# The Global Food Syndemic in Kiribati

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**Abstract**

With a maximum elevation of just 4 meters, Kiribati is among the most vulnerable to climate change. Sea level rise is a threat to economic livelihoods and could create a large population of climate refugees. Kiribati, which has the lowest GDP per capita of the Pacific Island Countries, did not attain any of the health Millennium Development Goals and is not on track to achieve related Sustainable Development Goals. Yet little research explores the interactions between climate change, food insecurity, and health outcomes in Kiribati. Using data from the 2019 – 2020 Kiribati Household Income and Expenditure Survey, we examine the socioeconomic determinants of food insecurity in Kiribati. Understanding the drivers of food insecurity in Kiribati is critical to improving physical and mental health, lowering the high rate of noncommunicable diseases, and adapting to climate change.

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# 1 Introduction

The world is facing a global food crisis. Even prior to the Covid-19 pandemic, food security was deteriorating. Since 2015, the number of moderately or severely food insecure people has increased by 745 million (FAO 2023). In 2022, 2.4 billion people, almost 30% of the world's population, were moderately or severely food insecure (FAO 2023). While the world is not on track to achieve any of the Sustainable Development Goals, progress on hunger is especially concerning (Sachs et al. 2023). Food insecurity is defined as lacking consistent access to sufficient, safe and nutritious food for development and an active and healthy life (FAO 2023). Food insecurity has been associated with a number of negative effects on human wellbeing. Among adults, food insecurity has been linked to an increased risk of diabetes and hypertension (Pérez-Escamilla et al., 2014), poorer mental health (Cole and Tembo, 2011; Trudell et al., 2021) and mild cognitive impairment in older adults (Koyanagi et al., 2019). Children in food insecure households are at greater risk of illness, anemia, and low height-for- age (Schmeer and Piperata 2017), have higher rates of asthma and depressive symptoms (Thomas et al. 2019), and are more likely to miss school or activities due to illness (Ramsey et al. 2011). In Kiribati, more than one third of households are experiencing moderate or severe food insecurity (Troubati and Sharp 2021). Difficulties in accessing nutritious foods lead to the coexistence of high levels of obesity and malnutrition. Climate change is likely to exacerbate the situation. In Kiribati, climate change threatens to increase sea level rise, air and water temperatures, and the frequency and intensity of extreme weather events including storm surges and droughts (McIver et al 2014). Some of these effects are already being felt. Sea levels in Kiribati have risen 3.9mm per year since 1992, a rate that is three times the global average (Anung et al. 2009). Concern over both food supplies and climate change has led Kiribati, as well as other Pacific island countries, to purchase land abroad (Doyle 2014). Yet, despite the fact that Kiribati is among the most vulnerable to climate change, there is little research investigating the interactions between food security and climate change in Kiribati. Using data from the 2019 – 2020 Kiribati Household Income and Expenditure Survey (HEIS), we examine the socio-economic determinants of food insecurity in Kiribati. We pay special attention to the role of climate change and noncommunicable diseases, which are particularly high in Kiribati. Understanding the drivers of food insecurity in Kiribati is vital to improving health and wellbeing and adapting to climate change.

## 1.1 The Kiribati Context

Numerous factors within Kiribati pose a threat to food security. First, with an average income of just $2,365, Kiribati has the lowest GDP per capita of any pacific island country (World Bank 2023). Low levels of income create financial barriers to accessing food, especially nutritious food which is often more expensive. The average household in Kiribati spends 60% of their household budget on food (FAO 2020), representing the largest single expenditure item.

Moreover, consumption of processed foods in Kiribati is increasing as it is the cheapest source of energy (Troubat and Sharp 2021). This may exacerbate health issues in Kiribati as increased consumption of processed foods has been associated with an increase in obesity and noncommunicable diseases (Monteiro et al. 2016). Second, comprising 33 islands, Kiribati is one of the smallest countries in the world with a land area of just 811 square kilometers. While fishing is widespread, both the quality and quantity of soil limit agricultural production (FAO 2018). Consequently, Kiribati, similar to most Pacific island countries, is heavily reliant on imported food. This can be detrimental to food security for multiple reasons. One, food supplies can be unreliable (UN Food Systems Hub 2021). In 2004, Kiribati experienced a food shortage lacking access to rice and flour for a month; another food shortage was experienced during the 2008 food crisis (FAO 2011). Anecdotal evidence suggests that food distributors in small island developing states have only about one month of food supplies on hand (FAO 2016). Additionally, much of the imported food is nutritionally poor, calorie dense and high in fat and sugar (FAO 2016) further contributing to health problems in the country. Third, while Kiriabit's land area may be small, it is geographically dispersed, spreading across 3.55 million kilometers of ocean. Approximately half of Kiribati's population of 120,000 live on one island, the capital, South Tarawa, with the remaining i-Kiribati living on the other outer islands (SPC 2022). Thus the government is dealing with social and environmental issues related to urbanization and overcrowding on South Tarawa (Locke 2009); while simultaneously addressing the challenges and costs of providing much needed resources to those on the vast, remote outer islands. Recent research has also suggested that cultural shifts from traditional, indigenous diets to imported, westernized diets may be contributing to poor nutrition and food insecurity in Kiribati. Cauchi et al. (2021) examine challenges to achieving food security in Kiribati via semi-structured interviews and focus group discussions. While food affordability and access were issues, respondents identified taste and convenience as important determinants of food choice. Similarly, Eme et al. (2019) conduct dietary surveys of 161 households in South Tarawa. They find a low degree of dietary diversity and while they note food availability and affordability are likely factors, they also argue that the preference for imported processed foods creates issues related to nutrition and food security. While numerous studies and reports have discussed issues related to health, nutrition and climate change in Kiribati, there is little research on the links between food security and climate change in Kiribati. Moreover, many studies are at the regional level and more research is needed to understand the key drivers of nutritional choices of households (Cauchi et al 2019). This study attempts to contribute to the literature by examining the determinants of food security at the household level. We also include several measures of climate change to better understand the links between climate change and food security in Kiribati.

## 2 Data

The data in our sample comes from the 2019-2020 Household Income and Expenditure Survey (HIES) for Kiribati. The survey was conducted from May 2019 to March 2020. The objective of the survey is to assess trends in the wellbeing of households in Kiribati and evaluate the government's social and economic policies and goals, including the Sustainable Development Goals. A total of 2,182 households were surveyed, representing approximately 11% of households in Kiribati. The survey was designed to interview household heads and questions were asked on a variety of topics including health status, education and age of the household head, wealth, income, expenditure and food security (Kiribati National Statistics Office 2021).

Table 1 displays the summary stats (all of which account for the survey design). The average I-Kiribati household has almost 6 members and 70% of household heads are male. The bulk of household heads have completed lower secondary education, which is the highest level of compulsory education in the country. Phone ownership, one way to proxy access to information (potentially about preparing healthy foods, and about being about to seek help in the face of food insecurity), is not very common, with only 37% of households owning a phone.

In terms of WASH indicators, we consider access to improved sanitation and water sources. We use the World Health Organization's (WHO) guidelines to define an improved sanitation source as a place to use the bathroom that is something other than a latrine or bucket toilet or something that flushes to an unsanitary location. Just over half of households are using an improved sanitation source, one factor that could be contributing to malabsorption and chronic illness more broadly. An improved water source (also defined using WHO guidelines) is anything that is protected (for example, something with purification). 75% of our sample has access to a clean water source for washing hands and for use in preparing foods.

Approximately 39% of households report having at least one member who has at least one chronic illness, which is lower than national estimates suggest. This lower than expected prevalence may be due to a hesitancy to share personal details with enumerators (Di Maio and Fiala 2020) or a lack of knowledge about their own health conditions due to a lack of healthcare access, especially on islands outside of Tarawa (Doctors without Borders 2023).

### 2.1 Village-Level Climate Variables

In conjunction with the household survey, the HIES also included a village resource survey (VRS). The VRS was administered to local chiefs of villages (each island is composed of multiple villages). Village leaders were asked about several topics related to resource availability. In total, 112 village chiefs were surveyed across 21 different islands.

Village chiefs were also asked about the impacts of climate change on their communities. We take three of these questions to try and measure the impact

Table 1: Summary Statistics

| Variable | Obs | Mean | Std. dev. | Min | Max |
|---|---|---|---|---|---|
| Household Size | 2,182 | 5.68286 | 2.991547 | 1 | 15 |
| Male | 2,182 | 0.7043996 | 0.4564168 | 0 | 1 |
| Lives on Capital Island | 2,182 | 0.2740605 | 0.4461419 | 0 | 1 |
| **Age Group of HH head** | | | | | |
| Age 15-24 (base) | 2,182 | 0.0274977 | 0.163566 | 0 | 1 |
| Age 25-34 | 2,182 | 0.2231897 | 0.41648 | 0 | 1 |
| Age 35-44 | 2,182 | 0.2557287 | 0.43637 | 0 | 1 |
| Age 45-54 | 2,182 | 0.2474794 | 0.4316465 | 0 | 1 |
| Age 55-64 | 2,182 | 0.1622365 | 0.3687521 | 0 | 1 |
| Age 65+ | 2,182 | 0.083868 | 0.2772533 | 0 | 1 |
| **Highest Edu of HH head** | | | | | |
| Lower Secondary (base) | 2,182 | 0.4789184 | 0.4996699 | 0 | 1 |
| Higher Secondary | 2,182 | 0.3143905 | 0.4643791 | 0 | 1 |
| Above Higher Secondary | 2,182 | 0.0549954 | 0.2280236 | 0 | 1 |
| Owns Phone | 2,182 | 0.3693859 | 0.4827492 | 0 | 1 |
| Has improved sanitation | 2,182 | 0.5187901 | 0.4997613 | 0 | 1 |
| Has improved water source | 2,182 | 0.7415215 | 0.4378986 | 0 | 1 |
| HH member has a chronic illness | 2,182 | 0.3854262 | 0.4868074 | 0 | 1 |

of climate change on food security. Due to anonymization, we lack the identifying data needed to link households directly to villages in which they reside. However we do know which villages are on which islands. Therefore we average values of all villages within each island and then connect island-level data to our household level data.

The first climate change question asked in the VRS is "Has saltwater inundation increased, decreased, or stayed the same in the last 10 years?" Saltwater inundation happens when land is flooded with seawater and can negatively impact crop yields (SPC 2022) and consequently access to food. On average 60% of villages within an island report an increase in saltwater inundation over the past decade.

Next, village chiefs were asked whether "sea level rise and flooding increased, decreased, or (has) not shown an effect on the availability of freshwater in your village in the last 10 years?" Locke (2009) argues the greatest threat to Kiribati from climate change is the breaching of its underground freshwater table by rising seas. On average, 18% of village chiefs on an island reported decreased freshwater due to rising seas.

Our final climate change variable is derived from the VRS question "has shoreline erosion in your village increased, decreased, or stayed the same in the last 10 years?" Approximately 78% of villages on a given island experienced increased erosion in their communities. An increase in erosion may diminish the already scant land available for agricultural purposes in Kiribati.

Almost 15% of the households in our sample live on an island where a UNDP project aimed at helping those most impacted by climate change, by way of bolstering their resilience against food insecurity.

Since economic conditions and demographic factors may impact resiliency against climate shocks, we also control for the average unemployment rate across the country is about 7%. The average population density is 689 people per square mile.

## 2.2 Food Insecurity Experience Scale

Our main dependent variable of interest is food insecurity. One of the most common ways to capture household's experiences of food insecurity is to use the Food and Agricultural Organization's (FAO) Food Insecurity Experience Scale (FIES). This scale asks eight questions about access to adequate food at the household level. Like other questions in the HIES, the FEIS questions were asked of the household head. The questions are:

1. During the last 12 MONTHS, was there a time when you or others in your household worried about not having enough food to eat because of a lack of money or other resources?
2. Still thinking about the last 12 MONTHS, was there a time when you or others in your household were unable to eat healthy and nutritious food because of a lack of money or other resources?
3. During the last 12 MONTHS, was there a time when you or others in your household ate only a few kinds of foods because of a lack of money or other resources?
4. During the last 12 MONTHS was there a time when you or others in your household had to skip a meal because there was not enough money or other resources to get food?
5. Still thinking about the last 12 MONTHS, was there a time when you or others in your household ate less than you thought you should because of a lack of money or other resources?
6. During the last 12 MONTHS, was there a time when your household ran out of food because of a lack of money or other resources?
7. During the last 12 MONTHS, was there a time when you or others in your household were hungry but did not eat because there was not enough money or other resources for food?
8. During the last 12 MONTHS, was there a time when you or others in your household went without eating for a whole day because of a lack of money or other resources?

Summary statistics for these 8 questions are displayed in table 2. Almost half of respondents reported worrying about not having enough food. Almost half of respondents also reported not being able to eat healthy due to a lack of resources. Approximately 8% of respondents reported not eating for an entire day due to lack of resources.

The FIES scale is validated using a Rasch model and is intended to transcend country borders by avoiding questions that may be interpreted differently in

Table 2: FIES Questions

| Variable | Obs | Mean | Std. dev. | Min | Max |
|---|---|---|---|---|---|
| You were worried you would not have enough food to eat? | 2,181 | 0.4750115 | 0.4994897 | 0 | 1 |
| You ate only a few kinds of foods? | 2,181 | 0.4722604 | 0.4993444 | 0 | 1 |
| You were unable to eat healthy and nutritious food? | 2,181 | 0.4938102 | 0.5000763 | 0 | 1 |
| You ate less than you thought you should? | 2,174 | 0.3371665 | 0.472851 | 0 | 1 |
| You had to skip a meal? | 2,181 | 0.1971573 | 0.3979433 | 0 | 1 |
| Your household ran out of food? | 2,177 | 0.2025723 | 0.4020087 | 0 | 1 |
| You were hungry but did not eat? | 2,175 | 0.1062069 | 0.3081731 | 0 | 1 |
| You went without eating for a whole day? | 2,176 | 0.0868566 | 0.2816896 | 0 | 1 |

varying cultures and contexts (Cafiero et al., 2018a). Borrowing from Item Response Theory with the aim of measuring unobservable traits, we use the "RM.weights" package from R (generated by Cafiero et al., 2018b) to confirm that the ordinal nature of the questions, ranked at a global scale, are consistent with the ranking in Kiribati. In other words, responding affirmatively to the question about worrying about not having enough to eat, corresponds to the lowest probability of being food insecure, whereas responding affirmatively to going a whole day without eating corresponds to the highest probability of food insecurity.

Building on the Rausch model, we compute the probabilities of moderate food insecurity and moderate-to-severe food insecurity. We also create binary variables to capture the two extremes of these experiences - a variable "secure" that equals one if the household responds negatively to all 8 questions and a variable "insecure" that equals one if the household responds affirmatively to all 8 questions.

# 3 Methodology

## 3.1 Modeling food security along a continuum

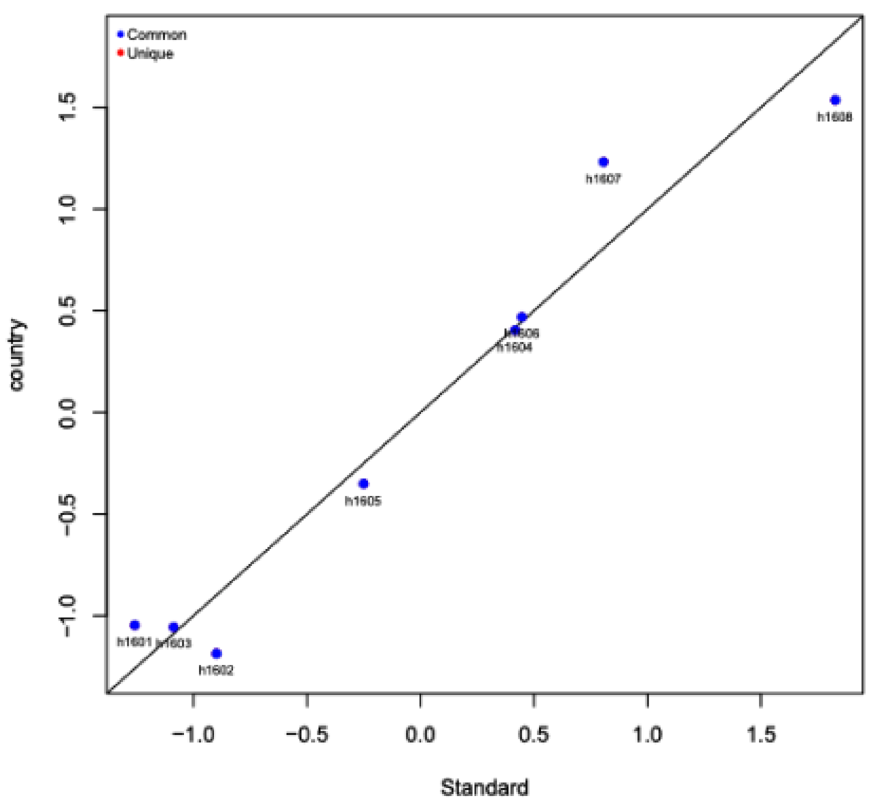
We begin our analysis by considering the household's raw FIES score, which ranges from 0 to 8. A zero indicates a respondent reported no to all 8 FIES questions and an 8 indicates the respondent reported yes to all 8 questions. Thus a lower raw score corresponds with being more food secure. We are interested in determining the factors which influence these scores, and the extent to which these scores are driven by the impacts of climate change. Thus, we run an OLS regression for each of our three climate variables as follows:

$$FIES = \beta_0 + \beta_1 X + \beta_2 climate + \epsilon \quad (1)$$

where FIES is the dependent variable. X is a vector of control variables which includes educational status of the household head, sex of the household head, age of the household head, household size, urban/rural status, income quintile, whether a member of the household has a chronic illness, whether the household has improved sanitation, whether the household has an improved water source and phone ownership. We also include island level variables such as the unemployment rate, population density, and a dummy variable for the existence of a UNDP project.

## 3.2 Looking at Probabilities of Moderate and Severe Food Insecurity

Using the calibrated Rausch model provided by the FAO and validated by global data on experiences of food insecurity, we compute the probability that households experience food insecurity based on their raw scores. We visualize an equating plot (see figure 1) which helps us understand that affirmative responses to different questions can be ranked ordinally, but we cannot confirm anything about their distance from each other. From there, we compute probabilities of moderate food insecurity and moderate and severe food insecurity. We then use these probabilities as a continuous dependent variable, utilizing equation (1) above.



### 3.3 Accounting for omitted variable bias

Interestly, when we first run equation 1, we find that climate change enhances food security. One potential explanation for this finding could be omitted variable bias. For example, it may be that islands that are suffering the most from climate change are getting the most food assistance. In fact, in 2016, the UNDP with funding from the Least Developed Countries Fund (LDCF) began implementing a project: Enhancing National Food Security in the Context of Climate Change. This project includes building institutional capacity and community-based adoption measures (UNDP). In an attempt to alleviate omitted variable bias, we include a binary variable in our regression model to account for the islands in which this project was implemented. In this specification, we consider the probabilities of severe and moderate to severe food insecurity as the dependent variables, based on the results derived from the Rausch model.:

$$FIES = \beta_0 + \beta_1 X + \beta_2 climate + \beta_3 UNDP + \beta_4 climateUNDP + \epsilon \qquad (2)$$

### 3.4 Evaluating the Extremes with Probit Models

Finally we run two probit models looking at the extremes of food security and food insecurity. In the food secure probit models, the dependent variable is equal to one if a household answered no to all 8 of the FIES questions. In the food insecure probit model, the dependent variable is equal to one if the household answered yes to all 8 questions.

## 4 Results

Table 3 displays our OLS results with the raw FIES scores being our dependent variable. The results reveal that higher levels of education for the household head mitigate the risk of food insecurity. Being of a higher income group also helps mitigate the risk of food insecurity, suggesting affordability is an issue in Kiribati. We find a positive relationship between having a chronic illness and being food insecure. While having access to an improved water source does not significantly influence food insecurity. Using the probabilities of insecurity from the Rausch models, (results available upon request) we note similar results.

We find that the UNDP programs were successful in their feat to reduce food insecurity on the islands in which they were active. We find that being impacted by saltwater inundation has no relationship with food insecurity, a relationship which is consistent across all specifications. Much to our surprise, we find that erosion and sea level rise lower the likelihood of insecurity. This is an unexpected result, and to help understand it, we add interaction terms and use the continuous probability of food insecurity as the dependent variables. When accounting for the fact that islands more impacted by climate change might receive more financial resources to counteract its repercussions, we still find that the impacts of climate change themselves are protective against the probability of food insecurity.

There are many potential factors which could be driving these results that, on the surface, seem counterintuitive. However, a more granular investigation reveals that Kiribati's unique position as a seafood exporter may make them better off (in terms of pure monetary cost) under climate change, on net. In a review of Sub-Saharan Africa, the IMF (2022) found that climate change may actually benefit exporters because of food price inflation under climate change. Most islanders make their livelihoods by exploiting resources from the sea, so higher prices may result in higher incomes. This increased income could help provide food for I-Kiribati, especially if prices of processed and imported foods are not increasing in cost enough to offset the gain from the increased export prices.

Table 3: OLS Results

| VARIABLES | (1) FIES Index | (2) FIES Index | (3) FIES Index |
|---|---|---|---|
| EDU: lower secondary (primary is base) | -0.263 | -0.263 | -0.298 |
| | (0.208) | (0.207) | (0.205) |
| EDU: higher secondary | -0.900*** | -0.902*** | -0.934*** |
| | (0.199) | (0.200) | (0.199) |
| EDU: greater than HS | -1.750*** | -1.739*** | -1.793*** |
| | (0.238) | (0.240) | (0.236) |
| Income: Poorer (Poorest is base) | -0.524** | -0.527** | -0.535** |
| | (0.210) | (0.210) | (0.209) |
| Income: Middle | -0.508** | -0.513** | -0.526** |
| | (0.215) | (0.216) | (0.214) |
| Income: Rich | -1.023*** | -1.022*** | -1.032*** |
| | (0.219) | (0.218) | (0.216) |
| Income: Richest | -1.520*** | -1.523*** | -1.532*** |
| | (0.247) | (0.247) | (0.246) |
| Age Group: 25-34 (15-24 is base) | 0.383 | 0.391 | 0.377 |
| | (0.339) | (0.343) | (0.342) |
| Age Group: 35-44 | 0.514 | 0.525 | 0.496 |
| | (0.345) | (0.349) | (0.348) |
| Age Group: 45-54 | 0.372 | 0.395 | 0.355 |
| | (0.350) | (0.358) | (0.353) |
| Age Group: 55-64 | 0.0589 | 0.0828 | 0.0400 |
| | (0.363) | (0.370) | (0.366) |
| Age Group: 65+ | -0.0560 | -0.0281 | -0.103 |
| | (0.383) | (0.390) | (0.385) |
| Chronic Illness | 0.280** | 0.275** | 0.274** |
| | (0.120) | (0.120) | (0.120) |
| Improved Sanitation Source | -0.491*** | -0.516*** | -0.476*** |
| | (0.147) | (0.149) | (0.147) |
| Improved Water Source | -0.0810 | -0.0821 | -0.100 |
| | (0.174) | (0.172) | (0.174) |
| HH Head is Male | -0.0683 | -0.0867 | -0.0524 |
| | (0.136) | (0.135) | (0.136) |
| Urban | -10.48*** | -9.464*** | -6.421* |
| | (2.662) | (2.656) | (3.566) |
| Household Size | 0.125*** | 0.125*** | 0.128*** |
| | (0.0235) | (0.0235) | (0.0233) |
| Phone Ownership | -0.299** | -0.292** | -0.306** |
| | (0.131) | (0.132) | (0.131) |
| Remittances | -0.000977 | 0.000749 | 0.00168 |
| | (0.125) | (0.125) | (0.125) |
| Unemployment Rate | 0.00772 | -0.00283 | 0.0243 |
| | (0.0216) | (0.0222) | (0.0251) |
| Population Density | 0.00298*** | 0.00271*** | 0.00190** |
| | (0.000698) | (0.000697) | (0.000950) |
| UNDPproject | -0.350 | -0.417* | -0.305 |
| | (0.234) | (0.236) | (0.233) |
| Island impacted by Saltwater Inundation | 0.377 | | |
| | (0.341) | | |
| Island impacted by Erosion | | -0.805* | |
| | | (0.415) | |
| Island impacted by Sea Level Rise | | | -0.860* |
| | | | (0.457) |
| Constant | 1.994*** | 2.951*** | 2.482*** |
| | (0.501) | (0.528) | (0.448) |
| Observations | 2,155 | 2,155 | 2,155 |
| R-squared | 0.148 | 0.149 | 0.149 |

Standard errors in parentheses
** p<0.01, ** p<0.05, * p<0.1

Next, we employ probit models (see table 4) to predict the probability of the two extremes, food security and food insecurity. Here, our control variable results are comparable to the OLS models. In addition, we find that chronic illness makes a person about 14% less likely to be secure, but chronic illness is not a significant predictor of insecurity. We also find that remittances are not a determinant of security or insecurity. Mora-Rivera and van Gameren (2022) found that in Mexico, remittances help to reduce food insecurity, but the impact is negligible. Furthermore, they find that internal remittances are less effective at reducing food insecurity than external remittances. This may help explain the situation in Kiribati, as many people may flee their own islands to escape the impacts of climate change, and send remittances internally within the country. Lastly, the interplay between intra-country migration due to climate change, internal remittances, and food insecurity likely plays a role in explaining our results. Unfortunately, data limitations leave us unable to uncover this relationship further.

Table 4: Probit Models

| VARIABLES | (1) secure | (2) secure | (3) secure | (4) insecure | (5) insecure | (6) insecure |
|---|---|---|---|---|---|---|
| EDU: lower secondary (primary is base) | -0.0218 | -0.0202 | -0.000965 | -0.345** | -0.346** | -0.350** |
| | (0.104) | (0.104) | (0.103) | (0.149) | (0.150) | (0.150) |
| EDU: higher secondary | 0.320*** | 0.324*** | 0.342*** | -0.466*** | -0.467*** | -0.469*** |
| | (0.106) | (0.107) | (0.106) | (0.149) | (0.148) | (0.148) |
| EDU: greater than HS | 0.651*** | 0.650*** | 0.677*** | -0.829*** | -0.827*** | -0.835*** |
| | (0.159) | (0.159) | (0.158) | (0.269) | (0.269) | (0.268) |
| Income: Poorer (Poorest is base) | 0.0962 | 0.105 | 0.108 | -0.215 | -0.216 | -0.215 |
| | (0.0919) | (0.0917) | (0.0921) | (0.147) | (0.148) | (0.147) |
| Income: Middle | 0.0444 | 0.0564 | 0.0634 | -0.265 | -0.267 | -0.267 |
| | (0.0973) | (0.0975) | (0.0976) | (0.172) | (0.172) | (0.172) |
| Income: Rich | 0.326*** | 0.338*** | 0.342*** | -0.768*** | -0.770*** | -0.770*** |
| | (0.111) | (0.111) | (0.111) | (0.173) | (0.174) | (0.173) |
| Income: Richest | 0.506*** | 0.520*** | 0.525*** | -0.933*** | -0.935*** | -0.935*** |
| | (0.132) | (0.133) | (0.133) | (0.209) | (0.209) | (0.209) |
| Age Group: 25-34 (15-24 is base) | -0.254 | -0.253 | -0.247 | 0.343 | 0.344 | 0.348 |
| | (0.178) | (0.178) | (0.179) | (0.453) | (0.453) | (0.453) |
| Age Group: 35-44 | -0.228 | -0.228 | -0.213 | 0.556 | 0.557 | 0.557 |
| | (0.176) | (0.176) | (0.177) | (0.468) | (0.468) | (0.468) |
| Age Group: 45-54 | -0.155 | -0.160 | -0.142 | 0.506 | 0.508 | 0.507 |
| | (0.178) | (0.179) | (0.179) | (0.479) | (0.480) | (0.479) |
| Age Group: 55-64 | -0.0688 | -0.0739 | -0.0553 | 0.368 | 0.370 | 0.369 |
| | (0.183) | (0.184) | (0.184) | (0.479) | (0.481) | (0.479) |
| Age Group: 65+ | 0.0893 | 0.0875 | 0.123 | 0.137 | 0.138 | 0.135 |
| | (0.189) | (0.189) | (0.191) | (0.424) | (0.424) | (0.423) |
| Chronic Illness | -0.143** | -0.137** | -0.137** | -0.0904 | -0.0904 | -0.0917 |
| | (0.0642) | (0.0641) | (0.0643) | (0.126) | (0.126) | (0.126) |
| Improved Sanitation Source | 0.151** | 0.154** | 0.138* | -0.232* | -0.234* | -0.230* |
| | (0.0747) | (0.0757) | (0.0746) | (0.118) | (0.119) | (0.118) |
| Improved Water Source | -0.0480 | -0.0448 | -0.0359 | -0.121 | -0.120 | -0.123 |
| | (0.0865) | (0.0861) | (0.0872) | (0.150) | (0.149) | (0.150) |
| HH Head is Male | -0.00250 | 0.00788 | -0.00917 | -0.191 | -0.192 | -0.187 |
| | (0.0740) | (0.0738) | (0.0735) | (0.119) | (0.120) | (0.120) |
| Urban | 3.449** | 2.814* | 1.356 | -4.835** | -4.656** | -3.752 |
| | (1.459) | (1.501) | (1.923) | (2.013) | (1.818) | (2.630) |
| Household Size | -0.0523*** | -0.0527*** | -0.0548*** | 0.0740*** | 0.0742*** | 0.0747*** |
| | (0.0111) | (0.0111) | (0.0111) | (0.0156) | (0.0156) | (0.0156) |
| Phone Ownership | 0.112 | 0.109 | 0.115 | -0.213 | -0.214 | -0.215* |
| | (0.0781) | (0.0785) | (0.0783) | (0.129) | (0.129) | (0.129) |
| Remittances | -0.0956 | -0.0955 | -0.0955 | -0.173 | -0.174 | -0.172 |
| | (0.0782) | (0.0782) | (0.0783) | (0.121) | (0.121) | (0.121) |
| Unemployment Rate | 0.00759 | 0.0124 | 0.000400 | 0.0259 | 0.0254 | 0.0291 |
| | (0.0121) | (0.0116) | (0.0141) | (0.0188) | (0.0197) | (0.0230) |
| Population Density | -0.00101** | -0.000847** | -0.000456 | 0.00136** | 0.00131*** | 0.00107 |
| | (0.000390) | (0.000402) | (0.000517) | (0.000541) | (0.000492) | (0.000712) |
| UNDPproject | -0.361** | | | 0.0510 | | |
| | (0.166) | | | (0.321) | | |
| Island impacted by Saltwater Inundation | 0.253* | 0.255* | 0.211 | -0.100 | -0.104 | -0.109 |
| | (0.139) | (0.143) | (0.149) | (0.273) | (0.263) | (0.252) |
| Island impacted by Erosion | | 0.311 | | | -0.0828 | |
| | | (0.203) | | | (0.369) | |
| Island impacted by Sea Level Rise | | | 0.401 | | | -0.254 |
| | | | (0.267) | | | (0.391) |
| Constant | 0.188 | -0.334 | -0.170 | -1.965*** | -1.859*** | -1.858*** |
| | (0.267) | (0.269) | (0.221) | (0.501) | (0.557) | (0.465) |
| Observations | 2,182 | 2,182 | 2,182 | 2,182 | 2,182 | 2,182 |

Standard errors in parentheses
** p<0.01, ** p<0.05, * p<0.1

Turning to our climate variables in the probit model, we see that those living on islands impacted by salt water inundation are 25% more likely to be secure. Again, this points to earlier suspicions and evidence that resources more impacted by climate change tend to receive more aid and assistance.

# 5 Conclusion

This paper investigates the socio-economic determinants of household experiences of food insecurity in Kiribati, with particular attention paid to the impacts of climate change at the island level. Using data from a 2019–2020 nationally representative household survey and OLS and probit models our results reveal that the impacts of climate change are protective against food insecurity, or not a significant determinant. Preliminary analysis suggests that islands more impacted by climate change may receive more resources to counteract its impacts. Furthermore, we find that having a chronic illness reduces the probability of food security by nearly 15%, but has no impact on the probability of insecurity. Our results also suggest that education predicts insecurity but not security and that wealth is protective against food insecurity, but only at higher levels of the income distribution. Due to data limitations, this paper was not able to pinpoint the methodological mechanism by which climate change has a positive impact on food security. We delegate this task to future research.

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