



National Disaster Management
Research Institute

Analysis on human casualties caused by disasters

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I. Research Background

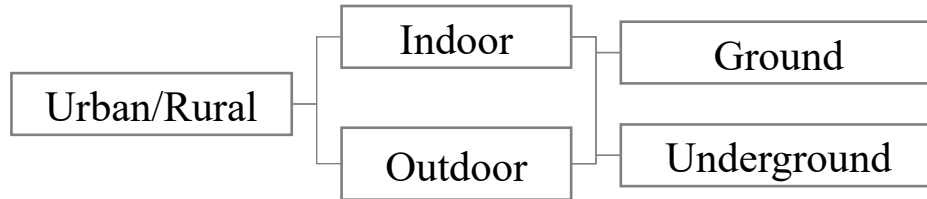
- Recent climate change has made **precipitation patterns more irregular**, increasing sudden damage from short-duration heavy rainfall.
- To effectively manage these impacts, analyses that **reflect actual damage patterns are needed**.
- In particular, human casualty data provide the most direct indication of risk and allow for an objective assessment of damage.
- In South Korea, **flood-related risks** are seasonally concentrated **in summer** due to the monsoon, typhoons, and localized heavy rainfall.
- Accordingly, by focusing management efforts on the summer season-when flood-related casualties are most frequent-we aim to contribute to reducing overall damage.
- The purpose of this study is **to systematically analyze** the characteristics and **causes of human casualties** resulting from summer natural disasters, such as floods and landslides.
- The findings are used to provide evidence for **science-based summer disaster mitigation strategies**.

II. Project Overview

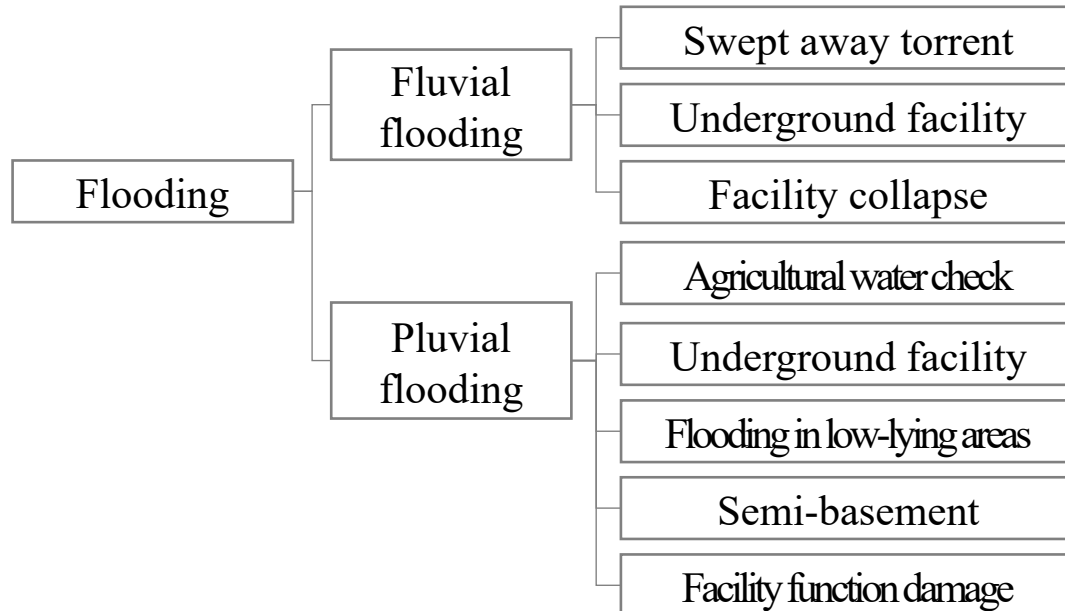
- **Data to be analysis** : Past 11 years (2014-2024) of human casualty field investigation report and over 1,000 online articles
- **Main point**
 - Derive human casualty vulnerability factors : Specific analysis of human casualty characteristics based on disaster types and the 5W1H(who, when, where, what, how, why)
 - Basic information on deceased, character analysis of spatial and time traits of casualty occurrence (space/place), time traits (daytime/night, time phase)
 - Implications for flood disaster countermeasures : Analysis of major causes of human casualty in multidimensional aspect (time-space-action)
 - Derive priority vulnerable groups based on the 5w1h
 - Create a sustainable data management framework : Human casualty analysis framework, automatically organize for collected data
 - Analysis systems improve for continuous management of necessary information

II. Project Overview

Human casualty analysis system(2024)

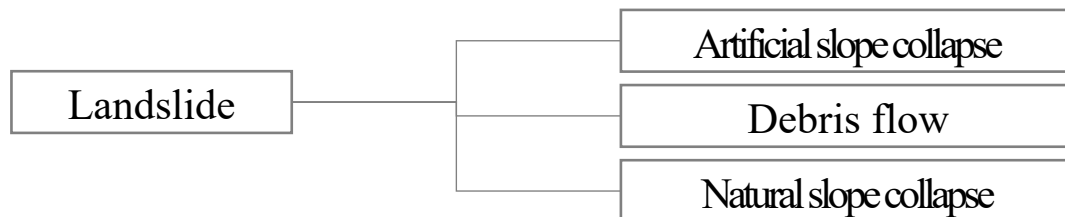


➤ Spatial classification : Urban/Rural, Indoor/Outdoor, Ground/Underground



➤ Disaster type classification **Flooding** : Fluvial/Pluvial
Landslide

➤ Casualty cause classification : **Fluvial** : Swept away torrent /Underground facility(road underpass)/Facility collapse
Pluvial : Agricultural water check/Underground facility/Flooding in low-lying areas/Semi-basement/Facility function damage
Landslide : Artificial slope collapse/Debris



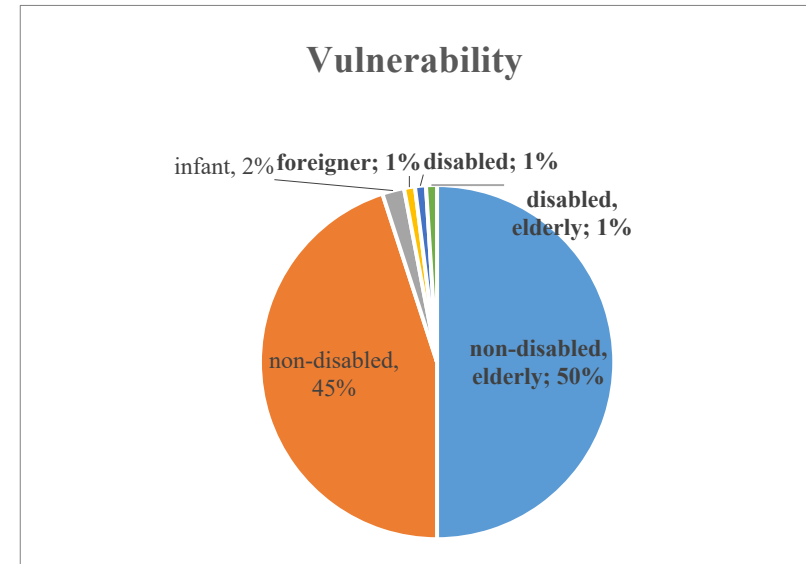
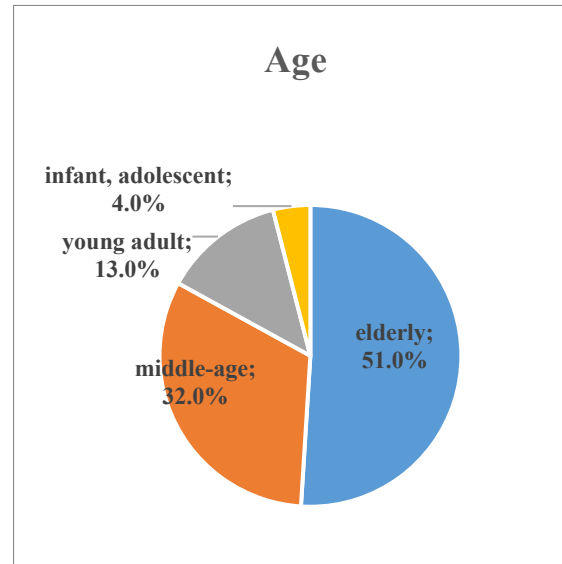
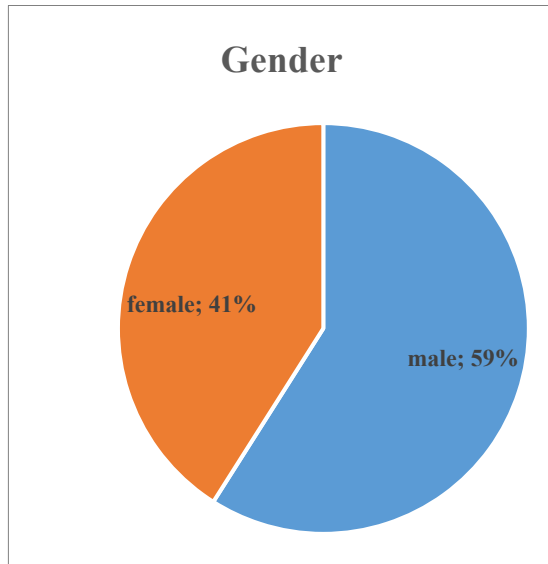
flow/Natural slope collapse

III. Statistical Analysis

Category	Major (14)	Medium	Note
Who ?	Gender	Male, Female	
	Age	Infant, adolescent, young adult, middle-aged, elderly	young adult(20-39), middle-aged(40-65)
	Others	Vulnerable group, Supervisor	
When ?	Year and month		
	Day	Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday	
	Time	24 hours, 4 sections	4 parts(dawn, morning, afternoon, night)
Where ?	Region	Provinces, cities	
	Location of incident	Building (underground), road(underground), waterfront, water drainage facility, etc.	
What ?	Behavior(in the incident)	Sleeping, moving, daily life, disaster-related activity	
Why ?	Disaster type	Downpour, flood, landslide(artificial slope, natural slope), strong wind, storm, etc.	
How ?	Casualty type	Buried, swept away, drowned, flying debris, fallen, electrocuted	

III. Statistical Analysis

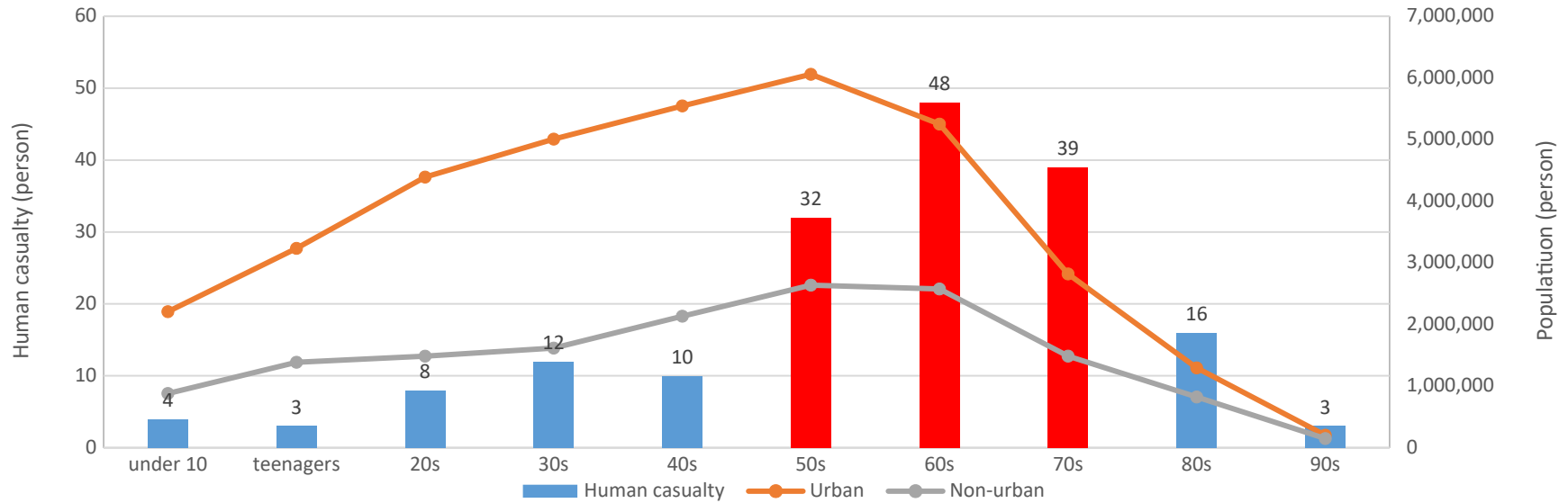
(Who?)



➤ Key contents (Gender, Age and Vulnerability)

- Gender : Male casualty rate is about 18% higher than females (Male (58.5%) > Female (41%))
- Age : Elderly (51%) > Middle-age (32%) > Young adult (13%) > Infant · adolescent (4%)
- Vulnerability : Disaster vulnerable groups ratio 55%

III. Statistical Analysis (Who?)



	under 10	teenagers	20s	30s	40s	50s	60s	70s	80s	90s
Human casualty	4	3	8	12	10	32	48	39	16	3
	2.3%	1.7%	4.6%	6.9%	5.7%	18.3%	27.4%	22.3%	9.1%	1.7%
Urban	2,206,988	3,235,248	4,391,739	5,007,686	5,546,426	6,059,286	5,251,545	2,819,159	1,294,528	202,369
	6.1%	9.0%	12.2%	13.9%	15.4%	16.8%	14.6%	7.8%	3.6%	0.6%
Non-urban	879,510	1,386,040	1,485,103	1,615,875	2,133,140	2,637,323	2,575,123	1,485,671	822,595	147,982
	5.8%	9.1%	9.8%	10.7%	14.1%	17.4%	17.0%	9.8%	5.4%	1.0%

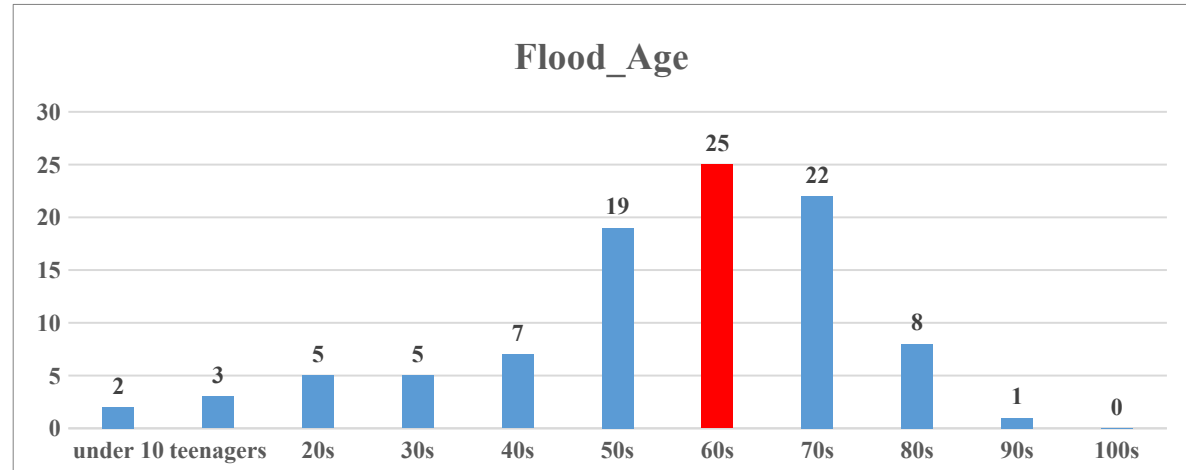
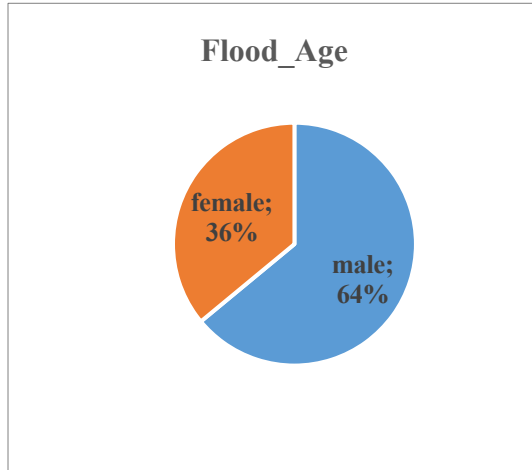
➤ Key contents (Age Group)

- Human casualties due to natural disasters are most common in the 60s, 70s, and 50s
 - Middle-aged and young adult groups are exposed to incidents through disaster-related activities
- Considering Korea's population distribution, the casualty rate is very high for those in their 60s and older
 - Need to enhance disaster preparedness, evacuation and rescue measures for the elderly

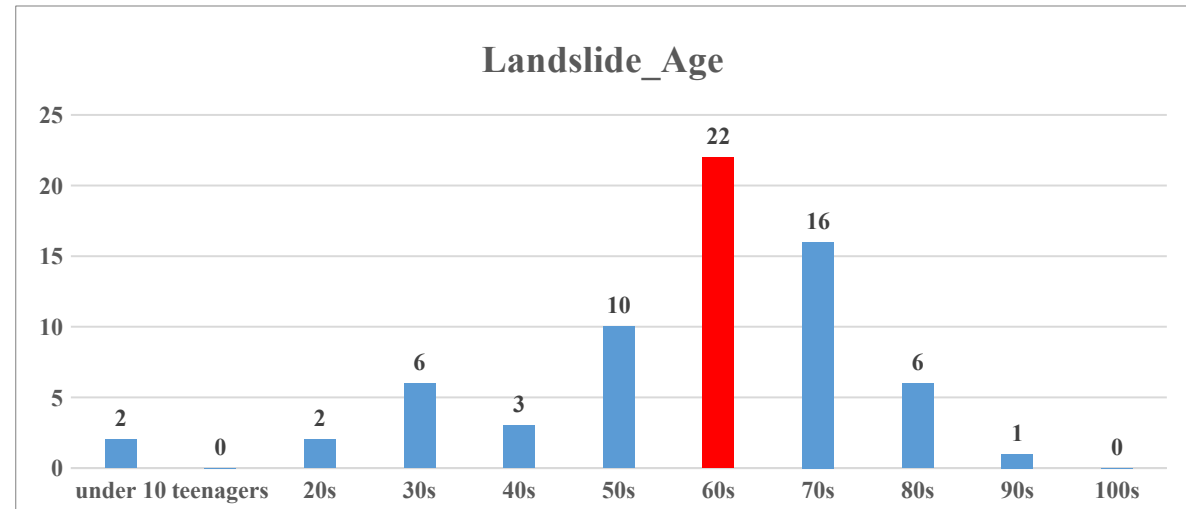
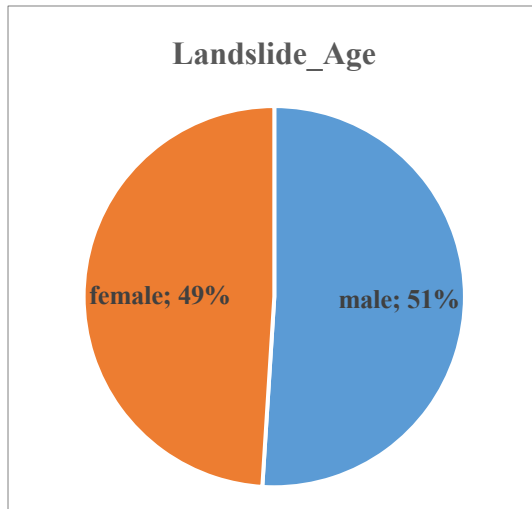
III. Statistical Analysis (Who?)

➤ Flood vs. Landslide (who?)

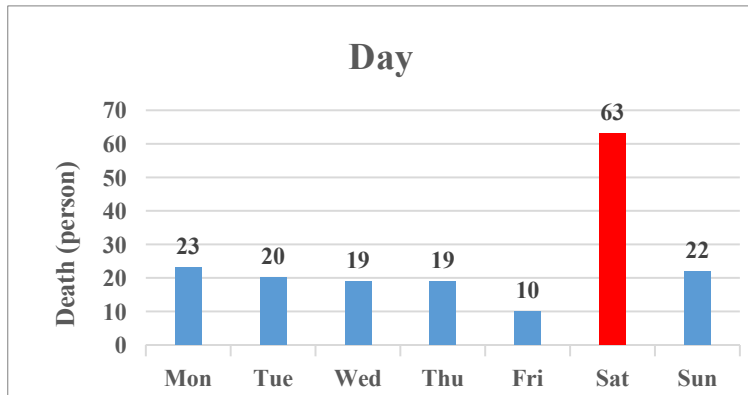
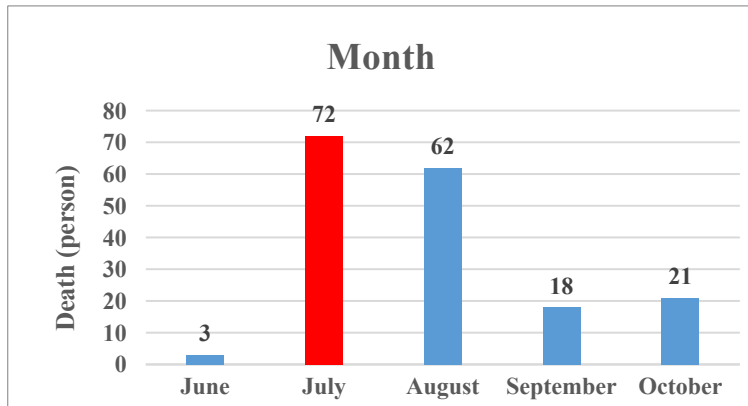
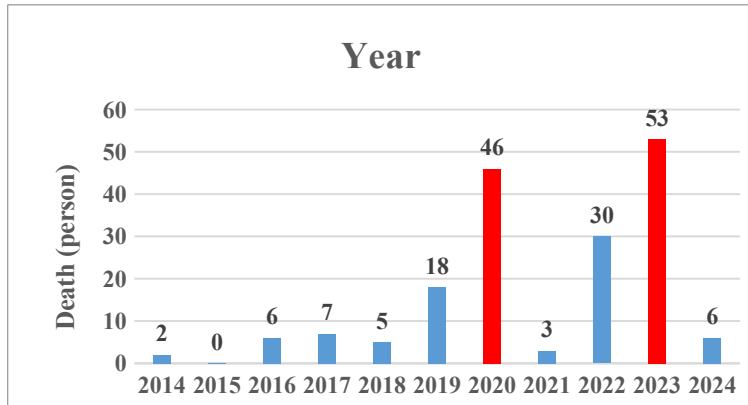
Flood



Landslide



III. Statistical Analysis (When?)



< Major disaster issues >

2023 : Gyeongbuk landslide (28), Gungpyeong underground road (14)

2022 : Flooding of pohang river (8), Flooding seoul semi-basement (3)

2020 : Longest period of 54 days of concentrated rain

2019 : Busan, Uljin, etc. Landslide

➤ 53 people (2023) > 46 people (2020) > 30 people (2022)

→ overall increasing trend

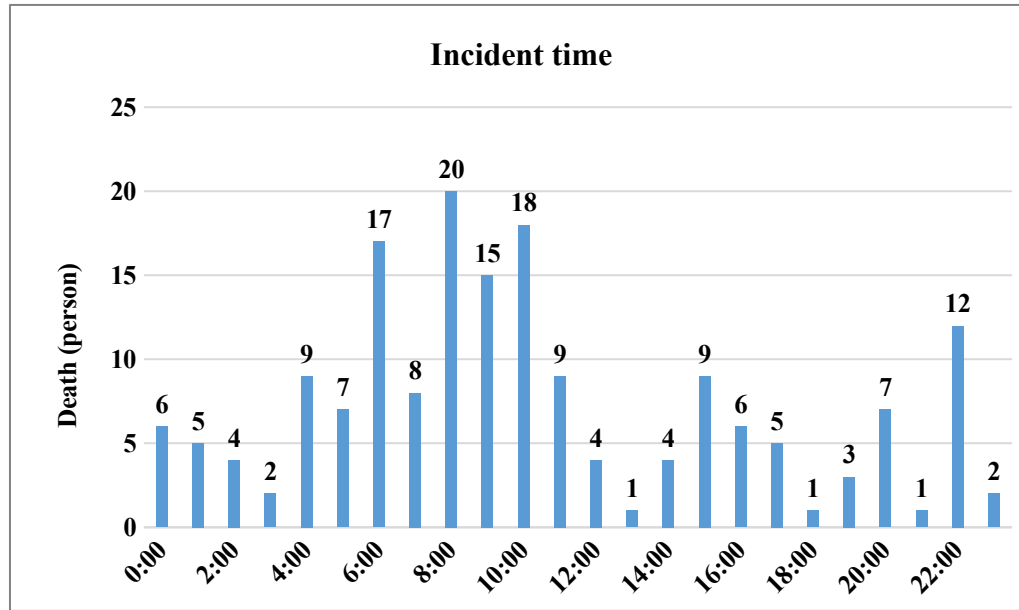
➤ July 72 people (41%) > August 62 (35%) > October 21 (12%)

→ Most (76%) of summer human damage occurs from July to August

➤ Saturday with the most human damage 63 people, Friday 10 people, the rest around 20

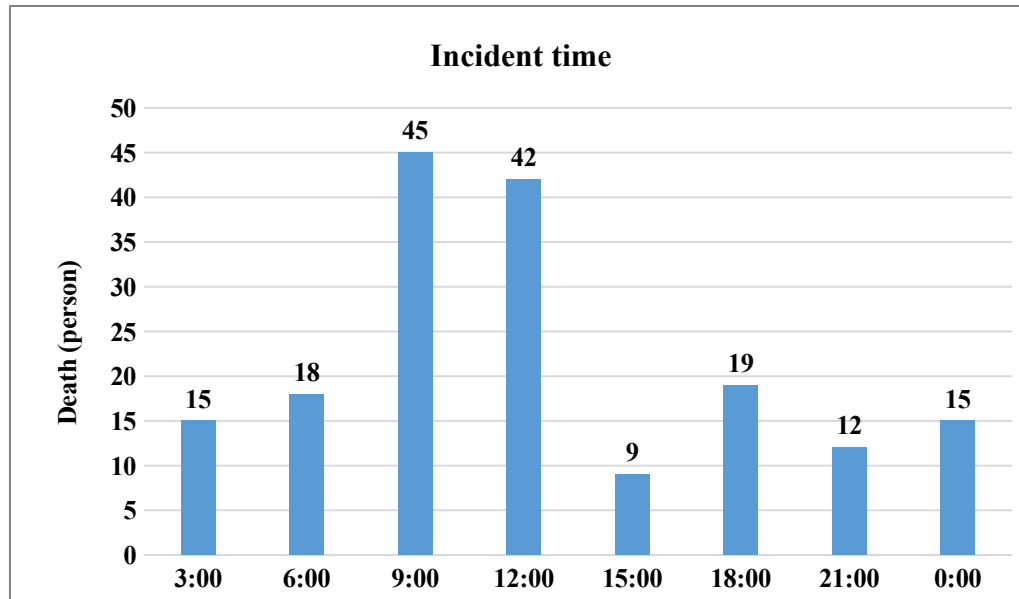
→ 2023 Gyeongbuk landslide 28 people, Gungpyeong underground road 14 people occurred on saturday

III. Statistical Analysis (When?)



➤ Incident time

: 8 o'clock 20 people, 10 o'clock 18 people, 6 o'clock 17 people, 9 o'clock 15 people in order of human damage



➤ 3-hour interval standard

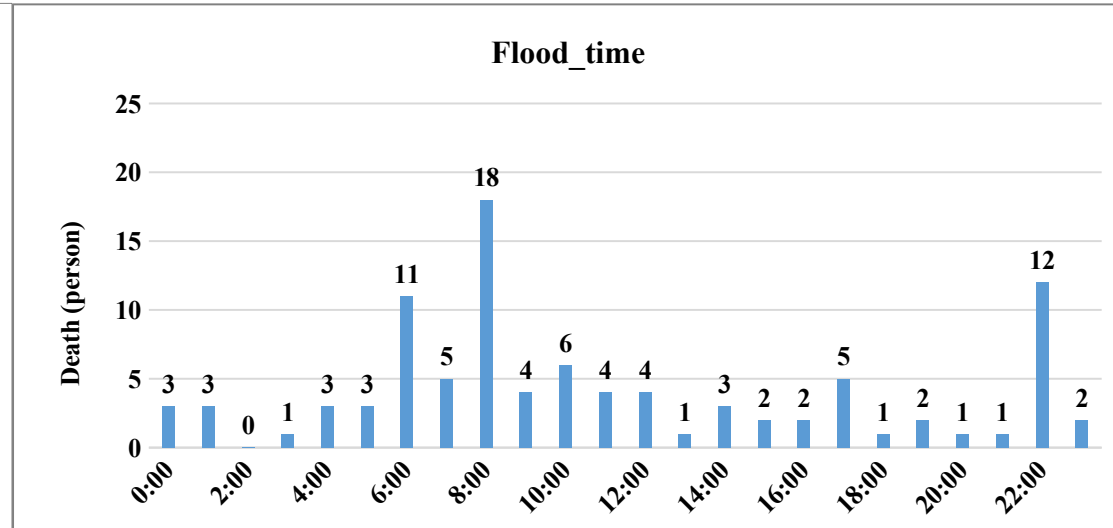
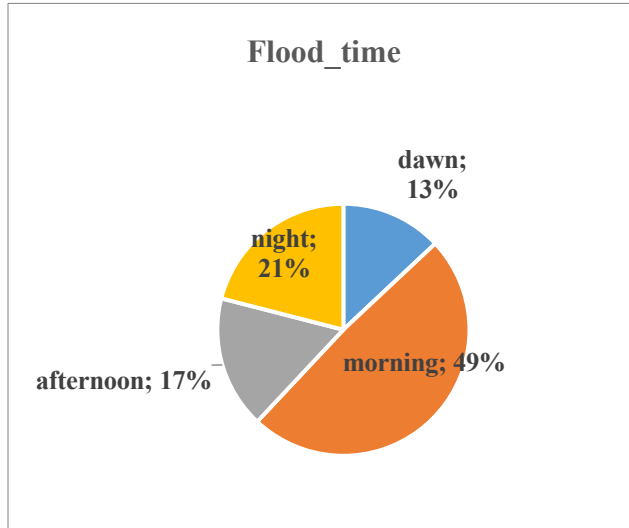
: 6 to 9, 45 people, 9 to 12, 42 people in order of human damage

→ 49% of human damage concentrated in the morning (6 to 9)

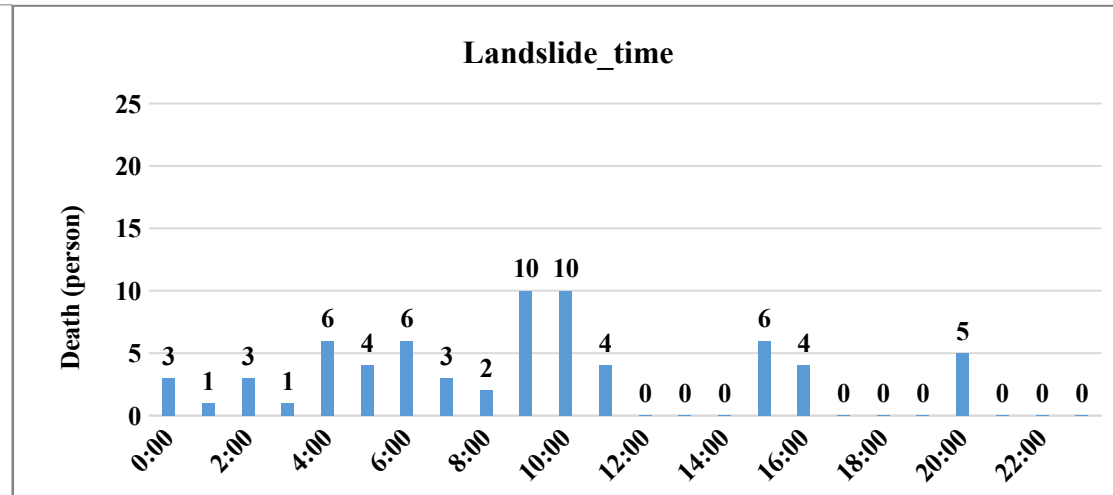
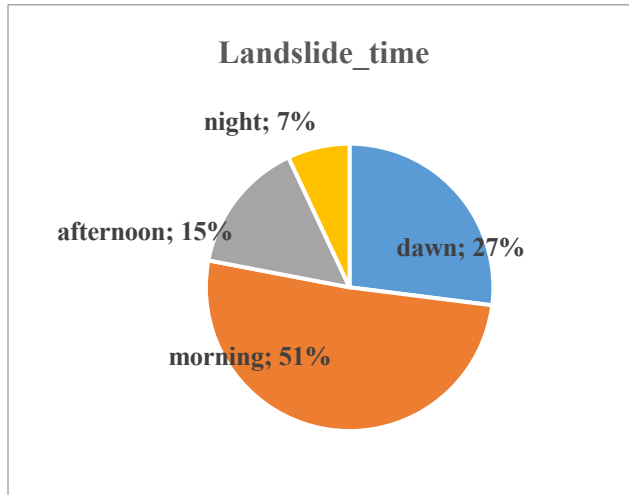
III. Statistical Analysis (When?)

➤ Flood vs. Landslide (who?)

Flood

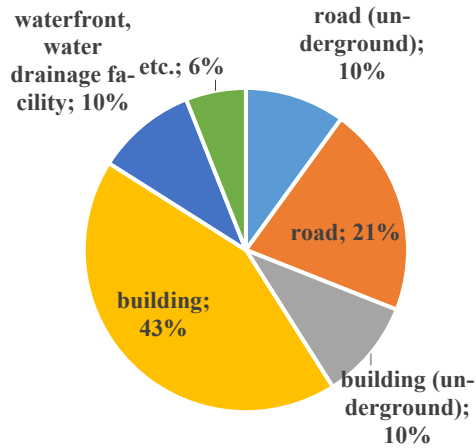


Landslide



III. Statistical Analysis (Where?)

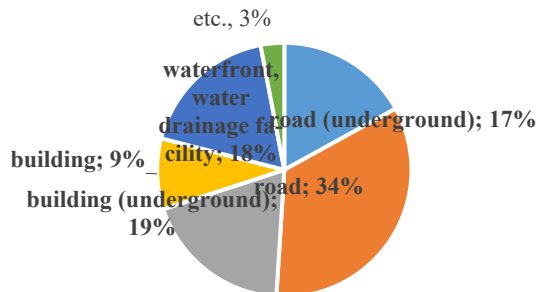
Damage location



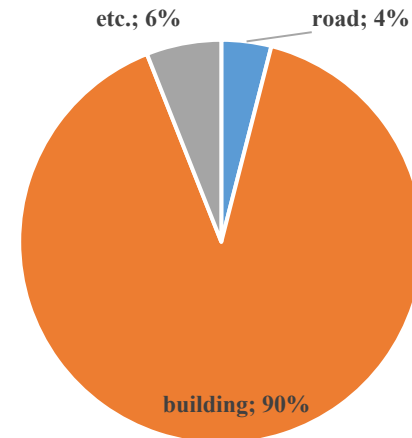
➤ Damage location

- : Building (including underground), 94people (53%)
- : Road (including underground) 53people (31%)
- : Underground space (building, road) 35people (20%)
- : Waterfront, water drainage facility 18people (10%)

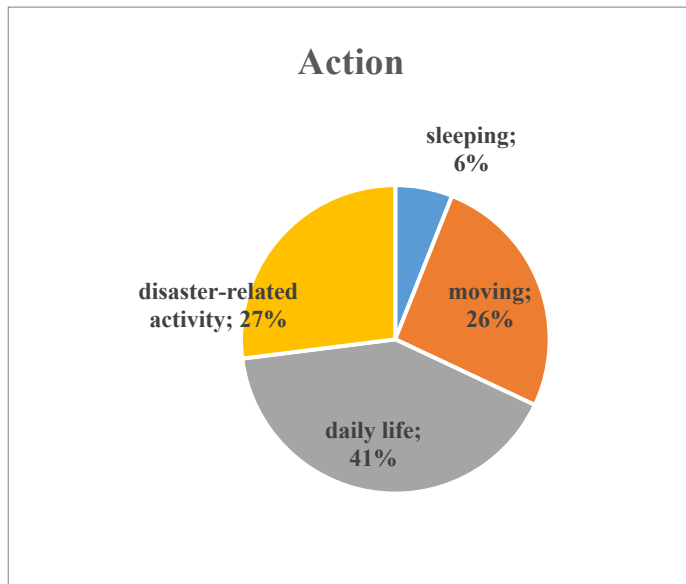
Flood



Landslide



III. Statistical Analysis (What?)



➤ Action

: Daily life, 73 people (41%)

☞ work, camping, fishing, farming, tourism spot(photo shooting), etc.

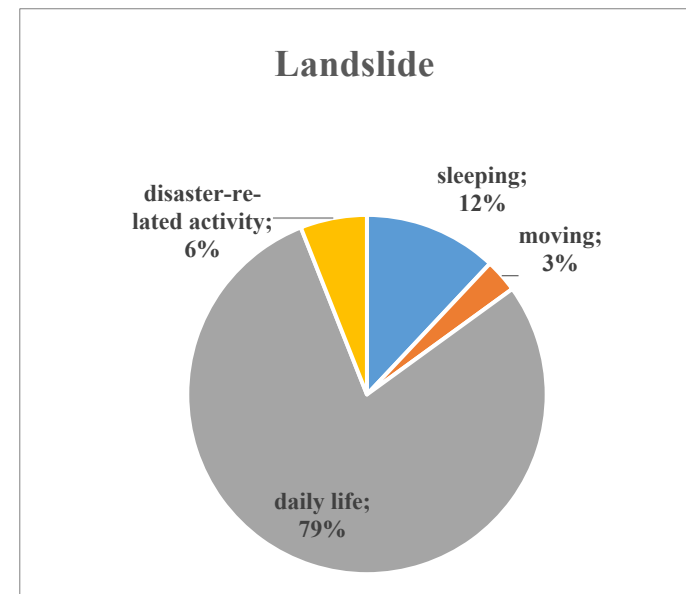
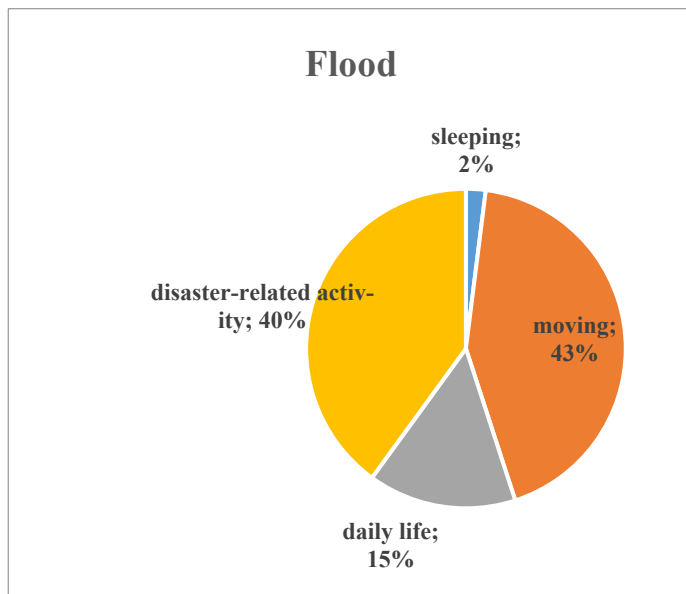
: Disaster-related activities 48 people (27%)

☞ moving parking, drainage work, damage check, rescue, etc.

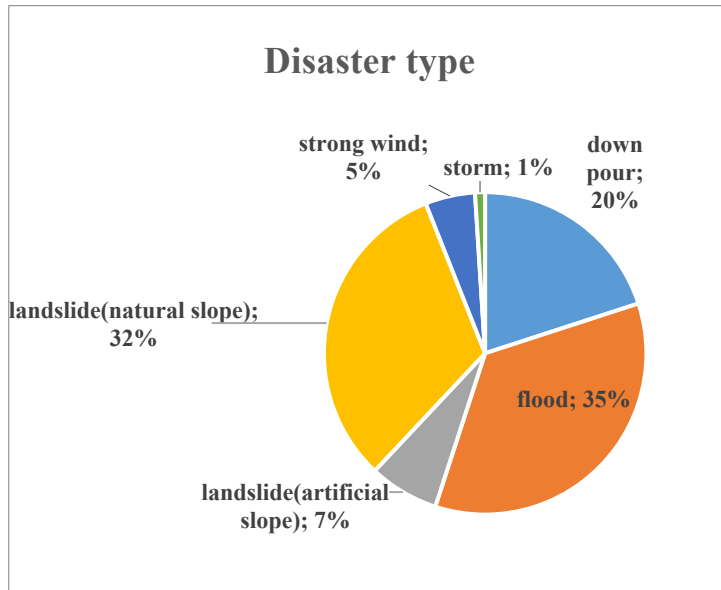
: Movement 45 people (26%)

☞ car driving, walk, evacuation, commuting, etc.

: Sleeping 10 people (6%)



III. Statistical Analysis (Why?)



➤ Disaster type

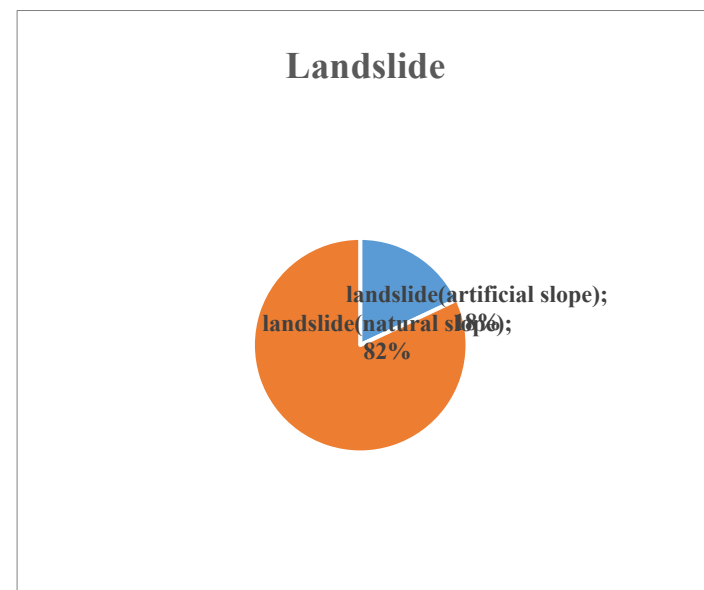
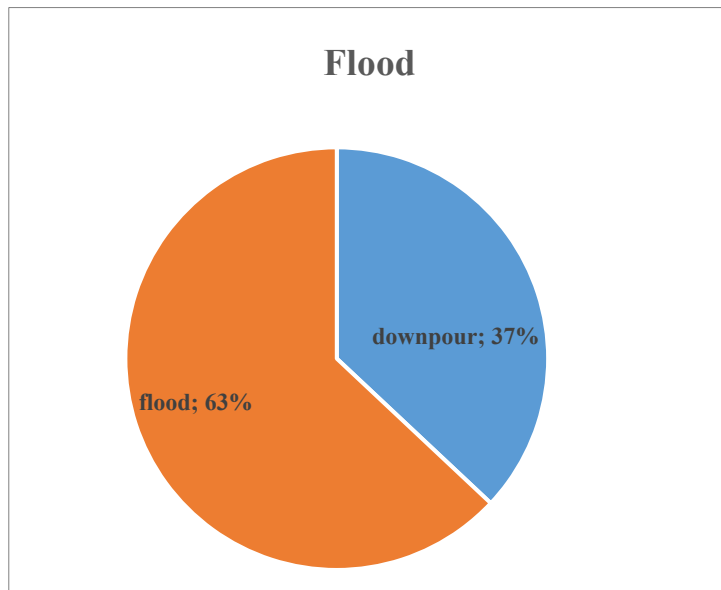
: Flood 61 people (35%)

: Landslide(natural slope) 56 people (32%)

: Downpour (rain) 36 people (20%)

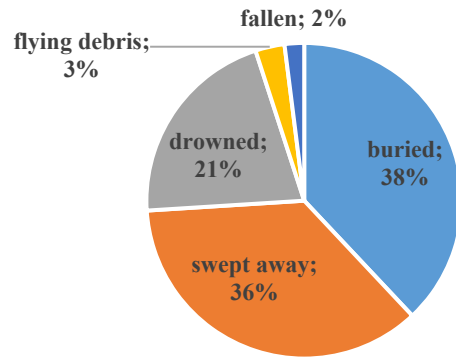
: Landslide(artificial slope) 12 people (7%)

→ 55% of flood disaster (flood + downpour), 39% of landslide (natural + artificial slope) resulted in human damage



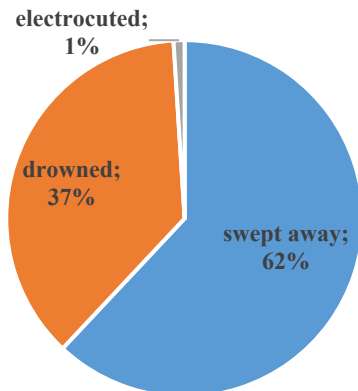
III. Statistical Analysis (How?)

Casualty type

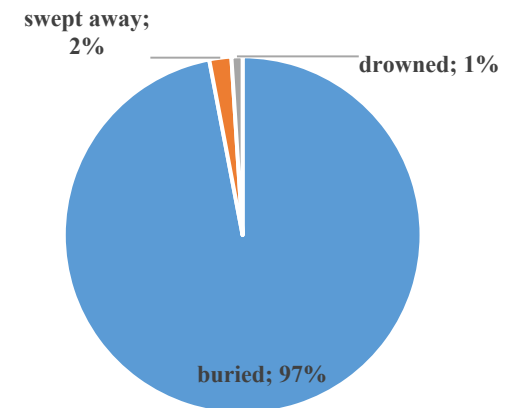


- Casualty type
 - : Buried 67 people (38%)
 - : Swept away 63 people (36%)
 - : Drowning 37 people (21%)
 - ※ Swept away occurs in both flood and landslide disasters

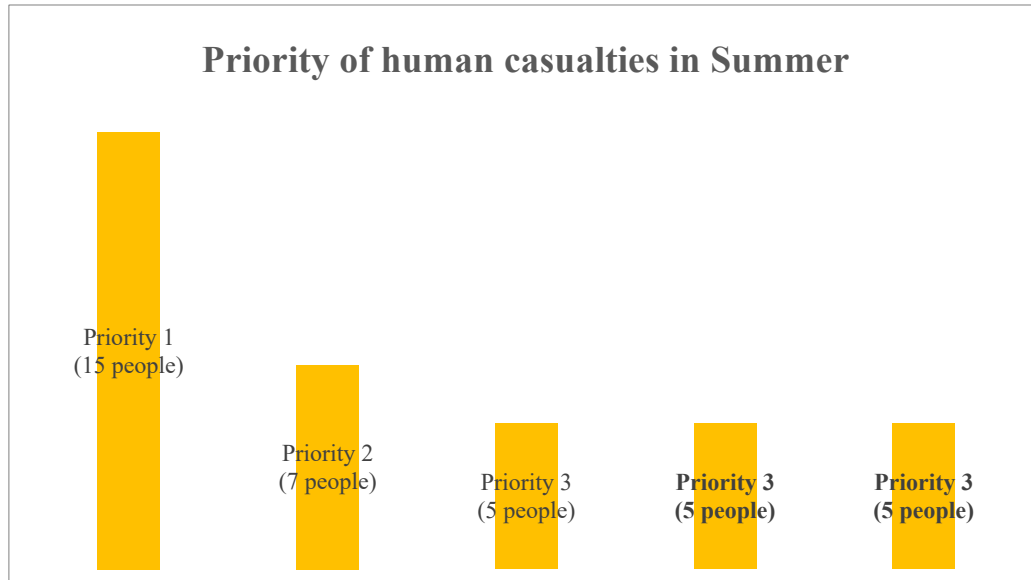
Flood



Landslide



III. Statistical Analysis (Priority of Human Casualties Occurrence)



➤ Results and implications

: Among the top 5 deadly vulnerabilities, the disaster are **landslide** and flood disaster, and major damages occur among the **elderly**.

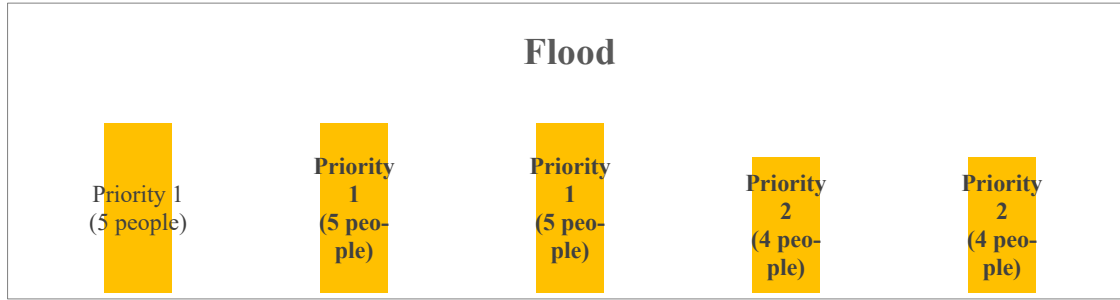
: Landslide disasters mostly occurred at home, particularly indoors during daily activities.

: Flood disasters mainly occurred while moving in underground roads.

: Most damages occurred in landslide and flood disasters during morning hours.

Priority	Priority of human casualties in summer	Deaths
1	Elderly - Morning - Building - Daily Life - Landslide Disaster - Buried	15
2	Middle-aged - Morning - Building - Daily Life- Landslide Disaster – Buried	7
3	Elderly - Dawn - Building - Sleeping - Landslide Disaster – Buried	5
	Middle-aged - Morning - Road (underground) - Moving - Flood Disaster - Drowned	5
	Elderly - Morning - Road (underground) - Moving - Flood Disaster - Drowned	5

III. Statistical Analysis (Priority of Human Casualties Occurrence)

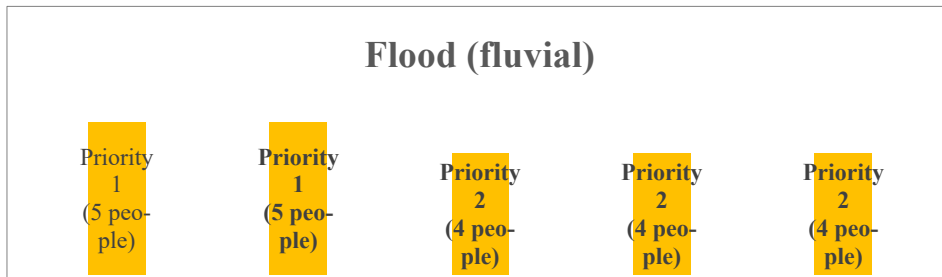


Priority	Priority of human casualties in summer	Deaths
1	Middle-aged - Morning - Road (underground) - Moving - drowned	5
	Elderly - Morning - Road (underground) - Moving - drowned	5
	Elderly - Morning - Road - Moving - Swept away	5
2	Young adult - Morning - Road (underground) - Moving - Drowned	4
	Elderly - Night - Drainage facilities - Disaster related activity - Swept away	4

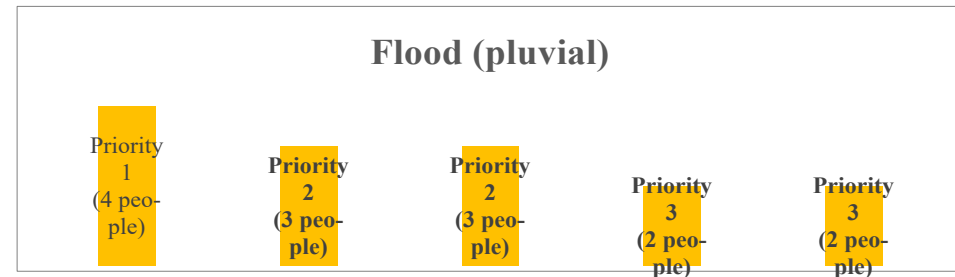
➤ Results and implications

: Both floods and heavy rain show vulnerability in underground spaces.

: Behavior is disaster-related activities (car moving).

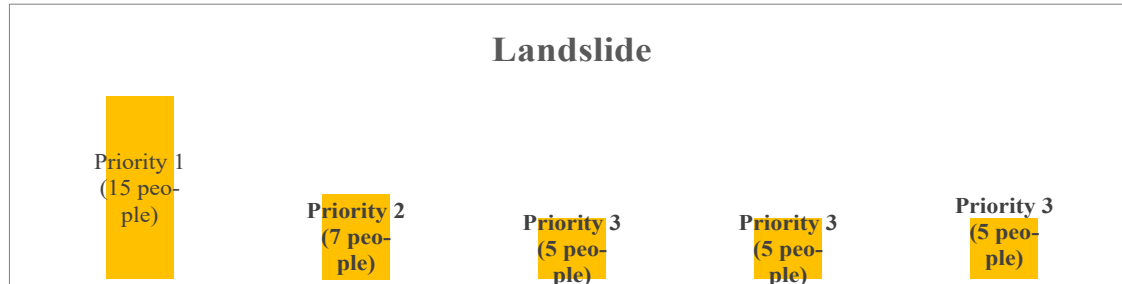


P	Priority of human casualties in summer	D
1	Middle-aged - Morning - Road (underground) - Moving - Drowned	5
	Elderly - Morning - Road (underground) - Moving - Drowned	5
2	Young adult - Morning - Road (underground) - Moving - Drowned	4
	Elderly - Morning - Road - Moving - Swept away	4
	Elderly - Night - Drainage facilities - Disaster related activity - Swept away	4



P	Priority of human casualties in summer	D
1	Elderly - Morning - Building(underground) - Disaster related activity - Drowned	4
2	Middle aged - Morning - Building(underground) - Disaster related activity - Drowned	3
	Middle aged - Night - Building(underground) - Daily life - Drowned	3
3	Young adult - Morning - Building(underground) - Disaster related activity - Drowned	2
	Middle aged - Night - Road - Moving - Swept away	2

III. Statistical Analysis (Priority of Human Casualties Occurrence)

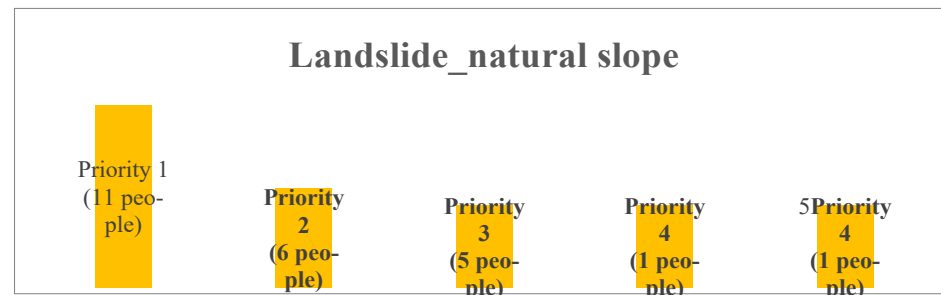


Priority	Priority of human casualties in summer	Deaths
1	Elderly - Morning - Building - Daily life - Landslide - Buried	15
2	Middle-aged - Morning - Building - Daily life - Landslide - Buried	7
3	Elderly - Dawn - Building - Sleeping - Landslide - Buried	5
	Elderly - Dawn - Building - Daily life - Landslide - Buried	5
	Elderly - Afternoon - Building - Daily life - Landslide - Buried	5

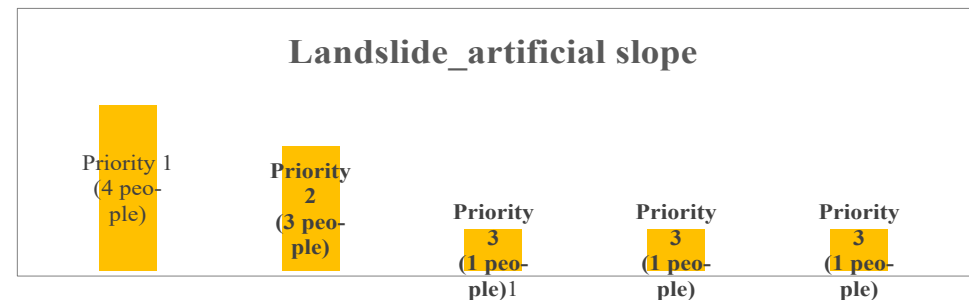
➤ Results and implications

: The cause of death in landslide was buried

: Most casualties concentrated during morning or early morning(dawn) hours.



P	Priority of human casualties in summer	D
1	Elderly - Morning - Building - Daily life - Buried	11
2	Middle-aged - Morning - Building - Daily life - Buried	6
3	Elderly - Dawn - Building - Sleeping - Buried	5
	Elderly - Dawn - Building - Daily life - Buried	5
	Elderly - Afternoon - Building - Daily life - Buried	5



P	Priority of human casualties in summer	D
1	Elderly - Morning - Building - Daily life - Buried	4
2	Young adult - Morning - Building - Daily life - Buried	3
3	Elderly - Dawn - Building - Disaster related activity - Buried	1
	Young adult - Dawn - Road - Moving - Buried	1
	Young adult - Dawn - Building - Sleeping - Buried	1

IV. Conclusion & Implication

- **Deriving vulnerable elements through statistical analysis of human casualties from summer natural disasters over the past 11 years**
 - The most vulnerable group to natural disasters is people in their 50s to 70s.
 - Casualties are most frequent on Saturdays (36%) and during the day (06:00 -12:00; 50%).
 - Locations of casualty occurrence are buildings, including underground spaces (53%)
 - For flood disasters, casualties often occur during moving and disaster-related activities (83%).

- **Identification of vulnerability factors for human casualties from summer natural disasters**

(flood disasters)

- P 1 : middle-aged^(who) - morning^(when) - road (underground)^(where) - moving^(what) – flood disasters^(why) - drowned^(how)
- P 2 : elderly^(who) - morning^(when) - road (underground)^(where) - moving^(what)- flood disasters^(why) - drowned^(how)
- P 3 : elderly^(who) - morning^(when) - road^(where) – moving^(what) - flood disasters^(why) – swept away^(how)

(landslide disasters)

- P 1 : elderly^(who) - morning^(when) - building^(where) - daily life^(what) - landslide disaster^(why) - buried^(how)
- P 2 : middle-aged^(who)- morning^(when) - building^(where) - daily life^(what) - landslide disaster^(why) - buried^(how)
- P 3 : elderly^(who) - dawn^(when) - building^(where) - sleeping^(what) - landslide disasters^(why) - buried^(how)

IV. Conclusion & Implication

- This study developed an analytical framework for human casualty characteristics by simultaneously considering individual attributes, temporal factors, spatial factors, behavioral factors, disaster causes, and damage mechanisms.
- By comprehensively analyzing victim characteristics, the framework significantly improves context-based explanations of human casualties that are not captured by conventional statistics.
- However, a major limitation of this study is the overall scarcity of human casualty data.
- For more accurate future analyses, it is essential to establish standardized investigation systems, strengthen on-site data collection at the time of damage occurrence, and continuously integrate big data sources, including spatial, meteorological, and hydrological data.

Thank you!



National Disaster Management Research Institute