

A SIMPLIFIED QUALITATIVE SCALE FOR ASSESSING AND COMMUNICATING CLIMATE CHANGE IMPACTS

A Dissertation submitted by

Mark Hugh Macfarlane B Info Tech

For the award of

Master of Science

2013

ABSTRACT

This thesis reports that a simple qualitative scale for assessing and communicating climate change impacts can be applied effectively to assess climate change impact to a region. The results presented on this simple scale could improve clarity in communication of climate change to the public.

The study identifies different approaches to modelling various natural event variables and different climate change indexes. It concludes that there is currently no available simplified scale for assessing and measuring current climate change impacts. The thesis makes a case for the inadequacy of these approaches, as they either do not measure climate change impacts or they are too complex. Accordingly, this research presents a simplified qualitative scale for assessing and communicating climate change impacts.

The scale was designed on existing scale frameworks contained within the Australian Risk Management Standard and other scaling methods. The scale was distributed to 20 Pacific nations as part of a climate change impact survey. Participants used the scale to assess the impact of climate change across a number of sub-systems including terrestrial and marine, water, tourism, socio economic, culture, health, food and agriculture and meteorological. The survey successfully elicited assessments of the different climate change impacts evident across the Pacific Island nation states. The results are presented in graphic and tabular form which provides a readily accessible appreciation of the different impacts of climate change. This in itself demonstrates the merits of constructing a scale. The assessment results indicate that there is currently a moderate to severe impact from climate change across the Pacific region.

CERTIFICATION OF DISSERTATION

I certify that the ideas, experimental work, results, analyses, software and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged.

MARK MACFARLANE

17TH February 2013

Signature of Candidate

Date

ENDORSEMENT

Signature of Supervisor/s

Date

ACKNOWLEDGEMENTS

I would like to thank my supervisor Dr Joachim Ribbe Associate Professor in Climatology University of Southern Queensland for his support and direction during the thesis.

Thanks to the many Pacific Island organisations that utilised the scale for assessment of climate change impacts within their country. This was the first application of the scale.

I would like to thank the following persons – Bonnie Macfarlane for statistical support, Kate Fenning for graphics support, Anthony Forlin for the French translation of the survey and Anne Cullinan for editing services.

A special mention to my dad “Thomas Macfarlane” who passed away in December 2010 during completion of this thesis. This thesis is dedicated to him. My dad instilled the importance of passion and a good work ethic in me. Without this I would never have completed this work.

Finally, I would like to thank my family – my wife Sally, and my two boys Ben and William – for putting up with me during the completion of this thesis. Thank you.

Table of Contents

CHAPTER 1: INTRODUCTION	1
1.1. CONTEXT OF THE STUDY	1
1.2. PROBLEM STATEMENT	1
1.3. AIMS AND SCOPE	4
1.4. SIGNIFICANCE OF THE STUDY	6
1.5. STRUCTURE OF THE DOCUMENT	7
CHAPTER 2: LITERATURE REVIEW	9
2.1. CONTEXT AND BACKGROUND	9
2.1.1. SCALES AND INDEXES TO MEASURE NATURAL PHENOMENA	9
2.1.2. PRIMARY EXISTING SCALES AND INDEXES FOR MEASURING CLIMATE CHANGE IMPACTS	12
2.1.3. CLIMATE SCALES AND INDEXES FOR THE ENVIRONMENT	15
2.1.4. CLIMATE SCALES AND INDEXES FOR FINANCIAL MARKETS AND SECURITIES	18
2.1.5. PACIFIC ISLANDS APPLIED GEOSCIENCE COMMISSION (SOPAC) ENVIRONMENTAL VULNERABILITY INDEX	19
2.1.6. RISK-BASED METHODS	19
2.2. RECENT MOTIVATION TO DEVELOP A SCALE	21
2.3. LITERATURE REVIEW FINDINGS	22
2.4. LITERATURE REVIEW SCALE DEVELOPMENT METHODS	23
2.5. A PROCESS METHOD FOR DESIGNING THE SCALE	24
CHAPTER 3: METHODOLOGY	26
3.1. INTRODUCTION	26
3.2. DEVELOPMENT OF CLIMATE CHANGE IMPACT ITEMS	26
3.3. DESIGN OF A PROTOTYPE SCALE	27
3.4. OUTCOMES	31
3.4.1. SCALE APPLICATION-PACIFIC ISLANDS CLIMATE CHANGE IMPACTS SURVEY 2011	32
CHAPTER 4: RESULTS	36
4.1. INTRODUCTION	36
4.2. CLIMATE CHANGE IMPACT ASSESSMENT DETAILED RESULTS	36
4.3. CLIMATE CHANGE IMPACT ASSESSMENT RESULTS BY SUB-SYSTEM	38
4.3.1. MARINE AND TERRESTRIAL SUB-SYSTEM RESULTS	42
4.3.2. WATER SUB-SYSTEM RESULTS	44
4.3.3. TOURISM SUB-SYSTEM RESULTS	46
4.3.4. SOCIO-ECONOMIC SUB-SYSTEM RESULTS	47

4.3.5.	<i>CULTURE SUB-SYSTEM RESULTS</i>	49
4.3.6.	<i>HEALTH SUB-SYSTEM RESULTS</i>	50
4.3.7.	<i>FOOD AND AGRICULTURE SUB-SYSTEM RESULTS</i>	51
4.3.8.	<i>METEOROLOGICAL SUB-SYSTEM RESULTS</i>	53
4.3.9.	<i>GOVERNMENT POLICY AND PROCESSES RESULTS</i>	54
4.4.	RESULTS OF SYSTEM ASSESSMENTS	55
4.5.	RESULTS OF SUB-SYSTEM ASSESSMENTS	58
4.6.	USABILITY	63
4.7.	SUMMARY OF RESULTS	63
 CHAPTER 5: DISCUSSION OF RESULTS		65
5.1.	PACIFIC ISLANDS CLIMATE CHANGE IMPACTS SURVEY 2011 – IMPACT SUMMARY	68
5.2.	<i>CLIMATE VARIABILITY AND CHANGE AND SEA LEVEL RISE IN THE PACIFIC ISLANDS REGION</i> REPORT – IMPACT SUMMARY	70
5.3.	<i>IPCC 4TH ASSESSMENT REPORT</i> - CHAPTER 16 SMALL ISLANDS-IMPACT SUMMARY	71
5.4.	<i>CLIMATE CHANGE IN THE PACIFIC: SCIENTIFIC ASSESSMENT AND NEW RESEARCH</i> – IMPACT SUMMARY	72
5.5.	EFFECTIVENESS OF THE SCALE	74
5.6.	EXTENDED APPLICATIONS FOR USE OF A SIMPLIFIED IMPACT SCALE 76	
 CHAPTER 6: CONCLUSIONS		79
6.1.	FUTURE WORKS AND IMPROVEMENTS TO THE SIMPLIFIED IMPACT SCALE 80	

REFERENCES

APPENDIX: PACIFIC ISLANDS CLIMATE CHANGE IMPACT SURVEY 2011

List of Tables

Table 2.1: Some known simplified physical science scales for classification of natural phenomena events

Table 3.1: AS/NZS Risk Standard Simple Consequence Table

Table 3.2: Initial Strawman Climate Change Impact Scale

Table 3.3: Second Strawman Climate Change Impact Scale

Table 3.4: A Simplified Qualitative Scale for Assessing and Communicating Climate Change Impacts

Table 3.5: List of respondents to the Pacific Islands Climate Change Impacts Survey 2011

Table 4.1: Pacific Island climate change impacts by sub-system

Table 4.2: Climate change impact assessments by country

Table 4.3: Summary table of counts in relation to importance of systems in relation to climate change impacts by percentage

Table 4.4: Summary table of counts in relation to importance of systems in relation to climate change impacts

Table 4.5: Count of Importance of systems in relation to climate change impacts by country

Table 4.6: Analysis of sub-system importance in relation to climate change by country

Table 4.7: Count of sub-system importance in relation to climate change by country

Table 5.1: Sample climate change event data set for health sub-systems in Pacific Small Islands Countries Region

List of Figures

Figure 4.1: Scaling map for the impacts to marine and terrestrial sub-systems

Figure 4.2: Scaling map for impacts to water sub-systems

Figure 4. 3: Scaling map for the impacts to tourism sub-systems

Figure 4.4: Scaling map for the impacts to socio economic sub-systems

Figure 4.5: Scaling map for the impacts to cultural sub-systems

Figure 4.6: Scaling map for the impacts to health sub-systems

Figure 4.7: Scaling map for the impacts to food and agriculture sub-systems

Figure 4.8: Scaling map for the impacts to meteorological sub-systems

Figure 4.9: Scaling map for the impacts to government policy and process sub-systems