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CLIMATE TECHNOLOGY CENTRE & NETWORK

AIT
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Data collection for

"Flood Risk Assessment for Dungsum Chu Basin in Samdrup Jonkhar"

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CONTENTS

1. Background and Context

Bhutan has been grappling with flooding problems for years. A combination of steep topography and the projected increase in rainfall in the coming decades due to climate change poses major threats, particularly during the monsoon season. In addition to direct flood damages to life and property, these events also trigger subsequent hazards such as landslides. The Government of Bhutan has recognized the need to urgently manage the recurring flood problems in the country. As a result, it has approved a budget of Nu.728 million in the 11th Five Year Plan for flood protections works throughout the country, and established the FEMD to oversee all flood management works in the country. The newly established FEMD, however, lacks the technical capacity to carry out the flood risk assessment studies, which is crucial in developing flood management plans to mitigate the impacts of floods.

In May 2016, FEMD and the National Designated Entity (NDE) of Bhutan, the National Environment Commission Secretariat (NECS), submitted a request for CTCN assistance on "*Capacity development for preparing an integrated flood management plan for Dungsamchhu Basin in Samdrupjongkhar*". The request was accepted by the CTCN, and consortium partner Asian Institute of Technology (AIT) was engaged to provide technical support. After several rounds of interaction between AIT and FEMD, the scope of the technical assistance was defined specifically and deemed to focus on "*Flood Risk Assessment for Dungsamchhu Basin in Samdrupjongkhar District*". The objective of the technical assistance is to enhance the skills of the relevant engineers in FEMD and Samdrupjongkhar municipality to indigenously undertake flood risk assessment and to translate this assessment into flood adaptation interventions.

One of the activities under this technical assistance is to collect the relevant primary and secondary data for the flood risk assessment. This report elaborates on the primary data collection, which includes a questionnaire survey for flood vulnerability assessment and river cross-section survey for flood hazard assessment. The primary data collection was carried out jointly by FEMD and Samdrupjongkhar Thromde officials. This document provides a comprehensive description of the various elements of the field surveys and primary data collection.

2. Overview of Data Collected

Table 1 presents the details of the data that has been collected for the CTCN technical assistance on 'Flood Risk Assessment for Dungsum Chu basin in Samdrupjongkhar'

Table 1: Overview of data collected for flood risk assessment in Samdrupjongkhar

Data type	Parameter/variable	Frequency	Duration	Source /Remarks
For Flood hazard maps				
Climatology data	• Rainfall	daily	1996 – 2016	(one meteorological station; data is only available for the rainy season)
Hydrological data	• Water level (floodplain)	N/A	N/A	Questionnaire survey
Cross sectional data	N/A	N/A	N/A	Field survey
Floodplain elevations	• Digital elevation model (DEM)	30 x 30 m	N/A	
For vulnerability assessment				
Demographical data	• Population size	N/A	N/A	Questionnaire survey
Important Land use/land cover	N/A	N/A	N/A	
Soil data	N/A	N/A	N/A	
Infrastructure locations (buildings, roads, bridges and etc.)	N/A	N/A	N/A	Questionnaire survey
Social data	• Household size • Gender of household head • Educational level of the household head • Health statues of the household head • Dependency ratio • Number of the disable family member • Length of residence with this community	Household level	N/A	Questionnaire survey
Economic data	• Total income of the household	Household level	N/A	Questionnaire survey

	• Occupation of the household head • Multiple earning source • Savings • Households take loan on a regular basis • Social capital • Number of unemployed people			
Physical data	• Location of the house • Distance of the river from house • Distance of the evacuation shelter from house			Questionnaire survey.
Exposure data	• Households understand warning • Households having mobile phone • Households experienced flood damages in past • Households possess indigenous knowledge • Household share warning with others			Questionnaire survey

3. Period of Field Survey

17Days: 14/09/2017 to 30/09/2017.

4. Questionnaire Survey for Flood Vulnerability Assessment

2.1 Overview of the questionnaire survey

The core objective of the questionnaire survey was to collect the primary data on flood vulnerability in the target area (Figure 1) and evaluate the degree of risk posed by the Dungsum River in Samdrupjongkhar municipality.

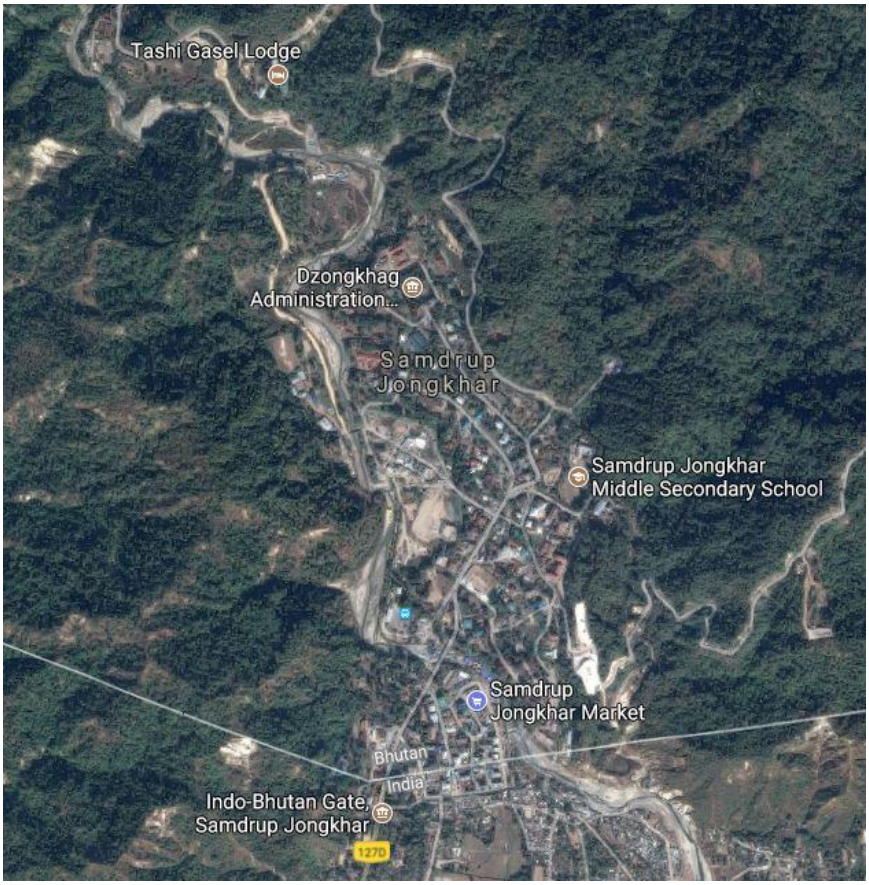

Figure 1: Target Area, Dungsum Chu in Samdrup Jongkhar Thromde, Bhutan

Based on the land use characteristics in the study area, the FEMD engineers and the team from AIT designed a questionnaire to fully capture the vulnerability of five different land uses, viz residential, institutional, industries/commercial, infrastructure and agricultural. A single questionnaire survey was designed that had five different sections in order to capture all the essential information. For details of the questionnaire survey form, please see Annex A. Provided hereafter are details of the survey conducted in each of the five categories:

1. **Residential**: 230 households were interviewed uniformly across the study area. The samples were taken from houses near the river and also away from the river to spatially overlay the vulnerability on the hazard maps to estimate the risk.

2. **Institutional:** As per the land use map, 10 institutions were interviewed. These includes hospitals (2), schools (3), regional labour and human resources (1), road safety and transport authority of Bhutan (1), royal Bhutan police (1), forestry division(1) and municipality (1).

3. **Industries/Commercial**: 26 interviews were conducted at different locations as per the land use map, 3-4 interviews in each area.

4. **Infrastructure**: 4 interviews were conducted with the offices dealing with infrastructure developments such as Department of Road, Bhutan Power Corporation, Municipality and Bhutan Telecom Limited.

5. **Agriculture**: As per the site investigation, Samdrupjongkhar municipality area does not have adequate agricultural land. Further, the land use map also does not show agricultural land in the Thromde. Therefore, survey was not taken for agricultural land use.

All data which are collected from the questionnaire survey has been uploaded to a specially created website (https://ctcnbhutan.wixsite.com/capacitybuilding)

2.2 Enumerators for vulnerability assessment

The list of officials involved for the vulnerability assessment survey is given in Table 2.

Table 2: Enumerators for vulnerability assessment

No	Name	Agency
1.	Megnath Neopaney	Flood Engineering and Management Division
2.	Pema Cheda	Flood Engineering and Management Division
3.	Kedhar Kr.Adhikari	Flood Engineering and Management Division
4.	Kezang Phuntsho	Flood Engineering and Management Division
5.	Pelden Wangchuk	Flood Engineering and Management Division
6.	Sonam Dhendup	Samdrupjongkhar Municipal
7.	Dechen Chezom	Samdrupjongkhar Municipal
8.	Jigme Gyeltshen	Samdrupjongkhar Municipal
9.	Sangay Dorji	Samdrupjongkhar Municipal
10.	Sherub Wangda	Samdrupjongkhar Municipal
11.	Sonam Dendup	Samdrupjongkhar Municipal

2.3 Glimpse from the questionnaire survey

Figure 2: Enumerators carrying out questionnaire survey

5. Highlights from Flood Vulnerability Survey

3.1 Flood vulnerable sites

There is an outfall below the Road Safety and Transport Authority (RSTA) of Bhutan office to discharge off the runoff from the industrial area into the river. The storm water drain from the industrial area and runs along the left bank of Dungsum River untill the outfall near RSTA (Figure 3). From visual inspection, it was seen that the storm water drain only caters to some areas above the football ground. The outfall is located between the two flood protection walls and there is an opening in between to allow storm water runoffs from the surrounding areas (RSTA, bus booking etc.) to discharge into the river. As per the site investigation, this area was found to be critical.

Figure 3: Outfall below the RSTA office

Some informal settlements are located in the area behind the Dzong (Dzong in Bhutan is a complex of fortified building which served as a principal seat of Buddhist school) in Samdrupjongkhar. These settlements are situated at a much lower elevation than the Dzong area as shown in Figure 4. There are about 10 households living in the settlements, and they come from low income group. The settlement area at present acts as a buffer zone for the Dzong against floods. During the site investigation, it was found out that there is a major scouring along the left bank of the Dungsum River behind the Dzong. The river has been meandering and the normal flow path of the river is towards the left bank. The flowing water in the river erodes the outer banks and deposits them on the inside. There is no significant elevation difference between the river bed level and the settlement area on the left bank (River bed level-Elevation 200 m, Latitude 26°48'25.7", Longitude 91°30' 15.1" and

Settlement Area- Elevation 206 m, Latitude 26°48'25.7", Longitude 91° 30'9.1").Therefore, there is higher chance of settlement area getting inundated by the flood, posing risk to the lives of people. If this area is not protected immediately, then the scouring will erode the land acting as a buffer zone and will increase the vulnerability of the people and infrastructure in the Dzong area to the flood.

Figure 4: Vulnerable settlements behind the Dzong

Another vulnerable site in the area is the Samdrupjongkhar prison (Figure 5). The prison is located along the left bank of Dungsum River and there are visible signs of scouring along the bank. As the scouring is significant immediate flood protection measures are essential in order to prevent the failure of the compound wall.

Figure 5: Area behind the Prison

The left bank along Dungsum River between points— a damaged suspension bridge and access road to a school— is also very fragile and prone to erosion as shown in

Figure 6. If scouring and erosion is not prevented immediately, more erosion will take place and the existing infrastructure like road, drains etc. on the left bank will be affected.

Figure 6: Highly erosive area on the left bank

The flood protection works on the right bank of DungsumChi near the international border with India has collapsed due to scouring of the foundation by the flowing river (Figure 7).

Figure 7: Damaged wall near international border

As per local residents, overflow of water from the irrigation canal brings the flooding to the Samdrupjongkhar Municipality (lower town area) during the rainy season. The canal brings water from Dungsum River to the border town of India. There are two

irrigation canals inundating roads and causing inconvenience to the people during the rainy season. The Figure 8 shows the location of the irrigation canal in the lower market and similarly, the Figure 9 gives the location of the weir and intake for the irrigation canal.

Figure 8: Irrigation canal in lower market

Figure 9: Weir and irrigation canal intake

The upper town area is located approximately 350 meters away from Dungsum River. The people residing in this area attribute the overflow from the storm water drain as presented in Figure 10 during monsoon as the main reason for flooding. They frequently experience overflow of drainage during rainy season.

Figure 10: Storm water drain in the upper town of Samdrupjongkhar

3.2 Flood mark and location

According to the local residents and the engineers who conducted the site investigation, there is a threat of flood in RSTA bus terminal area, housing colony, school area and industrial area. During severe flood events in 2012 and 2015, bus terminal, few private houses and some of the industrial infrastructures located at the lowest elevation are inundated by Dungsum River. The Municipality at present has constructed flood protection structures along RSTA and bus terminal area. Further, few more flood protection structures are being constructed along the industrial areas also. The Figure 11 and Figure 12 show the area under threat from Dungsumchu.

Figure 11: Bus terminal near RSTA office

Figure 12: Vulnerable housing colony in Samdrupjongkhar

There are few temporary structures along Dungsum River where flood marks are visible. During the year 2015, flood water has reached to 1.20 meters above ground (Figure 13). According to the owner of house, it took about 6 hours to remove water from his house. Few furniture and household items were damaged.

Figure 13: Flood mark on temporary structures from the 2015 flooding event

Samdrupjongkhar Thromde has been experiencing flood every rainy season. It not only experienced the flooding in August, 2015, it also experienced flooding in the year 2004 and 2012. The most recent flashflood of August, 2015 in Samdrupjongkhar caused damages to flood protection walls, roads, bridge and other infrastructure as seen. The rainfall for 29th and 30th August, 2015 was 142 mm and 215.8 mm respectively. The flooding at Dungsum Chhu in Samdrupjongkhar on 30th August 2015

has caused damage of worth more than Nu. 6,089,497.38 (about US$ 94,000) as given in Table 3 and also washed away a suspension bridge connecting the Primary School to the rest of the Thromde leaving it inaccessible for the inhabitants.

Table 3: Damage caused by flood of 30th August, 2015 (Disaster Assessment Report, Samdrupjongkhar Thromde)

No	Work Description	Location	Unit Length	Amount
1	Gabion wall	Truck parking	72.5	213,723.48
2	R.C.C Wall	Near Samdrupjongkhar Primary School	29.3	1,820,458.34
		Near Cement Godown	7.0	434,921.79
3	Road	NHDC Colony	150	936,065.10
		Truck Parking	72.5	452,431.47
4	Brick wall fencing	RSTA Boundary Wall	49	202,183.62
5	Suspension Bridge span 43 m	Near Samdrupjongkhar Primary School	1	1,500,000.00
6	HDPE pipeline 150mm	Gravity water source above Pinchina checkpost	210	353,669.40
7	Check dam and water drainage channel	Gravity water source above Pinchina checkpost	LS	60,000.00
8	Infiltration GI pipeline 150mm	Gravity water source below Pinchina checkpost	60	116,044.20
GRAND TOTAL AMOUNT IN NGULTRUM				**6,089,497.38**

6. River Cross-section Survey

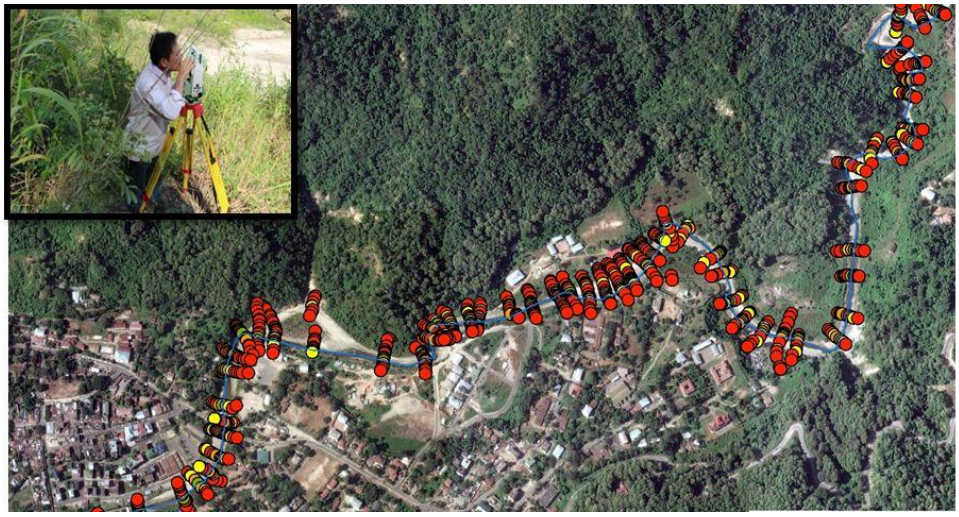

Figure 14: Cross-sectional survey locations

Flood hazard assessment is one of the main components in the flood risk assessment. For this technical assistance, a hydrodynamic model is being used to simulate the river flow characteristics and identify the hazardous areas. River and floodplain cross-sections are required to represent channel geometry in a river hydraulic model. The accuracy of the simulated water levels and the floodplain delineation are highly depends on the shape as well as extent of these cross-sections. The cross-section survey of Dungsum River was carried out by FEMD, DES, MoWHS. About 57 numbers of cross-section data along Dungsumchu were collected in the first batch as shown in Figure 14. The sections were identified based on the historical flooding events and also the location of the important structures. 52 number of cross section surveys were carried out in the second batch. The dimension and location of the structures to be used in the hydraulic models were also collected in this batch.

All data which are collected from the cross-sectional survey has been uploaded to a specially created website (https://ctcnbhutan.wixsite.com/capacitybuilding)

Annex A: Questionnaire Survey Form

Flood Vulnerability Assessment for Dungsumchu Basin, Samdrup Jongkhar District, Bhutan

No: ……
Name of the interviewer:

……
Land use type:
☐ (B)Residential
☐ (C)Institutional
☐ (D)Commercial/ Industrial
☐ (E)Infrastructure
☐ (F)Agricultural
Location:
Latitude: ……
Longitude: ……
App. Distance from river: …. km
Elevation: ……. m MSL

A. General Information

1. Survey date: ……
2. Survey area: ……
3. Name of interviewee: ……
4. Age: ……
5. Gender: ……
6. Highest level of education: ……
7. Occupation: ……
8. Address: ……
   ……
   ……

B. Urban Residential Damage

Section 1: Type of building

9. How long have you been living here? …… Years
10. Age of the building (year of construction): …….. year
11. Area of the property: …… m^2
12. Door plinth level (height of ground flood from ground): …….. m
13. Construction material: ☐Wood Structures ☐Concrete Structures ☐Mix Structures
14. No. of stories: ……..
15. Height of first floor: …… m
16. Height of second floor: …….. m
17. Does your building have a basement floor? ☐Yes ☐No
18. What is the type of your building according to the Bhutan building classification standard (select from below), and the current value of your building?

Classification of Building		Present value (BTN)
Reinforced cement concrete (RCC)	☐	
Mixed (RCC+ Masonry)	☐	
Load Bearing Structure	☐	
Timber structure	☐	
Steel Structure	☐	

Temporary structures	☐	
Mixed (steel + Masonry) Structure	☐	

19. What is the approximate total present replacement value of your properties (inside and outside of the building, Including equipment, furniture, means and other)? …….. (BTN)

Section 2: Flood damage and cost

20. How many times did you experience flood while living at this address?

☐Never been flooded ☐One ☐Two

☐Three ☐Four ☐More than four times

21. What was the maximum water level and duration of flood entered your building?

Year	Depth (m)	Duration (hrs)
2012		
2015		

22. What was the amount of structural damage to your building? (Structural damage is defined as damage to any building components including foundation, walls, floors, windows, roofs, attached carpeting, attached shelves and cabinets etc.)

Category of damage	Damage (BTN)	
	2012	2015
Built-in shelves and appliances		
Exterior walls, windows, doors (painting included) and roofing		
Interior doors and walls (painting included)		
Footing and foundation		
Other		

23. What was the amount of contents damage of your building? (Only include content replacement and repairs, do not include repair to the structure of the building. Content damage refers to damage to personal property kept inside the building that is not permanently affixed to the building)

Category of damage	Damage (BTN)	
	2012	2015
Equipment (including all electronics)		
Furniture		
Clothes		
Kitchen items		
Other		

24. What was the damage to the outside properties of your building? Please make entries below for whatever is applicable to you.

Category of damage	Damage (BTN)	
	2012	2015
Livestock's		
Tree/fences		
Vehicles		
Garage		
Parking areas		
Access roads		
Other		

25. What measure was taken to prevent the building from flood?

Year	Pumped	Used any type of temporary barrier	Other ways	Did nothing	Estimated cost (BTN)
2012					
2015					

26. What was the clean-up cost after flood occurrence? (Clean-up cost includes the costs of labor and materials to clean up interior and outside of the building)

Category of damage	Cost (BTN)	
	2012	2015
Cost for labor		
Cost for rented machines and equipment		
Other costs		

Section 3: Flood emergency response

27. Just before the flood, how did you first become aware that flood waters might reach your home?

☐ TV ☐ Siren
☐ Radio ☐ Observing the creek or river water level
☐ Newspaper ☐ Other ……
☐ None

28. Did you share the warning with others? ☐Yes ☐No

29. Do you have a mobile phone? ☐Yes ☐No

30. How many hours were there between the time you became aware that flooding might reach your home until the water actually reached to your property?……..... hrs

31. What was the percent of potential damage prevented due to warning? …… %

32. What is the minimum warning time would you need to move all your transportable contents to a safe location? ……. Hrs

33. Do you have insurance for:

a. Building ☐Yes ☐No

b. Contents ☐Yes ☐No

c. Persons ☐Yes ☐No

34. What is the shortest distance between your building and river? …… (m/km)

35. Do you have a safe place to move in case of flooding? ☐Yes ☐No

How far is it from your building? …… (m/km)

Section 4: Effect on livelihood and income

36. How many people live in your house?

Older than 18 years old: …….. Less than 18 years old: ……

37. Do you have any disabled family members with you? ☐Yes ☐No

If yes, how many? …….

38. Do you have children who are going to schools? ☐Yes ☐No

If yes, how many? …….

39. Do you have any other source of income except to your salary? ☐Yes ☐No

40. Do you have any savings in case of an emergency? ☐Yes ☐No

41. How many persons in your household earning? ……

42. What is the average income of your family per month? (BTN)

Source of income	**Year**	
	2012	**2015**
Salary	☐less than 3,000 ☐3,000 – 5,000 ☐5, 000 – 7,000 ☐7,000 – 9,000 ☐more than 9,000	☐less than 3,000 ☐3,000 – 5,000 ☐5, 000 – 7,000 ☐7,000 – 9,000 ☐more than 9,000
Others	☐less than 1,000 ☐1,000 – 3,000 ☐3,000 – 7,000 ☐7,000 – 9,000 ☐more than 9,000	☐less than 1,000 ☐1,000 – 3,000 ☐3,000 – 7,000 ☐7,000 – 9,000 ☐more than 9,000
Total	☐less than 1,000 ☐1,000 – 5,000 ☐5,000 – 10,000 ☐10,000 – 15,000 ☐15,000 – 20,000 ☐more than 20,000	☐less than 1,000 ☐1,000 – 5,000 ☐5,000 – 10,000 ☐10,000 – 15,000 ☐15,000 – 20,000 ☐more than 20,000

43. Does flood effect to your living condition by means of additional cost (BTN)

Categories of damage	**Value (BTN)**
Additional money for food	
Additional money for transportation	

Additional money for maintenance	
Additional money for repair access roads, parking areas	
Other	

Interruption:

Type of interruption	2012	2015
44. How long did it take for you and your household to get back to your normal daily routines? (hrs/days/months)		
45. For how many hours water supply was interrupted? (hrs)		
46. For how many hours electrical supply was interrupted? (hrs)		
47. For how many hours telephone connection was interrupted (hrs)		

48. Did you get any charity services (medicines, medical equipment, saline, water purifying tablets, bleaching powder etc.)? ☐Yes ☐No

49. Was there any outbreak of waterborne diseases? ☐Yes ☐No

If yes, then how much you had to pay for treating? …… BTN

50. Do you accept living with floods? ☐Yes ☐No

C. Institutional Damage

Section 1: Type of building

9. How long have you been working here? …… Years
10. Name of office or company: ……..
11. How many buildings are there at this facility (If several estimate the damage for whole)?: ……..
12. Age of the building (year of construction): …….. year
13. Area of the property: …… m^2
14. Door plinth level (height of ground flood from ground): …….. m
15. Construction material: ☐Wood Structures ☐Concrete Structures ☐Mix Structures
16. No. of stories: ……..
17. Height of first floor: …… m
18. Height of Second floor: …….. m
19. Does your building have a basement floor? ☐Yes ☐No
20. What is the type of your institutional building according to the Bhutan building classification standard (select from below), and the current value of the building?

Classification of Building		Present value (BTN)
Reinforced cement concrete (RCC)	☐	
Mixed (RCC+ Masonry)	☐	
Load Bearing Structure	☐	
Timber structure	☐	
Steel Structure	☐	
Temporary structures	☐	
Mixed (steel + Masonry) Structure	☐	

21. What is the approximate total present replacement value of your institute properties (inside and outside of the building, Including equipment, furniture, means and other)? …….. (BTN)

Section 2: Flood damage and cost

22. How many times did you experience flood while working in this address?

☐Never been flooded ☐One ☐Two

☐Three ☐Four ☐More than four times

23. What was the maximum water level and duration of flood entered your institute?

Year	Depth (m)	Duration (days/hrs)
2012		
2015		

24. What was the amount of structural damage to your institution building? (Structural damage is defined as damage to any building components including foundation, walls, floors, windows, roofs, attached carpeting, attached shelves and cabinets etc.)

Category of damage	Damage (BTN)	
	2012	2015
Built-in shelves and appliances		
Exterior walls, windows, doors (painting included) and roofing		
Interior doors and walls (painting included)		
Footing and foundation		
Other		

25. What was the amount of contents damage of your building? (Only include content replacement and repairs, do not include repair to the structure of the building. Content damage refers to damage to personal property kept inside the building that is not permanently affixed to the building)

Category of damage	Damage (BTN)	
	2012	2015
Equipment (including all electronics)		
Furniture		
Other		

26. What was the damage to the outside properties of your institute building?

Category of damage	Damage (BTN)	
	2012	2015
Tree/fences		
Vehicles		
Garage		
Parking areas		
Access roads		
Other		

27. What measure was taken to prevent the building from flood?

Year	Pumped	Used any type of temporary barrier	Other ways	Did nothing	Estimated cost (BTN)
2012					
2015					

28. What was the clean-up cost after flood occurrence? (Clean-up cost includes the costs of labor and materials to clean up interior and outside of the building)

Category of damage	Cost (BTN)	
	2012	2015
Cost for labor		
Cost for rented machines and equipment		
Other costs		

Section 3: Flood emergency response

29. Just before the flood, how did you first become aware that flooding might reach to your institute?

☐ TV ☐ Siren
☐ Radio ☐ Observing the creek or river water level
☐ Newspaper ☐ Other ……
☐ None

30. Did you share the warning with others? ☐Yes ☐No
31. Do you have a mobile phone? ☐Yes ☐No
32. How many hours were there between the time you became aware that flooding might reach your institute until the water actually reached to your institute? ……..... hrs
33. What was the percent of potential damage prevented due to warning? …… %
34. What is the minimum warning time would you need to move all your transportable contents to a safe location? ……. hrs
35. Does your institution have insurance for:
    a. Building ☐Yes ☐No
    b. Contents ☐Yes ☐No
    c. Persons ☐Yes ☐No
36. What is the shortest distance between your institution and river? …… (m/km)
37. Do you have a safe place to move in case of flooding? ☐Yes ☐No
    How far is it from your institution building? …… (m/km)

Section 4: Effect on livelihood and income

38. Briefly describe the major purpose of this Office? .....
    .....
39. How many workers are working there? (including full time and part time) ……

40. How long they are settled in this current building?.....years

Interruption:

Categories of damage	2012	2015
41. How long was this institute closed due to flood? (hr/days)		
42. How long did it take for institute to get back to normal daily routines? (hrs/days/month)		
43. For how many hours water supply was interrupted? (hr)		
44. For how many hours electric supply was interrupted? (hr)		
45. For how many hours telephone connection was interrupted? (hr)		

46. Does flood affect to your institute condition by means of additional money?

Categories of damage	Value (BTN)
Additional money for energy	
Additional money for transportation	
Additional money for import goods	
Additional money for maintenance of equipment and goods	
Additional money for repair access roads, parking areas	
Others	

D. Commercial/Industrial Damage

Section 1: Type of building

9. Name of company/shop/industry: ……
   ……
10. How many buildings are there at this facility (If several estimate the damage for whole)? : ……..
11. Age of the building (year of construction): …….. year
12. Area of the property: ……. m^2
13. Door plinth level (height of ground flood from ground): …….. m
14. Construction material: ☐Wood Structures ☐Concrete Structures ☐Mix Structures
15. No. of stories: ……..
16. Height of first floor: …… m
17. Height of Second floor: …….. m
18. Does your building have a basement floor? ☐Yes ☐No
19. What is the type of your company/shop/industry building according to the Bhutan building classification standard (Select from below), and the current value of the building?

Classification of Building		Present value (BTN)
Reinforced cement concrete (RCC)	☐	
Mixed (RCC+ Masonry)	☐	
Load Bearing Structure	☐	
Timber structure	☐	
Steel Structure	☐	
Temporary structures	☐	
Mixed (steel + Masonry) Structure	☐	

20. What is the approximate total present replacement value of your company/shop/industry properties (inside and outside of the building, Including equipment, furniture, means and other)? …….. (BTN)

Section 2: Flood damage and cost

21. How many times did you experience flood while working in this address?

☐Never been flooded ☐One ☐Two

☐Three ☐Four ☐More than four times

22. What was the maximum water level and duration of flood entered your company/shop/industry ?

Year	Depth (m)	Duration (days/hrs)
2012		
2015		

23. What was the amount of structural damage to your company/shop/industry building? (Structural damage is defined as damage to any building components including foundation, walls, floors, windows, roofs, attached carpeting, attached shelves and cabinets etc.)

Category of damage	Damage (BTN)	
	2012	2015
Built-in shelves and appliances		
Exterior walls, windows, doors (painting included) and roofing		
Interior doors and walls (painting included)		
Footing and foundation		
Other		

24. What was the amount of contents damage of your company/shop/industry building? (Only include content replacement and repairs, do not include repair to the structure of the building. Content damage refers to damage to personal property kept inside the building that is not permanently affixed to the building)

Category of damage	Damage (BTN)	
	2012	2015
Equipment (including all electronics)		
Furniture		
Value of all business records		
Storage goods		
Raw material		
Other		

25. What was the damage to the outside properties of your company/shop/industry building?

Category of damage	Damage (BTN)	
	2012	2015
Tree/fences		
Vehicles		
Garage		
Parking areas		
Access roads		
Other		

26. What measure was taken to prevent the building from flood?

Year	Pumped	Used any type of temporary barrier	Other ways	Did nothing	Estimated cost (BTN)
2012					
2015					

27. What was the clean-up cost after flood occurrence? (Clean-up cost includes the costs of labor and materials to clean up interior and outside of the building)

Category of damage	Cost (BTN)	
	2012	2015
Cost for labor		
Cost for rented machines and equipment		
Other costs		

Section 3: Flood emergency response

28. Just before the flood, how did you first become aware that flooding might reach to your company/shop/industry?

☐ TV ☐ Siren
☐ Radio ☐ Observing the creek or river water level
☐ Newspaper ☐ Other ……
☐ None

29. Did you share the warning with others? ☐Yes ☐No

30. Do you have a mobile phone? ☐Yes ☐No

31. How many hours were there between the time you became aware that flooding might reach your company/shop/industry until the water actually reached to your company/shop/industry? ……..... hrs

32. What was the percent of potential damage prevented due to warning? …… %

33. What is the minimum warning time would you need to move all your transportable contents to a safe location? ……. hrs

34. Does your company/shop/industry have insurance for:

a. Building ☐Yes ☐No
b. Contents ☐Yes ☐No
c. Persons ☐Yes ☐No

35. What is the shortest distance between your company/shop/industry and river? …… (m/km)

36. Do you have a safe place to move in case of flooding? ☐Yes ☐No
How far is it from your company/shop/industry building? …… (m/km)

Section 4: Effect on livelihood and income

37. Briefly describe the major purpose of this company/shop/industry?

.....

.....

38. How many workers are working there? (including full time and part time) ……

39. How long they are settled in this current building?.....years

Interruption:

Categories of damage	2012	2015
40. How long was this company/shop/industry closed due to flood? (hr/days)		
41. How long did it take for company/shop/industry to get back to normal daily routines? (hrs/days/month)		
42. For how many hours water supply was interrupted? (hr)		
43. For how many hours electric supply was interrupted? (hr)		
44. For how many hours telephone connection was interrupted? (hr)		

45. Does flood affect to your company/shop/industry condition by means of additional money?

Categories of damage	Value (BTN)
Additional money for energy	
Additional money for transportation	
Additional money for import goods	
Additional money for maintenance of equipment and goods	
Additional money for repair access roads, parking areas	
Others	

E. Infrastructure Damage

Section 1: Supply damages and costs

Categories of damage	2012	2015
9. For how many hours water supply was interrupted? (hr)		
10. For how many hours electric supply was interrupted? (hr)		
11. For how many hours telephone supply was interrupted? (hr)		

12. What was the damage by mean monetary because of flood?

Categories of damage (BTN)	2012	2015
13. Water supply repair fee		
14. Electric supply repair fee		
15. Sewerage lines repair fee		
16. Septic tanks repair fee		
17. Telephone line repair fee		
Total		

18. Was there any secondary source for water supply? ☐Yes ☐No

If yes then what was the extra cost? .....BTN

19. Was there any secondary source for electric supply?
If yes then what was the extra cost? .....BTN

20. Whether the sewerage lines and septic tanks under floodwaters were merged?
☐Yes ☐No

Section 2: System damages and costs

Categories of damage	2012	2015
For roads of the affected area:		
21. Length of inundated roads (km)		
22. Flood duration (hr/days)		
23. Maximum flood water depth (meter)		
24. Damage due to flood (BTN)		
For the bridges in the affected area:		
25. How many bridges damaged		
26. Total length of the bridges which are damaged (km)		
27. Total damage due to flood (BTN)		

F. Agricultural Damage

Section 1: Type of agriculture

9. Please list your average agricultural product and current market value?

Categories		Area (ha)	Yield (tons/ha)	Market value (BTN/kg)	Total (BTN)
Crops	1……				
	2……				
Livestock					

Section 2: Flood damage and cost

10. How many times did you experience flooding in your farm?

☐Never been flooded ☐One ☐Two

☐Three ☐Four ☐More than four times

11. What was the maximum water level and duration of flood entered your farm?

Year	Depth (m)	Duration (days/hrs)
2012		
2015		

12. How much you lost due to flood (total losses of agricultural product)?

Year	Total (BTN)
2012	
2015	

Section 3: Flood emergency response

13. Just before the flood, how did you first become aware that flooding might reach to your farm?

☐ TV ☐ Siren
☐ Radio ☐ Observing the creek or river water level
☐ Newspaper ☐ Other ……
☐ None

14. Did you share the warning with others? ☐Yes ☐No

15. Do you have a mobile phone? ☐Yes ☐No

16. How many hours were there between the time you became aware that flooding might reach your farm until the water actually reached to your property?……. hrs

17. What was the percent of potential damage prevented due to warning? …… %

18. What is the minimum warning time would you need to move all your transportable contents to a safe location? ……. hrs
19. Do you have insurance for farm ☐Yes ☐No
20. What is the shortest distance between your farm and river? …… (m/km)

Section 4: Effect on livelihood and income

21. How long have you been doing this farm? …… Years
22. Do you have any other source of income except to your income from farm?
    ☐Yes ☐No