas and health facilities are shown in Figure 14. The districts with the most drought-affected health facilities are Huoixai in Bokeo, and Kham and Nonghed Districts in Xiengkhuang. Other highly affected districts are Mahaxay District in Khammouane, Xonbuly District in Savannakhet, Xay District in Oudomxay and Phonxay District in Luangprabang.

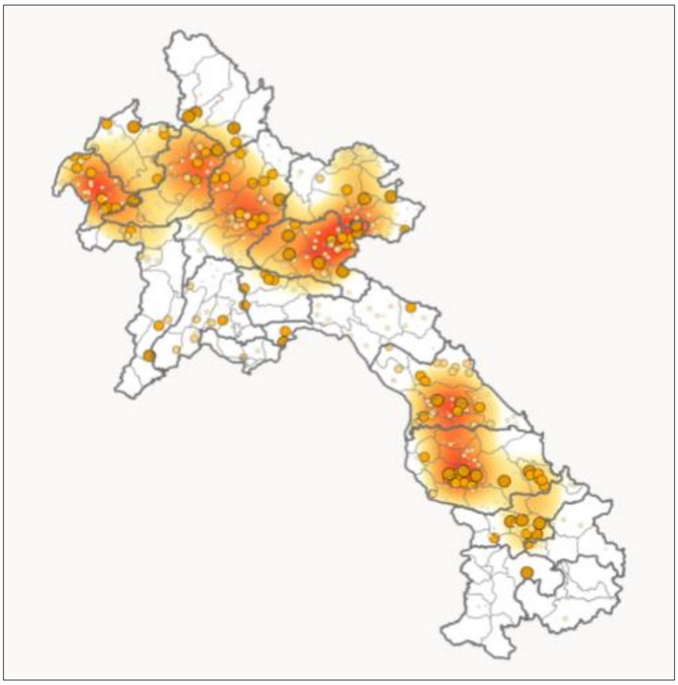


Figure 14: Heatmap of drought-affected facilities of Lao PDR

4.3 Occurrence of Storms in Provinces

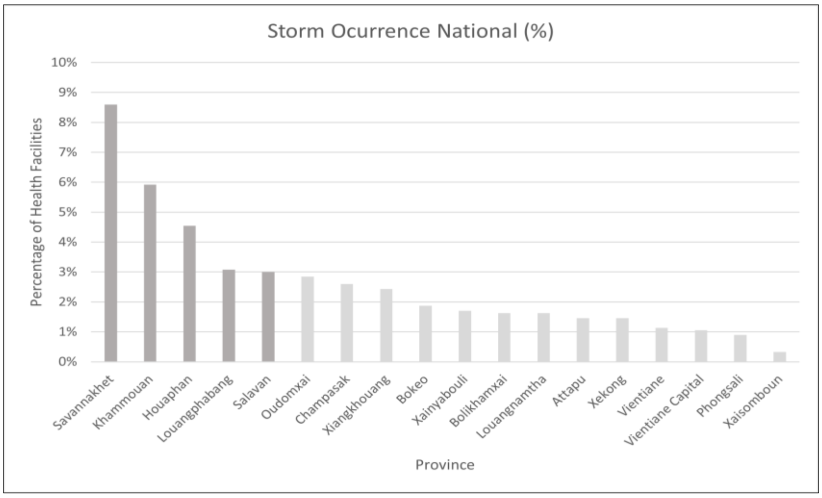


Figure 15: Storm-affected health facilities as a percentage of total health facilities in Lao PDR

All provinces had a significant number of health facilities which were impacted by storms. Savannakhet had 106 affected facilities, the highest number of any province. Figure 15 shows the storm-impacted health facilities in each province as a percentage of the total number of facilities in the country.

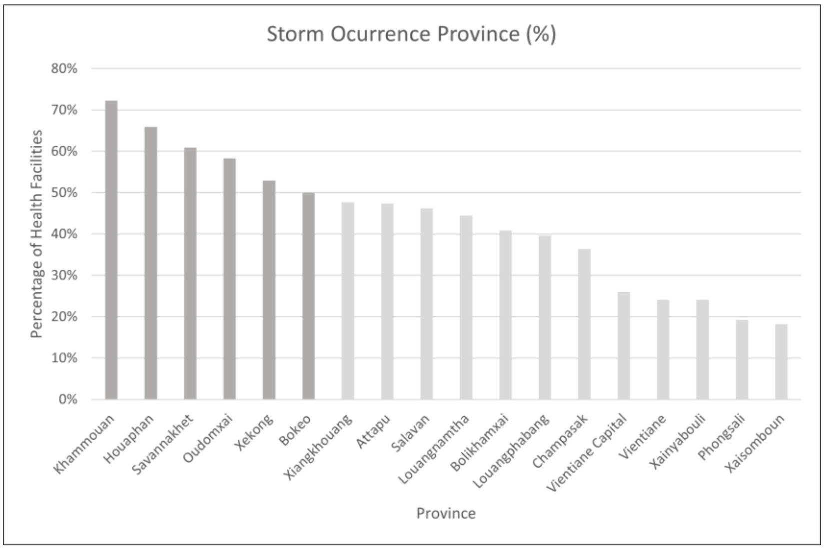


Figure 16: Percentage of total health facilities in province which are affected by storms.

Figure 16 shows the percentage of total storm-affected health facilities in each province. Xaisomboun and Phongsali had the lowest percentage of health facilities affected, at 18% and 19% respectively. The provinces with the highest percentage of health facilities affected by storms were Khammouane, with 72% of health facilities affected, and Houaphan, with 66% affected.

Figure 17 shows a large cluster of storm-affected health facilities in Savannakhet, the most populous province with the highest number of health facilities. Storm-affected health facilities are spread throughout the country, as there are many affected facilities but few obvious clusters on the map. The district with the highest number of storm-affected facilities is shown to be Champhone District in Savannakhet. Khammouane and Huaphanh are the provinces with the highest rates of storm-affected facilities. Their most affected districts are Nongbok, Xebanfay, southern Thakhek and southern Mahaxay in Khammouane, and Add and Xiengkhor Districts in Huaphanh.

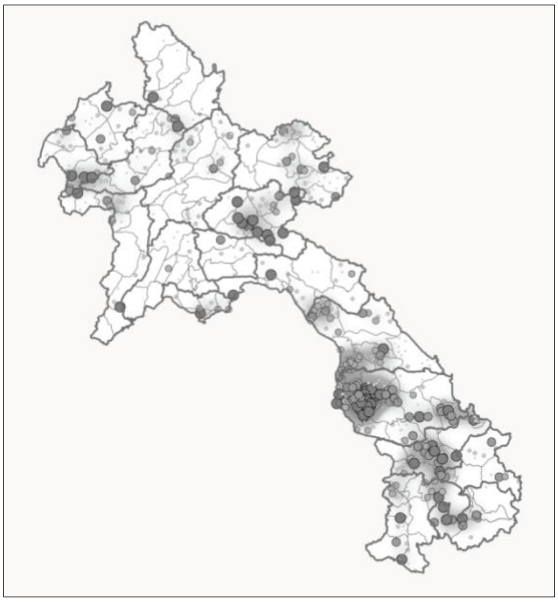


Figure 17: Heatmap of storm-affected facilities of Lao PDR

4.4 Occurrence of Landslides in Provinces

As was the case with droughts, Huaphanh had the highest number of health facilities which were affected by landslides with 63 facilities affected. Luang Prabang had the second highest number with 55 facilities affected. This was 22 more than the third ranked province and set Huaphanh and Luang Prabang apart in the number of landslides. As with droughts, Attapeu, Champasak and Vientiane Capital had very few landslide-affected facilities, with just over 0% of the total affected facilities in the country. Figure 18 shows the landslide-impacted health facilities in each province as a percentage of the total number of facilities in the country. Huaphanh had a significantly higher percentage of its health facilities affected by landslides than any other province, with 74% of health facilities affected. In contrast, the province with the second highest percentage of affected facilities, Luangprabang, had 57% of its facilities affected by landslides. The province with the lowest percentage of health facilities affected by landslides was Champasak with 3% of

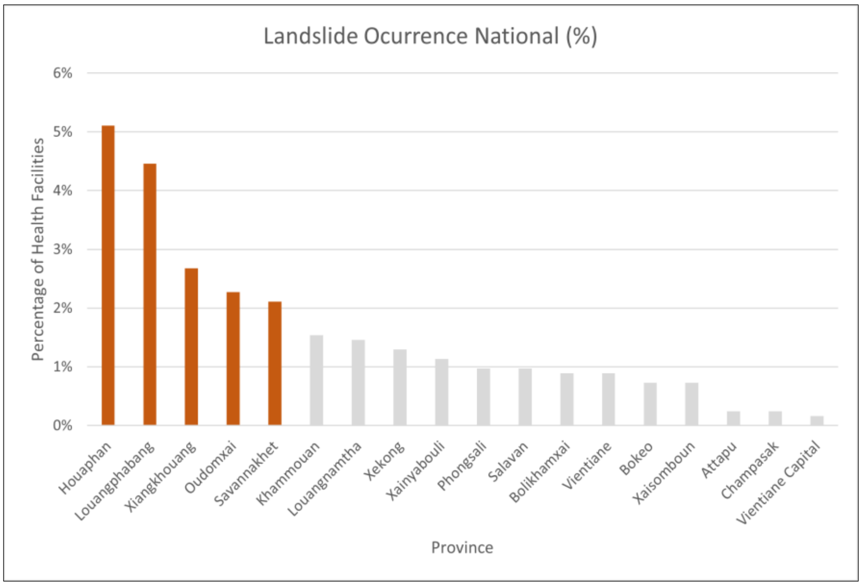


Figure 18: Landslide-affected health facilities as a percentage of total health facilities in Lao PDR

its facilities affected, and Vientiane Capital was the second lowest with 4% affected. Figure 19 shows the percentage of each province's health facilities which were affected by landslides.

Figure 20 shows the density of landslide-affected health facilities throughout the country, with the most significant clusters in the north, despite the lower number of health facilities in Houaphan and Xiengkhouang.

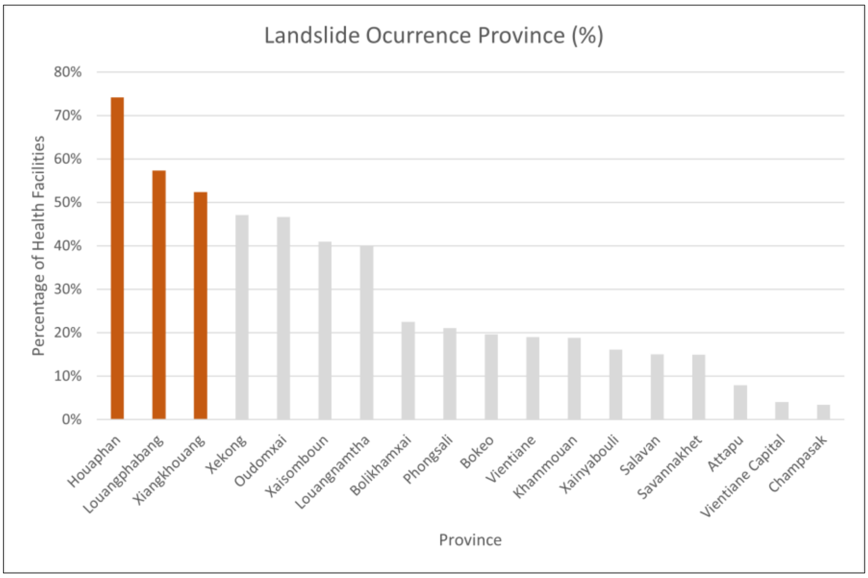
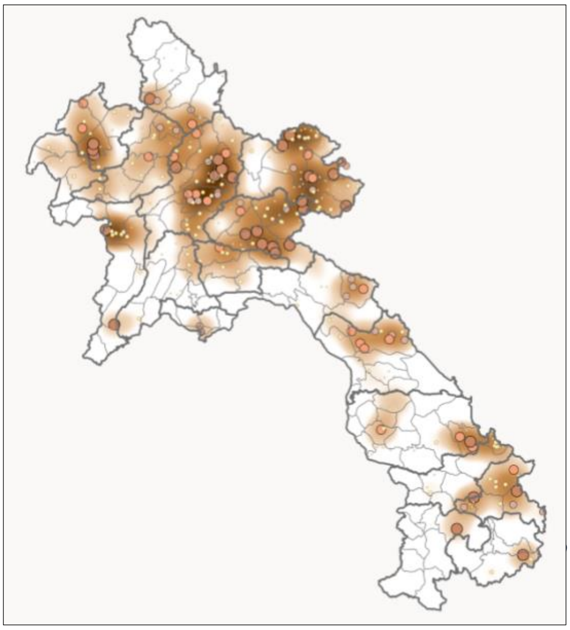


Figure 19: Percentage of total health facilities in province which are affected by landslides.

This aligns with the high rate of landslides in these provinces. The districts with the highest number of landslide-affected health facilities were Viengkham and Phonxay Districts in Luangprabang. Other highly affected districts were Viengphoukha District in Luangnamtha, Xaysathan District in Xayabury, Add, Sopbao, southern Xamneua and western Xamtay Districts in Huaphanh, and Kham, Nonghed and Khoune Districts in Xiengkhuang. Although the most severely affected areas were clustered in the north, there were also landslide-affected areas in the southern and central areas, particularly in the east of the country.



4.5 Occurrence of Wildfires in Provinces

Although wildfire is the hazard which occurs the least of those hazards assessed, it still has a significant impact on health facilities in Lao PDR, with 282 facilities throughout the country being affected. As with some other hazards, there are more wildfire-affected health facilities in Huaphanh than in any other province, with 51 facilities affected. This is 16 more than

Luangprabang, which had the second highest number. Attapeu, Champasak, Vientiane Capital, Xayaboury and Sekong all had very few health facilities affected by wildfires.

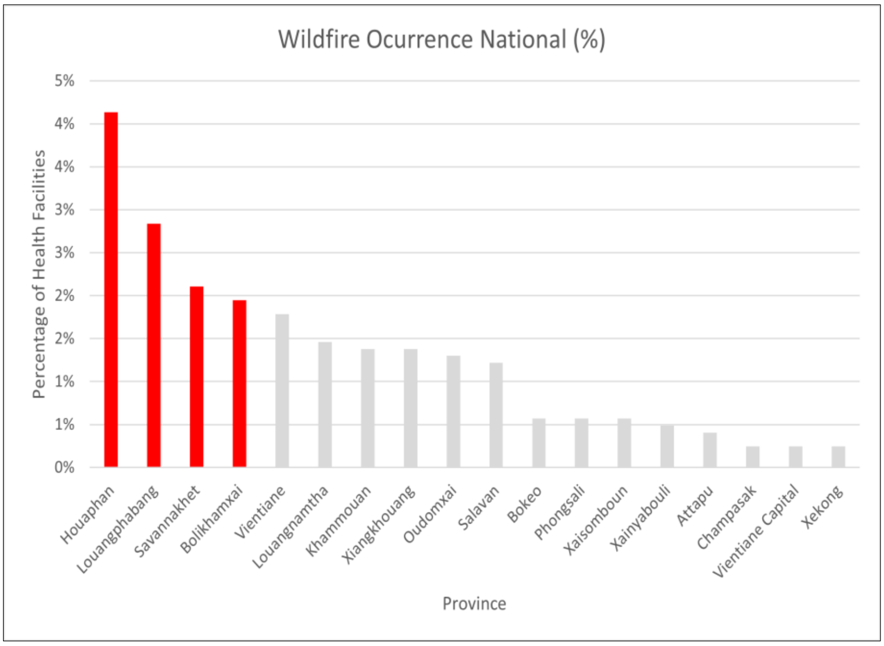


Figure 21: Wildfire-affected health facilities as a percentage of total health facilities in Lao PDR

Figure 21 shows the wildfire-impacted health facilities in each province as a percentage of the total number of facilities in the country.

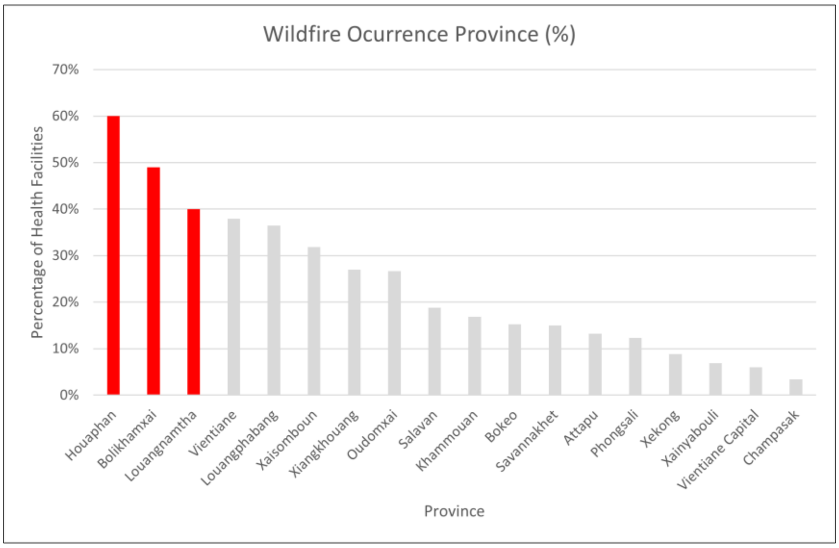


Figure 22 shows the percentage of each province's health facilities which were affected by wildfires. There are three provinces in which over forty percent of the health facilities were affected, these being Huaphanh, Bolikhamxay and Luangnamtha.

4.6 Multihazard Occurrence

Each hazard is significant. However, a more complete picture can be painted by analysing the multihazard occurrence.

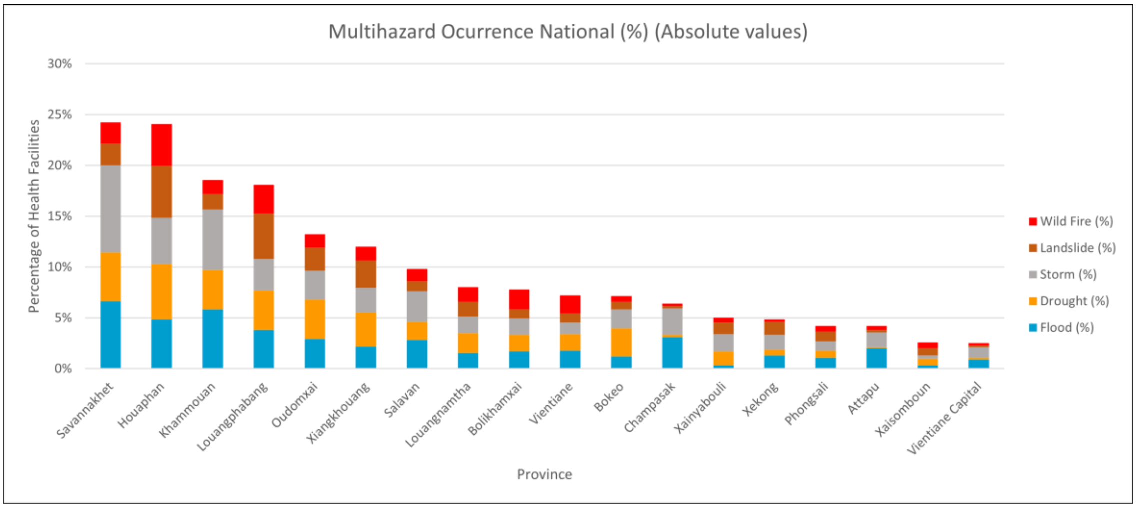


Figure 22: Percentage of the national total of hazards occurring in each province.

For each type of hazard, Figure 22 shows the hazard- affected health facilities in each province, as a percentage of the total number of health facilities in Lao PDR. This shows that the two provinces with the highest number of hazard-affected health facilities are Savannakhet and Huaphanh. Since Savannakhet has the highest number of health facilities of any province, it could be expected that it would have a high number of hazard-affected facilities. However, although Huaphanh has the sixth highest number of health facilities, it ranks in the top three for the number of hazard-affected health facilities for every one of the five hazards assessed. Other provinces that have a high number of hazard-affected health facilities relative to their total number of facilities include Bolikhamxay, Luangnamtha and Oudomxay.

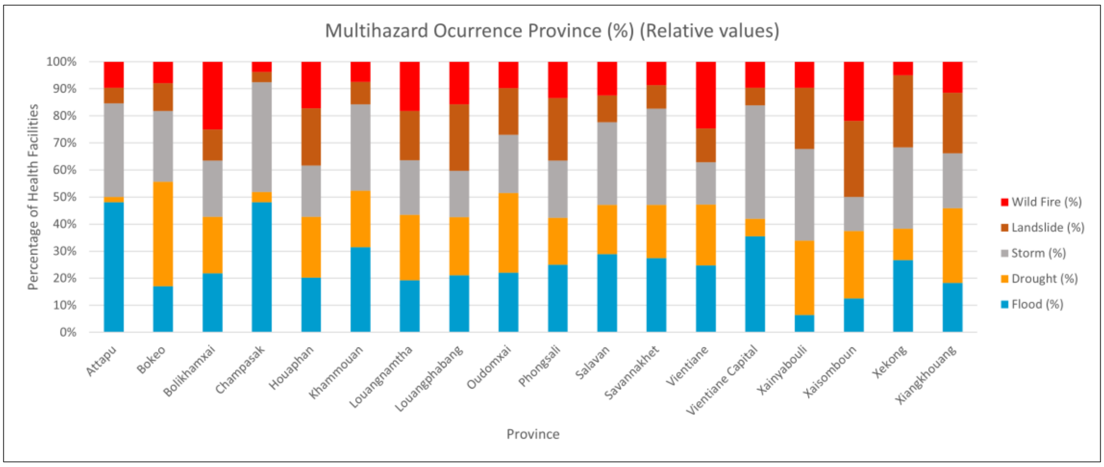


Figure 23: Distribution of hazards in each province

Figure 23 shows the distribution of hazards in each province. Savannakhet, for example, has more health facilities affected by storms than by wildfires or landslides. Huaphanh, on the other hand, has a uniform distribution of hazards so, for example, a drought is just as likely as a flood, and so on.

5. Infrastructure Impact

This section explores the specific effects on health facility infrastructure. Graphs displaying the breakdown of the climate hazard effect on each infrastructure category are available in Annex 0 on page J.

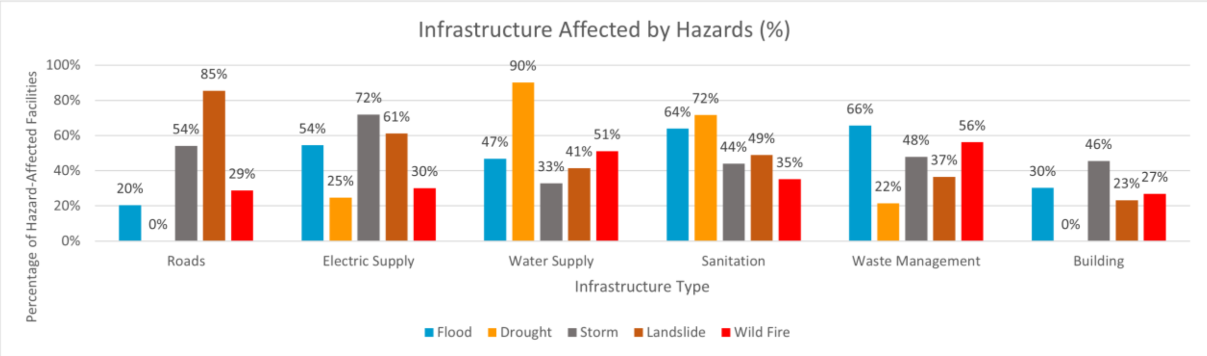


Figure 24: The percentage of health facilities experiencing hazard-related infrastructure issues broken down by infrastructure and hazard type.

Figure 24 illustrates the percentage of hazard-affected health facilities in Lao PDR that had infrastructure affected by the various climate-related hazards. It reveals that droughts have a severe impact on water supply, affecting 90% of facilities. Landslides significantly affect roads, impacting 85% of facilities, and storms significantly affect the electricity supply, impacting 72% of facilities. Floods have a significant effect on waste management and sanitation, impacting 66% and 64% of health facilities, respectively. Wildfires also have a big effect on waste management, impacting 56% of facilities. This data highlights the real-world consequences of the climate hazards. It is crucial for prioritizing infrastructure resilience initiatives to ensure uninterrupted health services during climate hazards. Figure 25 shows the number of health facilities affected by different types of infrastructure impacts.

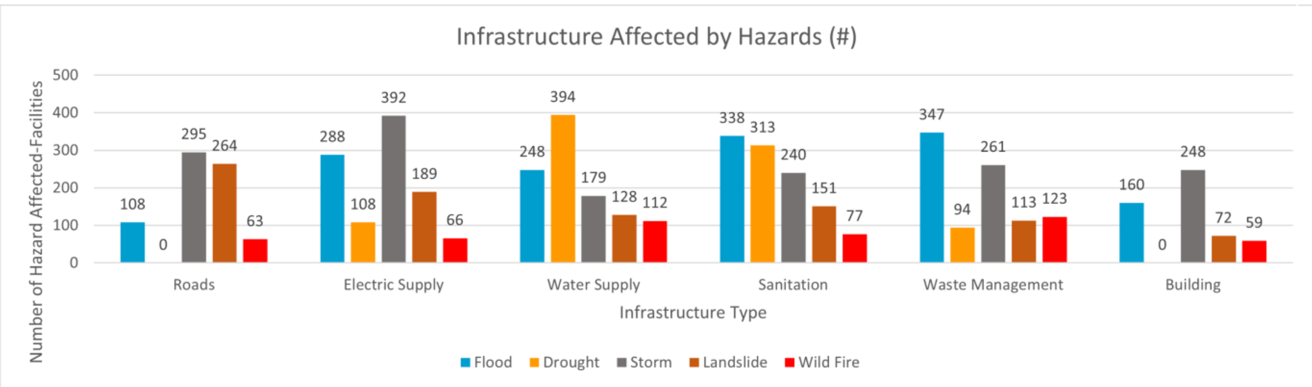


Figure 25: The number of hazard-affected health facilities experiencing infrastructure issues broken down by infrastructure and hazard type.

ANNEX

Annex 1: Provincial Periodicity, Severity, Frequency and Vulnerability Graphs

Periodicity

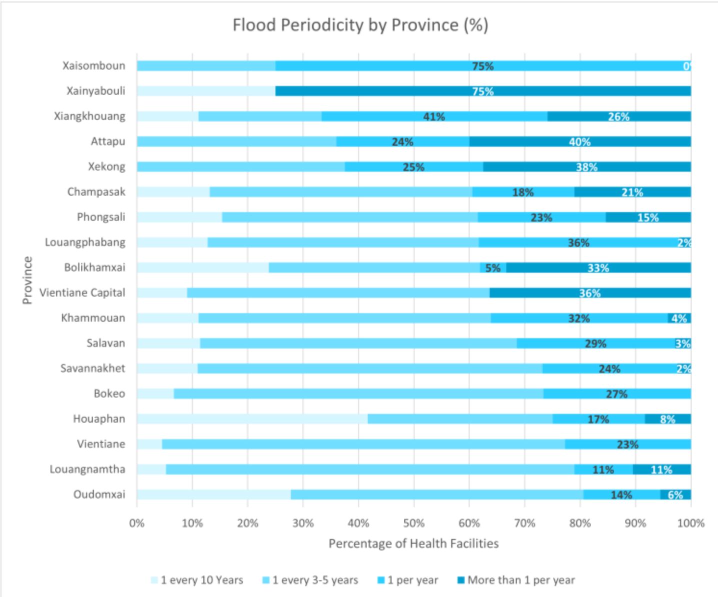


Figure A: Percentage of health facilities in each province with each category of storm periodicity

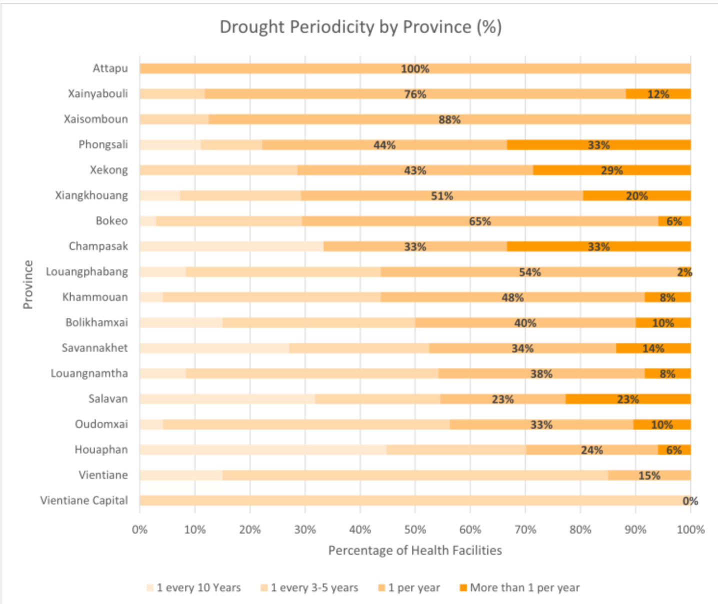


Figure B: Percentage of health facilities in each province with each category of drought periodicity

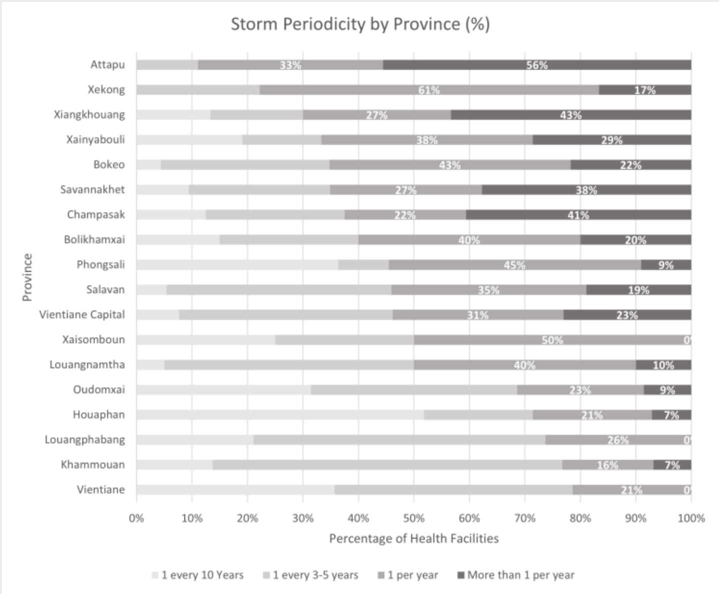


Figure C: Percentage of health facilities in each province with each category of storm periodicity

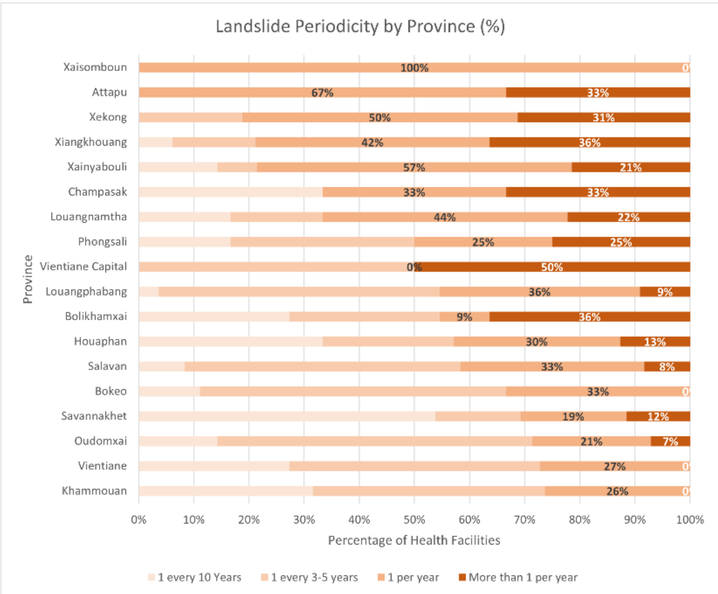


Figure D: Percentage of health facilities in each province with each category of landslide periodicity.

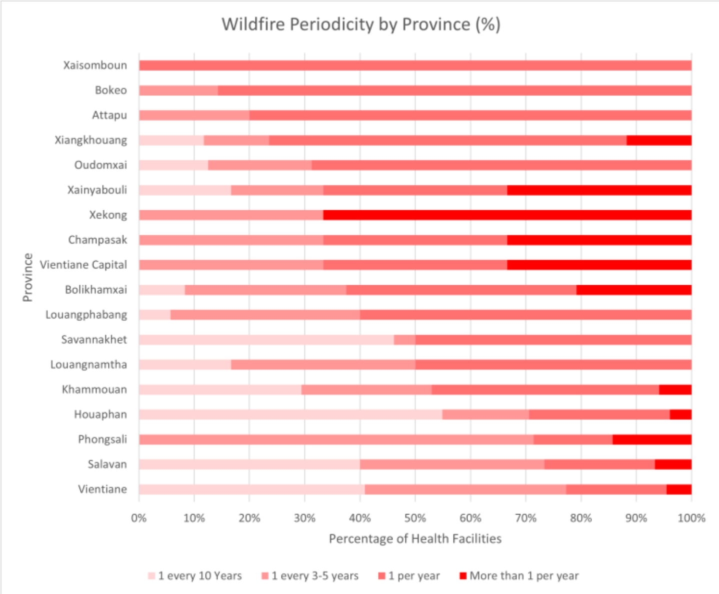


Figure E: Percentage of health facilities in each province with each category of wildfire periodicity

Severity

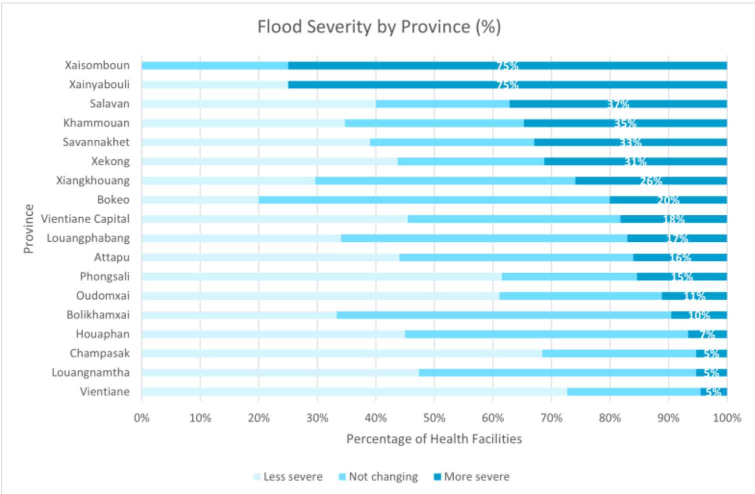


Figure F: Percentage of health facilities in each province with each category of flood severity

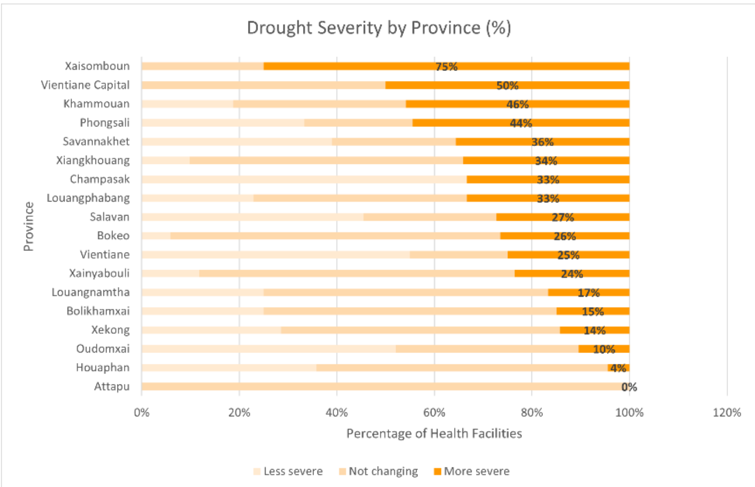


Figure G: Percentage of health facilities in each province with each category of drought severity

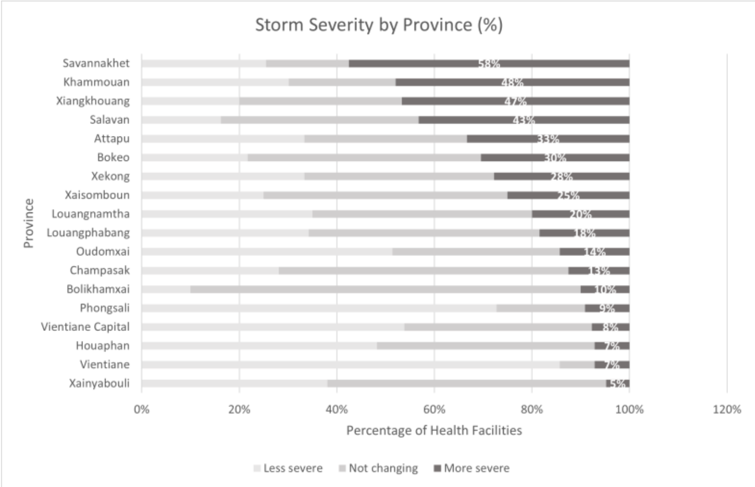


Figure H: Percentage of health facilities in each province with each category of storm severity

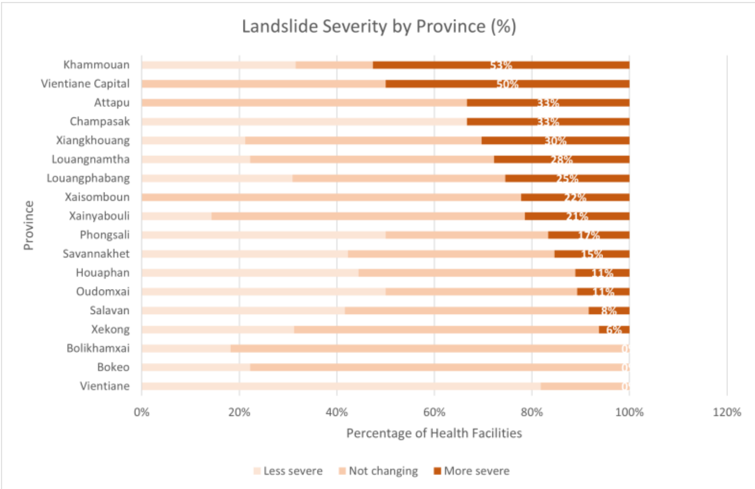


Figure I: Percentage of health facilities in each province with each category of landslide severity

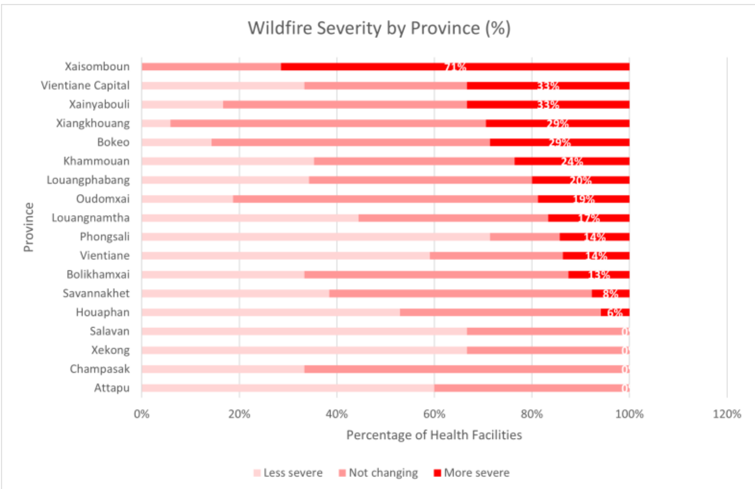


Figure J: Percentage of health facilities in each province with each category of wildfire severity

Frequency

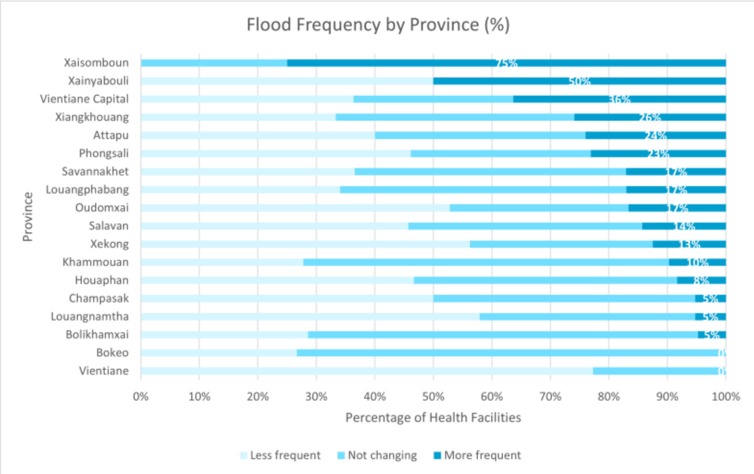


Figure K: Percentage of health facilities in each province with each category of flood frequency

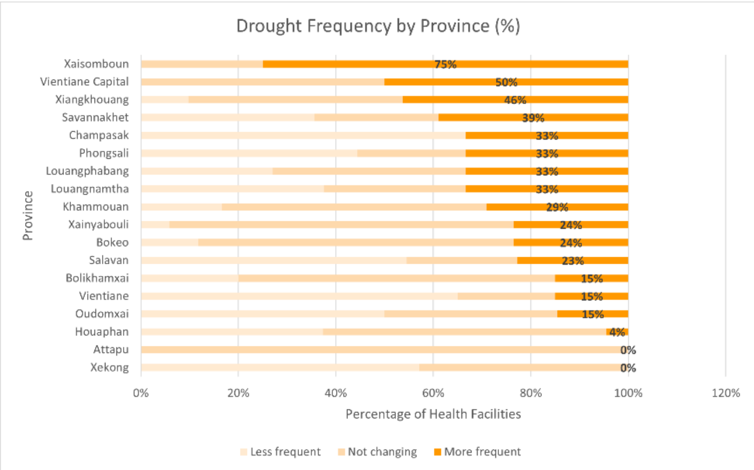


Figure L: Percentage of health facilities in each province with each category of drought frequency

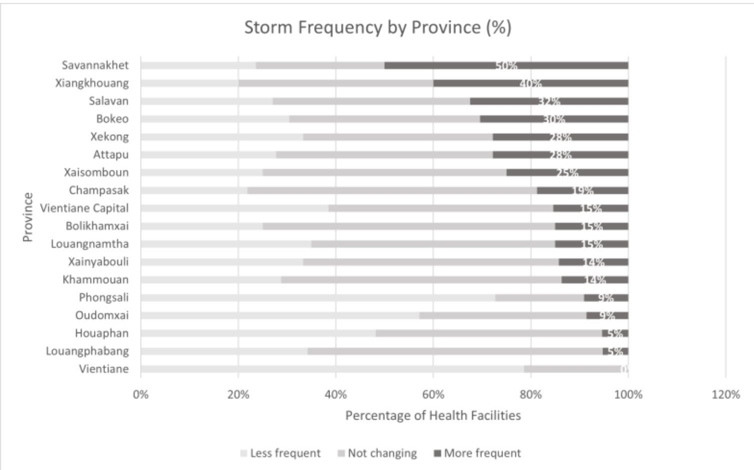


Figure M: Percentage of health facilities in each province with each category of storm frequency

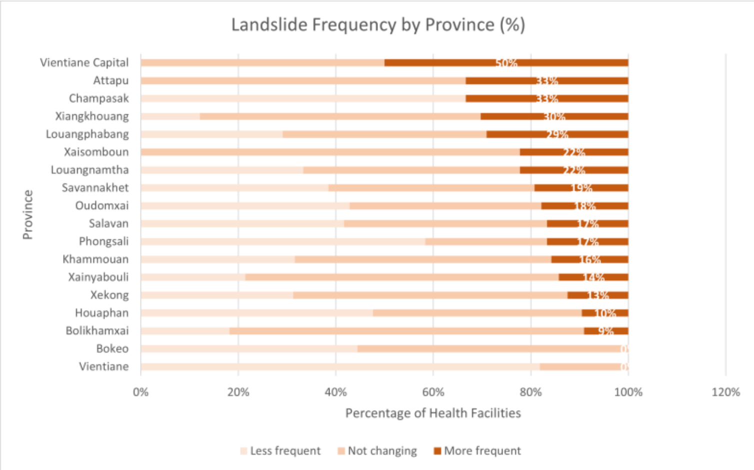


Figure N: Percentage of health facilities in each province with each category of landslide frequency

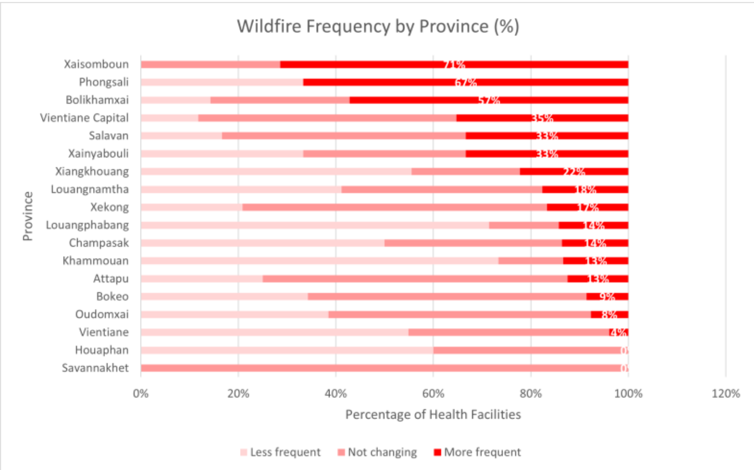


Figure O: Percentage of health facilities in each province with each category of wildfire frequency

Vulnerability

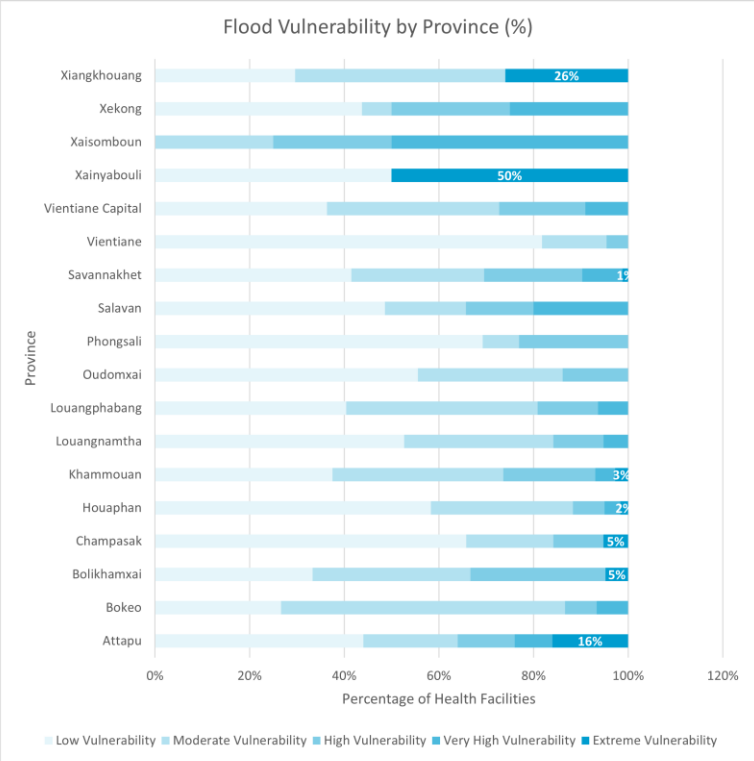


Figure P: Percentage of health facilities in each province with each category of flood vulnerability

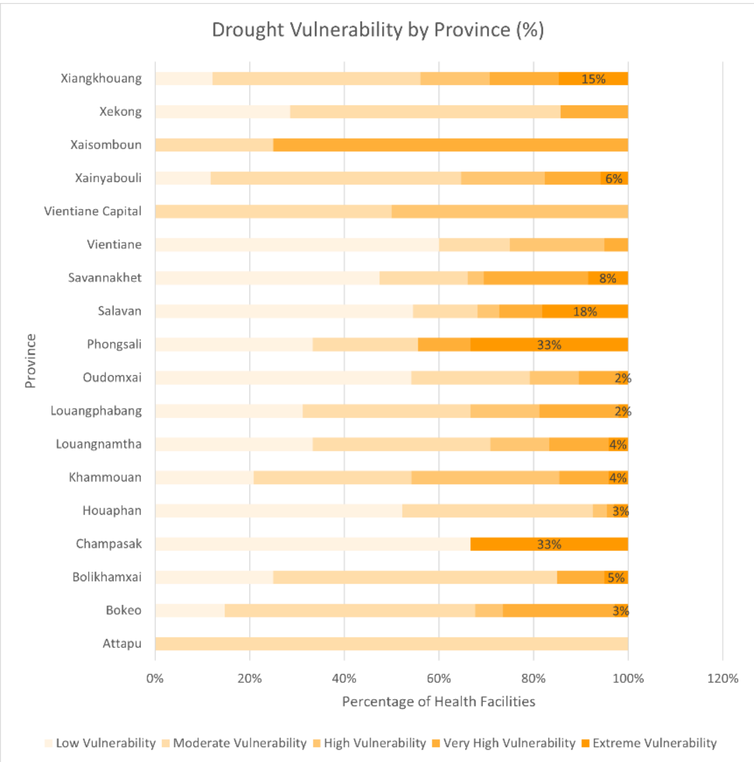


Figure Q: Percentage of health facilities in each province with each category of drought vulnerability

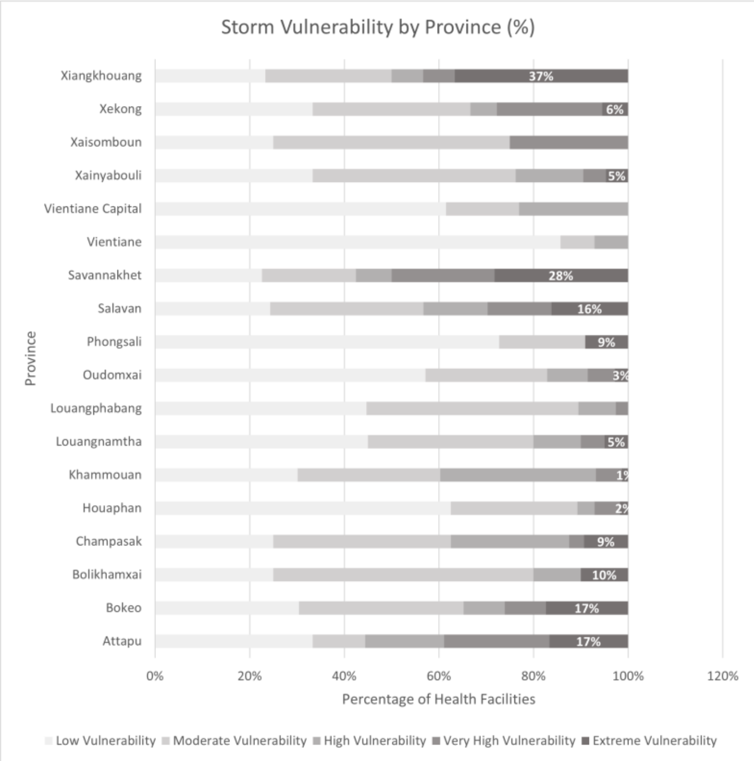


Figure R: Percentage of health facilities in each province with each category of storm vulnerability

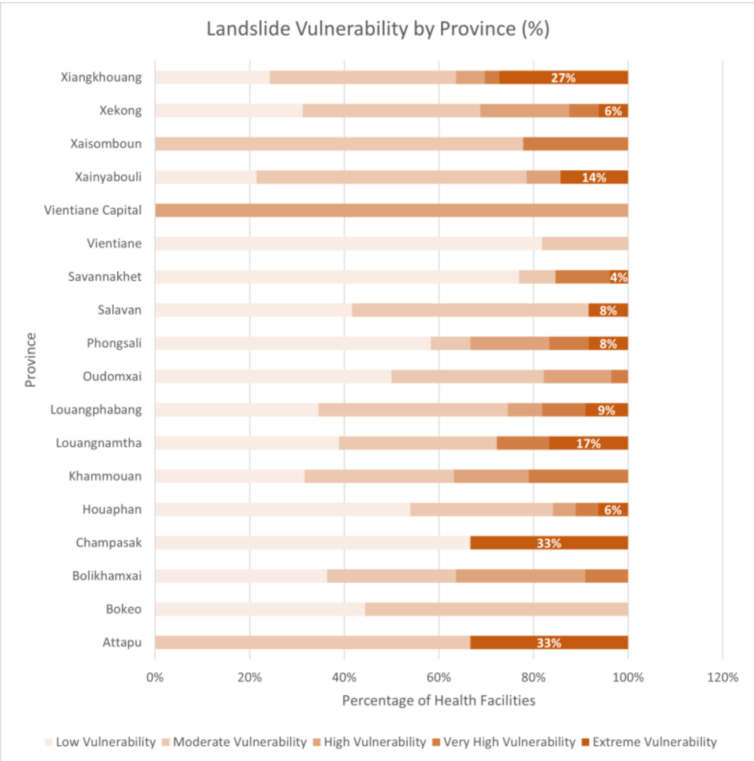


Figure S: Percentage of health facilities in each province with each category of drought vulnerability

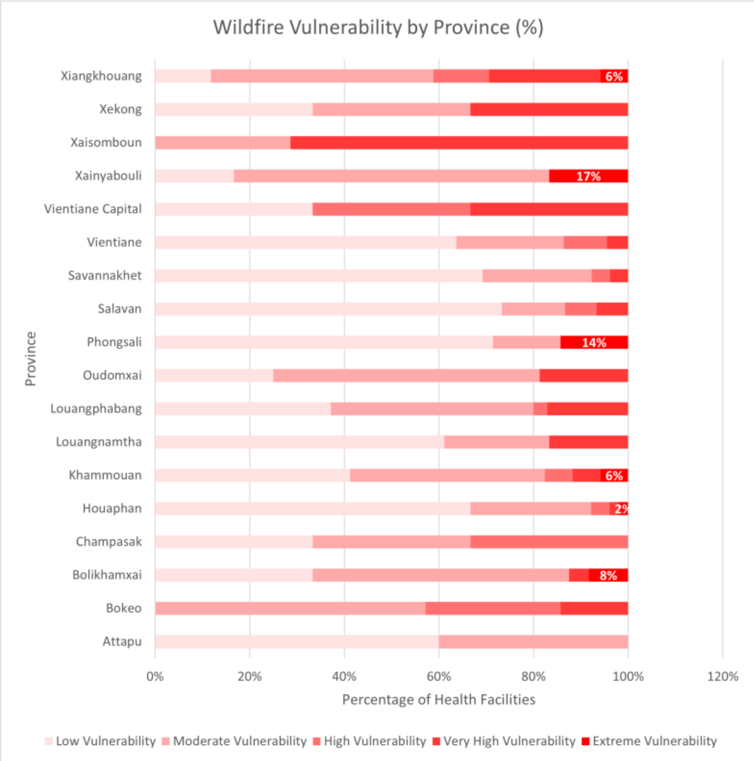


Figure T: Percentage of health facilities in each province with each category of wildfire vulnerability

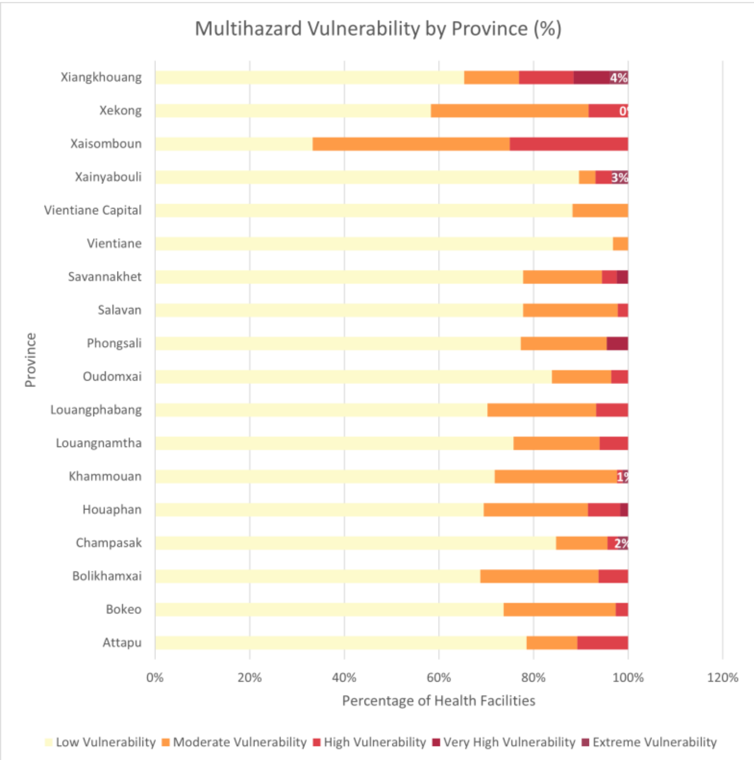


Figure U: Percentage of health facilities in each province with each category of overall multihazard vulnerability

Annex 2: Infrastructure Graphs

Roads

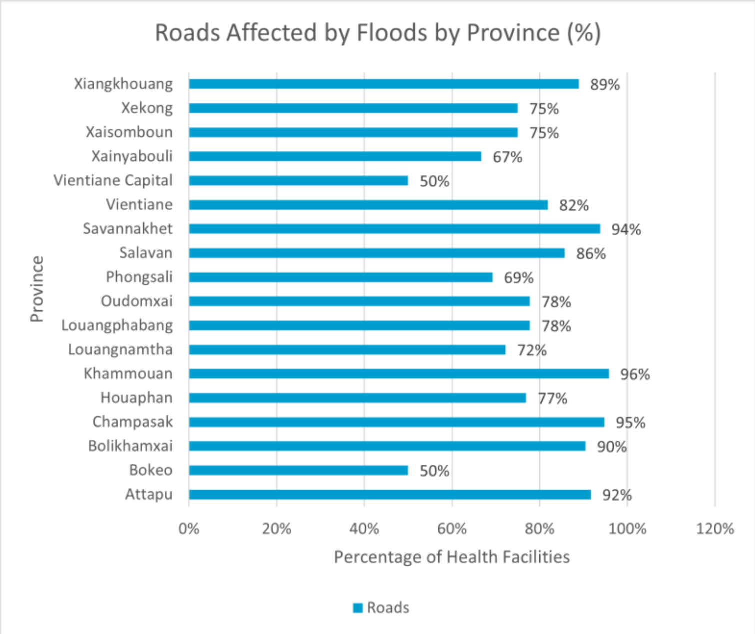


Figure V: Percentage of health facilities with roads affected by floods.

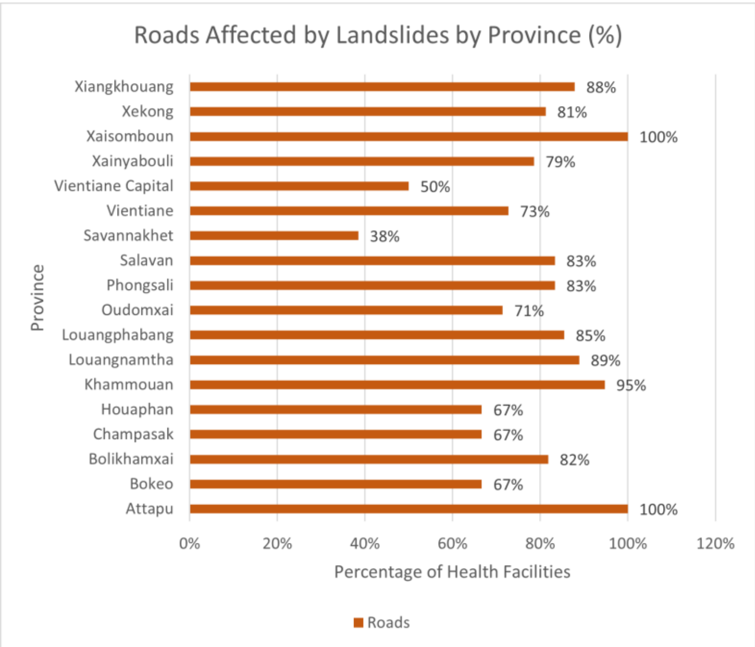


Figure W: Percentage of health facilities with roads affected by landslides.

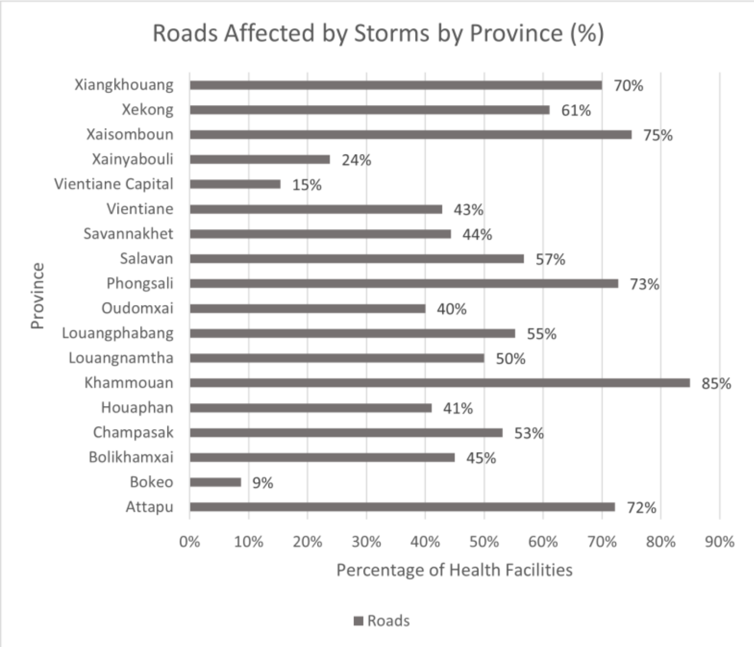


Figure X: Percentage of health facilities with roads affected by storms.

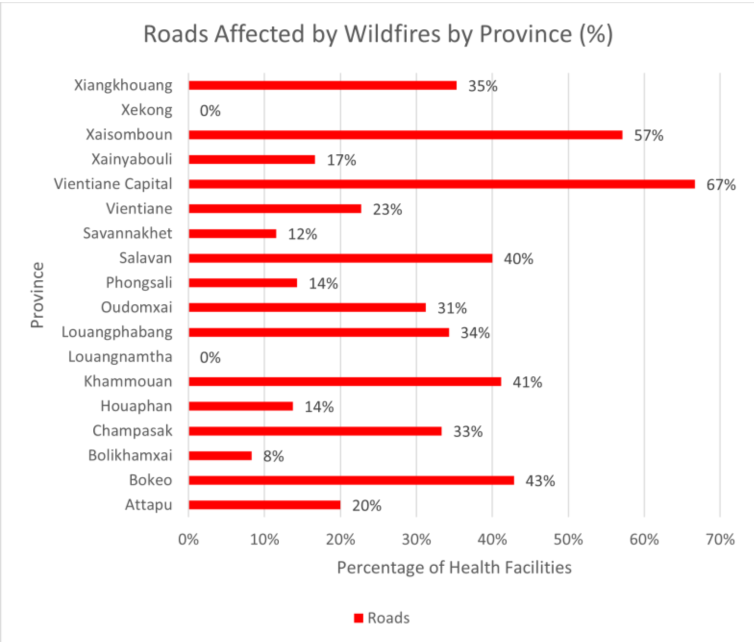


Figure Y: Percentage of health facilities with roads affected by wildfires.

Electric Supply

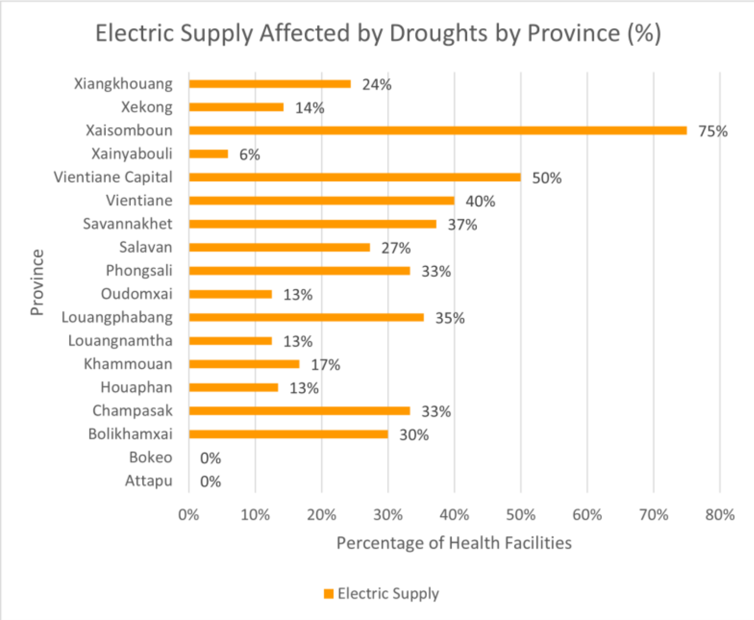


Figure Z: Percentage of health facilities with an electric supply affected by droughts.

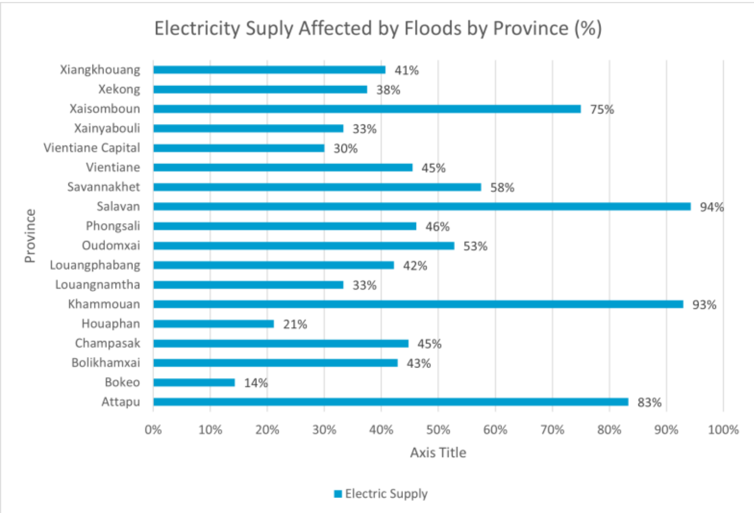


Figure AA: Percentage of health facilities with an electric supply affected by floods.

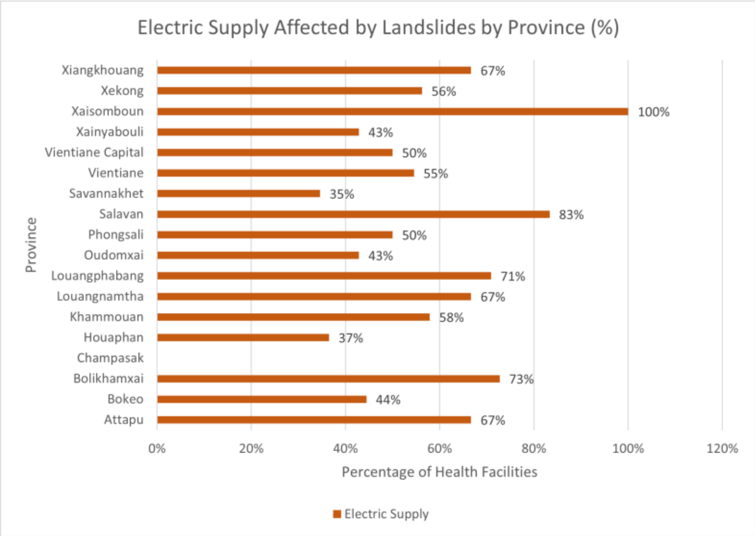


Figure BB: Percentage of health facilities with an electric supply affected by landslides.

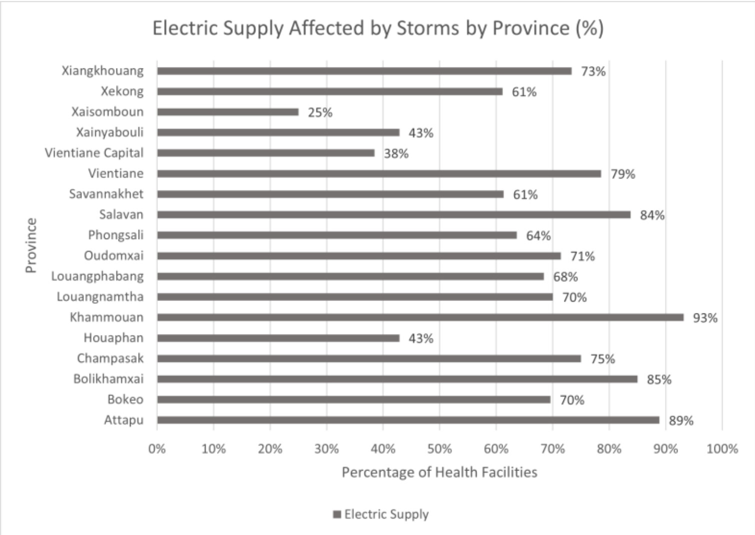


Figure CC: Percentage of health facilities with an electric supply affected by storms.

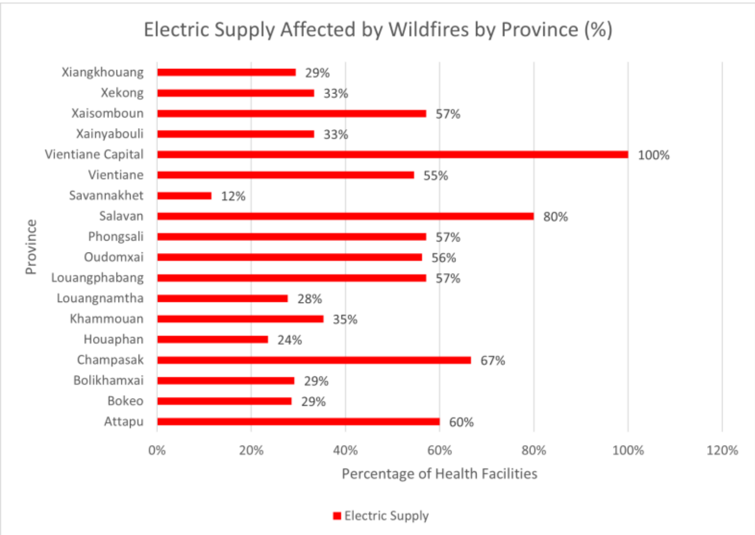


Figure DD: Percentage of health facilities with an electric supply affected by wildfires.

Water Supply

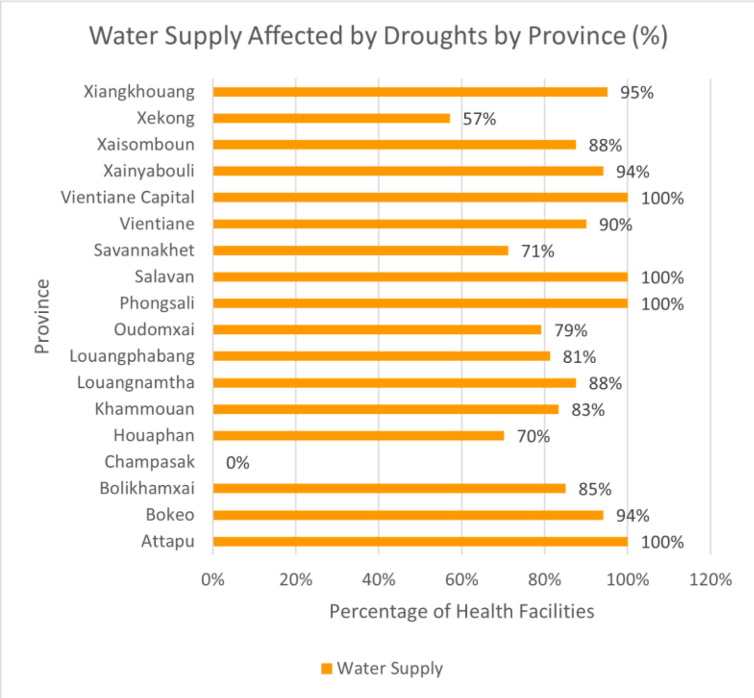


Figure EE: Percentage of health facilities with a water supply affected by droughts.

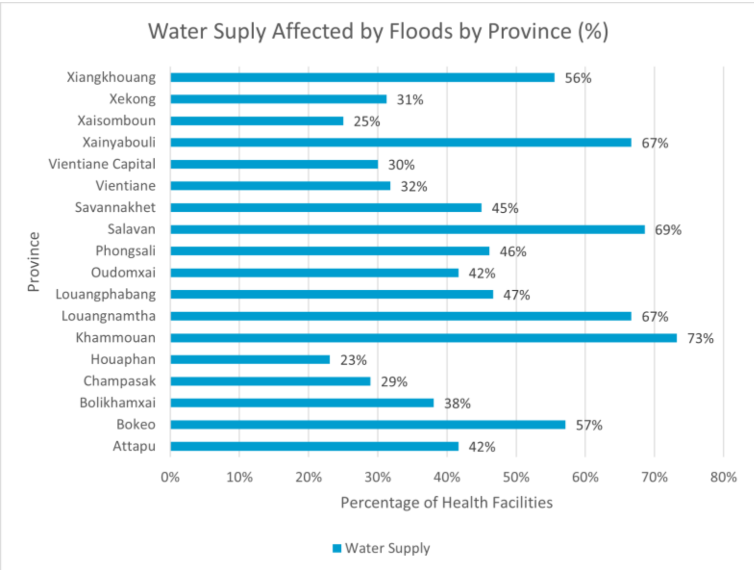


Figure FF: Percentage of health facilities with a water supply affected by floods.

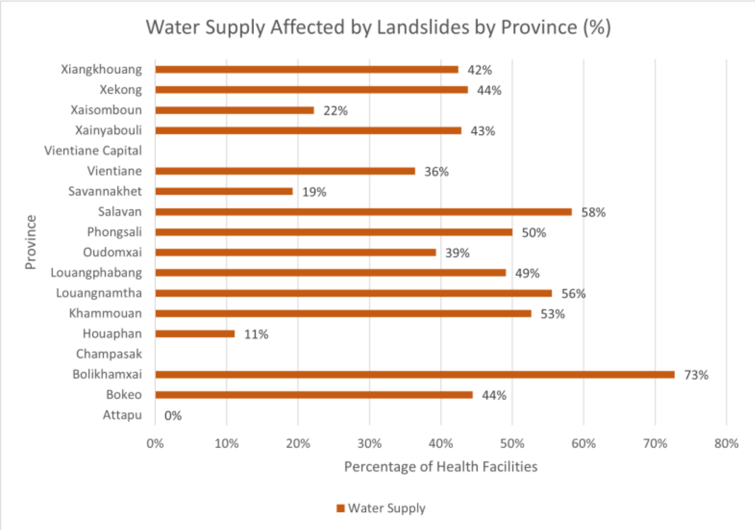


Figure GG: Percentage of health facilities with a water supply affected by landslides.

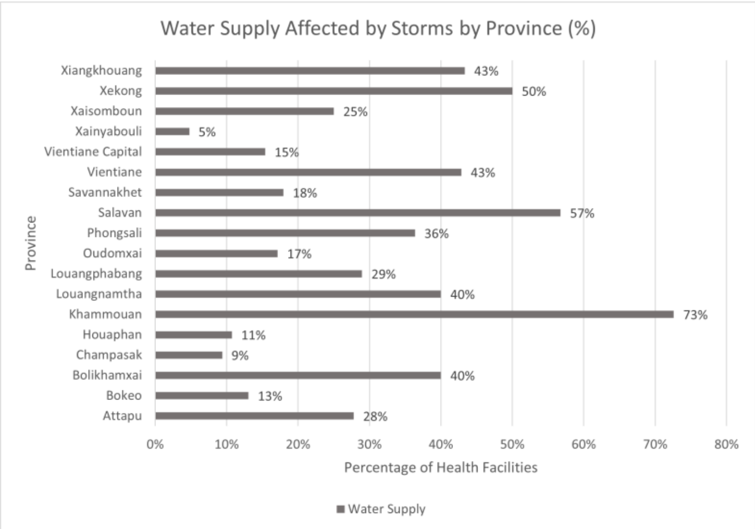


Figure HH: Percentage of health facilities with a water supply affected by storms.

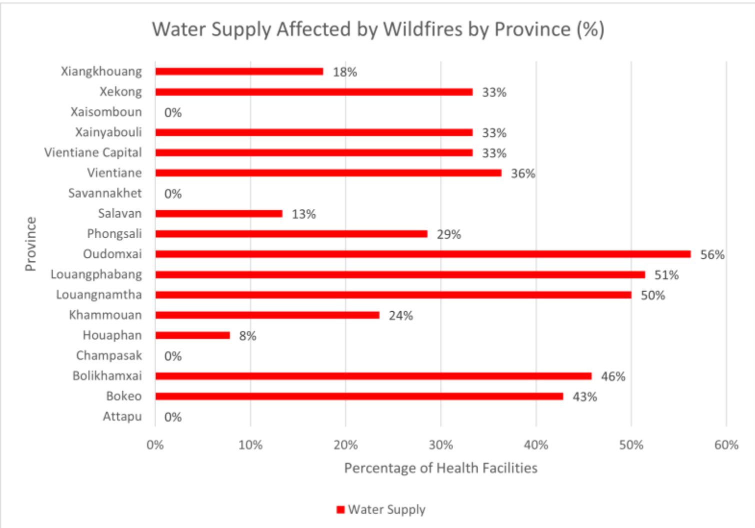


Figure II: Percentage of health facilities with a water supply affected by wildfires.

Sanitation

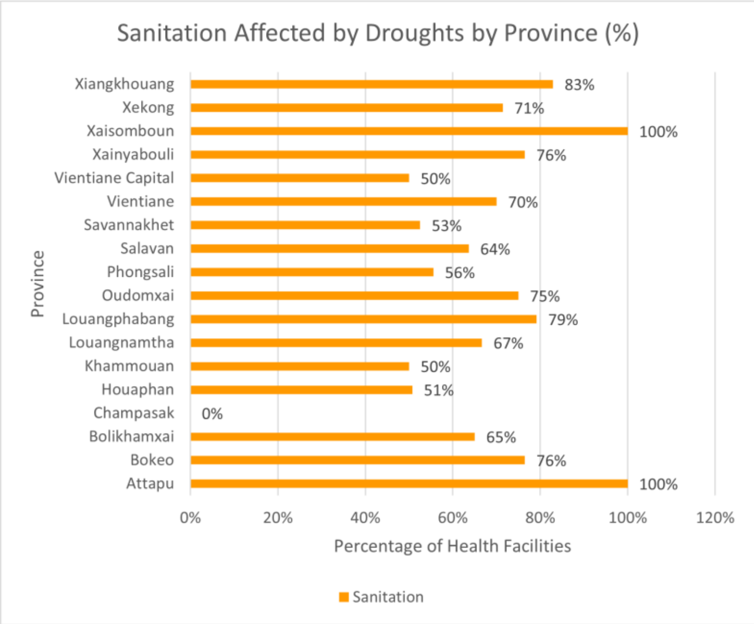


Figure JJ: Percentage of health facilities with sanitation affected by droughts.

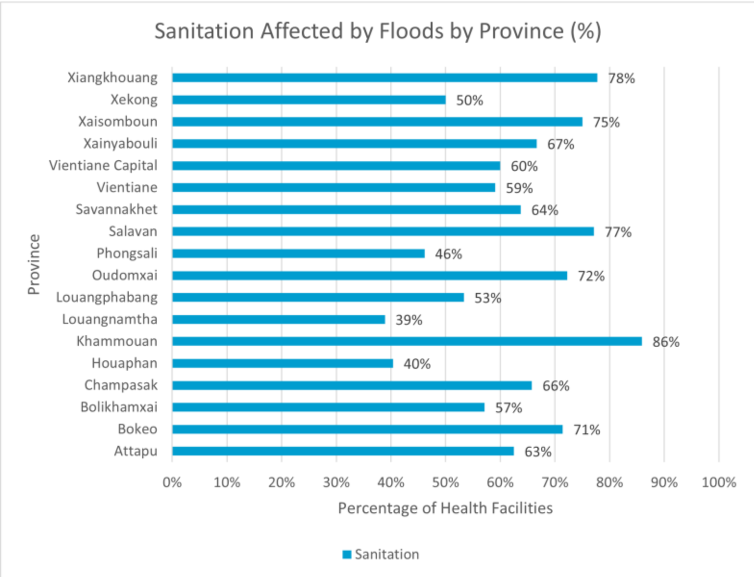


Figure KK: Percentage of health facilities with sanitation affected by floods.

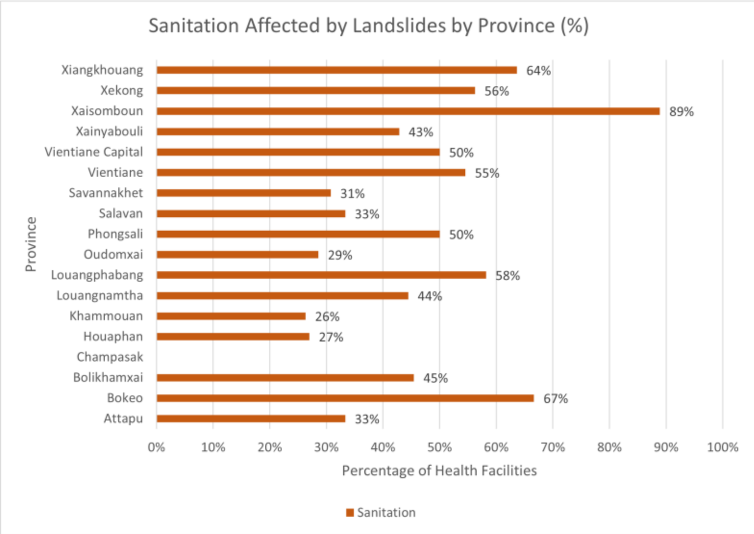


Figure LL: Percentage of health facilities with sanitation affected by landslides.

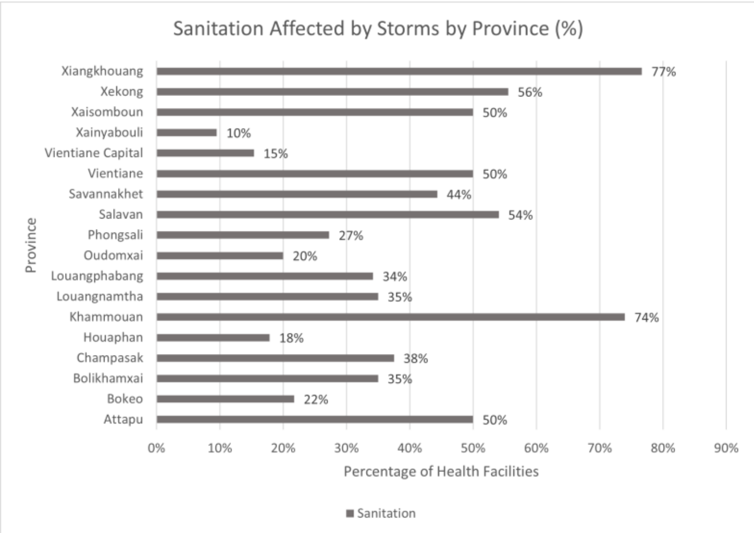


Figure MM: Percentage of health facilities with sanitation affected by storms.

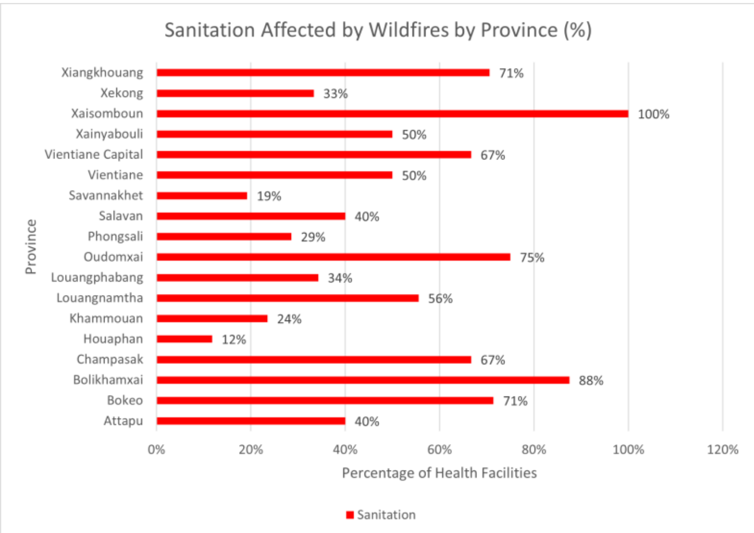


Figure NN: Percentage of health facilities with sanitation affected by wildfires.

Waste Management

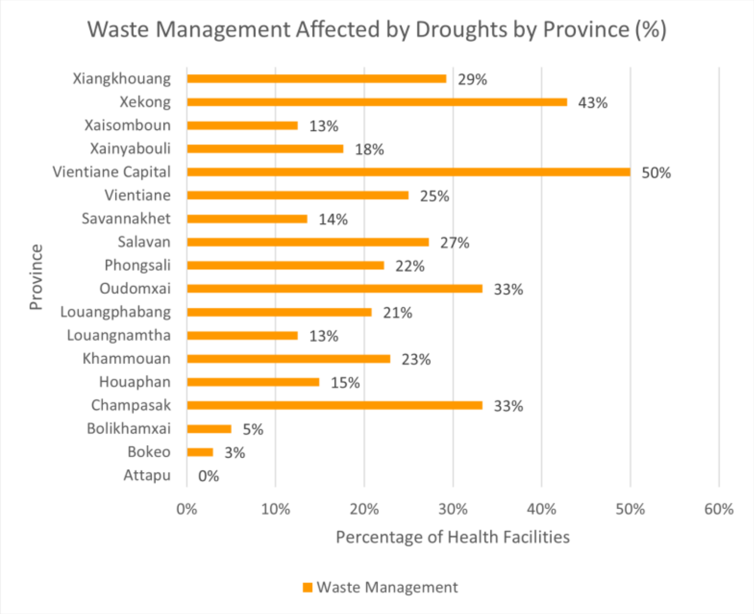


Figure OO: Percentage of health facilities with waste management affected by droughts.

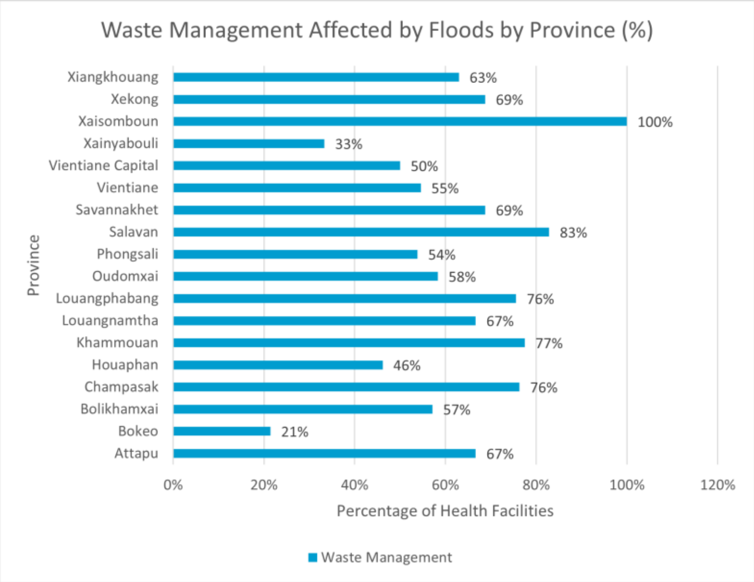


Figure PP: Percentage of health facilities with waste management affected by floods.

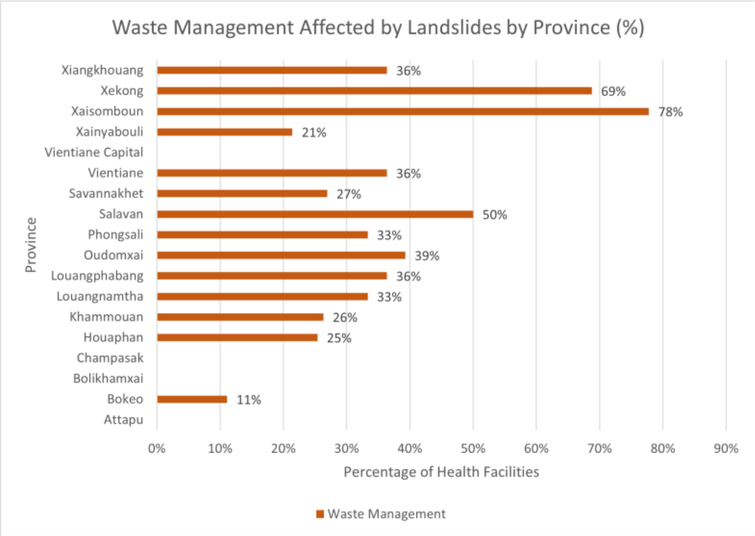


Figure QQ: Percentage of health facilities with waste management affected by landslides.

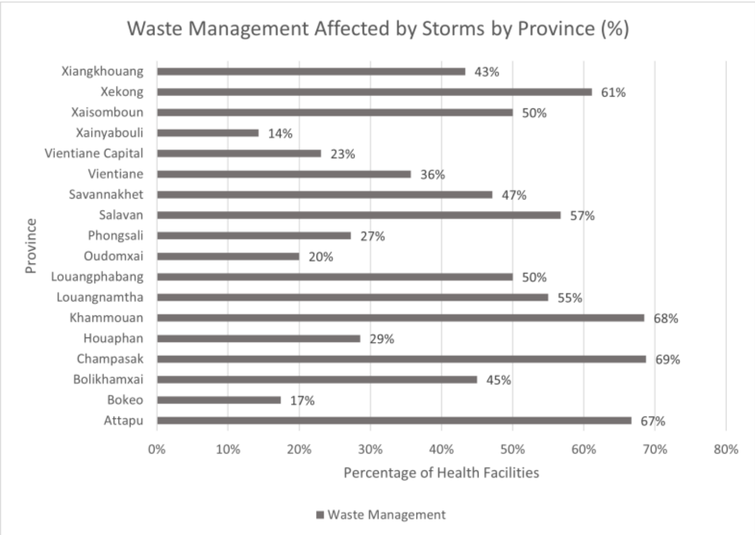


Figure RR: Percentage of health facilities with waste management affected by storms.

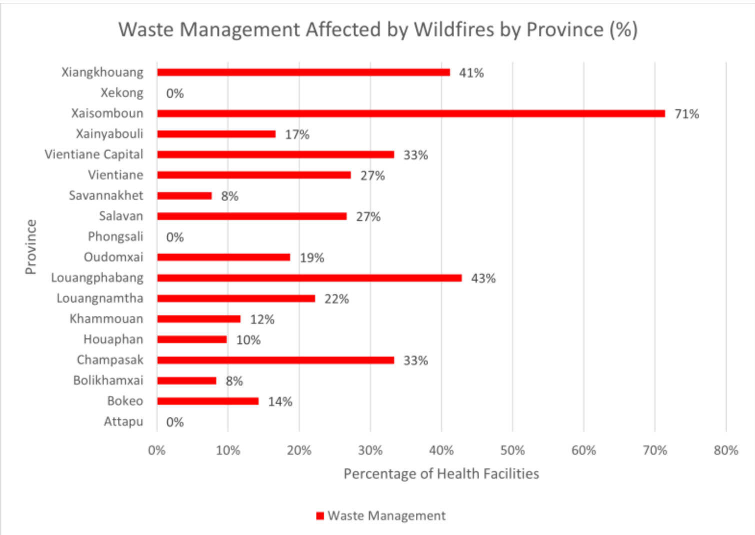


Figure SS: Percentage of health facilities with waste management affected by wildfires.

Building

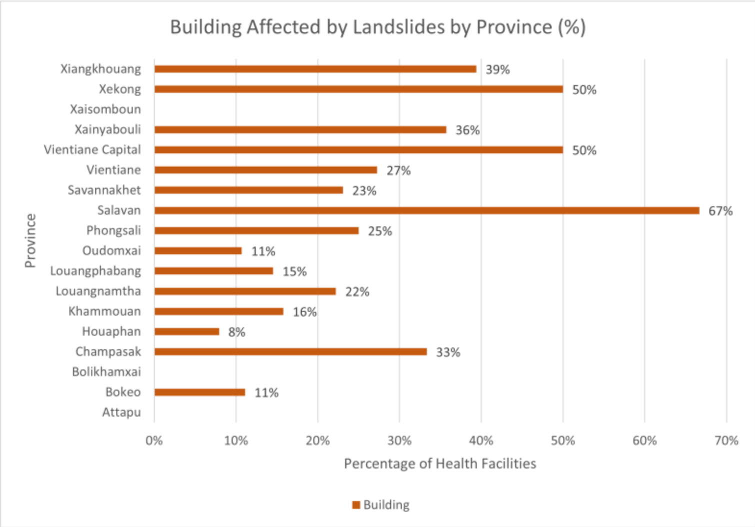


Figure TT: Percentage of health facilities with a building affected by landslides.

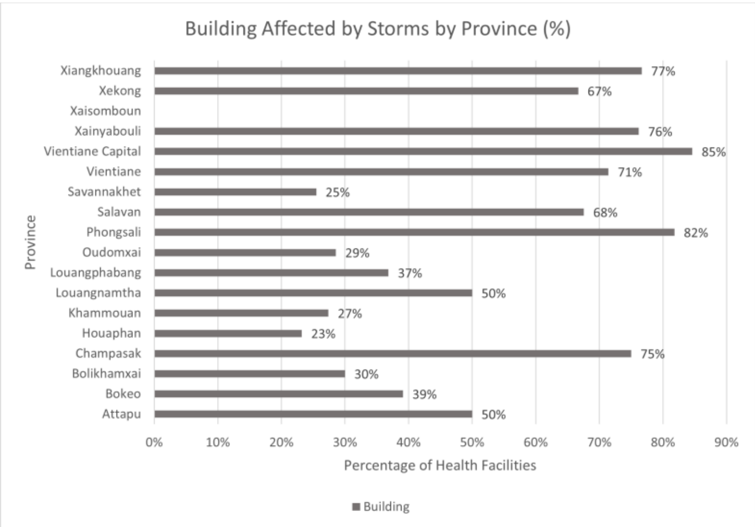


Figure UU: Percentage of health facilities with a building affected by storms.

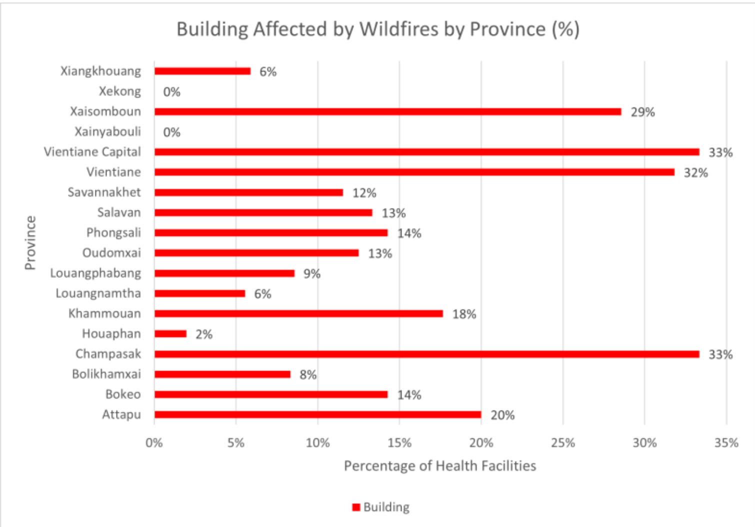


Figure VV: Percentage of health facilities with a building affected by wildfires.

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