



Research

# How food-system resilience is undermined by the weather: the case of the Rama Indigenous group, Nicaragua

Andrew J. Papworth<sup>1</sup>, Mark Maslin<sup>2</sup> and Samuel Randalls<sup>2</sup>

**ABSTRACT.** Climate change is likely to increase both the extent of seasonal weather variation and the magnitude of extreme weather events. The food security of those living in poorer countries and in poorer communities will be disproportionately affected by this change in weather patterns. We explored how the heterogeneity that exists within the Rama Indigenous community (Nicaragua) interacts with seasonal weather variation and extreme weather events to adversely affect food-system resilience. Firstly, we show that there are different levels of food system resilience between the Rama who fish using the traditional methods of hand nets and paddle-powered canoes, and those that can afford gill nets and motorboats. Secondly, there are significant differences in the way Rama farmers respond to threats to their food security: some rely on short-term resilience-based strategies, whereas others focus on more transitional responses. These differences contribute to short-term inequalities in food security and are also likely to have a differential impact on the future food-system resilience of the Rama community. More research at the household scale is vital for understanding how to improve food-system resilience for the most vulnerable populations without introducing policies that are unsustainable and/or curtail future options.

**Key Words:** *adaptation; climate change; food security; inequality; Indigenous; Rama; Nicaragua; resilience*

## INTRODUCTION

At present, there are between 720 and 811 million people facing hunger in the world (FAO 2021). Any attempts to reduce this burden are likely to be affected by changes in population size (Popkin et al. 2002, Loring and Gerlach 2009, Godfray et al. 2010, Nally 2015), changing tastes and global market shifts (Connell and Lowitt 2019), biodiversity loss (Phalan et al. 2011, Tscharnkte et al. 2012), and climate change (Schmidhuber and Tubiello 2007, Costello et al. 2009, Challinor et al. 2014, Milliken 2017).

Climate change will, in all probability, increase the extent of seasonal weather variation (SWV) and the magnitude of extreme weather events (EWEs) (Maslin 2013, Gillis 2012), both of which have significant consequences for food availability and supply (Schmidhuber and Tubiello 2007, Costello et al. 2009, Challinor et al. 2014, Milliken 2017, Dolbec et al. 2001). Those living in less-developed countries (LDCs) and poorer communities will be disproportionately vulnerable (Black et al. 2013, Stratton 2007, Van de Poel et al. 2008) because their livelihoods are more likely to be reliant on natural resources (Adger 2000) and/or on informal or temporary jobs that have less protection against weather-related disruption (Silva et al. 2015). This raises critical questions about the current and potential impacts of climate change on food security.

Food security can be defined as “a situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (FAO 2017). This definition includes four dimensions: availability, access, utilization, and stability (Table 1) (Gregory et al. 2005, FAO 2006), and it is an example of the food entitlement decline (FED) conception of food security.

FED states that the proximate cause of food insecurity is “entitlement failure” (Sen 1981, Sen 1986). Individuals have endowment sets, which are resources that they legally own (e.g., land, fishing equipment) and they translate these into an

entitlement set of goods and services (Osmani 1993). An individual’s endowment set is transformed into food through production, trade, labor, and transfers (Devereux 1988). Food insecurity is thus a failure in the way an individual acquires their endowments or in the ways they convert them into entitlements.

There is considerable inequality in endowments within communities in less-developed countries (Papworth et al. 2022), and SWV and EWEs are likely to interact with these existing inequalities and further reinforce them in contextually-specific ways (Vicens et al. 2018, Brown and Kroll 2021, Nazrul Islam and Winkel 2017). More research at the household scale is vital for understanding resilience in food systems and to avoid policy responses that are unsustainable and/or curtail future effective options.

Therefore, we draw here on a case study of the Rama Indigenous group in Nicaragua to explore how their endowments interact with SWV and EWEs.

## THEORETICAL FRAMEWORK: FOOD SYSTEM RESILIENCE

Food-system resilience is defined as “the capacity over time of a food system and its units at multiple levels, to provide sufficient, appropriate, and accessible food to all in the face of even unforeseen disturbances” (Tendall et al. 2015), and it is closely linked to the stability dimension of food security. This conception of food-system resilience draws on a definition of resilience as being the ability of a system to rebound from specific or general disturbances (Walker et al. 2004). Food system resilience is thus bound up in the way that systems change or react over time (Meyer 2020).

If resilience to specific disturbances is pursued by a community, it is likely that the community will become less resilient to unusual events (Folke et al. 2010) as it is liable to be less adaptive (Bodin and Crona 2009, Mertens et al. 2015).

<sup>1</sup>Department of Health Sciences, University of York, <sup>2</sup>Department of Geography, University College London (UCL)

**Table 1.** The four dimensions of food security.

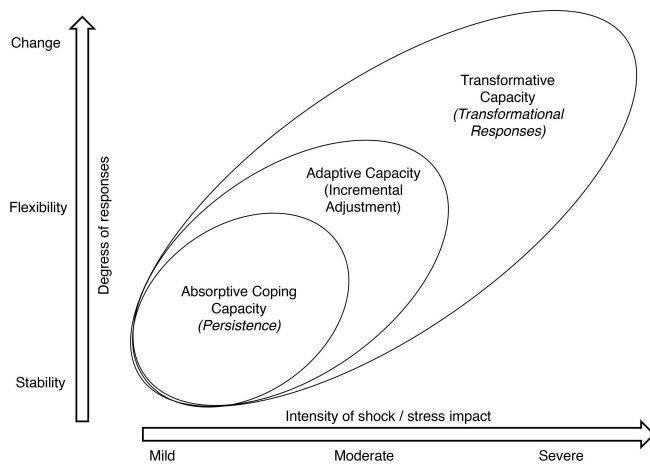
Availability	Relates to the amount of food there is and whether there is enough to meet demand (Schmidhuber and Tubiello 2007; Burchi and Muro 2016; Carletto, Zezza, and Banerjee 2013). It is determined by both animal and crop yields, the functioning of markets, and the requirements of the population.
Access	Refers to whether certain populations and individuals can acquire the available food; the demand side of food security (Dréze and Sen 1991, Barrett 2010). This may be determined by food prices, legal, and political factors.
Utilization	Refers to whether individuals can consume the available food to which they have access, and includes dietary quality, food safety, and people's food preferences (Pinstrup-Andersen 2009, Barrett 2010, Hendriks 2015). The available food may not be safe to eat, or it may be culturally inappropriate.
Stability	Refers to whether certain populations and individuals are always able to access adequate food (Carletto, Zezza, and Banerjee 2013). It differentiates between chronic (continuous) food insecurity and transitory food insecurity, which may be caused by seasonal changes or other crises that affect food availability, access, or utilization for a specific period. This is the most common form of food insecurity (Carletto, Zezza, and Banerjee 2013).

In contrast, a community could aim for general resilience, intending to have the flexibility to cope with uncertainty (Folke et al. 2010). Some scholars have argued, however, that focusing on achieving general resilience could reinforce existing inequalities because the best outcome for a specific system might be to allow some groups to become or remain vulnerable, either at a different scale, in a different place, or at a different time (Yamane 2009, Pelling 2011).

It is important that policymakers consider what resilience-focused policies aim to address and for whom (Adger 2000). Not doing so means the failures of existing power structures will not be addressed and may perpetuate the vulnerability of certain communities (Cutter 2016).

An interpretation of resilience that has emerged in the climate change adaptation literature views the concept as consisting of three dimensions: the ability to absorb, the ability to adapt, and the ability to transform (Carpenter et al. 2001, Smit and Wandel 2006, Nelson et al. 2007, Pelling 2011, Béné et al. 2016). Figure 1 shows how these three dimensions operate in a nested manner.

**Fig. 1.** The three dimensions of resilience: absorbing, adapting and transforming. Source: Adapted from Béné et al. 2016.



These three dimensions are similar to Pelling's (2011) conception of adaptation. In this instance, resilience adaptation (coping) is defined as the maintenance of "functional persistence" (McGray et al. 2007). Transitional adaptation (transitioning) is an

incremental or intermediary form of change, which is defined by Pelling (2011) as being where individuals or communities attempt to exercise the rights to which they are already entitled under existing political and governance regimes (Tanner and Mitchell 2008, McEvoy and Wilder 2012, Bassett and Fogelman 2013).

Finally, transformational adaptation (transforming) is defined as a form of adaptation that not only defends present social gains but also provides scope to overturn, revise, or reform existing social contracts (MacKinnon and Derickson 2012). Pelling (2011) sees transformational adaptation as the most desirable form of adaptation as it is the most likely to challenge existing vulnerabilities.

This conception of resilience provides a useful framework through which to account for inequalities within a community over time and to categorize and explain the ways Rama endowments interact with SWV and EWEs.

**CASE STUDY - NICARAGUA**

Indigenous peoples tend to be more food insecure than their non-Indigenous counterparts (Jernigan et al. 2017, Patterson et al. 2017). The reasons for this include the fact that Indigenous food systems are particularly sensitive to weather conditions because of their close links to the environment and their tendency to have poor access to land and other resources (Elliott et al. 2012, Ford 2012, Lemke and Delormier 2017).

The Rama, who live on Nicaragua's Caribbean Coast, are heavily reliant on agriculture; fishing in rivers, the Caribbean Sea, and the Bluefields Lagoon; and hunting and foraging on nearby islands. Nevertheless, their economy has become increasingly monetized in recent years (Riverstone 2004, Coe 2008a, b). They are the smallest Indigenous group in Nicaragua with an estimated population of about 1500 (Barclay 2007).

The Caribbean Coast was not settled formally by the Spanish prior to Nicaragua's independence in 1821. It was first a British protectorate and was then exploited by US multinational companies (Loveland 1973, Coe 2008a, b, Riverstone 2004, Baldi 2013, Baldi et al. 2014). The subsequent, continuous presence of Indigenous groups, enslaved laborers, and the influx of low-wage migrant labor has meant there are now six different ethnic groups in the region: the Indigenous Miskito, Mayanga, and Rama; the Afro-Caribbean Creoles and Garifunas; and migrant Pacific Nicaraguans (Loveland 1973, Bourgois 1981, Envio 2003).

The region was granted autonomy from the national government in 1987, but its turbulent history and the extraction of its resources by colonial and imperial actors has meant it is significantly poorer than the rest of the country (Envío 2014, Mitchell et al. 2015).

Nicaragua has a long history of food insecurity (Karfakis et al. 2011). In 2004, Nicaragua had the highest malnutrition rate in Latin America (HabibMintz 2004). Government policies targeting improved food access for lower income households, a slowdown in population growth, and an increase in grain production levels has led to progress in recent years (Rosen et al. 2014).

There is, however, still extensive regional and demographic inequality, including disparities between rural and urban areas (David et al. 2004, Dumazert 2008, Karfakis et al. 2011, Pérez et al. 2018, Tumwebaze 2018), and between the west of the country (known as the Pacific Coast) and the east of the country (known as the Caribbean Coast) (Papworth 2019).

Nicaraguan governments, both past and present, have allowed Pacific Nicaraguans to settle large areas of Indigenous territory on the Caribbean Coast (Morris 2016, Finley-Brook 2016). The Inter-American Court on Human Rights and the Nicaraguan government's Law 445 specifically prohibit these actions (Grossman 2001, Anaya 2005), but it is not officially enforced, and the delimitation, demarcation, and titling of land are incomplete for the Rama territory (Papworth et al. 2022).

Disaggregated climate data for the Caribbean Coast is sparse and the majority of regional-level climate projections for the country tend to focus on the Pacific Coast (Field et al. 2014, Maurer et al. 2017). Nevertheless, research has clearly shown that SWV have a considerable impact on food security in the Caribbean Coast because a large proportion of the population relies on seafood and crops that are seasonally sensitive (Nietschmann 1973, Riverstone 2004). The region is also very vulnerable to EWEs: in the last five years, the region has been hit by a lengthy drought (2014–16), bore the brunt of Hurricane Otto (October 2016), and suffered significant disruption as a result of Hurricanes Eta and Iota (November 2020) (BBC 2020, NPR 2020).

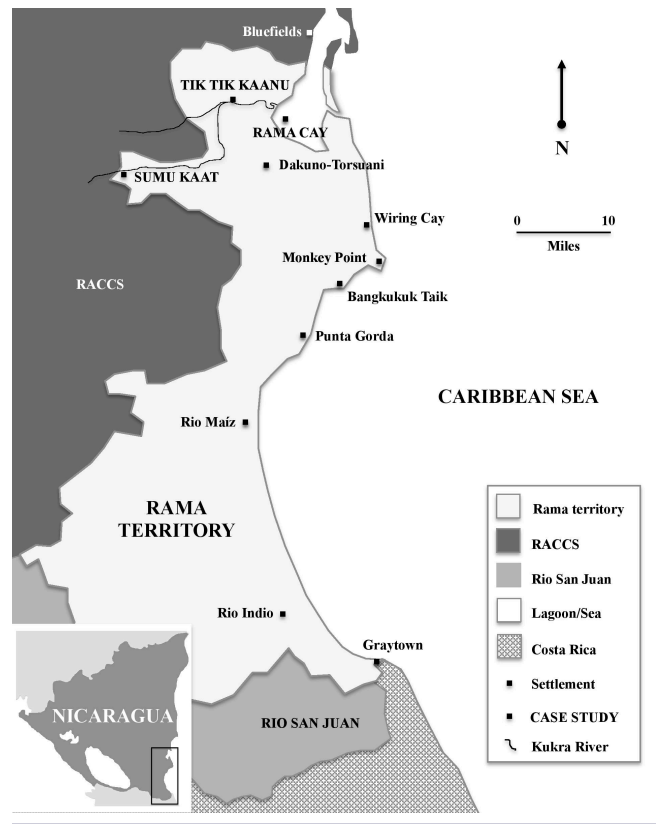
Local weather conditions are likely to change as a result of climate change (Field et al. 2014). The 2013 Germanwatch Global Climate Risk Index ranked Nicaragua as the third most vulnerable to EWEs (Harmeling and Eckstein 2013). Climate change is likely to lead to changes in average temperature and precipitation levels (Karfakis et al. 2011, Castellón 2015) and increase the likelihood of extreme events (Maslin 2013).

### The field sites

There are nine Rama communities. Fieldwork was conducted on Rama Cay, and in Tik Tik Kaanu and Sumu Kaat because the vast majority of the Rama population lives in these three communities and because of logistical constraints (Barclay 2007). Figure 2 shows the study location.

Rama Cay is a small island, approximately 0.11 square miles in size, located within the Bluefields Lagoon and about 10 miles to the south of the town of Bluefields (Baldi 2013, Baldi et al. 2014). There are approximately 80–100 households on the island, constituting approximately 80 percent of the entire Rama population (Riverstone 2004, Coe 2008a).

**Fig. 2.** Map of the Rama-Creole territory and the Rama settlements. Inset shows location of area depicted within Nicaragua.



Tik Tik Kaanu is laid out along both banks of the Kukra River approximately six miles from where the river meets the Bluefields Lagoon close to Rama Cay. The community is approximately half a square mile in size and is more sparsely populated than Rama Cay (Riverstone 2004, Papworth 2019).

Sumu Kaat is also situated along the Kukra River, further inland from Tik Tik Kaanu and about 24 miles from Rama Cay. The community is accessed using traditional paddle-powered canoes called dories or by a three-hour mule ride or a four-hour walk from the town of San Pancho. Sumu Kaat consists largely of individual houses connected by tracks running through the plantations farmed by the residents (Papworth 2019).

There are key differences between the three communities in terms of their access to markets and resources. Rama Cay has the best access to the fishing grounds in the Bluefields Lagoon and the sea, and also to local markets and job opportunities due to its proximity to Bluefields and because boat-based traders often pass close to the island (Papworth 2019). Sumu Kaat has the best access to farmland but the worst access to markets and job activities; its residents have to partly rely on the smaller nearby community of San Pancho. Tik Tik Kaanu has better fishing grounds than Sumu Kaat but worse market and job access than Rama Cay (Papworth 2019).

## METHODS

The data for this paper were collected in the second, qualitative stage of a study using an explanatory sequential mixed-methods approach (Creswell and Plano Clark 2011). Interviews were conducted with household heads between February and June 2016. These methods were designed to determine what threats the Rama perceive to their food security and how they respond to them.

The interview schedule and sampling strategy were informed by the literature and the findings of the first stage of the study, which administered household surveys to all inhabitants of the three communities. Households were purposively chosen to be interviewed in the second stage of the study, based on the survey data, to ensure the interviews included a representative sample in terms of household characteristics such as family size, wealth, and the livelihood strategies they used. Convenience sampling was also used, with opportunities taken to speak to respondents who wanted to have an input into the study. Additional data came from local archive research and observations.

In total, 41 semi-structured (signified by “#”) and 91 unstructured informal interviews (signified by “S#”) were conducted. The sample size and representivity of these interviews are presented in Table 2.

**Table 2.** Study sample size and representivity of the total Rama population.

	Rama Cay	Tik Tik Kaanu	Sumu Kaat	Totals	% of c. 1500 population
Informal Interviews (% of female participants)	65 (57)	15 (67)	11 (82)	91 (62)	6.1
Formal Interviews (% of female participants)	34 (71)	4 (50)	3 (33)	41 (66)	2.4

The data were analyzed using Applied Thematic Analysis, which is designed to complement mixed-methods research and answer research questions of a practical nature (Guest et al. 2012). Within the identified themes, content analysis was used to determine differences between households (Vaismoradi et al. 2013), which were then mapped onto the three dimensions of resilience (Carpenter et al. 2001, Smit and Wandel 2006, Nelson et al. 2007, Pelling 2011, Béné et al. 2016).

The Rama speak Rama Creole as their first language, and this has some similarities to Standard English. Some Rama speak Rama and/or Spanish as a second language. Indicative quotes are either in Rama Creole or translated from Spanish into Standard English in accordance with best practices for research in this region (Mitchell et al. 2015).

Ethics approval was granted by the UCL Research Ethics Committee on 18/11/15. The Rama-Kriol Government (GTR-K) gave its permission on 21/01/16.

## RESULTS

This results section is split into two parts: *Fishing and Seasonal Weather Variation*, and *Farming and Extreme Weather Events*. The data presented first show how seasonal weather conditions

are creating and reinforcing inequalities among Rama who predominantly rely on fishing for their food. The data in the second section show how different responses to extreme weather conditions are creating and reinforcing inequalities among Rama who predominantly rely on farming for their food.

### 1. Fishing and Seasonal Weather Variation (SWV)

Respondents who fished regularly were asked what factors made it difficult to catch fish. In total, the majority (34) of those asked this specific question (38) mentioned the weather as being a threat to their food. Of these 34 respondents, 22 named a particular type of weather, such as “when calm time” (Respondent #30), or “when time is rough” (Respondent #21), or named a specific month or months based on the typical weather during that time period. Table 3a shows the weather conditions during which certain respondents said they found it difficult to fish; the most common and strongly asserted response being that it was most difficult to fish in windy weather.

**Table 3.** Weather conditions that affect the ability of the Rama to fish.

	Respondents <sup>†‡</sup>
A) Difficulty when:	
Windy	#3; #6; #9; #11; #14; #18; #21; #22; #25; #26; #27; #34; #S48
Calm	<b>#8; #30</b>
Rainy Season	#6; #28
Dry Season	<b>#8</b> ; #20; #S59; #S70
B) Easy/easier when:	
Windy	<b>#8; #30; #31</b>
Calm	#3; #6; #26
Rainy Season	<b>#8</b> ; #20; <b>#30; #31</b> ; #38; #S40
Dry Season	#S12

<sup>†</sup>These data do not represent a quantitative frequency table; some of the participants’ assertions were more significant in context or put more strongly than others. In the case of respondents stating that windy and/or rainy weather makes it easier to fish, however, this was a clear assertion. Not all respondents commented on all weather conditions.

<sup>‡</sup>Respondents who own boat motors and gill nets are highlighted in bold.

*[H]ere in the fishing [...] in the lagoon [...] well we can't go for look it when the weather hard.* Respondent #6

*The blowing of the north wind [is when it is hard to fish].* Respondent #14

Two respondents (#8 and #30), however, said they found it more difficult to fish when the weather was calm (Table 3a). In fact, these respondents held the completely opposite view to the 12 respondents who cited windy weather as being the most difficult weather for fishing. This can be seen in Table 3b, which shows the type of weather respondents considered to be the *easiest* in which to catch fish. As with the data presented in Table 3a, these responses represented strong opinions.

*The fish weather is plenty breeze. Them the time that fish is plenty. Then it's almost fishing is good, running good we say, and the fisherman catch a lot.* Respondent #8

*Well, we have [more fish] from this month [at the end of May]. Whole time we have fish. Like this rough time, we have fish plenty, the people find that.* Respondent #30



Correspondingly, three respondents (#3, #6, and #22) said the calm (less windy) months were easier for fishing. This shows there is a clear divide between respondents: some find calm conditions to be best for fishing and find windy conditions more difficult, whereas others find windy conditions to be best for fishing and find calm conditions more difficult.

Based on a comparison of the research by Browne (2009) and Nietschmann (1973), there is no clear explanation for this difference based on seasonal weather conditions alone. This difference is, therefore, most likely to be due to the different fishing equipment owned by the two groups of people. Whereas most Rama fish using traditional hand-cast nets and traditional wooden canoes called dories, respondents #8, #30, and #31 own gill nets, fiberglass boats called pangas, and have boat motors.

#### *Boat technology and fishing nets*

Most respondents who said the windy weather made fishing difficult said this was because they had to paddle or sail their dories against the wind and through rough conditions to fishing grounds and the oyster and cockle banks.

*[W]hen we see the breeze is from the north is very hard, it's strong. So, in them times it's difficult to row and maybe get shrimps and those things because [...] some of us maybe not have motor [or other] things to go against the breeze.* Respondent #3 (does not own a boat motor)

In contrast, those who own a boat motor can go out in windy conditions because they do not have to sail or row against the wind.

*I have motor, so I can go out in stiff breeze, not like some.*  
Respondent #31 (owns a boat motor)

Respondents also asserted that the fiberglass pangas are more able to cope with large waves than the traditional wooden dories.

*Yeah, we can't go out when the weather too rough [...] The dory too small so we catching with line them.*  
Respondent #14

These findings are similar to research conducted with Lamaleran fishermen in Indonesia that showed there can be large variances in the success of fishing as a result of whether or not a boat motor is used (Nolin 2012).

Several respondents - regardless of whether they owned a gill net or not - said that it was easier to catch fish with a gill net in windy weather:

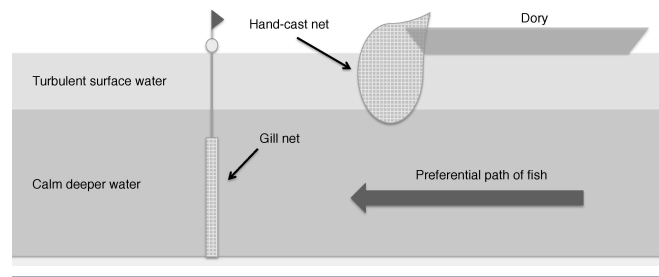
*[Y]ou see December time plenty wind [...] everything is hard in December. [But for] those who have gill net, sure it not hard because they have just set the net in the night and next morning they go and take up them fish.*  
Respondent #18

Respondent #27 said that he found the “breezy time” very difficult to fish in, but because his son has a gill net, he is able to “survive” on the gifts of food he receives from him until the weather is better.

The traditional hand-cast nets used by most of the Rama are used to catch fish close to the surface. In contrast, gill nets are designed

to sit on the bed of the sea river or lagoon. During windy weather, the surface of the lagoon is churned up by the wind more than the water at the bottom, so it may be the case, therefore, that during windy weather, traditional Rama fishing nets are ineffective at reaching the areas in the Rama fishing grounds where the fish are swimming (Fig. 3).

**Fig. 3.** The effect of the wind on catching fish with different nets.



Collectively, the evidence suggests that if a household owns a boat motor, panga, and/or gill net they view the windy weather as being advantageous for fishing, whereas if they fish using the traditional methods of hand nets and sail- or paddle-powered canoes, they view the windy weather as being disadvantageous for fishing.

#### *Long-term inequality*

Pangas, boat motors, and gill nets are expensive; their cost is prohibitive for many Rama. The richer families who can afford to purchase them appear to have a short-term advantage during the seasonal windier weather, which appears to affect the relative stability of food security within the Rama community. This is because the way the Rama's endowments interact with SWV differentially affects households' ability to convert their endowments into food in the short term. This disparity also contributes to longer-term inequalities within the Rama communities because of three mechanisms.

The first mechanism comes from the increase in overfishing within the Rama territory. Most of the Rama believe there are now fewer fish available than there used to be and many claim that the gill nets are the reason.

*The gill net [is] too big. It not allow fish coming in from the sea and reduces [the] lagoon amount.* Respondent #29

If it is true that gill nets have reduced fish stocks in Rama fishing grounds, not only are those who do not own a gill net being disadvantaged in the short-term by not being able to catch the same quantity, quality, and variety of fish as other fishermen, but the use of gill nets by others is also reducing the long-term availability of fish for everyone.

The second mechanism results from the unequal extent of market engagement within the communities. Those that have gill nets and boat motors are more able to catch and deliver the quantities of fish required by fish market traders in Bluefields, and these commercial connections can lead to other wage opportunities (Papworth 2019).

The third mechanism causing longer-term inequality within the community results from the credit arrangements that some households use. When they are unable to catch sufficient food, or less able to procure replacement foods from other sources, many respondents said they buy food on credit from Rama shop owners before resorting to wild foods such as oysters and cockles.

This contrasts with some literature that suggests families tend to exhaust their other resources (including wild foods) before relying on credit arrangements (Maxwell 1996). It is possible this difference is because the Rama buy a large percentage of their food and, therefore, always require a cash supply (Papworth 2019, Papworth et al. 2022). It may also be because some wild foods are unavailable in certain seasons. During interviews with the shop owners, all of them linked the number of customers buying on credit from their shops to the weather conditions.

*[W]hen you say (.) the breeze [...] them is the time that sometime the people them go to me and say, "I need a bread". They need like a 20 [Cordobas] or something [...] And other time when the [fishing is better for them] them just pay me back. Respondent #8*

It is fair to assume, therefore, that in the months of the year when the weather is very windy, some Rama who do not own a boat motor, panga, and/or gill net will not only struggle to catch enough fish for their needs but will also be increasing their indebtedness. During these same windy conditions, Respondent #8, who is also one of the Rama who owns a boat motor, panga, and gill net, will probably see the amount of fish he catches largely unaffected and through credit agreements linked to his shop he will also be owed money that he can recoup and reinvest at a later date. Divisions of a similar nature were also found among Kenyan pastoralists where those with access to certain key resources had greater coping ability during droughts (Unks et al. 2019).

#### Summary

This example has shown that the interaction between the Rama's endowments (ownership of certain fishing equipment) with SWV (windy weather) has a differential impact on Rama households' short-term food security. As a result, some households who use hand nets and dories are likely to become locked into a series of "coping" behaviors, such as taking on debt or relying on family members (Walker et al. 2004). In contrast, households with gill nets and/or boat motors, have been able to follow more "transitional" responses, such as selling to fish markets and/or benefiting from credit arrangements (Pelling 2011, MacKinnon and Derickson 2012).

This difference in resilience dimensions (coping vs transitioning) can also drive further long-term household-level resilience in a circular pattern (Fig. 4). Equally, this widened community-level inequality could well harm community-level resilience to further SWV and EWEs as households are forced to, or are able to respond to these future threats differently (Brown and Kroll 2021).

This possible vicious circle of resilience supports previous research suggesting that inequalities in technology (and also skills and knowledge) tend to exponentially increase inequality within society over time, particularly during social and ecological changes (Broad 1999, Singh 2001, Orlove et al. 2004, Eriksen and Lind 2009, Nazrul Islam and Winkel 2017).

Attempts to address this inequality could, however, create further inequality at different scales, times, and spaces (Adger and Kelly 1999, Bunce et al. 2010). For example, providing all Rama fishermen with a gill net would almost certainly quicken the collapse in fishing yields, which would affect food-system resilience for all Rama.

## 2. Farming and Extreme Weather Events (EWEs)

There is significant heterogeneity in how Rama households respond to threats to their crops from extreme weather events. This section of the paper presents these as three distinct responses that can occur concurrently: fatalism; replanting or changing crops; and changing livelihood strategies.

### Fatalism

Some Rama expressed a fatalistic attitude toward the weather. For example, Respondent #3 said the impact of the weather on his crop was "in the hands of God," and Respondent #8 said they can't do anything about EWEs like floods and droughts. These responses are echoed by the findings of other studies in all types of settings, but they are usually found in places where institutional power is weak and the routes to contest power are poorly defined (Kenny 2002, Paolisso 2002, Paolisso 2003, Jahan et al. 2015).

For example, Kenny's (2002) Brazilian-based study of Sertanejos (disadvantaged people from the country's rural interior) found that drought was seen as unchangeable and in God's hands. Similarly, Jahan and Wahab (2015: 60) found that many poor Bangladeshis were resigned to "Allah's will" in the aftermath of the food price shocks of 2007–08 and 2011–12. They engaged in "continuous innovative practices to survive" but took no action to transform their future prospects.

Both Kenny (2002) and Jahan and Wahab (2015) argue that this fatalism may harm a population's ability to respond effectively because their resignation contributes to reinforcing the status quo of unequal power structures in the same way that some "resilience-focused" approaches have reinforced institutional inequalities (MacKinnon and Derickson 2012, Joseph 2013, Welsh 2014). Fatalism, thus, can be viewed as a form of the coping dimension of resilience (Walker et al. 2004).

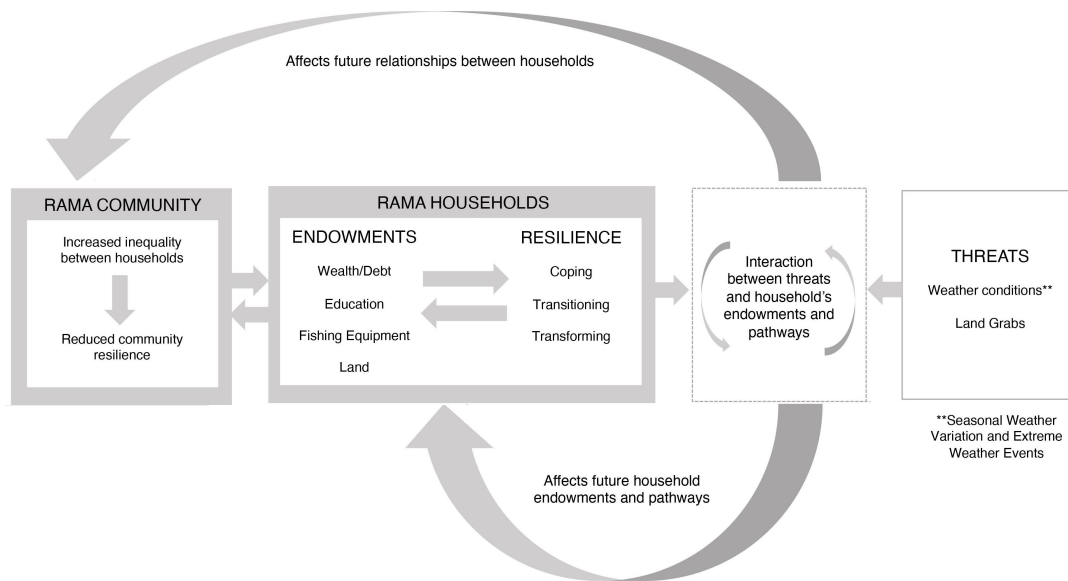
The Rama's vulnerability to food insecurity is determined to a great extent by processes they do not control, such as national land policies and the inaction taken against Pacific Nicaraguan colonizers (Papworth et al. 2022). If some Rama do not challenge power structures or how they are enacted in the belief that it is already predetermined, whereas others do, this is likely to reinforce existing inequalities within the community.

### Replanting or changing crops

The most common adaptation used by farmers when their crop fails due to EWEs is to replant the same crop. When this happens, the farmers will typically buy food on credit and rely on other livelihood strategies until the new crop is ready to harvest. Families that responded to crop loss in this way expressed a sense of helplessness similar to the fatalistic expressions mentioned previously.

*Well, what we do? We have to plant again the crops [...] because we not going to solve [the loss of crops]. We have to try that [again]. We turn back again and make a next little plantation. Respondent #6*

**Fig. 4.** The interaction of the Rama's endowments with SMVs and EWEs, and its cyclical effect on food system resilience



The opinion of Respondent #S94 is that replanting crops again overworks the land and increases the chance of future crop failures. Because the land on the Caribbean Coast is generally quite poor for agriculture, there is a lot of pressure on the better alluvial soils closest to the rivers (Riverstone 2004). This is exacerbated by the illegal encroachment of Pacific Nicaraguans into the Rama territory (Riverstone 2004, Papworth 2019). Planting crops back in this way might achieve food security for these farmers in the short term - at least within the coping dimension of the concept - but is likely to cause long-term harm to the region's soil and harm food-system resilience.

Respondents #S86, #S94, and #S80 stopped cultivating beans and started to grow cassava and banana because they consider these two to be less susceptible to EWEs. Respondent #S93 said he chose not to plant beans in 2016 because he had found it to be too risky in the past, and Respondent #29 said he no longer plants beans or cocoa because he knows they always “burn.”

This adaptation is similar to farmers in Madiama in Mali who plant both sorghum and millet (which have different tolerances to rainfall) and then cut down one of these early depending on the rainfall level (Crane et al. 2011). For both these farmers and the Rama, the responses that they can choose can be classified as “transitional resilience” because they are still bound by the same factors that determined their initial vulnerability, which in this case is the interaction between their socio-economic status, their crop and the environment (Pelling 2011).

Similar to the results presented in part one, these findings show that resilience varies across time and scale (Yamane 2009, Pelling 2011). Some adaptation responses, including the diversification of crops, could have a harmful impact on the Rama in the future and/or further increase local inequalities (Brown and Kroll 2021, Nazrul Islam and Winkel 2017).

#### Changing livelihood strategies

Rama families have started to adjust their livelihood strategies - seasonally and long term - to adapt to EWEs. A large proportion of Rama families' incomes come from selling their own produce, game or seafood (Papworth 2019). If food availability is reduced, the impact will be felt primarily through a drop in income rather than a drop in the calorie contribution of these items to their diets. The Rama often plug these income gaps with short-term informal jobs (which they call “chambas”).

Work in the region is usually seasonal and difficult to find, and many Rama will take jobs whenever they become available. This competition is heightened when there are crop failures or a drop in fish stocks due to EWEs. Respondent #S94 said that when his crop fails, he has no choice but to take a job to earn enough money to be able to buy food. Respondent #S53 explained that he had done some informal work - including chopping wood and clearing land - to replace the income lost when his crop failed.

The fieldwork data also suggested, however, that some families are choosing to permanently shift their focus to waged employment in light of these past failures. For example, Respondent #S47 stated that he and his family moved to Rama Cay so that he could look for a job; a move away from his traditional livelihood strategy toward one reliant on the labor market.

This has been a common occurrence in recent years. Respondent #4 states that as the risk of traditional livelihood strategies has increased, largely due to reduced yields, though sometimes because Rama families have been forced off their land by Pacific Nicaraguans, many Rama have been faced with a choice.

*Some of [them] say [...] I am going to make a business instead [...] or get a job because it's much easier than to reap corn. Respondent #4*

This is another representation of the shift within the Rama community toward more market integration that was seen in part one of this paper. For many Rama families, though, there exists a tension between focusing on traditional livelihoods versus engaging with the market economy. They may have to choose between maintaining their land on the one hand and furthering their education in order to access the job market on the other.

Respondent #25 explained that when she was younger, her family owned a farm. When she was old enough to start working on the land, her father insisted that she and her brother go to school. Because they were busy studying, the family was unable to tend their land properly and it was taken over by her uncle.

While Respondent #25 may not have known that losing the farm would be the result of focusing on education, this was a fear of other Rama respondents. Respondent #19 was asked about her future ambitions and her response is worth quoting at length as it shows how the competing interests of land ownership and furthering education are rationalized as opposing opportunities.

*Well for me, first [ambition is to] go school. If I can't study then to have some big land, some farm for my children. I think [focusing on] the farm be better. I take the land before we lose it [...] because if we leave that land [Pacific Nicaraguans are] going to take it over. Right now, them out there on the beach side [ready to move here]. They take and not ask nobody. They just go and chop [...] and plant the food. Respondent #19*

Nevertheless, those Rama who have been able to further their education and/or transform their livelihoods to be able to engage with the market economy of the region, tend to be wealthier (Papworth 2019). It is likely that these individuals will, therefore, have even greater endowments on which to draw in the face of future threats. This response could be classified as the Rama following the transitional resilience dimension, but it is possible that for some Rama changing their livelihood is a transformational action because they are no longer bound by the same factors that determined their initial vulnerability (Pelling 2011).

#### Summary

This section has explored how Rama farmers respond to the damage that EWEs do to their crops. It has shown that the resilience dimension they follow can have an impact on their future endowments, such as education and land holdings.

This process can be viewed as being part of the same vicious cycle of food-system resilience outlined previously (Fig. 4) (Nazrul Islam and Winkel 2017): for many families, their decision whether to follow a certain resilience dimension, such as diversifying their income or increasing their market engagement, is constrained by their endowments, such as their education status and/or the location of the community they live in. For example, families who live in the communities further away from Bluefields have fewer opportunities than those who live on Rama Cay.

Furthermore, the heterogeneity of these responses to EWEs is likely to make inequality within the community even more pronounced, affecting future community-level resilience (Bunce et al. 2010, Misselhorn et al. 2010, Pelling 2011, Brown and Kroll 2021).

## DISCUSSION

This research has drawn on a case study of the Rama Indigenous group in Nicaragua to explore how their endowments interact with SWV and EWEs to reduce household- and community-level resilience to future threats.

The first section of the results showed that those Rama fishermen who can afford boat motors, pangas, and gill nets have an advantage relative to their peers in certain seasonal weather conditions. Those fishermen who do not own this equipment are less able to catch fish in windy weather and generally have smaller catches that are also of lower quality. This inequality among the Rama is likely to be further reinforced through adaptation actions. For example, those who don't have sufficient food from their own production follow the coping dimension of resilience by buying food on credit from better-off Rama shop owners, and this increases their vulnerability to food insecurity while simultaneously advantaging the better-off Rama households.

The second section of the results showed that the adaptation actions taken by Rama farmers in the face of EWEs are stratified according to their endowments, such as access to land, education, their personal and culturally-determined perception of risk, and externally- or culturally-determined constraints upon their livelihood strategies. Those who have been able to take transitional or transformational resilience pathways, such as changing their livelihood strategy, are likely to have greater resilience in the face of future threats. This reinforces evidence showing that those who already possess power, wealth, and influence are best positioned to take advantage of the opportunities presented by change (Broad 1999, Singh 2001, Orlove et al. 2004, Eriksen and Lind 2009).

These results suggest, furthermore, that these interactions can create and extend existing inequalities in the Rama community, which are likely to then feed back into future interactions (Fig. 4). This finding is supported by other research that has concluded that the relationship between climate change and social inequality is a vicious cycle with initial inequality making vulnerable people suffer disproportionately, resulting in greater subsequent inequality (Nazrul Islam and Winkel 2017).

On a global scale, the threat of climate change to the Rama's food security - enacted through the interactions between their endowments and SWV and EWEs - will be best alleviated by continued efforts to mitigate against global climate change, specifically focusing on policies that will restrict global temperature increases to below 2°C above pre-industrial levels (Masson-Delmotte et al. 2018).

While livelihood diversification is evidently an important pillar of both adaptation to climate change and policies that seek to alleviate poverty (Yamane 2009, Pelling 2011), the results presented here suggest that policies to promote this could actually reduce food-system resilience.

It is equally important, however, that households are not locked into unsustainable livelihood trajectories. For example, if all Rama fishermen were given gill nets this would probably hasten the decline of the Rama's fishing grounds. Equally, if all Rama were encouraged to engage in market diversification, it is possible that Pacific Nicaraguans would be able to colonize even more Rama land.



This is a key issue for resilience theory: When resilience is enacted at one scale, space, and/or time, it does not guarantee resilience in other scales, spaces, and/or times (Carpenter et al. 2001, Bunce et al. 2010, Misselhorn et al. 2010, Taylor 2015, Mochizuki et al. 2018). Based on the evidence presented here, it is unlikely that top-down, one-size-fits-all policies will effectively boost resilience in communities that are similar to the Rama.

#### *Policy responses*

Providing policy interventions disaggregated at the household level is unlikely to be logistically possible in many communities that are similar to the Rama. It is important, however, that all interventions should be properly evaluated, wherever resources permit, so that future responses can be designed to address any adverse effects.

Food sovereignty has been proposed as a potential solution for communities grappling with food security inequalities, particularly those facing threats resulting from the prevailing, neoliberal, global food system. The concept is contested but can be summarized as foregrounding the rights of food producers to control the production, consumption, and sharing of their own food (Wittman et al. 2011, Lang and Barling 2012, Robbins 2015, Bini 2018). Recently published research on the Rama has, however, shown the utility of the food sovereignty concept is currently limited in providing a solution for this community, largely because of the encroachment of Pacific Nicaraguans into the Rama territory (Papworth et al. 2022).

Participatory approaches that allow communities to decide for themselves how best to respond to SWV and EWEs might present useful solutions (Bebés-Blázquez et al. 2014, Mertens et al. 2015). Co-designed interventions intended to reduce harmful fishing practices on the Caribbean Coast of Nicaragua may need to include participants from the Pacific Nicaraguan community in order to be successful, as their activities are one of the main threats to regional food security. This risks legitimizing the activities of this community, which would not be appropriate because the Rama's rights as an indigenous group outstrip those of Pacific Nicaraguans (Grossman 2001, Gobierno de Nicaragua 2002). Finding a solution to the problem of Pacific Nicaraguan colonization, therefore, must be one of the first priorities when seeking to improve food-system resilience in this region.

#### **CONCLUSION**

We have explored how the Rama's endowments interact with SWV and EWEs to affect the community's food security. We've shown that there is considerable heterogeneity within the community in terms of short-term impacts and household-scale responses, and we have also explored how these existing inequalities could also further recreate inequality. As climate change is very likely to make SWV more pronounced and EWEs more common, it is vital that efforts to mitigate against climate change continue.

Potential policy options to improve food-system resilience for the Rama are hindered by the Pacific Nicaraguan colonization of the Rama territory, which needs to be urgently addressed. This shows that household-level research is required to be able to fully understand all the local processes and inequalities that could harm food-system resilience for the poorest individuals.

*Responses to this article can be read online at:*

<https://www.ecologyandsociety.org/issues/responses.php/13376>

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#### **Data Availability:**

*The data that support the findings of this study are available on request from the corresponding author, AP. None of the data are publicly available because the research participants have not approved the upload of their research data to a repository. Ethical approval for this research study was granted by the UCL Research Ethics Committee on 18/11/15. The Rama-Kriol Government (GTR-K) gave its permission on 21/01/16.*

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