National Flood Hazard Analysis of IDP Sites in Yemen

REACH & CCCM Cluster Yemen

April 2024

REACH Informing more effective humanitarian action

YEMEN
CCCM CLUSTER
دعم مجتمعات النازحين

Content

01
Background

Photo credits: IDP camp in Aden flooded by the rain. © ACTED/2020

OCHA

Background

- Flooding is one of the major threats to Internally Displaced Person (IDP) sites in Yemen.

- Site Reporting Tool (SRT) 2023 data indicated that flooding was a site threat in most assessed managed sites in Ansar Allah (AA) areas and just under half of unmanaged sites in Government of Yemen (GoY) areas.

- Site Monitoring Tool (SMT) 2023 data across R1-R8 found that a majority of assessed and operational managed sites in IRG areas reported a 'medium' flood exposure or higher during at-least one round *(REACH SMT 2023)*

- Between June 2021 and January 2024, 892 flooding events reportedly occurred across 474 existing sites *(CCCM Flood Report & December 2023 Site Master List)*

- REACH updated the findings of its 2023 analysis to support the 2024 Flood Contingency and Response Planning of CCCM Cluster partners, OCHA in addition to informing the Inter-Cluster Coordination Group (ICCG)

02

Methodology

Scope & Data sources

Scope

This analysis aimed to classify all IDP sites in Yemen with 'flood hazard' scores, covering 1,830 (80%) out of 2,285 IDP sites *(December 2023 ML)*.

Data gaps were prevalent in AA-areas and unmanaged sites.

Data sources

In total **4 primary data sources** and **1 back-up data source** was triangulated to develop Estimated Food Hazard scores (see Table 1).

REACH HEC-RAS modelling was used as a back-up data source for 2024, in absence of coverage across primary data sources (*see Limitations & Annex II)*

Data source	Number of IDP sites reported on
2023 National IDP Site Flood Hazard Analysis	Total scores for **2301 IDP sites** Estimated flood hazard scores of SNCCs: **1940 sites**
CCCM Site Monitoring Tool (SMT)	**308 sites** covered across R1-R8 in 2023 (managed sites in IRG-areas only)[4]
CCCM Site Reporting Tool (SRT) 2023	**268** managed sites in AA-areas and **365** unmanaged sites in IRG-areas[5]
REACH HEC-RAS modelling (January-September 2022)	30 M: 409 sites 12 M: 42 sites 2.5 M: 74 sites **Total: 522 sites[6]**
CCCM Flood Report (June 2021-January 2024)	**892** Flood incidents since June 2021

Acronyms
- SNCCs - Sub-National Cluster Coordinators
- HEC-RAS – Hydrologic Engineering Center's – River Analysis System

Analysis Framework

1. **Determination of Flood Hazard Scores per site based on primary data sources**

Evaluation of primary data sources (i.e CCCM Flood Report, SMT, SRT, 2023 SNCC Feedback) to determine an estimated 'flood hazard' classification per site based on triggering a scenario associated with that classification.

2. **REACH Regional Flood Hazard Mapping (back-up source) (HEC-RAS analysis)**

For sites not covered primary data sources, REACH determined HEC-RAS scores based on flood hazard models developed by REACH and UNOSAT between 2021-2023 measuring **flood hazard** and **flood depth** per IDP site.

3. **Review by CCCM Cluster & Sub-National Cluster Coordinators (SNCCs)**

The SNCCs confirmed the Draft 2024 Flood Hazard Scores developed by REACH, and no modifications were requested to the feedback provided for 2023.

Acronyms
• HEC-RAS – Hydrologic Engineering Center's – River Analysis System

Flood Hazard Scenarios

Each site was assigned a flood hazard classification according to the highest severity scenario that the site fulfilled the conditions for.

For example, if a site met the criteria for Scenario A, that site would be classified as 'Critical Hazard' irrespective of the number of 'High', 'Medium' or 'Low' scenarios the criteria were met for.

Scenarios	IF	ESTIMATED Flood Hazard of IDP site				
		Critical hazard	High hazard	Medium hazard	No/low hazard	Unknown
Scenario A	If SMT/SRT data indicated 'very high' exposure to flooding and at-least one flood occurred according to REACH-CCCM SMT/SRT or CCCM Flood Incident Report	x				
Scenario B	At-least 5 flooding incidents recorded in the CCCM Flood Incident Report since June 2021	x				
Scenario C	Flood occurrence reported for IDP site in CCCM Flood Report **and/or** REACH-CCCM SMT/SRT[1]		x			
Scenario D	2023 REACH-CCCM SMT or SRT data indicates that the exposure to flooding is *'very high'* or *'high'*		x			
Scenario E	2023 REACH-CCCM SMT or SRT data indicates that the exposure to flooding is *'medium'*			x		
Scenario F	2023 REACH-CCCM SMT or SRT data indicates that flooding and/or heavy rain was not reported as a site threat and no flooding occurred				x	
Scenario G	In the 2023 National Flood Hazard Analysis feedback, the Sub-National Cluster Coordinator (SNCC) considered the site to fitting of the 'high' hazard clarification		x			
Scenario H	In the 2023 National Flood Hazard Analysis feedback, the Sub-National Cluster Coordinator (SNCC) considered the site to fitting of the 'medium' hazard clarification			x		
Scenario I	In the 2023 National Flood Hazard Analysis feedback, the Sub-National Cluster Coordinator (SNCC) considered the site to fitting of the 'low' hazard clarification				x	
Scenario J	Site has no available data in CCCM Flood Incident Report, REACH-CCCM Site Profiling Tools (SMT & SRT) or 2023 SNCC feedback and a HEC-RAS severity score of 3 or higher.		x			
Scenario K	Site has no available data in CCCM Flood Incident Report, REACH-CCCM Site Profiling Tools (SMT & SRT) or 2023 SNCC feedback and a HEC-RAS severity score of 2.			x		
Scenario L	Site has no available data in CCCM Flood Incident Report, REACH-CCCM Site Profiling Tools (SMT & SRT) or 2023 SNCC feedback and a HEC-RAS severity score of 1.				x	
Scenario M	Site has no available data in CCCM Flood Incident Report, REACH-CCCM Site Profiling Tools (SMT & SRT) or 2023 SNCC feedback and no HEC-RAS data available.					x

1. Determination of Estimated Flood Hazard Scores at site level

01

Critical Hazard

- 5+ floods reported in CCCM Flood Report since June 2021

  or

- *'very high'* flood exposure reported in SMT/SRT 2023 data (*multiple flooding events causing harm to residents and infrastructure*)+ at-least one flooding event since June 2021

02

High Hazard

- CCCM Flood Report shows at least one flooding event since June 2021

  or

- REACH SMT/SRT 2023 indicated *'very high' (see critical)* or *'high'* flood exposure (*multiple flooding events with limited harm*)

  or

- SNCC reported high flood hazard

- **Back-up:** REACH HEC-RAS Analysis identifies high hazard

03

Medium Hazard

- REACH SMT/SRT 2023 indicated *'medium"* flood exposure (*flooding event(s) with limited harm to residents & infrastructure*)

  or

- SNCC reported medium flood hazard

- **Back-up:** REACH HEC-RAS Analysis identifies high hazard

04

Low Hazard

- No flooding events reported since June 2021

  and

- REACH SMT/SRT data does <u>not</u> report IDP site at threat of flooding

  or

- SNCC reported low flood hazard

- **Back-up:** REACH HEC-RAS Analysis identifies low hazard

2. REACH Flood Hazard (HEC-RAS) Modelling

- Models **hydrologic flows** based on large precipitation events (*designed* storm)

- Can model **flash floods**

- Informs about flood extent, depth & velocity (hazard)

REACH determined **specific Flood Hazard (HEC-RAS) scores for 108 sites** not covered by primary data sources (SMT/SRT/Flood report) through below steps

- Creating an estimated buffer/site boundary per IDP site

- Overlaying available IDP site location with flood models

- Extracting flood hazard & depth per site

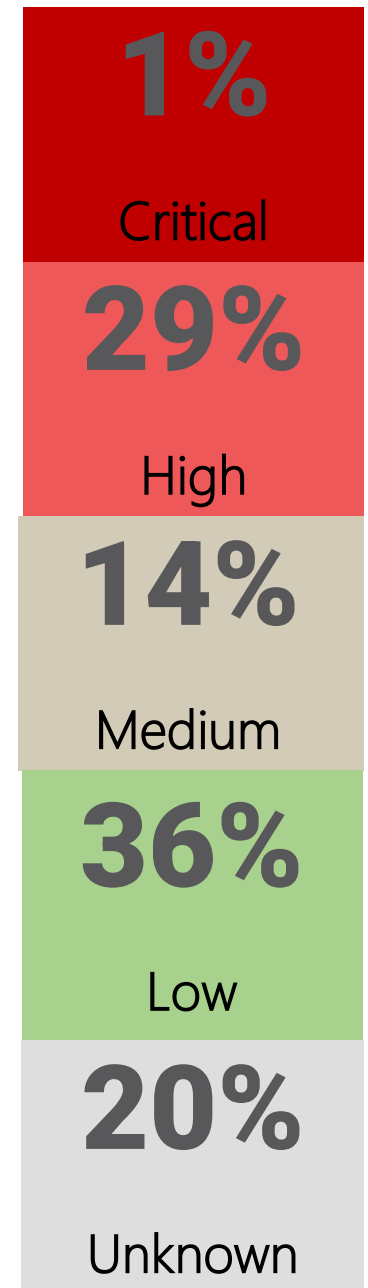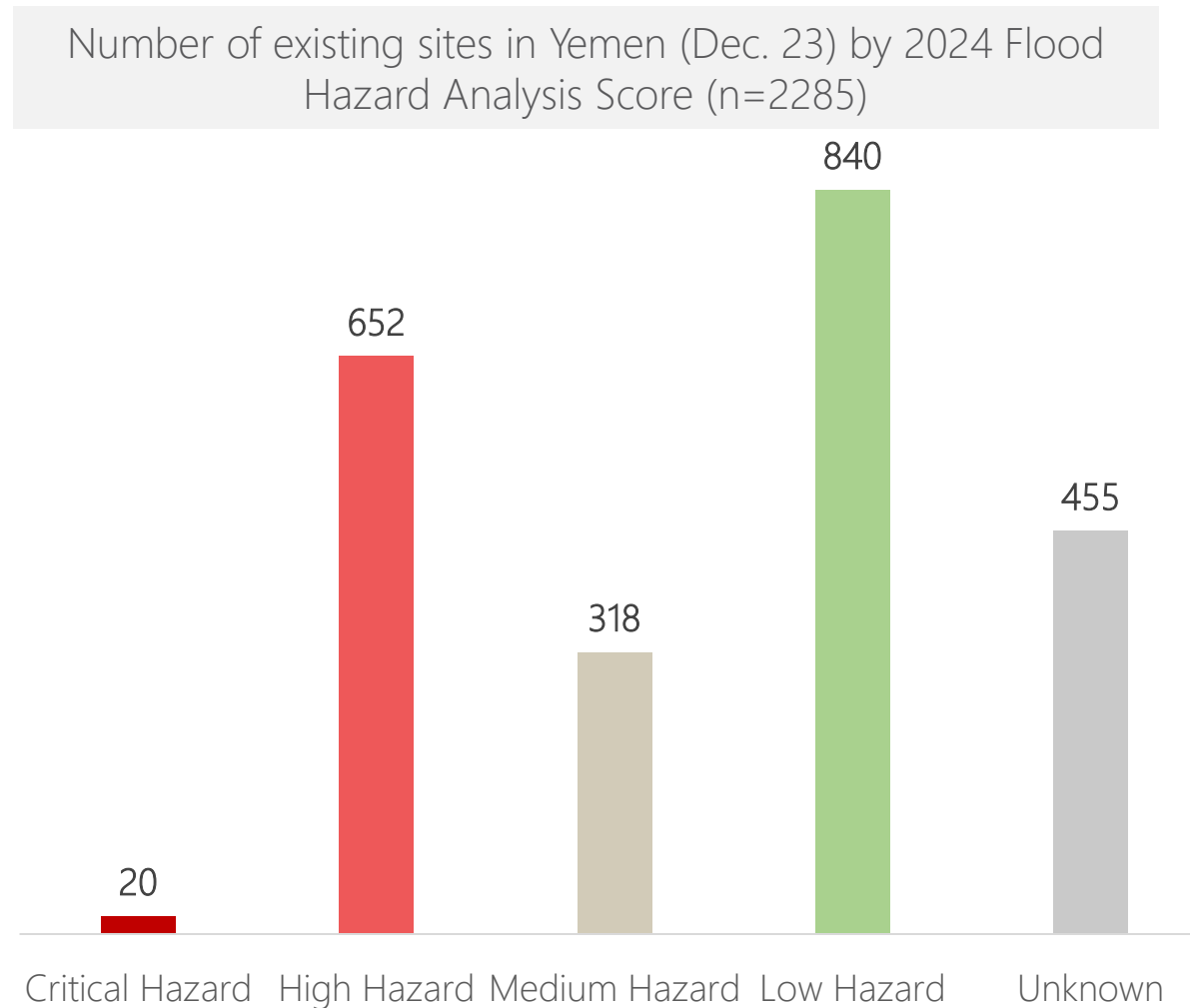- Calculating estimated flood hazard score
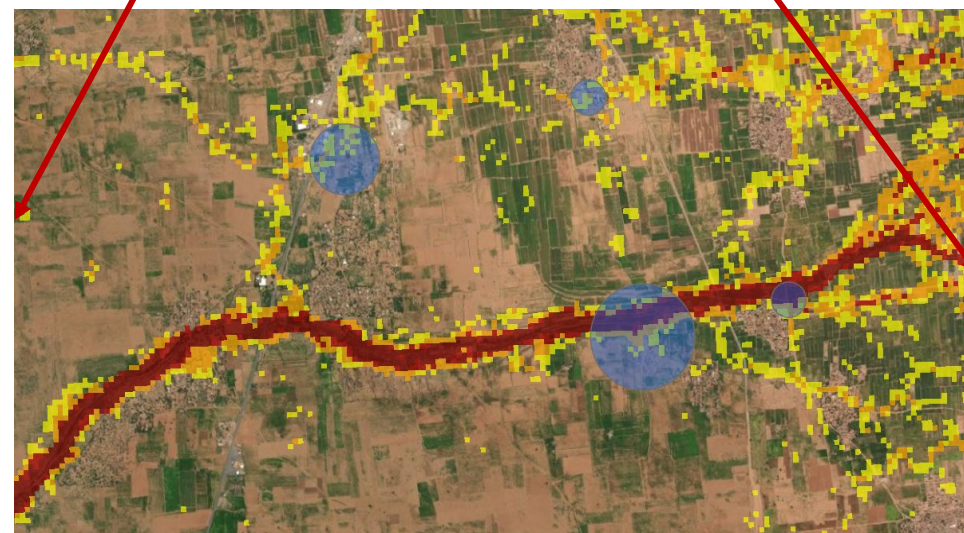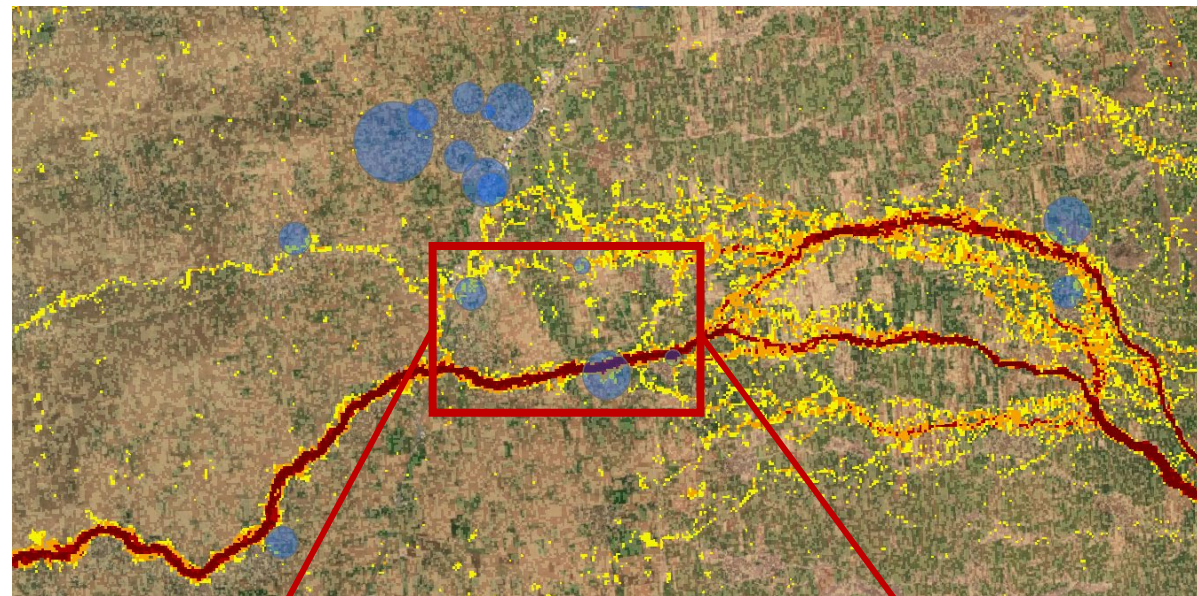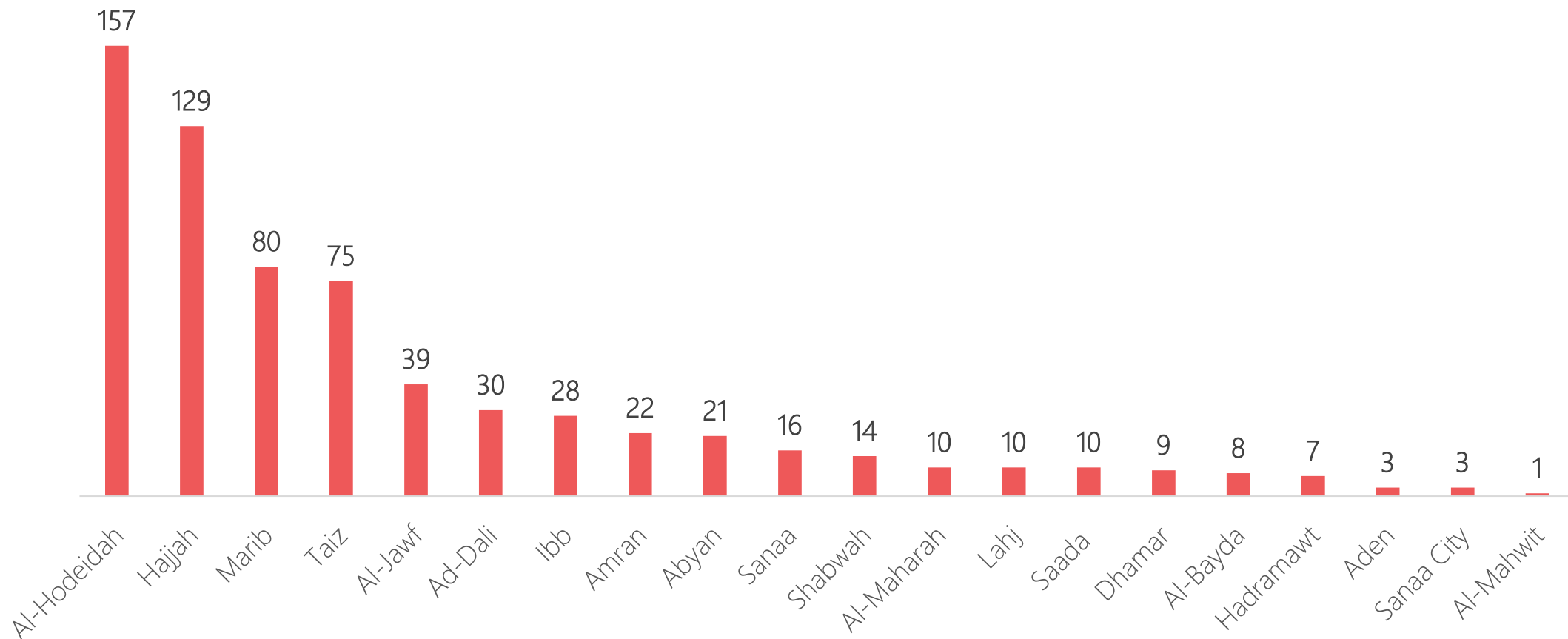
03
Findings & Limitations

Findings

Findings indicated that 30% of IDP sites have a 'Critical' or 'High' Flood Hazard classification, compared to 25% in the 2023 National Flood Hazard Analysis.*

Number of existing sites in Yemen (Dec. 23) by 2024 Flood Hazard Analysis Score (n=2285)

Critical Hazard	High Hazard	Medium Hazard	Low Hazard	Unknown
20	652	318	840	455

1%	Critical
29%	High
14%	Medium
36%	Low
20%	Unknown

*Comparability between 2024 & 2023 analysis is limited by methodological adjustments, wider historical flood data being available for 2021-2024, improved data availability for sites covered by SMT and wider data gaps in AA-areas (*see* limitations)
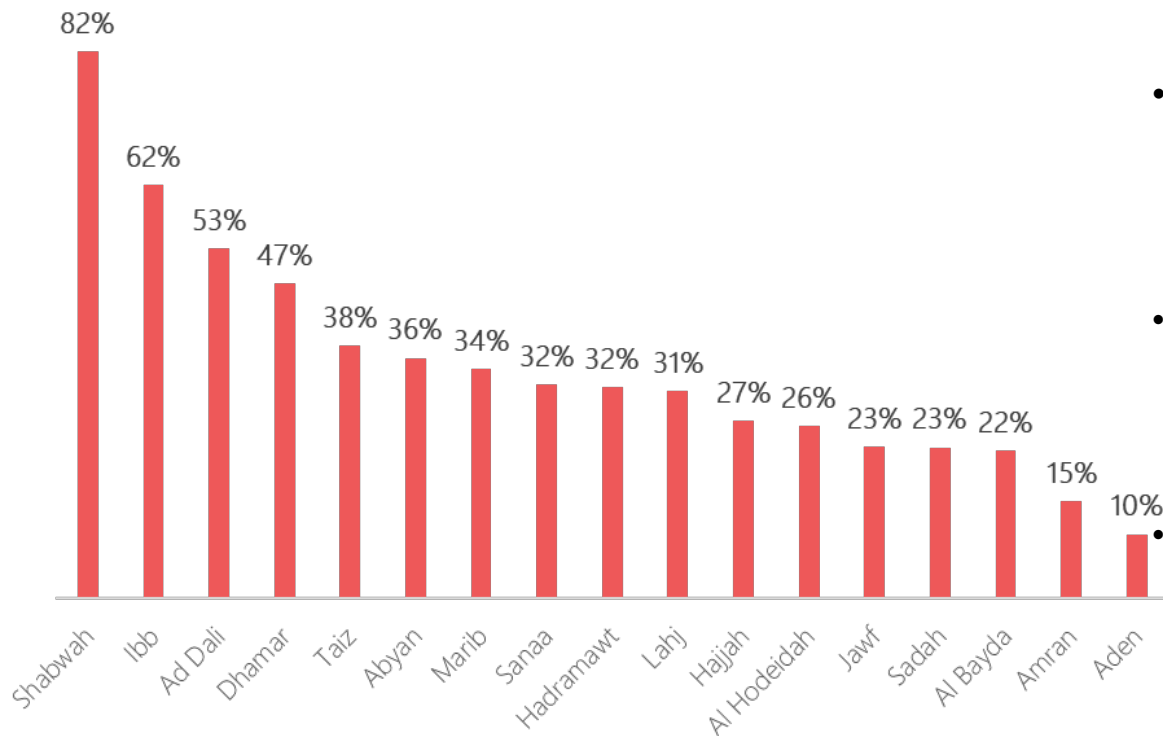
Findings by Governorate

Total number of sites classified as having a 'Critical' or 'High' Flood Hazard, disaggregated per governorate (Dec.23)

Governorate	Count
Al-Hodeidah	157
Hajjah	129
Marib	80
Taiz	75
Al-Jawf	39
Ad-Dali	30
Ibb	28
Amran	22
Abyan	21
Sanaa	16
Shabwah	14
Al-Maharah	10
Lahj	10
Saada	10
Dhamar	9
Al-Bayda	8
Hadramawt	7
Aden	3
Sanaa City	3
Al-Mahwit	1

Geographical Variations

Bar chart values:
- Shabwah: 82%
- Ibb: 62%
- Ad Dali: 53%
- Dhamar: 47%
- Taiz: 38%
- Abyan: 36%
- Marib: 34%
- Sanaa: 32%
- Hadramawt: 32%
- Lahj: 31%
- Hajjah: 27%
- Al Hodeidah: 26%
- Jawf: 23%
- Sadah: 23%
- Al Bayda: 22%
- Amran: 15%
- Aden: 10%

IDP sites with Critical or High Flood Hazard

- **672 IDP sites** have a 'Critical' or 'High' Flood Hazard classification, equating to 11,778 IDPs residing in 'Critical' and 735,365 in 'High' classification sites respectively. *(status: CCCM IDP Hosting Site Master List, December 2023).*

- 71% of these sites reported a flood incident since June 2021 in the CCCM Flood Incident Report, whilst 31% reported flood occurrence in the REACH SMT or SRT tools.

- Of the 20 'Critical Hazard' sites, 30% (n=6) are in Ad-Dali governorate: At district-level, 20% (n=4) are in Qatabah district (Ad-Dali) 15% of sites (n=3) in Aslam district (Hajjah).

- **62% of IDP sites** with Critical or High Flood Hazard are **managed** by CCCM partners, yet managed sites comprise just 30% of Yemeni IDP sites – reflective of information gaps in unmanaged sites** *(status: CCCM IDP Hosting Site Master List, December 2023).*

*This graph only includes governorates which contained at least 15 IDP sites as of December 2023, the data for other governorates is available in the [dataset](#)

**The proportion of sites that have a 'critical' or 'high' flood hazard that are managed is likely to be considerably lower given the increased data availability for managed IDP sites due to better coverage in REACH site profiling tools (SMT & SRT) in addition to the assumption that flood incidents are more likely to be reported for managed IDP sites than unmanaged ones.

Districts by quantity of sites with 'Critical' or 'High' Flood Hazard Classifications

Interpretation of Estimated Flood Hazard Scores

- **Flood Hazard Scores** per IDP site based on SRT/SMT/Flood report data mostly refer to the likelihood of flooding in a site based on historical flood events and the perception of Key Informants (Site Managers & SNCCs). This analysis does <u>not</u> incorporate risk or vulnerability criteria based on the quality of shelters and site infrastructure, presence of flood contingency planning or vulnerabilities based on site demographics.

- **SNCC derived Estimated Flood Hazard Scores** may implicitly consider the number of people/assets historically affected, and cwhether any flood prevention activities have been implemented in the site. However, no SNCCs updated 2024 feedback, potentially indicative of a lack of large-scale flood preparedness and mitigation measures in sites.

- Estimated Flood Hazard Scores may be used to **identify support prioritization of flood preparedness activities for specific IDP sites at national level**.

- **Further detailed site flood hazard assessments** are necessary to understand the exact potential extent & impact of a flooding event and appropriate flood response plans for sites with 'Critical' or 'High' classifications.

Limitations

01 General Analytical Limitations

o **Information gaps:** Estimated Flood Hazard Scores could be derived for 80% of IDP sites in Yemen. Critically, no REACH site profiling (SMT/SRT) assessments occurred in 2023 for unmanaged sites in AA-areas.

o **Contradictory information:** Data sources had contradictory information (e.g flood reported in SMT/SRT, but no CCCM Flood Report or vice versa). It is crucial for partners to report all flooding events in CCCM Flood Report for upcoming 2024 season (form *here*).

o **Comparability across years:** Due to the relegation of HEC-RAS to a back-up data source, added nuance to SMT/SRT tools and wider data coverage gaps in AA-areas, hence, 2024 & 2023 datasets should not be compared to assess improvements/deteriorations. Partners can contact REACH to assess 2023 and 2024 data for specific sites.

o **Interpretation of results:** Given the above and a lack of representative data, Flood Hazard scores should be considered as **indicative** estimates rather than definitive classifications.

02 REACH Flood Hazard Mapping (HEC-RAS)

o **Site boundaries:** The exact site boundaries of IDP sites are not available. REACH developed estimated buffer radiuses based on population size, which may not be accurate.

o **Site location:** Exact site locations are not available for all IDP sites and have not been verified by REACH. Some potential errors were found in GPS coordinates provided to REACH.

o **Interpretation of HEC-RAS score:** HEC-RAS Flood Hazard modelling might slightly overestimate or underestimate flood hazard.

o **REACH Severity Model:** The HEC-RAS severity model employed by REACH was self-developed and not verified by an accredited external body.

o **Technical limitations:** Use of 30-meter DEM in certain locations and absence of hydraulic structure incorporation

04

Next steps

Prioritization of IDP sites

Prioritization of IDP sites with Critical or High classifications for flood preparedness activities

CCCM implementing partners must further analyse sites classified as 'Critical Hazard' and 'High Hazard' to determine suitability for prioritisation for flood preparedness and anticipatory action (AA) activities, with prioritisation especially important given funding constraints in 2024 due to lack of Yemen Humanitarian Fund (YHF) allocation.

From the 20 IDP sites with 'Critical' classifications in addition to the 632 IDP sites with 'High' classifications', **priority locations** need to be selected for flood preparedness, mitigation and anticipatory action activities.

These sites can be shortlisted for future localized flood hazard assessments conducted by REACH or other CCCM partners.

05

Conclusion

Conclusion

Persistent & Widespread Flood Hazards

- 2024 findings indicated widespread susceptibility to flood hazard threats, which when considered alongside unaltered SNCC feedback and large-scale absence of flood contingency planning (SMT & SRT) may reflect that climatic conditions remain persistent. Moreover, there were geographical variations in needs at governorate and district-level.

Proactive > Reactive

- Given the potential lack of YHF funding allocation and non-activation of OCHA's AA WG in 2024, it is even more crucial for inter-cluster partners to implement proactive interventions targeting anticipatory action, flood preparedness and mitigation measures which can endure for multiple flooding seasons versus only providing short-term relief in response to major flooding events.

Coordination

- It is vital to consider CCCM Cluster Yemen guidelines to coordinate between clusters and the Civil Defence authorities to determine priorities, divide tasks and avoid duplication of activities, in addition to Protection Cluster guidelines.

- Ensure all flooding events are reported in the CCCM Flood Incident Report to avoid overlooking sites with flood hazard susceptibility.

Thanks for your attention!

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Annex I: Data Sources & Outputs

Below you can find links to references and outputs relating to REACH-CCCM 2024 IDP Hosting Site Flood Hazard Analysis.
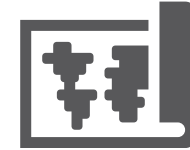
Methodology Note

2024 REACH-CCCM IDP Site Flood Hazard Analysis – Methodology Note

Dataset

2024 REACH-CCCM IDP Site Flood Hazard Analysis – Dataset

HEC-RAS Maps

- Available on REACH Resource Centre

Annex II: Overview of methods and limitations of data sources

Data source	Method	Limitations
REACH-CCCM Site Monitoring Tool (SMT) R1-R8 (January-November 2023)	**CCCM Site Monitoring Tool (SMT) contains** an indicator on flood exposure of an IDP site, categorized across 'very high'. 'high', 'medium' and/or 'low' thresholds, with a relevancy constraint based on reporting 'flooding' and/or 'heavy rain' as a site threat	This data source reflects the perceptions of the site manager based on the data sources available to them. This is not based on dedicated spatial flood hazard criteria and analysis.
REACH-CCCM Site Reporting Tool (SRT) (April - June 2023)	**CCCM Site Reporting Tool (SRT) contains** an indicator on flood exposure of an IDP site, categorized across 'very high'. 'high', 'medium' and/or 'low' thresholds, with a relevancy constraint based on reporting 'flooding' and/or 'heavy rain' as a site threat	This data relies on reports from Key Informants on whether flooding may be a threat to the site. No official flood hazard assessment. Data coverage is less comprehensive than the SMT data, covering April-June 2023. Therefore, some flood incidents that occurred during the remainder of the 2023 flooding season may have gone unreported.
CCCM Flood Report (June 2021-January 2024)	**CCCM Flood Report** highlights sites where flooding occurred since 2021. **Overall, the CCCM Flood Report is considered the most authoritative dataset in this analysis, since it reports actual events.** The CCCM Flood Report also allows REACH to validate its HEC-RAS model findings over time.	This dataset includes sites where reports of flooding have occurred since June 2021. It is also possible that not all flood events were flagged and/or accurately reported (particularly for unmanaged sites), so total number of flooding might be higher.
REACH HEC-RAS modelling Only utilized in cases where no information is available from the above sources. (January 2022 – December 2023)	**Flood Hazard (HEC-RAS) models** can provide flood hazard and flood depth products based on a *designed* storm. These products are overlaid with IDP site location and an estimated buffer / boundary to derive estimated flood hazard scores.	Based on modelling a designed storm and not an actual flooding event. Also, exact IDP site extents/boundaries are not available, and coordinates might be inaccurate. Thus, the models may overestimate or underestimate Flood Hazard.
SNCC Flood Estimates (February 2023)	In 2023, SNCCs provided feedback on the 2023 Draft IDP Site Flood Hazard scores. Their feedback was based on their field knowledge, including of historical flooding events. 2023 scores will be considered in 2024 – with SNCCs responsible for updating scores in cases of changes in site severity.	SNCC feedback is not available for all sites and subjective interpretation of flood hazard. This is not a substitute for an official, dedicated flood hazard assessment.

Annex III: Findings by Governorate, both with total number and proportion of sites

Governorate	No. Sites ' High' or 'Critical'	% Sites 'High' or 'Critical'
Al-Hodeidah	157	26%
Hajjah	129	27%
Marib	80	34%
Taiz	75	38%
Al-Jawf	39	23%
Ad-Dali	30	53%
Ibb	28	62%
Amran	22	15%
Abyan	21	36%
Sanaa	16	31%
Shabwah	14	82%
Al-Maharah	10	77%
Lahj	10	31%
Saada	10	23%
Dhamar	9	47%
Al-Bayda	8	22%
Hadramawt	7	32%
Aden	3	10%
Sanaa City	3	43%
Al-Mahwit	1	13%