A Simplified Scale for Assessing and Communicating Climate Change Impacts

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Climate change is regarded as one of the greatest policy challenges ever faced by governments and policy makers. To understand and compare the impact of climate change between regions requires a clear and consistent measure. To date, there is no one simplified scale for measuring climate change impact for policy makers and the general public. This paper highlights the need for a simplified impact scale to improve clarity and reduce complexity in communicating climate change impacts to a broader audience. Further, the paper presents a simplified prototype scale option for measuring and communicating climate change impacts. Subsequently, the scale was trialled by 18 Pacific Island states and a survey was undertaken. The paper analyses the results of the Pacific trial and provides a synopsis on the findings. Such a scale could be applied to gain a high-level understanding of climate change impacts for a region.

1. INTRODUCTION

Climate change is regarded as one of the greatest policy challenges ever faced by governments and policymakers (Garnaut, 2008). To understand and compare the impact of climate change between regions requires a clear and consistent measure. To date, there is no one simplified scale for measuring climate change impact for policy makers and the general public. This study proposes the development and an initial trial application of such a scale.

A simplified climate change impact scale would provide a method for comparison of climate change impacts between regions. This supports improved policy decisions around provision of resources for mitigation and adaptation projects. A climate change impact scale needs to be simple to be understood by both the general public and by policy makers who undertake assessments of climate change impacts.

In this short paper, a simplified prototype of a newly developed climate change impact scale is introduced. The main aims of the prototype include ease of use in completing assessments for users and simplicity in understanding assessment ratings by users such as the general public and policy makers.

2. METHOD

The prototype scale was designed utilising methodology contained within the risk management standard AS/NZS ISO 31000:2009 (Figure 1). Some existing scale development methods were reviewed (Devellis, 1991) and (Tharenou et al., 2007). Additionally, other possible existing scales and index candidates for measuring climate change impacts were reviewed. (Hansen et al, 1998; Manton and Jasper, 1998; Nicholl et al., 2000; Petersen et al., 2001; Programme U.N.E, 2004; Petersen, 2005; Gray et al., 2005; Pongracz and Bartholy, 2006; Baettig et al.,2007; Programme W.C.D.a.M., 2007; Council P.I.M., 2008; Hohne et al, 2008; McSweeny et al. 2008; NOAA, 2008).

The prototype scale was distributed to over 20 Pacific nations as part of a climate change impact survey in early 2011. Overall, there were 18 respondents to the climate change impact survey: American Samoa; Cook Islands; Fiji; Guam; Hawaii; Kiribati; Marshall Islands; Micronesia; Nauru;

Palau; Papua New Guinea; Pitcairn Island; Samoa; Tokelau; Tonga; Tuvalu; Vanuatu; and Wallis and Furtuna.

The survey was designed to use the prototype scale to measure the impact of climate change across a number of sub-systems: terrestrial and marine; water; tourism; socio-economic; culture; health; food and agriculture; and meteorological (Hay et al., 2003)(Mimura et al., 2007). Firstly, a number of sub-systems with related climate change impact events for the Pacific Ocean (Oceania) region were provided to the participants. The participants then were asked to use the prototype scale (Figure 1) to make an assessment of climate change impact for each sub-system for their country. Secondly, the survey asked participants to rank which sub-systems were most important to them. Finally, participants were required to rank which systems (human, ecological and physical) were most important to their country in relation to climate change impacts. This paper will not discuss the results of the systems and sub-system components of the survey.

A rating of ….	**Scale**	**Means that the occurrence of the impact ……**
Severe	5	• Threatens the survival of the country. • Has extreme impacts on the viability of the country/island; • Or has extreme impact on natural or human systems of the country/island.
Major	4	• Threatens the survival or continued effective function of a natural or human system of the country/island. • Has a major impact on the governments strategic objectives; • Or have a major impact on natural or human systems of the country/island.
Moderate	3	• Does not threaten natural or human systems, but would mean that the system could be subject to significant maintenance or changed ways of operation. • Moderately impacts on the governments strategic/operational objectives; or • Have a moderate impact on the natural or human systems of the country/island.
Minor	2	• Threatens the efficiency or effectiveness of some aspect of natural or human systems but can be managed by adaptation actions. • Minor impact on the governments strategic/operational objectives; or • Has a minor impact on natural or human systems of the country/island.
Negligible	1	• Results in impacts that can be dealt by routine adaptation actions.

Figure 1: The prototype climate change impact scale

3. RESULTS

Table 1 summarises the assessments by percentage of respondents' ratings for climate change impact responses only. It should be noted that nil or blank responses have been omitted from the percentages table. Additionally, there were three countries that did not respond to the survey – Northern Marianas, Tonga and French Polynesia.

Close to a quarter of respondents ranked food/agriculture and meteorological factors as being severely impacted by climate change. Food and agriculture sub-systems are being severely affected by climate change in the Solomon Islands, Micronesia, Marshall Islands, American Samoa, and Tuvalu. The severe impact to food and agriculture sub-systems is concentrated in countries located in the central and north Pacific region, as shown in Figure 2.

Approximately one-fifth of respondents rated current climate change impacts to water and socio-economic areas as severe.

Impacts by climate change to tourism and culture was assessed as negligible by around 18%. However, given the close relationship between natural environment and tourism in many of the respondent countries, the collateral damage to these and other sub-systems may be greater than anticipated.

Table 1: assessments by percentage of respondents' ratings for climate change impact responses

Climate change impacts	Severe (5)	Major (4)	Moderate (3)	Minor (2)	Negligible (1)
Marine and terrestrial	20.0%	30.0%	40.0%	-	-
Water	21.1%	36.8%	26.3%	10.5%	-
Tourism	-	10.5%	42.1%	21.1%	26.3%
Social economic	21.1%	21.1%	36.8%	15.8%	-
Culture	10.5%	15.8%	36.8%	15.8%	21.1%
Health	-	42.1%	36.8%	10.5%	-
Food and agriculture	26.3%	31.6%	31.6%	5.3%	5.3%
Meteorological	25.0%	35.0%	25.0%	10.0%	-
Government and policy	17.6%	23.5%	35.3%	17.6%	-

Table 1 Key

Indicates highest percentage of responses for each area of concern

Severe impacts

Lowest percentage of responses

Figure 2 -Food and Agriculture impacts ratings by country

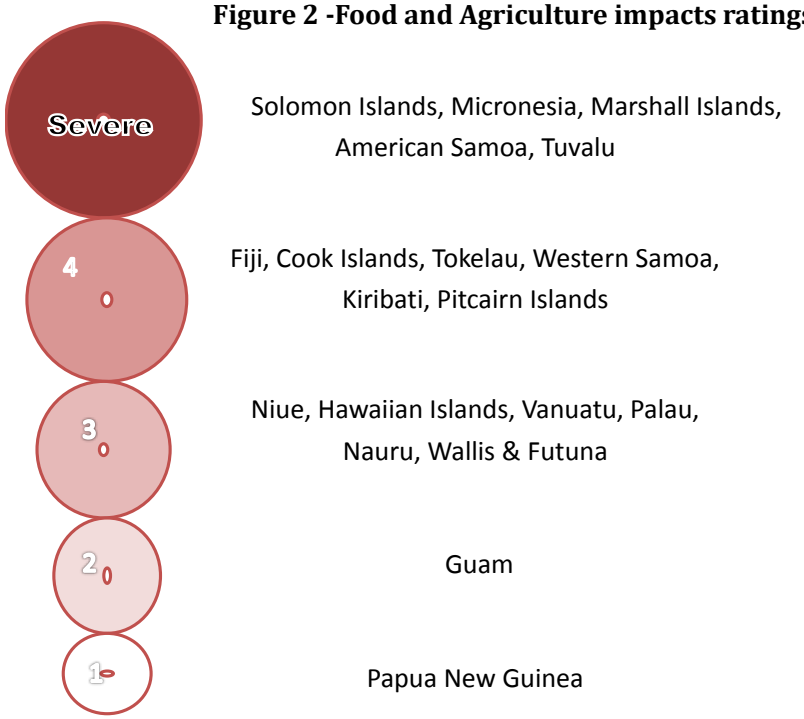

Figure 2: Food and Agriculture impact ratings

4. SYNOPSIS OF RESULTS

The results of the survey indicate that a simplified scale for measuring climate change could be used to measure climate change impacts. However, several assumptions are incorporated within this conclusion.

Firstly, it assumes that a climate change event or series of events have been clearly attributed to the impact and that the impact is not a result of over-consumption.

Secondly, the use of the scale without an agreed weighting component may be open to value judgments, especially with regards significant impacts. Scale stakeholders may interpret results differently depending on their use for the results. This may affect their specific thinking about decisions based on the scaling.

Next, the prototype assumes that the user is aware of the vulnerability of their region to each climate change event that may impact a sub system. As a result the user of the scale would be aware of the impact a sub system event has on their region.

Finally, the prototype is in essence a scale and not an index. A scale measures a single concept through multiple indicators. In the case of the prototype, the indicators are alternative expressions of the underlying sub-systems and hence should correlate highly. These alternative expressions are noted climate change impacts within the Pacific to date, as detailed in existing assessment reports (Hay, et al., 2003; Barnett, 2005; Mimura et al., 2007; Australian Bureau of Meteorology and CSIRO, 2011). An index is a sum of items that do not necessarily have to measure a single concept, indeed they may not even correlate with each other (e.g. as in the South Pacific's Applied Geoscience Commissions (SOPAC) Environmental Vulnerability Index). The prototype presented in this research is a scale where the items in a given sub-system are alternative reflections or expressions of climate change impact, where 'impact' is the underlying concept that causes manifest responses. An index (also called a formative indicator) would imply that the 'impact' itself is derived from the items, that is

the cause goes the other way from indicator to concept.

A simple scale could be utilised to measure climate change impacts in a region in the absence of existing historical data or, in the case of the Pacific, where empirical evidence is piecemeal or limited (Barnett and Campbell, 2010). It may also be the case when there are time constraints to gathering existing data or only a prima facie impact assessment is required.

The results of the scale assessment of impacts are in agreement with most climate change impact assessments completed to date (Hay, et al., 2003; Barnett, 2005; Mimura et al., 2007; Australian Bureau of Meteorology and CSIRO, 2011).

A number of scaling maps were produced. Figure 3 provides an example of the scaling map for climate change impacts to water. The scaling maps provide a representation of scale score by sub-system on a physical map of the Pacific region. The scaling maps show another possible representation of the simple impact scaling. The map representations promote easier understanding of climate change impacts across large areas of the Pacific.

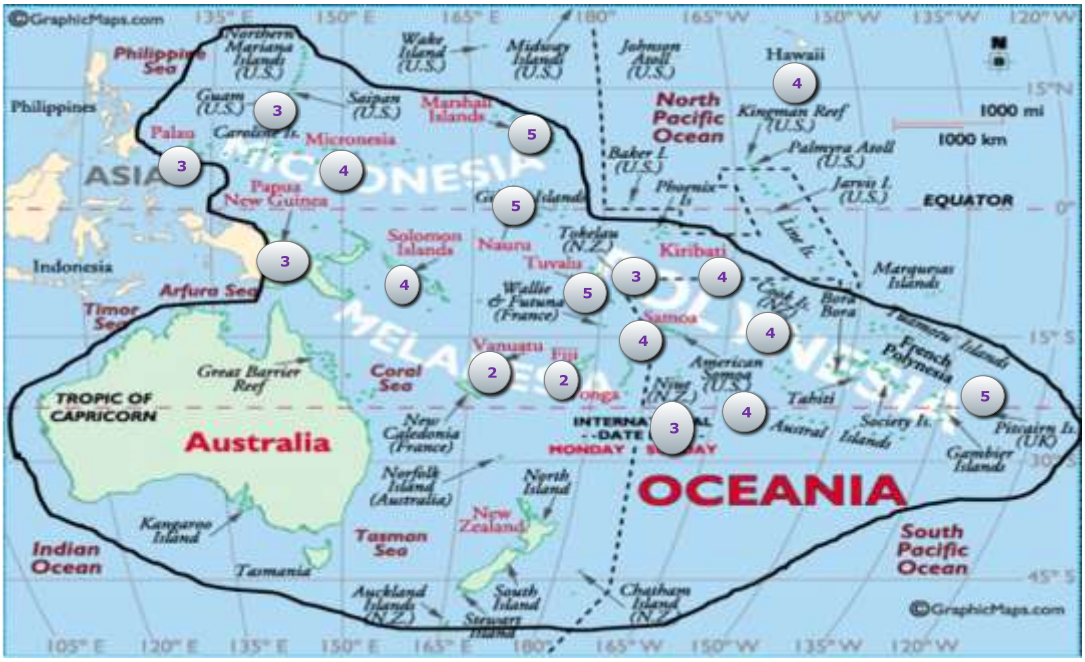

Figure 3: Scaling map Pacific region climate change impacts to water sub systems

5. CONCLUSION

There is currently no simplified scale for measuring climate change impact to a region. A prototype simplified climate change impact scale was developed and utilised to measure and communicate climate change impact levels within 18 Pacific countries in early 2011. The respondents were able to effectively assess and communicate what they believed to be climate change impacts on their country. The prototype scale could be further developed for impact event sets for any region or sub system at both a macro and micro scale level. Additionally, a next generation scale could utilise system and sub-system weightings to derive the overall weighted assessment scores. Such a scale could assist policy makers in achieving a broader and simple understanding of impacts. As a result, it could be an opportunity for improved responsiveness of effective climate change adaptation policy within a region.

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