



PROJECT MAPIT

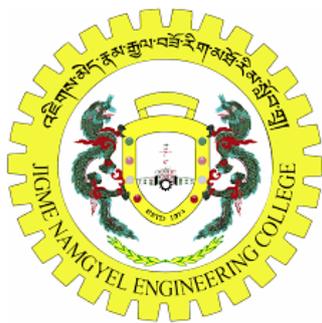
PBL South Asia - Bhutan

Final report - an overview

WAT-E2070 Sustainable Global Technologies (SGT) Studio 2021
Aalto University School of Engineering
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TABLE OF CONTENTS

Foreword: About the project and this report	1
Prolog: A word about landslides in Bhutan	1
Chapter 1: Beginning of the project	3
<i>Why did we choose this topic?</i>	3
<i>Who were we working with?</i>	3
<i>Our initial plans for the project</i>	4
<i>Our first steps with the project work</i>	5
Chapter 2: New direction	7
<i>The project develops</i>	7
<i>Second expert meeting with validation for our refined plans</i>	8
Chapter 2.1: New direction with JNEC	9
<i>Setting a new objective</i>	9
<i>Planning an intensive workshop</i>	9
<i>Warming up the connection</i>	10
<i>The intensive workshop</i>	10
Chapter 3: The Handbook	15
<i>The impact</i>	15
<i>The outcome</i>	15
<i>The handbook as an output</i>	15
<i>The activities</i>	16
<i>Beneficiaries</i>	17
<i>Content of the handbook</i>	19
Chapter 4: Reflection	21
<i>Managing the timeline</i>	21
<i>Managing the activities</i>	23
<i>Evaluation of sustainability</i>	23
<i>Success of the delivered material</i>	24
References	25

FOREWORD: ABOUT THE PROJECT AND THIS REPORT

This is the final report of Project Mapit, a five-month collaborative project implemented during the spring 2021. The project aimed at raising the awareness of landslides in the area of Dewathang Gewog in Bhutan by producing information about the hazard, and it was implemented by a student team from Aalto University in Finland with a student team from Jigme Namgyel Engineering College (JNEC) at Royal University of Bhutan. The collaboration between the two student teams was executed as a part of a cooperation project called Problem Based Learning (PBL) South Asia and as a part of Aalto University's Sustainable Global Technologies (SGT) Studio course.

The aim of this report is to walk you through our working process with the project from the beginning and initial ideas, through re-evaluating our aims and finding the purpose of the project, to finally finalizing the project and looking back at what we have achieved. The report is written in chronological order starting with choosing the topic, then going through the most important landmarks that guided our work and redefined our targets, and finally presenting the work with our final deliverable, the Handbook of landslides, and reflecting on how we have succeeded with the project. In the report, there is a timeline similar to Figure 1 at the bottom of each page highlighting the part of the working process we are describing.



Figure 1. Working process we went through during the project.

In addition to this final report, there is also other material available if you are interested in our project:

- Project document describing our plans for the project
- Project Mapit blog with posts about the working process and the most important parts of the project: <https://blogs.aalto.fi/sgtbhutan2021/>
- Handbook of Landslides for Dewathang, our final deliverable

PROLOG: A WORD ABOUT LANDSLIDES IN BHUTAN

Landslides are a common and severe natural hazard in Bhutan due to the country's climate and location in the mountainside of Himalayas (Sarkar & Dorji, 2019; Stockwell et al., 2019). From the year 2000 onwards, there has been at least seven severe landslide events in the country (United Nations, 2018). The most important factor causing landslides are the heavy monsoon rains in the area, but also some human activities, such as deforestation and construction, can destabilize the soil and increase the area's proneness to the hazard. (Sarkar & Dorji, 2019). The country's location in the mountainside also decreases the stability of the

soil, which makes the area even more prone to landslides. Additionally, other natural hazards, such as flooding, earthquakes, and forest fires, as well as climate change can increase the risks of landslides in the area. (Stockwell et al., 2019).

When a landslide occurs, it has various severe consequences. A single landslide event can damage or block a road and cause damage to a village or agricultural land – and on top of that, be life-threatening and cause loss of life. Landslides can also have economic consequences, as for example clearing a roadblock can take weeks, and thus cause difficulties for example to transportation. (Sarkar & Dorji, 2019; Stockwell et al., 2019). Similarly, economic losses can be also caused by loss of property or agricultural land caused by a landslide.

Nevertheless, even though landslides are a major issue in Bhutan, there is not much information available about them. For example, there is a very limited number of studies about rainfall-induced landslides in Bhutan (Sarkar & Dorji, 2019). Especially for our study area in Bhutan, Dewathang Gewog, there is very little information available. Thus, raising awareness of the severity of landslides in the area is crucial, and it is also the aim of our project.



Figures 2&3. Landslides in Dewathang, Bhutan. Pictures by Deewash Mishra.

CHAPTER 1: BEGINNING OF THE PROJECT

Why did we choose this topic?

As any other project, also Project Mapit started with defining our topic and targets. Initially, we did not have detailed information of our study area, Dewathang Gewog, or Bhutan in general. Thus, the first phase of our project work was to do background research of our study area to familiarize ourselves with the area and to determine the possible topics for our project. Already at this stage, we recognized that landslides are a major natural hazard in Bhutan.

Soon after familiarizing ourselves with Bhutan, we also got multiple project proposals from JNEC. Also these project proposals included a topic focused on landslides: A landslide susceptibility analysis. This, combined with the fact that our own background study had pointed out the severity of landslides in Bhutan, led us to the decision of choosing landslides as our project topic. Afterwards, we also noticed that there is not much information available about landslides in our study area, which also highlighted the importance of our project.

Who were we working with?

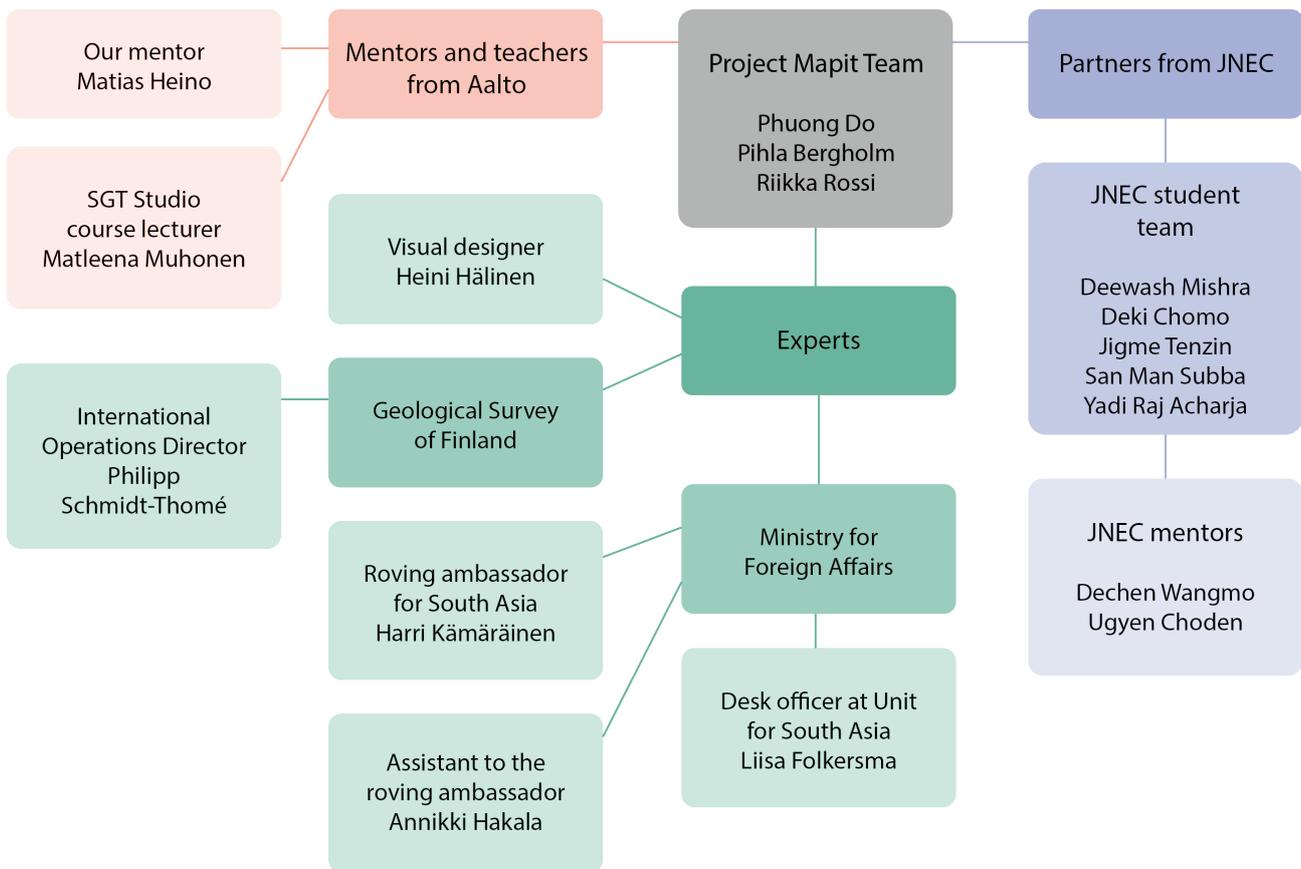


Figure 4. People involved in the project.



The core of the Project Mapit team were us, the Aalto student team (a.k.a. the Project Mapit team), consisting of three students with various backgrounds:

- Phuong Do (master's student in Water and Environmental Engineering),
- Pihla Bergholm (master's student in Water and Environmental Engineering), and
- Riikka Rossi (master's student in Landscape Architecture).

Throughout the project, we were guided by our mentor from Aalto University, Matias Heino (Doctoral Candidate, Department of Built Environment), and the SGT Studio course lecturer Matleena Muhonen (SGT Programme Coordinator, Lecturer in Landscape Architecture).

Our project was implemented as a collaborative project with our partners in Bhutan, a student team of five students from JNEC who were working with the same topic:

- Deewash Mishra (student in Surveying),
- Deki Chomo (student in Surveying),
- Jigme Tenzin (student in Surveying),
- San Man Subba (student in Surveying), and
- Yadi Raj Acharja (student in Surveying).

They were guided by their mentors from JNEC, Dechen Wangmo (B. Tech. in Geo-informatics Engineering) and Ugyen Choden (B.E. in Civil Engineering).

In addition to these two key teams implementing the project and the mentors guiding the work, there are also other people without whom our project would not have been possible. The most important ones for our project were the experts we met during the project:

- Philipp Schmidt-Thomé (International Operations Director of the Geological Survey of Finland),
- Harri Kämäräinen (Roving ambassador for South Asia),
- Annikki Hakala (An assistant to the roving ambassador for South Asia),
- Liisa Folkersma (Desk officer at Ministry for Foreign Affairs of Finland, Unit for South Asia), and
- Heini Hälinen (Visual Designer).

Our initial plans for the project

Together with the Bhutanese students, our collaboration project's goal was to raise the awareness of landslides in Bhutan. As the project proposal from JNEC was to do a landslide susceptibility analysis using a Geographical Information Systems (GIS) software, GIS



analysis was also the initial main method for both teams for producing information to raise the awareness of landslides. The plan was that using GIS we would produce landslide susceptibility maps showing the landslide prone areas in Dewathang, and the maps would be delivered to the local authorities, who could take our results into account in their decision-making to protect the local people from landslides.

In addition to the susceptibility maps, our Aalto student team decided to complement this information by creating an additional information package about landslides to the local people. Our main focus was still strongly on the susceptibility mapping with GIS, but the information package was a small additional complementary deliverable that could for example include our susceptibility maps with brief explanations as well as some general information about landslides. However, as the project proceeded, our focus shifted from the maps to the information package, but more about this in Chapter 2.

The actual project work was planned to be implemented by the two separate student teams who would still collaborate closely by for example sharing information and data. Our Aalto student team and the JNEC student team did our own activities independently, while we were still working on the same goal. The collaboration was an important part of the project, as we shared information about the progress and the data for the GIS analysis. In addition, an important part of the collaboration was our intensive three-day workshop together with the JNEC students, for which we did not have clear plans yet at the beginning phase of the project but we thought that it could include working together with the GIS analysis. However, later in the spring, when also our focus with the project had changed, the purpose of the workshop also changed and became more clear for us, and the workshop turned out to be one of the most important parts of our collaboration. The purpose and implementation of the workshop is explained in more detail in Chapter 2.

Our first steps with the project work

After deciding the topic and planning the project it was time to start working with the project. The first two activities we were working on were understanding the local people's existing knowledge about the landslides to have a clearer picture for the information package, and starting to do the landslide susceptibility analysis.

We were not able to travel to Bhutan due to Covid-19, and thus we needed the JNEC students' help for understanding the knowledge of the local people. However, they too were unable to interview the local people due to Covid-19 restrictions, and thus they carried out a survey about landslides among the other students of JNEC. The survey consisted of some general questions of landslide frequency, factors causing landslides and consequences of landslides to the students themselves and their community. The purpose of the survey was to determine how aware the students were about the severity of landslides and landslide



frequency in the area, as well as how much impact the landslides have on their lives, to understand what we should include in the information package.

After getting the survey results it was time to interpret them. We noticed that many of the students saw landslides as a severe natural hazard for their community (Figure 5a), and that a single landslide event can impact their lives for days – or even weeks (Figure 5b). However, there was also some incoherence in the students’ responses: For example, it seemed that they did not have a clear picture of the frequency of landslides in their area, as there were a lot of differences in their answers (Figure 5d), and that maybe for example the causes of landslides could be clarified as well, as the majority of the students only recognized heavy rainfall as a causative factor (Figure 5c). Thus, we concluded that there would be a need for more information about landslides for the students.

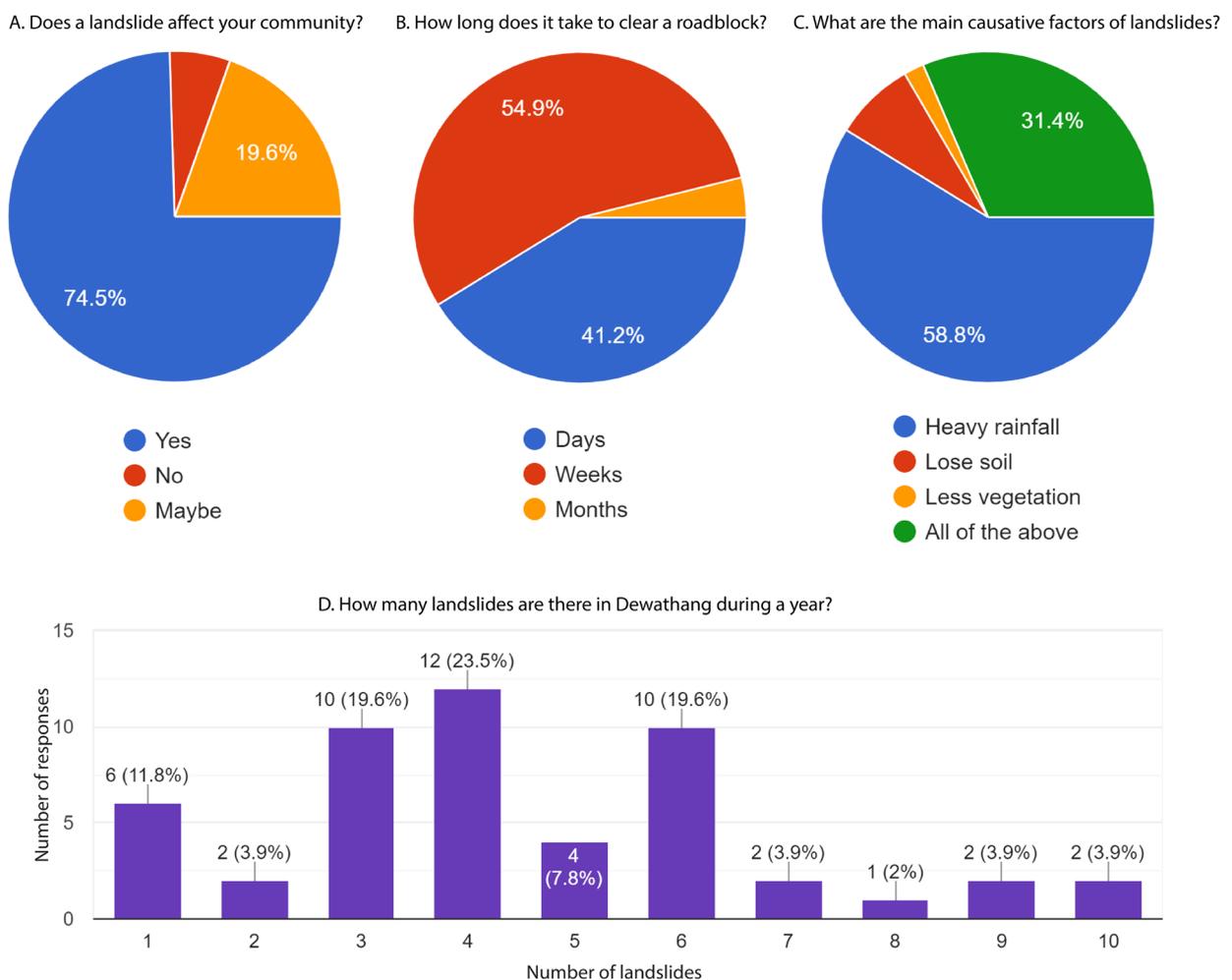


Figure 5. Some of the survey results.



In addition to interpreting the survey results, another important activity at this stage of the project was to start the landslide susceptibility analysis. As there was a very limited amount of open data available for the GIS analysis, we were using the same data as the JNEC students. Thus, an important part of our collaboration was that the JNEC students shared with us the data they had got for the analysis. Unfortunately, there was some data not available for the analysis: There was no information about the past landslide events, which meant that the analysis would have to be done without comparing the results to the locations of actual past landslide events, or that the JNEC students should do the landslide inventory themselves. Additionally, the precipitation data the JNEC student first got for the analysis confused both the student teams, as we did not see how it could be used in the GIS analysis. Despite these delays, we still thought that it would be useful if both teams did the analysis.

At that point of our project, we also had our first expert meeting with Philipp Schmidt-Thomé from the Geological Survey of Finland. Together we discussed the possibilities of our project, the landslide susceptibility analysis, and the ways to make the project more sustainable. Ph.D. Schmidt-Thomé helped us to understand our topic better and to realize the complexity of landslides. The meeting with him opened our eyes to see that there might be ways to make the project more useful than with both teams focusing on the susceptibility mapping, especially now that the map might be quite technical, if the JNEC students decided to do it without comparing the results to past landslide events. Ph.D. Schmidt-Thomé for example suggested that we could focus on producing information for the local students, as they are in a better position than us to deliver the message about the severity of the landslides to their own communities in Bhutan.

The discussion with Ph.D. Schmidt-Thomé together with the contradictory results of the survey led us to re-evaluate our approach on raising the awareness of landslides. We had gained more understanding of the complexity of our topic, the lack of information available for the students and that we could reach the local people better via the local students. It was time to rethink why we were doing the project, how we should do it, and to whom we should target it to be more sustainable and to make a difference.

CHAPTER 2: NEW DIRECTION

The project develops

After meeting with Ph.D. Schmidt-Thomé we faced the fact that we are forced to re-evaluate our project's true sustainability and it did not anymore seem reasonable to keep the focus only on the susceptibility analysis maps. And as the Bhutanese team will continue working with the maps and GIS analysis, there would be heavy overlapping in the final deliverables



by the two teams. Hence the idea of producing educational material to complement the maps would be worthwhile and what's more important – feasible.

We had introduced the prospect of producing an information leaflet about landslides in our initial project document and result chain. Thus, we decided to proceed with the concept of an information leaflet - or a landslide 'cookbook', as it was referred to by Ph.D. Schmidt-Thomé. The thought of producing educational material to the students of JNEC seemed like a logical option, as it is the local community we are most closely linked to.

Although at this point making the material to the JNEC students was just an idea, the more localized approach to the final deliverable was also a proposal from Ph.D. Schmidt-Thomé. With our limited resources and with the fact that we were not able to visit the target country within the context of this course, the biggest impact we could make is via students, who are the future professionals.

Second expert meeting with validation for our refined plans

The second expert meeting was with the staff from the Ministry for Foreign Affairs. We were honoured to meet the roving ambassador for South Asia Harri Kämäräinen, an assistant to the ambassador Annikki Hakala and a Desk officer at the Unit for South Asia Liisa Folkersma.

In addition to having a great discussion on the Bhutanese culture and the connection between Bhutan and Finland, we introduced our idea of raising awareness on landslides with an information leaflet (or a handbook as we now called the outcome). The concept of a-kind-of-a-handbook got really good feedback and we were told how very important the topic is and how there is an actual need to build resilience towards landslides within the communities.

The experts reminded us that there are some aspects to be taken into consideration which would affect the final form of the 'handbook', such as the level of illiteracy in the local communities. Ambassador Kämäräinen envisioned our project even further and suggested different companies and organizations for us to possibly engage in the process. At this point the project scope and its opportunities seemed to widen extensively.

After the meeting we pondered the possibility of swelling our project but at the end, we decided to keep to our renewed original plan; although Mr. Kämäräinen had a valid point and expanding the project sounded like everyone's dream project, we did not quite have the resources for that.



CHAPTER 2.1: NEW DIRECTION WITH JNEC

Setting a new objective

As we were set to work with the handbook, we wanted to engage the Bhutanese team to plan the structure and the concept of it with us. We also wanted the team to understand how important it was for us to work with them. Hence, at this point we needed to re-warm our communication between the groups and start to plan an intensive workshop around the planning process.

The educational material that would be produced could be in any form - not only a literal handbook. For example, last year's project's main deliverable was a board game on waste management. Although this motivated us to think outside of the box, we still needed the Bhutanese student's opinions and insights on the matter before proceeding. Thus, we decided to use the intensive workshop as a method for both teams to contribute for planning the educational material. This approach seemed practical and suitable for our process and project's progress.

Planning an intensive workshop

There was a small setback when the Bhutanese students chose the timetable suitable for them; we got only 6 hours for working together - 2 hours in three consecutive days. Hence, we really needed to plan each day and a logical order to the whole event.

We planned the first day to be an introduction day, introducing our studies and Finnish culture but also our progress in the project. The second day would mainly be for the Bhutanese team to plan and some warming up for the third day when we would dive into our main topic - landslides and planning the educational material. Luckily, both Mr. Kämäräinen and Ph.D. Schmidt-Thomé agreed to attend our workshop, Mr. Kämäräinen keeping the opening speech on the first day, and Ph.D. Schmidt-Thomé providing us information on communication and landslides on the final day.

Each day was planned to begin with an ice breaker game to get our brain cells working and getting rid of any extra tension. Before the beginning of the workshop, we had prepared the core of the workshop thoroughly but some parts we decided to plan as we go and make quick adjustments based on the recognized needs.



Warming up the connection

During the times of only online working, we recognized the fact that suddenly beginning to work with relatively unknown people can be a handful for the participants, especially as there had been a significant break in the informal communication between the groups. Therefore, we organized a cultural exchange in our shared Whatsapp chat to lower the threshold for participation. The purpose of it was to warm us all up for the workshop, and get to see and share glimpses of our everyday lives. Although living very far from each other, from the shared pictures we could see that we as people were not that different; we enjoy similar things such as good food, nature and outdoors.



Figure 6. During the week we shared snapshots with each other.

The intensive workshop

First day

The first day of the workshop began with an ice breaker activity called *Things in Common*. For this activity we divided into smaller groups to discuss the things that we share in common. The planned activity worked well and led to informal and bubbly chatting with a lot of laughter.

After the ice breaker, our team provided two presentations – one about our studies and the life in Finland and another one about the progress of our project. The latter presentation led to a conversation about the final deliverable and its concept. We briefly discussed the concept of a handbook and it seemed to raise some confusion within the Bhutanese team.



The day ended with an unforgettable opening day discussion led by the roving ambassador for South Asia, Harri Kämäräinen. In this presentation, Mr. Kämäräinen had emphasis on the relationship and interaction between students of Finland and Bhutan. He reminded us how there were many dimensions in our lives that we could all learn from each other and how under the current climate change situation, by dealing with it together, it is possible to narrow down the distance between the countries.



Figure 7. Mr. Kämäräinen's tweet about attending our workshop (Twitter/14.4.2021)

After the first workshop day, our team had a brief reflection session of how the day went. We noticed how excited everyone was and decided to tackle the recognized confusion with the handbook concept. Hence, we prepared a presentation to spell out our thoughts more elaborately; how the concept could and maybe also should be something out of the box.

Second day

Most of the second day was hosted by the JNEC team. The Bhutanese students had organized activities to introduce us to their culture and traditions. The day started with a boedra welcome dance shown by the Bhutanese team, along with the zhungdra and rigsar songs. Many of these Bhutanese traditional dances are meant for good luck and happiness. Some



other Bhutanese cultural aspects were also introduced, for example, their traditional dresses and a recipe for Ema Datshi – the national dish of Bhutan.

The JNEC team also provided us their mid-review presentation about the progress regarding the landslide susceptibility analysis, clarifying us the causative factors for the landslide analysis. JNEC's session closed with a Dzongkha language learning activity, which brought us a lot of fun and laughing together.

At the end of the second day, we initiated the discussions about the handbook concept with a presentation, to let us brainstorm and prepare for the main discussion on the final day.

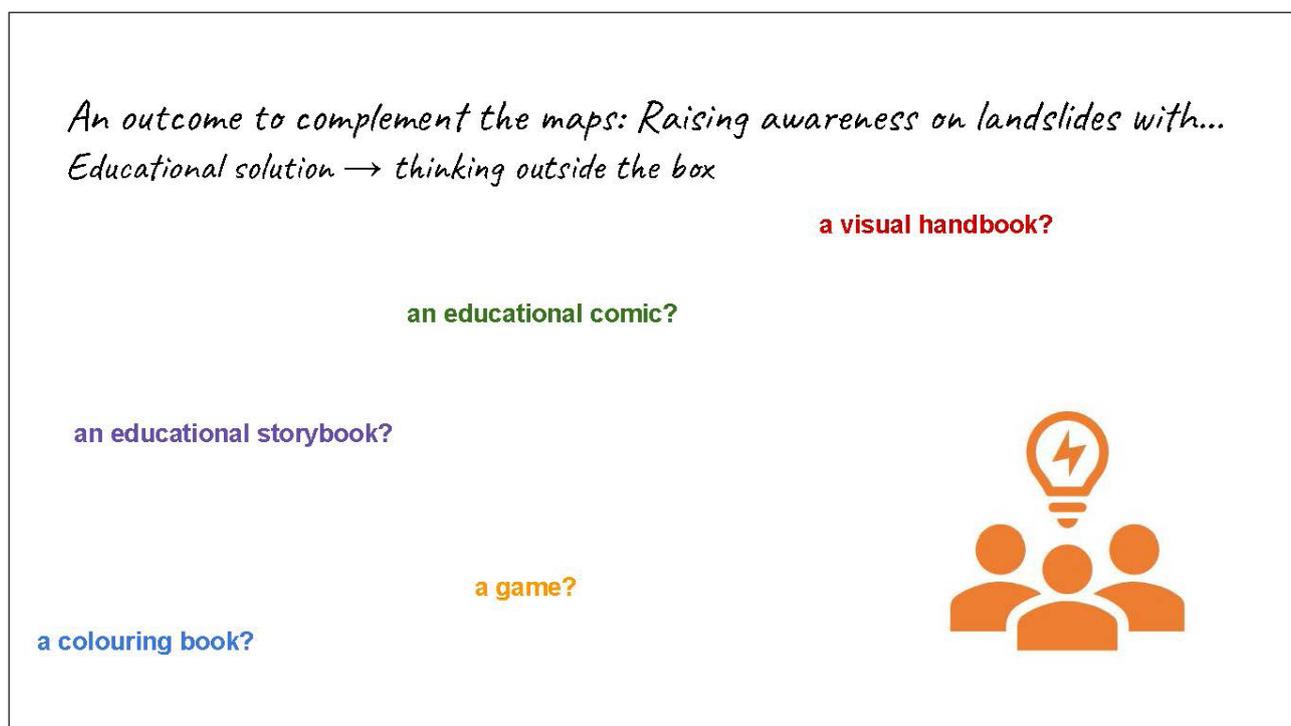


Figure 8. A slide from the presentation on the handbook concept

Final day

The final day of our workshop concentrated on our actual working topic – landslides. To bring back the feeling of calmness and joy after two intensive days, we began the day with a short meditation session. This activity helped us to relax our bodies and our minds, in order to be more productive for this last workshop day, as there were a lot of activities planned for the whole team.



The discussion on landslides was initiated and was led by Philipp Schmidt-Thomé from The Geological Survey of Finland. He shared with us a presentation on landslide risk assessment from a stakeholder communication point of view. He pointed out that we should clarify our project objectives and outputs by defining the values of the project, considering the gap in the knowledge of landslides within the local community.

The following activity was a highly active discussion on the handbook as an output of our project. We used different kinds of methods in Miro for narrowing down the best options. The Bhutanese team was highly active in the planning process and shared with us their knowledge on local circumstances and people.

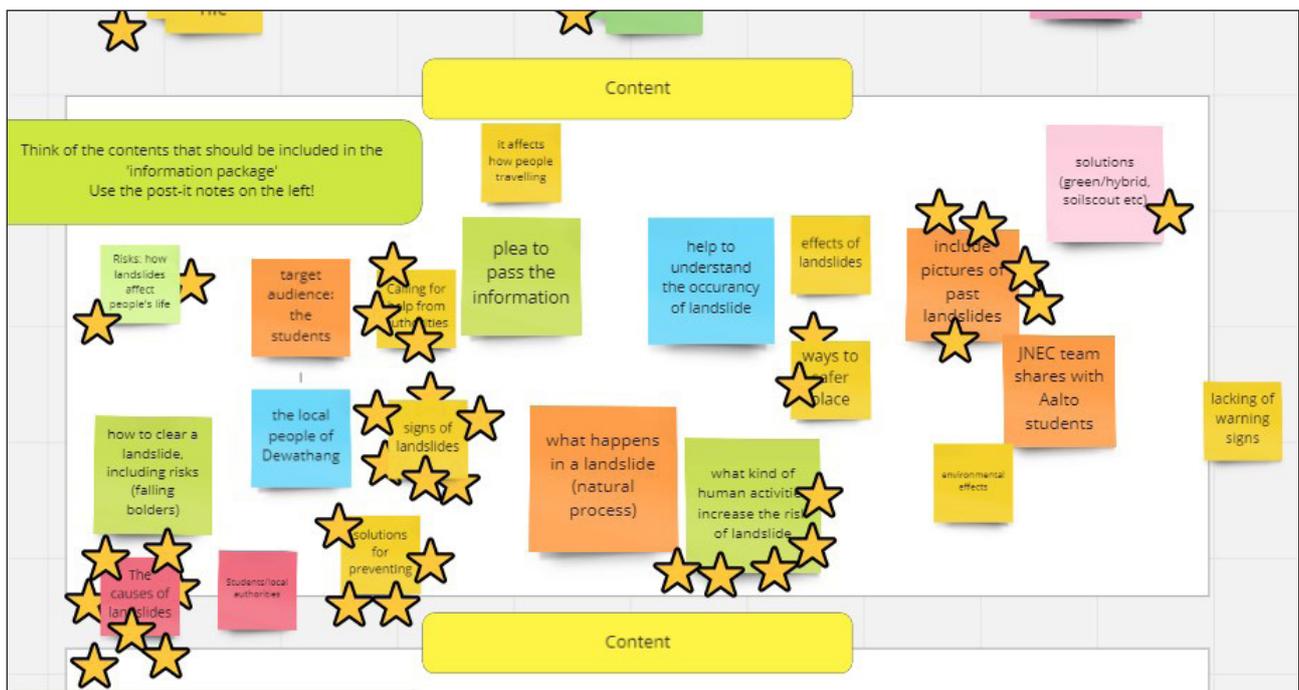


Figure 9. Majority of the planning was done together in Miro

Together, we came up with the final decision, that the handbook will be produced in the form of an actual handbook, including general yet localized information on landslides with many pictures and other visualizations. The handbook would also include the landslide susceptibility map made by the Bhutanese team. The proposed contents for the handbook included, e.g., the causes of landslides, how landslides affect people's lives, signs of landslides, human activities that increase the risk of landslides and contact information under emergency. The target group for our handbook was selected to be the students of JNEC, as they can deliver the message further on their own families and other communities.



After the workshop

Working with the Bhutanese students in an intensive workshop was not only an unforgettable lesson, but also meaningful and simply fun. Although we could not meet in Bhutan this year, we can truly say that we all got an experience of working together. Enabling one to participate in the planning process not only contributes to the outcome but also enhances the sense of ownership for the project.

After the workshop we were really content how active everyone was and how well everything went, although the workshop had been organized with a very compact timetable. We got the needed things done with great results. Because of the tight schedule both presentations from our special guests were quite brief but nonetheless important and served us many tools to proceed working with our task.

The key for a successful workshop is to plan the activities and schedule well. Fortunately we had plenty of different online tools on hand to combine for managing an efficient process. The difficulties we had with communication were tackled with persistent activation and working with our own motivation levels and being positive.

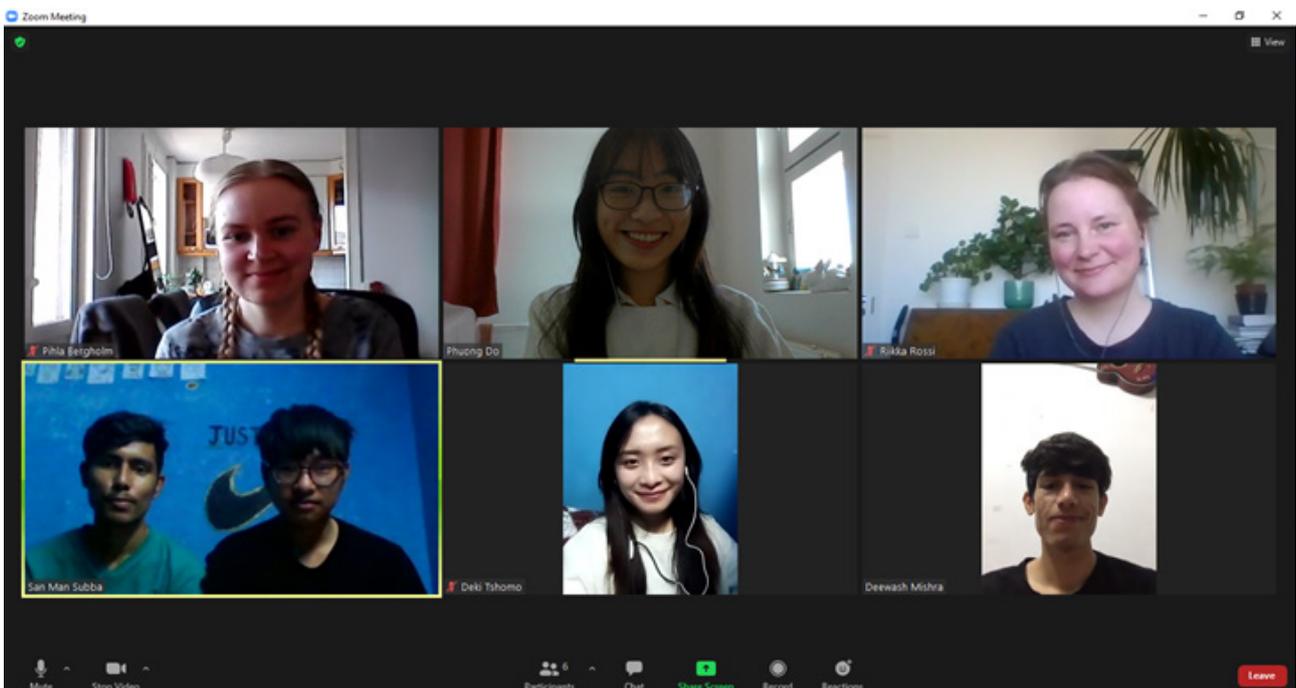


Figure 10. Happy faces in Zoom.



CHAPTER 3: THE HANDBOOK

The “Handbook of Landslides” was our final deliverable that provided the local students with general information on landslides. The handbook can be considered to be a reflection on our result chain - impacts, outcomes, outputs, and activities - that had been mentioned in the project document.

The impact

Landslide is a major natural hazard in Bhutan. They can cause severe damages to the living environment as well as to the wellbeing of the people and even cause loss of life. Thus, reducing the risk of this severe natural hazard would improve the safety of the people living in the landslide risk areas. The aim and the impact of our project was to improve the safety of the area of Dewathang Gewog by reducing the risk of landslides. The impact was also closely related to achieving SDGs. SDG 11, Sustainable Cities and Communities, is related to improving the safety and resilience of cities and communities, and its sub-target 11.5 focuses on reducing the amount of affected people and loss of lives caused by disasters (United Nations, 2015). Creating solutions to reduce the risk of landslides would reduce the amount of people affected by landslides and contribute to SDG 11. Moreover, as one of the reasons for landslides in Bhutan is climate change, our impact was also linked to SDG 13, Climate Action. Its sub-target 13.1 aims at improving the resilience and ability to adapt to natural hazards caused by climate change (United Nations, 2015). Our project aimed to mitigate the risk of landslides partly caused by climate change, it is also about adapting to climate change and improving the community’s resilience towards it.

The outcome

With the idea of the handbook, we aimed at better awareness and understanding towards landslides among the locals with the help of students. Our outcome was to enhance the awareness and understanding of the local people regarding the landslides and the risks related to them. Raised awareness can help the locals to identify the level of risks in their neighborhood and the ways they could protect themselves.

The handbook as an output

“a book that contains instructions or advice about how to do something or the most important and useful information about a subject” – Cambridge Dictionary.

As a result of our study on landslides and the local conditions, an educational information package - the handbook about landslides was created. The handbook was published to be available for the public and to raise their awareness towards landslides. Moreover, there



was a possibility for our peers in JNEC to disseminate the handbook further in Bhutan to enhance the contribution of this output. As the handbook provided information about landslides, preparing the information helped us to find possible solutions for mitigating the risks.

Being a part of our project, the Bhutanese students produced a map showing the areas with the highest risks of landslides. The map was included as an important session in the handbook. Creating and publishing the map contributed to the outcome as the map provided information about the risk areas and can thus raise the awareness of the risks of landslides.

The activities

Many activities were done to contribute to the outcome and the completion of the handbook.

Activity 1. Interview experts on the prospects of the project and survey local people about their current situation.

The aim of the interviews and survey was to provide a broader understanding of the current situation and the landslides in Dewathang Gewog and Bhutan than we could gain by merely reviewing literature. A brief survey was made among the Bhutanese students (due to Covid restrictions). This helped us to create the handbook with information relevant to the local people of our study area.

Activity 2. Study landslides

This activity was done in the form of literature review to get a comprehensive picture of causes of landslides and the past landslide events in the area, and to complement the information we gained from the interviews with the experts and the local people of Dewathang. Like the interviews and survey, this contributed to creating the handbook, as it provided vital information for the contents of the handbook.

Activity 3. Benchmark related or similar projects

Benchmarking related or similar projects helped us to know where to start our project, what had already been done and how we could use the information already available. There were different papers dealing with landslides in Bhutan but mostly scientific.

Activity 4. Study the environmental & geographical conditions

The environmental and geographical conditions, e.g., slope and climate of Dewathang Gewog affect the risks of landslides in the area, therefore, it was important to understand the



conditions in our study area. Studying these conditions was done by reviewing literature and interviewing local people and experts. This activity helped as the study provided us relevant background information to be used in the handbook and ideas of where the high-risk areas for landslides could locate and what kind of data needed for creating the maps.

Activity 5. Collect the data and do landslide susceptibility analysis

This activity included collecting the data for the landslide susceptibility analysis. As a result of the analysis, a map of high-risk areas for landslides in Dewathang Gewog was created. Most of the data was not available for public downloading and to prevent the heavy overlapping in the outputs, the Bhutanese students were responsible for this data collection, landslides analysis and map visualization.

Activity 6. Gather all information

Throughout the process, we had to gather and summarize the relevant information gained during the project. This helped us to decide what to be included in the handbook and create our final report/presentation about the whole process the project included.

Beneficiaries

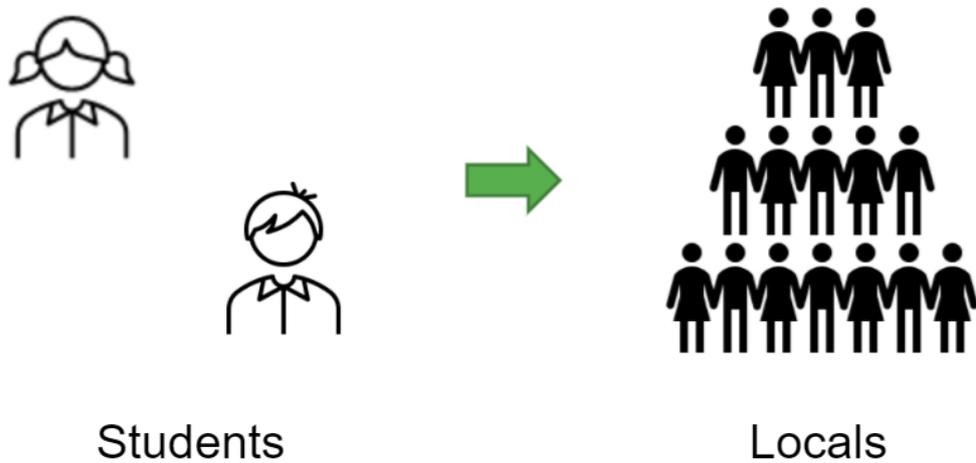


Figure 11. Direct & final beneficiaries of our project



Direct Beneficiaries

The direct beneficiaries of our project were the JNEC student team and the staff in JNEC with whom we were collaborating during our project as well as the local students. We believed that it was most beneficial to have the local students as our handbook's target audience, since we were focusing on the educational purpose. The illiteracy rate in Bhutan is high, at 34% in 2017 (the Bhutan Living Standards Survey), hence, they were the potential group that can use and disseminate our results further to better reach our final beneficiaries in Bhutan.

Final Beneficiaries

Our main final beneficiaries were the local people of Dewathang Gewog, Bhutan. The area consists of 20 villages that in total correspond to the population of almost 2900 residents (Bhutan Local Government Portal, 2018). They can benefit from our project in multiple ways. Firstly, our direct beneficiaries – the local students and JNEC staff will spread the information on landslides that was provided in our handbook to the local community, for example, to their friends, families, relatives, and even future workspaces. Secondly, the handbook can be widely distributed, which will raise their awareness towards landslides. Thirdly, the produced map about the high-risk areas of landslides in Dewathang can also inform people on whether their homes are located in the prone area. In the long term, the project can contribute to improving the safety of the area by reducing the risk of landslides and enhancing the area's resilience towards landslides. Therefore, our project contributes to protecting the local people from landslides and improving their living environment, and thereby the most benefits focus on the local people.

Additionally, a wider area in Bhutan can benefit from our project in the long term. Firstly, reducing the risk of landslides can make the horticulture and dairy production in the area more stable, as the risk of damage to the crop or dairy livestock due to landslides is mitigated. Secondly, the information handbook that we provided can be useful in other areas of Bhutan as it included general and not only area-specific information about landslides and protecting oneself against landslides. The handbook can be disseminated to broader areas to improve the safety on a bigger scale.

Other groups of final beneficiaries for our project were the local authorities, such as the local government in Dewathang Gewog. The created landslide handbook and map of the risk areas in Dewathang can provide them useful information about the areas where the risks should be mitigated and how the risk mitigation could be done. Furthermore, being a part of PBL South Asia and Aalto University's SGT Studio course with the Royal University of Bhutan, the project's documentation, outputs, and outcomes were also available online (for



example on the website of PBL South Asia and possibly in our own blog) for the students and staff of both schools, as well as for public. Hence, students taking part in PBL South Asia Bhutan in following years can benefit from the results provided by our project.

Reaching the beneficiaries

The handbook included general information on landslides with infographics and the landslide susceptibility map made by the Bhutanese team as a core. The handbook was written in English with tailored information to fit the local people. The aim was mainly to provide the most general information on landslides with educational purposes. The handbook was designed to be as visual as possible, as pictures were a great way to convey this type of information. The illiteracy rate in the study area was quite high, therefore, in order to make the handbook accessible, the material was made to be simple, with a limitation of text.

The size of the handbook was A4, including in total 16 pages. There was a meeting with a visual communication design professional Heini Hälinen to discuss about the possibility of ways to create the handbook that is most suitable for the purpose of educating the students about landslides. The discussion with Heini helped us gain a clearer vision on how a handbook should be designed, for example, what kind of figures and amount of text it should include, the layout of each page and the recommended binding, etc.

For distribution, we aimed to provide the handbook in an electronic form and also in hard-copied version, thus the document setup was adjusted to fit both types. After the English version was finished, the whole book was initially planned to be translated into the local language – Dzongkha with the help of staff from JNEC. We got a budget from the PBL project that can be used for translating and printing the handbook into hard copies, in addition to the digital file. Due to some practical issues and difficulties in communication, we cannot make it by the time of finalising this report, however, there might be a possibility to print and translate the handbook if needed in the future.

Content of the handbook

After the intensive discussion during our workshop with the Bhutanese students and asking for advice from different stakeholders, along with a thorough consideration within our team, we had agreed on the content of the handbook, which included the followings:

- What is a landslide?: A general definition of landslide
- Basic landslide types: How landslides are classified and figures of different landslide types
- The causes of landslides:
 - Natural Occurrences: slope, soil, rainfall, etc.
 - Human Activities: excavation, vegetation removal, drainage, mining, irrigation, etc.



- Where/when do Landslides occur?: Signs of landslides in water, nature and built environment
- Effects and Consequences of Landslides: On People, on Built Environment, on Natural Environment
- Simple Mitigation/Prevention Techniques: Some basic techniques for mitigating/preventing landslides (avoid deforestation, analysis of prone areas, etc.)
- How to prepare for a landslide?: Actions for the preparedness of landslides
- What to do in case of a landslide?: Actions for the response of landslides
- The landslide zoning map: The landslide susceptibility map for Dewathang made by the JNEC students
- Pictures of past landslides: Pictures of landslides in Dewathang in 2021, taken by a JNEC student
- Contact information under emergency: Who is responsible for the emergency management of landslide hazards in Dewathang? To whom people in Dewathang can contact in case of a landslide?

These were considered as fundamental knowledge of landslides for the people in Dewathang. We found that those contents were in high importance for the purpose of providing general information on landslides.



Figure 12. A demo for the spread of the handbook.



CHAPTER 4: REFLECTION

As earlier mentioned in our project document, the progress of achieving the objectives of the project can be measured with different indicators and monitoring procedures. It was important to reflect our progress based on those indicators under the context of our result chain and evaluate what we had done so far.

Since the impact was something that our project contributed to but was not supposed to be achieved within the project, we did not have indicators or monitoring procedures to measure the progress related to achieving the impact. However, the impact was connected to the SDGs, hence, using them as an indicator of the progress was possible.

The progress of achieving the outcomes of the project was measured with following indicators and monitoring procedures:

- Number of people with whom the handbook, map and/or our final presentation were shared: about 50
- Number of solutions proposed: 15

The progress of achieving the outputs was monitored with following indicators and monitoring procedures:

- The level of progress with our output products (handbook, map, final presentation): finish

The following monitoring procedures were to monitor our progress with the activities:

- Meeting the deadlines: all the deadlines were met
- Number of relevant expert meetings: 3, with 5 different experts

Managing the timeline

The project was implemented within three major phases, as aforementioned in our project document: planning, implementing (with the intensive workshop) and finalizing, reporting & evaluating. There were some delays in the actual timeline from the planned timeline due to unexpected changes in different project stages. Unforeseen delays can come naturally and are one of the most common problems in project management. The objectives were set a bit unclear at the early phase of the project, which required us more time to solve this issue and to understand what really needed to be done in our project. We arranged the expert



meetings quite late in the process as many new thoughts and adjustments were done after that. The planning for the activities was redone frequently to fit the limited amount of time and resources. Despite these, the key timesteps for the project were ensured, including: the background study, the project document, the mid-review, the media release, and the final report/presentation.

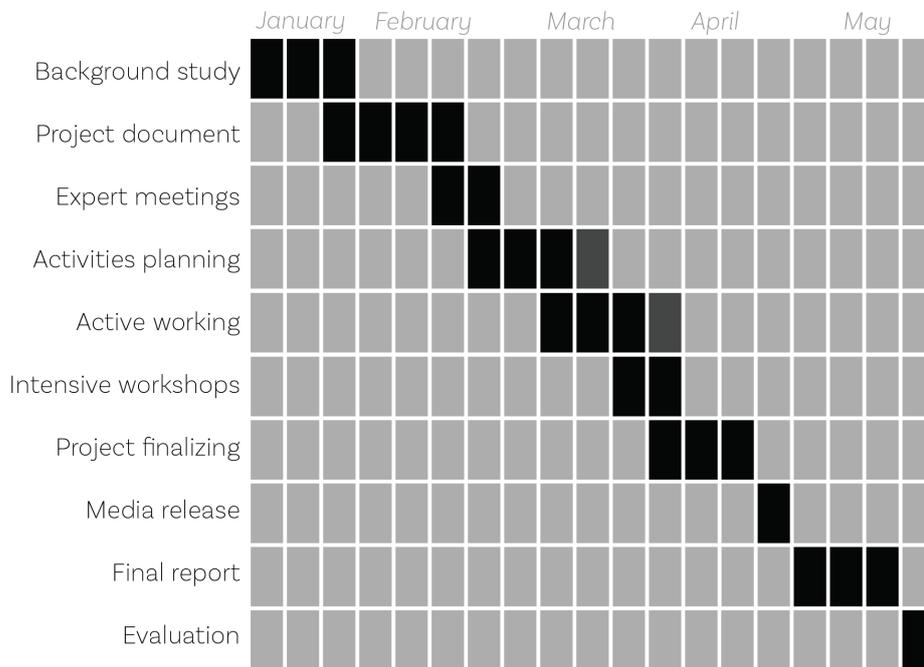


Figure 13. Initial timeline for our project.

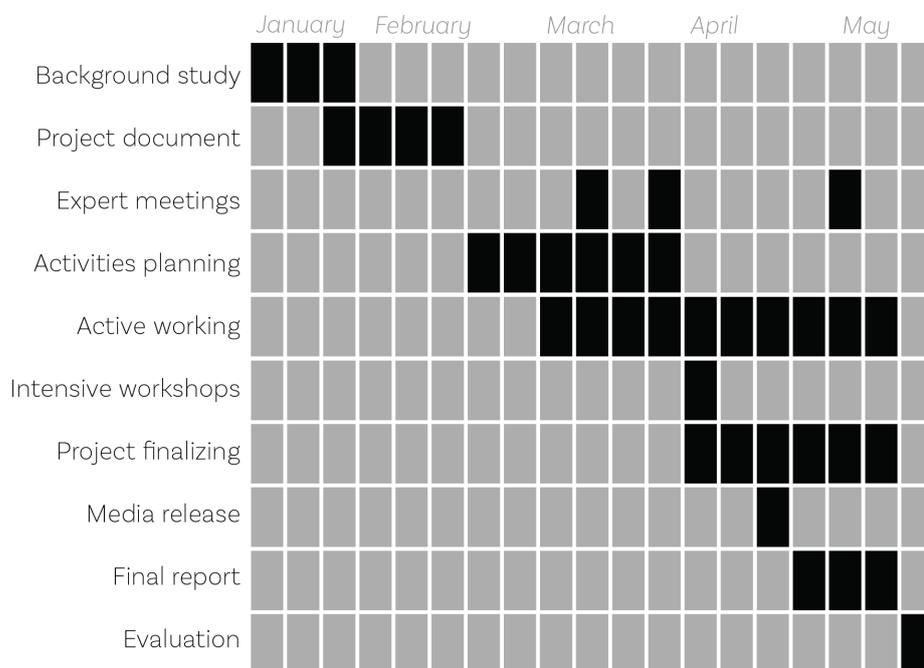


Figure 14. Updated timeline for our project.



Managing the activities

The planned activities were quite in order, even though we had some changes in the methods. For example, from two original outcomes, we narrowed down to only one: Better awareness and how to protect oneself towards landslides is gained among the locals. The form of the information package was changed from the leaflet to the handbook with infographics. Some planned activities were cut to be appropriate with the limited resources and the pandemic situations. Our team was no longer doing the GIS mapping, therefore, there was no need for GIS expert consulting or data collecting activities.

Many meetings were organized between our team members, the experts as well as the people from both schools and the SGT course. We tried to enhance our collaboration within our team by frequent meetings and open discussions. The implementation of the project was a combination of teamwork, group work and independent work. A big highlight in the activities was the intensive workshop as our project was reaching an intensive phase that required active participation from both our team from Aalto University and the Bhutan team from JNEC. After the whole process, we understood that communication was the key aspect to facilitate the efficiency of collaborative activities.

Evaluation of sustainability

Different aspects of sustainability were considered in the project. For the project implementation, we focused on the dimensions of institutional, social and cultural, financial, technical, and environmental sustainability.

The institutional sustainability was enhanced by enabling the engagement between the final products and local community Dewathang Gewog. The project was mainly carried out by Aalto team and JNEC team, therefore, JNEC ownership and commitment were crucial to the project both during and after the implementation. After the end of the project, we hope that JNEC together with the Dewathang Municipality will continue to take care of the final outputs and they have the rights to further develop the activities if needed. From the sides of Aalto University and JNEC, students and mentors can continue to get involved in the distribution of the handbook to the local community. As the project was recorded in the PBL South Asia, Aalto University and JNEC database, it will be a valuable reference for other students to get to know with the project, especially for the Sustainable Global Technologies Studio (SGT) course at Aalto University and the Diploma of Surveying Programme in JNEC in following years.

Throughout the project, the local needs were put in high priority. Landslide is an important problem in the study area; therefore, the provision of information and analysis of landslides were highly relevant to the current situation of the local community. This project was



implemented under the context of Bhutan's culture and religion, to be consistent with the customs and traditions of the area. The dissemination of the handbook to the local community should be done after the project, at least in the electronic form. The activity of getting access to and gaining the information from the local people will contribute to the social and cultural sustainability.

In terms of financial situation, the activities in the project were not profitable. After the final product was finalized, the required costs only came from the translation of the handbook to the local language and the printing. The local community and JNEC may take the responsibility for the costs if the project is further developed afterwards. However, the financial problem is not a significant problem and the sustainability in terms of finance can be easily achieved.

The original main method used for the implementation of the project, i.e., the susceptibility analysis of landslides was GIS. However, our team from Aalto was not responsible for GIS tasks, therefore, all the rights for handling the techniques might belong to the JNEC team. We might ask the JNEC team for permission to transfer the technology. The acquired data can be stored in Aalto University or JNEC databases after the project. These GIS techniques can be further utilized for other similar projects in the future both in Bhutan and Finland.

As aforementioned, our project was related to achieving the SDGs: SDG 11, Sustainable Cities and Communities and SDG 13, Climate Action. Although this project solved the needs of the local people by providing the information towards landslides, it brought about values for the risk mitigation that can involve climate and environmental sustainability approaches. Mr. Kämäräinen recognized a lot of potential in our project for further development and he thought that the handbook came at just the right time as there was a need to build resilience towards landslides within the local communities in Bhutan. We were suggested an ambitious vision to develop our project in the future and engage more organizations to the project such as Red Cross and World Wildlife Fund (WWF) as our project provided sustainable values to both cultures.

Success of the delivered material

All of the final outputs, including the final presentation, the final report and the handbook were delivered within the deadlines. A final presentation of the SGT course was organized on 26/05/2021, where there were approximately 50 participants and we were proud to present our draft of the handbook to the audience. It was hard to say if we were successful with the final deliverables as there were no scales for evaluating them. However, we believe that our handbook will be helpful for the community of JNEC as well as Dewathang, and together we can create an impact on our society, especially in places that are susceptible to landslides.



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Image sources:

Cover photo by Tanay Dedhia/Unsplash

1 Pihla Bergholm, 2021

2 & 3 Deewash Mishra, 2021

4, 8, 12-14 Riikka Rossi, 2021

5 JNEC student team, 2021

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7 Harri Kämäräinen, Twitter/14.4.2021

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