

Climate Change Management

Walter Leal Filho *Editor*

# Climate Change Impacts and Adaptation Strategies for Coastal Communities

 Springer

# **Climate Change Management**

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Editor

# Climate Change Impacts and Adaptation Strategies for Coastal Communities

 Springer

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# Preface

Climate change is known to impact coastal areas in a variety of ways. According to the 5th Assessment Report produced by the Inter-Governmental Panel on Climate Change (IPCC), coastal zones are highly vulnerable to climate change and climate-driven impacts may be further exacerbated by other human-induced pressures.

Apart from sea level rise which poses a threat to both human well-being and property, extreme events such as cyclones and storm surges lead not only to significant damages to property and infrastructure, but also to saltwater intrusion, the salinisation of groundwater, and intensification of soil erosion, among many other problems. There are also many negative impacts on the natural environment and biodiversity, which include damages to important wetlands and habitats that safeguard the overall ecological balance, and consequently the provision of ecosystem services and goods on which the livelihoods of millions of people depend.

These impacts are particularly acute in the developing countries and island States in the Pacific, Caribbean, Latin America and Asian region, since they have limited access to the funding and technologies needed to allow them to be more resilient and recover from the damages caused by hurricanes, floods and other extreme events.

The above state of affairs illustrates the need for a better understanding of how climate change affects coastal areas and communities, and for the identification of processes, methods and tools which may help the countries and the communities in coastal areas to adapt and become more resilient. There is also a perceived need to showcase successful examples of how to cope with the social, economic, and political problems posed by climate change in coastal regions.

It is against this background that this book has been prepared. It is a truly interdisciplinary publication, with contributions from scholars, representatives from social movements, practitioners and members of governmental agencies, undertaking research and/or executing climate change projects in coastal areas and working with coastal communities.

The focus of the book is ‘managing climate change in coastal regions’, meaning that it serves the purpose of showcasing experiences from research, field projects and best practice to foster climate change adaptation in coastal areas and communities, which may be useful or implemented elsewhere.

The aims of this book are as follows:

- i. to document the influences of, the damages and the threats posed by climate change to estuaries and coastal communities;
- ii. to introduce approaches, methods, initiatives and projects which demonstrate how coastal communities can successfully meet the challenges climate change poses to them. Here, an emphasis is given to the latest research, but also on infrastructure projects, demonstrations on the use of technologies and natural and artificial means to reduce the impacts of extreme events and sea level rise to coastal communities;
- iii. to introduce funding schemes and mechanisms which can finance climate change adaptation in coastal areas.

Last but not least, a further aim of the book is to document and disseminate the wealth of experiences available today.

The book is structured along two parts:

Part 1-Principles, Approaches and Projects on Change Adaptation in Coastal Areas

Part 2-Case Studies on Climate Change Adaptation in Coastal Areas

I thank the authors for their willingness to share their knowledge, know-how and experiences, as well as the many peer reviewers, who have helped us to ensure the quality of the manuscripts.

It is hoped that this publication will help to outline the need for integrated approaches towards handling the impacts of climate change to coastal areas, and hence contribute towards advancing this field of work even further.

Enjoy your reading!

Hamburg, Germany  
Spring 2018

Prof. Walter Leal Filho  
B.Sc., Ph.D., D.Sc., D.Phil., D.Ed., D.L.

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**Part I**  
**Principles, Approaches and Projects on**  
**Change Adaptation in Coastal Areas**

# “We’re not Refugees, We’ll Stay Here Until We Die!”—Climate Change Adaptation and Migration Experiences Gathered from the Tulun and Nissan Atolls of Bougainville, Papua New Guinea

Johannes Luetz and Peni Hausia Havea

**Abstract** Atoll island communities are naturally vulnerable to flooding hazards such as king tides, storm surges and overtopping, among others. Climate change can be expected to catalyse the susceptibility to flooding through extreme weather events, sea level rise (SLR) and other climate related pressures. Further, population growth in coastal proximity can exacerbate vulnerabilities by degrading ecosystems such as mangroves and coral reefs that island communities tend to rely on for protection. The net effect: More and more people are congregating in a high-risk zone for floods and storms, but are less and less protected from them. Conventional adaptation wisdom suggests three responses: (1) plan a managed retreat (e.g., move inland); (2) accommodate the changes (e.g., build stilt houses); (3) resist the intrusion (e.g., build sea walls). On the Carteret Islands of Bougainville/Papua New Guinea (PNG), also known as the Tulun or Kilinailau Atoll, none of these adaptation measures have so far enabled the islanders to adapt in situ to mounting people and sea level pressures, resulting in both ad hoc and planned out-migration responses. Drawing on pilot research conducted on the Tulun and Nissan Atolls of Bougainville/PNG, this paper examines the linkages between climate change and human movement. It extends previous research by expressly inviting the grassroots perspectives of atoll communities of origin and mainland communities of destination in Tinputz and Buka. The research develops recommendations in areas of education, livelihood security, government planning and countering misinformation. Experiences and lessons gathered in this paper will be useful for both policy and practice serving the cause of climate change adaptation in Pacific island communities. Working towards a

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better understanding of climate change related vulnerabilities in coastal areas will also enable better adaptation responses.

## Introduction: Geographic, Demographic and Climate Change Issues

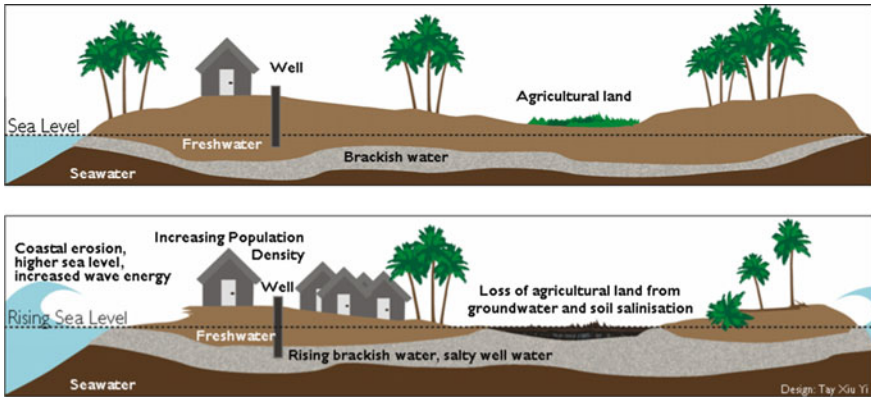
Over recent years, remote atolls to the north and northeast of Bougainville, an autonomous region of Papua New Guinea (PNG), have been described numerous in public discourse as being in danger of inundation and permanent submersion (Roberts 2002; Vidal 2005; Gupta 2007; MacFarquhar 2009; Harman 2013; Beldi 2016). Regional atolls include the Nissan (Green), Nuguria (Fead) and Malum groups to the north of Buka Island, the largest of the Solomon Islands archipelago, and the Tulun (Carterets, Kilinailau), Takuu (Mortlock) and Nukumanu (Tasman) groups to the northeast (O'Collins 1989, pp. 248–250). To date several video documentaries have been produced which discuss both regional climate change vulnerabilities and present and anticipated resettlement from these low-lying islands in the Pacific (UNU 2009a; OTLP 2010; Metzger and Redfearn 2011; Light Studios 2016).

Anecdotal islander eyewitness reports typically point to extraordinary flooding events that can momentarily overcome human coping capacities: “[s]torm surges regularly overtop our islands—then the sea and low-lying land become ‘level.’ My home island—the Island of Huene—was sliced in two.<sup>1</sup> The time for adaptation and mitigation has run out. The time for migration and relocation has come. Resettlement is underway. It is so sad to leave.” (U. Rakova, pers comm, 17 March and 10 April 2008, cited in Luetz 2008, p. 20). A map from 1964 provided by the Geography Department of the University of Papua New Guinea still depicts Huene Island as one unfractured island (O'Collins 1989, p. 252), thus revealing the splicing in two to be a more recent event.

The multiplicity of precursory problems to island abandonment typically comprise progressive pressures depicted in Fig. 1. As shown, islands have disproportionately large coastal areas compared to total land available (Nunn and Kumar 2006), and storm surges and island “overtopping” can cause erosion and freshwater lens contamination (Barnett and Campbell 2010, p. 172), while population growth and decreasing land area may exacerbate water stress, making rain catchment and freshwater storage systems increasingly indispensable to safeguard water security in rain water dependent localities (Fig. 2). Taken together, these figures align with research participant responses that commented on polluted wells on the Tulun Atoll no longer serving as a viable means of meeting the drinking water requirements of the islanders: “the well water is salty, we don't use [it] anymore” (P9).

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<sup>1</sup>A photo of the two islets Huene One and Two is available online: <http://planetprepare.blogspot.com.au/2010/11/phd-pilot-study-carteret-islands.html>.



The Ghyben-Herzberg or freshwater lens may be polluted by salty seawater long before the island is ultimately submerged (Barnett & Campbell 2010, p. 172).

**Fig. 1** Schematic representation of island subsistence (normal sea level) and progressive island submergence (rising sea level). (Illustration © World Vision, quoted from Luetz 2017, p. 5; adapted from Aung et al. 1998, p. 97)

**Fig. 2** Rainwater catchment system on the Island of Huene One, Tulun Atoll



Being heavily reliant on rainwater harvesting, steady freshwater supplies present significant challenges for low-lying atoll islands and coastal communities. (Photo taken in 2010 by Luetz)

Figure 2 also illustrates environmental consequences on the Island of Han where “the ocean water is now seeping up through the ground, creating swampy breeding grounds for malaria-carrying mosquitoes ... The results are rotting roots, degraded arable land and tiny taros.” (Luetz 2008, p. 20; cf. UNU 2009b). Photographs taken on the Tulun Atoll in 1960 and available through the National Library of Australia (Fig. 3) show taro plants in apparently healthy size and condition (Spencer and Spencer 1953), thus suggesting that the erosion of food security could be an SLR related phenomenon experienced predominantly since the 1960s in conjunction with population growth (O’Collins 1989; see also Connell 1990).

A number of explanations for the progressive inundation of the affected islands have been offered, including above average rates of SLR affecting the western

**Fig. 3** *Taro plants Carteret Islands, Papua New Guinea, 1960* [picture slide]/Terence and Margaret Spencer



Source with attribution: (Spencer & Spencer 1953, held in National Library of Australia, NLA)

Pacific (Amos 2012); the possibility that the “old volcano [is] ... sinking back into the sea” (Gupta 2007, para. 4); dynamite fishing and consequent reduction of reef protective capabilities (Roberts 2002, para. 4, 14); and seismic activity on account of shifting plate tectonics (Traufetter 2012; Connell 2015, pp. 5–6), among others.

Notwithstanding, none of these factors alone seems to adequately explain the high rate of locally experienced SLR. Chalapan Kaluwin, Professor of Environmental Science at the University of Papua New Guinea (pers comm, 20 March 2008), has pointed to some of the complexities surrounding sea level science: “The causes of sea level rises are manifold, intertwined and acting in concert. Research requires a prolonged, multidisciplinary investigation with scientific contributions from different fields of study—glaciologists, oceanographers, geodesists, geologists, meteorologists, and climate scientists.” (cited in Luetz 2008, p. 21). A comprehensive discussion of the causes of SLR lies beyond the scope of this research paper. However, given the high incidence of SLR experienced in the region of investigation, relative to other locations in the world, the following discussion is useful.

According to Bamber and Riva (2010), Pacific Islands have been shown to be subject to some of the highest rates of “regional sea-level rise due to land-ice melt only” (cited in World Bank 2012, p. 33), a point both corroborated and explained by Professor John Schellnhuber CBE, founding director of the Potsdam Institute for Climate Impact Research (PIK) and chair of the German Advisory Council on Global Change (WBGU), who discussed the “injustice” of SLR at the 2011 Melbourne conference “Four degrees, or more?”<sup>2</sup>:

This [is] the injustice of sea level rise ... on average you have about a metre of sea level rise by 2100, ... all over the globe. But the ... very vicious thing is, that this sea level rise will be distributed in a highly inhomogeneous way across the planet. [...] Elementary physics – if Greenland is losing mass, that means its gravitational pull for seawater will be diminished

<sup>2</sup>Transcribed from audio file of Session 1 @ 51:00 min previously posted at <http://www.fourdegrees2011.com.au>.

– that means, around Greenland, sea level may even drop, in particular for the north-eastern part of the American continent, while ... the Pacific Islands ... that haven’t done anything to contribute to global warming, will again get the brunt of it, will get all the water which is released from Greenland. [...] And those who are most responsible for that, northern Europe, northern America, will be spared sea level rise, at least for a while. So you see nature can be extremely unfair, if humanity is sort of provoking that injustice (cited in Luetz 2013, p. 231).

According to the Intergovernmental Panel on Climate Change (IPCC), sea levels have been relatively stable for 2000–3000 years and “did not change significantly ... until the late 19th century ... Estimates for the 20th century show that global average sea level rose at a rate of about 1.7 mm year<sup>-1</sup>. Satellite observations available since the early 1990s provide more accurate [global] sea level data [which show] that since 1993, sea level has been rising at a rate of around 3 mm year<sup>-1</sup>, significantly higher than the average during the previous half century.” (IPCC 2007, p. 409). Satellite altimetry also provides “unambiguous evidence of non-uniform sea level change in open oceans, with some regions exhibiting rates of sea level change about five times the global mean” (ibid., p. 411).

Research in Papua New Guinea has shown SLR on the order of 7.0 mm year<sup>-1</sup> (AusAID 2010, pp. 2, 12), and monitoring in the Pacific has shown enormous variability, including rises in sea level of 7–10 mm year<sup>-1</sup> (Albert et al. 2016) or even 25 mm year<sup>-1</sup> (Kaluwin 2008, p. 8), far above IPCC global SLR averages discussed above. To summarise, “[r]egional variations, significant discrepancies, and some uncertainty remain in measures of SLR, according to sources and analytical techniques, but *a distinct overall upward trend exists throughout the western Pacific*.” (Connell 2015, p. 5 emphasis added; attributed to Merrifield 2011; Zhang and Church 2012). Further, “it is reasonable to assume that the rate of SLR is increasing, [and] that it will increase further in the future” (ibid., attributed to Church and White 2006; Horton et al. 2014).

With SLR rates in the region “amongst the highest globally” (Albert et al. 2016, p. 2), it may perhaps not be surprising that most media accounts present migration responses from the Tulun Atoll to locations in Bougainville as a new, recent, and predominantly climate change related phenomenon (Roberts 2002; Vidal 2005; Gupta 2007; MacFarquhar 2009; Harman 2013; Beldi 2016; cf. Barnett and Campbell 2010, p. 173). However, complicating the picture, there is evidence from a UNEP compendium that resettlement as a “response to land loss and population growth” was considered even before the 1990s (O’Collins 1989, p. 247), with the research reporting that collective relocation on account of food shortages and people pressures was contemplated as far back as 1968 (ibid, p. 250), at which point in time the Carteret Islanders “were reported to have a unanimous desire for resettlement” (ibid.). Hence in summary, it is not unreasonable to anticipate that in light of climate change related pressures now progressively bearing on these and other affected regional atolls, which Campbell and Warrick (2014, p. 29) already described as “urgent cases”, historical human resettlement intentions flagged almost three decades ago (Connell 1990) could be increasingly accentuated further. Expressed in simple language, this research seeks to better understand climate change related vulnerabilities in coastal areas, since a better understanding in this area will likely lead to better coping and adaptation responses.



## Rationale for and Intended Contribution of This Research

Island abandonment is not a new phenomenon (Arenstam Gibbons and Nicholls 2006; Albert et al. 2016; cf. Leon 2016), and macro-managed human migrations within and across atolls have been documented before, for example in the Maldives (Luetz 2017). While challenging for the islanders involved, impelled migration experiences can also be seen as useful in that they can inform policy makers to assume a more forward thinking posture of migration policy development, where lessons are gleaned retrospectively, to help benefit policy research and development prospectively, thereby enabling the preparation of appropriate anticipatory migration management mechanisms, which can then be implemented before they are needed as instruments to assuage future island abandonment situations (UNISDR-UNDP 2012). Given the diverse vulnerabilities of atoll environments discussed above, climate change impacts seem to be closely related to the erosion of food, water and human security (Barnett and Adger 2003), wherefore incidences of island depopulation and abandonment could conceivably increase, especially if recent island submersions in the Solomons Islands are to be taken as a guide to the future (Leon 2016, cf. Albert et al. 2016). Arenstam Gibbons and Nicholls (2006) have cautioned: “[l]ooking to the future, ... many small low-lying islands could be abandoned due to sea-level rise long before they become physically uninhabitable” (p. 40). Moreover, Barnett and Campbell (2010) have advocated that “communities that are likely to be exposed to climate change effects might be encouraged to consider relocation *as an adaptive process*. If it is necessary to relocate communities, *it should be proactive and planned*” (p. 173, emphasis added). In short, the benefits of foresight and preparedness in adaptation research seem to be straightforward and have been advocated both in the literature (e.g., Blanco et al. 2009; Foresight 2011), and by UN agencies tasked with human development: “[h]oping—and working—for the best while preparing for the worst, serves as a useful first principle for adaptation planning” (UNDP 2007, p. 198); “early preparedness could also help avert a humanitarian catastrophe by promoting orderly movements of affected populations and increasing the viability of the move” (UNHCR 2009, p. 3; see also Leighton 2012, pp. 703, 718). Given the sheer size of the Pacific Island region comprising 22 countries and territories, a total land area of 551,385 km<sup>2</sup>, and a total population of 9,498,829 (Barnett and Campbell 2010, p. 5; attributed to SPC 2008), it seems prudent to learn lessons from past and present migration experiences to prepare vulnerable coastal communities for future scenarios.

This research represents an inquiry into what lessons may be learned from the experiences of forced human movements from, to and between atolls in Bougainville, PNG. This study extends previous research by expressly inviting the participation of both migrants and hosts in communities of origin and destination. Moreover, given a certain tendency in some news media reporting toward sensationalist representations with headlines such as “Pacific Atlantis: First climate change refugees” (Vidal 2005), and recurrent characterisations of the Carteret (Tulun) Islanders as “the world’s first environmental refugees” (Gupta 2007, para. 4)

or “[t]he world’s first climate change refugees” (Tweedie 2009; cf MacFarquhar 2009; Harman 2013; Beldi 2016), this research was also interested to learn more about the preferred self-description/s of affected islanders in communities of origin and destination. This offers potential benefits with respect to appropriately informing the terminologies of future policy and research discourses. In short, “[a]n alternative language ... may be more likely to lead to constructive outcomes.” (Barnett and Campbell 2010, p. 174).

## Research Design, Methodology, and Data Collection

This pilot study engaged participants aged 25–67 in six (6) locations: Port Moresby, Buka Island, Torotsian Island, Tulun Atoll, Tinputz, and Nissan Atoll in Bougainville, Papua New Guinea.<sup>3</sup> There was a total of 28 semi-structured face-to-face on-site interviews conducted, each having an average duration of approximately 1 h. Of those recruited to participate in the research there were more men (67.9%) than women (32.1%), with most participants aged between 40 and 50 years (Fig. 4). Given that interviewees were recurrently encountered in the company of by-standing conversation partners, a small number of impromptu focus group contexts were spontaneously accommodated, thus raising the total estimated number of respondents broadly informing this pilot study to between 55 and 60. Quantitative data collection and verbatim qualitative quotes were limited to interview participants.

Research participants were recruited for the study using a non-probability sampling framework,<sup>4</sup> snowballing technique and respondent driven sampling (Heckathorn 2011; Babbie 2010). Data collection occurred during October and November 2010, and the availability of locally sensitive guides and interpreters assisted in moderating discussions. Information was collected using key informant interviews (KII) and a survey interviewing questionnaire (SIQ). Research participants were recruited based on their personal or proximate migration experience/s, and all respondents in Tinputz were migrants from the Tulun Atoll. As a mixed method approach this research used an ‘exploratory design’ paradigm (Creswell 2013, 2014; Creswell and Plano Clark 2011), in the sense that the overall approach was weighted heavily on the qualitative study rather than the quantitative study.

Field research was also aided by a preceding research visit to Bougainville in March 2008, during which options for heightened community level disaster preparedness were explored, and data were gathered for the “World Vision Asia Pacific Annual Disaster Report 2008 Planet Prepare” (Luetz 2008). This earlier research visit broadly informed this pilot study, enhancing familiarity with cultural,

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<sup>3</sup>Selected interview locations are available online: <http://goo.gl/maps/byNOF>.

<sup>4</sup>According to Earl Babbie, non-probability sampling represents “[a]ny technique in which samples are selected in some way not suggested by probability theory. Examples include reliance on available subjects as well as purposive (judgmental), quota, and snowball sampling” (Babbie 2010, p. 192).

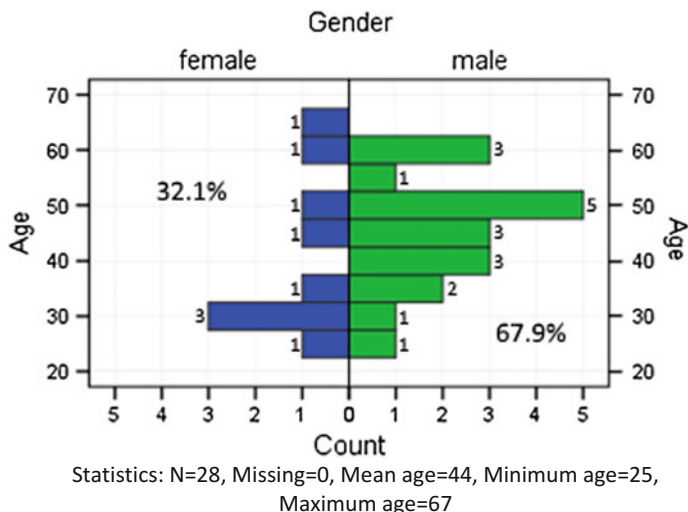


Fig. 4 Study population pyramid, 2010: total number of participants by age and gender

environmental, and socioeconomic issues, and laying a foundation for collaboration in areas of translation/interpretation, logistics and overall research support.

There were six overarching research questions: (1) What are the environment related push factors (ERPFs) and their respective contributions to migration? (2) What are the non-environment related push factors (NRPFs) and their respective contributions to migration? (3) What is the preferred terminology to describe/characterise forced migrants? (4) What is/are the problem situation/s? (5) What is/are the proposed solution/s? (6) What is/are the preferred migration destination/s?

### Data Analytical Strategy

The data analysis was carried out using exploratory and thematic analytical strategy. The first phase of the analysis was done by transcribing and entering the data into the computer and then exploring it by focussing on the participants’ responses regarding factors that cause or contribute to migration, including preferred migration destinations. The data were analysed qualitatively with Nvivo 11 (QSR International 2016) and a word clouding, tree mapping and clustered analysis was conducted. Results were then compared with the transcripts and themes iteratively. In the second phase of the analysis, the quantitative study was then explored using frequency analysis in SPSS 24 (George and Mallery 2016) and Likert plotting using r (RStudio Team 2016). The qualitative and the quantitative findings from the two phases of the analysis were then discussed with reference to prior research. Data analyses broadly incorporated approaches informed by grounded theory (Charmaz 2006) and phenomenography (Marton 1981).

## Results and Key Findings

From the research, several key findings have been synthesised and consolidated below. These are presented chronologically in congruence with the six (6) research questions detailed above.

### (1) *Environment related push factors (ERPFs) are contributing to migration*

As highlighted by quantitative data (Fig. 5), environment related push factors (ERPFs) appear to be strongly correlated with migration, with 71–96% of respondents considering ERPFs as either “important” OR “very important” factors in migration.

The contributing role of ERPFs in migration was also expressed qualitatively through interview data that highlighted both environmental primary causes and secondary environmental knock-on effects. During interviews two primary causes were recurrently mentioned, namely SLR and sudden onset disasters:

“The sea is rising really fast. Every day the sea is eroding away land.” (P4) “Sea level rise is eating up the island, washing away the island. Towards the back of the island coconut trees are now in the sea, it happened during the last two years.” (P6) “Rises in sea level [are] the cause of everything – this is the main one.” (P14) “[The island] is only 80 m wide, so erosion matters.” (P22) “Rises in sea level [are] very important ... because of currents, they are stronger than in the past.” (P27) “Very strong storms, no place to hide.” (P8) “Recurrent king tides... destroy all of the island” (P5).

These primary environmental causes then seemed to enhance secondary environmental problems:

“Sudden natural disasters, cyclones, destroy buildings and mangroves, breadfruit ... food trees.” (P21) “Higher tides bring sea water into swamps where mosquitos breed. Wind storms knock down coconut trees, this then results in higher waves... shortage of food and lack of land is what drives people to migrate away.” (P6) “Han Island is the worst place for

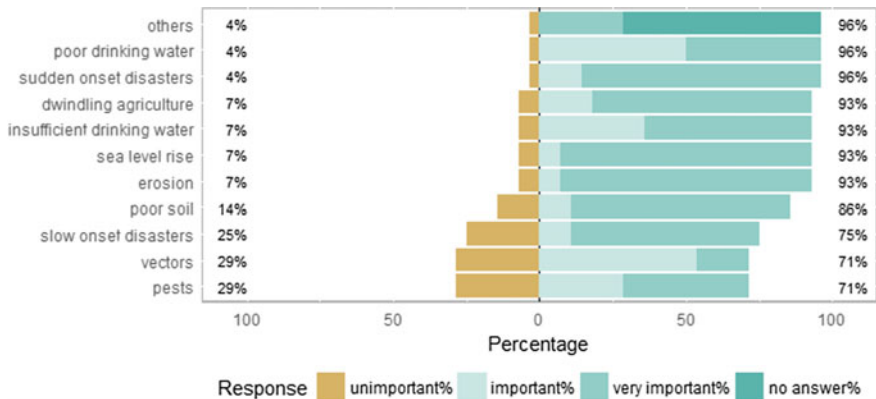


Fig. 5 Environment related push factors (ERPFs)

mosquitos [I have] ever seen, and February to April 2009 was the worst mosquito season. High tide once a month ... mosquitos! People complain and talk about moving on account of the mosquitos.” (P12) “Mosquito problem has been getting worse, less fruit, organic matter increasingly thin, salinisation.” (P2) “sea water, infertile soil, thin layer of soil” (P12) “Saltwater content in soil very high: 80% – borehole wells [are not possible], World Vision did a feasibility study.” (P25) “Diseases [are] enhanced by poor nutrition, people don’t eat greens, malaria [is] quite common.” (P12) “Soil fertility can’t be improved” (P14).

Research participants also pointed out what they interpreted to be signs of erosion (Fig. 6) and evidence of sea level rise and decreasing island size (Fig. 7).

(2) *Non-environment related push factors (NRPFs) are contributing to migration*

As highlighted by quantitative data (Fig. 8), non-environment related push factors (NRPFs) are also strongly correlated with migration, although views were more

**Fig. 6** Coconut trees on the Island of Han, Tulun Atoll

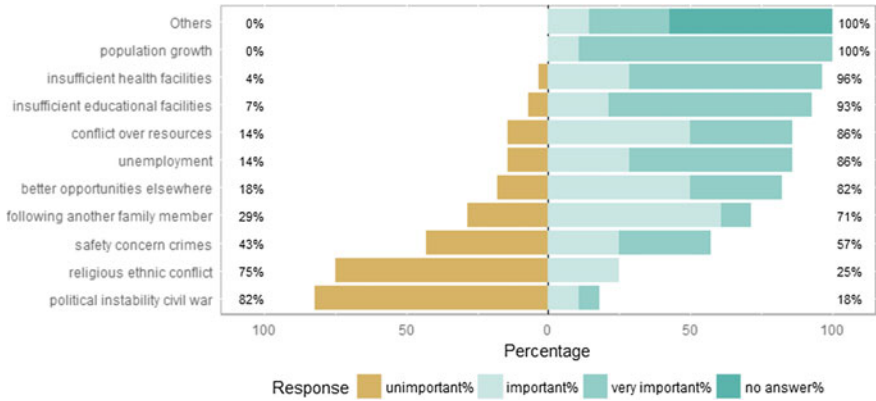


Research participants pointed to coconut trees being gradually eroded away as evidence of the vulnerability of their coastal atoll environment. (Photo taken in 2010 by Luetz)

**Fig. 7** Coconut tree stump about 10 m from shore on the Island of Han, Tulun Atoll



Numerous older islanders encountered during this research offered stories of where their land and huts used to be – now covered by water like this coconut tree stump. (Photo taken in 2010 by Luetz)



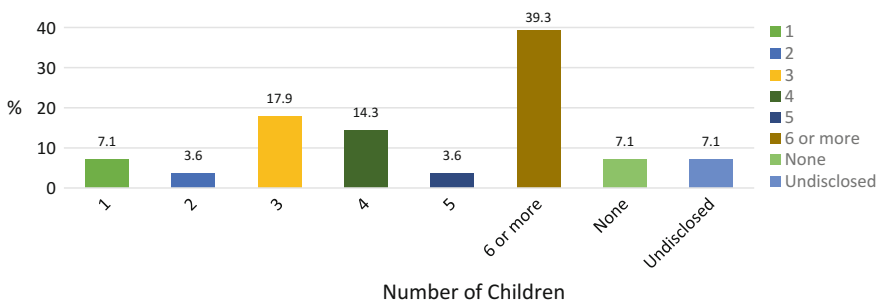
**Fig. 8** Non-environment related push factors (NRPFs)

nanced and category dependent, with between 18 and 100% of respondents considering NRPFs as either “important” OR “very important” factors in migration.

A number of NRPFs were considered paramount, first and foremost “population growth”, which all respondents unanimously considered either “important” or “very important” for migration. At times population growth and overcrowding were linked in discussions to lack of available land: “Overcrowding [is] very important, the average number of children [is] seven... so many kids coming up and little available land... big problems coming up.” (P25). “Population growth, overcrowding very important... average family size per couple: seven to ten children” (P28).

The average number of children per participant in this research is 4.65 (Fig. 12), and the result shows that 39.3% (11) of the participants have six children or more (Fig. 9).

There was also the sense that population growth appears to work in concert with ERPFs presented above, exemplified by the following respondent commentary: “[There is] less land, less food, more people” (P14).



**Fig. 9** Number of children per participant

Again, there was a sense that some primary NRPFs seemed to enhance secondary problems. For example, several respondents linked large populations and landlessness to incidences of conflict and competition over scarce resources:

“People are hungry, [there is] not enough food! Subsistence farming is very difficult now.” (P12) “Conflict over resources is ... important ... Han islanders come here [Iolasa Island] to fish ... building conflict.” (P9) “[There are] conflicts over land ... too many children, not enough resources for everyone ... people fight ... squabble over resources.” (P20) “[Islanders] fight over who owns the land, the pigs, ... when someone steals another person’s pig.” (P25) “Conflicts over resources [are] very important, people are arguing over food and land” (P27).

Other related NRPFs linked high population densities and inadequate provision of services such as health facilities to secondary problems and outmigration: “Diseases spread easily, malaria, syphilis, AIDS, gonorrhoea, SDIs, cholera, etc.” (P14). “Malaria [is] quite common here [on the atolls], people then go to Buka.” (P12).

(3) *Respondents resist the label “refugees” and seem to prefer local terminology*

As highlighted by quantitative data (Fig. 10), respondents overwhelmingly rejected the representations “refugees” (79%) and “exiles” (68%) to refer to migration from atolls off the coast of Bougainville, and instead preferred local terms (100%) that were suggested during the semi-structured interviewing process.

The following local *Tok Pisin* terms were offered as counter-proposals:

- (1) *tripman (male)/tripmeri (female)* “someone who wanders from place to place” (Verhaar 1990, p. 355). The term conveys “flexibility” and is “not a sealed identity”, being reminiscent of a “passenger”, “drifter”, “traveller” (P4). If people return home, they “would no longer be called *tripman* or *tripmeri*” (ibid.).
- (2) *Turangu* “victim, something happened to you, you need help.” (P18). It “conveys empathy. Popular term in PNG, meaning, ‘I am sorry for what happened to you.’ The word reaches out from one person to another. Not a

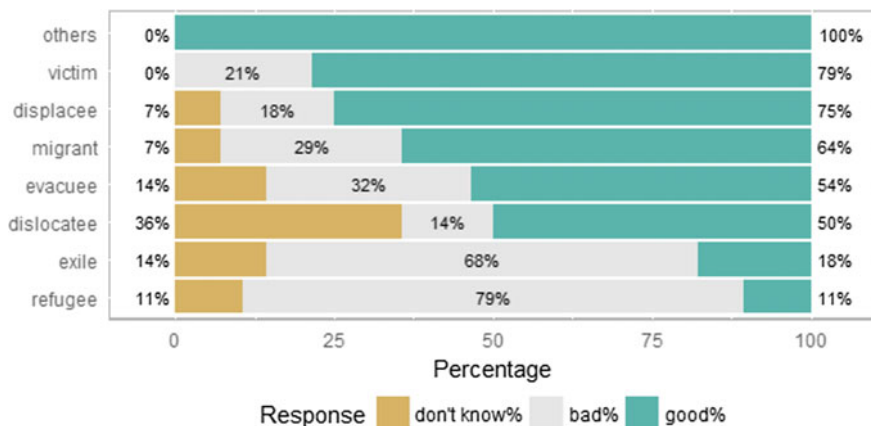


Fig. 10 Preferred nomenclature: characterisations and emotional responses

permanent label, but only a situational term. People like being a ‘Turangu’, but wouldn’t want to stay one.” (P23). “Oh, poor one!—Covers almost every individual person or place, all ‘manmeri’. Sweeping word that captures many contexts, droughts, displacement ... and strikes people’s hearts in Pidgin language, used throughout PNG. For example: ‘your friend, John, died yesterday.’ Response: ‘oh, poor one, Turangu!’” (P25).

- (3) *Mekim wokabout* “contextualised term that is easier to understand in Pidgin than ‘migrant’” (P26).

Some respondents also suggested temporal fluidity and flexibility as important requirements: “there is no one-size-fits-all name ... You cannot give a single permanent term to a person. Time and situation influence the usage” (P1).

Finally, more than three quarters of respondents commented positively on the term “victim” (79%), as the following commentary exemplifies: “Victim is the best word because the disaster has forced the people to leave the island, for example, climate change” (P6).

- (4) *The problem compound is complex and comprises dissimilar contributing factors*

The following issues were mentioned by participants as constituent parts of an overall complex problem commixture: Environment; climate change; geography (remoteness, inaccessibility); poor governance; disputes over customary land ownership; unemployment (limited cash economy); subsistence development context; limited access to reliable news, information and education; among others.

“The problem is we have more mouths to feed than what we are producing. More people go hungry ... because of the issue of climate change there is sea level rise, even just a few centimetres ... is a contributing factor, limiting the ability to produce enough food supply for the people. High deposit of salt on the surface of the soil [means] we cannot grow food crops that will sustain the escalating population. People are starving. This is inevitable, the only solution is a forced relocation to ... Bougainville.” (P26) “Soil structure in Carteret Islands not conducive to intense farming” (P1); “severe erosion on the island” (P2); “on balance more land [is] eroded away than [is] deposited elsewhere” (P20); “no VHF radio, no telephone, no internet” (P9); “not enough tanks for rain catchment” (P20); “land problems are delaying [the] move” (P4); “there are two relocation sites” (P7) “Autonomous Bougainville Government [ABG] and Tulele Peisa [TP] are coordinating two different locations: Tinputz [TP] and Carola Plantation [ABG], big problem relocating everyone to one site... land issue!” (P26); “government wants young couples to leave - their first priority” (P9); “too much rubbish, no waste disposal” (P20); “sea walls are washed down. Higher tides bring sea water into swamps where mosquitos breed” (P6); “population is growing, island is shrinking” (P13).

Traversing Han Island on foot, and circling it by boat, also revealed limits to coastal in situ adaptation<sup>5</sup> as illustrated both by Fig. 11 and the following research

<sup>5</sup>Limits of sea walls and coastal in situ adaptation on the Tulun Atoll are also shown in this United Nations University (UNU) (2009b) edited documentary: *Sinking Paradise, Carteret Islands, PNG*, <https://youtu.be/Hgw4HTokgk?t=1m15s>.



**Fig. 11** Flooded sea walls made of “gabion baskets”



“Gabion baskets”, wire-enforced structures filled with rocks on the Island of Han, Tulun Atoll.  
(Photos taken in 2010 by Luetz)

participant commentary: “ultimately, sea walls, gabion baskets and mangroves failed” (P2).

(5) *The proposed solutions may be subdivided into “soft” and “hard” solutions*

“Soft” solutions are presented first and include attitudes, social research, consultation, governance, and education:

“Elderly are the hardest group of people to convince; they never move out, even after disasters – cultural bonds are strong, and prior experience – [they] have experienced bad things and disasters before and are the highest risk takers, therefore hard to convince – you can preach but they’re not listening. A solution is to integrate climate change adaptation into the curriculum ... focus on the young people in advocacy and education. Older people can hold back young people as they have a shorter remaining life expectancy. Psychological issue – people won’t be listening until information comes from many directions.” (P1) “Protect their cultural identity” (P3); “[should resolve] the land issues so

the land is ready for resettlement” (P4); “more research is needed to hear from the Carteret Islanders what they want to do before, during and after the move: research at origin and destination communities” (P3); “limit their families to two kids because of overcrowding” (P21); “industrialised countries that are responsible for the cause of this should help” (P13); “proper consultation [is] essential among all stakeholders: host communities, land owners, Government (ABG and National Government), churches, re-settlers. Everything must be documented to make [the process] transparent, ensure longevity, leave evidence” (P17); “[more] consultation with the community” (P11); “create micro finance for seafood – bêche-de-mer is big business, but people don’t know how to commercialise” (P5); “the government should do more speaking and more listening. The communication from the government is not reaching the village” (P22); “technical expertise, education, build up local pool of experts” (P24).

In contrast, “hard” solutions include land reclamation and engineering approaches:

“Waste from copper mine should be brought and dumped in the islands. The mine [is] not now operating, but waste is still there. They’ve done that in Bougainville in Kobeinan, central Bougainville, – sea walls from the mined waste – big rocks!” (P5). “Building sea walls works with limited temporary success” (P2); “concreting and land reclamation ... Using mining waste could really work ... Dependent on reopening Panguna Mine. Very promising adaptation potential. Right now barges wait at dump sites, trucks load up the barge and dump the waste in a sea trench” (P17).

#### (6) *Bougainville Island is the most preferred migration destination*

There are two aspects in which islanders do not wish to leave: (1) they do not wish to leave their atoll islands, however, *if* forced to do so, then (2) they do not wish to leave their Bougainville region, language, culture, clan and family attachments. This may be visualised as concentric circles, with islanders preferring familiar and proximate over unfamiliar and non-proximate destinations:

“I would like to go someplace where the environment is similar to where I’m living and the way of living is the same so that I will feel that I did not lose my home but that my home is still here ... want to stay in Bougainville, where it’s culturally similar, but maybe, if there is no more space left, then moving from close and known to wider and different: 1<sup>st</sup> choice: Bougainville; 2<sup>nd</sup> choice: PNG; 3<sup>rd</sup> choice: Australia; 4<sup>th</sup> choice: Germany” (P24).

Elderly islanders especially emphasised that they would “stay here [Tulun Atoll] until we die” (P5), a finding aligned with previous research that “[t]here has been reluctance to leave, especially among older islanders” (Luetz 2008, p. 20).

Some respondents explicitly stated that they did not wish to move to Australia (P12), as “in Australia it’s all about money” (P9), or that they would be “afraid of the tall buildings there” (P13). “Australia? Not unless you got nowhere else to go.” (P18). One research participant elaborated that “educated people can go further afield to pursue opportunities. Less educated people tend to stay much closer to where they’ve relocated from to safe areas known to them. The vast majority will choose Bougainville. Very few people will go overseas [to] Vanuatu, Solomon Islands, Fiji” (P17).

## Discussion of Core Issues: “We’re not Refugees”

Although environmental factors (Fig. 5) seem to have a stronger contributing effect on migration than non-environmental factors (Fig. 8), research made it quite clear that ERPFs and NRPFs are interrelated and cannot be meaningfully discussed in isolation of each other, thus raising the need for holistic development and migration approaches. An example of this is the following problem description, which links ERPFs and NRPFs:

“[There is] too much rubbish, no waste disposal; [atoll islanders] just pile up rubbish at the shore, cover with sand ... this also provides breeding grounds for mosquitos ... too many breeding places, when the sea comes up, it doesn’t drain out” (P20) “Malaria [is] quite common here [on the atolls], people then go to Buka” (P12).

The example highlights a complex interrelationship between waste management practices, environmental effects, related health outcomes, and corresponding migration consequences. As this pilot study has discovered, reasons for migration are numerous, interdependent and complex, making it impossible to disaggregate the intertwined mix of reasons why people decide to move. Hence a monocausal attribution of reasons why people migrate appears methodologically unsound, given that reasons for migration are inclusive, not exclusive (Barnett and Campbell 2010, pp. 170–174; Betts 2010, p. 378; Brown 2008, p. 9; CCEMA 2010; Hamilton et al. 2016).

Extreme population pressures on atolls have been documented long before climate change ever registered as a problem in mainstream public awareness (Bayliss-Smith 1974, 1975), and even the Nukumanu (Tasman) Atoll to the northeast of Bougainville “experienced a considerable population reduction in the 1870s following overpopulation.” (Connell 2015, p. 17; attributed to Bayliss-Smith 1975, pp. 312–323). Hence a single cause of migration arising uniquely and exclusively from the effects of climate change, as sometimes simplistically suggested in the mainstream media through headlines such as “Pacific Atlantis: First climate change refugees” (Vidal 2005), appears to fall well short of encapsulating the complex interplay of environmental, sociodemographic and historical realities that have long shaped the region through a combination of both “physical factors (tectonic movements, SLR, ENSO events, cyclones) and human factors (particularly intense where populations are growing)” (Connell 2015, p. 20).

However, this should not be misconceived as implying that climate change is not a major causal factor in migration, or that its contribution to the depopulation of islands in the region is not growing (Albert et al. 2016). While conceiving of climate change and migration as a chain of cause and effect is too simplistic, de-linking the two issues as causally unrelated seems similarly untenable, seeing that “absence of evidence about a problem does not imply evidence of absence of a problem” (Myers and Kent 1995, p. 29). On the contrary, it seems that physical factors and human factors are inseparably intertwined, and that the contribution of climate change to migration, relative to other factors, could be growing:

“[W]hile the evidence for a distinctively anthropogenic ‘climate change signal’ in forced migration so far is circumstantial, *it is mounting*. And with all available scenarios predicting accelerating climate change impacting growing populations and more people living on marginal land, *forced climate migration is certain to increase*” (Brown 2007, p. 18; emphasis added).

This could be particularly pertinent for coastal communities on atolls, seeing that “there is already a strong awareness of the risk of accelerated sea-level rise (e.g., Church and Gregory 2001; Nurse and Sem 2001), [which] could accelerate the process of abandonment ... as people lose faith in the future of low-lying islands based on the thought of the impacts of sea-level rise.” (Arenstam Gibbons and Nicholls 2006, p. 46). This seems to be especially urgent in view of recent scientific evidence that in the nearby Solomon Islands “[s]ea-level rise has claimed five whole islands” (Leon 2016; cf. Albert et al. 2016).

In this context continued population increase remains a significant human pressure point, and this has had little or nothing to do with climate change (Fig. 12), and more to do with the levels of development and educational attainment that are realisable in remote atoll environments where even the constancy of electricity can present significant challenges. Further, fertility has a significant positive correlation with age and household size but not education (Fig. 13), thus suggesting that higher levels of education are conducive to better family planning. Expressed differently, the results presented in Figs. 12 and 13 seem to suggest that higher levels of

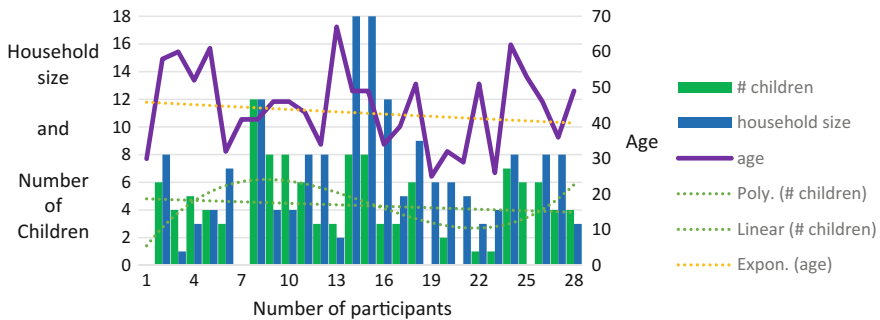


Fig. 12 Study participants and number of children: on average, each participant had 4.65 children

	Children	Household	Age	Education
Children	----	.521**	.453*	-.438*
Household	.521**	----	-.063	-.341
Age	.453*	-.063	----	-.114
Education	-.438*	-.341	-.114	----

N=28, \*P<0.05, \*\*P<0.01.

Fig. 13 Correlations: Participant fertility and educational attainment. The average level of education is secondary education (grade 10)

education lead to fewer children, and that lower levels of education lead to more children. Hence the situation on the Tulun Atoll seems to be influenced not only by climate change and ERPFs but also by developmental matters observed elsewhere in the world where higher levels of education are commonly shown to be inversely related to childbearing (UN-DESA 1997; Basu 2002). This makes education a promising adaptation response.

Relatedly, this field research encountered one atoll islander who already had 12 children, and his wife was pregnant at the time with his 13th child. While this number of children may seem unusually high in any environmental context, both the smallness of the island where the face-to-face encounter took place (measuring little over 100 m in diameter) and its limited subsistence potential, visually illustrate the geospatially confined limits to population growth. Further, it is worth remembering that contemporary population growth dovetails historical fertility trends flagged as locally unsustainable long before climate change entered mainstream global consciousness:

In 1964, [a] survey team had recorded a population of 721, noting that this represented an average annual growth rate of 2.4% since the 1954 census figure of 581. They warned that by 1984 the population would be well over 1,000 ... this prediction proved correct but increasingly out-migration has been a factor reducing the rate of resident population growth. (O'Collins 1989, p. 253; see also Figure "Population projection for the Carteret Islands" depicted on p. 254).

In short, high fertility rates are not newly experienced in the region of investigation. However, the interplay between ERPFs and NRPFs could have important implications. For instance, accelerated sea level rise may interact with adaptive capacity in ways that also reinforced island abandonment in other parts of the world, where "the population growth removed the possibility of internal relocation and hence reduced the adaptive capacity" (Arenstam Gibbons and Nicholls 2006, p. 46).

To synthesise, the multicausality that characterises migration in the region of investigation suggests that the description of the Carteret (Tulun) Islanders as "the world's first environmental refugees" (Gupta 2007, para. 4) or "[t]he world's first climate change refugees" (Tweedie 2009; cf MacFarquhar 2009; Harman 2013; Beldi 2016), is untenably simplistic. It is perhaps not so much that this emphasis on climate/environment in migration is causally incorrect but rather that it is causally incomplete, as Adichie (2009) cautions in her reflections about "the danger of a single story" (para. 42): "The single story creates stereotypes, and the problem with stereotypes is not that they are untrue, but that they are incomplete. They make one story become the only story".

Additionally and importantly, a further compelling reason to reconsider the continued use of the term "refugee" in referring to migrating atoll islanders is that local respondents overwhelmingly resist this characterisation. While this understanding is not newly discovered (McNamara and Gibson 2009), it accompanies the well-established recognition that in a strictly legal sense affected migrating atoll islanders are, in fact, not "refugees" at all, being denied the very status of protection that this term was originally legislated to bestow (McAdam 2010).

Although islanders overwhelmingly meet the “well-founded fear” requirement stipulated by the Refugee Convention in Article 1 A.(2), as shown above in the results section, they are evidently not “persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion”, and also do not find themselves “outside the country of [their] nationality” (UNHCR 2010, p. 14), to mention only a few of the major impediments to the legal correctness and applicability of the term “refugee” in this socioenvironmental context. While alternative constructs involving “climigrants” and “climigration” (Hamilton et al. 2016) may manage to steer clear of the legal difficulties surrounding the term “refugees”, such terms nevertheless also fall short of conveying the multicausality inherent in migration where human movement is typically triggered or supported by a complex combination of human and physical, push and pull factors, which are impossible to disentangle or quantify (Barnett and Campbell 2010, pp. 170–174).

Against this background it is conjectured that the “refugee” label, whether linked to “environmental refugees” (Rakova et al. 2009), “climate change refugees” (Tweedie 2009), “sea-level refugees” (WBGU 2006, p. 61), or other alternative types of “refugees” that have been suggested in the literature,<sup>6</sup> owes its enduring popularity to the relative ease of comprehension among non-expert audiences that are typically addressed by the media or NGOs in the hopes of enlisting their advocacy for social justice (Luetz 2008, p. 121).

Clearly, terms such as “climate refugees” are far more easily comprehended in the public space than more precise albeit more cumbersome academic constructs such as “climate change-related migrants” (Campbell and Warrick 2014, p. 2), or people “forced to leave their homes due to sudden-onset climate-related natural disasters” (UN-OCHA 2009, p. 15).

This ease of use may also explain the continued utilisation of this term by both scholars (e.g., McNamara and Gibson 2009, p. 475; Hartmann 2010, p. 233; Bettini 2013), UN development groups (e.g., Campbell and Warrick 2014, p. 24; Brown 2007, pp. 3, 8), and nongovernmental organisations (e.g., Bauer 2010; Luetz 2008, p. 121<sup>7</sup>), who perpetuate variations of the term “climate refugees” in inverted commas, apparently recognising the widespread comprehension that this construct enjoys among readerships, and yet without conceding personal assent.

As suggested by Barnett and Campbell (2010), “[a]n alternative language, based on notions of risk, and focusing on adaptation and adaptive capacity, may be more likely to lead to constructive outcomes.” (p. 174). This research suggests that local

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<sup>6</sup>See “2.2 Nomenclature: Definitional difficulties” in Luetz (2013, pp. 29–30) for a list of terms that have been conceptually proposed in the literature to describe climate change related human movement.

<sup>7</sup>Endnote (a) in Luetz (2008, p. 121) states: “The term ‘climate refugee’ is used in this report on the understanding that World Vision does not endorse this term but rather recognises its usage by various commentators. World Vision acknowledges the legal definition of refugees as rendered by the 1951 Convention on Refugees”.