risk profile

Sudden-Onset Hazards and the Risk of Future Displacement in Fiji

iDMC internal displacement monitoring centre

Cyclone Evan, Fiji. Many houses were flattened when Cyclone Evan tore across Fiji causing widespread damage. Photo Rowena Harbridge/AusAID. © Benoit Matsha-Carpentier / IFRC

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Cover image: Women gather in front of a house destroyed by Cyclone Winston in a village of Ra Province, Fiji.

Summary

Disaster displacement is one of the world's biggest humanitarian and sustainable development challenges, and climate change and urbanisation are expected to aggravate the phenomenon.

IDMC has used its global internal displacement database to look at future displacement risk associated with sudden-onset hazards such as earthquakes, tsunamis, cyclonic winds and storm surges. The analysis considered a wide range of possible hazard scenarios, their likelihood and their potential to cause housing damage, which served as a proxy for displacement.

This technical paper represents initial results assessing the risk of disaster displacement in Fiji. It acknowledges that displacement associated with climate change and disasters in the country happens to communities, households and individuals and response is not state-led. It also recognises that while displacement based on Fiji's Displacement Guidelines is distinct from planned relocation and evacuation, there are clear indicators that the group of people affected by both processes intersect.

This baseline country risk profile provides initial results of hazard, risk and uncertainties for these sudden onset hazards via two metrics at the national level:

- **Probable Maximum Displacement (PMD)** is the maximum displacement expected within a given time period. It answers the question: What is the maximum expected displacement within a time range of X years? It represents the outlier event that could occur during that time frame.
- **Average Annual Displacement (AAD)** represents the annualized accumulated effect of all the catalogue events. It is a compact metric which accounts for the probable displacement of small to medium and extreme events.

Fiji's displacement risk, for example, is highest with storm surges. There is a 56 per cent probability that in the next 20 years about **35,000** people will be displaced as a result of storm surges in the archipelago.

About **5,800** people on average are likely to be displaced during any given year in the country by sudden-onset hazards, such as earthquakes, tsunamis, cyclonic winds and storm surges. This is the **Annual Average Displacement** metric.

Displacement risk is based on the well-known equation of risk, using 3 components:

1. **Hazard**: this component assesses the likelihood of different hazards, as well as their intensity
2. **Exposure**: the number of people and assets exposed to hazards
3. **Vulnerability**: assesses the likelihood of collapse and structural damage to exposed buildings. Vulnerability should not be considered from an economic and social point of view. This model uses only the physical aspect of vulnerability and how assets react to different hazard intensities that render them uninhabitable.

IDMC's Global Displacement Risk Model presents results at a national level to provide insight into future displacement situations, allowing decision-makers to make risk-informed decisions that can help prevent and reduce the risk of disaster displacement before it happens.

Disaster displacement is one of the world's biggest humanitarian and sustainable development challenges. Climate change and urbanisation are expected to compound the issue.

The inhabitants of developing island states in the Pacific are among the most vulnerable populations. At least 50,000 Pacific Islanders are at risk of being displaced each year. In these countries, where almost all major services, human settlements and tourism infrastructure are located in coastal areas, sudden-onset hazards such as cyclones, sea-level rise and coastal flooding pose severe social and economic risks.

This baseline report is a first attempt to take stock of the risk of future displacement associated with sudden-onset events. It is divided into four main parts:

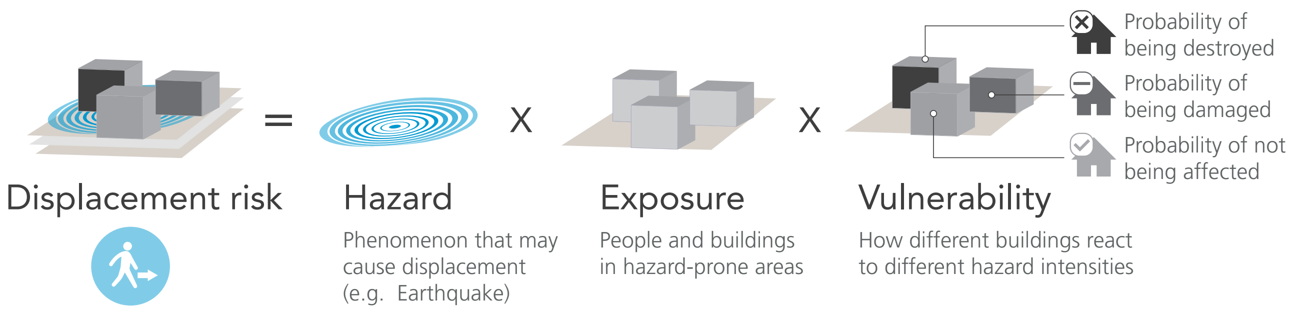
1. Background on Fiji
2. A baseline risk of displacement in the country
3. Towards risk-informed decision-making in Fiji and
4. A last section on how IDMC's Global Disaster Displacement Risk Model was constructed, as well as caveats and future improvements

What is displacement associated with disasters and the risk associated with it?

Disaster displacement refers to situations where people are forced to leave their homes or places of habitual residence as a result of a disaster or in order to avoid the impact of an immediate and foreseeable natural hazard. Such displacement results from the fact that affected persons are (i) exposed to (ii) a natural hazard in a situation where (iii) they are too vulnerable and lack the resilience to withstand the impacts of that hazard.[1]

Disaster risk refers to the potential loss of life, injury, or **destroyed** or damaged **assets** which could occur to a system, society or a community in a specific period of time, determined **probabilistically** as a function of hazard, exposure, vulnerability and capacity.[2]

Fig 1: Displacement risk: How is it calculated?



Social and demographic context

Map 1: Fiji location map

Located to the east of Australia and north of New Zealand, the archipelago has more than 320 islands and 500 islets, of which slightly more than a hundred are inhabited. With a population of 885,000 and a total land mass of 18,274 square kilometres, it is one of the larger nations in the Pacific island region.

The capital, Suva, is on the island of Viti Levu, which is home to about three-quarters of the population. The economy is large and developed as a result of a significant natural resource base, and GDP per capita is between $5,000 and $6,000. Tourism also makes up a substantial portion of the economy as does agriculture, especially sugar exports.

The climate of Fiji is generally categorized as oceanic tropical, with a dry season from May to October and a rainy season from November to April. Climate change is expected to affect the country's coastal resources through higher marine temperatures and sea level rise. The country is prone to El Niño events, and infrastructure may be affected by an increase in the frequency and intensity of cyclones and other tropical storms. During an El Niño-Southern Oscillation (ENSO) event, drier and hotter conditions can be expected from June to August. During the November to April wet season, Fiji is normally traversed by tropical cyclones.[3]

One element of the risk equation is the "exposure" of people and assets in a risk-prone area. Risk and urbanisation are linked. Locations with dense populations tend to have higher levels of risk.

The latest census from 2017 reveals that 55.9 per cent of Fiji's population reside in urban areas, an increase from 50.7 per cent in 2007. The urban population stood at 494,252, an increase of 69,406, or 16.3 per cent, from 2007. This change is attributed to an extension of town boundaries and the movement of people from rural to urban areas.[4] The Fiji Bureau of Statistics (2017) revealed that 76.6 per cent, or 678,153 out of 884,887 of Fiji's total population live on Viti Levu island. Given that most of the population is situated in coastal areas exposed to cyclones and storm surges, disasters in these places will not only have a human impact, but also an economic one. Fishery resources are critically important in the Pacific Islands region as a source of food and employment, a generator of government revenue and a foundation for economic development.[5] More than 90 per cent of the population, both rural and urban, live in coastal areas where the vast majority of services, infrastructure and agricultural production are located.

In many Small Island Developing States (SIDS), exposure to hazards is driven by the growing concentration of people and assets in low-lying coastal areas and the marginalisation of the urban poor in risk-prone areas. This also means disasters affect more urban dwellers with increasingly harmful consequences for employment, housing and critical infrastructure, such as roads, and power and water supplies.[6]

Many Pacific cities have expanded in recent years, including informal settlements on riverbanks and estuaries, and in peri-urban areas, waste disposal sites and mangrove swamps. This has increased the exposure and vulnerability of populations and assets to hazards, driving up the risk and potential impacts of displacement.[7]

Fiji experienced many disasters during the current and previous century. At least 225 people died in 1931 as a result of a hurricane and flood, the largest loss of life from a disaster in Fiji's history.[8]

Eleven tsunamis have been recorded in Fiji, of which three were generated within Fiji's waters. The most damaging one occurred in 1953, claiming five lives in Suva and Kadavu and flooding parts of Suva City. The waves reached estimated heights of about two meters in Suva and about five meters at Nakasaleka in Kadavu.[9]

Box 1: Government initiatives

Fiji has identified 800 vulnerable communities with over 40 sites identified to be relocated because of climate-related disasters.[10] Some of these communities have already been relocated, including Vunidogoloa in Vanualevu and Narikoso in Kadavu. The government launched its Planned Relocation Guideline in 2014 to respond effectively to the relocation needs of communities affected by climate change and disasters. It enacted Act 21 in 2019, establishing the Climate Relocation and Displaced Peoples Trust Fund for Communities and Infrastructure to assist communities with relocation. Fiji's guidelines on displacement were also launched that year to reduce the vulnerabilities associated with displacement and consider durable solutions to prevent and reduce displacement's drivers in affected communities. The guidelines recognise that addressing displacement is not primarily a process led by the state, while providing guidance for non-state actors to address it in various stages. Through its National Climate Change policy, its implementation of its National Development Plan (NDP), its National Disaster Risk Reduction Policy and its National Humanitarian Policy for Disaster Risk Management, Fiji aligns itself with the fundamental principle of humanity and free movement of people, both of which are non-political in nature. The guaranteed civil, political, social, economic and cultural rights enshrined in the country's constitution apply to persons who are resettled, including the rights of judicial redress.

Box 2: Local definitions

The following definitions are from the national relocation and displacement guidelines:

Relocation refers to the voluntary, planned and coordinated movement of climate-displaced persons within states to suitable locations, away from risk-prone areas, where they can enjoy the full spectrum of rights including housing, land and property rights and all other livelihood and related rights. It includes: displacement, evacuation (emergency relocation) and planned relocation.

Displacement is the movement of persons who have been forced or obliged to flee or to leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalised violence, violations of human rights or natural or human-made disasters.

Evacuation refers to the rapid physical movement of people away from the immediate threat or impact of a hazard to a safer place. The purpose is to move people as rapidly as possible to a place of safety and shelter. It is commonly characterised by a short timeframe (from hours to weeks) within which emergency procedures need to be enacted to save lives and minimize exposure to harm. Evacuations may be mandatory, advisory or spontaneous.

Planned Relocation is understood as a solution measure, involving the state, in which a community (as distinct from an individual/ household) is physically moved to another location and resettled permanently there.

Disaster displacement in Fiji: historical trends (2008-2019)

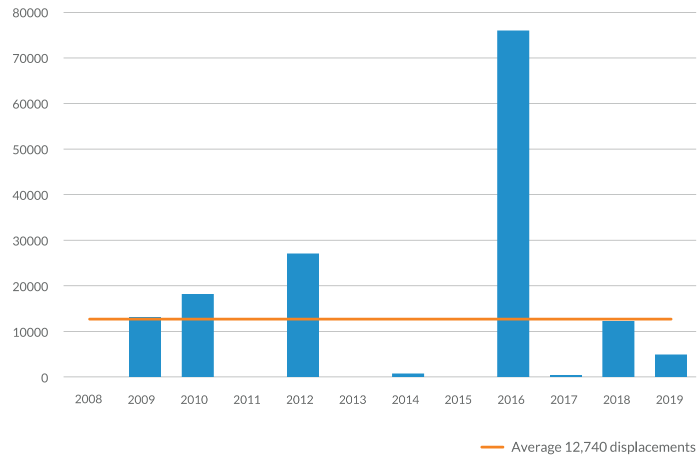
Disasters have triggered about 153,000 displacements in Fiji since IDMC began collecting data on the phenomenon in 2008. IDMC has detected 30 disaster displacement events related to weather, such as storms and floods.

The data on new displacements presented in table 1 corresponds to the estimated number of internal displacement movements that have taken place as the result of an event. Summed up by years or decades, the numbers could include individuals who have been displaced more than once. In this sense, the number of new displacements is not equal to the number of people displaced during a year.

A large number of displacements in Fiji have been triggered by weather-related events. Storms, especially cyclones, are the main triggers of displacement. Tropical Cyclone Winston, the most powerful cyclone to strike Fiji in recent times, led to widespread destruction after striking on 20 and 21 February 2016. It generated 40 per cent of the displacement recorded during the decade in Fiji and was the strongest recorded cyclone in the southern hemisphere with estimated wind speeds of up to 295km/h. Forty-four people were killed, and 350,000 people were affected. Thirty-two thousand houses were destroyed or damaged.[11]

Tropical depressions have generated widespread flooding. Torrential rains in 2012 caused by multiple tropical depressions resulted in severe damage to schools, homes, businesses, agriculture and infrastructure, especially in the Western Division. Flash floods, also common, pose a serious threat. Floods and landslides in recent years have claimed lives, damaged property and infrastructure, affected businesses and livelihoods, and erased decades of development. Parts of the Nadi area were under water in February 2017 as continuous, heavy rains triggered flash floods.[12]

Fig 2: New disaster displacements in Fiji [2008-2019]



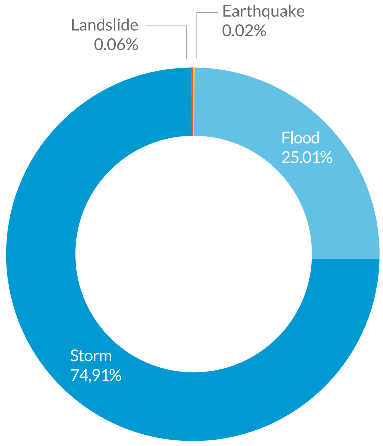


Table 1: Historical displacement events in Fiji 2008-2019

Year	Event Name	Hazard Type	New Displacements
2009		Flood	9,400
2009	Cyclone Mick	Storm	3,845
2010	Cyclone 'Tomas'	Storm	18,000
2012		Flood	3,646
2012		Flood	15,000
2012		Storm	8,416
2014	Tropical depression	Storm	800
2016	Tropical Cyclone Zena	Storm	12,000
2016	Tropical Depression - FIJI	Storm	2,072
2016	Tropical cyclone Winston	Storm	62,000
2017	Fiji: Magnitude-6.9 earthquake - Fiji - 04/01/2017	Earthquake	30
2017	Fiji: Tropical Cyclone Ella - Country wide - 09/05/2017	Storm	155
2017	Fiji: Viti Levu Flood - 08/02/2017	Flood	189
2018	Tropical Cyclone Keni - 09/04/2018	Flood	10,000
2018	Tropical Cyclone Josie - 31/03/2018	Storm	2,313
2019	Cyclone Pola - 23/02/2019	Storm	15
2019	Tropical Cyclone Mona - 02/01/2019	Storm	2,327
2019	Landslide - Navosa - February 2019	Landslide	80
2019	Tropical Cyclone Sarai - 12/12/2019	Storm	2,490
2019	Flooding - Central Division - 22/04/2019	Storm	57
2019	Storm - Viti Levu (Veriaisi) - 07/10/2019	Storm	20
2019	Landslide - Cakaudrove (Northern Division) - 24/04/2019	Landslide	10

The village of Nukubalavu on Fiji's Vanua Levu island was badly damaged during Cyclone Winston in February 2016. © Corinne Ambler/IFRC, Fiji, April 2016.

Box 3: The rural impact of Tropical Cyclone Winston

Tropical Cyclone Winston struck Fiji as a category five system on 20 February 2016, with sustained winds of 230 kph and gusts of up to 325 kph. At the time, an estimated 40 per cent of the population lived within 50km of the cyclone's centre, the range defined by Fiji's meteorological service for experiencing "very destructive hurricane force winds". On 4 March, the National Emergency Operations Centre reported that 29,237 people were temporary sheltered in 722 evacuation centres. Many other people stayed with relatives or friends.[13]

The cyclone harmed the national economy and caused an immediate and prolonged decline in the quality of life and wellbeing of affected households and communities. It affected the livelihoods of people working in different industries, including 57 per cent of those employed in the agricultural sector, 17 per cent of those in commerce, 10 per cent in manufacturing, and 8 per cent each in tourism and transportation.[14]

Rural areas and remote islands suffered greatly in the aftermath. On the volcanic island of Koro, the village of Kade was levelled and nearly all structures destroyed. North-east of Koro, on the larger island of Taveuni, 722 homes were destroyed and another 837 damaged. Half of the population were rendered homeless.[15]

While cyclonic winds can be devastating, the secondary impacts of heavy rainfall, such as landslides, can also harm lives, especially in communities continuously affected by storms. Achieving durable solutions under these conditions is challenging. In the case of Tukuraki, a small village on the northern side of Fiji's main island, Viti Levu, displacement associated with storms and landslides occurred continuously during more than five years. The village was almost wiped off the map by a deadly landslide in January 2012, and the community, fearing additional landslides, was forced to relocate to temporary homes. The community was hit by Cyclone Evan only ten months later and then forced to flee to nearby caves as a result of Tropical Cyclone Winston in February 2016, its third major disaster in four years. After some people had spent more than five years in temporary housing, the community of Tukuraki moved into a newly built, disaster-resilient village in Ba.[16]

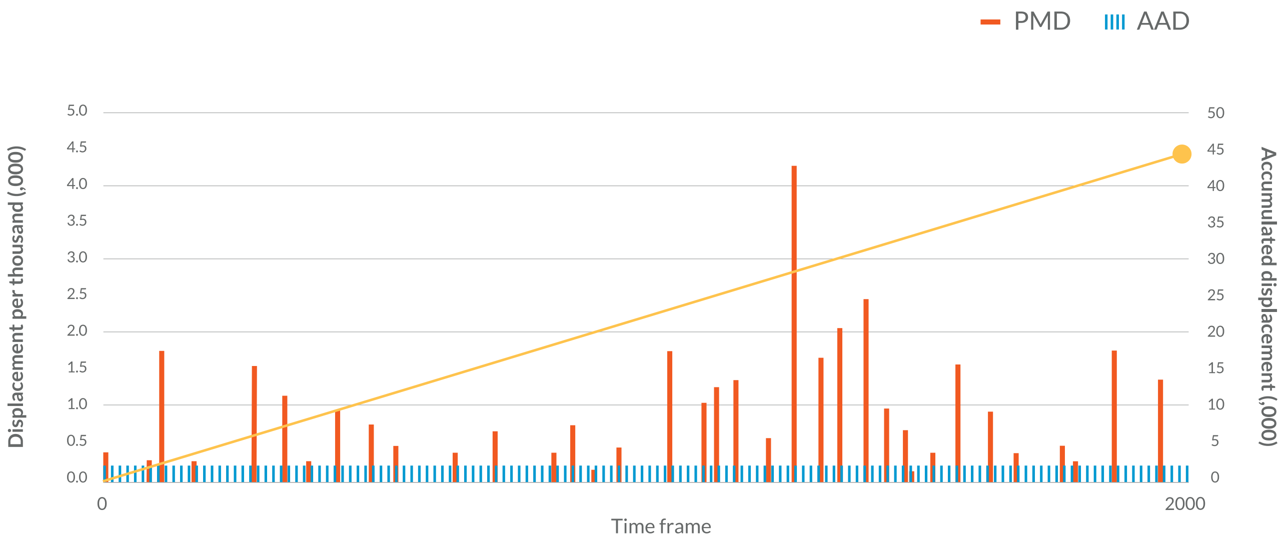
Disaster displacement risk in Fiji

The baseline based on our global model presents results at a national level and aims to provide insight into future displacement situations. This analysis of future displacement risk associated with sudden- onset hazards, including earthquakes, tsunamis, cyclonic winds and storm surges, considers a large number of possible hazard scenarios, their likelihood, and the potential damages to housing, which is used as a proxy for displacement.

Displacement risk: two key metrics and how to read them

Our "multi-hazard" Global Disaster Displacement Risk Model provides two metrics at the national level: the Average Annual Displacement (AAD) by hazard and the Probable Maximum Displacement (PMD) by hazard. These metrics are based on a displacement risk model developed at the global level, so the granularity of the data is low and estimates should be considered

Fig 3: How we calculate Probable Maximum Displacement (PMD) and Average Annual Displacement (AAD) by hazard



Source: UNDRR, 2015

Box 4: Risk return period, the concept

The concept of return period is often misunderstood. If a "displacement" has a 500-year return period, this does not mean that the "displacement" will occur only every 500 years, nor does it mean that if the "displacement" occurred today, it would not recur for another 500 years. Rather, it means that the loss happens once every 500 years on average. For example, if there are four extreme events in the space of a century followed by 19 centuries without such extreme events, the return period would still be 500 years.[17] A longer return period (for example, 100 vs. 20 years) suggests a lower probability that an extreme hazard will occur in any single year.

The most common misconception is that a 100-year flood will only occur once per century. That is not true. There is a small probability that such an intense event could happen every year. If a 100-year flood happened last year, it can happen again before the next century, or even this year. It is also possible for such an event to not occur within a 100-year period.

Houston, Texas in the US, for example, has experienced 500-year floods three years in a row, including one caused by Hurricane Harvey. This has prompted a revision of the city's zoning regulations to account for changes in the flood drainage basins around it.

We expect to see many similar revisions as climate change alters the frequency and intensity of extreme events, and the rapid sprawl of cities shrinks the natural areas available to absorb floodwater.[18]

as conservative. The model considers the likelihood of different hazards, as well as their intensity, to estimate the number of people that could be forced to flee from their habitual place of residence as a result of severe damage or destruction that could render housing uninhabitable. Many factors could also influence the severity and duration of displacement: insurance penetration and coverage, coping capacity, recovery and humanitarian response.

Probable Maximum Displacement (PMD) by hazard

Probable Maximum Displacement (PMD) is the maximum displacement expected within a given time period. It answers the question: What is the maximum expected displacement within a range of X years? It represents the outlier event that could occur during a specific time frame. The PMD can be used, for example, to determine the assets or the size of shelters that should be made available by governments to cope with the magnitude of potential displacement.

"**A hundred** years does not mean it will occur every **100** years." (see Table 2). The **Probable Maximum Displacement (PMD)** for different return periods can therefore be expressed as the probability of a given displacement amount being exceeded over different periods of time.

Even in the case of a thousand-year return period, there is still a five per cent probability of a PMD being exceeded over a 50-year time frame. This metric is relevant, for example, to the planners and designers of infrastructure projects as investments may be made for an expected lifespan of 50 years.

Average Annual Displacement (AAD) per hazard and multi-hazards

AAD is the "magnitude" of future displacement by hazard types that a country can experience. It is not the number of displacements that the country will struggle with each year. Rather, these numbers represent the number of people expected to be displaced per year considering all the events that could occur over a long timeframe in the area being assessed. The AAD is a compact metric with a low sensitivity to uncertainty.

Results - Displacement risk by hazard

As described above, **AAD** represents the annualized accumulated effect of all the catalogue events. It is a compact metric which accounts for the probable displacement of small to medium and extreme events.

The multi-hazard AAD was obtained by aggregating the AAD of each individual hazard. It should be noted that this multi-hazard metric encompasses the probability that one single house could be potentially destroyed by cyclonic winds and storm surge, and could be double "counted" when we sum it to "multi-hazards". The probability that it occurs (double severe damages) is not nil.

Total: 5,766

EARTHQUAKE
75

STORM SURGE
3,614

TSUNAMI
1

CYCLONIC WIND
2,076

Table 2: Concept of probabilities for different return periods

Return period (years)	Probability of displacement exceedance per year	Probability of displacement exceedance in 20-year timeframe	Probability of displacement exceedance in 50-year timeframe
25	4.0%	56%	87%
50	2.0%	33%	64%
100	1.0%	18%	39%
250	0.4%	8%	18%
500	0.2%	4%	10%
1,000	0.1%	2%	5%

Table 3: Displacement risk by hazard in Fiji

		Return Period in years						
Hazard	ADD	PMD 10	25	50	100	250	500	1,000
Storm Surge	3,614	8,600	35,000	50,000		79,000		103,000
Cyclonic Wind	2,076	175	19,500	35,000	55,000	65,000		100,000
Earthquake	75	4	75	300	1,100	4,000	8,200	15,000
Tsunami	1						5	80

Our Global Disaster Displacement Risk Model highlights that around 5,800 people could be displaced in Fiji in any given year of the future. This is the Average Annual Displacement (AAD) - (see Table 3).

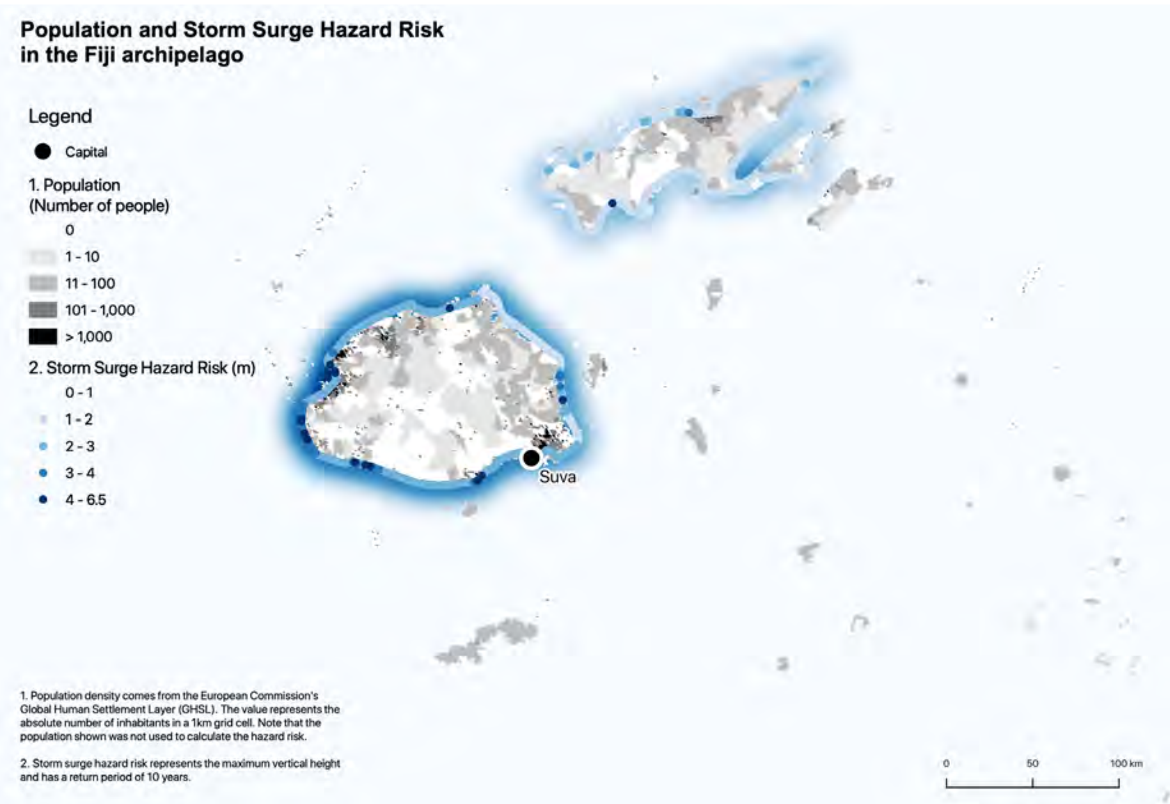
While the AAD metric is useful for providing a sense of the scale of the annual risk of displacement, it tends to hide potential outliers. High intensity but low frequency events could take place in extremely long spans of time, leading to mass displacement. A category 5 cyclone or a 6.5-magnitude earthquake, for instance, could strike Fiji unexpectedly and cause significant displacement. While such extreme events may not have occurred since record keeping began, they can still take place, and it is important that the country be prepared for them. Cyclones Winston and Pam are examples of disaster at an unprecedented level.

The model for Fiji considers the likelihood of different hazards, as well as their maximum intensity at different return periods (see table 3 – in red. The estimate of risk displacement is explained in each hazard section, above). This national level resolution is based on the observations and data at the global level. It provides multi-hazard risk metrics and enables comparisons of risk levels between countries and regions across hazards types. At this scale, the estimates should therefore be considered conservative.

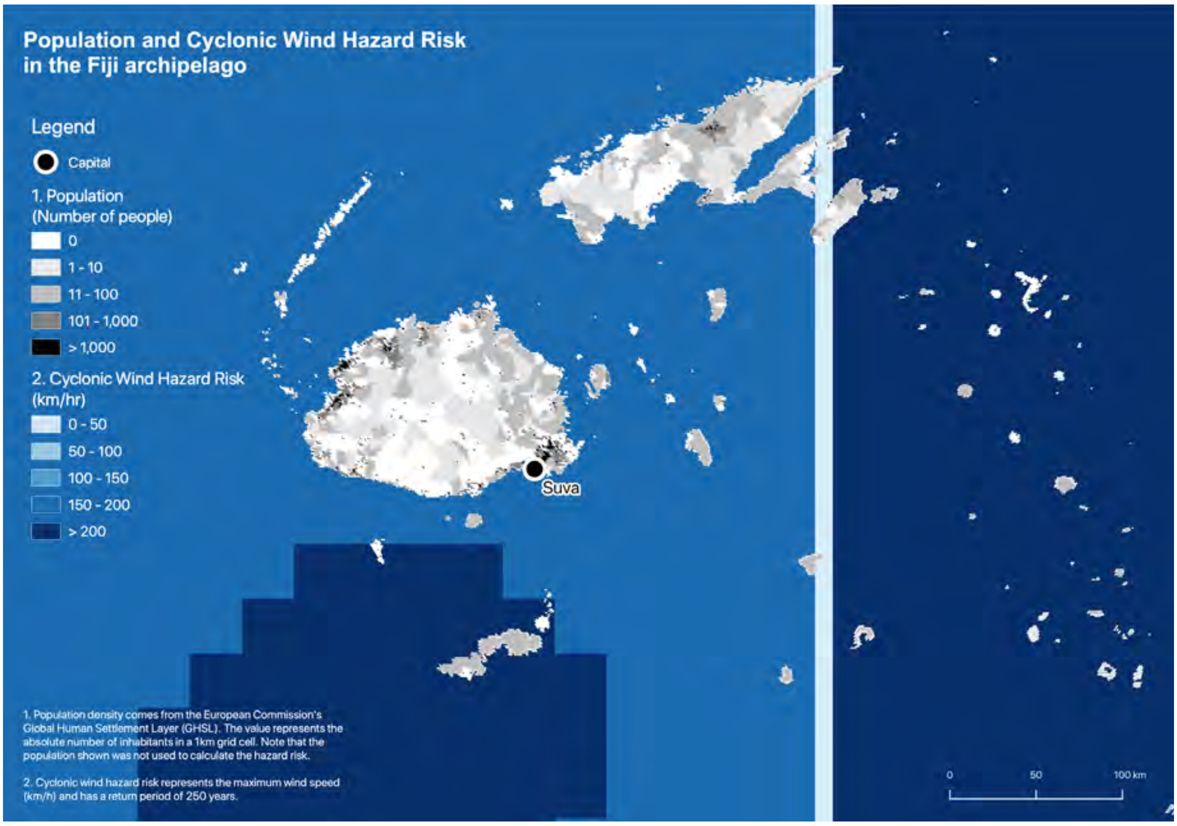
Risk of displacement as a result of storm surges

Fiji's displacement risk is highest with storm surges. On average 3,614 people are expected to be displaced per year considering all the events that could occur over the return period.

Map 2: Storm surge risk map



Map 3: Cyclonic wind risk map



Regarding the maximum probable displacement, there is a 56 per cent probability that in the next 20 years about 35,000 people will be displaced because of storm surges in the archipelago. As a cyclone moves across the Pacific ocean, its winds push the water into a wall as the storm moves onshore. The impacts will depend on the coast's topography and the tides. The risk of displacement enters uncharted territory even with king tides, which occur when extreme weather events coincide with uncommonly high tides caused by the alignment of solar and lunar gravitational pulls.[19]

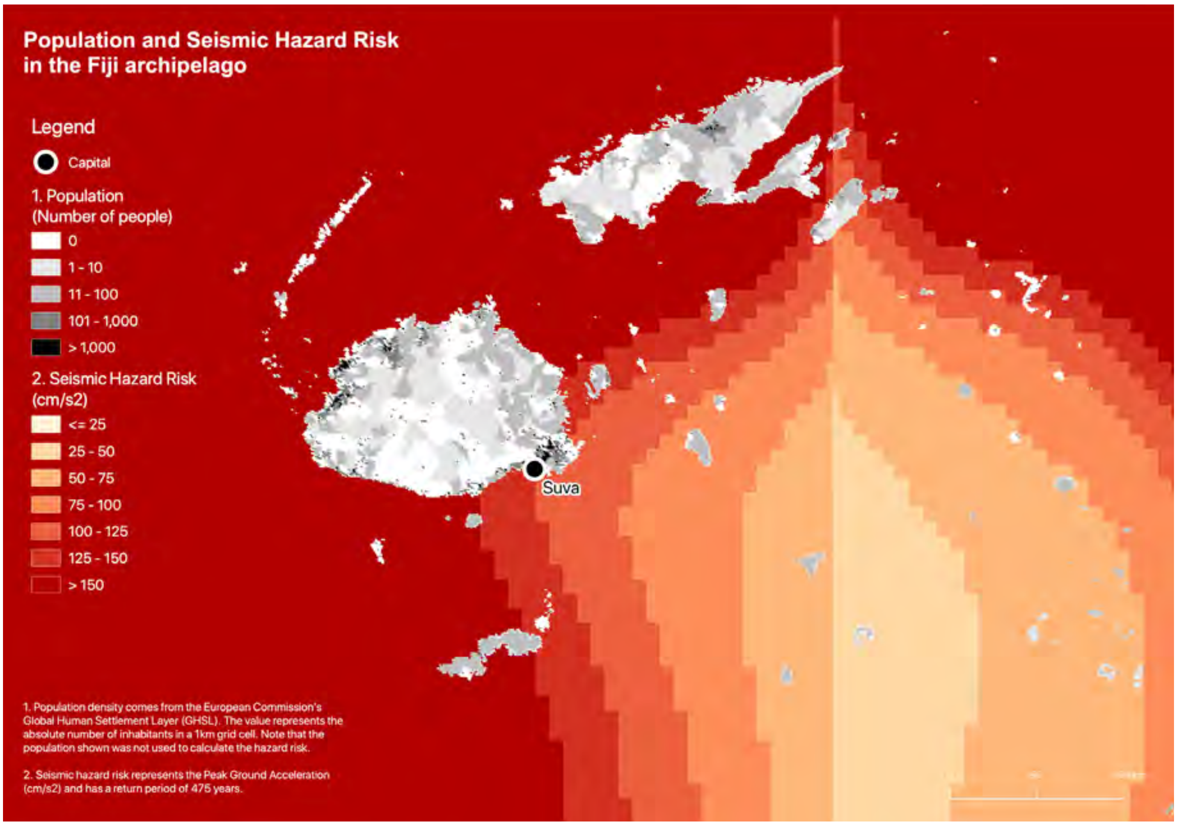
Storm surge risk in Fiji is high around the main island of Viti Levu. That is especially true on the west coast around Nadi Bay where there is a 33 per cent probability that in the next 20 years the area may experience storm surges of between three and four meters.

Risk of displacement as a result of cyclonic winds

Cyclonic winds risk in Fiji is very high. The country is located to the south of the equator in an area called the South Pacific Convergence Zone. This is known for the frequent occurrence of tropical cyclones.

Cyclones are like giant engines that use warm and moist air as fuel. That is why they form only over warm ocean waters near the equator. In the South Pacific Convergence Zone, they remain strong for a longer time because they do not face large land masses that would isolate them from the moisture and heat of tropical ocean water and slow them down with greater friction than exists on the sea surface.[20]

Map 4: Seismic hazard risk map



On average 2,076 people are expected to be displaced per year considering all the events that could occur over the return period. Surrounded by ocean, the archipelago of Fiji, especially Kadavu and Taveuni and the sparse islands situated in the east, could experience wind speeds greater than 230km/h. Regarding the probable maximum displacement, there is an 18 per cent probability that in the next 50 years about **65,000** people will become displaced by cyclonic winds.

Risk of displacement as a result of earthquakes

Earthquake risk in Fiji is high around the main islands, including Viti Levu, which could also experience intense tremors in coming years. Viti Levu is located in a seismically active area within the Fiji Platform - a remnant island arc that lies in a diffuse plate boundary zone between the Pacific and Australian tectonic plates in the south-western Pacific.[21] The Fiji-Tonga region accounts for about 70 per cent of the world's earthquakes with depths greater than 400 kilometres.[22]

On average 75 people are expected to be displaced per year given all the events that could occur over the return period. When it comes to the probable maximum displacement, there is a 39 per cent probability that in the next 50 years about 1,100 people will be displaced by an earthquake in the archipelago.

The map below highlights earthquake intensity zones and indicates where there is a 10 per cent probability that degrees of intensity will be exceeded in 50 years.

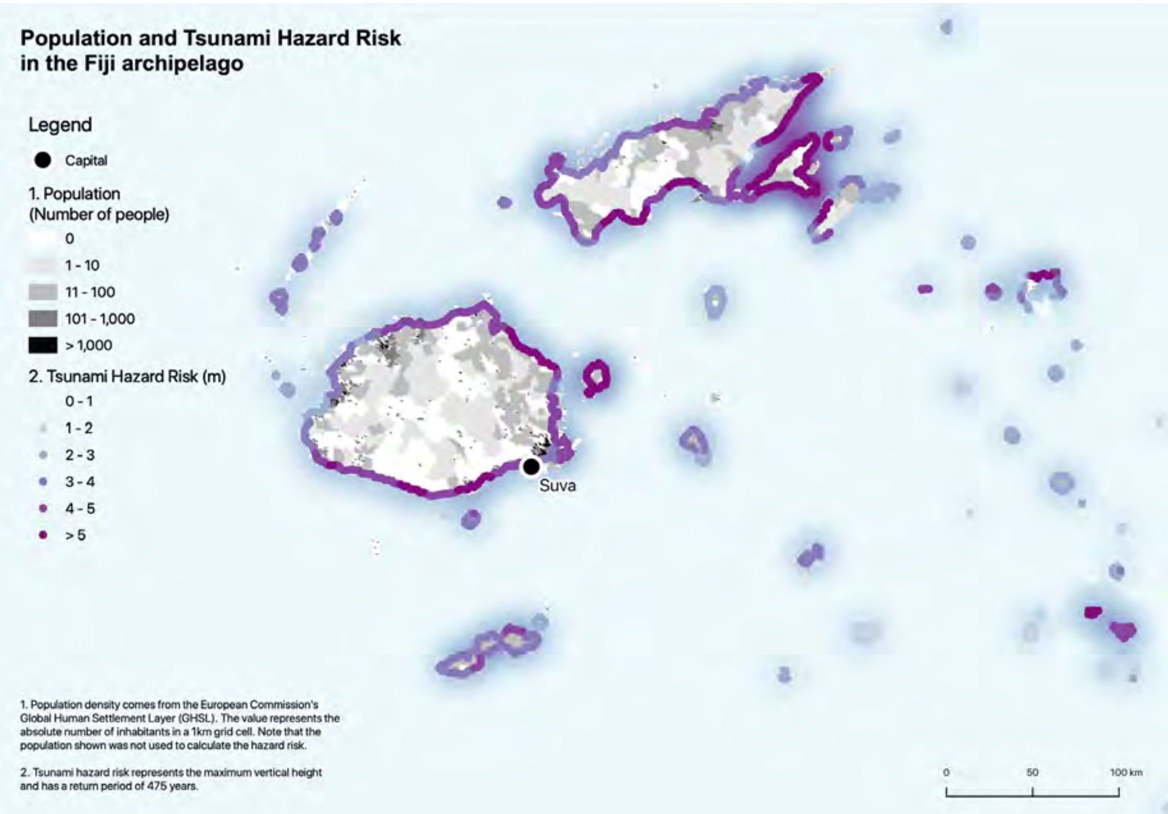
Risk of displacement as a result of tsunamis

The archipelago of Fiji is particularly vulnerable to tsunamis. During a tsunami, waves push a large amount of water above sea level onto the shore. This is known as the run-up, the maximum vertical height above sea level reached by a tsunami onshore. In Fiji this is estimated to be around five to eight meters for most of the coastal areas at risk. The highest estimated risk is on the north-eastern part of Vanua Levu where waves could rise to more than 10 meters. While the archipelago of Fiji is "protected" by coral reefs that can dissipate wave energy, the islands can suffer considerable damage from smaller waves, and the effect can be greatl enhanced by high or king tides.

On average, one person is expected to be become displaced per year considering all the events that could occur over the return period. When it comes to the probable maximum displacement, there is a five per cent probability that in the next 50 years, about **80** people will become displaced by a tsunami in the archipelago.

The most damaging tsunami in Fiji was in 1953. It claimed five lives in Suva and Kadavu and flooded parts of Suva City. The height of the waves in Suva was estimated to be about two meters and about five meters at Nakasaleka in Kadavu.[23]

Map 5: Tsunami risk map



Towards risk-informed decision-making in Fiji

Disasters have triggered about 290 million displacements around the world since IDMC began collecting data on the phenomenon in 2008. This is more than three times the number of people displaced because of conflict and violence. Given the scale of the threat, the need to address the risk of displacement associated with disasters has been explicitly recognised in global policy agendas on disaster risk reduction and climate change.

Global agreements on disaster risk reduction, such as the Hyogo Framework for Action 2005–2015 and the Sendai Framework for Disaster Risk Reduction 2015–2030, have promoted and significantly increased efforts to reduce disaster risk in general. The Sendai framework recognises the importance of addressing displacement risk in particular.[24]

Disaster displacement is likely to grow in the future. Weather-related hazards account for more than 87 per cent of all disaster displacement. Climate change and the increasing concentration of populations in areas exposed to storms and floods mean that ever more people are at risk of being displaced.

People displaced by disasters face similar challenges to those who flee conflict and violence. Many of them lose their homes, assets and income. They face insecurity, reduced access to services such as water, food, healthcare and education, and disrupted social networks.

Box 5: Risk definition

/rɪsk/

The **potential** loss of life, injury, or **destroyed** or damaged assets which could occur to a system, society or a community in a specific period of time, determined **probabilistically** as a function of hazard, exposure, vulnerability and capacity. *(UNDRR – 2017)*. Risk is the possibility of something bad happening.

Floods are very frequent in Waelea settlement, Suva, but the biggest issue is the lack of sanitation. All the houses have toilets which flow directly on the ground carried by a constant stream of dirty water. © Benoit Matsha-Carpentier/IFRC, Fiji, May 2013.

The Fiji Red Cross works with Wailotua village to help them prepare for the cyclone season, by ensuring they understand weather warnings, have an emergency plan and kit and know where a safe place to evacuate is. © Hanna Butler/IFRC, Fiji, 2018.

Akuila Yaran, 63, has been living in Waelea settlement for more than 20 years. He is the community leader. © Benoit Matsha-Carpentier/IFRC, Fiji, May 2013.

IDMC is the leading source of information on internal displacement around the globe. It has monitored displacement associated with disasters since 2008 and has compiled the information in its global database. Our data shows that internal displacement is on the rise globally. While this will require significant humanitarian and development measures, resources are becoming increasingly stretched to service a growing number of priorities. This calls for a new and more comprehensive approach to addressing the phenomenon.

Why do we need to understand risks?

Monitoring disaster displacement typically includes accounting for the number of people displaced of the homes that have been destroyed after a disaster occurs. This information provides a baseline for decision-making processes to support emergency response and disaster management. This retrospective analysis, however, is only one element of planning and informed decision-making, especially when it comes to mitigation and prevention. It should also be complemented with probabilistic analyses and metrics, such as assessments of the likelihood of certain displacement events taking place within a specific timeframe.

The risk of future displacement is determined by how policies and processes influence peoples' exposure and vulnerability to hazards. Policies to address the challenge have been developed at both national and global levels and are vital to reducing the risks and impacts of displacement.

The UN Office for Disaster Risk Reduction (UNDRR) emphasises that most disasters that could happen have not happened yet. Many governments and operational stakeholders recognise the need to understand future displacement risk. Demand for models and tools to estimate the potential scale and severity of future displacement is growing, but their development and improvement take time.

Estimating displacement risk using probabilistic approaches requires highly localised and detailed information. Many governments, however, lack the data needed to validate risk models and conduct complete quantitative assessments. More capacity building is needed before they will be able to adapt models to their own needs and apply the results to policy development and investment planning. Investments should be made in understanding disaster risk in all its dimensions: the exposure and vulnerability of people and assets, hazard characteristics, response capacity and environmental factors. Such understanding would also support the development and implementation of preparedness measures and effective responses that build back better.

These initial results of displacement risk using our probabilistic model can be used as baselines and will prove useful for policymakers working to implement the Sendai Framework for Action, the Paris Agreement of the UN Framework Convention on Climate Change (UNFCCC), the Warsaw International Mechanism and the Agenda for Humanity.

"Catastrophic earthquakes or tsunamis may only happen every 500 or 1,000 years in any given place. As such, even though records may go back centuries, most of the extreme events that could potentially occur have not happened yet. And, although data on disaster loss provides a guide to the past, it is insufficient to predict and estimate damages that may occur at present and in the future." UNDRR - Global Assessment Report – 2013

Methodological considerations and caveats

IDMC's Global Disaster Displacement Risk Model

IDMC released a unique probabilistic modelling exercise for internal displacement in 2017 called the Global Disaster Displacement Risk Model. It presents information on how to address internal displacement by assessing the likelihood of such population movements in the future. The results from the model can be used to inform national and sub-national disaster risk reduction (DRR) policies and investments and identify areas where large numbers of people face the risk of homelessness associated with disasters. Estimates of displacement risk also can shed light on the capacities required for evacuation centres and the amount of investment needed to support displaced people. The model provides a benchmark for measuring progress toward DRR and climate change policy objectives, such as reducing displacement risk and its drivers. It can be adapted to support operations in real time by indicating the number and location of damaged and destroyed homes caused by observed and forecasted hazards. This can lead to more timely and targeted responses and ultimately save lives.

Why use the disaster displacement risk model?

1. To prepare for and respond to disaster-related displacement
2. To prevent future displacement and reduce its impacts on people and communities
3. To achieve durable peace and security and strengthen global governance

Our global model, presenting results at a national level, aims to provide insight into future displacement situations. It allows decision-makers to take risk-informed decisions that can help prevent and reduce the risk of displacement before it happens. The model calculates how many people will be displaced on average every year by sudden-onset hazards, (earthquakes, tsunamis, floods, cyclonic winds and storm surges). Results are based on the likelihood of **housing destruction** and show that, globally, **14 million** people on average could be displaced in any given year. The model also calculates the probable maximum displacement (PMD) that could be expected within a given return period. (See section **Two key metrics and how to read them**).

The model excludes those displacements associated with pre-emptive evacuations. As a result, the estimation of risk is inherently conservative. In countries with strong disaster preparedness capacity where pre-emptive evacuations occur, such as Bangladesh, China, Cuba, Japan and Viet Nam, IDMC's model underestimates the number of reported displacements. In countries with weaker capacities for early warning and pre-emptive evacuations, and for hazards such as earthquakes for which there are limited early warning systems, historical data and the model's risk estimation are a closer fit.

A local man stands in his home located near a river in Votua Village, Ba town, Fiji. His home is frequently flooded as the level of the river has been increasing every year due to erosion of the surrounding mountains. © Benoit Matsha-Carpentier / IFRC

Neighbours help rebuild each others' houses after Tropical Cyclone Winston hit Nukubalavu village in Savusavu District, Fiji, in March 2016. The Category 5 Cyclone was the biggest to ever hit Fiji and killed 44 people. © Holly Griffin/IFRC

What about the risk of displacement as a result of slow-onset hazards?

The results of IDMC's model cover only displacement risk associated with sudden-onset hazards. It is also possible to model displacement risk for drought, desertification, sea-level rise, coastal erosion, changes in sea surface temperature, alterations in oceanic oxygen and other slow-onset hazards. IDMC has, for example, modelled drought-displacement risk in the Horn of Africa. Such complex models need to take into consideration many human factors. For that reason, they are time-consuming and require historical data on various indicators to validate and generate confidence in the results. IDMC does not yet have such a model for countries in the Pacific, but we would be willing to develop one if there is interest and the resources available to do so.

Caveats and future improvements

This baseline country risk profile for Fiji provides a view of risks and uncertainties for sudden-onset hazards (earthquakes, tsunamis, cyclonic winds and storm surges). The risk assessment considers a large number of possible scenarios, their likelihood, and associated damages to housing.

The risk model is informed by and relates to medium-to-large-scale events, but small and recurrent events still require the daily monitoring of empirical information to understand the full spectrum of displacement.

The results are indicative of the potential impact of the event in a probabilistic manner. There are, however, underlying limitations and simplifications. For that reason, the results for individual probable events, or the calculated impacts on particular assets, are unlikely to be precise.

While the metrics of displacement risk were developed at the global level with low granularity, they are a baseline and a guide. They can support further analysis in preparing for and responding to disaster-related displacement. The resolution of this global model analysed more the 4.5 million cells containing proxies regarding assets and population at five km by five km, with a higher resolution of one km by one km along the coastline. Millions of hazard scenarios also have been compiled. The resolution used in 2017 did not allow us to run a proper risk assessment for riverine floods on small islands states.

The global risk model excludes displacements associated with pre-emptive evacuations. This information must be collected in the aftermath of disasters. Where no specific indicators exist to monitor disaster displacement, states could report on other indicators established by the Sendai framework and the Sustainable Development Goals (SDGs) without duplication of effort. Target B of the Sendai framework, for example, includes the "number of directly affected people attributed to disasters". It is linked to SDG targets 1.5, 11.5 and 13.1, which refer to monitoring and reporting on the "number of people whose destroyed dwellings

Fig 4: Displacement risk: How is it calculated?

were attributed to disasters". Sendai's target G and particularly G-6 could be also monitored using data on pre-emptive evacuations.

The model can be used to inform national and local disaster risk reduction policies and investments, and to identify areas where large numbers of people are at risk of losing their home. Its resolution, however, does not allow for its use in decisions on land use and urban planning.

IDMC is working closely with the Swiss Federal Institute of Technology in Zurich (ETHZ) and Oxford University to improve the model's ability to predict displacement risk for rapid-onset hazards, including floods on small island states. Increasing the resolution of the exposure layer from five square kilometres to one allows for a more granular assessment of the people and assets exposed. This, coupled with a rerun of hazard scenarios using the latest technologies, has produced a more accurate estimate that suggests the number of people at risk of displacement from all hazards is significantly higher than previously thought. Better resolution also allowed the disaggregation of displacement risk figures by urban and rural locations.

A school which was badly damaged during Cyclone Winston is rebuilt by humanitarian aid workers and the local community in Ra Province, Nalawa, Fiji. © IFRC, January 2017

Endnotes

1 Platform on Disaster Displacement, Key Definitions, 2017

2 UNDRR, Disaster Risk, 2 February 2017

3 UNDP, Fiji, 2020

4 Government of Fiji, Fiji Bureau of Statistics Releases 2017 Census Results, 10 January 2018

5 FAO, Marine fishery resources of the Pacific Islands, 2010

6 UNDRR, Poorly planned urban development, accessed on the 30 November 2020

7 Asian Development Bank, The Emergence of Pacific Urban Villages, Urbanization Trends in the Pacific Islands, 2016

8 Stephen W. Yeo, Russell J. Blong, Fiji's worst natural disaster: the 1931 hurricane and flood, 09 June 2010

9 Government of Fiji, Tsunami, accessed on the 30 November 2020

10 GIZ, Overview of Fiji's Response to International Frameworks on Human Mobility in the Context of Climate Change, 9 April 2020

11 Fiji Red Cross Society, Fiji Cyclone Winston: One Year On, 2017

12 WMO, Fiji to Implement Flash Flood Guidance System, 28 November 2018

13 Government of Fiji, National Emergency Operation Center, Tropical Cyclone Winston, Situation Report 51, 4 March 2016

14 Government of Fiji, Tropical Cyclone Winston, Post-Disaster Needs Assessment, May 2016

15 Government of Fiji, National Emergency Operation Center, Tropical Cyclone Winston, Situation Report 53, 4 March 2016

16 European Union, European Union - ACP Group of States assist in Tukuraki Village relocation in Fiji, 27 October 2017

17 UNDRR, Global Assessment Report – Risk Atlas, 2017

18 GFDRR, Understanding Risk, 100 Year Flood, accessed on the 30 November 2020

19 IDMC, Silent Disasters: Preparing For The King Tide, Expert Opinion, March 2020

20 Smithsonian, Hurricanes, Typhoons, And Cyclones, accessed on the 30 November 2020

21 Tariq Iqbal Hamid Rahiman, Neotectonics, Seismic and Tsunami Hazards, Viti Levu, Fiji, 2006

22 Joeli Varo, Tingneyuc Sekac, Sujoy Kumar Jana, Earthquake Hazard Micro Zonation in Fiji Islands: A Research of VitiLevu Island, September 2019

23 Government of Fiji, Tsunami, accessed on the 30 November 2020

24 UNDRR, Sendai Framework for Disaster Risk Reduction 2015-2030, 2015

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International Organization for Migration (IOM)
The UN Migration Agency

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FOLLOW-UP TO THE NANSEN INITIATIVE

Every day, people flee conflict and disasters and become displaced inside their own countries. IDMC provides data and analysis and supports partners to identify and implement solutions to internal displacement.

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