

論文の内容の要旨

論文題目 **Ciguatera Fish Poisoning and Its Association with Climate Change and Food Choice in the Pacific: Implications for Surveillance and Response Systems**
 (太平洋諸島におけるシガテラ中毒の気候変動および食料選択との関連性：サーベイランスと対応策への示唆)

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The Pacific is in fact without a doubt one of the most vulnerable regions when it comes to several challenges due to climate change, particularly in many of the remote outer islands. Such challenges may affect local communities' health, sustenance, livelihood and economic activities. For instance, local prevalence of "fish poisoning" has adversely affected the food and public health system of many Pacific island countries. One most common form of fish poisoning is called ciguatera. Ciguatera fish poisoning (CFP) is caused by ingestion of a wide spectrum of coral reef fish that contains bio-accumulated neurotoxins. These toxins, produced by the toxic dinoflagellate *Gambierdiscus*, accumulate and transform as they pass up the marine food web from herbivorous to carnivorous fish, and subsequently to human. CFP is an endemic disease across all Pacific Island countries and territories. It is estimated over 500,000 Pacific islanders might have suffer from CFP in their life time while the true incidence rate remains difficult to be verified due to underreporting and misdiagnosis.

Since toxic dinoflagellates are sensitive to various climate factors, scientist community reckons that climate change and its subsequent anomalous weather events represent a serious threat of CFP. Existing studies assessing the relationship between climate factors and CFP are very limited, and only a few studies consider the time interval between environmental parameters and CFP events, all basing on old data or suffering for significant limitations. Meanwhile, an important gap remains in the field of socioeconomic impact of CFP, particularly in small island communities where fish provides primary source of food and dietary protein for the local people. This study contributes to fill the research gaps and unfold the nexus between climate change, CFP and food security in the Pacific using meteorological, epidemiological and original household survey datasets. In particular, I analyze the relation between climate change and occurrence of CFP, quantitatively exploiting the time-series data in two Pacific countries and examine how CFP incidences are affecting food choice and utilization of indigenous people based on primary cross-sectional data in Fiji. It is expected that the results of this study have important policy implications which could improve the current health surveillance and response system in many small island countries under the context of climate change.

After the introduction in Chapter 1, Chapter 2 reviews the existing literature regarding the effects of climate change and climate variability on ciguatera, as well as the health and socio-economic impacts of ciguatera. Chapter 3 discusses the overall prevalence of CFP, current reporting schemes and attempted intervention programs in the Pacific Island countries and territories.

In Chapter 4, I conduct time-series analysis to postulate the climate effects on CFP incidence at macro-level. Cross-correlation analysis and auto-regressive integrated moving-average (ARIMA) model have been used to develop predictive

models of ciguatera incidence rate in Cook Islands and French Polynesia, two long-lasting endemic territories in the Pacific. The monthly CFP incidence rate evolved in close lagged correlation to several variables that are associated with sea surface temperature in the Economic Exclusive Zones of these two countries, with a 12-month lag in Cook Islands and 32-month lag in French Polynesia. Results of model validation proved extreme weather-related variables (e.g. sea surface temperature anomaly) as significant predictors of CFP incidence, indicating the possible relevance between extreme seawater temperature and disturbances of coral reefs system.

In Chapter 5, I assess how ciguatera as a local disease challenges the health and food choice of indigenous communities and seek to explain their food consumption behavior under the risk of fish poisoning at micro-level, using the original survey data collected from 239 households in 12 villages in a remote Fijian island in 2019. My case study has found that CFP incidences result in the temporal to permanent dietary change, and as a natural source of protein, fish has been replaced with an increased consumption of other food sources, including imported processed foods. A number of factors were found to have been important for the consumption of risky species – on household level, food and income diversity could be essential coping mechanism in response to potential food shock of CFP; and on individual level, the role of taste, risk perception and optimistic bias are shown to contribute to food aversion of risky species.

Taking the analyses results from the above two Chapters, Chapter 6 presents the policy implications for surveillance and response on future risk of CFP. For example, the time-lagged correlations between climate variables and CFP incidences found in the time-series analyses would allow health authorities to take appropriate actions by evaluating and refining strategies for disease control, to avoid or limit the epidemic risk, especially on high-risk climate scenarios; findings of case study in Fiji have referential significance for designing and developing interventions with higher effectiveness and efficacy on food safety and health behavior to reduce the negative impacts of fish poisoning for the small island communities. In addition, limitations of my studies point to the importance of better data management to reduce the under-reporting and misdiagnosis rate of CFP, as well as more communications among countries and international organizations about CFP epidemiology.