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Intergovernmental Oceanographic Commission

Executive Summary

Capacity Assessment of Tsunami Preparedness in the Indian Ocean

Status Report, 2018

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English Only

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(IOC/BRO/2020/2)

INTRODUCTION

The Indian Ocean tsunami of 26 December 2004 resulted in over 230,000 casualties and the displacement of over 1 million people in coastal communities around the Indian Ocean making it the most destructive tsunami in history. Recognising the need for a tsunami early warning system in the Indian Ocean region, the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS) was established in 2005 as a primary subsidiary body of the Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO), with the objective to mitigate the hazard posed by local and distant tsunamis in all parts of the Indian Ocean.

After several years of international cooperation and development coordinated by the IOC-UNESCO, the IOTWMS became fully operational on 31 March 2013 when the Tsunami Service Providers (TSPs) of Australia, India and Indonesia assumed full responsibility for the provision of tsunami advisory services for the Indian Ocean region. The Secretariat of the ICG/IOTWMS was established in 2005 at the Perth Programme Office in support of IOC-UNESCO and has been funded and hosted by the Australian Bureau of Meteorology (BoM) since 2005. The Indian Ocean Tsunami Information Centre (IOTIC) is based in Jakarta, Indonesia and has been funded and hosted by the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG) since 2014. In 2005, IOC-UNESCO coordinated missions to 16 Indian Ocean Member States to identify capacity building requirements for an effective and durable tsunami warning and mitigation system in the Indian Ocean. The 2005 capacity assessment report[1] provided a regional overview of existing capacity and identified support requirements of Member States to build regional capacity in tsunami warning and mitigation.

Recognising the importance of conducting an up-to-date capacity assessment of tsunami preparedness in the Indian Ocean 13 years after the first survey, the ICG/IOTWMS at its 11th session (Putrajaya, Malaysia, April 2017) established a Task Team on Capacity Assessment of Tsunami Preparedness (TT-CATP). The Task Team designed and conducted an online survey covering all aspects of the end-to-end tsunami warning and mitigation system. Twenty ICG/IOTWMS Member States[2] provided inputs to the assessment. The capacity assessment status report[3] provides a baseline of the current status of tsunami preparedness capacity in the region, identifies specific gaps and prioritises capacity development requirements at both the regional and national levels. Together with the IOTWMS Medium Term Strategy 2019-2024[4] and the IOTWMS 2019 Factsheet[5], the capacity assessment status report provides an overview of the governance and structure of the IOTWMS; details of its detection, warning and dissemination systems; the status of current capacity in end-to-end tsunami warning and mitigation; and an outline of the strategic objectives, plans and activities for the IOTWMS up to 2024.

1 UNESCO-IOC; UN-ISDR/PPEW; WMO. Assessment of Capacity Building Requirements for an Effective and Durable Tsunami Warning and Mitigation System in the Indian Ocean: Consolidated Report for 16 Countries Affected by the 26 December 2004 Tsunami. Paris, UNESCO 2005. IOC Information Document No. 1219

2 Australia, Bangladesh, Comoros, France (Indian Ocean Territories), India, Indonesia, Iran, Kenya, Madagascar, Malaysia, Mauritius, Mozambique, Myanmar, Oman, Pakistan, Singapore, Sri Lanka, Tanzania, Thailand and Timor Leste.

3 UNESCO/IOC, 2020. Capacity Assessment of Tsunami Preparedness in the Indian Ocean – Status Report, 2018. IOC Technical Series No. 143. Paris, UNESCO

4. UNESCO/IOC. 2019. Indian Ocean Tsunami Warning and Mitigation System (IOTWMS): Medium Term Strategy, 2019–2024. Paris, UNESCO. Technical Series No. 144

5 ICG/IOTWMS Factsheet 2019. Perth, Australia. IOC/BRO/2019/7.

GOVERNANCE AND STRUCTURE

The IOTWMS is an important component within the IOC-UNESCO framework for Tsunamis and Other Hazards related to Sea-Level Warning and Mitigation Systems (TOWS). The governance of IOTWMS is provided through an Intergovernmental Coordination Group (ICG), a primary subsidiary body of IOC-UNESCO that reports directly to the IOC Assembly. All 28 Member States within and bordering the Indian Ocean are members of the ICG. Intersessional work of the ICG is currently (2019–2021) pursued through the following bodies that provide for wide representation and contributions by all the IOTWMS Member States as well as other experts:

- Steering Group
- Working Group 1 on tsunami risk, community awareness and preparedness
- Working Group 2 on tsunami detection, warning and dissemination
- Sub-regional Working Group for the North West Indian Ocean
- Task Teams
  - Capacity assessment of tsunami preparedness [2017–2019]
  - Indian Ocean wave exercise [renewed each session]
  - Tsunami preparedness for a near-field tsunami hazard [2019–2021]
  - Scientific tsunami hazard assessment of the Makran subduction zone [2019–2021]

The Secretariat provides facilitation, coordination and support to the activities of the ICG/IOTWMS.

The Indian Ocean Tsunami Information Centre (IOTIC) provides support for the countries of the Indian Ocean region in disaster risk reduction, focusing on tsunamis, through the preparation and dissemination of awareness and preparedness materials and the development of educational programmes.

IOTWMS STRATEGIC PILLARS

The IOTWMS is comprised of three strategic pillars supported by six foundational elements, around which the Medium Term Strategy is structured. The three pillars are

1. Risk Assessment and Reduction: Hazard and risk assessment and risk reduction.
2. Detection, Warning and Dissemination: Rapid detection and warning dissemination down to the last mile.
3. Awareness, Preparedness and Response: Public education, evacuation, emergency planning and response.

2018 INDIAN OCEAN CAPACITY ASSESSMENT OF TSUNAMI PREPAREDNESS

Much progress has since been made in establishing the IOTWMS which became fully operational on 31 March 2013. For example, the IOTWMS developed Risk Assessment Guidelines[1], enhanced observing networks (>150 seismic stations, >100 sea level stations and 11 tsunameters), generated awareness material and

1 Tsunami risk assessment and mitigation for the Indian Ocean; knowing your tsunami risk – and what to do about it. IOC Manuals and Guides No. 52, Paris: UNESCO, Second edition 2015 (English)

continues to conduct communication tests, capacity development workshops and tsunami drills. Current and future work of the ICG/IOTWMS is focused towards sustainability of and improvements to the system, as well as enhancing community awareness and response mechanisms in its Member States.

The 2018 capacity assessment was designed to provide a benchmark of the current status of the IOTWMS, identify specific gaps and prioritise capacity development requirements at both the regional and national levels for strengthening the end-to-end tsunami warning and mitigation system in the Indian Ocean. The assessment was conducted through an online survey questionnaire covering all aspects of the end-to-end tsunami warning and mitigation system. The questionnaire assimilated and built upon the existing ICG/IOTWMS National Reports, Post-IOWave Surveys and IOC-UNESCO Post-Event Assessment Surveys. The survey had five distinct sections: basic information; risk assessment and reduction; detection, warning and dissemination; public awareness, preparedness and response; and narrative with each section requiring inputs from different stakeholders based on their national responsibility in the end-to-end tsunami warning and mitigation system.

The dataset underpinning the regional analysis for the Capacity Assessment of Tsunami Preparedness includes timely survey responses from twenty IOTWMS Member States, namely Australia, Bangladesh, Comoros, France (Indian Ocean Territories), India, Indonesia, Iran, Kenya, Madagascar, Malaysia, Mauritius, Mozambique, Myanmar, Oman, Pakistan, Singapore, Sri Lanka, Tanzania, Thailand and Timor Leste. Submission of responses was timed to coincide with Member States' formal reporting to the 12th Session of the ICG/IOTWMS (Kish, Iran, March 2019) eliminating the need for countries to submit a separate national report. The status report forms a new baseline over which progress of the IOTWMS can be routinely monitored by the ICG. The survey will be repeated biennially to coincide with every ICG session allowing the ICG to assess the status of the IOTWMS against key performance indicators, monitor progress, identify gaps and prioritise requirements of the Member States.

REGIONAL OVERVIEW OF IOTWMS STATUS AND CAPACITY SUPPORT REQUIREMENTS

POLICIES, PLANS AND GUIDELINES

In 2005, the assessment survey of the capacity of 16 countries affected by the December 2004 tsunami in the Indian Ocean, showed most countries had national platforms or other mechanisms in place for guiding disaster risk reduction in general and many had tsunami warning and mitigation coordination committees or similar mechanisms in place at national and community levels. However, relatively few countries had tsunami emergency plans, tsunami evacuation plans or tsunami signage in place. In 2018, most countries (19) have some form of national tsunami policy, with the majority of countries addressing tsunami as part of a multi-hazard policy. Policies at local level are less prevalent with 15 countries having some form of local tsunami policy. Eighteen countries have some form of tsunami disaster risk reduction plan, again mostly in a multi-hazard framework. Across the four phases of the disaster management cycle, the availability of plans is higher at national level followed by local level with least availability at community level (figures 1 and 2) . Notably, all countries reported that their tsunami risk reduction plans are based on hazard and/or risk assessments. Fewer countries (13) have any form of national tsunami guidelines and not all phases of the disaster management cycle are covered by guidelines. However, there is more availability at the local

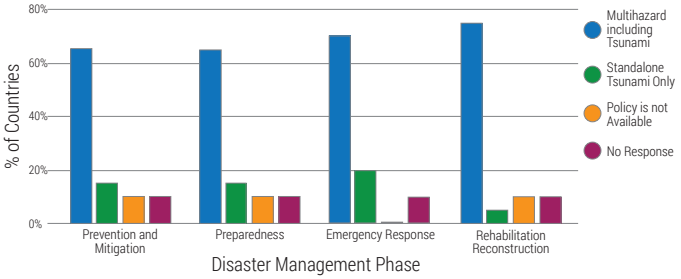

Figure 1. Availability of national tsunami policies for different phases of disaster management cycle.

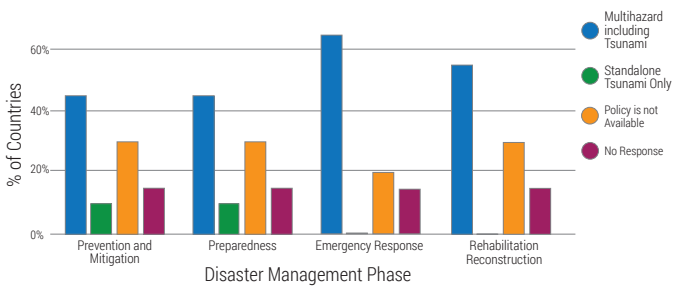

Figure 2. Availability of local tsunami policies for different phases of disaster management cycle.

level with 16 countries having local tsunami guidelines, with the majority of these countries addressing tsunami as part of multi-hazard guidelines.

Across policies, plans and guidelines, from national to local level, there is greater focus on tsunami within the emergency phase of disaster management. While the rehabilitation and reconstruction phase may share many similarities with other hazards, the lack of tsunami specific focus for preparedness and the prevention and mitigation phases is more difficult to explain and further support should be provided to countries requiring assistance to develop policies, plans and guidelines for these phases. Support may also be required to increase the availability of policies, plans and guidelines at the local level for countries that express a need for such assistance.

Recommendations (Policies, Plan and Guidelines)

- Provide support to increase availability of tsunami policies, plans and guidelines at the prevention and mitigation, preparedness, and recovery and reconstruction phases of disaster management
- Provide support to increase availability of tsunami policies, plans and guidelines at the local level, either as standalone or as part of a multi-hazard approach

RISK ASSESSMENT AND REDUCTION

Hazard Assessment

Less than half of the countries assessed in 2005 had conducted tsunami hazard assessments and numerical modelling of tsunami inundation had been conducted by

less than a quarter of countries. In contrast, all countries participating in the 2018 capacity assessment survey have conducted tsunami hazard assessments and a majority have these as part of multi-hazard assessments. In many countries there is reliance on a sole national agency to carry out hazard assessments. There is therefore an opportunity to increase engagement of other national, regional or international actors, such as research institutes and universities. Their expertise would help to address some of the capacity shortcomings revealed at the national level, particularly the areas of hazard, inundation and evacuation mapping.

The level at which hazard assessments have been carried out also differs among countries, although this may partly be explained by the wide variations in geographic area, population size and hazard threats among them. Thirteen countries have carried out tsunami hazard assessment at the national level, 8 at the regional level, 9 at the city level and 6 at the village level. Half of the participating countries have carried out hazard assessments at multiple levels.

Countries draw upon a range of data types to support their tsunami hazard assessment, mainly bathymetry, topography and land cover. The availability of this data has considerably improved since 2005, but in many cases the data is not publicly available. This may be due to the cost of making it available, a lack of understanding on how this data could be used for the benefit of others, security, data protection or similar. Whatever the reasons, countries should be encouraged to increase the availability of publicly accessible data for tsunami hazard and risk assessment.

The survey results indicate the requirement for capacity improvement in different areas of tsunami hazard assessment in some countries, with evacuation mapping ranked as the highest priority, followed by hazard mapping and inundation mapping (figure 3). The capacity to offer training in these areas is already available across the Member States of the IOTWMS and this could be used to assist those countries with poor capacity.

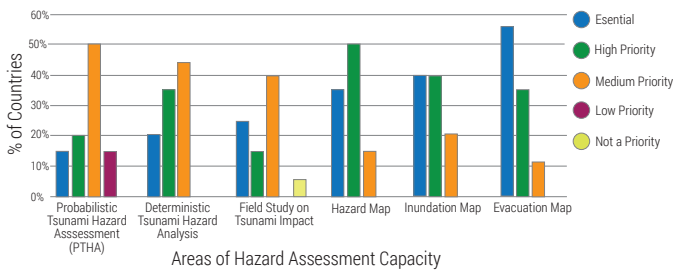

Figure 3. Requirement for capacity improvement in different areas of tsunami hazard assessment.

Risk Assessment

In the 2005 assessment, less than a quarter of the participating countries had conducted a tsunami vulnerability assessment, which is an important component or risk assessment. In the 2018 assessment, 16 countries have conducted tsunami risk assessments of which 15 included tsunami as part of a multi-hazard assessment, with flooding, cyclone and earthquake hazards included by 50% or more of countries. Most of the countries that have carried out tsunami risk assessment did so at national level, some did so at regional and city level but only 4 countries conducted risk assessments at village and/or community level. These differences may in part be explained by the variations in geographic area, population size and hazard threat, but may also be due to inadequate capacity.

The assessment indicates wide-ranging capacity to undertake tsunami risk assessment across the 20 participating countries. As with hazard assessments, it would appear that in many countries there is sole reliance on a national agency to carry out risk assessments and there may be opportunity to increase engagement of other national, regional or international actors, such as research institutes and universities. Their expertise would help to address some of the capacity shortcomings revealed, particularly at city, village and community levels (figures 4).

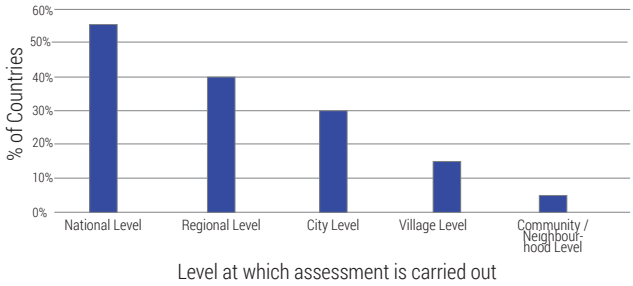

Figure 4. Percentage of countries that have carried out tsunami risk assessments at different levels.

Recommendations (Risk Assessment and Reduction)

- Increase engagement of other national, regional or international actors in the carrying out of tsunami hazard and risk assessments
- Increase the availability of publicly accessible data for tsunami hazard and risk assessments
- Increase the capacity for tsunami hazard assessment, especially in the areas of evacuation mapping, hazard mapping and inundation mapping
- Capitalise on the existing capacity in Member States for delivering training on hazard mapping and inundation mapping
- Increase the capacity for city, village and community level tsunami risk assessments
- Increase the capacity for developing products from tsunami risk assessments, such as risk maps, evacuation maps, guidelines and action plans

DETECTION, WARNING AND DISSEMINATION

In 2005, nearly all of assessed countries had an agency for receiving international tsunami warnings from PTWC and/or JMA and staffed 24x7, but few had a national agency for monitoring and warning their citizens of regionally or locally generated tsunamis. In the 2018 capacity assessment survey, all countries reported that they have the capability to assess and/or receive potential tsunami threat information and provide advisories or warnings to their coastal communities. for determining national tsunami threat, the majority of countries either

rely solely on the data provided by the IOTWMS Tsunami Service Providers (TSPs) or use a combination TSP data and their own threat assessment data (figure 5).

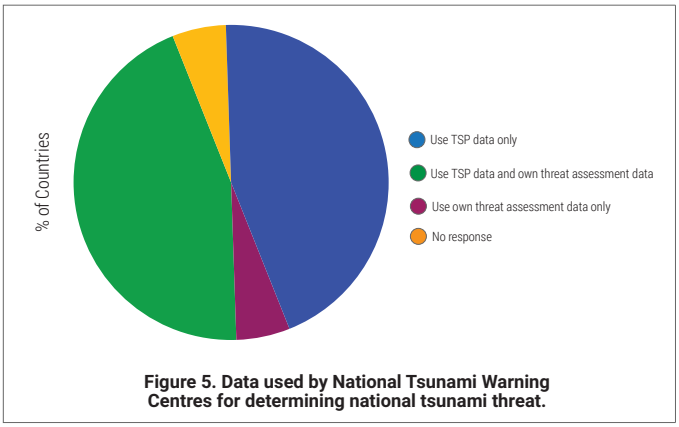

Figure 5. Data used by National Tsunami Warning Centres for determining national tsunami threat.

Most countries (18) reported that the organisation responsible for assessing and/or receiving potential tsunami threat information operated on a 24x7 basis and 16 countries reported that this organisation also has responsibility for issuing national tsunami watches, advisories, alerts and/or warnings.

In 2005, less than half of the countries assessed were receiving real-time seismic and sea-level data. In 2018, 18 countries reported that they have access to national or a variety of international seismic networks such as the California Integrated Seismic Network (CISN), Seedlink and IRIS. Seventeen countries are able to access national or international sea level networks via the GTS, IOC sea level monitoring website or Tide Tool. The 3 countries that do not have access to sea level data (Madagascar, Mozambique and Pakistan) should be encouraged to access the international networks via the readily and freely available monitoring tools. Thirteen countries have the capability to analyse real-time seismic and sea-level data using a wide variety of software tools. However, further support is required to improve the capacity of the 7 countries that do not have capability to analyse real-time seismic and sea level data.

Twelve countries reported having the capability to use tsunami models to support the generation of threat forecasts using software tools including ComMIT, TUNAMI, TOAST, COMCOT, MOST and other in-house developed applications. The wide variety of tools could hinder the ability of the region to provide training and support for those countries that have inadequate modelling capacity. However, the IOTWMS has focused much effort since 2006 on conducting tsunami modelling training using the ComMIT tool which also forms the basis to the Indian Ocean Tsunami Ready (IOTR) training programme coordinated by IOTIC and the IOTWMS Secretariat. The IOTWMS should also consider providing further support to those countries that wish to build their capacity in tsunami modelling to support the generation of national tsunami threat forecasts.

Four countries reported that they had been impacted by a tsunami since 26th December 2004, although only Indonesia had suffered damage/losses from these events. The lack of recent experience of tsunami events in many countries poses a number of threats to effective early warning, including loss of commitment, a reduction in priority level, difficulty in obtaining resources, lack of practical experience within agencies and their staff, and lack of experience or engagement among the public. Tsunami drills and exercises are therefore important to test communications links, maintain a state of readiness in the warning and response agencies and maintain public awareness. In this context, 19 countries reported that their National Tsunami Warning Center (NTWC) and/or Tsunami Warning Focal Point (TWFP) had participated in the 6 monthly IOTWMS communications tests and all countries had participated in the 2018 IOWave exercise. The IOTWMS should review and consider increasing the frequency of exercises to test Standard Operating Procedures (SOPs) and reduce the potential for complacency among countries that have not experienced a recent tsunami event.

Countries use a wide range of media to disseminate tsunami information (warnings, public safety action etc.) to their citizens. Email messaging is used by all countries and most countries (19) also use SMS and television broadcasts. Other media widely used include, telephone, fax, websites and radio. Social media, sirens, and public alert systems are used by about half of the countries.

Recommendations (Detection, Warning and Dissemination)

- Provide support to increase the capacity for analysing real-time seismic and sea-level data for tsunami threat
- Provide support to increase the capacity for tsunami modelling to support generation of threat forecasts
- Undertake a further study to examine whether there is a need for so many different software tools to be used to analyse data for tsunami threat or tsunami modelling
- Increase the frequency of tabletop or similar tsunami warning exercises to review and test SOPs, and reduce the potential for complacency among countries that have not experienced a recent tsunami event

AWARENESS, PREPAREDNESS AND RESPONSE

Standard Operating Procedures

In the 2005 capacity assessment, the existence of SOPs was not explicitly addressed. However, closely related awareness and response procedures were assessed. For example, local government disaster preparedness and emergency response had been assessed or partially assessed by 10 of 16 countries. On the other hand, response procedures for regionally or locally generated tsunamis were in place in only 3 countries. The 2018 capacity assessment indicates that 18 countries have developed SOPs for their upstream operations. For downstream operations, most countries have developed SOPs for warning dissemination, communications with the NTWC and other stakeholders, evacuation call procedures and media arrangements. Fewer countries (13) have developed SOPs for community level evacuation.

Overall, despite SOPs being widely available for most aspects of upstream and downstream early warning operation, many countries have requested further support to develop them (figures 6 and 7), along with the

associated human resources and infrastructure. The lack of community level evacuation SOPs in 7 countries is also notable and it is apparent that many countries will require further support to develop these.

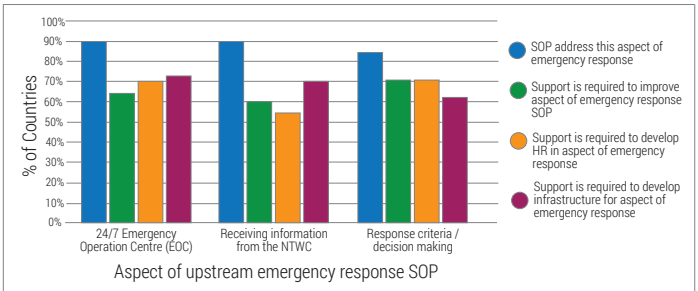

Figure 6. Support required to develop upstream emergency response standard operating procedures.

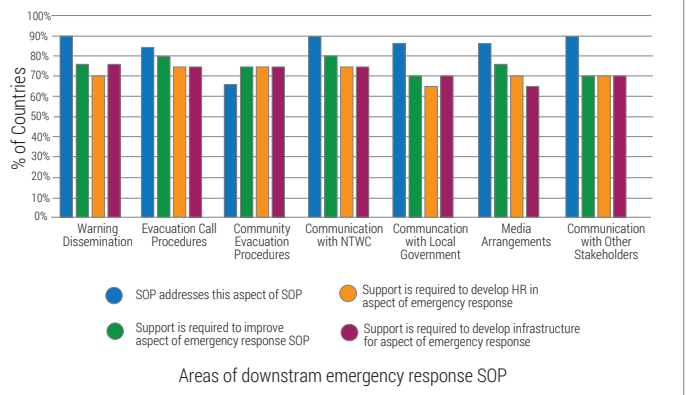

Figure 7. Support required to develop downstream emergency response standard operating procedures.

Furthermore, the Palu and Sunda Strait tsunamis in Indonesia in 2018 have highlighted the need to develop SOPs that are appropriate for near-field, rapid onset events. This will be a challenge for the IOTWMS and specific SOP training will need to be developed for countries that are vulnerable to such hazards.

Encouragingly, 19 of the countries surveyed indicated their willingness to share SOPs with IOTIC and other countries, which would provide a good basis for capacity building across the Member States. The IOTIC should capitalise on this willingness by coordinating the sharing of SOPs among the Member States.

Evacuation Infrastructure

Evacuation infrastructure is in place in at least 17 countries of which 13 countries rely on natural or artificial hills for vertical evacuation. Evacuation shelters are available in 11 countries and vertical evacuation structures are available in 7 countries. These countries either suffered high fatalities during the Indian Ocean Tsunami of 26 December 2004 (India, Indonesia, Sri Lanka and Thailand) or have multi-hazard vertical evacuation structures in place for other hazards such as cyclones (Bangladesh and Mozambique). A majority of countries (15) reported that their evacuation infrastructure is integrated within their evacuation plan. The IOTWMS and IOTIC should consider organising a training workshop to share Member States' experience of different types of evacuation structure to assist countries to develop infrastructure that is appropriate for their needs and circumstances.

Tsunami Exercises

In the 2005 assessment, only 1 country (Thailand) had tested or exercised its response procedures and another 4 countries reported partial testing. In the 2018 assessment, all 20 countries reported that they had conducted tsunami exercises at one or more levels (national, regional, city, village, community, school) and all countries participated in at least one Indian Ocean Wave exercise. Thirteen countries have incorporated tsunami exercises into their national policies and 16 countries into their national guidelines. National level exercises included organisational and inter-organisational tabletop exercises. Local (village to school level) tsunami exercises were undertaken in 12 countries, but further support may be required to expand tsunami. Local (village to school level) tsunami exercises were undertaken in 12 countries, but further support may be required to expand tsunami exercises at these levels.

Public Awareness

In 2005, community level education and preparedness programmes for national hazards or tsunami existed in nearly half of the countries assessed. However, tsunami education and public outreach programmes were partially in place in only 2 countries. Earthquake and tsunami hazards and preparedness were incorporated or partially incorporated into educational curricula for school children in 5 countries. In 2018, public awareness programmes were the responsibility of the National Disaster Management Offices (NDMOs) in 13 countries, the NTWC in 5 countries and the Local Disaster Management Offices (LDMOs) in 5 countries. In one country (Thailand) many organisations at national and local level have responsibility for promoting public awareness programmes, which perhaps is also the reality in many other countries.

Countries were asked to indicate the tsunami-related education and awareness material that they have developed from a broad list of 10 categories. Posters, leaflets and flyers, video or other visual/oral media and booklets are the most commonly used and tsunami signage and public evacuation maps were the least commonly used. This implies that relatively few countries have developed evacuation maps and consequently have not introduced evacuation signage.

Nearly all countries indicated their willingness to share their educational and awareness material with IOTIC and other countries. IOTIC should consider assisting countries to develop educational material to encourage the incorporation of tsunami awareness into school curricula. All countries except Singapore also requested assistance from IOTIC to develop or enhance public awareness with support in the development of tsunami awareness

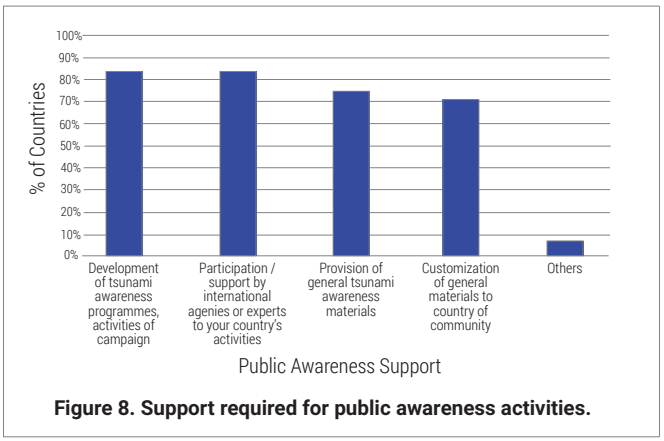

Figure 8. Support required for public awareness activities.

programmes, activities or campaigns the most widely requested (figure 8).

Each country will develop educational and awareness material that is appropriate to its own risk profile, including its exposure to hazard, demography and vulnerability of its population, and it is natural that there will be a variety of different material developed across the Indian Ocean region. It is notable that Sri Lanka has developed material across all 10 categories and 5 other countries have material in 8-9 of the categories. On the other hand, Singapore has not developed any educational and awareness material which reflects its low tsunami risk.

The range of tsunami awareness activities undertaken varies greatly across the countries. Sixteen countries have undertaken school and children-related awareness activities and 15 countries have conducted tsunami exercises. However, only 9 countries have participated in International Disaster Risk Reduction Day (held annually on 13 October) or have conducted competitions or similar activities to highlight tsunami safety (4 countries).

The IOTWMS should raise awareness of global events such as World Tsunami Awareness Day (held annually on 5 November) and International Disaster Risk Reduction Day as a means of maintaining tsunami awareness in its Member States.

The Indian Ocean Tsunami Ready (IOTR) initiative is being piloted in 7 of the respondent countries although an additional 4 countries chose to rank their performance against the IOTR indicators listed in the survey (figure 9). Of the 7 countries that are piloting IOTR, self-assessed performance varies greatly across the indicators, with upstream indicators being generally rated higher than downstream indicators. This suggests that further attention needs to be paid to areas such as outreach and public education and community tsunami risk reduction plans. For the additional 4 countries that ranked their IOTR performance, their self-assessed performance is generally lower across all indicators.

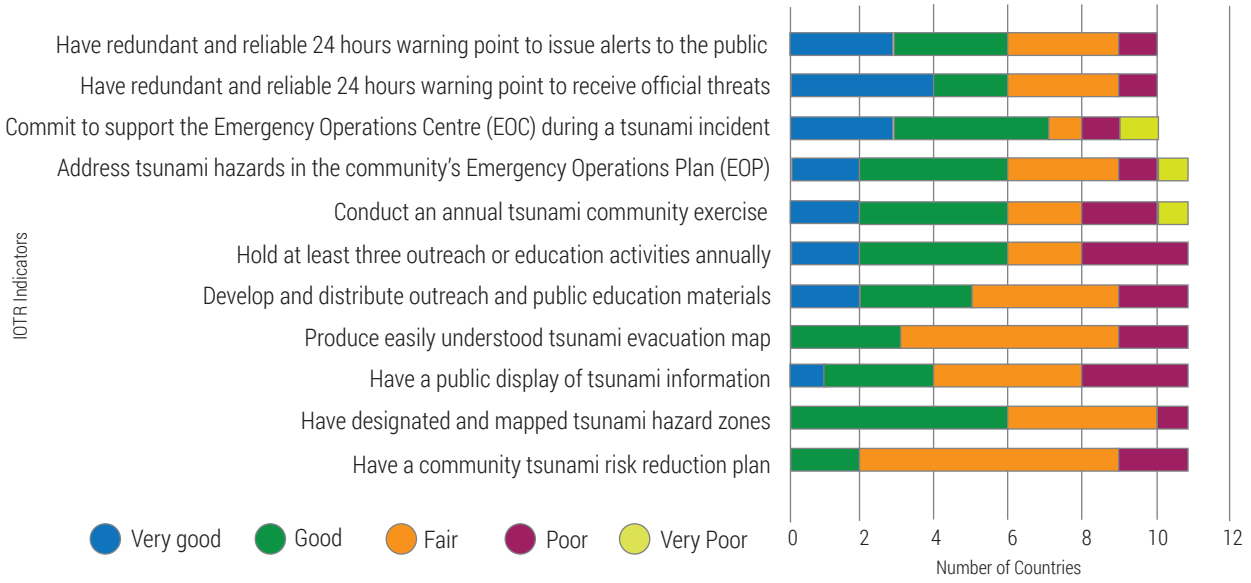

Figure 9. Status of Indian Ocean Tsunami Ready Indicators.

Recommendations (Awareness, Preparedness and Response)

- Provide support for countries to improve their SOPs at the interface between upstream and downstream, including the operation of a 24/7 emergency operation centre, receiving information from the NTWC, and response criteria and decision-making, as well as the associated human resources and infrastructure.
- Provide support for countries to improve their SOPs to address warning dissemination, communication with the NTWC, communication with other stakeholders, evacuation call procedures, communication with local government and media arrangements, as well as the associated human resources and infrastructure.
- Provide support for the development of community level evacuation SOPs.
- Capitalise on the willingness of countries to share their SOPs to share good practices across Member States.
- Provide training and share Member States' experience of different types of evacuation infrastructure.
- Provide support to incorporate tsunami exercises into cities, villages, communities and schools.
- Provide training and share Member States' experience of different public engagement materials.
- Develop educational materials such as teaching kits, and encourage the incorporation of tsunami awareness into the school curricula.
- Raise awareness of the Global Disaster Risk Reduction Day (13 October) and World Tsunami Awareness Day (5 November).

WAY FORWARD

The Medium Term Strategy provides a framework and forward direction in which the IOTWMS should develop in the five year period 2019-2024. The 2018 capacity assessment of tsunami preparedness in the Indian Ocean complements the Medium Term Strategy by providing a baseline of the status of the IOTWMS at the beginning of the five year cycle with the intention that it should be updated biennially.

The 2018 capacity assessment has shown that there has been considerable improvement across all components of the IOTWMS since the baseline assessment conducted in 2005 in the immediate aftermath of the December 2004 Indian Ocean Tsunami (table 1). Nevertheless, the IOTWMS is not a static system and must improve, evolve and adapt to serve the needs of its Member States. As described in the Medium Term Strategy, the over-arching vision of the IOTWMS is to save lives and protect property and infrastructure. To achieve this the IOTWMS has been designed and developed as an interoperable system based on best practices and operational technology providing timely and effective advice to the NTWCs. However, it is widely understood that such advice at the national level is useless unless the communities at risk are aware of the tsunami threat that they face and are prepared and ready to respond to advisory messages and/or warnings that they receive from their designated national authorities. In this context, the following page provides a summary of the capacity gaps and support requirements that have emerged from the 2018 Indian Ocean capacity assessment of tsunami preparedness.

	IOTWMS Status 2005		IOTWMS Status 2018	
Policies, Plans and Guidelines	• Legal framework in place for disaster warning formulation, dissemination and response	59%	• National tsunami policy in place	90%
	• National platform or other mechanism in place for guiding disaster risk reduction in general	94%	• Local tsunami policy in place	60%
	• National Tsunami Warning and Mitigation and Coordination Committee or some other coordination mechanism in place	59%	• National tsunami disaster risk reduction plan in place	75%
	• Disaster coordination mechanisms at community level established	75%	• Local tsunami disaster risk reduction plan in place	55%
	• Tsunami emergency plans, tsunami evacuation plans and/or signage exist indicating routes to safety or higher ground	19%	• Community tsunami disaster risk reduction in place	40%
			• National tsunami guidelines established	70%
			• Local tsunami guidelines established	60%
Risk Assessment and Reduction	• Tsunami hazard evaluation conducted prior to 26 December 2004	44%	• Tsunami hazard assessment conducted	100%
	• Historical record of past earthquakes and tsunamis documented	37%	• Tsunami risk assessment conducted	75%
	• Tsunami vulnerability assessment conducted	22%	• Numerical modelling conducted for hazard assessment (PTHA and/or DTHA	35%
	• Numerical modelling studies conducted to calculate inundation from tsunamis	22%	• Bathymetry used for tsunami hazard assessment	85%
	• Accurate bathymetry and topography data exist for the coastlines	25%	• Topography used for hazard assessment	80%
Detection, Warning and Dissemination	• International tsunami warnings received for teletsunamis from PTWC and/or JMA	94%	• National capability to assess and/or receive potential tsunami threat information and advise and/or warn coastal communities	100%
	• Agency receiving warnings staffed 24x7	94%		
	• National or regional tsunami warning centre to monitor and warn of regionally or locally generated tsunami in operation	28%		
	• Warning centre staffed 24x7	31%	• Warning centre staffed 24x7	90%
	• Real-time seismic data received	41%	• Access to national or international seismic networks	90%
	• Sea level data available real-time to the central monitoring site, or available in near real-time	41%	• Access to national or international sea level networks	85%
Standard Operating Procedures	• Local government disaster preparedness and emergency response assessed	59%	• Warning dissemination SOPs in place	90%
	• Community and ordinary citizen disaster preparedness and emergency response assessed	25%	• Evacuation call SOPs in place	80%
	• Response procedures for regional or locally generated tsunami in place	19%	• Community evacuation SOPs in place	60%
Tsunami Exercises	• Response procedures have been tested or exercised	19%	• Tsunami exercises conducted at national level	70%
	• Public is aware of what a tsunami is and how to respond to both locally generated and distant tsunamis	37%	• Tsunami exercises conducted at regional level	55%
			• Tsunami exercises conducted at city level	35%
			• Tsunami exercises conducted at village level	50%
			• Tsunami exercises conducted at community level	50%
			• Tsunami exercises conducted at school level	30%
Awareness, Preparedness and Response	• Community level education and preparedness programmes for national hazards or tsunami exist	47%	• Tsunami related education and awareness material	
	• Tsunami education and public outreach programme in place	6%	◦ Leaflets or flyers	65%
	• Earthquake and tsunami hazards and preparedness is incorporated into educational curricula for school children	12%	◦ Posters	70%
			◦ Booklets	60%
			◦ Information Boards	30%
			◦ Tsunami signage	25%
			◦ Video or other visual/oral media	65%
			◦ Indigenous knowledge	35%
			◦ Teaching kits	50%
			◦ School curricula	45%
	• Training programmes for the media on tsunami hazards, mitigation, warning and preparedness exist	22%	◦ Public evacuation maps	25%
			• Media arrangement SOPs in place	80%

Table 1: Comparison of the status of the IOTWMS in 2005 and 2018. The percentage columns refer to the percentage of countries participating in each survey answering "yes" to the related question, with a "partial yes" in the 2005 assessment counted as a "half yes". The 2005 percentages are based on responses from 16 countries and the 2018 percentages are based on responses from 20 countries, with 14 countries in common. Given the differences between the two assessments, the table is intended to provide a broad comparison only to indicate the scale of capacity improvement in the IOTWMS since 2005.

Policies, Plans and Guidelines

The capacity assessment reveals that there is greater focus on tsunami policies, plans and guidelines within the emergency phase of disaster management. Although the rehabilitation and reconstruction phase shares similarities with other hazards, the lack of tsunami specific focus for the preparedness, prevention and mitigation phases is difficult to explain and further support should be provided to countries requiring assistance to develop policies, plans and guidelines for these phases. The need for such support has previously been identified at the conference to commemorate the 10th anniversary of the Indian Ocean Tsunami in November 2014, which recommended that national tsunami programmes should be codified in law and that key functions should be institutionalised. The 2018 capacity assessment shows that most countries are working towards including tsunami risk management in multi-hazard legislative and policy frameworks.

Risk Assessment and Reduction

The need to improve capacity in tsunami hazard and risk assessment has been identified in several fora since 2014 and is a key activity of IOTWMS Working Group 1 on Tsunami Risk, Community Awareness and Preparedness. Inundation modelling has been identified as a priority to better inform evacuation planning and community responses and Probabilistic Tsunami Hazard Assessment will help provide estimates of uncertainties to assist decision makers. The 2018 tsunamis in Palu and Sunda Strait demonstrated that tsunami hazard assessments are generally too broad to facilitate detailed local planning or to address all potential sources and the hazard assessments will need to be revised for at-risk countries based on more recent data and scientific understanding.

Detection, Warning and Dissemination

Although capacity for analysing real-time seismic and sea-level data and tsunami modelling has improved considerably in many countries of the Indian Ocean region, there are still some countries that require support to develop this capacity and develop their self-sufficiency to generate threat forecasts. To some extent, this is being achieved through regional cooperation, for example in the North West Indian Ocean. However, more rapid and accurate assessments of earthquake source characteristics for near-field events is required to enable timely community responses, and real-time modelling incorporating earthquake focal mechanism and sea level observations should be explored to provide more accurate tsunami forecasts. Such developments would increase the requirement for capacity building in Indian Ocean countries.

Awareness, Preparedness and Response

The IOTWMS Secretariat and IOTIC have worked with the IOTWMS Member States since 2008 to assist them to develop their tsunami warning and emergency response SOPs. However, the 2018 capacity assessment clearly indicate that further support is required, particularly for downstream activities such as community evacuation and at the interface between the upstream tsunami warning and downstream emergency management operations. Furthermore, the Palu and Sunda Straits tsunamis have highlighted the need to develop SOPs that are appropriate for near-field, rapid onset events. This will be a challenge for the IOTWMS and specific SOP training will need to be developed for countries that are vulnerable to such hazards.

The issue of complacency among countries that have not experienced a tsunami event since 2004 is a potential risk to the long-term sustainability of the IOTWMS and is difficult to manage when many countries experience other more frequently occurring hazards such as cyclones and flooding. It is important to conduct tsunami exercises and drills to test SOPs and maintain public awareness. However, a balance needs to be struck between maintaining awareness and preparedness and over-sensitising communities to infrequent events, which could in itself lead to loss of interest and/or an increase in complacency. The incorporation of tsunami exercises at city, village, community and school levels will require countries to develop capacity in accordance with the “Tsunami Ready” indicators, which will require strong commitment at national government level. IOTIC can provide support through the Indian Ocean Tsunami Ready (IOTR) initiative but the countries themselves will need to have the commitment and provide the resources to achieve Tsunami Ready recognition.

Due to the infrequency of tsunami events, it is important that efforts are focused on enhancinging the inter-generational awareness of communities to strengthen their long-term resilience. In this regard, tsunami awareness, education and preparedness should be embedded in school curricula from an early age. IOTIC has a vital role to play in the development and sharing of tsunami related knowledge and the development and implementation of educational programmes, as well as organising workshops and training programmes together with the Secretariat to develop the capacity of IOTWMS Member States.

It is important to sustain operations of the IOTWMS Secretariat and IOTIC over the long term to ensure efficient functioning of the end to end Indian Ocean Tsunami Warning and Mitigation System.

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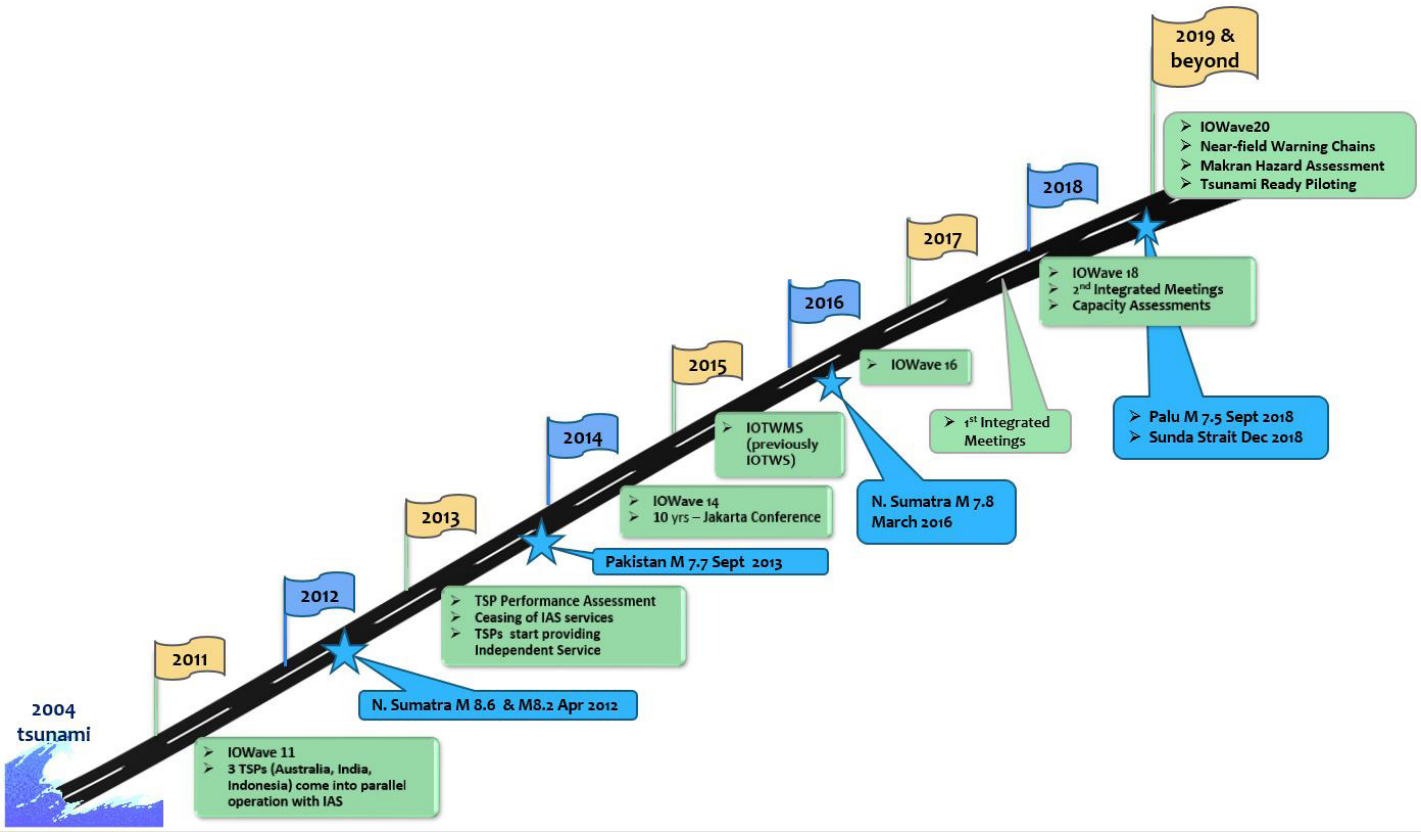
The dataset underpinning the regional analysis for the Capacity Assessment of Tsunami Preparedness includes survey responses from twenty IOTWMS Member States, namely Australia, Bangladesh, Comoros, France (Indian Ocean Territories), India, Indonesia, Iran, Kenya, Madagascar, Malaysia, Mauritius, Mozambique, Myanmar, Oman, Pakistan, Singapore, Sri Lanka, Tanzania, Thailand and Timor Leste. The survey results were analysed and compiled by Dr. Richard Haigh, Dr. Dilanthi Amaratunga, Dr. Pournima Sridarran and Dr. Harkunti Rahayu. Dr. Srinivasa Kumar Tummala, Mr. Tony Elliott and Ms. Nora Gale made substantive contributions to authoring the publication. Mr. Ardito Kodijat and Mr. Ganni Mulya Ramadhan were responsible for the layout and design. The report greatly benefited from reviews by Dr. Thorkild Aarup of IOC-UNESCO.



IOTWMS Roadmap from 2004 to 2019 & beyond.

The stars and blue boxes indicate significant tsunami events while the green boxes correspond to notable initiatives to enhance the Indian Ocean Tsunami Warning and Mitigation System. Key initiatives in the system following the initial capacity assessment in 2005 are the establishment of 3 Tsunami Service Providers (Australia, India and Indonesia); regular ocean-wide exercises, workshops and meetings; and the Indian Ocean Tsunami Ready initiative.

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