

# Climate change-induced loss and damage in small-island developing states in the Pacific: a scan of the scientific literature

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# Climate change-induced loss and damage in small-island developing states in the Pacific

A scan of the scientific literature

This document synthesises the key findings of just over a hundred documents in the scientific literature. It has been prepared as input to one of the activities undertaken in the European Union-funded SINCERE project (http://www.jpi-climate.eu/sincere).

The document consists of two sections. The first section outlines the process followed to select the literature, and gives and overview of the documents reviewed. Details are provided in Annex 1 and Annex 2, respectively. The second section presents brief summaries of the individual documents, organised by theme. Annex 3 provides full references for all documents, sorted alphabetically.

The information provided in this document does not represent a proper review of the literature, as the time required to complete one far exceeds the time available. Instead, a scan of the scientific literature is presented, to highlight salient issues with regard to research on loss and damage in small-island developing states in the Pacific.

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# 1. Selection of the literature and overview of the documents reviewed

The method followed to select the literature sought to (i) be replicable and (ii) ensure a comprehensive selection. To this end, the online database Scopus was queried using a set of search criteria that yielded over five hundred documents. A read of the individual abstracts and, in some cases, of the entire documents made it possible to narrow down the selection to seventy-three documents. This selection included documents in the two languages (English and French) that are most relevant with regard to scientific publishing in, and about, the region. In-text citations in the seventy-three documents selected provided an additional thirty-two documents that were relevant, and had not been picked up in the database search. These took the final count to one-hundred and five documents. Annex 1 provides additional information on the process followed to select the documents.

Documents were drawn from ten journals focused on climate change, thirty-two journals focused on environmental and broader issues, and two books. Fiji, Tuvalu and two country groupings (Pacific SIDS and all SIDS) concentrate most research, whereas just a handful of documents focus on Palau or Nauru, and none on Tonga. Most articles discuss migration, a broad range of potential policy responses to loss and damage, and risk management. Only a handful of the corresponding authors are affiliated to research institutions in a Pacific SIDS: the vast majority are affiliated to Australian universities. Most of the documents reviewed consider both extreme and slow-onset events. Similarly, most of the documents reviewed consider both economic and non-economic losses. Annex 2 gives more details in a tabular format.

# 2. Summaries of the individual documents

By putting together all the keywords in the individual documents, a selection of the most frequently used keywords was obtained. Based on this selection, nine categories were established: migration, policy response, risk management, human health, aid effectiveness, biodiversity loss, traditional knowledge, local beliefs and relocation. Each document was placed in one of these categories, which have been used to structure the summary presented in this section. Within each category (and sub-category, in the cases of ‘migration’, ‘policy response’ and ‘risk management’), an overview is provided upfront.

For each of the one hundred and five documents reviewed, a summary is provided. Each individual summary attempts to present a reasonably brief account of the main findings in the corresponding document. Since some authors reach similar conclusions, there is overlap among summaries. Nonetheless, for the sake of completeness, this overlap has not been eliminated. In some instances, the text provided in the summaries is taken verbatim from the individual documents. While succinctness was favoured, some summaries are longer than the rest, to ensure that all key points were captured. Each summary begins with the citation of the relevant article (full references are given in Annex 3).

The authors of the individual documents have not been asked to review this analysis. Any inadvertent mischaracterisation of their views is regretted.

## 2.1 Migration

A little over one-fourth of the documents reviewed focus on migration. A first striking finding is that, with regard to the inevitability of migration, markedly contradicting views are found. A second finding relates to the scope of the documents, which span over a dozen subjects. Eight broad themes emerge, each addressed in two-to-five documents: international agreement, migration in Kiribati, the Marshall Islands and Tuvalu, migration as mobility, the drivers of migration, climate justice, agency (or lack thereof), planning processes, and lack of evidence. A 'miscellaneous' category is added at the end, listing the five documents that do not fit any of these themes.

### 2.1.1 International agreement

**OVERVIEW.** The literature touches upon the complex international governance aspects of climate change-driven migration. This research highlights three main issues: the relative strengths and weaknesses of the negotiating positions of small-island developing states and prospective host countries; the need for an all-encompassing approach to migration, which considers both practical and ethical issues; and the intriguing possibility of a "pan-Pacific citizenship model".

**(Kelman, 2015):** Among small-island developing states, migration is both disliked and recognised as an eventuality. For these reasons, small-island developing states request the power and resources to make decisions for themselves on their own terms. Nevertheless, island peoples are not a single group with a single view or single voice. This presents challenges and opportunities in formulating and implementing decision-making processes for migration linked to climate change, while accepting that such decision-making processes are not removed from other social, environmental and governance interactions.

**(Klepp and Herbeck, 2016):** At the global level, a legal stalemate has arisen with regard to environmental- and climate change-driven migration. Options to overcome this stalemate include soft-law approaches anchored in human rights, labour migration to New Zealand and Australia, and a pan-Pacific citizenship model.

**(Noy, 2017):** Climate change migrants remain few in number. Tuvalu's approach to international climate change negotiations may explain why. Tuvalu has called for heightened adaptation and mitigation efforts, failing what litigation would be the only option. This strategy can be seen as strengthening Tuvalu's negotiating positions. Nonetheless, it is unlikely to change the long-term fate of Tuvaluans – forced migration. Planning and funding will be required to transition from today's position to a situation in which migration is likely to be inevitable.

**(Weber, 2017):** Migration is a form of adaptation, and climate change impacts may force Pacific islanders to migrate. From the perspective of the receiving countries, acceptance of migrants depends on their skills and whether or not they can integrate easily in labour markets and society. From the perspective of migrants, the host country should offer a livelihood, legal and social recognition, and the opportunities required to integrate. Intergovernmental negotiations on mobility should consider both perspectives.

### 2.1.2 Kiribati, the Marshall Islands and Tuvalu

**OVERVIEW.** These three countries' approaches to migration are both prominent (in the Pacific and beyond), and very different from one another. As a result, the literature focused on these countries is comparatively larger. Notwithstanding the differences, two common issues emerge. First, for prospective migrants from any of these three countries, migration remains challenging, due to strict eligibility requirements and unclear or non-existent bilateral agreements. Second, development aid continues to flow, in what might be interpreted as a signal that, even in small-island developing states with explicit migration policies, the international community does not envisage mass migration as a short- or mid-term issue.

**(Smith and McNamara, 2015):** The governments of Tuvalu and Kiribati have taken different stances with regard to the immediacy of migration as a response to climate change. Nonetheless, their differences are relatively minor compared to the commonalities of the situation in both countries. First, migration is seen by many as unavoidable in the mid- to long-term. Second, the funding required to manage migration would come from multilateral and bilateral aid agencies. This means that the governments of Tuvalu and Kiribati are not entirely free to manage the process. Third, thus far, aid agencies continue financing infrastructure work, which implies that implies no mass migration is contemplated for the near future. Simply stated, both Australia and New Zealand prefer "aid" to "migration".

**(Constable, 2017):** For people from Tuvalu and the Marshall Islands, migration to Australia and New Zealand is challenging, due to strict eligibility criteria and restrictions in the number of accompanying dependants. Although Marshallese citizens do not require a visa to enter the United State (as per the Compact of Free Association between the two countries), lack of financial assistance deters many potential migrants. Inter-Pacific migration is hampered by the multiple land right and land tenure systems which, in most cases, establish that land can only be transferred according to kinship arrangements. As the number of potential migrants grows, the need to formalise "climate change migration" will also increase. A definition of climate change-related migration is needed, outlining the conditions under which a person may be required to move, and the rights and obligations of both the migrant, and the host country.

**(Smith, 2018):** The Marshall Islands, Kiribati and Tuvalu have taken very different approaches to migration. Citizens of the Marshall Islands, through the country's long-standing relationship with the United States, built up under the Compact of Free Association, are likely to continue to migrate to the United States, the dilemma being if and when mass migration should be considered. The government of Kiribati, if not all the population, have begrudgingly accepted the need for some form of mass relocation (possibly to Australia and New Zealand), and thus enhancing the skills of the population is a major government priority. Tuvaluans largely refuse to consider mass migration, but the dominating narrative ("there is no future for these islands") may result in a gradual reduction in vital foreign aid flowing to the country.

**(Heslin, 2019):** The members of the Marshallese diaspora in the United States have sought to maintain their cultural heritage. Their experience highlights that, in the event of permanent and irreversible migration, established diasporas afford opportunities for cultural preservation, notably the conservation of language and traditions.

### 2.1.3 Migration as mobility

**OVERVIEW.** Research on climate change-driven migration underscores that climate change is but one of several drivers of migration. Authors note that, as such, policy efforts in the area of migration should be integrative, in the sense of considering all other drivers, notably improved livelihoods and education opportunities. Not least, authors caution against a "wholesale approach" to migration policy, and call for giving centre stage to ethical and cultural concerns.

**(Kelman *et al.*, 2015):** Analyses of mobility under climate change often miss a key contextual element: climate change is but one driver amongst many. Different forms of mobility and non-mobility together could be used by islanders to address climate change, as long as resources are made available for the islanders to enact their own choices.

**(Murphy, 2015):** Mobility is multi-causal, and climate change influences existing drivers of mobility. This influence unfolds according to existing economic, political, social, environmental and demographic contexts and historical patterns of mobility. Mobility can increase resilience, or it can be maladaptive and thus reduce resilience. As a household-level response to the impacts of climate change, mobility must be analysed in relation to alternatives such as in-situ adaptation.

**(Farbotko *et al.*, 2018):** For the mobility–adaptation–development nexus to be more than a rhetoric of a triple-win solution, it is essential that climate-related mobility occurs with sensitivity to cultural contexts and histories, existing politics and processes of migration dynamics, a global moral awareness of questions of climate justice and climate financing, and commitment to ensure that human rights and equity are promoted and sustained. Mobility that meets these requirements has been termed "transformative mobility".

### 2.1.4 Drivers of migration

**OVERVIEW.** To illustrate that migration is a decision based on a multiplicity of drivers, climate change being a secondary one in most cases, the literature draws on the disconnect between the "climate refugee" narrative that prevails in Western countries, and the realities in Tuvalu. Authors dwell on two main issues. First, mobility is intrinsic to the Pacific islanders' millenary cultures. Second, poverty is far more likely to drive migration, compared to uncertain threats about irreversible climate change impacts, which are often presented in Western scientific discourses that do not speak to the experiences and circumstances of communities in small-island developing states in the Pacific.

**(Mortreux and Barnett, 2009):** For most Tuvaluans, climate change is not a reason for concern, let alone a reason to migrate. The vast majority of those who are considering migration do not cite climate change as a reason to leave. This stance underscores that social responses to climate change are fundamentally mediated by perceptions of the problem: people filter information, shaped by their multiple experiences, values and observations, and respond in ways that reflect their diverse experiences and circumstances. This has a direct impact on people's decision-making processes and therefore needs to be closely considered in assessments of population movement with regard to climate change.

**(Farbotko and Lazrus, 2012):** Tuvaluans are being used as the immediate evidence of displacement that the climate change crisis narrative seems to require. Yet, Tuvaluan conceptions of climate challenges and mobility practices show that more inclusive sets of concepts and tools are needed to equitably and effectively approach and characterise population mobility. Simply put, Tuvaluans have long histories of ordinary mobility and they overwhelmingly refuse to discount land-based adaptation. Intergovernmental negotiations, and the narrative established around them, should incorporate Tuvaluan conceptions of the climate change crisis.

**(Connell, 2016):** For many atolls and atoll states, migration has increasingly become a livelihood strategy, irrespective of climate change – in other words, sea-level rise compounds other problems, notably poverty. Migration is likely to become even more common in the future, but the outcome will be dependent on policies and practices in metropolitan destination states.

### 2.1.5 Climate justice

**OVERVIEW.** The growing literature on "climate justice" includes research on climate change-induced migration in small-island developing states in the Pacific. This research touches upon the fundamental issue of normalising migration (that is, discounting from the outset any possible alternative to managing climate change-induced loss and damage). This approach is claimed to be both ill-founded and morally wrong. In the even that migration does occur, climate justice considerations call for an inclusive approach to it, that strikes a balance between the economic and social concerns of both migrant and host communities. Finally, one author suggests that, in light of the small contribution to climate change of small-island developing states, complete freedom of choice of the host country would be "a moral duty".

**(Zellentin, 2015):** In the context of forced migration, identity is often neglected. From a (climate) justice point of view, this should not be the case. In practice, this means that small-island developing states should be a central part of discussions to define measures taken by the international

community. Such measures could involve: conducting preparatory training, to ensure migrants enter as valuable additions to their host countries' labour market; systematically developing diaspora communities; and ensuring that the inhabitants of disappearing small-island developing states have a voice in the debates that determine any adaptation- and migration-related aid that might come their way.

**(Barnett, 2017):** The idea that climate change may cause the loss of atoll countries is now taken for granted, and migration is often seen as an inevitable outcome. However, planning for mass migration effectively deters future investments and discounts the possibility of adapting through vastly improved and significantly more creative approaches than those implemented today. The international community has the responsibility and wherewithal to enact a comprehensive strategy to minimise the risks climate change poses to atolls. Normalising the loss of atoll countries obscures recognition of these responsibilities.

**(Vaha, 2018):** It has been claimed that forced migration can only be compensated by offering (forced) migrants the possibility to move wherever they wish, including to low-emitting countries. (In line with this, there may be a moral duty to continue recognising small-island developing states as 'states', even if their territories become inhabitable.) Stated differently, freedom of choice of the host country would be a moral duty. Contingent reasons add to this moral duty, namely development levels and proximity (both in geographic and in cultural terms). In addition, what matters to hosts (not just to migrants) should also be taken into account – an aspect that the literature systematically neglects.

### 2.1.6 Agency

**OVERVIEW.** Pervading most of the literature on climate change-induced migration in small-island developing states is the notion of agency, in the sense of the extent to which sovereign states remain so when it comes to managing climate change through migration. Questions raised include the extent of the agency that a country has in the event of migration, and whether or not a country of migrants ceases to exist, if and when it becomes inhabitable and/or largely abandoned.

**(Roberts and Andrei, 2015):** The government of Kiribati has taken steps to prepare for mass migration, should the country become inhabitable. In principle, loss of territory may not amount to loss of sovereignty, statehood or national identity, especially if migration is facilitated with dignity. Nonetheless, sovereignty related to host country issues is unclear at best. What is certain is that migration will have tremendous impacts on the culture, traditions and language of migrants.

**(Baldacchino, 2018):** For small-island developing states, statehood implies sovereignty. However, their smallness and islandness implies that "there is neither space nor scope for [anything other than] a basic and modest liveability". This is also the case for resilience to climate change: (permanent or circular) migration is out of the hands of small-island governments, while development-aid funding to counter climate change diverts scarce resources from "shorter-term and locally spawned development trajectories and objectives".

### 2.1.7 Planning processes

**OVERVIEW.** The literature draws attention to a grave problem – poor planning – that is commonly overlooked. From the point of view of managing the impacts of climate change, a key rationale for migration is that it reduces loss and damage. Yet, this may not be the case. Reducing loss and damage requires careful planning from the dual viewpoints of livelihoods and, crucially, "cultural and kinship connections".

**(McNamara *et al.*, 2018):** The involuntary or voluntary relocation of populations away from hazardous locations may be considered as an adaptation strategy. However, the ability to adapt through relocation does not mean that people do not suffer loss and damage. The extent of the loss and damage will depend on whether relocated populations are able to maintain or improve

livelihoods, cultural and kinship connections, as well as have access to the basic necessities that enable people to live dignified lives in the new place.

**(Nalau and Handmer, 2018):** Resettlement does not necessarily always reduce the vulnerability of a community: vulnerability can increase due to the way in which new settlements are planned and designed (or are not), and the kinds of impacts that this has on people's livelihoods and resource access. Prior to relocation, it would be beneficial to assess the planned new settlements with regard to existing land rights and entitlements, the extent of existing services, the cultural context, access to the labour market and potential for pursuing particular livelihoods, and geophysical risks. At present, the adaptation and disaster-risk reduction communities consider these issues through different perspectives, notably with regard to their respective time horizons.

### 2.1.8 Lack of evidence

**OVERVIEW.** The literature includes one intriguing argument, supported by two separate research efforts: there is no evidence that small-island developing states in the Pacific will become inhabitable in the future. The authors that make this claim rely mostly on reviews of the literature, covering a wide range of disciplines, from political economy to biophysical and geomorphological studies.

**(Gay, 2014):** A great deal of the rhetoric concerning unavoidable migration has little scientific basis, and intentionally so: some non-governmental organisations, researchers and politicians use it to obtain prominence and funding, misleading small-island developing state inhabitants and public opinion everywhere. More scientific rigour is needed.

**(Mclean and Kench, 2015):** In spite of sea-level rise rates three-to-four times higher than average, there is little evidence of heightened erosion or reduction in size in Pacific coral atoll islands. Instead, island shores have adjusted their position and morphology in response to (i) human impacts such as seawall construction and (ii) variations in climate-ocean processes. Indeed, regular environmental influences such as erosion and accretion processes or variations in sediment supply appear to predominate over any long-term morphological trend or signal related to sea-level rise. For this reason, the challenge for atoll nations into the future is to develop adaptation strategies that (i) contemplate the likely persistence of the islands over the next century, and (ii) acknowledge that sea-level rise is just one of a series of multiple stressors. Stated differently, science calls for a substantial shift away from the present adaptation paradigm of external migration, to focus instead on the persistence of atoll islands and in-country solutions.

### 2.1.9 Miscellaneous

**OVERVIEW.** As stated in the introduction to this section, five of the documents reviewed do not fall under any of the categories above. These documents touch upon the following issues: the benefits of migration, the pros and cons of migrating (as seen from Kiribati), the role that faith-based organisations play in pre- and post-disaster management, the misconceptions that prevail in the West with regard to Tuvaluan's stance on migration, and the role that supra-national regional entities can play with regard to strengthening the quality of migration efforts and coordinating them.

**(Betzold, 2015):** Faced with limited awareness about coping with the impacts of climate change, few resources to do so, and ineffective institutions, Pacific islanders may choose to migrate. Migration can be seen as both failure to adapt and an element of islanders' way of life (in response to limited local resources, islanders have migrated, temporarily or permanently, to obtain education, employment or healthcare elsewhere). Remittances from the diaspora abroad or from seafarers are an important source of revenue for many island states, and indeed contribute to local resilience by diversifying income sources and paying for adaptation measures at home.

**(Allgood and McNamara, 2017):** Consideration of migration (as an option of last resort) may be higher than ever before. A survey in Kiribati reveals that a majority would consider migrating (to another country, over another island in Kiribati) due to sudden or gradual impacts of climate change. The strong connection to their land, way of life and the potential loss of culture and traditions were the most popular reasons cited against migration. Even for those who indicated that they would migrate, it was clear that the process of migration and resettlement would still be devastating.

**(Rowan Gard and Veitayaki, 2017):** Tropical cyclone Winston hit Fiji in February 2016. Two lessons can be learned from the aftermath of Winston. First, extreme weather events force people to leave their homes, as they are no longer habitable. Yet, most displaced people return to their homes as soon as possible, seeking to literally rebuild their lives. The view that migrants are a monolithic group that stays abroad once they migrate, is inaccurate and misleading. Second, many faith-based organisations often have deeper histories than other non-governmental organisations, which can in turn strengthen their connections with local communities. In times of crises, faith-based organisations are able to build on established foundations of trust and expedite response in emergency situations.

**(Perumal, 2018):** The way many media outlets and policy specialists speak of climate-related migration is sensationalised, over-simplistic, and unrepresentative of how Pacific islanders approach the issue. In Vanuatu, communities are unwilling to resettle as a result of climate change, unless as a last resort; they prioritise in-situ adaptation measures; and they want to maintain cultural and livelihood links, should resettlement occur.

**(Thomas and Benjamin, 2018b):** Small-island developing states in the Pacific lack the policies and mechanisms required to manage climate change-induced migration and displacement. Nonetheless, they are better off than their Caribbean counterparts. Indeed, Pacific islands have "a number of national initiatives focused on upskilling for migration with dignity, land audits and mapping to identify vulnerable communities, pursuing a policy of dual nationality and the integration of climate change adaptation with disaster risk reduction plans". Regional bodies in the Pacific have helped establish these initiatives. For example, the Framework for Resilient Development in the Pacific 2017-2030 considers relocation and labour migration policies. Efforts to manage climate change-induced migration need to consider economic costs, sovereignty issues, and cultural elements. Further, these efforts should ensure equity across income levels and should be gender-neutral.

## 2.2 Policy response

Although loss-and-damage *per se* is rarely the object of policy making, a number of policy actions (and lack thereof) are relevant to loss and damage. This is especially apparent in the areas of flooding, resettlement, and food security. The literature on policy responses that are relevant to loss and damage includes these and a number of narrower issues, several of which are specific to Pacific islands. This literature can be divided in eight themes: international negotiations, policy priorities, policy design, food security, resettlement, culture, narratives and poverty.

### 2.2.1 International negotiations

**OVERVIEW.** Authors underscore the shortcomings of the international response to climate change-induced loss and damage. International negotiations are criticised for neglecting precautionary approaches and climate justice, and avoiding the issue of financing. Nonetheless, it is recognised that, even if international negotiations gave more weight to these issues, small-island developing states lack the resources to monitor, let alone manage, loss and damage. In this context, the point is made about the thin line that could separate maladaptation and loss-and-damage. Not least, authors caution about the need to distinguish, in a negotiating context, between the markedly

different realities of three types of islands: small-island developing states, dependent islands (such as Chenega, in Alaska) and sub-national island jurisdictions (such as Mayotte, in the Comoros archipelago).

**(Barnett and Adger, 2003):** Climate change threatens the long-term sustainability of sovereign atoll countries in the Pacific. Existing techniques for assessing optimum climate-policy responses are incapable of dealing with the risks posed to atoll countries and cultures. This is, in effect, a call for both new precautionary science and new institutions for decision-making at the global scale. The possible risks to atoll countries, and the mechanisms for insurance or funding for adaptation, have yet to be sufficiently incorporated into international climate change negotiations. These risks call for an explicit conception of justice such as that embodied in other international treaties and in some norms of international law.

**(Burkett, 2016):** Loss and damage is explicitly recognised in the Paris Agreement which, in itself, is an achievement for small-island developing states. In future negotiating rounds, island states (and least-developed countries) will have to deal with the absence of a clear funding stream, the treatment of climate-related displacement, and questions regarding compensation for climate impacts.

**(Ourbak and Magnan, 2018):** The Alliance of Small Island States (AOSIS) works to raise the profile of loss and damage and to develop concrete responses, such as financial instruments or comprehensive risk management approaches. Central to this work is the need to determine which climate change impacts are related to maladaptation versus (tolerated impacts and) loss and damage. The more maladaptation accounts for negative impacts on small-island developing states, the weaker AOSIS' negotiating positions will be.

**(Thomas and Benjamin, 2018a):** Small-island developing states face three main challenges when it comes to managing loss and damage: lack of data, which prevents most assessments and, specifically, only allows for the use of basic attribution methodologies; gaps in financial assessments; and lack of policies. As a result, loss and damage may go unreported, notably with regard to slow-onset events.

**(Petzold and Magnan, 2019):** Much effort has gone into researching climate change impacts on small-island developing states, which has helped mainstream the literature on islands and climate change. However, these efforts have inadvertently introduced biases, in the sense that the realities of small-island developing states are not always the same as those of dependent islands (such as Chenega, in Alaska) and sub-national island jurisdictions (such as Mayotte, in the Comoros archipelago). For example, depopulation is on the rise on dependent islands, but not in other types of islands; and access to insurance is better in dependent islands and sub-national island jurisdictions, compared to small-island developing states. These differences call for integrating three dimensions into studies of climate change impacts on islands: governance structures and relations of power; inter-island and island-mainland mobility of both people and resources; and centre-periphery relations within archipelagos.

### 2.2.2 Policy priorities

**OVERVIEW.** The literature on policy priorities includes two types of research outputs. On the one hand, biophysical research highlights a range of climate change impacts, which are expected to affect small-island developing states in the Pacific in unprecedented ways. On the other hand, social sciences research suggests that the lead-up to the above impacts will be deleterious in its own right (that is, life in Pacific islands will be completely changed before the consequences of these impacts manifest themselves fully). These developments are likely to be felt sooner and more strongly in smaller islands.

**(Mcleod *et al.*, 2010):** Sea-level rise will significantly affect coastal regions and habitats in the Coral Triangle countries, but the impacts will differ across the region in terms of people flooded annually, coastal wetland change and loss, and damage and adaptation costs. In one scenario, by 2100 the Solomon Islands will have lost 68 percent of coastal wetlands (relative to 2000). Appropriate response measures must be broadly applied.

**(Fisher, 2011):** In Tuvalu, and from the point of view of human security, the impacts of climate change affect human systems in two ways. First, biophysical changes (brought about by climate change) threaten human support systems, thus creating psychological pressures that further increase vulnerability. Second, threats to, in particular, human health and food security bring about inequality, which drives insecurity (mostly, but not exclusively) in a domestic context. In sum, "mounting societal pressures produced by climate changes could create an uninhabitable space long before island inundation".

**(Duvat, 2019):** Over the past decades to century, atoll islands exhibited no widespread sign of physical destabilization by sea-level rise. Atoll island areal change was mainly influenced by island size: while the smallest islands exhibited contrasting areal changes (stability, increase, or decrease in size) and highly variable values of areal change (from −22.7 to +125.5%), the islands larger than 5 ha. generally experienced areal and positional stability. Therefore, from a geomorphic perspective, smaller islands may be more vulnerable to climate change than larger islands, and should be the focus of monitoring and assessment activities.

### 2.2.3 Policy design

**OVERVIEW.** Mostly on the basis of case studies, authors have put forward a number of recommendations with regard to policy design. Examples of these include calls to (i) adopt 'low-regrets' policies, with a view to reflecting the large prevailing uncertainties; (ii) empower local communities, including local youth, and rely on traditional knowledge for the framing of policy solutions; and (iii) strengthen responses from the points of view of both the technologies used and the approaches followed to make decisions.

**(Barnett, 2001):** In Pacific islands (and elsewhere), anticipatory policies to manage sea-level rise are inappropriate, given prevailing uncertainties. Instead, the policies considered should meet the following requirements: be precautionary and no-regrets in nature; incorporate and, to the extent possible, reduce uncertainty; and foster social and policy learning.

**(Nunn, 2009):** In Pacific island, current approaches to manage the impacts of climate change suffer from three types of shortcomings. First, governments should seek to empower communities and rely on external assistance only for out-of-ordinary situations or when innovative methods are tested. Second, technological breakthroughs are needed (for example, new strains to counter decreased agricultural productivity, or improved storage capacity to counter decreases in freshwater supply). Third, management breakthroughs are needed (for example, subsistence food-supply mapping and planning should be undertaken, building codes should be introduced and research should be sponsored). Key priorities are sea-level rise, inundation and salinization of economically critical lowland, and coral-reef degradation.

**(Lefale, 2010):** Samoans can accurately predict the onset of extreme climate events, relying solely on local knowledge and environmental changes. When it comes to planning for climate change, traditional ecological knowledge of weather and climate should be just as important as western scientific knowledge.

**(Nunn and Kumar, 2018):** Adaptation failure is a key factor in sustaining, even amplifying, perceptions of island vulnerability. Better adaptation policies are needed, to counter such perceptions and avoid loss and damage. In the context of small-island developing states, better adaptation involves at least two types of actions. First, there is a need to ensure that islander values

and aspirations are at the heart of future adaptation planning and that this is environmentally appropriate as well as communicated in culturally acceptable ways. Second, the idea that "one size fits all" in terms of community intervention should be replaced by one that acknowledges the differing exposure to traditional and global knowledges, and the differing coping abilities of communities with varying degrees of "peripherality".

**(Scott-Parker and Kumar, 2018):** Pacific island youths are often marginalised within traditional decision-making hierarchies: typically, they are excluded from participating in meaningful discussions at community and government levels. Overwhelmingly, Fijian youths feel that they could have an effective voice on climate change if their message(s) had the backing from the council, government or environmental organisations. The government outreach interventions that occur within Fiji schools appear to be having some effect on students' knowledge and concern for climate change. Yet for these interventions to create behavioural change, they need to be complemented by community-wide outreach activities.

### 2.2.4 Food security

**OVERVIEW.** The literature reports on likely changes in the distribution and size of fisheries in the Pacific. These studies include policy recommendations that warn about what authors consider insufficient policy emphasis on a sector that is crucial to the economies of Pacific islands. At least partly, limited progress with policy making in the area of fisheries and, more generally, food security, could be due to limited knowledge co-production, which is linked to resource and culture gaps.

**(Bell, Reid, *et al.*, 2013):** Due to increases in sea surface temperature, changes in velocity of major currents and decreases in nutrient supply, the distribution of the four species of tuna that underpin oceanic fisheries in the tropical Pacific (skipjack, yellowfin, bigeye and albacore tuna) is expected to change. Islands in the east of the region (notably, Kiribati) will see tuna stocks increase. Because most of these islands rely on license fees for government revenue, the increase in tuna fisheries will afford Kiribati and other countries in the east with increased development opportunities. Conversely, countries in the west of the region will see tuna stocks decline. These countries rely on tuna mostly for securing food for their rapidly growing populations. In spite of the expected decline in tuna stocks, food security in countries like Palau or Micronesia should not be threatened. When drawing up developments plans, governments in the region should take into account these expected changes in the distribution of tuna.

**(Cvitanovic *et al.*, 2016):** In Pacific islands, managing food security in the face of climate change impacts requires that communities can access, understand and use new knowledge to inform their decision-making processes. Barriers to doing so include cultural differences between western science and cultural knowledge, a lack of trust among local communities and external scientists, inappropriate governance structures, and a lack of political and technical support. Breaking down these barriers requires long-term, sustained, participatory research approaches (that is, knowledge co-production) that engage key actors (notably, influential and trusted community members and church leaders) from the outset.

**(Rosegrant *et al.*, 2016):** The fisheries sectors in Vanuatu and Timor-Leste are important sources of food and income. However, they are vulnerable to the impacts of climate change, more so because of their geographic location, and the socioeconomic conditions and political instability in these countries. Nonetheless, there are approaches to build resilience against these threats. Such approaches include aquaculture development, natural resource management through the establishment and/or expansion of marine protected areas, and the deployment of low-cost inshore fish aggregating devices. To date, the level of deployment of these strategies remains insufficient.

### 2.2.5 Resettlement

**OVERVIEW.** Research on policy-relevant aspects of resettlement highlights two complementary issues. First, the risk of maladaptation that is associated with large-scale (permanent) resettlement, which suggests that other types of policies should be favoured, such as promoting volunteer labour mobility. Second, the difficulties faced by labourers who voluntarily (and temporarily) leave atoll islands to seek income in urban areas within the country. Notwithstanding, it seems clear that, for some communities, relocation may be inevitable.

**(Barnett and O'Neill, 2012):** Resettlement of those living on islands in anticipation of climate impacts carries a high risk of maladaptation, with adverse social and environmental outcomes. Other kinds of migration, such as increasing voluntary labour mobility, carry fewer risks and larger rewards in terms of coping with the impacts of climate change.

**(Nunn, 2013):** Around the middle of the twenty-first century, in the Pacific region, traditional coastal livelihoods will most likely to be difficult to sustain, so people in the region will need alternative food production systems. Within the next 20-30 years, it is likely that many coastal settlements will need to be relocated, partly or wholly. There are advantages in anticipating these needs and planning for them sooner rather than later. In many ways, the historical and modern Pacific will end within the next few decades.

**(Birk and Rasmussen, 2014):** In the Solomon Islands, migration from remote atoll islands to Honiara, the capital city, provides income to family members in the atoll islands, thus increasing their ability to manage some of the impacts of climate change. However, migrants face high transportation costs, and have few job opportunities and housing options. Through policies that improve the conditions of internal migration, including atoll migrants' rights to access land and resources in other islands, more drastic measures such as relocation of entire islands or communities may be avoided, at least in the near term.

### 2.2.6 Culture

**OVERVIEW.** The literature reports on the ways in which climate change impacts threaten culture, identity, community cohesion and sense of place, in spite of efforts to manage those impacts. At least partly, these failures are due to the difficulty associated with characterising the cultural dimensions of lives and livelihoods, and the near-incompatibility between these characteristics and most decision-making paradigms. Strong community involvement, possibly through churches, may help integrate into policy the cultural dimensions of lives and livelihoods.

**(Adger *et al.*, 2013):** Climate change threatens cultural dimensions of lives and livelihoods that include the material and lived aspects of culture, identity, community cohesion and sense of place. However, culture and identity are difficult to incorporate into public policy: losses of public goods such as community and place are not easily compensated or swayed by arguments over economically rational adjustments to risk. The challenge remains to address cultural dimensions, perhaps through appropriate-scale individual and community involvement in determining the goals of climate change policies and shaping their means of implementation.

**(Monnereau and Abraham, 2013):** Autonomous adaptation measures taken by communities in Kosrae (Micronesia) have been insufficient to counter sea-level rise. Reasons for this relate to both exogenous aspects (notably, the means available to these communities to construct seawalls) and endogenous factors (mainly, land tenure systems constrain relocation options). As a consequence, affected communities face costs (economic, social and cultural) that are not regained.

**(Haluza-Delay, 2014):** Churches play a significant role in the cultures and authority systems of local communities in the Pacific. For this reason, they are systematically involved in disaster-response programmes. For example, the presence of churches in every community in the Solomon Islands

fosters response to island disasters better than a national government that is perceived as distant. In addition, churches allow for female participation of an extent that would be difficult to achieve through traditional village authorities. On the negative side, concerns have been raised about the donations made by households to churches, in that the financial resources donated by parishioners are therefore not available for individuals and thus decrease their resiliency. In general, it can be argued that more institutionalized faiths (such as Christian or Muslim groups) are better positioned to be useful in the context of climate change, compared to faiths with lower degrees of organization or centralization (such as Hinduism and most indigenous faiths).

### 2.2.7 Narratives

**OVERVIEW.** Prevailing Western narratives about climate change offer no hope to small-island developing states in the Pacific. In her seminal 2005 article, Carol Farbotko contests this view, which would hinder policy design and implementation in Pacific islands (mostly, but not exclusively, through the links with development aid, which has assumed the narrative). The literature puts forward suggestions to counter such fatalist narratives. Yet, these suggestions contrast with the apathetic stance that, in some cases, Pacific islanders show with regard to more immediate and simpler environmental problems.

**(Farbotko, 2005):** Implicating climate change in the identity of people and place can constitute Tuvaluans as 'tragic victims' of environmental displacement, marginalizing discourses of adaptation for Tuvaluans and other inhabitants of low-lying islands, and silencing alternative constructions of Tuvaluan identity that could emphasize resilience and resourcefulness. The problematic ways in which island identities are constituted in the media's climate change discourse effectively hinder a more critical approach to the production and consumption of representations of climate change.

**(McNaught, Warrick and Cooper, 2014):** Dominant discourses of extraordinary vulnerability to climate change in the Pacific can create a misperception of risk and misplaced anxiety at the community scale. Three actions have been put forward to avoid this misperception. First, avoid a 'fatalistic' discourse and instead focus on communicating how local knowledge, combined with science, can be used to solve tangible local problems. Second, since long-term climate projections are difficult to conceptualise at the community level, priority should be given to 'no-regrets' actions focused on current problems and current risks, rather than possible impacts far into the future. Third, organisations working at the international and local levels need resources to communicate to these two different types of communities, which have different needs.

**(Rufin-Soler and Lageat, 2015):** Tuvalu's disappearance is regarded as inevitable. Yet, Tuvaluans face more immediate problems, notably drought, salinization and pollution of water supplies, and poor management of household waste. Although Tuvaluans refuse to see themselves as inevitable climate refugees, they show little initiative to change that fate, as evidenced by the apathy with which they are facing present-day environmental crises. Government would be well advised to counter the established pessimism with a vision for the future that also considers the community's immediate problems.

### 2.2.8 Poverty

**OVERVIEW.** Although most authors highlight the links between poverty and evidence of climate change-induced loss and damage, few focus on this topic. Those who do note the "downward slope of declining well-being and security" in which the poorest may fall as a result of loss an damage, and the gender gap in this area, which implies that women are more likely than men to fall into poverty.

**(Warner and Geest, 2013):** Vulnerable communities incur loss and damage through one of four pathways. Three of them can be changed by "increasing adaptive capacity, reducing exposure and vulnerability, and undertaking measures that increase the ability of affected people to adjust to the stressors they face within their social-ecological systems". Only the fourth pathway ("no measures

are adopted, due to the lack of capacity to respond to the climate threat or because coping/adaptation was not possible") refers to unavoidable impacts. Contrary to the coping strategies used to deal with drought and flood impacts, adaptation measures were much more diverse across the communities that experienced extreme events (notably cyclones and tropical storms) and slow-onset events, such as sea-level rise and changing rainfall patterns. Small-island developing states in the Pacific are among the latter. Communities that have few or no viable livelihood diversification opportunities resort to erosive coping strategies, such as selling livestock to compensate for poor harvests. This traps them in a downward slope of declining well-being and security.

**(Thomas *et al.*, 2018):** Extreme weather events such as droughts and cyclones increase the vulnerability of communities who depend on natural resources for their livelihoods. In the aftermath of category 5 tropical cyclone Winston, which landed on Fiji in February 2016, mud crab fishers were hard hit. Many reported the intention to find alternative livelihoods. Doing so was more difficult for women, because the knowledge and skills they had with regards to their fishing-related roles were not easily transferred to other types of occupations. Besides, migration is less of an option for women, compared to men. For these reasons, governmental post-disaster support to fishing communities ought to be gender sensitive.

## 2.3 Risk management

Disaster-risk reduction is a well researched area. In the Pacific, most research is arguably biased toward cyclones. Although this bias is understandable, it may have had the unintended impact of crowding out other types of studies. The literature on disaster-risk reduction in small-island developing states in the Pacific can be divided in four themes: governance, assessment, planning, and implementation.

### 2.3.1 Risk management governance

**OVERVIEW.** Managing disaster risk requires consideration of factors such as the merits of centralised versus decentralised governance models, and the approaches available to engage stakeholders that may have different and even conflicting interests. Not least, the risk management process would benefit from placing increased emphasis on preparedness and "build-back-better" approaches to reconstruction.

**(Nalau *et al.*, 2016):** In Australia, the responsibility for integrating climate-change adaptation and disaster-risk reduction is distributed across departments and agencies. In contrast, in both Vanuatu and the Solomon Islands a single focal point holds this responsibility. This choice is expected to reduce overlaps and provide a clearer picture of what actions are being implemented, by whom and where. For isolated communities, both models of responsibility allocation have been successful in dealing with climate change-induced disasters.

**(Edmonds and Noy, 2018):** Pacific island countries have made progress with regard to strengthening disaster risk governance and investing in disaster-risk reduction. Notwithstanding, more needs to be done on a third aspect that is crucial to managing the impacts of climate change, namely enhancing disaster preparedness for effective response and to "build-back-better" in recovery, rehabilitation and reconstruction. In the Pacific, and elsewhere, more knowledge is needed about what kind of ex-ante policies make recovery more successful, and what kinds of ex-post interventions further push in that direction.

**(Granderson, 2018):** In the area of disaster-risk reduction, integrated and participatory risk assessments are increasingly promoted as the most credible response, ensuring community buy-in and overcoming data and resource restrictions. However, integrating the risk assessments of

multiple actors can prove problematic, and demands attention to the diverse values and politics of the various actors involved. In Vanuatu, villagers assessed current impacts and risks from climate change in relation to wider socio-economic changes, and prioritized maintaining their way of life. In contrast, representatives of civil society organisations adopted a technocratic approach, drawing on climate science and focusing not only on the severity of risks but also on the potential need for external interventions. These differences reveal key challenges concerning actors' ways of knowing, conflicting values and worldviews, and the political interests influencing risk assessments.

### 2.3.2 Assessing risks

**OVERVIEW.** The literature reports a number of assessments in the areas of freshwater availability and sea-level rise, among others. Although projections are worrisome in all cases, authors warn about the variability across and even within regions, thus calling for case-specific assessments.

**(Terry and Chui, 2012):** In Pacific atoll islands, a 10 cm raise in sea levels results in relatively minor changes in the freshwater lens. However, a 40 cm raise in sea levels can lead to the thickness of the freshwater lens being reduced by half. These findings point towards Pacific atolls becoming increasingly uninhabitable long before their complete submergence by sea-level rise, owing to irrecoverable groundwater salinization and, therefore, seriously reduced freshwater availability.

**(Albert *et al.*, 2016):** Within the period 1947-2014, five out of thirty-three low-lying reef islands in the Solomon Islands have vanished, and a further six islands have experienced severe shoreline recession. Rates of shoreline recession are substantially higher in areas exposed to high wave energy, indicating a synergistic interaction between sea-level rise and waves.

**(Brown, Daigneault and Gawith, 2017):** In Fiji, the January and March 2012 floods damaged household crops and businesses. Flooding is projected to be more frequent and more severe under both moderate and severe climate change scenarios. The January 2012 food, which was estimated to have a 1-in-50-year return period, could become a 1-in-20-year or 1-in-10-year flood under climate change. Annual losses would increase by approximately 100 percent with moderate climate change, and 300 percent with severe climate change.

**(Schmutter, Nash and Dovey, 2017):** Ocean acidification drives erosion and displacement of communities, reduces food security, and threatens aquaculture, fisheries, biodiversity and tourism worldwide. These risks are lower in small-island developing states, because most are located in tropical areas of relatively low acidity. For this reason, and compared to other regions, small-island developing states may have a relative advantage in aquaculture and an important role to play in preserving marine species that may no longer be viable in other latitudes.

**(Giardino, Nederhoff and Vousdoukas, 2018):** In Ebeye island (the Marshall Islands), and without additional adaptation measures, expected annual damages associated with climate change impacts on coastal areas would increase by a factor of three to four by the end of the century, whereas the number of affected people would increase by a factor of two. Compared to a 1.5 °C scenario, in a 2 °C scenario damages increase by twenty percent and the number of affected people increases by fifteen percent.

**(Karnauskas *et al.*, 2018):** In small-island developing states, climate change-induced aridity (that is, the ratio of potential evaporation to rainfall) combined with anticipated population growth will threaten freshwater availability. Modelling results indicate that population growth will dominate changes in projected water stresses, especially toward the end of the century. A number of Pacific small-island developing states (Timor-Leste, Vanuatu, Solomon Islands and Papua New Guinea) are among the top seven water stressed small-island developing states. For these countries, water stresses remain high even in a 1.5 °C scenario. In addition to climate change-induced aridity, sea-level rise and wave-induced run-up contribute further to freshwater stresses. Actual projections vary greatly from across regions, which underscores the need for regionally specific risk assessments.

### 2.3.3 Developing risk management plans

**OVERVIEW.** Risk management plans have to consider a multiplicity of issues, ranging from potential societal conflict, to geophysical parameters, to anthropogenic change, to the mental health implications associated with disaster and loss. Plans have to be disaggregated by sector, and especial attention should be devoted to buildings and infrastructures that are close to the coastline.

**(Weir and Virani, 2011):** Climate change can increase tension that is already present in a Pacific island. Most obviously, this occurs when the manifestation of climate change results in relocation of an affected community onto someone else's land, since almost everywhere in the Pacific islands, a change in land use or land rights is a contentious issue. Risk management plans should integrate not only climate change and disaster considerations, but also (potential) conflict.

**(Siméoni and Ballu, 2012):** In 2004, Lataw village on Tegua Island (Vanuatu) was displaced by several hundred meters, to avoid coastal flooding. At the time, the flooding was attributed to sea-level rise. Today, the cause of the flooding is known to have been a combination of tectonic movements and multiannual El Niño / La Niña events over the period 1997-2009. It follows that climate-change risk planning in the Pacific should not neglect geophysical parameters.

**(Duvat, 2015):** Vulnerability trajectories vary greatly across regions and even across islands within the same region. This contrasts with the one-size-fits-all approach that is common in most international fora. In light of this diversity, future response strategies will have to evolve, to incorporate both natural and anthropogenic change. A typology of vulnerability trajectories in reef islands is proposed, to support the design of response strategies.

**(Kumar and Taylor, 2015):** Kiribati, the Marshall Islands and Tuvalu have over 95 percent of their built infrastructure located within 500 m of their coastlines, thus exposed to a variety of natural and climate change-related hazards. This situation calls for careful (and expensive) risk management plans.

**(Pearce *et al.*, 2018):** In Vusama village (Fiji), drought affects agriculture and livestock (directly) and human health and well-being (indirectly) by reducing food production and creating anxieties about not being able to sustain one's livelihood. While the former impact is well documented in the literature, the latter is less so. Regrettably, current risk management plans are reactive and short-term, and exclude mental well-being concerns.

### 2.3.4 Managing risks

**OVERVIEW.** The literature reports the effect that the income gap and a community's ethnical background can have on risk profiles, as do maladaptation or the lack of early-warning systems. In general, a worsening trend (a shift from "tolerable" to "intolerable" risk) is noted.

**(Mimura and Nunn, 1998):** In Fiji, sea-walls built to counter sea-level rise have been largely inappropriate, often exacerbating the problems that they were trying to solve. Lessons learned over the past few decades suggest four types of improvements. First, natural protections, notably vegetation such as mangroves should be enhanced and/or restored. Second, where the coastline has artificial structures, protective structures should shift from line to area protection, to better absorb wave energy. Third, where possible, vertical structures should be replaced with gently sloping structures with toe protections such as stones or concrete blocks. Fourth, the height of the ground on which coastal villagers live should be increased.

**(Gawith, Daigneault and Brown, 2016):** In Fiji, community resilience was only effective at mitigating climate-related loss-and-damage when communities had sufficient time and ability to respond to impending threats. This suggests that early warning is essential for community resilience to become responsive.

**(Brown *et al.*, 2018):** With regard to risk management, perceptions matter: over-inferring the risk of a future disaster may lead to under-investment in productive activities and/or over-investment in preventive measures. In Fiji, communities struck by cyclone Evan had diverging subjective expectations about future risks, depending on whether they are Indo-Fijians or indigenous Fijians. There may be two reasons for this. First, the "collectivist" social structure of indigenous Fijians effectively provides them with increased social protection after a shock. Second, environmental knowledge transmitted orally by successive generations is fundamental to Pacific peoples' wider holistic understanding of the natural and spiritual world, and oral traditions frequently include detailed information about natural disasters.

**(Taupo, Cuffe and Noy, 2018):** In Tuvalu, poor households are more vulnerable to negative climate change impacts because they lack the resources to respond. Besides, they are more likely to reside in areas highly exposed to disasters (closer to the coasts and at lower elevation) and have less ability to migrate (between and within the islands).

**(Handmer and Nalau, 2019):** In small-island developing states in the Pacific, the policy-options space is constrained by a combination of current climate variability and extremes, geographical conditions and socio-economic patterns (notably, subsistence economies). Risk profiles are shifting from "tolerable" (that is, low sea-level rise and inundation, and infrequent storms and storm surges) to "intolerable" (namely, permanent inundation, loss of drinking water resources and loss of livelihoods). Accordingly, policy responses will likely move from building seawalls, strengthening building codes and setting up early warning systems, to involuntary relocation and resettlement, and toward an increase in the importance of remittances to sustain local livelihoods.

## 2.4 Human health

**OVERVIEW.** The literature covers three main topics: food security, migration and psychological impacts. Food security is a growing problem in Polynesia and Micronesia (but not in Melanesia). In these regions, poor diets are responsible for the prevalence of chronic diseases, and people are reluctant to returning to traditional (healthier) diets. Migration plans often neglect the health implications associated with displacement, notably access to health systems. Regrettably, funding is more readily available for disaster response, compared to planned relocation. More generally, the catastrophe narrative associated with climate change, and also food security and migration issues (see above) have negative psychological health impacts.

**(Barnett, 2011):** Agreement on what is valuable to people is elusive, because values are subjective and highly cultural. Nonetheless, all human beings surely value access to sufficient, safe and nutritious food at all times. Climate change will adversely affect food systems in Pacific islands, including the supply of food from agriculture and fisheries, the ability of countries to import food, all food distribution systems, and the ability of households to purchase and utilise food. As a result, climate change puts at risk the very basic and universal need for people to have access to sufficient, safe, and nutritious food at all times. From this point of view, and for Pacific islanders, climate change threatens something intrinsically valuable.

**(Ahlgren, Yamada and Wong, 2014):** In the Marshall Islands, dependence on food aid has gradually increased over the past 70 years. The health impacts of the supplemental imported diet, combined with migration to population centres, may result in an even greater prevalence of chronic diseases. Food aid donors and the government of the Marshall Islands should re-examine the content of food aid, and ensure it is of sufficient quality to meet the right to health obligations. In addition, despite the inherent barriers to it, a return to local food production must be encouraged.

**(Allen, 2015):** On Malo island (Vanuatu), only one-fifth of the caloric intake comes from food imports

which, in most years, could be easily substituted with surplus subsistence production. Furthermore, in spite of localised pressure on land caused by population growth and extensive cash cropping, Malo people have been finding innovative solutions based on traditional practices and institutions. In short, Malo island underscores that not all Pacific Islands are characterised by vulnerability and food insecurity: while Polynesia and Micronesia may fit the food insecurity narrative, Melanesia does not. It follows that policy and donor interventions must be tailored to reflect the diverse food security contexts encountered in Pacific islands, including within individual countries.

**(Connell, 2015):** In Micronesia, agriculture, fishing and local food production have declined over the past 50 years – a trend that climate change is worsening. As a result, diets have incorporated more processed and imported foods, because of prestige, accessibility, cost and convenience. Simply put, Micronesians have generally gone from inadequate to unhealthy diets. Attempts have been made to encourage traditional agriculture through, for example, credits to households. However, such a return to tradition is perceived as regressive, and faces challenges associated with land shortages. Remittances may play a key role in helping Micronesians improve their diets – but only if the money is used to finance the purchase and/or production of healthier foodstuff.

**(McIver *et al.*, 2016):** Pacific island countries are among the most vulnerable in the world to the health impacts of climate change. This vulnerability is a function of their unique geographic, demographic, and socioeconomic characteristics, combined with their exposure to changing weather patterns (associated with climate change), the health risks this entails, and the limited capacity of the countries to manage such risks.

**(Schwerdtle, Bowen and McMichael, 2017):** Efforts to manage climate change-related migration should take into account both the human health impacts of migration and the quality of human health systems. The human health impacts of migration involve issues such as the risk of both infectious and non-communicable diseases, food security, environmental exposures (notably heat extremes), mental health and access to health services. The quality of human health systems can be measured by the extent to which these systems are both climate resilient and migrant inclusive.

**(Dannenberg *et al.*, 2019):** Relocating communities has disruptive health, sociocultural, and economic impacts. Health impacts include mental health, social capital, food security, water supply, sanitation, infectious diseases, injury, and health-care access. Few assessments of past relocations study health-related impacts. Doing so (for example, through health indicators before and after communities relocate) would help improve the planning and implementation of future relocation efforts. All impacts associated with relocation, including health impacts, can be managed more effectively when relocation is proactive (as opposed to reactive, in the aftermath of a disaster). However, funding is more readily available for disaster response, compared to planned relocation.

## 2.5 Aid effectiveness

**OVERVIEW.** Development aid directed toward disaster-risk reduction is relevant in the context of managing loss and damage. A number of changes would help improve the effectiveness of this type of aid: better integration with climate change adaptation, more inclusive community engagement, different design and implementation models for community-level projects, and a focus beyond biophysical issues. In addition, aid agencies and beneficiary governments could draw more on domestic approaches for resilience building, with a view to ultimately reducing reliance on aid.

**(Agrawala and Aalst, 2008):** Guidance is needed on how to integrate climate change risk management into development cooperation. Specifically, such guidance could give pointers toward (i) improving the usability of climate information, (ii) developing and testing climate-risk screening tools, and (iii) improving coordination and sharing of good practices.

**(Gero, Méheux and Dominey-Howes, 2011):** Better integration between initiatives in the areas of (i) disaster-risk reduction and (ii) climate change adaptation can help increase the effectiveness of the development aid-funded projects that support this kind of initiatives in small-island developing states in the Pacific. From the point of view of governance, two aspects are most influential in determining the extent and pace of integration: 'agency' and 'architecture'. With regard to 'agency', key issues include (i) the proliferation of actors from an increasingly larger range of sectors, with the newcomers being "unaware of pre-existing agency", and (ii) the learning required to understand and adhere to established hierarchies (for example, strong traditional local governance structures including formal "omen's Committees and Council of Chiefs" and faith-based groups). With regard to 'architecture', key issues include (i) fragmented policies, (ii) separate and uncoordinated funding mechanisms, (iii) the overlapping roles and separate agendas of the key regional agencies, and (iv) the need to increase technical capacities across actors in both the disaster-risk reduction and climate-change adaptation communities.

**(Gero *et al.*, 2014):** Disaster-response mechanisms require both informal communication and relationships, and formal relationships. Besides, these mechanisms are enhanced by appropriate participation of traditional leaders and churches, and the recognition and support for the coordination role played by national disaster management offices. Disaster response mechanisms are constrained by the lack of clear policies for requesting international assistance, the lack of coordinated disaster assessments, and limited human resources for disaster response.

**(Johnston, 2014):** In Fiji, people on the outer islands wait two to three weeks for aid to arrive after a disaster, whereas those in the main islands are in outcry after two to three days. A more sustainable middle point may entail embracing and expanding the self-reliance and preparation that people on outer islands have no choice but to exhibit.

**(Nunn *et al.*, 2014):** In Pacific SIDS, most impact studies have focused on the most densely populated areas, where top-down governance is most effective. Rural and outer-island communities, where long- established systems of environmental governance exist that contrast markedly with those which governments and their donor partners in the region favour, have seldom been subject of study. In these communities, when it comes to managing climate change impacts, traditional systems of environmental governance suffer from three shortcomings: lack of awareness among key community decision makers about climate change, the inappropriateness of traditional decision-making structures for dealing with both the complexity and pace of climate-driven environmental changes, and the short-term views associated with resource management in these communities. In light of this, development aid should be targeted directly at the community level, and should seek to overcome the three shortcomings above.

**(Barrowman and Kumar, 2018):** Most development aid-funded programmes conceptualise vulnerability as a biophysical issue "rather than a consequence of the dynamic interactions between political, institutional, economic and social structures". The dominance of this conceptualisation across most development aid-funded projects means that the shift needed to respond to anticipated impacts (under global temperature rises beyond the 1.5 °C) is delayed. In addition, some of these projects effectively lock-in development pathways that limit the choices available to future generations and may favour maladaptation.

## 2.6 Biodiversity loss

**OVERVIEW.** Ocean acidification is changing the marine ecosystem in the Pacific. While some species may thrive, the majority will decline, although dynamically through time and space. The balance between coastal and tuna fisheries will be affected, to the detriment of the former in most Pacific waters.

**(Fabricius *et al.*, 2011):** Ocean acidification, together with temperature stress, will probably lead to severely reduced diversity, structural complexity and resilience of Indo-Pacific coral reefs within this century. Although some species may thrive, the majority will decline.

**(Karnauskas and Cohen, 2012):** Around the Equator, warming and associated marine productivity decline will be mitigated by enhanced upwelling. (Upwelling refers to a process in which deep, cold water rises toward the surface – in this case, as a response to a strengthening of the equatorial undercurrent.) Thus, the coral reefs in this area (for example, in Kiribati's Gilbert islands) could become refuges for marine productivity and coral reefs in an otherwise desolate tropical seascape.

**(Bell, Ganachaud, *et al.*, 2013):** In the coming decades, Pacific islands tuna is expected to become more abundant, and both freshwater aquaculture and fisheries are likely to become more productive. Conversely, coral reefs, coastal fisheries and mariculture are likely to decline. Coastal communities, which will see marked increases in population, will need to adapt. Transferring fishing effort from coral reef fish to tuna will be especially important. Not least, effective integrated coastal zone management, to reduce the impact of local stressors on coastal fish habitats, will be imperative to counter some of the decline of coastal fisheries.

**(Munday *et al.*, 2014):** Natural carbon dioxide seeps in Papua New Guinea can be used to test the effects of continuous exposure to elevated concentrations of carbon dioxide (ocean acidification) on reef fish behaviour and metabolism in their natural habitat. Fish appear to adapt only partially to continued exposure to higher-than-normal concentrations of carbon dioxide in water. As acidification progresses, behavioural abnormalities will result in (i) increased mortality from predation, and (ii) adverse changes to the structure and function of future reef communities.

**(Ortiz *et al.*, 2014):** The effects of reducing emissions of greenhouse gases are felt by coral reefs only several decades after the reductions occur. In the event of a stark reduction in emissions, and contrary to Caribbean reefs, Pacific reefs would start to show recovery within the first half of this century. Moreover, it seems that Pacific reefs have the potential to maintain their ecological integrity and ecosystem state in the mid- to long term if carbon emissions are reduced, but only if plate-like corals are present.

**(Albert *et al.*, 2017):** In 2007, an earthquake in the western Solomon Islands resulted in a localised subsidence event in which sea level (relative to the previous coastal settings) rose by approximately 30-70 cm, providing insight into impacts of future rapid changes to sea level on coastal ecosystems. Over the period 2006-2014, coral reef habitats increased their areal coverage, whereas mangrove ecosystems experienced a decline. However, seven years after the earthquake, mangrove forests had recovered, albeit with a different community structure. In sum, it can be inferred that winners and losers from the impacts of sea-level rise may vary over time and space.

## 2.7 Traditional knowledge

**OVERVIEW.** Overwhelmingly, the literature underscores the need to rely on valid traditional knowledge to manage the impacts of climate change. In addition to the intrinsic value it has with regard to framing effective policy responses, this knowledge is embedded in a hopeful attitude to the future that contrasts with Western views. Tragically, traditional knowledge is being marginalised and can be lost, as Western lifestyles and decision-making paradigms become more prominent among Pacific island communities.

**(McNamara and Prasad, 2014):** Traditional knowledge from Fiji and Vanuatu is documented, with a focus on strategies to cope with cyclones and droughts. These strategies involve using particular planting techniques, innovative water storage practices and particular food preservation techniques. Community-level vulnerability and risk assessments in the Pacific focus on science and seldom

reflect traditional knowledge. Integration of both approaches is badly needed.

**(Hiwasaki *et al.*, 2015):** Indigenous knowledge enables communities to better face and respond to the impacts of climate change and climate-related hazards. Such knowledge is embodied in four different elements of Pacific island culture. First, folklore, rituals and ceremonies, which prevent and mitigate climate-related hazards and engender and reinforce respect for the environment. Second, customary laws that govern behaviour, and strengthen social cohesion thus contributing to disaster prevention. Third, local food, materials and structures used for mitigation and adaptation to hazards and climate change, and preparation for their impacts. Fourth, observations of changes in the environment and celestial bodies, to predict climate-related hazards. Some of this indigenous knowledge can be integrated into science. All of it can be used to further research, education and policy.

**(Leon *et al.*, 2015):** Local and traditional knowledge is of great value for managing climate change impacts, especially when local measurements and scientific data at appropriate spatial and temporal scales are lacking or limited. In BoeBoe village (Fiji), integration of traditional knowledge with geographically-referenced and other scientific data helped raise awareness about exposure to coastal hazards.

**(Janif *et al.*, 2016):** In Fiji's remote communities (and in similar communities elsewhere in the Pacific), there is a wealth of knowledge about the precursors of environmental threats and about how to prepare for these. The former are mostly long-held beliefs that have not been scientifically validated (stories like catching particular fish, or observing hornets' nests), while the latter generally represent knowledge of undisputed validity. In these communities, there is a tension around privileging of traditional or Western scientific knowledge – a tension that increasingly encourages people to choose one or the other. The erosion of traditional environmental knowledge over recent decades has been severe and is likely to continue apace, which will reduce community self-sufficiency and resilience.

**(Nunn *et al.*, 2017):** Plans to sustain coastal livelihoods will be neither effective nor sustainable unless they incorporate key cultural attributes such as the stonework tradition that is engrained so deeply in Micronesian culture. More broadly, the characterisation of Pacific Islands as especially vulnerable to climate change often undervalues the cultural resilience of their inhabitants by silencing alternative identities that emphasise more empowering qualities of resilience and resourcefulness.

**(Weir, Dovey and Orcherton, 2017):** Pacific islander have developed customary or "traditional" practices that enable communities to adapt and recover from climate-related disasters such as tropical cyclones, floods and droughts. However, three new developments are weakening these practices. First, consumerism and urban migration, especially among the youngest and even at the level of small villages. Second, traditional knowledge is hard to apply to potentially vulnerable components of national infrastructure (for example, roads, town water supplies and hospitals, schools, and port and airport facilities). Third, customary practices are less suitable for climate change-induced impacts such as sea-level rise and ocean acidification.

## 2.8 Local beliefs

**OVERVIEW.** The literature systematically highlights both the gap between scientifically-informed Western approaches and local beliefs, and the need to manage climate change impacts in a wat that reflects local beliefs. How to do the latter has to be determined on a case-by-case basis. Possibly because they reflect centuries of experience with climatic and environmental stresses, local beliefs about climate change tend to be more optimistic than science-driven Western appreciations.

**(Lata and Nunn, 2012).** For communities in the Rewa Delta (Fiji), climate change is perceived as an alien concept because (i) the information available about it is in a foreign language, which alienates audiences, and (ii) the examples of people impacted feel remote, even when these people live in Pacific islands. This misguided perception reduces the effectiveness of traditional decision-making procedures. For this reason, traditional (hereditary and hierarchical, non-democratic and exclusive) decision-making procedures are often unsuited to cope with long-term environmental challenges. These procedures are not informed by science and at best are based on the emulation of solutions in familiar situations. So-called participatory learning and action tools have been used successfully to bring science into traditional decision-making processes.

**(Martin *et al.*, 2018).** Survey data from Denimanu (Yadua island, Fiji) shows that the way locals respond to the multiple climate-linked stressors they face is influenced by the significant gap between scientifically-determined risk and perceived risk, which "frustrates the development of effective and sustainable adaptation strategies for climate change". Perceived risk would be a function of three issues. First, spiritual beliefs ("ultimate causes [of disasters, including climate change-linked disasters] often concern deities and people's behaviour towards them"). Second, traditional governance structures ("so that communal decision-making is often slow to catch up with contemporary (scientific) understanding of observed environmental changes and how best to respond to these"). Third, "to be effective and sustainable, adaptation strategies should acknowledge residents' worldviews and beliefs rather than try to uncritically substitute them."

**(Walshe *et al.*, 2018).** At the community level, perceived risks differ from actual risks. Even within one community, perceptions vary across stakeholder groups. Nonetheless, all stakeholders agree that "something can be done" about climate change. This view contrasts with the prevalent discourse, "in which islanders are passive and doomed". Notwithstanding, any response to climate change impacts "should be done by communities, not on communities".

## 2.9 Relocation

**OVERVIEW.** When it comes to relocation (that is, moving within the borders of a community's own country), land tenure becomes a central issue. Securing land in a manner that respects customary tenure systems can take time, may lead to changes in social practices, notably inter-marriages, and is likely to rely increasingly on remittances. In all instances, affected communities should be deeply involved in the planning process, which should foresee the creation of livelihoods for these communities.

**(Edwards, 2013):** To date, the Carteret Islands (Papua New Guinea) is the most widely publicised case of relocation. It highlights many of the issues and obstacles that future climate-induced resettlement projects may face. Simply put, successful resettlements can only be achieved with land security, the creation of livelihoods, and support from host communities.

**(McNamara and Des Combes, 2015):** Relocation processes completed thus far reveal three pre-conditions for success. First, the affected communities need to lead the relocation decision-making process (in terms of where, how and when). Second, governmental technical and financial cooperation is needed to ensure sustainable livelihoods in the short- and long-term. Third,

availability of land to relocate to has to be secured, especially if communities cannot relocation within their customary land borders.

**(Albert *et al.*, 2018):** A governance framework for relocation (in response to climate change-induced sea-level rise) is missing. Such a framework should guide decisions concerning land tenure, and the financial support and planning required for the relocation. It should incorporate the customary land tenure system where access to land and resources is controlled by lineage and kinship. Such a framework should reflect three overriding trends. First, decisions today are subject to a process of consultation and negotiation with leaders, which can take years. Second, inter-marriages may become common where communities living in coastal areas are culturally different from communities living in high-elevation land. Third, remittances (where applicable) could help finance relocation.

# Annex 1: Selection of the literature

The following paragraphs describe the steps taken to select the literature that was analysed. The selection was a two-pronged process, involving a database search complemented with a scan of in-text citations.

A total of 105 documents were identified, 73 through a database search and 32 through in-text citations:

- the database search yielded 73 documents, as per the following breakdown:
  - 56 documents from English-language journals that publish regularly on loss and damage
  - 14 documents from any other English-language journals
  - 3 documents from French-language journals
- relevant in-text citations in the 73 articles above yielded 32 additional documents, as per the following breakdown:
  - 31 documents in English
  - 1 document in French

## 1. Database search

The search was performed on Scopus, an online database that includes most indexed peer-reviewed literature. Two separate searches were performed: one for English-language documents and one for French-language documents. Both searches were performed on March 14th, 2019.

### 1.1 English-language documents

The search consisted of two different strings: one restricted to the journals that (focus on climate change and) publish most of the existing articles related to loss and damage, and one for all other journals.

#### 1.1.a English-language journals that publish regularly on the topic of loss and damage

**Search criteria:**

- the title, abstract or list of keywords should contain one or more of the following terms: "Fiji", "Kiribati", "Marshall Islands", "Micronesia", "Nauru", "Palau", "Papua New Guinea", "Samoa", "Solomon Islands", "Timor-Leste", "Tonga", "Tuvalu", "Vanuatu", "Pacific", or "island*"
- any part of text should contain one or more of the following terms: "impact*", "loss*", or "damage*"

- the search should only consider the following journals: "Nature Climate Change", "Climatic Change", "Regional Environmental Change", " Wiley Interdisciplinary Reviews: Climate Change", "Climate Policy", "Climate and Development", " International Journal of Global Warming", "Climate Risk Management", "International Journal of Climate Change Strategies and Management", or "Climate Law"

Search string:

( ISSN ( "1758-6798" OR "0165-0009" OR "1436-378X" OR "1757-7780" OR "1469-3062" OR "1756-5529" OR "1758-2083" OR "2212-0963" OR "1756-8692" OR "1878-6553" ) AND TITLE-ABS-KEY ( "Fiji" OR "Kiribati" OR "Marshall Islands" OR "Micronesia" OR "Nauru" OR "Palau" OR "Papua New Guinea" OR "Samoa" OR "Solomon Islands" OR "Timor-Leste" OR "Tonga" OR "Tuvalu" OR "Vanuatu" OR "Pacific" OR "island*" ) AND ALL ( "impact*" OR "loss*" OR "damage*" ) )

Results:

- 504 documents retrieved, of which 66 were selected for analysis based on the text in the abstract
- after having studied the documents in detail, 10 of them were discarded, thus leaving a sub-total of 56 documents

### 1.1.b Remaining English-language journals

Search criteria:

- the title, abstract or list of keywords should contain one or more of the following terms: "Fiji", "Kiribati", "Marshall Islands", "Micronesia", "Nauru", "Palau", "Papua New Guinea", "Samoa", "Solomon Islands", "Timor-Leste", "Tonga", "Tuvalu", "Vanuatu", "Pacific", "island*", or "climat*"
- any part of text should contain one or more of the following phrase: "loss and damage"
- the search should exclude the following journals: "Nature Climate Change", "Climatic Change", "Regional Environmental Change", " Wiley Interdisciplinary Reviews: Climate Change", "Climate Policy", "Climate and Development", " International Journal of Global Warming", "Climate Risk Management", "International Journal of Climate Change Strategies and Management", or "Climate Law"

Search string:

( TITLE-ABS-KEY ( "Fiji" OR "Kiribati" OR "Marshall Islands" OR "Micronesia" OR "Nauru" OR "Palau" OR "Papua New Guinea" OR "Samoa" OR "Solomon Islands" OR "Timor-Leste" OR "Tonga" OR "Tuvalu" OR "Vanuatu" OR "Pacific" OR "island*" ) AND TITLE-ABS-KEY ( "climat*" ) AND ALL ( "loss and damage" ) AND NOT ISSN ( "1758-6798" OR "0165-0009" OR "1436-378X"

OR "1757-7780" OR "1469-3062" OR "1756-5529" OR "1758-2083" OR "2212-0963" OR "1756-8692" OR "1878-6553" ) )

### Results:

- 82 documents retrieved, of which 14 were selected for analysis based on the text in the abstract (11 journal articles and 3 book chapters)
- after having studied the documents in detail, none of them were discarded, thus leaving a sub-total of 14 documents

## 1.2. French-language documents

### Search criteria:

- the title, abstract or list of keywords should contain the French translation of one or more of the following terms: "Fiji", "Kiribati", "Marshall Islands", "Micronesia", "Nauru", "Palau", "Papua New Guinea", "Samoa", "Solomon Islands", "Timor-Leste", "Tonga", "Tuvalu", "Vanuatu", "Pacific", "island*", or "climat*"
- any part of text should contain the French translation of one or more of the following terms: "impact*", "loss*", or "damage*"
- the search should only consider French language journals

### Search string:

( ( LANGUAGE ( french ) AND TITLE-ABS-KEY ( "Iles Marshall" OR "Samoa" OR ''Iles Salomon" OR "Timor-Leste" OR "Tonga" OR " Tuvalu" OR "Vanuatu" OR "Pacifique" OR "île*" OR "insulaire*" ) AND TITLE-ABS-KEY ( "climat*" ) AND ALL ( "impact*" OR "perte*" OR "dommage*" ))) OR ( ( LANGUAGE ( french ) AND TITLE-ABS-KEY ( "Fidji" OR "Kiribati" OR "Micronésie" OR "Nauru" OR "Palau" OR "Papouasie Nouvelle Guinée" OR "Pacifique" OR ''île*" OR "insulaire*" ) AND TITLE-ABS-KEY ( "climat*" ) AND ALL( "impact*" OR "perte*" OR "dommage*" )))

### Results:

- 38 documents retrieved, of which 3 were selected for analysis based on the text in the abstract
- after having studied the documents in detail, none of them were discarded, thus leaving a sub-total of 3 documents

## 2. In-text citations

In reviewing the documents selected as per the description above, relevant in-text citations were identified (that is, relevant documents that the database search did not pick up). Through this process, an additional 32 documents were added to the list (31 documents in English and 1 document in French).

# Annex 2: Overview of documents

**Table 1: Main journals, by number of articles reviewed**

| Journal | Articles |
|---|---|
| Regional Environmental Change | 17 |
| Climatic Change | 10 |
| Climate and Development | 9 |
| Nature Climate Change | 8 |
| International Journal of Climate Change Strategies and Management | 5 |
| International Journal of Global Warming | 4 |
| Annales de Géographie | 3 |
| Asia Pacific Viewpoint | 3 |
| Wiley Interdisciplinary Review: Climate Change | 3 |
| Climate Policy | 2 |
| Climate Risk Management | 2 |
| Disaster Prevention and Management | 2 |
| Environmental Research Letters | 2 |
| Global Environmental Change | 2 |
| Singapore Journal of Tropical Geography | 2 |
| World Development | 2 |

Note: journals from which only one article was drawn are not listed

**Table 2: Geographical focus, by country or country grouping**

| Country or country grouping | Articles |
|---|---|
| Fiji | 20 |
| Pacific SIDS | 19 |
| All SIDS | 17 |
| Tuvalu | 17 |
| Kiribati | 14 |
| Vanuatu | 11 |
| Marshall Islands | 10 |
| Solomon Islands | 10 |
| Papua New Guinea | 8 |
| Micronesia | 6 |
| Samoa | 4 |
| Timor-Leste | 3 |
| Nauru | 2 |
| Palau | 1 |
| Tonga | 0 |

Note: the article count exceeds 105 because some articles focus on more than one country or country grouping

**Table 3: Main theme of the article**

| Theme | Articles |
|---|---|
| Migration | 28 |
| Policy response | 27 |
| Risk management | 19 |
| Human health | 7 |
| Aid effectiveness | 6 |
| Biodiversity loss | 6 |
| Traditional knowledge | 6 |
| Local views | 3 |
| Relocation | 3 |

**Table 4: Corresponding author, by affiliation**

| Affiliation of the corresponding author | Articles |
|---|---|
| Foreign research centre | 97 |
| Pacific SIDS research centre | 8 |

**Table 5: Corresponding authors**

| Author | Articles |
|---|---|
| Jonathon Barnett (University of Melbourne, Australia) | 5 |
| Patrick Nunn (University of the Sunshine Coast, Australia | 4 |
| Simon Albert (University of Queensland, Australia) | 3 |
| Carol Farbotko (Commonwealth Scientific and Industrial Research Organisation, Australia) | 3 |
| Karen E. McNamara (University of Queensland, Australia) | 3 |
| Johann D. Bell (University of Wollongong, Australia) | 2 |
| Philip Brown (Landcare Research, New Zealand) | 2 |
| John Connell (University of Sidney, Australia) | 2 |
| Virginie K. E. Duvat (Université de La Rochelle, France) | 2 |
| Anna Gero (University of Technology Sidney, Australia) | 2 |
| Kristopher B. Karnauskas (University of Colorado at Boulder, United States) | 2 |
| Ilan Kelman (University College London, United Kingdom) | 2 |
| Johanna Nalau (Griffith University, Australia) | 2 |
| Roy Smith (Nottingham Trent University, United Kingdom) | 2 |
| Adelle Thomas (University of the Bahamas, Bahamas) | 2 |
| Anthony Weir (Australian National University, Australia) | 2 |

Note: authors with only one article are not listed

**Table 6: Events, by type**

| Event | Articles |
|---|---|
| Extreme events | 25 |
| Slow-onset events | 29 |
| Both types | 51 |

**Table 7: Losses, by type**

| Losses | Articles |
|---|---|
| Economic losses | 41 |
| Non-economic losses | 14 |
| Both types | 50 |

# Annex 3: References

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