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Predominant Factors in Perceptions of Climate Change: The Case of University and College Students in the Marshall Islands and Kiribati

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ABSTRACT *This study identifies key factors influencing perceptions of climate change among college students in the Marshall Islands and Kiribati. Using Random Forest analysis on survey data from 271 students, the research reveals distinct patterns in each country. In the Marshall Islands, dominant factors include trust in media, community discussions, and family conversations. In Kiribati, internet information, media trust, formal education, and religious beliefs play significant roles. While both nations exhibit strong media influence, the Marshall Islands demonstrates greater impact from traditional social structures, whereas Kiribati shows more influence from education and religion. These findings highlight the complex interplay of information sources, social structures, and cultural factors in shaping climate change perceptions in atoll nations. The study suggests that tailored approaches may be necessary for effective climate change education and adaptation strategies in different cultural contexts.*

Keywords: Atoll Nations, Climate Change Perception, Cultural Influences, Pacific Island Students, Random Forest Analysis

Introduction

From 2017 to 2019, an international research initiative titled "Aspirations and Livelihood Transition of Migrants from the Pacific to Abroad" was conducted (Nakayama, Drinkall & Sasaki, 2019). This initiative aimed to find out how the concept of climate change is perceived by students in an atoll country, namely the Marshall Islands and Kiribati, compared to a non-atoll country, the Federated States of Micronesia (Moriya, 2019). The research sought to examine how religion, culture, and education shape views on climate change and its consequences. Researchers surveyed college students in the Republic of the Marshall Islands (RMI) and university students in Kiribati using a questionnaire.

The study found that more than 80% of students at the College of the Marshall Islands in Majuro, Republic of the Marshall Islands, and the Kiribati campus of the University of the South Pacific in Tarawa, Kiribati, believed they were well informed about climate change and its impact on rising sea levels. Results also indicate that education plays a more significant role than religious or cultural factors in shaping perceptions of climate change and understanding its impacts in both countries. This finding is notable, given the distinct historical, cultural, and

religious backgrounds of the RMI and Kiribati (Nakayama, 2019; Nakayama et al., 2019; Sasaki et al., 2019).

For those of the authors who worked as administrators or faculty at these institutions of higher learning, it remained unclear how these students had developed their understanding of these issues. This persistent uncertainty has motivated us to reinvigorate our efforts to identify the dominant factors influencing the perceptions of climate change using an advanced analytical tool.

Objectives

This study aims to quantitatively identify the dominant factors shaping perceptions of climate change among highly educated students in the atoll countries of the Marshall Islands and Kiribati.

Methodology

A survey was conducted with 119 students from the College of the Marshall Islands (CMI) in the Republic of the Marshall Islands (RMI) and 152 students from the Kiribati Campus of the University of the South Pacific in the Republic of Kiribati. The participants were drawn from randomly selected classes at each institution across various academic disciplines, including natural sciences, social sciences, humanities, and technical/vocational programmes. This diverse sampling approach was chosen to capture varying levels of exposure to environmental education and to understand how different academic backgrounds might influence perceptions of climate change.

At the time of the survey, both institutions had approximately 1,000 students enrolled. The sample size represented approximately 12% of the total student population at CMI and approximately 15% at the Kiribati campus, providing a statistically significant representation of the student body. The significance level for the data in these study cases was set at $p < 0.1$.

The questionnaire consisted of 17 statements about perceptions of climate change and related matters. Most of the opinion-based questions in this survey utilised a 5-point Likert scale for responses. Participants were asked to evaluate statements by selecting one of five options: "Strongly Disagree" (1 point), "Disagree" (2 points), "Neither agree nor disagree" (3 points), "Agree" (4 points), or "Strongly Agree" (5 points). This scale provided respondents with a range of choices to express their level of agreement or disagreement with each presented statement.

A prediction model was built using a machine learning algorithm "random forest," with the question $x1$ "I am certain that Climate Change is taking place" as the objective variable and the other 16 questions as explanatory variables.

Random forest is an ensemble learning technique that leverages multiple decision trees to create a robust model for predictive analysis and behavioural pattern recognition (Breiman, 2001). The algorithm builds multiple decision trees, each using a random subset of data and features, then combines their predictions for improved accuracy. During this process, it evaluates variable importance by tracking how each feature affects prediction accuracy across all trees. This is done by measuring the increase in prediction error when a variable is excluded or its values are randomised (Biau & Scornet, 2016).

This approach not only produces robust predictions by leveraging the collective insights of many trees but also provides valuable information about the most

influential variables. The method's strength lies in its ability to handle complex, high-dimensional data while simultaneously offering a built-in mechanism for assessing feature importance. This makes it a powerful tool for both prediction and interpretation in machine learning tasks.

Unlike individual decision trees, which can be pruned to optimise performance, the trees within a random forest remain unaltered, preserving the diversity of the ensemble. The method's ability to handle vast amounts of data while maintaining predictive accuracy has made it increasingly popular in machine learning and data science applications. Its resistance to overfitting and capacity to provide insights into feature importance further enhance its utility across various domains. The R package 'randomForest' was used for this analysis.

Results

The model output (estimation of the objective variable) was rounded to the nearest integer, because the objective variable was categorised using the Likert scale from 1 to 5. The error of estimation of the objective variable by the random forest model was 4.7% for RMI and 2.1% for Kiribati.

The random forest model produces a variable importance plot. Figures 1 and 2 feature the "Increase in Node Purity" (IncNodePurity), which indicates the rise in model error when a specific variable undergoes random permutation or shuffling (Tohry et al., 2020). As shown in Figure 1, the random forest model developed for the RMI suggests that the following five factors predominate in shaping respondents' perceptions of climate change.

- x2: Views or information about climate change, which is conveyed through mass media (newspaper, television, radio), are trustworthy.
- x9: How often does your community leader talk about climate change?
- x10: How often does your family talk about climate change?
- x3: Information about climate change available through internet is trustworthy.
- x14: I understand what religious leaders say about climate change is trustworthy.

The random forest model formulated for Kiribati suggests the following five dominant factors, as shown in Figure 2.

- x3: Information about climate change available through the internet is trustworthy.
- x2: Views or information about climate change, which is conveyed through mass media (newspaper, television, radio), are trustworthy.
- x5: I believed what high school teachers say about climate change is trustworthy.
- x15: The atoll countries in the Pacific will never be submerged by sea level rise caused by climate change, for according to the Bible (Isaiah 54:9) God said "I once promised Noah that I would never again destroy the earth by a flood."
- x14: I understand what religious leaders say about climate change is trustworthy.
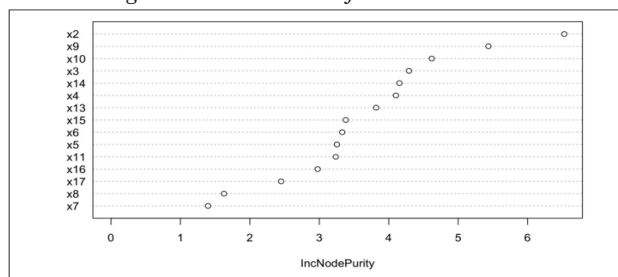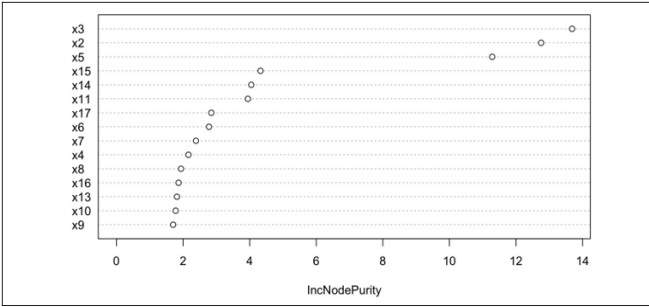
Figure 1 Predominant factors in RMI

Figure 2 Predominant factors in Kiribati

Discussion and Implications for the Maldives

Mass media and internet influence are significant in both RMI and Kiribati. In the RMI, family and community matters hold considerable importance, suggesting strong traditional social structures. Kiribati, in contrast, sees notable influence from formal school education and religious factors. These differences highlight the unique social priorities of each nation, despite shared exposure to global media influences.

The findings of this study have important implications for understanding climate change perceptions in atoll nations, particularly for potential application in the Maldives. While the Maldives shares many characteristics with RMI and Kiribati as an atoll nation, it presents unique challenges and opportunities for climate change education and awareness.

The gap in environmental studies between grade 5 and graduate degree level in the Maldives may present a distinct context compared to RMI and Kiribati. However, this study's methodology could be particularly valuable in the Maldivian context for several reasons:

1. Understanding Information Sources: The study's approach to identifying dominant information sources could help Maldivian educators and policymakers understand how students receive and process climate change information despite the formal education gap.
2. Cultural Context: The methodology's ability to distinguish between formal education, media influence, and cultural factors could help identify alternative channels for climate awareness in the absence of formal environmental education.
3. Community Impact: The study's findings about the role of family and community discussions suggest potential pathways for climate change education outside the formal education system, which could be particularly relevant in the Maldivian context.

A similar study in the Maldives could be modified to:
- Include questions about informal learning sources and community knowledge.
- Explore the role of traditional environmental knowledge.
- Assess the impact of media and internet sources in bridging the formal education gap.
- Evaluate the potential of community-based education initiatives.

Such research could inform strategies for:
- Developing community-based environmental education programmes.
- Strengthening climate change awareness through existing cultural and social structures.
- Identifying effective channels for climate change communication in the absence of formal environmental education.

Declaration

The authors report no conflicts of interest.

The conduct of the survey on which this study is based was approved (identification number: 17-258) by the Research Ethics Committee of the University of Tokyo, where the first author of this article, Mikiyasu Nakayama, formerly worked as a professor at the Graduate School of Frontier Sciences. Ethical review and approval were waived for this study based on the ethical code of the Global Infrastructure Fund Research Foundation Japan (GIF Japan), where the first author currently works.

Informed consent was obtained from the respondents to the survey.

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