MSF GeoHazards

Assessing climate and environmental hazards where we work

Humanitarian Action for Climate and the Environment

Overview

MSF GeoHazards is a geo-spatial assessment that helps us understand where key climate and environmental hazards are most likely to occur, and how severe they might be, where we operate. Currently it considers **floods** (fluvial, pluvial, and coastal), **droughts**, **extreme heat**, **tropical cyclones**, and **water scarcity**. Since each hazard is based on different datasets and methods, this report includes a brief explainer for each—outlining what it is, why it matters, the data used, and how the scores are calculated.

MSF GeoHazards offers two main outputs: (1) **rankings** of MSF project locations based on the severity and likelihood of extreme climate–related events, and (2) **webmaps** to visualize the geospatial data layers used in the analysis.

Risk is generally understood as a combination of **hazard** (the event itself), **exposure** (who or what is in harm's way—such as people, health facilities, or infrastructure), and **vulnerability** (how well communities can cope, recover, or access support)- *see figure to the right*. **MSF GeoHazards addresses only one part of this equation: the hazards themselves**. It does not include information on population or vulnerability, and so, it doesn't offer a full risk assessment. However, by relying on the best available global geospatial data, the tool provides a strong foundation for broader risk assessments and helps identify areas where more detailed, localized analysis may be required.

Disclaimers

This assessment relies on historical data, but climate change is altering the frequency, intensity, and location of hazards. Additionally, the MSF presence layer may contain location inaccuracies (outdated MSF presence and/or incorrect spatial coordinates), which can affect hazard classification.

Regions often face a combination of different hazards, which can have a combined effect that is additive or even multiplicative. While this analysis doesn't model cascading hazard interactions, users can view overlapping hazard scores to spot potential high-risk projects.

For mapping and earth observation support:

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For support on weather, climate and environment contact HACE:

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Floods

What floods are and why they matter

Floods fall into three main types, depending on their cause. Fluvial floods happen when rivers overflow after prolonged rain or snowmelt. Pluvial floods occur when heavy rain overwhelms the soil and drainage systems. Coastal floods are caused by storm surges, high tides, or tsunamis. **Impact:** Floods disrupt communities by displacing populations, damaging homes, health facilities, and infrastructure. They cut off access to healthcare, clean water, and food, while increasing the risk of waterborne and vector-borne diseases. Cascading impacts include damaged infrastructure, loss of livelihoods, and prolonged vulnerability, often overwhelming humanitarian response capacities and exacerbating existing health and social inequalities. **Vulnerable groups** include those living in floodplains, informal settlements, or low-lying coastal areas.

*To learn more about what floods are and how to prepare for them, consult our **Flood Handbook**.*

The data used

To assess flood hazards at MSF sites, we used the World Bank / Fathom 2: Global Flood Exposure dataset. It models **fluvial, pluvial, and coastal flooding** based on a **1-in-100-year return period** (rare but severe flood events) - meaning a 1% chance of flooding in any given year. We looked at a 5 km radius around each MSF project location (data for 250m and 1km are also available upon request), focusing on the risk to the MSF infrastructure and the surrounding area. Although a 1-in-100-year return period sound rare, this is based on historical data. Therefore, in some areas where the risk has changed over recent decades due to changing rainfall patterns, the last 100 years are no longer representative of the current risk – i.e. what was once a 1-in-100-year event is now at risk of happening more frequently.

The score and what it means

A composite flood severity score was calculated for each MSF project by multiplying two factors: the **percentage of flooded area** within a 5 km radius (scaled from 0 to 5) and the **average flood depth** in that area. Flood depth was rated from 1 (shallow, <15 cm) to 5 (very deep, >1.5 m). Scores range from 0 (no flooding) to 5 (widespread, deep flooding).

To access the full rankings

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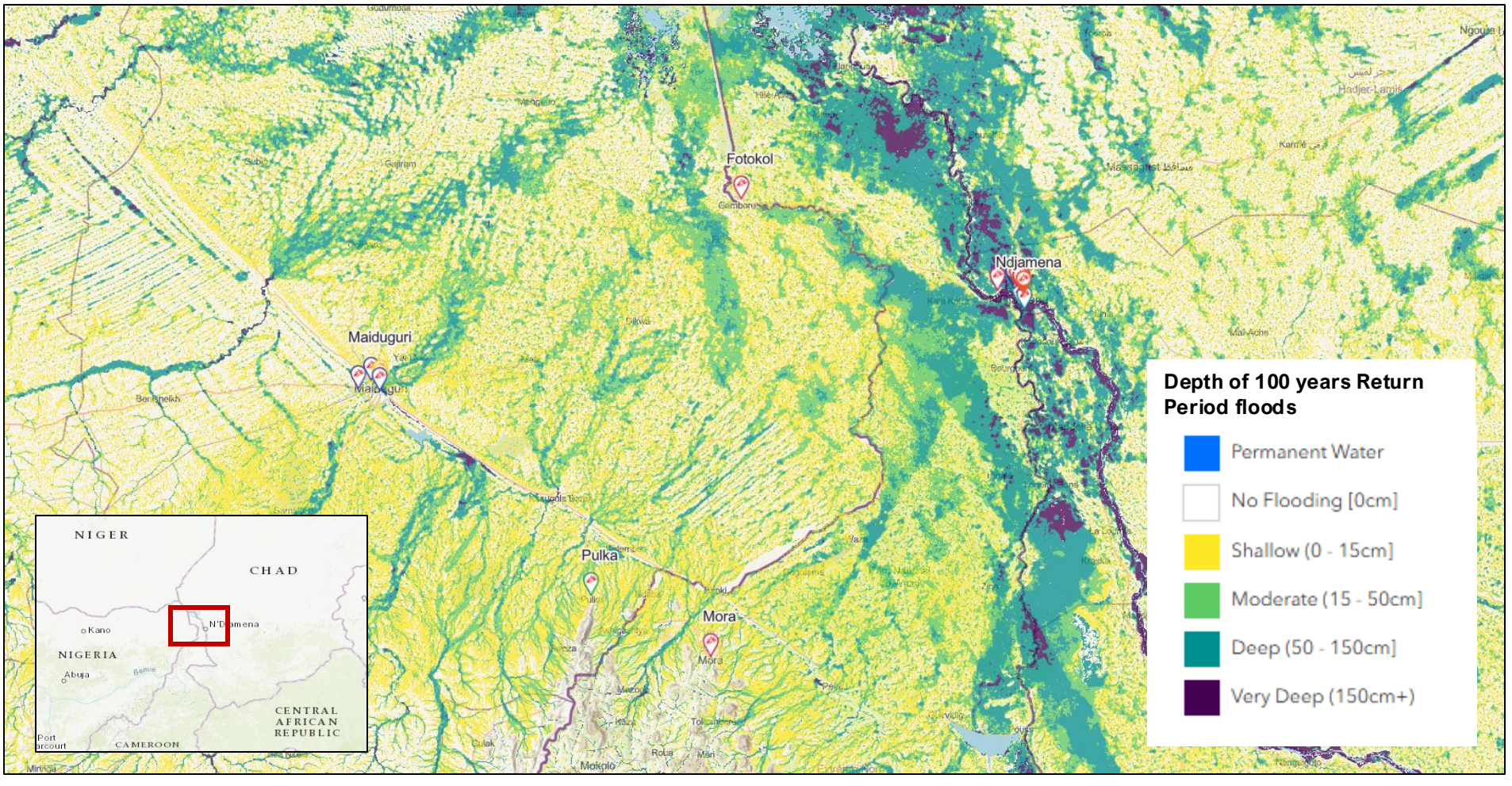
Floods



Top 10 MSF projects exposed to floods

	Project(s)	Country	Magnitude (/5)
1	Unity	South Sudan	5,0
2	Karakalpakstan	Uzbekistan	3,6
3	Kachin	Myanmar	3,2
4	Maungdaw	Myanmar	2,9
5	Bentiu	South Sudan	2,8
6	Massakory	Chad	2,6
7	Jonglei	South Sudan	2,4
8	Kashmir	India	2,3
9	Patna	India	2,2
10	Sila	Chad	2,2

	Project(s)	Country	Magnitude (/5)
1	Ad Damazin	Sudan	3,6
2	Niono	Mali	3,3
3	Renk	South Sudan	3,0
4	Kassala	Sudan	2,1
5	Gaza	Palestine	1,8
6	Jega	Nigeria	1,6
7	Kunduz	Afghanistan	1,6
8	Tucupita	Venezuela	1,5
9	Ukhia	Bangladesh	1,5
10	Marajo	Brazil	1,5

	Project(s)	Country	Magnitude (/5)
1	Arauca	Columbia	4,0
2	Atbara	Sudan	3,6
3	Khartoum	Sudan	3,4
4	Malakal	South Sudan	2,8
5	Zamfara	Nigeria	2,4
6	Renk	South Sudan	2,2
7	Diffa	Niger	2,2
8	Ansongo	Mali	2,2
9	Koro	Mali	2,1
10	Ulang	South Sudan	2,0

	Project(s)	Country	Magnitude (/5)
1	Milezi	Chad	3,9
2	Mayom	South Sudan	3,9
3	Mayen Abun	South Sudan	3,5
4	Dawei	Myanmar	2,9
5	Mangala	DRC	2,5
6	N'Djamena	Chad	2,5
7	Ango	DRC	2,2
8	Matamoros	Mexico	2,2
9	Banalia	DRC	1,9
10	Zinga	Tanzania	1,8

	Project(s)	Country	Magnitude (/5)
1	Zuwarah	Libya	3,5
2	Aweil	South Sudan	2,8
3	Tenenkou	Mali	2,4
4	Moissala	Chad	2,3
5	Old Fangak	South Sudan	2,3
6	Cité Soleil	Haiti	1,9
7	Madarounfa	Niger	1,9
8	South Emergency	Yemen	1,8
9	Kasese	Uganda	1,6
10	Goyalmara/Cox's Bazar	Bangladesh	1,6

	Project(s)	Country	Magnitude (/5)
1	N'Djamena	Chad	2,6
2	Budjala	DRC	1,5
3	Agboville	Côte d'Ivoire	1,1
4	Akor	Nigeria	1,1
5	Madaoua	Niger	1,0
6	Guidan Roumdji	Niger	0,8
7	Ouangolodougou	Côte d'Ivoire	0,6
8	Bouake	Côte d'Ivoire	0,5
9	Kinshasa	DRC	0,5
10	Touloum	Chad	0,5

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Extreme Heat

What extreme heat is and why it matters

Extreme heat refers to prolonged periods of unusually high temperatures, posing serious risks to human health and survival. **Impact:** Heat stress can lead to exhaustion, heat stroke, and death, particularly when humidity limits the body's ability to cool itself. In humanitarian settings, extreme heat can exacerbate malnutrition, dehydration, and disease outbreaks, while straining health services. **Vulnerable populations** include the elderly, children, people with chronic illnesses and outdoor workers. Urban areas face heightened risks due to the heat island effect and air pollution.

*For more information, see our **HACE Heat Stress Guide**.*

The data used

For this project we used the Annual Global High-Resolution Extreme Heat Estimates (1983-2016) developed by NASA. This geospatial dataset uses the **Wet Bulb Globe Temperature (WBGT)**, an index that estimates heat stress by combining temperature, humidity, wind speed, and solar radiation to assess conditions affecting human health in hot environments. The WBGT gives a better indicator of heat risk than just temperature alone, since when it is more humid and less windy our bodies are less able to cope. The WBGT is an ISO (International Organization for Standardization) screening method to establish the presence or absence of heat stress. A Wet Bulb Globe Temperature (WBGT) over 30°C indicates extreme heat stress, where prolonged exposure or physical activity can quickly lead to heat exhaustion or heat stroke, especially without adequate hydration or rest.

The score and what it means

The score used here is an estimated duration of exposure to heat stress for 2025 measured as **number of days per year where WBGT exceeded 30°C**. As the data was limited to 2016, to project the values for 2025 we used the historical trend and applied it to the average count from 2014-16, providing a more stable baseline. This projection assumes a continued linear increase, which likely results in a conservative estimate of current exposure levels.

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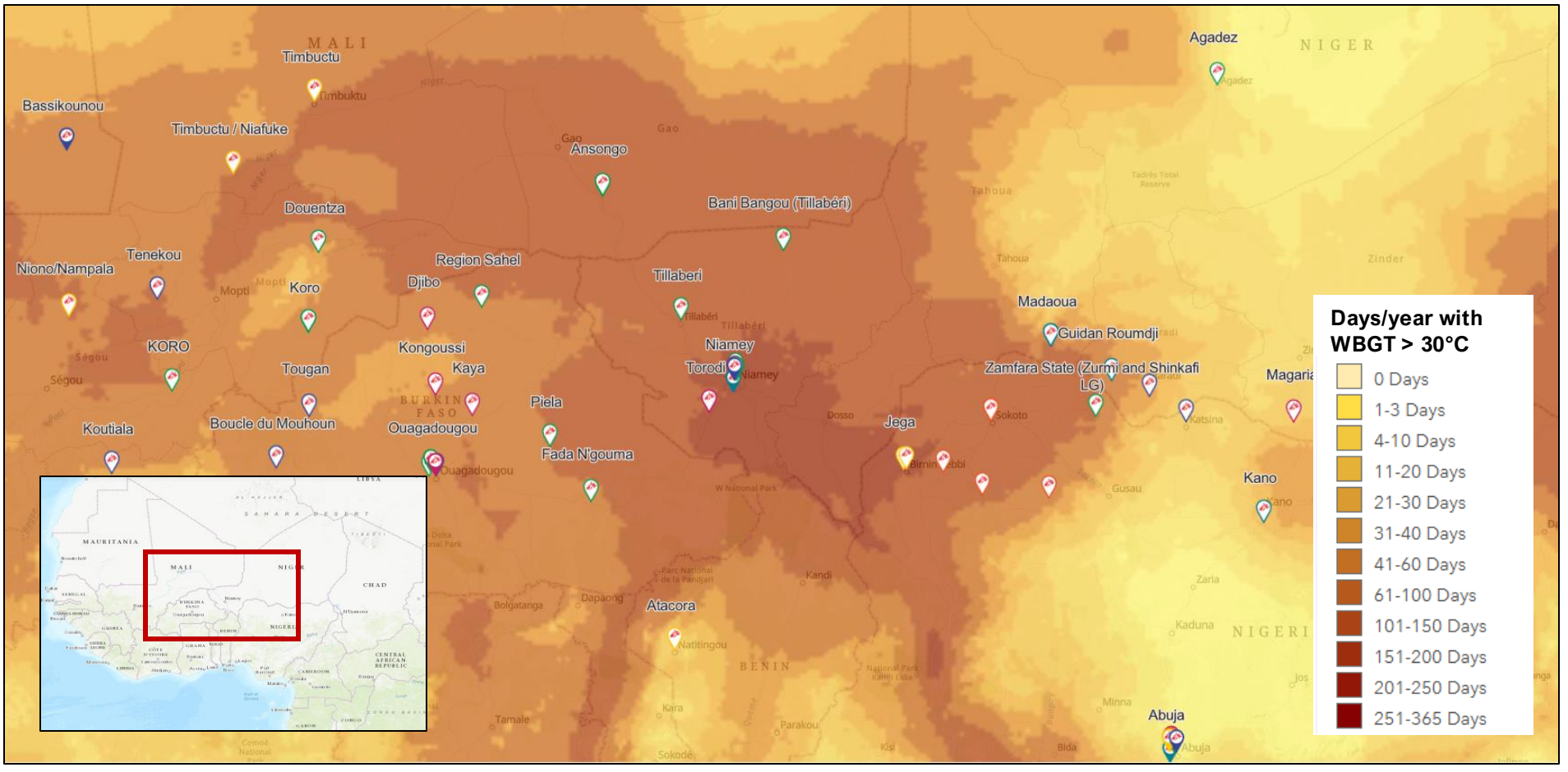
Extreme Heat



Top 10 MSF projects exposed to extreme heat

	Project(s)	Country	Days/year with WBGT>30
1	East Balochistan	Pakistan	171
2	Patna	India	151
3	Massakory	Chad	108
4	Mandalay	Myanmar	94
5	Tambuwal	Nigeria	85
6	Yangon	Myanmar	82
7	Sokoto	Nigeria	78
8	Chhattisgargh	India	73
9	Gummi	Nigeria	62
10	Bentiu	South Sudan	55

	Project(s)	Country	Days/year with WBGT>30
1	Bahgdad	Iraq	100
2	Maiduguri	Nigeria	96
3	Jega	Nigeria	87
4	Karachi	Pakistan	81
5	Mumbai	India	78
6	Couffo	Benin	64
7	Timbuctu	Mali	63
8	Niono	Mali	60
9	Renk	South Sudan	53
10	Kassala	Sudan	49

	Project(s)	Country	Days/year with WBGT>30
1	Al Qanawis/Abs	Yemen	203
2	Niamey	Niger	109
3	Diffa	Niger	98
4	Ansongo	Mali	91
5	Tillaberi	Niger	83
6	Malakal	South Sudan	69
7	Ulang	South Sudan	68
8	Biela	Burkina Faso	62
9	Zamfara	Nigeria	60
10	Pulka	Nigeria	58

	Project(s)	Country	Days/year with WBGT>30
1	Ad-Dahi	Yemen	196
2	Hodeida	Yemen	195
3	Fotokol	Cameroon	123
4	N'Djamena/Milezi	Chad	112
5	Nyamey	Niger	109
6	Wajir	Kenya	107
7	Torodi	Niger	106
8	Dagahaley/Dadaab	Kenya	102
9	Batha	Chad	84
10	Reynosa	Mexico	83

	Project(s)	Country	Days/year with WBGT>30
1	Gujranwala	Pakistan	110
2	Borno	Maiduguri	88
3	Gwange	Nigeria	86
4	Manila	Philippines	78
5	Tenekou	Mali	62
6	Peshawar	Pakistan	60
7	Moissala	Chad	51
8	Tougan	Burkina Faso	47
9	Jigawa	Nigeria	46
10	Mouhoun	Burkina Faso	45

	Project(s)	Country	Days/year with WBGT>30
1	N'Djamena	Chad	111
2	Guidan Roumdji	Niger	50
3	Madaoua	Niger	48
4	Kano	Nigeria	23
5	Agboville	Côte d'Ivoire	22
6	Ouangolodougou	Côte d'Ivoire	18
7	Bouake	Côte d'Ivoire	9
8	Akor	Nigeria	6
9	Budjala	RDC	2

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Tropical Cyclones

What tropical cyclones are and why they matter

Tropical cyclones are powerful storms forming over warm ocean waters, bringing destructive winds, heavy rainfall, and coastal storm surges. They are known as hurricanes in the Atlantic and Northeast Pacific, typhoons in the Northwest Pacific, and as cyclones in the South Pacific and Indian Ocean. **Impact:** They can lead to flooding and landslides, damaging homes, health facilities, and infrastructure. Impacts on population include displacement, injury, disruptions to healthcare, and outbreaks of waterborne diseases. The most **vulnerable groups** are coastal, island, and low-lying communities, particularly where housing is fragile and access to essential services is limited. Their recovery can often be delayed by damage to roads, supply chains, and healthcare systems.

The data used

We assessed the severity of these events by using the **maximum sustained wind speed** expected at each MSF location based on a **1-in-100-year return period** (a relatively rare but severe event) through the Synthetic Tropical cyclOne geneRation Model (STORM) dataset.

The score and what it means

Maximum sustained wind speed is a key indicator of a tropical cyclone's destructive potential, influencing rainfall intensity and accumulation, storm surge, structural damage, and overall humanitarian impact. **Maximum sustained wind speeds for a 1-in-100-year event** are shown**.** This means that tropical cyclones of such magnitude, have a 1% chance of occurring in any given year, i.e. they are rare but severe tropical cyclones. For reference, tropical storms have winds of 63–118 km/h. Hurricanes start at 119 km/h (Category 1) and reach 178 km/h or more for major hurricanes (Category 3+), based on the Saffir-Simpson scale. For more information about this scale and the impacts tropical cyclones, see the HACE Spotlight on Hurricanes.

Disclaimer

Wind speeds shown reflect conditions at specific locations, not the cyclone's peak strength at sea, as cyclones weaken after landfall. Even without cyclone-force winds, MSF projects may face heavy rain, landslides, or flooding. If a country or project isn't listed, it may still be impacted.

To access the full rankings

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To access the webmap

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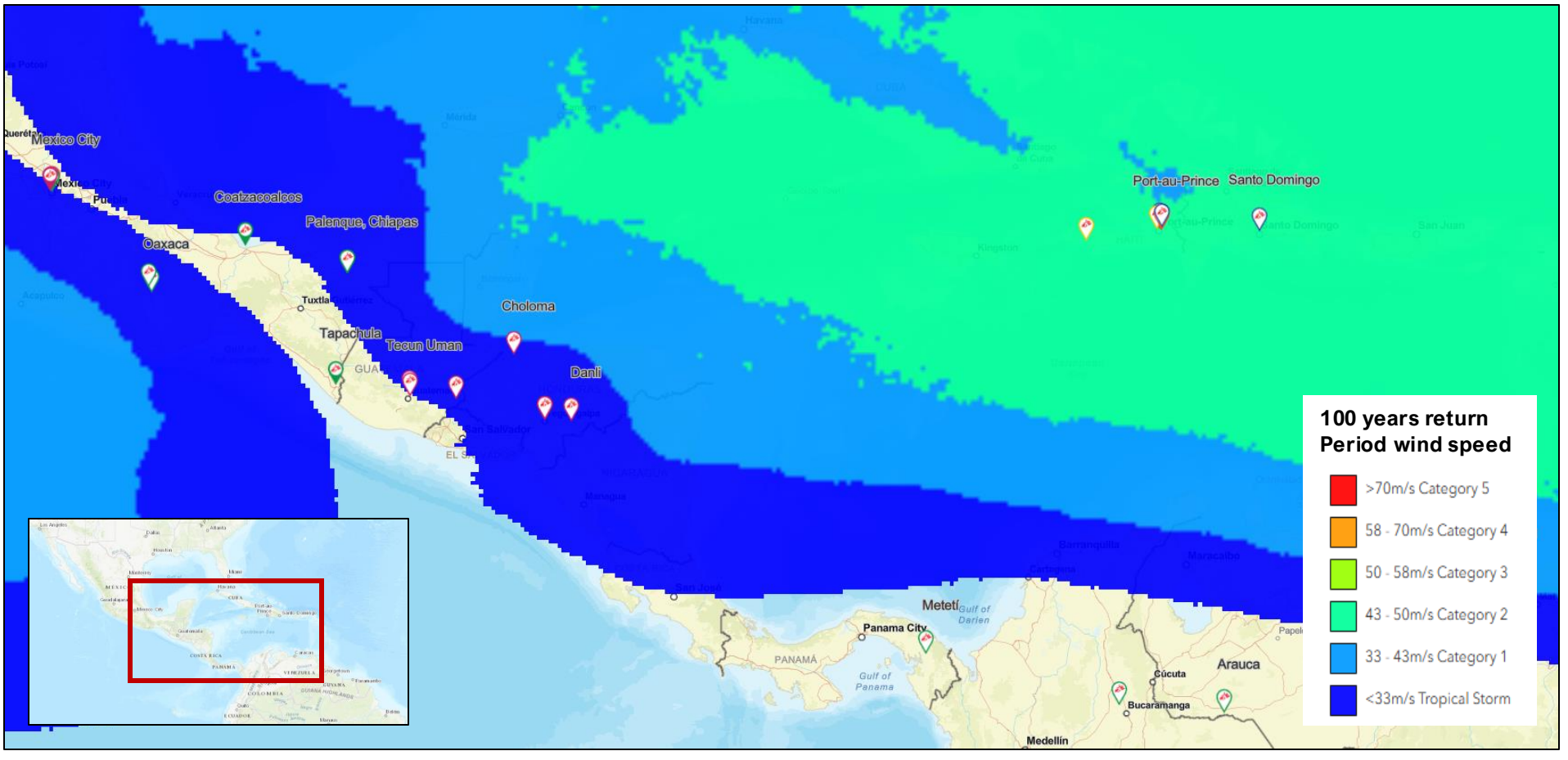
Tropical Cyclones



MSF projects exposed to tropical cyclones

OCA

	Project(s)	Country	Sustained wind speed (km/h)
1	Port-au-Prince	Haiti	167.0
2	Kutupalong	Bangladesh	145.1
3	Balukhali	Bangladesh	144.4
4	Maungdaw	Myanmar	143.6
5	Sittwe	Myanmar	133.2
6	Chhattisgargh	India	82.8
7	Yangon	Myanmar	76.3

OCB

	Project(s)	Country	Sustained wind speed (km/h)
1	Port-à-Piment	Haiti	167.0
2	Port-au-Prince	Haiti	166.7
3	Ukhia	Bangladesh	145.4
4	Hong Kong	Hong Kong	131.8
5	Karachi	Pakistan	128.9
6	Anzoategui	Venezuela	112.3
7	Mumbai	India	107.6
8	Beira	Mozambique	96.5
9	Tucupa	Venezuela	88.2
10	Macomia	Mozambique	84.6
11	Shabwa	Yemen	71.3
12	Palma	Mozambique	68.8

OCBA

	Project(s)	Country	Sustained wind speed (km/h)
1	Mizoram	India	135
2	Tapachula	Mexico	91.1
3	Mocimboa da Praia	Mozambique	75.2
4	Mueda	Mozambique	74.2
5	Palenque	Mexico	72.7
6	Piedras Negras	Mexico	65.9

OCG

	Project(s)	Country	Sustained wind speed (km/h)
1	Pyongyang	North Korea	127.8
2	Ikongo	Madagascar	125.6
3	Matomoros	Mexico	124.6
4	Reynosa	Mexico	113.4
5	Choloma	Honduras	100.8
6	Nampula	Mozambique	95.4
7	Tegucigalpa	Honduras	79.6
8	Yangon	Myanmar	76.7
9	Mexico Ciudad	Mexico	69.1

OCP

	Project(s)	Country	Sustained wind speed (km/h)
1	Port-au-Prince	Haiti	166.7
2	Manila	Philippines	166.0
3	Cox's Bazar	Bangladesh	145.1
4	Goyalmara	Bangladesh	143.6

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Droughts

What droughts are and why they matter

Droughts are prolonged periods of unusually low rainfall leading to water shortages that impact food production, ecosystems, and access to safe water. Measuring droughts is complex, as different indicators capture different dimensions of their impact, such as rainfall deficits, soil moisture levels, river flows, and vegetation health. These indicators also vary by region, timescale, and type of drought - whether meteorological, agricultural, or hydrological. **Impact**: In humanitarian contexts, droughts drive food insecurity, malnutrition, displacement, and poor sanitation due to limited water access. Their severity and duration vary, often compounding existing vulnerabilities and straining already fragile health systems. **Vulnerable populations** include subsistence farmers, pastoralists, and communities reliant on unstable water sources. Drought effects are often slow-onset but devastating, compounding existing vulnerabilities and overstretching health services.

The data used

For this project, we have chosen to focus on agricultural droughts, given their direct link to food production, nutrition, and malnutrition - key concerns in humanitarian crises. To assess this, we used the Agricultural Stress Index (ASI) developed by the FAO, which links drought conditions to food insecurity and malnutrition. The geospatial layer used in this assessment maps **the frequency of severe droughts in areas where at least 30% of cropland or grassland has been affected**. The historical drought frequency, as defined by ASI, is based on data from the entire 1984–2023 period.

The score and what it means

To evaluate the potential impact on MSF locations, we applied a 100 km radius around each site. Within this area, we measured the percentage of cropland and pastures affected by severe droughts, distinguishing between two key indicators: one related to vegetal nutrition (grains, cereals, legumes, vegetables, fruits, etc.) and the other to livestock-derived nutrition (dairy, meat). This score reflects **how often more than 30% of the agricultural land around an MSF location experiences severe drought**. For example, a likelihood of 25% means that such drought conditions occur, on average, once every four years in that specific location.

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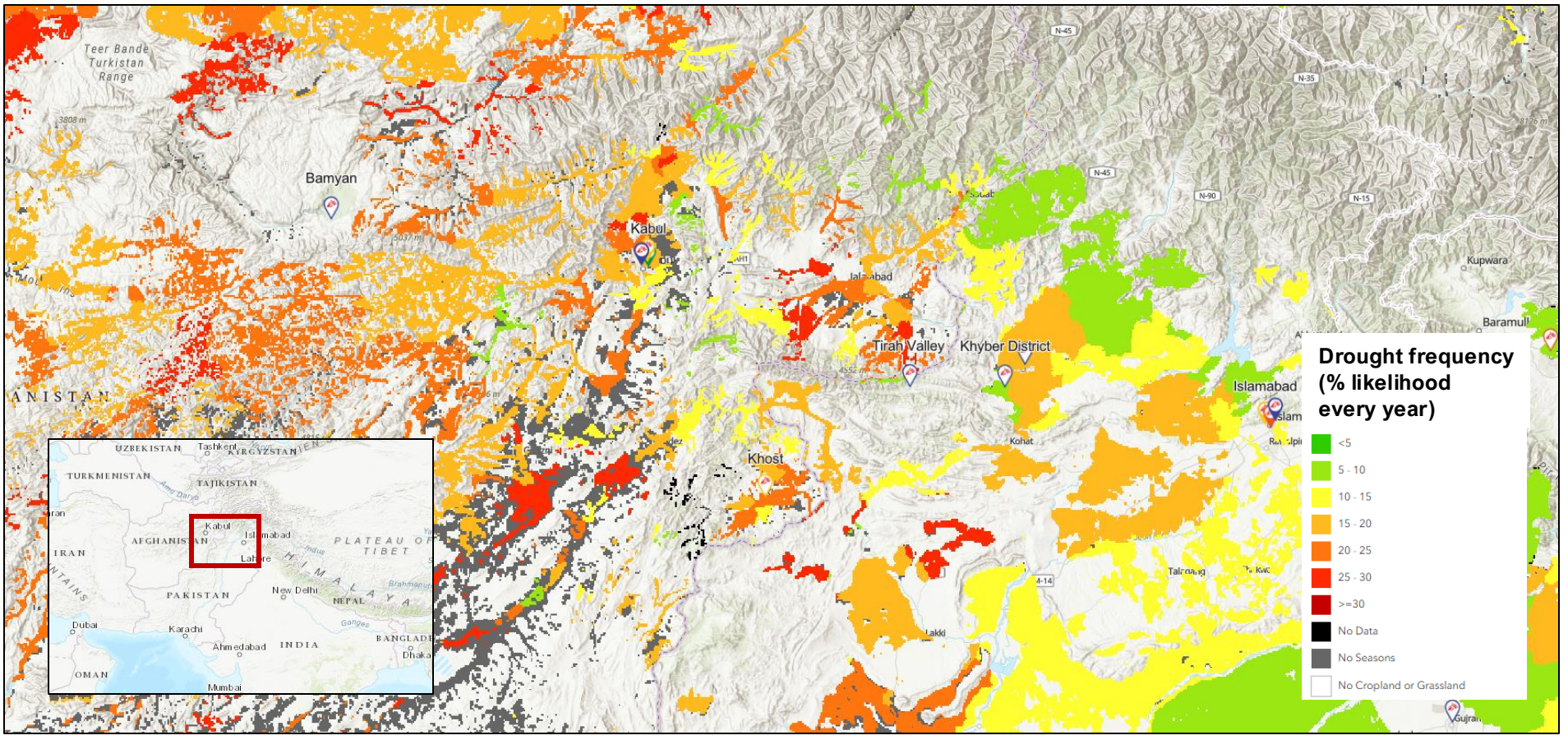
Droughts



Top 10 MSF projects exposed to droughts

	Project (s)	Country	Drought frequency
1	Somali region	Ethiopia	31,8%
2	Raqqa	Syria	30,9%
3	Helmand	Afghanistan	29,3%
4	Chaman/Quetta	Pakistan	26,7%
5	Taiz	Yemen	26,0%
6	Kandahar	Afghanistan	24,9%
7	Al Hol camp/Hassekeh	Syria	24,5%
8	East Balochistan	Pakistan	19,1%
9	Kassala	Sudan	17,8%
10	Patna	India	17,8%

	Project (s)	Country	Drought frequency
1	Mokha	Yemen	31,1%
2	Shabwa	Yemen	30,0%
3	Afar	Ethiopia	27,9%
4	Mosul	Iraq	22,7%
5	Khost	Afghanistan	19,8%
6	Karachi	Pakistan	18,3%
7	Kunduz	Afghanistan	18,2%
8	Niono	Mali	17,9%
9	Baghdad	Iraq	17,8%
10	Abiy Addi Tigray	Ethiopia	17,3%

	Project(s)	Hajja	Drought frequency
1	Baidoa	Somalia	25,7%
2	Mazar	Afghanistan	23,8%
3	Noreste	Mexico	20,9%
4	Agadez	Niger	20,0%
5	Abs/Hajja/Sanaa/Al Q.	Yemen	20,0%
6	Aleppo/Jandaris/Idal	Syria	19,5%
7	Nimert	Nigeria	18,4%
8	Douentza/Koro	Mali	17,2%
9	Région Sahel	Burkina Faso	15,5
10	Renk	South Sudan	14,8%

	Project(s)	Country	Drought frequency
1	Dagahaley/Dadaab	Kenya	33,0%
2	Arizona	USA	29,9%
3	Kerman	Iran	29,4%
4	Kilo/Al Sahul	Yemen	24,8%
5	South Tehran	Iran	23,7%
6	Mosul	Iraq	23,0%
7	Mombasa	Kenya	21,1%
8	Al-Hazm	Yemen	20,8%
9	Al Salakhanah	Yemen	19,3%
10	Kampala	Uganda	18,9%

	Project(s)	Country	Drought frequency
1	Mashhad	Iran	30,7%
2	North Darfur/Tawila	Sudan	26,5%
3	Herat	Afghanistan	25,3%
4	South emergency	Yemen	24,4%
5	Bamyan	Afghanistan	23,4%
6	Zuwarah	Lybia	20,9%
7	Tenenkou	Mali	20,4%
8	Allepo	Syria	19,7%
9	Tirah Valley	Pakistan	19,5%
10	Amran/Khamer District	Yemen	19,3%

	Project(s)	Country	Drought frequency
1	Cross River	Nigeria	12,9%
2	Réfugiés Est Tchad	Chad	12,7%
3	N'Djamena	Chad	8,9%
4	Madaoua	Niger	8,2%
5	Kano	Nigeria	8,0%
6	Guidan Roumdji	Niger	7,7%
7	Agboville/Bouake	Côte d'ivoire	5,7%
8	Budjala	RDC	5,0%
9	Ouangolodougou	Côte d'Ivoire	3,4%
10	Kinshasa	RDC	0,7%

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Water scarcity

What water scarcity is and why it matters

Water scarcity arises when water demand surpasses available resources, due to factors like overuse, climate change, climate variability or environmental degradation. **Impact:** Water scarcity can trigger displacement, heighten tensions over resources, and worsen malnutrition. It also limits access to safe drinking water, sanitation, and hygiene, escalating health risks such as dehydration, diarrheal diseases like cholera, and poor infection control in healthcare settings. **Vulnerable groups** include displaced populations, communities in arid regions, and those relying on degraded water systems.

The data used

For this hazard, we used the **Water Risk Atlas** (also know as Aqueduct) by the World Resources Institute, an online tool that maps and assesses water-related risks around the world. It provides key indicators such as baseline water stress, seasonal variability, drought and flood risk, groundwater depletion, and access to safe drinking water.

The score and what it means

For this analysis, we used five key indicators from the Water Risk Atlas: **water stress** (the ratio of total water demand to available renewable surface and groundwater), **water depletion** (the ratio of total water consumption to renewable supply), and **groundwater table decline** (the average drop in groundwater levels from 1990 to 2014). We also included indicators reflecting both **year-to-year** (inter-annual) and **seasonal** (intra-annual) **fluctuations** in water availability, as such variability can further affect access for communities vulnerable to drought. These five indicators were then weighted to produce a combined water scarcity score on a scale of 0 to 5 - which represents the highest likelihood of water scarcity.

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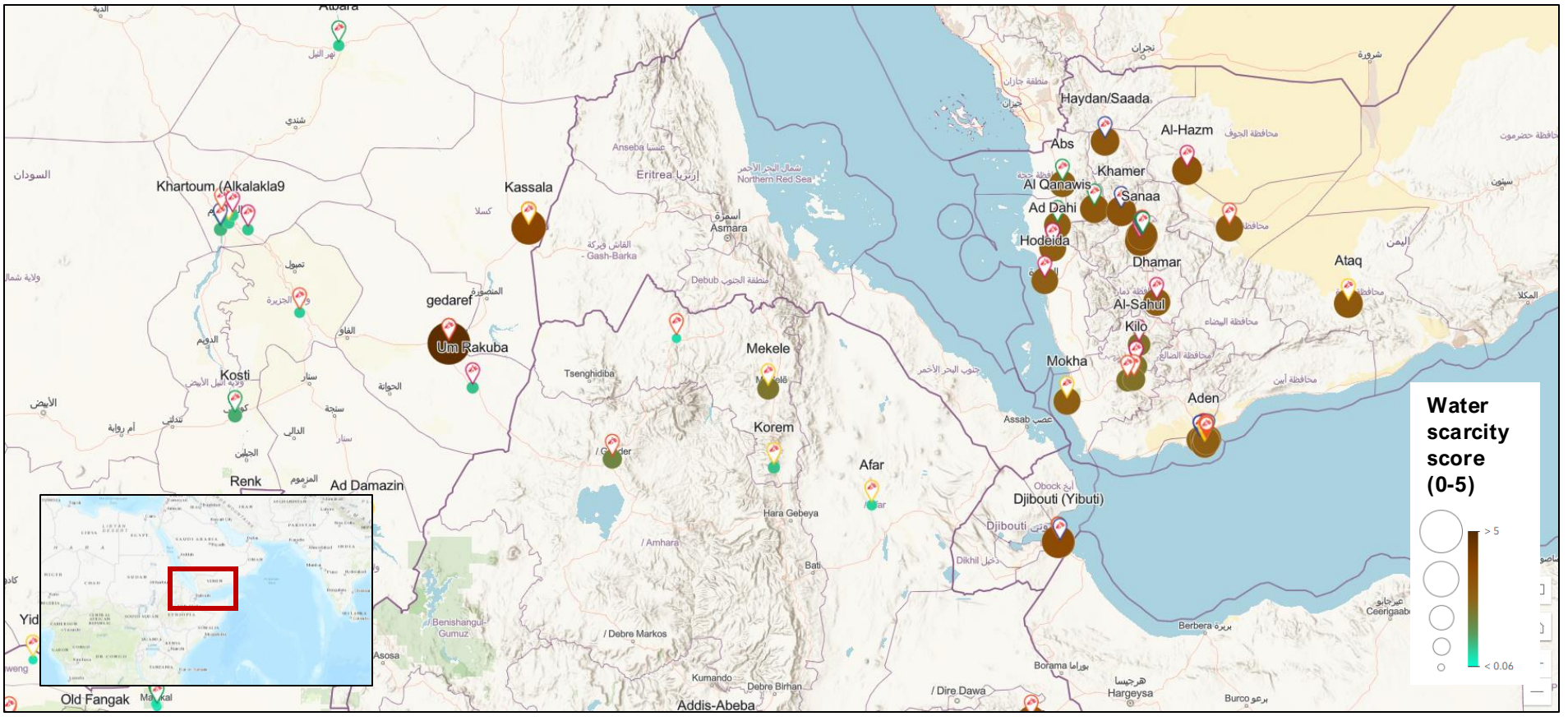
Water scarcity



Top 10 MSF projects exposed to water scarcity

	Project(s)	Country	Water scarcity score (/5)
1	Jonglei*	South Sudan	4,3
2	Al Hol/Hassekeh	Syria	4,2
3	East Balochistan	Pakistan	4,2
4	Quetta	Pakistan	4,2
5	Kandahar	Afghanistan	4,0
6	Unity*	South Sudan	3,8
7	Somali Region	Ethiopia	3,1
8	Chaman	Pakistan	3,1
9	Marib	Yemen	2,9
10	Kulob	Tajikistan	2,8

	Project(s)	Country	Water scarcity score (/5)
1	Wadi Fira	Chad	4,7
2	Karachi	Pakistan	4,5
3	Niono	Mali	4,3
4	Gwanda	Zimbabwe	4,2
5	Kajo Keji*	South Sudan	4,1
6	SA Emergencies	South Africa	4,0
7	Gaza	Palestine	3,8
8	Mornay	Sudan	3,7
9	Tripoli/Beirut	Lebanon	3,7
10	Shabwa	Yemen	3,2

	Project(s)	Country	Water scarcity score (/5)
1	Koro	Mali	5
2	Kidal	Mali	4,9
3	Agadez	Niger	4,6
4	Métché	Chad	4,5
5	Région Sahel	Burkina Faso	4,2
6	Zamfara	Nigeria	4,2
7	Ouagadougou	Burkina Faso	4,1
8	Mazar	Afghanistan	4,1
9	Rockero	Sudan	4,1
10	North Aleppo	Syria	3,8

	Project(s)	Country	Water scarcity score (/5)
1	Magaria	Niger	4,9
2	Emergency nut south	Sudan	4,7
3	Gedaref	Sudan	4,6
4	El Geneina	Sudan	4,5
5	Eastern Chad	Chad	4,5
6	Tarawa	Kiribati	4,4
7	Djibo/Kaya/Koungoussi	Burkina Faso	4,2
8	Batha	Chad	4,2
9	Torodi	Niger	3,9
10	Akkar/Beirut	Lebanon	3,7

	Project(s)	Country	Water scarcity score (/5)
1	Katsina	Nigeria	4,6
2	Adré	Chad	4,5
3	Amman	Jordan	4,1
4	Tawila	Sudan	4,1
5	Punjab	Pakistan	4,1
6	Madarounfa	Niger	4,0
7	Old Fangak	South Sudan	3,8
8	Aleppo	Syria	3,8
9	Humanitarian corridor Lybia-Italy	Tunisia	3,8
10	Atmah	Syria	3,6

	Project(s)	Country	Water scarcity score (/5)
1	Kano	Nigeria	4,7
2	Eastern Chad	Chad	4,3
3	Guidan Romdji	Niger	4,0
4	Madaoua	Niger	3,6
5	Budjala	RDC	1,1
6	N'Djamena	Chad	0,6
7	Agboville, Ouangolodougou	Côte d'Ivoire	0,4
8	Akor	Nigeria	0,3
9	Bouake	Côte d'Ivoire	0,0
10	Kinshasa	RDC	0,0

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