Static on the Relief Channel

In mid-September 2017, all the news channels in Washington, DC, and across the country had shifted from the flooded homes in Houston, and the crowded highways and empty gas stations in Florida to the incredible power of Category 5 Hurricane Maria as it was on a collision course with Puerto Rico. Not long after the images from Houston faded, Hurricane Maria devastated the islands of Puerto Rico and St. Croix in the US Virgin Islands on September 20, 2017. Within nine days, televisions across the country were inundated with images of the San Juan Mayor, Carmen Yulín Cruz, pleading: "We're dying here. We truly are dying here. I keep saying it: SOS. If anyone can hear us; if Mr. Trump can hear us, let's just get it over with and get the ball rolling." [1] This coverage received the ire of the President, who responded in retorting tweets. US mainland public perception was further driven by other media reports that indicated the island's supply chain had totally failed. Some volatile headlines in the days and weeks following landfall included the following:

Figure CS2-1. San Juan Mayor Carmen Yulín Cruz on CNN pleading for resources

Source: CNN, September 29, 2017

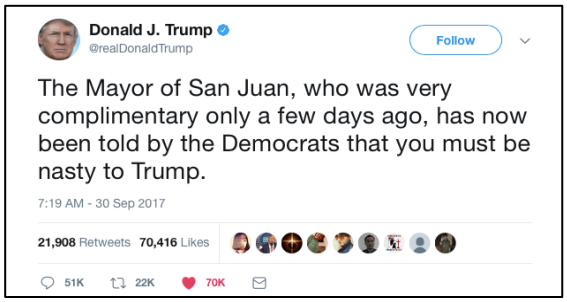

Figure CS2-2. President Trump tweets in response to the Mayor of San Juan

Source: Twitter

- *CNN*, September 26: No gas. No food. No power. Puerto Ricans fear their future
- *USA Today*, September 30. By the numbers: More than half of Puerto Rico still without drinking water
- *Business Insider*, September 29: Hurricane Maria decimated Puerto Rico's food supply

The concerns were real, but there was more to the story—omissions or blind spots had a profound effect on the response to Hurricane Maria. In the midst of enormous and persisting challenges, water, food, and fuel supply chains in Puerto Rico had actually demonstrated

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considerable resilience. The speed, scope, and scale of both recovery and adaptation of the citizens meant that within four weeks of landfall, over 90 percent of residents were fulfilling fundamental needs through the capacity of preexisting systems (or temporary/ad-hoc replacements). There was, however, no systematic process by which local, commonwealth, or federal authorities could be confident of this recovery and adaptation, or accurately map where and when the recovery was not happening. The perception of shortfall and human suffering argued for a massive response from the nation to help its fellow American citizens in Puerto Rico.

This response fit with the Federal Emergency Management Agency's (FEMA) whole community approach to emergency management and Administrator Brock Long's vision for the agency as presented in the new Strategic Plan: *a prepared and resilient Nation is a shared responsibility and, while recognizing FEMA's essential role, meaningful improvements will occur only when we work in concert across Federal departments and agencies, as well as with leaders from state, local, tribal, and territorial governments and non-governmental organizations and the private sector*. [2]

FEMA's approach for disasters in the United States has been to provide all potentially necessary resources as quickly as possible to ensure that lives are saved, even if it means risking waste—an approach that came about after decades of responding to many large-scale disasters such as Hurricane Andrew and Hurricane Katrina. The previous FEMA Administrator, Craig Fugate, was often quoted as crystalizing this strategy as, "Go Big. Go Early. Go Fast. Be Smart." [3]

Anticipating that existing supply chains will fail, FEMA, and specifically it's Logistics Management Division, helps manage the "relief channel" – a replacement supply chain to provide needed goods. The "push" of emergency supplies like food, water, and blue tarps typically occurs early in a response, before there is good situational awareness at the local level. The "pull" of needed resources occurs when the local government has completed damage assessments and began to request specific aid from FEMA. The objective of this push/pull process during a response is to be effective in fulfilling immediate and lifesaving needs and to reduce the flow of resources gradually as things "return to normal." The cost of the upfront push is often degraded efficiency, but it is a risk that the federal government has been willing to accept during disasters, when lives are at stake.

Having a "pull" signal from disaster victims, indicating what they actually need and want, is a more economical and practical solution. Private sector retailers use these demand signals to run their businesses on a daily basis. But local businesses are often disrupted in emergency situations and are unable to receive and convey consumer demand when power and communication are down. The "push" of goods from the public sector (as well as from well-

meaning volunteers), while focused on supplementing private systems in the face of these breakdowns, can also be superfluous and unintentionally disruptive to the private sector.

FOOD MISSION: PUERTO RICO

Sitting in his office at the Puerto Rico Emergency Management Agency (PREMA) late one evening in May 2018—eight months into the recovery from Maria—Heriberto Sauri, Director of Puerto Rico Homeland Security Office, reflected on the hurricane, "We were most worried about fuel and food. Most of the food in Puerto Rico is imported from the states or other places." Indeed, approximately 85 percent of grocery products consumed in Puerto Rico arrive at the Port of San Juan. In addition, there is only a 30-day supply of grocery products on the island at all times because Puerto Rico has an inventory tax from the Puerto Rico Treasury Department, which limits the amount of inventory companies can stockpile. In 2016, roughly $5.6 billion was expended at food stores.[4] Notably, approximately 40 percent of all food purchases are made with the Department of the Family's Electronic Benefit Transfer (EBT) card, also known as the PAN card. [5]

Most residents were not ready or prepared for Hurricane Maria. Supplies were scarce and the power grid was already damaged from Hurricane Irma, which skirted the island two weeks prior, knocking out power to 1 million people. [6] Most did not have the resources on hand to prepare for such a large storm. In the rural parts of the island, few had cash readily available to pay for supplies and most depended upon electronic access to their public benefits. [5] Poverty levels overall in Puerto Rico are more than 40 percent, and in some areas like Yabucoa, where Maria made landfall, the poverty levels are even higher, at 65 percent. "People generally are not able to keep large sums of cash around in preparation for a disaster," according to Jerry Medina an Emergency Medical Technician in Yabucoa.

At 6:15 a.m. on September 20, 2017, a disaster came nonetheless. Hurricane Maria made landfall just south of Yabucoa Harbor, Puerto Rico, as a Category 5 hurricane with winds over 157 mph. Puerto Rico's electrical infrastructure was destroyed. The entire island—all 1,569,769 customers and 3.4 million people—was without power. "I don't remember anything that didn't collapse besides the will of the people," said Hector Pesquera, Secretario de Seguridad Publica.

Disasters outside the continental United States are a major challenge because of logistics, cultural issues, and the time it takes for systems to gear up. Typically, in events on the mainland, there are several options for resourcing needs from across the country. Supplies can be trucked from nearly anywhere in the country through a system that is predictable, efficient, and effective. On islands, the systems for supply chains are not as responsive, may have particular aspects absent (e.g., a 30-day food supply), and may be less resilient to

disasters themselves (i.e., limited numbers of ports of entry, trucks, storage places, operators, and logisticians). In addition, the time it takes to ship from Florida to the island Puerto Rico (and indeed to further islands such as St. Croix) incurs a longer time for the system to engage and get up to maximum output—and that is if the system works well.

In some ways, FEMA was well-prepared to surge goods to Puerto Rico. As the massive response to Harvey in Texas, and to Irma in Florida had started winding down, the relief channel was operating at a high capacity, and primed to redirect supplies to Puerto Rico.

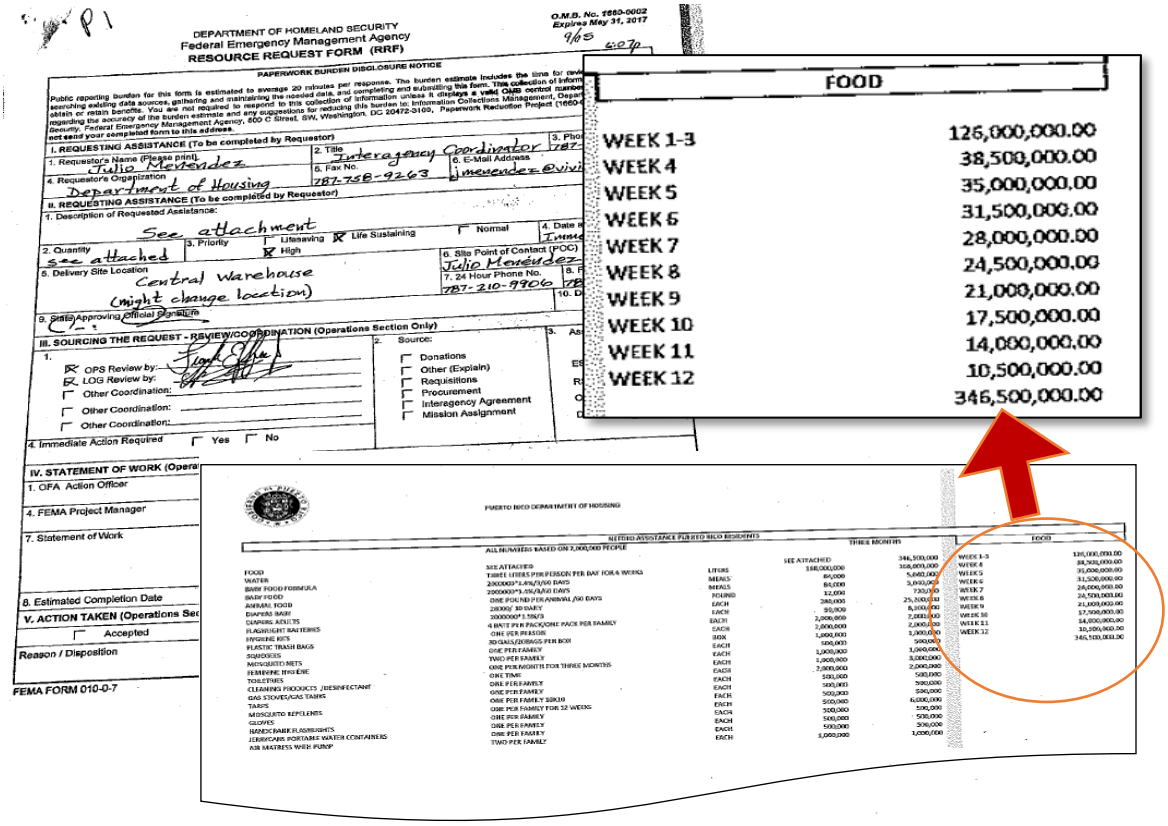
Sending in Food - the Push Begins

Hurricane Maria left the island with no power, no communications, significant flooding and damage, and blocked or washed out roads that isolated many communities. In Washington, DC, FEMA Logistics worked to enable a minimum of 1.5 million meals per day in Puerto Rico. Based on their initial estimates, they aimed to feed, water, and provide essential life-saving services to 20 percent of the population on the island. This goal made sense in terms of realistic system capacities and constraints. Then, on September 25, 2017, FEMA Region 2 received a Resource Request Form from Julio Menendez, the Interagency Coordinator for the Puerto Rico Department of Housing, on behalf of the Governor's Office, asking for immediate aid for 2 million people on an island with 3.4 million people. Mr. Menendez specifically requested 346,500,000 meals over a 12-week period. For the first three weeks after landfall, his request was for 6 million meals per day (see Figure CS2-4). [7]

Figure CS2-3. Devastation in Ultuado, Puerto Rico

Source: Hector Cruz, Emergency Management Director, Ultuado

Figure CS2-4. Resource Request Form seeking six million meals per day

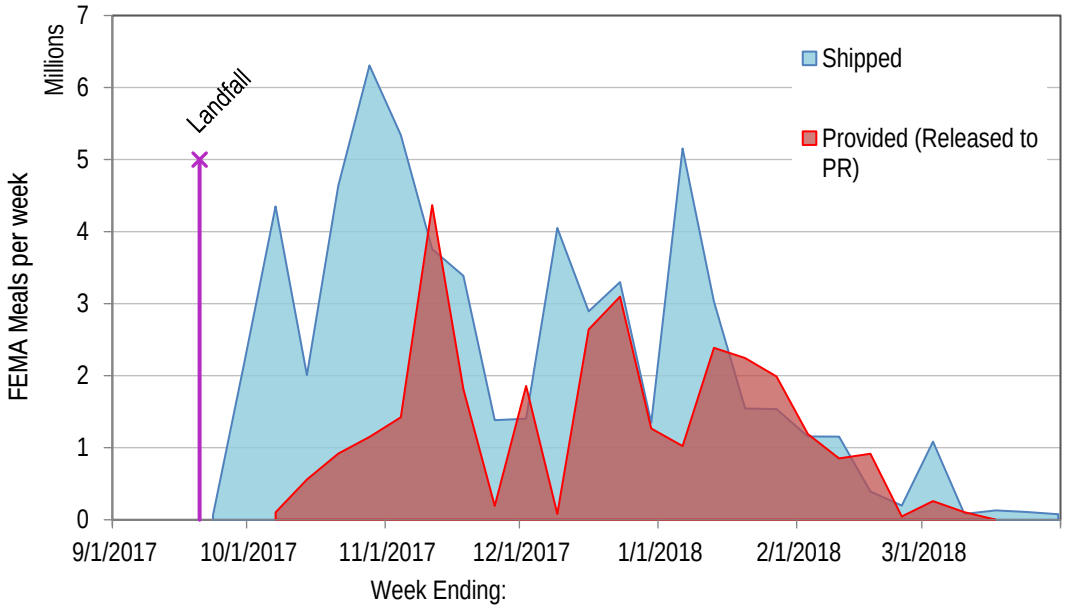


There are several paradoxes in understanding the FEMA food mission in Puerto Rico. The total food provided was massive, record-breaking for FEMA, and likely more than needed. Yet, it was still small when viewed in the overall context of the islands' total consumption. From September 20, 2017 through March 31, 2018, FEMA shipped 62,062,317 meals to Puerto Rico [8], and provided[1] 30,486,710 meals to the government of Puerto Rico [9]. In only one week did FEMA actually ship more than 6 million meals total (one-seventh of the 6 million per day request). This was the largest food mission in FEMA's history; yet for the island's population, it equated to about nine meals per capita over six months (or 1.5 meals per person per month).

[1] Meals "provided" refers to meals that are released to the government of Puerto Rico at one of the destination facility cities in one of Puerto Rico's 12 emergency management zones. From these facilities, the government of Puerto Rico, local governments, local FEMA managers or contractors manage distribution to the general population.

Another paradox is that the food deliveries were at once rapid and also too late, and the deliveries did not seem to follow the track of the storm. Figure CS2-5 shows that food started arriving quickly after landfall, but the distribution of food released to Puerto Rico does not really ramp up until October. The food is most needed in the initial weeks after landfall, but food provided to the population does not peak until mid-November. A possible explanation is that it takes a long time to ship food from the mainland to Puerto Rico, and distribution of food was significantly hampered by local issues with transporting goods.

Figure CS2-1. FEMA meals shipped and provided to population during Hurricane Maria Response in Puerto Rico. [8-9]

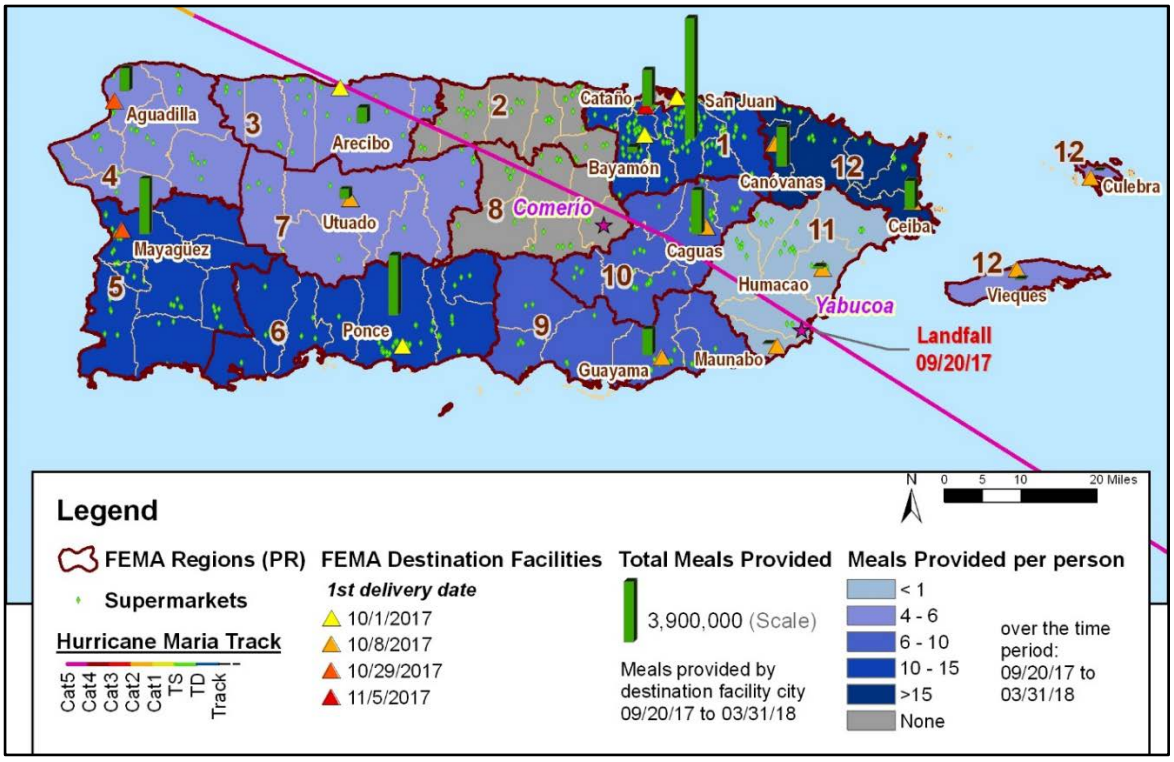


Source: CNA based on data from FEMA

Figure CS2-6 indicates when FEMA food deliveries first arrived to an area and shows the total amount delivered through the end of March 2018. Cities with ports such as San Juan, Ponce, and Arecibo receive and release food the earliest. The total food provided by zone is normalized to 2016 populations. This distribution of the meal rations across the island was not equal. Interestingly, the per capita food deliveries seem to be inversely proportional to distance from the hurricane track. Notably, Zone 11 (including Yabucoa, where Maria made landfall), received the least. Zones 2 and 8 had no food provided from their destination facilities according to FEMA data (though 23,724 meals were shipped to Comerio). A possible explanation is that those zones likely received transfers from facilities in neighboring zones (e.g., Caguas, Bayamon).

In total, 10,559,752 meals (or 35 percent) went Zone 1, with 7,880,640 meals (or 26 percent) being released to the destination facility in San Juan [9]. The population of San Juan is 355,074, which means that the San Juan facility released on average, 22 meals per capita over the six-month period.

Figure CS2-2. FEMA meals provided, by emergency zones [9]



Source: CNA. Data Source: FEMA

What is unclear is whether the food distribution matched or mismatched with population needs and how much of the distribution was based on subsequent Resource Request Forms. Angel Vazquez, President of B. Fernandez & Hnos, explained, "As a rule, the smaller the store, the quicker the recovery. Our largest customers have the most sophisticated systems and were, as a result, the most disrupted by long-term outage of the grid. Our smallest customers, up in the mountains—even though they had been hit really hard—were the first to open." Accessibility may have played a role in the distribution as well. For example, Mr. Medina noted that for the first 45 days after Maria, Yabucoa received aid and food from the National Guard in Ceiba, not FEMA. They were not able to communicate with PREMA for a month to even make their requests and needs known.

Concerns over crowding out the local businesses

Among the local public sector a narrative developed that FEMA's response actions had a negative effect on the island's food supply chains and economy. Reflecting on the monumental task of delivering over 30 million meals to the island, Heriberto Sauri, Director of Puerto Rico Homeland Security Office, said, "The federal government acts as a parent to feed Puerto Rico. People didn't have to go to supermarkets for months because of the food FEMA provided. But this doesn't help Puerto Rico get its economy back on track."

This sentiment was echoed in the mountains in the interior of the island. Amaury Figueroa, the Emergency Management Director for the Municipality of Naranjito, said, "Instead of going to the super market for groceries, people preferred to stand in lines to get their food from FEMA. For two months, FEMA interrupted the supply chain for the local markets. When our stores reopened, the lines for FEMA food began to decrease, but they were still there because that food was free. Our mayor had to ask FEMA to stop supplying food to help out our local stores."

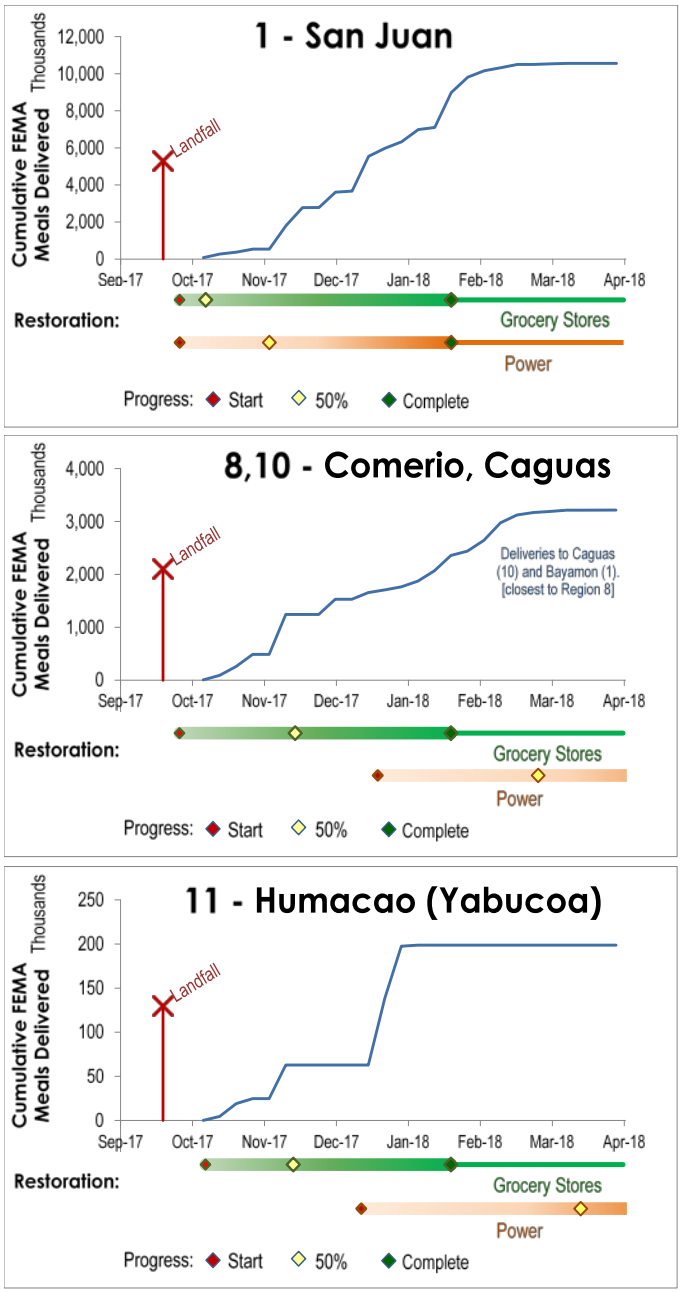


Figure CS2-3. FEMA food deliveries released to the Puerto Rico government relative to the restoration of services

Looking at three regions in Puerto Rico—San Juan, Comerio, and Yabucoa—Figure CS2-7 denotes when grocery stores reopened

after the storm in comparison to when FEMA began delivering meals. In two of three regions, grocery stores were already open in the region prior to FEMA's first deliveries.

Mr. Medina in Yabucoa said, "We stopped requesting food in January 2018 because the PAN cards were working and people could buy groceries at the grocery stores," further noting that the local grocer, Ralph's Food Warehouse, went six months without power, but was open because it ran on generators. Figure CS2-7 for Yabucoa accurately reflects what you would expect when the pull signal is restored (especially PAN card transactions) soon after the power was turned back on: the push stopped.

By contrast, Zone 1 (containing San Juan), saw a huge ramp-up in FEMA meals even after the majority of communities in the area had grocery stores open and power restored. San Juan proved to be the center of the glut. While most of the destination facilities released nearly as many meals as were shipped, the facility at San Juan received over 36 million meals, and released roughly 8 million. This accounts for much of the 32 million meal difference between the total meals shipped (62,062,317) and provided (30,486,710) for all of Puerto Rico. [9]

So what effects did this glut of food have? Were the grocers actually harmed? Had the island reached its capacity to absorb food, or had something else happened?

Although the amount of food sounds massive, there are several indications it did not really overwhelm the existing food supply chain. As stated previously, the number of meals actually released amounted to only 1.5 meals per person over six months across Puerto Rico. When asked about the effect of FEMA's food mission on his store, Jose Perales, manager of Ralph's Food Warehouse in Yabucoa, smiled, shrugged his shoulders, and said, "The free food had almost no impact on our sales. People came here to buy what they wanted to buy. Then they stood in line for the free food because it was free. Some they ate; most they put away for next hurricane season. In any case, it did not impact what they bought from me." A grocer in Comerio complained about FEMA's effect, but his actual sales were approximately 20 percent higher in October 2017 and continued to be higher through at least April 2018. A bigger issue in Puerto Rico was access to cash and PAN benefits because of the lack of power.

Further evidence from the private sector shows that food was available in Puerto Rico and grocery stores opened quickly and experienced surging sales. In December 2017, Puerto Rico realized its strongest food sales in eight years (see *Case Study 1: Retail Resilience in Puerto Rico*). The total food sector sales for Puerto Rico in the wake of Maria are [4]:

- August 2017: $444.9 million
- September 2017: $460.2 million
- October 2017: $496.8 million
- November 2017: $512.6 million
- December 2017: $531.0 million.

The “free food” had not meaningfully harmed sales. Yet, even if the food supply chain was not overwhelmed, there were substantial impacts related to the push of goods. There are also significant lingering questions. Why was so much more food ordered than was used in the first place?

UNDERSTANDING THE PUSH – CAUSES AND SPILLOVER EFFECTS

Fundamentally, FEMA Logistics is in the business of fulfilling requests for aid in the form of emergency supplies, especially food, water, fuel, tarps, generators, etc. Puerto Rico, after Hurricane Maria in particular, provided several challenges that make this process difficult.

On May 23, 2018, eight months—almost to the day—after Maria made landfall, the Joint Recovery Office in Guaynabo, Puerto Rico, is bustling. The circular floorplan feels like carefully organized chaos. In the midst is R. Scott Erickson, the Chief of Logistics, who is responsible for executing a near-impossible task of managing an enormous amount of commodities onto an island with severely damaged infrastructure and limited ports of entry. If any person is up for the job, Mr. Erickson appears to be it. He’s intense, energetic, and commanding. He leads a team of logisticians who come across as down-to-earth, no-nonsense professionals who just want to get the job done despite months of grueling hours and harsh working conditions.

Figure CS2-4. Emergency ration meals in a home in Yabucoa

Source: Ben Nieves, owner, ISP

Mr. Erickson and his team have a firm grasp on the situation and the criticism they face on the island. “FEMA was giving away food and water until the 18th of May. There was no incentive to go to the store and buy food because FEMA was delivering grocery boxes with whole meals in it. In most cases, they don’t appear to need it; they are taking it because it is free,” he explained, adding, “When we cannot validate a requirement, it probably tells the story.” He also speculated that people are hoarding food in preparation for the next disaster, a reminder to everyone of the upcoming hurricane season beginning in a little over a week (on June 1, 2018).

The team understood how the situation unfolded and got out of hand. First, there were no communications on the island right after the hurricane, so there was minimal situational awareness and Puerto Rico could not make its requests. Because there were no initial requirements, FEMA began to push material based on estimates made by staff at headquarters. Second, there were two different teams placing these orders within the overall relief system—FEMA and Emergency Support Function 6, Mass Care. The two groups did not communicate clearly and, as a result, more commodities were sent than required. "Instead of coming up short, FEMA over-flooded the supply chain with product. A big issue is you can't move product once it floods an island. There are insufficient locations and resources to take the products," he explained. FEMA Logistics was challenged with the volume of supplies piling up at the port. The port had significant issues, many unrelated to FEMA, and his team struggled with the containers because of inadequate labeling.

Figure CS2-5. Food deliveries in Ultuado, Puerto Rico

Source: Hector Cruz, Emergency Management Director, Ultuado

Anything coming to the island was designated "Disaster Relief." They often did not know what was inside a container until it was opened. At one point, there were 2,000 containers holding bottled water sitting in the port, with no associated requirement. "The supply chain is only as good as the last link in the chain. If there is no one to consume the product it just sits and backs up. We should not push food faster than it can be consumed; we had to throw away 2 million meals that spoiled or were damaged," said Mr. Erickson.

Mr. Erickson recommended the following idea, "Instead of FEMA moving products, let's do vouchers and let the private sector supply the food. Currently, there is no incentive for the private sector to come to the table and assist if FEMA is going to pour massive amounts of free food on the population anyway." However, he noted that the private sector was not able to meet their contract requirements when given the opportunity in some isolated cases. The voucher recommendation is compelling because as shown in Figure CS2-9, grocery stores were open, and many residents – especially those relying on EBT cards – just needed a way to pay for food in stores that lacked power (and connectivity) to process electronic transactions.

One lingering question Mr. Erickson continues to ask is, "if most grocery stores were open, why were the Emergency Managers and Mayors still asking for food and water help? At six months in, we were still getting requests in for truck-loads of food and water from individual municipalities. Up until two weeks ago, Mayors were still asking for food and water."

Whispers from many interviewed across the island indicated, “It’s good politics to hand out free food.”

So, FEMA had delivered food as requested—more than needed, but too little to meaningfully impact the island-wide food supply. Nevertheless, the surge of FEMA supplies did have very real and cascading impacts on other supply chains on the island.

Supply Chain Impacts in Puerto Rico – Where the Push Did Make a Difference

FEMA’s food mission did not prevent grocery stores from opening or from selling their product. It did not crowd out supermarkets. In fact, sales had surged. The quantity of food moved into Puerto Rico was large, but at the same time, met only a small portion of the islands’ total caloric needs. Nonetheless, the huge push did have a variety of direct and indirect effects on other supply chains via effects on transportation systems, and other (i.e., not retail food) economic sectors. Mr. Sauri explained, “FEMA obstructed the private sector because FEMA had priority for supplies that were transported on boats and trucks. The port even segregated the barges by who pays more. FEMA would pay more money so delivering their supplies became priority. Ultimately, FEMA made the private sector another victim, not their partner.” Mr. Pesquera echoed this concern, “Our private sector complained that FEMA took over the ports and incoming supplies. FEMA’s presence took over everything.”

“I could not get vessel space for goods I regularly bring from the mainland,” Angel Vazquez explained. “FEMA food and more had higher priority. So, we (B. Fernandez) increased buying from Mexico and Europe where I could surge flow with much more confidence. Because we regularly buy and sell many international products, it was easier for us than others to diversify our inventory mix.”

“We also lost up to 10 percent of our trucking capacity,” the president of B. Fernandez reports. “Several independent truckers went to work moving relief supplies. To fill the gap and increase volume, we helped a small trucking company purchase eight pre-owned trucks. In exchange he hired drivers and guaranteed long-term service to B. Fernandez and our customers.”

The water supply chain was another story. FEMA’s intervention in the bottled water market had a much larger effect than for food. In the case of bottled water, FEMA’s push did suppress the private sector supply chain. Mr. Erickson said that there are currently (as of May 2018) 21 million bottles of water sitting under a blue tarp in Puerto Rico that FEMA has now excessed to the commonwealth, adding, however, “it doesn’t help the economy.”

According to Mr. Sauri at PREMA, "Puerto Rico has two or three companies that can produce and bottle water and they had water and power. What they lacked was the raw materials to manufacture the caps, which were stuck at the port. These companies went weeks without producing water bottles because their containers in the port were not considered a high priority and not released. FEMA bringing in more water and other commodities created a cycle of goods getting stuck at the port."

Eventually FEMA did contract locally for bottling water; however, it had a negative effect on local supply and demand. "We basically took product out of the commercial channel, moved it into the relief channel, and probably ended up distributing it less widely—and at a much greater overall expense—than if we had sourced elsewhere for emergency needs and let the preexisting channel respond to retail demand," a FEMA official said, adding, "We contributed to empty store shelves and this had predictable effects on consumer behavior."

The displacement of bottled water out of the stores—creating empty shelves—increased the public sense of disruption that kept hoarding behavior so high well into December. According to Mr. Vazquez of B. Fernandez, "Once the water aisles in the grocery stores were regularly restocked, the market finally began to calm down. Lots and lots of water in the aisles was the signal shoppers finally found to be reassuring."

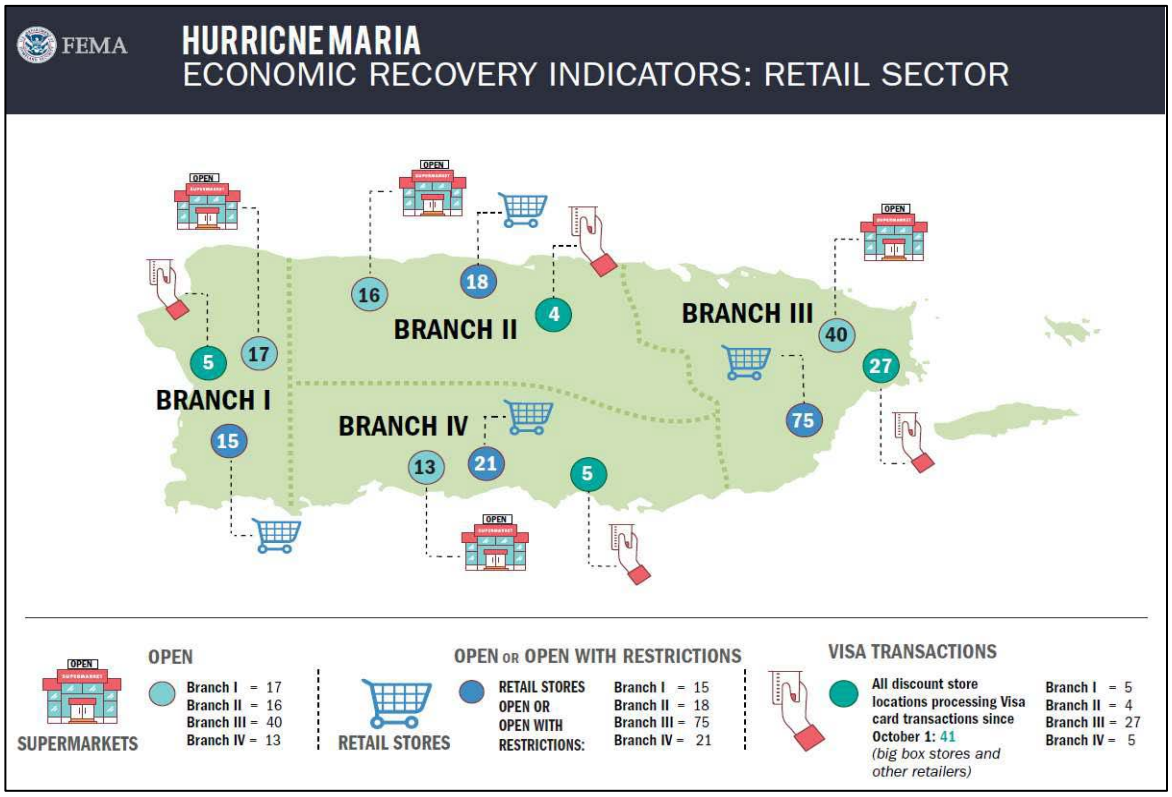
Finding the Pull Signal through Situational Awareness

Federal, commonwealth, and local authorities focused primarily on deploying an effective relief channel for mass feeding and other direct assistance to all survivors. As a matter of policy and strategy, this relief channel assumed the failure or near-failure of the preexisting demand and supply chain. The relief channel was organized to replace, not to supplement or gap-fill preexisting strategic capacity. The overwhelming push appears to be a combined effect resulting at first from a desire to fill an anticipated need when communication was cut-off, followed by fulfilling continuing requests for aid without accurate situational awareness of the private sector supply chain.

Situational awareness practices are generally linear and prescriptive and are not designed to look for unintended consequences or interdependencies. Situational awareness relies on observations and validation from the field, mostly from local, state, and federal response workers, and from the local private sector system if it is mature and capable of coordination. However, since the destruction following Maria was so widespread, this was a gap. Challenges in building and validating holistic situational awareness arose from a lack of access, lack of communications, and lack of effective processes from PREMA to build an accurate picture of local capabilities and needs, and to build a reliable picture of how the private sector was responding to those needs.

In an effort to bridge this gap and improve visibility into local businesses, FEMA helped to bring visibility of the private sector into the EOC, establishing the Business EOC (BEOC) on September 27 and 28, 2017. Figure CS2-10 shows the level of information the BEOC provided to FEMA leadership on the status of the private sector, particularly on the amount of open grocers in each area and access to electronic transitions—all good indicators that the supply chain was surprisingly resilient.

Figure CS2-10. Food retailer status presented to the FCO on 10/22/2017



Source: FEMA

Ultimately, in response to the ambiguity about food, FEMA created a "Food Acquisition Index" to help assess the specific status in each one of the 78 municipalities and determine how much and where food needed to go on the island. Prior to this, "FEMA was operating under pressures from the media, political pressure, and the requests from the government of Puerto Rico—all at the detriment of the private sector," said Rob Glenn, FEMA's Director of Private Sector. The Food Availability Index is an example of trying to be smart by moving beyond government-to-government pull to understand what is happening in the whole community,

the real economy, the preexisting and—hopefully recovering or effectively adapting—demand and supply network.

As an effort to boost situational awareness specifically related to the food supply chain, however, the Food Acquisition Index failed to influence decisions made both in the field and especially in headquarters about FEMA's continued delivery of food—including both usable and unsuitable leftover food from Texas—as the supply chain was coming back online. While the BEOC undoubtedly had positive effects, its work did not link commonwealth and FEMA situational awareness or drive decision-making and the calibration of requirements with ongoing feedback loops.

The private sector has an important role in helping FEMA to build situational awareness. With a more complete picture of food supply chain systems reopening, the private sector could have greatly helped transition from FEMA's "push" model, which provides life-saving resources immediately following a disaster, back to the normal "pull" model where demand for goods drives supply and distribution decision-making.

Mr. Figueroa, the Emergency Management Director in Naranjito, said of the private sector in his municipality, "The private sector failed. They didn't have the generators or cisterns of water they needed. The local cafeteria only had a 200-gallon cistern that ran out of water in one day. They didn't have enough inventory. They thought they would be helped within three days, so they didn't maintain enough inventory to last any longer than three days." He noted one exception, "One bakery, Marina, surprised us. They had diesel, water, and a large inventory. They were open within 24 hours and lasted for seven days. They were the only business open for seven days."

PRELIMINARY CONCLUSIONS

The situation in Puerto Rico after Hurricane Maria was austere: information was sparse, communication was nearly impossible, and ambiguity prevailed. At the end of September, it appeared that very little was moving through the supply chain on the island. Within three days of Puerto Rico's request for 6 million meals per day, commercial movements of goods surged. Moreover, within three weeks, the local supply chain system was adapting to the situation and was able to provide commodities to local grocery stores. But FEMA's "free" goods and water were simultaneously flowing into the island. Eventually, the requirement for 6 million meals was recognized as too much and was reduced, but this could have occurred much sooner in the response if the information linkages were made.

A different approach to push/pull could have prevented the negative perception of the "free food and water" from the push of too many commodities, and alleviated the actual supply

chain issues caused by it. The push of food and water onto an island with limited transportation options, led to cascading impacts most readily witnessed at the port where the release of containers was backlogged. In addition, the local public sector developed a reactive narrative around food disruption that was inaccurate, but created a tension nonetheless. As a result, both levels of government struggled with their roles in the food mission, but their resources would have been better served focusing on facilitating transportation and fuel deliveries, which both proved to have broader, positive effects on lifesaving.

This case study was developed by the Institute for Public Research at CNA, a not-for-profit research organization that serves the public interest by providing in-depth analysis and result-oriented solutions to help government leaders choose the best course of action in setting policy and managing operations.

Additional case studies related to issues of Supply Chain Resilience emerging from the 2017 Hurricane Season are available at: www.cna.org/supplychainresilience

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