Climate risk insurance in Pacific Small Island Developing States: possibilities, challenges and vulnerabilities—a comprehensive review

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Abstract
For the Pacific Small Island Developing States (PSIDS), climate change will greatly exacerbate their vulnerability. The PSIDS have a high ranking in the Climate Risk Index and the World Risk Index. Financial losses due to climate-induced disasters, in terms of gross domestic product (GDP), are also high in the Pacific region. While climate risk insurance solutions could play a key role in the efficient distribution of recovery resources, there are many challenges to their successful implementation. Effective climate risk insurance products for the vulnerable sections of these societies are almost non-existent in this part of the world. Among the worst climate-induced disasters to affect the PSIDS are those related to cyclones and floods. These not only adversely impact the welfare of the households affected by these disasters, but they lower the long-term development potential of the countries involved. There is also evidence to suggest that climate-induced disasters are increasing in frequency and intensity over time due to climate change. It is against this background that an inquiry into the necessity for climate risk insurance products in the context of PSIDS should take place. This paper gives a comprehensive review of the literature addressing climate risk insurance as a risk mitigation or climate adaptation tool for managing the climate-induced financial vulnerabilities in the PSIDS. The paper explores the affordability of climate risk insurance, particularly among the vulnerable sections of society, and discusses the challenges of implementing an appropriate climate risk insurance model in the region. Finally, it examines recent climate risk insurance initiatives that have been attempted by multilateral agencies, such as the United Nations Development Programme (UNDP), the United Nations’ Pacific Financial Inclusion Practice (UNCDF), Pacific Insurance and Climate Adaptation Programme (PICAP), and respective local governments.

Keywords Climate risk insurance · Economic impact of climate-induced disasters · Climate risk mitigation · Pacific Small Island Developing States (PSIDS) · The South Pacific

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1 Introduction

The Pacific Small Island Developing States (PSIDS)\(^1\) have the highest vulnerability to climate-induced disasters (World Risk Report 2019). Data released by the World Bank in September 2019\(^2\) indicate that these countries had a combined population of 2.3 million people, spread over hundreds of islands, and scattered over an area roughly equivalent to 15% of the surface area of the earth. Of these, Fiji was the most populous country, with a population of about 900,000, whereas Tuvalu and Nauru had the smallest populations of 11,000 each. In this context, the World Risk Index (2019)\(^3\) ranks five PSIDS among the most prone to risk in the world, with Vanuatu and Tonga ranked numbers 1 and 2 respectively.

The ‘poverty headcount ratio’ (the percentage of the population living below the national poverty line) has remained high in the PSIDS over the last decade (World Bank 2021). There are some deep structural reasons why the PSIDS are unable to raise living standards rapidly. These reasons include the small size of the countries, their remoteness, limited natural resources, narrowly based economies, large distances from major markets, and vulnerability to external shocks, all of which affect growth and have often led to a high degree of economic volatility in the region (ADB-Pacific Approach 2016; Edwards and Romero 2020). Therefore, the PSIDS remain unable to attain sustained rises in living standards and are highly aid-dependent (Jain et al. 2020).

The cost of naturally induced disasters in the PSIDS has been estimated to range from a few per cent to over 30% of GDP (Ramachandran and Masood 2019). Among the worst climate-induced disasters to affect the PSIDS, the most serious are those related to climate (such as cyclones, floods, and wildfires). These events often destroy individual households, but they also tend to lower the long-term development potential of the countries involved. Furthermore, it seems highly likely that climate-induced disasters are increasing in frequency and intensity over time (Thomas and López 2015).

Handmer and Nalau (2019) discussed the estimation of losses and damages in PSIDS due to climate-induced disasters. They highlighted a scheme for estimating losses that uses a multilateral approach (including several national and international agencies such as reliefweb, United Nations Office for the Coordination of Humanitarian Affairs (OCHA), and the twenty-third Conference of the Parties (COP-23)).

The vulnerabilities of PSIDS are also rising due to the increasing frequency and ferocity of climate-induced hazards. The climate change vulnerability consists of exposure, sensitivity, and adaptive capacity. It is called the susceptibility of a species, system, or resource to the negative effects of climate change and other stressors (Glick et al. 2011). There are several methods of Climate Change Vulnerability Assessment (CCVA) prevalent among governments, institutions, and organisations. The Intergovernmental Panel on Climate Change (IPCC 2014) describes climate change vulnerability as the product of exposure and coping capacity, which arises due to the frequency of climate-induced hazards. The

\(^1\) The World Bank lists the following as Pacific Island Countries (PIC): Fiji, Kiribati, Marshall Islands, Federated States of Micronesia, Nauru, Palau, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu. However, some references include in addition to the 11 above: the Cook Islands, Niue, and Tokelau.

\(^2\) See https://www.worldbank.org/en/country/pacificislands/overview. Accessed 9 January 2020.

\(^3\) See https://weltrisikobericht.de/english-2/. Accessed 9 January 2020.
vulnerability assessment, together with the actual hazard, determines the risk due to the hazard.\footnote{There are good discussions on Climate Change Vulnerability Assessment (CCVA) tools on the webpage: climateactiontool.org (CCVA 2017) and in Downing et.al. (2020).}

The insurance sector, as the world’s biggest risk aggregator, can play an active role in understanding and managing the financial vulnerability of climate-induced disasters (Mills 2007). Climate risk insurance integrates financial mitigation strategies to handle losses and damages due to climate-induced disasters (Linnerooth-Bayer et al. 2018). It is against this background that an inquiry into the possibility, and benefits, of climate risk insurance in the context of PSIDS should take place.

This paper reviews financial mitigation policies and strategies reported in the literature for handling climate risk in PSIDS. After reviewing the projects related to climate risk insurance of various international agencies actively engaged in climate risk insurance, the possibility of a more effective policy-oriented strategy is explored.

This study contributes to the gap in the literature related to the use of climate risk insurance as an effective mitigation strategy in PSIDS. This paper also explores possible climate risk mitigation policies which involve tripartite arrangements of private insurers, international aid agencies, and local governments.

The remainder of the paper is organised as follows. Section 2 deals with the updated assessment of climate-induced disasters in the PSIDS. It identifies compelling reasons for having efficient climate risk insurance for the sections of society that are vulnerable to climate-induced disasters, and it discusses their vulnerabilities. Section 3 surveys the relevant literature for insurance solutions for climate-induced disaster risk reduction. Section 4 reviews the various climate risk insurance schemes implemented elsewhere in the world and suggests a possible framework for climate risk reduction in PSIDS. Section 5 concludes indicating the best way forward.

2 Background

2.1 Recent major climate-induced disasters and their impact

In February 2016, the category 5 Tropical Cyclone (TC) Winston struck Fiji. It was the most devastating tropical cyclone in the southern hemisphere since records began. It affected approximately 540,400 people or 62% of the national population of Fiji (estimated as 865,611 at the end of 2014 (Esler 2016)). It resulted in the loss of 14,450,129 workdays and F$351.45 million in personal income, and it affected the livelihoods of about 108,083 households (Esler 2016). By April 2016, nearly 5780 employees and workers were laid-off, with the resultant loss of income (Esler 2016). Fiji’s Post-Disaster Needs Assessment (Esler 2016) further estimated that 263,000 women were affected by the disaster (some 89.75%). In terms of livelihoods affected, 57% related to the agricultural sector, 17% to commerce, 10% to manufacturing, and 8% to tourism and transportation equally (Esler 2016).

Table 1 captures the experiences of three countries (Fiji, Tonga, and Vanuatu) after major cyclones. It shows the amount of loss and damages incurred, the amount paid by
### Table 1  Loss assessment, assistance and relief measures

| After Tropical Cyclone Winston in Fiji (2016) | After Tropical Cyclone Pam in Vanuatu (2015) | After Tropical Cyclone Gita in Tonga (2018) |
|------------------------------------------------|------------------------------------------------|---------------------------------------------|
| • $220 million USD was given by the Gov. of Fiji to ordinary Fijians to rebuild | • Spending on emergency relief operations from ministries’ recurrent budgets totalled $450,000 USD | • $47.3 million USD was allocated by the Government of Tonga over 3 years for rebuilding |
| • $216 million USD in losses were experienced by the agricultural sector | • Pacific Catastrophe Risk Insurance Company (PCRIC) payout of $1.9 million USD | • $43 million USD in losses were experienced by the agricultural sector |
| • Only $64 million USD was provided by the international community for financial assistance | • The government of Vanuatu has received grants worth $4.1 million USD | • The government received $11.17 million USD foreign assistance for its cyclone recovery program |
| • The government of Fiji had to take out a $50 million USD loan from the World Bank | • Total agriculture sector damage and losses are estimated to be approximately $53 million USD | • Pacific Catastrophe Risk Insurance Company (PCRIC) payout of $3.5 million USD |
| Fiji is still paying for the damages from Tropical Cyclone Winston today | Vanuatu is expected to incur, on average, $48 million USD per year in losses due to earthquakes and tropical cyclones | • The total economic value of the effects was estimated to be approximately $164.1 million USD |
| | | Tonga is expected to incur, on average, $15.5 million USD per year in losses due to earthquakes and tropical cyclones |

Source: Pacific Finance Inclusion Program (PFIP)
Fiji Government Budget supplement 2017–2018
http://www.worldbank.org/en/news/press-release/2016/06/30/world-bank-commits-50m-to-support-fijis-long-term-cyclone-winston-recovery
https://www.worldbank.org/en/news/feature/2017/12/19/taking-matters-into-own-hands-disaster-risk-insurance-in-the-pacific
https://cop23.com/fi/wp-content/uploads/2017/06/vanuatu_pdna_cyclone_pam_2015.pdf
https://reliefweb.int/sites/reliefweb.int/files/resources/tonga-pdna-tc-gita-2018.pdf
https://reliefweb.int/report/tonga/tonga-receives-record-insurance-payout-following-cyclone-gita
governments, donors, and the regional insurance body, Pacific Catastrophe Risk Insurance Company (PCRIC). These disbursements were significantly lower than the actual need since many affected people could never recover their livelihoods and incomes.

Since 2016, we have witnessed two more category 5 cyclones (Harold and Yasa). Yasa devastated Fiji and Vanuatu in 2020. Harold hit Fiji, Vanuatu, and Tonga also during 2020. Additionally, there have been 9 smaller events of category 2 or 3 since Winston in 2016.

2.2 Need for climate risk insurance in PSIDS: the South Pacific context

The South Pacific region consists of many small island countries. Almost all countries in the region endure the population penalty syndrome (Haque et al. 2012). Additionally, there are other challenges, such as their dependence on external aid and foreign investment, capacity constraints, lack of resources, and a lack of awareness of climate risk-related insurance products. Pacific island states are highly vulnerable, not only to climate-induced disasters, but also to other natural hazards, such as earthquakes, volcanic eruptions, tsunamis, storm surges, wildfires, and associated hazards (World Bank 2017). The World Bank estimated that the average annual total direct losses caused by disasters in the South Pacific were about US$284 million. Despite this high exposure to hazards, most people in this vulnerable region did not have any type of insurance, with penetration rates for insurance reaching only 12% in Fiji, 13% in Tonga, and 5% in Vanuatu. However, the insurance penetration rate has increased to 15% in Fiji since 2016 (RBF 2021). Moreover, many governments in the Pacific are not a member of any type of risk pool and thus do not have quick access to emergency financial resources after climate catastrophes. Rather, these countries depend on budget reallocation, international aid, and taking out additional credit, which can affect their long-term economic development. The Global Climate Risk Index is based on exposure and vulnerability assessment of society towards climate hazards or disasters. This index also includes assessments of susceptibility, lack of coping capacity, and lack of adaptive capacity. Table 2 depicts the ranking of these parameters for select South Pacific countries.

Except for Samoa, all of the selected countries of the South Pacific are in the top twenty high-risk indexes in all five parameters. Therefore, there is a need for urgent implementation of strategies of disaster risk reduction and mitigation, where climate risk insurance may play a vital role.

2.3 The sections of society affected by climate-induced disasters in PSIDS

What does a fresh produce seller in Samoa, a fish and crab seller in Vanuatu, a handicraft person in Tonga, a honey beekeeper in the Solomon Islands, and a dalo farmer in Fiji have in common? They are all part of the informal economy, supporting themselves and their

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5 The term population penalty is used to express the small size of population in Island countries. It is referred to as capacity constraints Small Island countries. See a detailed discussion on this in Haque, Knight, and Jayasuriya (2012).
6 https://www.worldbank.org/en/results/2012/04/01/pacific-islands-disaster-risk-reduction-and-financing-in-the-pacific
7 http://www.pfip.org/wp-content/uploads/2016/08/Fianancial-Services.pdf
8 http://www.pfip.org/wp-content/uploads/2017/08/TONGA-DSS-REPORT-LOWRES-FINAL.pdf
9 http://www.pfip.org/wp-content/uploads/2017/05/VANUATU-DSS.pdf
| Country       | WRI | Exposure | Vulnerability | Susceptibility | Lack of coping capacity | Lack Adaptive capacity | Top 20 ranking |
|---------------|-----|----------|---------------|----------------|-------------------------|------------------------|-----------------|
| Fiji          | 16.58 | 35.51   | 46.68         | 22.33          | 75.48                   | 42.24                 | 10              |
| Kiribati      | 15.42 | 26.37   | 58.47         | 41.64          | 82.61                   | 51.15                 | 15              |
| P.N.G         | 20.88 | 31.05   | 67.24         | 55.58          | 83.8                    | 62.35                 | 6               |
| Samoa         | 6.71  | 14.12   | 47.53         | 26.28          | 72.11                   | 44.19                 | 76              |
| Solomon Islands | 23.29 | 37.81   | 61.59         | 47.28          | 82.3                    | 55.19                 | 4               |
| Tonga         | 29.42 | 55.92   | 52.61         | 28.93          | 80.06                   | 48.83                 | 2               |
| Vanuatu       | 50.28 | 86.46   | 58.15         | 36.07          | 86.37                   | 52                    | 1               |

Interpretation of the index scores

| WRI index | Exposure | Vulnerability | Susceptibility | Lack of coping cap | Lack of adaptive |
|-----------|----------|---------------|----------------|-------------------|------------------|
| Very high risk | 10.44–50.28 | 17.74–86.46 | 63.01–76.47 | 46.49–70 | 84.10–92.28 | 54.78–72.52 |

Source: https://reliefweb.int/report/world/world-risk-report-2018 pp-48
families, creating new livelihoods, jobs, and helping to drive economic growth in their communities. They are called informal because they operate to some extent outside the realm of formal legal protection and without easy or full access to the advantages of formal financial and business support systems. They work as single-person operations or as micro and family enterprises with hired workers or unpaid family workers engaged in income-generating activities where women predominate.10

In the Pacific, the contributions of the informal economy11 have been unseen and undervalued for many years. But this sector has been the natural absorber of those leaving the rural agricultural sector, as well as those who could not get jobs in the formal (public and private) sector. According to some estimates,12 the incidence of the informality of economic activity is very high in the Pacific’s Melanesian and Micronesian countries (60–85%), and it is increasing in Polynesian countries (40–60%) (UNDP 2017). The informal economies contribute up to 50% of GDP in PSIDS, and they provide private and waged employment to more than half the working populations in Asia and the Pacific region (ILO 2018). The informal economy employed around 66.2% of the population, with more than half being women (ILO 2018). Furthermore, 70% of informal workers had just primary education (ILO 2018). The informality of work was most prevalent in agriculture (24.3%), domestic workers (22.2%), and wholesale and retail workers (13.7%) (ILO 2018).

Informal workers, particularly women, tend to occupy the bottom of the economic pyramid, with less protection and flexibility than their formal counterparts do (ILO 2018). Informal businesses in times of economic hardships and recent climate-induced disasters (TC Winston in Fiji, TC Pam in Vanuatu) had no cushion to fall back on and have no option but to keep operating or working (PFIP estimates are shown in Table 1).

Schaefer and Waters (2016) undertook extensive studies13 on climate insurance and concluded that the extremely poor and poor people were hardest hit by climate change because they had higher exposure to climate change impacts, were more vulnerable, and had lower coping capacities. The United Nations Office for Disaster Risk Reduction estimated that between 1995 and 2015, climate-induced disasters globally caused losses worth $1.89 billion, and they claimed approximately 606,000 lives (UNISDR 2015). Concerning national income, direct economic losses were more than double in low-income countries than in high-income countries, suggesting that countries with ‘lower per capita income generally

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10 One full chapter (Ch. 25) is dedicated to informal aspects of an economy in 5th Revision of Standard National Accounts (2008) of the IMF. Further discussion on estimating informal economy is found in UN handbook on non-observed economy (NOE) and OECD handbook on NOE.

11 There are many variations in defining the informal economy in the literature. Feige (1990) classified underground economies into four categories: the illegal economy, the unreported economy, the unrecorded economy, and the informal economy. Our objective is to address the fourth category, though there are some interconnections between the other categories. Feige (1990) said, ‘the salience of informal activities derives from the fact that their existence is intimately connected with the institutional arrangements imposed by the State. As such, whatever positive or negative outcomes that are associated with the emergence of the informal economy can in principle be either reinforced or weakened by policy actions which modify the institutional setting. In order to determine the causes and consequences of informal activity, it is necessary to estimate the size and composition of the informal economy’. There are various methods and models to estimate size of the informal economy, but that is beyond the scope of this paper. This subject is dealt with in our forthcoming paper ‘Measuring the informal economy in the South Pacific—Review of measurement methods and a suitable model for the South Pacific’.

12 Multiple reports of UNDP and ADB have estimated these figures.

13 MCII-Climate Risk Insurance for the poor and the vulnerable (2016). Literature references are drawn from these studies.
suffer more than countries with higher per capita income in terms of economic losses as a percentage of GDP’ (Ghesquiere and Mahul 2012).

Agriculture, in particular, is critical for poor people’s food security and nearly two-thirds of the extremely poor are employed in this sector (ILO 2016 p143). A recent World Bank study on the nature of poverty determined that poverty is concentrated in rural areas and the poor are most likely to earn agricultural income (Olinto et al. 2013). Moreover, modelling of the effects of climate change suggests that ‘climate change could result in global crop yield losses as large as 5% in 2030 and 30% in 2080’ (Hallegatte et al. 2016).

Hertel et al. (2010) found that price adjustments due to the impacts of climate change could increase poverty rates for households by 20–30%, in the 15 developing countries studied, by 2030. Ahmed et al. (2009) showed that poor urban labourers were the most vulnerable in the developing countries they studied, and the poverty headcount for this group could increase by as much as a factor of two due to a once-in-30-years extreme climate event.

The Munich Climate Risk Insurance Initiative (MCII) studies14 concluded that due to a lack of resources, access to information, financial services, and financial support from the family and community, the vulnerable and poor had fewer coping and adaptation capacities compared to the non-poor (Hallegatte et al. 2016). Since the poor often have no access to any formal protection schemes (Deblon and Loewe 2012), when a crisis occurs, they often resort to a variety of coping strategies that might impede sustainable development and exacerbate their poverty. Examples of coping strategies include consumption smoothing, which destabilises their consumption (such as food, education, and health) to protect and maintain productive assets (such as grain and livestock), and asset smoothing, where people sell productive assets to protect consumption (Carter 2014; Hoddinott 2006; Churchill 2007). Other strategies that might exacerbate dependence on aid and insecurity, in the long run, including borrowing money from family or friends, borrowing from microfinance institutions (MFIs) or moneylenders, relying on savings, or taking out loans (Churchill 2007; Deblon and Loewe 2012). In general, these informal strategies to manage climate risk usually cover only a small portion of the loss, so ‘the poor have to patch together support from various sources’ when an event occurs (Churchill 2007).

While the rich may lose more in absolute terms, the impacts of climate change have been most severe on those living below the poverty line. The immediate impacts include the loss of life, homes, livelihoods, earning capacities, and crops (Wilkinson et al. 2015). In a Pacific specific study on estimated loss of output due to disasters, the authors found that the disasters in the Pacific impacted both the supply side and aggregate demand (Hesiaie et al. 2019). Lopez-Calva and Ortiz-Juarez (2014) used a regression-based approach to determine the relationship between income and the probability of slipping back into poverty, in the event of a shock. They used income as the dimension onto which vulnerability to poverty was mapped. They suggested that the income threshold for vulnerability should be set at a 10% probability of descending into poverty in a 5-year interval.

The above account of the extant literature demonstrates that vulnerability itself is dynamic and related to exposure as well as to assets and poverty. Although many households may be non-poor in economic terms, they may still suffer from a lack of important elements (such as health, education, and sufficient assets), which in the event of a shock

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14 ibid.
might bring them back into poverty, especially in the absence of comprehensive risk management mechanisms and safety nets (Baulch and Hoddinott 2000).

3 Survey of literature and experience in the PSIDS

There are many innovative insurance solutions for disaster risk reduction, as discussed by Warner, et al. (2013). The authors suggest that insurance can create a degree of certainty that can facilitate investment. When climate risk insurance products are available in the market, there is the opportunity for increased investment in the agriculture sector as well as increased food security for the macroeconomy. The cost of adoption of climate risk reduction measures is high in small island states due to ‘socio-economic reality’ or ‘indivisibility’ (a disproportionate impact on GDP of an extreme climate catastrophe on small island states compared to large countries) of these small states (Nurse et al. 2014). This gives rise to another question: can insurance be considered as an appropriate response to the financial losses and damages of climate disasters? Experts (Linnerooth-Bayer et al. 2018) have raised doubts about the effectiveness of market-based insurance products for providing affordable, equitable, and compensatory responses. Linnerooth-Bayer et al. (2018) suggest that climate risk insurance products would need subsidies from global or regional insurance pools to make them affordable to informal and marginal sections of the affected societies.

The bundled micro-insurance products of Fiji Care (a private insurance company), when it was launched in 2017, was the first of its kind in the South Pacific. It was a joint initiative of PFIP15 and Australia Aid (now Department of Foreign Affairs and Trade). The Department of Foreign Affairs and Trade New Zealand also came on board in 2014. Fiji Care provided group insurance products covering the risk of life, accident, health, and funeral expenses. Initially targeted at sugar cane farmers, it was later extended to other farmers (copra, rice, and dairy). Surprisingly, these micro-products were extended to include civil servants (formal sector) and social welfare recipients through Government budgetary support whose numbers, which were higher than the farming communities in this scheme, made this scheme scalable and feasible. The Fiji Times (18 May 2019) suggested that the total payout under this bundled micro-insurance scheme was FJD 1.7 million (from the beginning to May 2019). The ratio of insurance premiums to payouts for civil servants was much higher than for the informal sector and marginal farmers, so the overall scheme was sustainable. But this product was not a pure climate risk insurance product, as it primarily targeted sugar cane farmers.

An assessment report in 2021, of six major PSIDS, showed that the majority of people and small businesses had no effective insurance to date (UNCDF 2021 -Climate Risk Insurance-literature review series). This report emphasised the importance of creating awareness in the targeted populations for increasing the uptake in insurance and designing tailor-made climate risk insurance products (country-specific).

A related key issue is to understand the best processes for estimating losses and damages in PSIDS. Handmer and Nalau (2019) investigated each specific risk context and the

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15 Pacific Financial Inclusion Program (PFIP, 2008–2021) is a joint program of United Nations Capital Development Fund (UNCDF) and United Nations Development Program (UNDP), based on the the pass through and parellel financing concepts. Its main objective is to achieve greater financial inclusion in PSIDS, being the most unbanked regions of the world.
available options in these countries. Post-Disaster Need Assessment (PDNA) is a systematised process that has been an internationally accepted methodology to estimate losses and damages resulting from disasters, for both the formal and informal sectors (Relief Web 2018). In a case study of TC PAM-2015 (Vanuatu), it was found that 69% of losses were in the private and informal sectors (PDNA-PAM 2015). The adopted method of assessing losses and damages should consider asset ownership variance (Handmer and Nalau 2019). There is still a need to develop an acceptable framework of assessment for losses and damages. This will be a building block for the effective implementation of climate risk insurance. The three main frameworks used to assess and quantify the financial risk are International Emergency Database (EM-DAT), DesInventar, and the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) (Relief Web 2018). However, Edmonds and Noy (2018) found inconsistencies in these three databases which resulted in an underestimation of the risk of catastrophe, ‘especially for atoll nations’. They also identified four trends in climate risk development that particularly affect Pacific island nations.

There has been a growing consensus on how to develop market-based climate risk insurance products in the Pacific. PCRAFI has been mandated to examine the viability of these insurance products. The Global Forum for Disaster Risk Reduction (GFDRR) has also been actively involved in addressing some of the issues related to the implementation of climate risk insurance in Small Island Developing States (SIDS). Their focus has been on assessing innovative financial instruments with private sector participation to promote sustainable resilience investments in SIDS (GFDRR 2019).

The low penetration of insurance is often linked with the developmental phase of an economy. According to one study, only 3% of disaster losses were covered by insurance in developing economies, while the percentage of insurance cover of disaster losses was 40% in developed economies (Hoeppe & Gurenko 2006). While in the Pacific (Fiji), there was an overall insurance gap of 88% in a demand-side survey of financial services during 2015.16

Palæari (2019) found that a high penetration of insurance is directly linked with the participation of the government in climate risk insurance schemes. Participation by society members may be voluntary or compulsory. The study evaluated various schemes in the European Union (EU) countries on various parameters such as penetration rate, voluntary or compulsory, push factors, risk reduction, and state role in the scheme. In fact, government pool schemes scored better than private insurers since government pools could raise funds post-disaster. There was a higher possibility of sustainability if there was government participation and effective implementation of those schemes towards the informal sector or marginal sections of the society (McAneney et al. 2016). Moreover, the number of claims may be high but total payouts may not be beyond the bounds of sovereign resources if they were designed with the support of global aid agencies and private insurance companies. Tripartite syndication may go a long way to increase insurance penetration in the South Pacific. The magnitude of financial losses due to climate-induced disasters affecting PSIDS was very high, as discussed earlier. The cost of rehabilitation post-disaster would be moderated if there were initiatives to provide affordable and feasible insurance to the informal sector.

Small amounts of governmental budgetary support, plus regular contributions from global aid agencies, may be enough to create government-monitored pools that are capable
of combating climate-induced disaster risk. The climate risk awareness and prevention efforts would add to the success of such micro-schemes. While studying the fiscal impact of climate-induced disasters, Melecky and Raddatz (2011) concluded that,

Disasters in countries with high insurance penetration also have smaller real consequences but do not result in deficit expansions. From an ex-post perspective, the availability of insurance offers the best mitigation approach against real and fiscal consequences of disasters. (Page 2)

There is an incentive for governments to strive for higher penetration of insurance to reduce the fiscal burden of climate-induced disasters. In other words, a subsidised insurance product is a better way of providing relief to the informal sector rather than using direct transfers after climate-induced disasters.

4 Climate risk insurance in the PSIDS

4.1 Factors important for designing climate risk insurance products in PSIDS

Flooding is the most common and recurring weather-related disaster in most parts of the world, including the Pacific. A flood-specific insurance product is gaining much attention in climate risk reduction strategies (Hudson 2018). For instance, Surmins (2013) reviewed the state of flood insurance in established insurance markets and developing countries. The study highlighted the increasing supply and demand gap in the flood insurance market.

The increasing costs arising from climate-induced disasters have compelled researchers and policymakers to strengthen the private-public partnership model to maintain the affordability and feasibility of such climate risk insurance products (Surmins et al. 2019). Mysiak and Pérez-Blanco (2016) reviewed the legal framework of the EU towards private-public partnerships and highlighted the requirements needed to succeed in this model of climate risk insurance. The set of requirements included the following: public procurements and concessions, state aid, solvency, solidarity, and civil and environmental liability.

A weather-based index insurance scheme for crops was recommended in the recently concluded study by Shirsath et al. (2019), where claim payments were linked to weather parameters such as rainfall and temperature. The authors discussed the pros and cons of this type of climate risk insurance product and its effectiveness in some developing countries. Similarly, Meenan et al. (2019) discussed the options for Disaster Risk Finance, and they provided practical guidance for policymakers. Various climate and disaster risk financing instruments and their implementation have also been analysed in the report CDRF (2021). They concluded that any disaster risk management (DRM) plan should consider financing recovery from the beginning before an event occurs.

The cost of climate-induced insurance for the informal sector is very high due to high transaction costs and a lack of state or institutional support (IPCC 2014). The present cyclone insurance and climate risk insurance products in Fiji and the South Pacific are typically unaffordable for the informal sector as well as for small and medium enterprises (SMEs) in the formal sector. For instance, Ramachandran and Masood (2019) report that only 1% of households and 3% of businesses in low and middle-income countries have insurance coverage against catastrophic risks, whereas the figure is 30% in developed countries.
There are also no incentives for private players in this market due to their limited scalability and limited commercial viability. Currently, private insurers insist on there being an engineer’s certificate for providing cyclone risk insurance. This is more specifically applied to properties. The majority of buildings in PSIDS do not have proper building codes; therefore, they fall outside the certification process (Ahmed and McDonnell 2020). As such, the informal and marginal sectors, including SMEs, cannot buy these kinds of products in the market as it stands.

Ghesquiere and Mahul (2012) presented a five-step structure for addressing climate-induced risks for small island countries. These are the following: (i) risk identification, including hazard mapping, social perception, and priority settings; (ii) risk reduction, including territorial and sectoral planning, building codes, risk mitigation, infrastructure upgrading, education, and imbibing a culture of prevention; (iii) financial protection, including the development of a reserve mechanism, budget planning, and design of budgetary response in an emergency; (iv) preparedness, including alerts, early warning systems, and response planning; (v) post-disaster reconstruction, including institutional planning, recovery, and rehabilitation.

Individual countries need to devise a financial protection strategy using a combination of instruments to match the financial needs and volatility of their fiscal accounts. Two sources of financing have been identified: ex-ante and ex-post. As the name suggests, ex-ante risk financing tries to anticipate the onset and outcomes of disasters and plans accordingly. The study by Hill et al. (2014) recommended the use of subsidies for inclusive insurance. Budget provisions, reserve funds, and contingent credit are also important parts of this approach. If there were effective ex-ante financing, then the need for ex-post financing would be reduced. Ex-post financing involves increased foreign aid, budget reallocation, external borrowing, and tax increases. However, these take a relatively long time to activate.

The design criteria for climate risk-related insurance products must include affordability, viability for risk providers, and the risks covered. In the Pacific context, there are two potential areas to target. These are comprehensive housing insurance (covering flood, fire, and cyclone for small and marginal households in the formal and informal sectors) and crop insurance covering agricultural produce for small and marginal farmers only (Lashley and Warner 2013).

The informal sector and the overall economy pay a heavy price for the effects of climate-induced disasters on housing and crops. The overall objective of the insurance products should be to focus on climate change adaptation (CCA, long-term planning to slow down the effects of increasing climate change) and disaster risk reduction (DRR). The effective implementation of DRR strengthens the preparedness of a country for the possible impact of climate change. This should involve migration from a cycle of risk perpetuation to a cycle of risk reduction (Sivapuram, et al. 2015). The subsidised climate risk insurance products need to be provided to the target groups for them to remain sustainable in the long term and for all stakeholders (such as private insurers, governments, and aid agencies) to remain sustainable.

While working on designing these two products, it is important to differentiate insurable risks from uninsurable risks (only risks for which losses can be calculated are insurable). In addition, the objectives and barriers need to be identified and assessed to achieve effective implementation of these Pacific-specific climate risk insurance products (subsidised products). These include considering the following factors:
1. Developing a tripartite partnership among insurers, aid agencies, and the government, where a country-specific risk pool is created. The payout triggers should be well defined with sub-limits for each category.

2. The select target groups must be well defined. The scheme should be able to differentiate lower and marginal income users of insurance products, from middle- and higher-income groups.

3. Voluntary vs. compulsory: This depends on the view of policymakers. In our opinion, comprehensive housing insurance coverage should be made compulsory for all income groups for it to be effective and affordable. The cost of insurance should be made part of the building contract and approval process, just as third-party insurance is for motor vehicles.

4. Boosting factors: Insurance awareness and education should be part of the broader objectives. Effective and efficient education may also encourage voluntary participation in risk reduction.

5. Risk reduction: The goal of climate-induced disaster risk reduction (DRR) should be to move from risk perpetuation to risk reduction by making efforts to reduce risk. The cyclone, fire, and flood hazards have potential socio-economic impacts on the affected communities in terms of resulting damages to poorly constructed houses. The socio-economic benefit of any insurance product for the society is to educate them towards risk reduction. The policy-oriented approach towards improving the quality of housing construction in the affected areas may serve as one of the risk reduction strategies.

Three levels of beneficiaries can be targeted (Hermann et al. 2016):

- **Micro-level (direct):** where policyholders are individuals (e.g. farmers, market vendors, fishers), who hold policies and receive payouts directly. These policies are often sold at the local level and retailed through a variety of channels, including microfinance institutions, farmers’ cooperatives, banks, NGOs, and local insurance companies. Premiums are either paid in full by clients or subsidised, or both.

- **Meso-level (indirect):** Policyholders are risk aggregators such as associations, cooperatives, mutuals, credit unions or NGOs, whereby a (re)insurer makes payments to the risk aggregators, which then provide services to individuals.

- **Macro-level (indirect):** Policies are held by governments or other national agencies, within the international/regional reinsurance market. Payouts can be used to manage liquidity gaps, maintain governmental services, or finance post-disaster programs and relief efforts for predefined target groups. Beneficiaries of these programs can be individuals or organisations. These schemes can be operationalised through regional risk pools, such as PCRIC.

Some of the popular climate risk insurance products are available in the following categories:

- **Indemnity-based insurance:** claims are calculated by measuring the percentage of damage after it occurs and providing payouts based on this loss assessment.

- **Index insurance:** payouts are paid directly after an index has been triggered by exceeding a predefined threshold. Index insurance can be triggered by a weather-based, satellite-based, or yield-based outcome. The notable studies on index-based risk insurance schemes are Barrett et al. (2007), Balzer and Hess (2010), Barrett and Mude (2014), Norton et al. (2014), and Bertram-Huemmer and Kraehnert (2015).
Revenue insurance: involves multiplying the yield by the price (e.g. crop-yield times crop-price) to calculate the revenue. The insurance is based on the deviation of the revenue from the farmer’s mean revenue.

4.2 DRF strategy as an alternative to climate risk insurance in PSIDS

Currently, very few governments in the world have devised efficient and effective disaster risk financing (DRF) plans for responding to extreme weather events and catastrophes. While international organisations and multi-national development banks have provided technical advice and recommendations for DRF plans, most have not been properly implemented. Without a thorough DRF plan, governments are forced to make quick decisions after a disaster event on how best to reallocate their short-term budgets and find additional credit, which may not result in the best long-term results. The strategy must focus on how to work together with governments to determine which DRF instruments, such as insurance, funds, risk pools, CAT bonds (Catastrophe bonds), and capital markets, can best be used by particular countries. Given the increasing frequency of climate catastrophes due to climate change in the Pacific, there is a growing necessity for innovative DRF instruments to be embedded in each country’s disaster risk management strategy (Thirawat et al. 2016).

4.3 Issues related to the implementation of climate risk insurance products in PSIDS

Several forces influence the development of effective climate insurance policies for the PSIDS. For one, as indicated above, many of the PSIDS regularly need budgetary support from foreign aid. Indeed, as Ramachandran and Masood (2019) argue, most PSIDS would be unviable without high levels of foreign assistance. Aid per capita in the PSIDS is the highest in the world (Dornan and Pryke 2017). No other country group comes close. Additionally, there are limitations on foreign aid flow due to pre-allotted quotas from the donor countries. There is hardly any evidence of donor countries increasing their foreign aid post-disaster. It means that expectations of high post-disaster foreign aid are not realistic (Becerra et al. 2015). Hence, a relevant question is whether disaster relief should be viewed separately from the budgetary processes.

Second, given that many climate-induced disasters are quite debilitating, delay in attending to the impact of such disasters may exacerbate their impact on people. In other words, the longer the delay in attending to the effects of a disaster, the greater will be the suffering of the people, and the higher the likelihood of them falling back on maladaptive recovery processes (such as ignoring building codes, or consuming seed-grain and stock). In the immediate aftermath of a disaster, PIC governments face the challenges of acquiring access to resources for financing the emergency response and of maintaining essential public services until additional resources become available.

In a parallel vein, if individuals, households, or people working in the informal sector do not have access to resources in the immediate aftermath of a climate-induced disaster, they are likely to draw down on assets and to dis-save. For instance, many governments in PSIDS have practised a premature withdrawal of pension funds during climate-induced disasters such as cyclones or COVID-19.17 This would mean that the adverse impacts

17 The Reserve Bank of Fiji, June 2020 review, revealed that by June 30th, a total of 85,959 members has received around $54.2 m in phase one, while 15,920 members will be paid around $17.5 million in phase
of climate-induced disasters would be drawn out. If insurance was available, then these adverse impacts would be ameliorated to some extent. The primary obstacle to having a robust insurance scheme is the affordability of the premium (Hudson 2018). The percentages of populations below the poverty line in PSIDS range between 20 and 30%. This indicates the minimum threshold of unaffordability (Hudson 2018). Under these circumstances, the ability of the population to pay high premiums under a market-based system is highly restricted. The damage from disasters is high and rising, and the supply of insurance is very thin (addressable market size is small and unsustainable for insurers) — with only a very limited number of suppliers. Consequently, premiums are high because (i) the insurers are conservative, (ii) the payouts must cover large damages, and (iii) the small number of insurance suppliers means that there could be an element of monopoly pricing. This indicates that disaster risk insurance needs to be subsidised in these countries for a substantial length of time.

If this were accepted, then the climate risk insurance premiums would be funded by bilateral or multilateral aid. This would require that there be separate provisions for insurance premiums in aid budgets. If that were the case, it would provide a signal for insurers about the maximum they could collect in premiums. In that case, there would be scope for a moral hazard problem to emerge and for premiums to escalate. In addition to the risk associated with disasters, there is basis risk. This is the difference between expectations of payout and the actual payout. This basis risk also implies that there is an imperfect hedge. Clearly, quantification of basis risk requires a detailed analysis of the sources of uncertainty.

These are all factors that exacerbate the sense of distrust between the insurers and the insured. In addition, since the insurers are based in developed countries, they might adopt standards of their home countries to assess risk in PSIDS. Also, there is the problem of establishing standards and regulations by which insurance claims would be assessed. If, as is often the case, regulations for building construction are poor (or even non-existent), then the standards by which damages to buildings are assessed become vague. Even when regulations exist, there might be a paucity of qualified civil engineers who can certify that the buildings are following established standards. It came to our knowledge that PICAP is developing practice guidelines (procedures) for the smooth implantation of climate risk insurance products in PSIDS.

Hence, there may be serious challenges when designing an appropriate insurance mechanism for PSIDS. Apart from the issue of basis risk, there is a concern about the timing of the payoff after a disaster. One approach to circumvent this problem is that of index insurance. This is insurance that is linked to an index such as rainfall, temperature, humidity, or crop yields, rather than the actual loss. However, these index triggers should be used with caution.

Although claims can be settled relatively quickly with index insurance, there is the problem that affected households would not get compensation for a disaster that is just below the threshold level but is nevertheless costly. A general declaration of a disaster avoids this problem. There is also the issue of evaluating the losses incurred during a disaster. For this reason, there has been the development of hybrid models (indemnity and index) in other developing countries (Hill, et al. 2019).

Footnote 17 (continued)
two over a period of 10 weeks. Compared to TC Winston, total funds withdrawn are just 20% (TC Winston, $276 m) and 48% (TC Winston, 180,000) had received assistance.
In addition, there is a need to build a resilient infrastructure that can withstand some degree of climate-induced disasters. This involves three different levels of risk mitigation: (i) mitigation of locational risk, which involves building critical infrastructure in less risky spots; (ii) structural risk mitigation, by using construction materials that would withstand disasters, e.g. earthquake-resistant building materials; and (iii) operational maintenance, which requires emergency preparedness and recovery planning steps to be put in place. This is a long-term process involving a lot of policy initiatives and pathways to affordable housing.

Finally, although it is not called insurance, remittances from PIC nationals working in Australia, New Zealand, and other countries (Pacific diaspora) often serve to insulate recipients against climate-induced disasters.

Insurance transfers risk from those who will be affected by the climate-induced disaster to the insurer. The advantage of insurance is that funds are made available soon after the incident. As Hess et al. (2006) said (in the case of Ethiopia), one dollar that is quickly available after an extreme weather event may save five dollars in preventing any further impact.

Different types of insurance instruments could facilitate enhanced climate resilience. These include:

1. Sovereign disaster risk transfer, where the government retains most of the natural hazard risk and uses risk transfer mechanisms to manage the extra volatility of their budget.
2. Agricultural insurance, particularly crop insurance, for ameliorating the impact of risk to harvest from extreme weather events. This could involve single crop or multi-crop insurance. This is subject to adverse selection, since the insured has better information about the possible impact of a natural hazard, and it is also costly to administer.

At the macro-level, governments also face challenges in effectively managing their risks. Due to limited tax bases, high indebtedness, and low or no insurance cover, many highly exposed developing countries cannot fully recover from disaster shocks by simply relying on their limited resources and external donor aid. Based on 40 years of historical data for Latin America, the Inter-American Development Bank concluded that on average a country can expect international assistance to cover only about 8.6% of direct disaster losses (Andersen et al. 2010). In turn, external investors are wary of the risk of catastrophic infrastructure losses, and thus, small firms and farmers cannot receive the credit necessary for investing in higher-return, higher-risk activities (Andersen et al. 2010).

Given the key challenges discussed above, this paper assesses the concept of climate risk insurance and assesses the climate risk insurance products which have been used elsewhere in the world, to identify the best model for making climate risk insurance work for everyone in the PSIDS. The model would need to take a holistic approach that addresses the needs of people, culture, and livelihoods. To explore the possibilities of suitable and sustainable climate risk insurance products, it is necessary to develop knowledge of products based on theoretical and empirical evidence of how they support decision-makers in developing suitable policies and programs for the public and private sectors. Furthermore, to support all levels of society, it is necessary to have a theoretical framework of climate risk insurance focusing on the informal sector in the PSIDS with ‘pro-poor public–private partnerships’ (5Ps) initiatives that not only make individuals and communities sustainable but are technically feasible and financially viable.
5 Conclusions and way forward

In the earlier literature on disaster risk reduction and disaster risk management, the focus was on the PPRR approach: prevention, preparedness, response, and recovery. This approach does not consider the important role of risk transfer, which can help strengthen the other activities in the PPRR approach. The climate risk insurance products for poor and vulnerable sections of the society (informal sector) play an important role in risk transfer.

We have discussed some possible challenges in implementing climate risk insurance for the informal sector in the PSIDS. A particular focus of our discussion has been on the impact of the recent TC Winston on Fiji’s informal economy and livelihoods. Indeed, the current COVID-19 pandemic crisis is exacerbating the risks due to extreme weather events and other natural hazards. Building on the empirical evidence on damage and loss, research suggests that PSIDS need to develop climate risk insurance portfolios that can be made available to offset the financial burden on individuals, communities, governments, and donors in the post-loss, recovery, and reconstruction phases.

This paper has also reviewed various climate risk insurance initiatives that have been developed around the globe, and based on lessons on what works and what does not work, some possible insurance portfolios in PSIDS have been recommended. For instance, OECD (2015) and Tigre (2013) reported that disaster insurance may be expanded by combining it with other insurance policies, such as fire insurance. It was also shown that incentives are needed to encourage insured households and agencies to take up mitigation activities. Wright (2013) also suggested that it might be worthwhile to link insurance premiums to mitigation activities, whereby premiums could be reduced when mitigation activities were undertaken.

Sensing the urgency of the issue of subsidised climate risk insurance products, UNDP (being the administrative agency) has designed a climate risk insurance product for six Pacific Island countries in collaboration with PICAP, the UN University Institute for Environment and Human Security (UNU-EHS as a technical partner), MCII, and the UN Capital Development Fund (UNCDF) in 2020. The UN Capital Development Fund-led Pacific Insurance and Climate Adaptation Programme (PICAP) has recently launched a parametric microinsurance product to provide immediate financial support in case of floods and cyclones (UNDRR 2021).

This paper not only highlights the critical needs of climate risk insurance for the PSIDS vulnerable populations, including the informal sectors, but it provides a platform for further needs-based research on making climate risk insurance work for everyone. This research needs a central focus on people, culture and livelihoods, and needs to develop innovative solutions for disaster risk reduction (DRR). This paper, therefore, fills some critical lacuna in the extant literature on risk insurance and risk reduction in PSIDS.

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Declarations

Conflict of Interest The authors declare no competing interests.

18 https://www.uncdf.org/article/6145/the-case-for-climate-disaster-risk-insurance-in-fiji
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