

Hurricane Maria's Impacts on Puerto Rican Farmers: Experience, Challenges, and Perceptions

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Background

2017's Hurricane Maria struck the United States unincorporated territory of Puerto Rico as a category 4 hurricane, causing 2,975 deaths [1]. The archipelago's agriculture, which was experiencing production improvement during Puerto Rico's financial crisis, was decimated [2]. Damages to production were estimated to reach approximately 200 million dollars, and 80% of its crop value was devastated [3]. Hurricanes in the Atlantic are likely to become more intense and persistent in the upcoming years due to climate change, which will have profound impacts in island countries and territories, especially in their agricultural systems and food security [4]. Thus, understanding how farmers prepare for and are affected by hurricanes, as well as what strategies they may use to increase their resiliency in the future, is critical for future adaptation. This research explores Puerto Rican farmers' experience with Hurricane Maria and climate change perceptions, and its relationship to farm management, food security, policies and sociodemographic factors. The objective of the present brief is to highlight key basic results, and provide an overview of our findings.

Data Collection

This research was carried out in collaboration with the Extension Service of the University of Puerto Rico at Mayagüez (UPRM). Ethics approval was obtained from the University of Vermont Institutional Review Board prior to research. A survey was developed and piloted with a small sample ($n=32$) of farmers between January and March 2018. Then, the survey was deployed by Extension agents of UPRM between May and June 2018 throughout Puerto Rico. A total of 405 farmers participated out of 440 surveyed for a response rate of 87.7%. Surveys were distributed according to the Extension Service's regions.

Key Descriptive Results

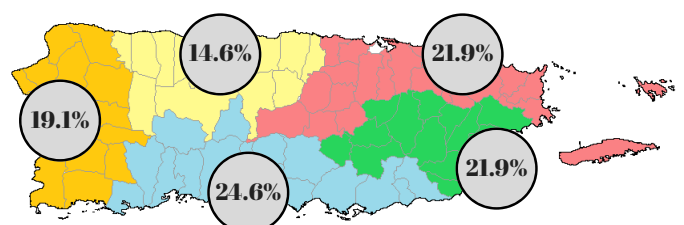
Farm and Farmer Characteristics

- 14% female and 86% male farmers, with an average age of 54 (SD: ± 13.5), participated in this research project.
- 52.8% of our respondents are participants of the *Bonafide* farmers program of the Puerto Rico Department of Agriculture, which provides several benefits and incentives to farmers who qualify.
- On average, farmers work 56 acres (SD: ± 96), and own 72.4% of the land they farm.
- 36.4% of respondents have an overall income less than \$20,000 a year, and 33.0% earn between \$20,000 and \$40,999 a year. On average, 58.7% of their income comes from farming.

Agricultural Production

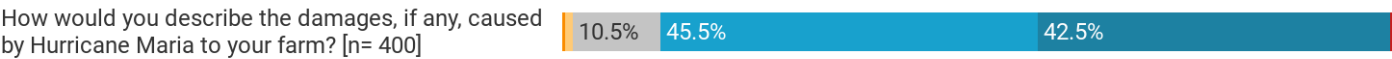
- In total, the top five agricultural products produced among respondents were: plantains (55.2%), sweet peppers (37.6%), aromatic herbs (30.8%), root vegetables (29.5%), and tropical squash (28.4%).
- Data suggests that farm diversity decreased after Hurricane Maria. Farmers produced an average of 3.15 (SD: ± 2.5) products before the hurricane, 2.20 products (SD: ± 2.0) at the time of the study (eight months after Maria), and indicated that in the upcoming three months they will produce on average 2.01 products (SD: ± 2.3).

Distribution of Respondents' Farms Among Extension Service's Regions



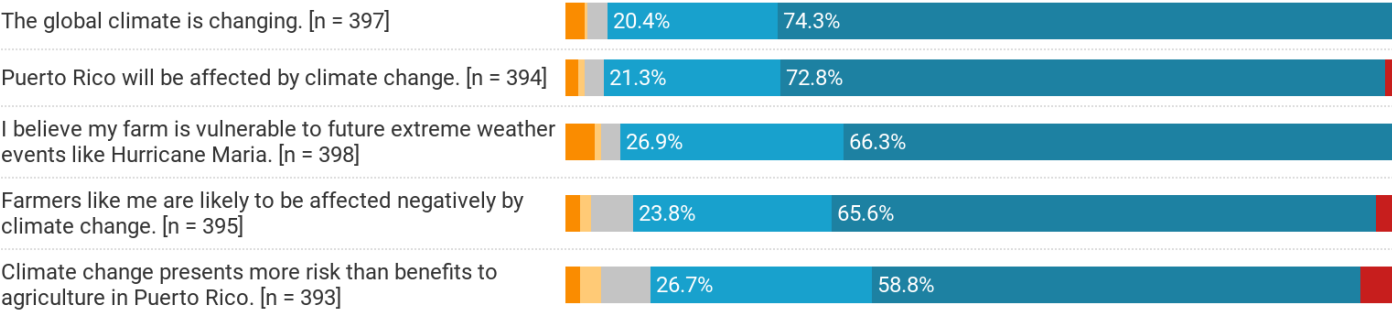
Farmers' Reported Damage

No Damages Insignificant damages Moderate damages Significant damages Total loss I don't know



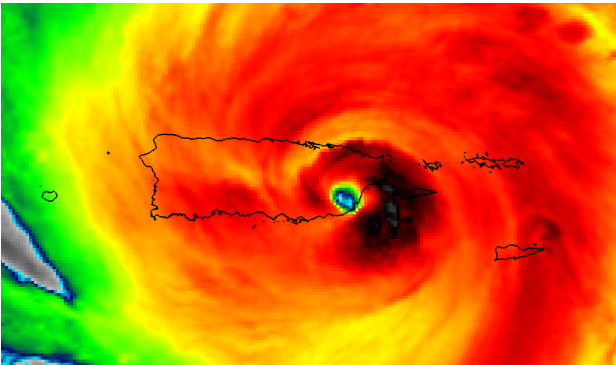
Farmers' Climate Change Perceptions

Strongly disagree Disagree Neutral Agree Strongly agree I don't know



Hurricane Maria

- The great majority of farmers had significant losses due to the hurricane. 42.5% reported a total loss, 45.5% significant damages, and 10.5% reported moderate damages. The top reported damages were to crops (77.6%), infrastructure (69.4%), and livestock (27.1%).
- 89.8% of our respondents faced at least one obstacle towards recovering from Hurricane Maria. The most common obstacles included:
 - 43.7% reported farm-related obstacles (e.g. infrastructure damages, lack of laborers, etc.)
 - 31.3% reported government-related obstacles (e.g. lack of aid/assistance, etc.).
 - 23.0% reported utility-related obstacles (e.g. no power, water).

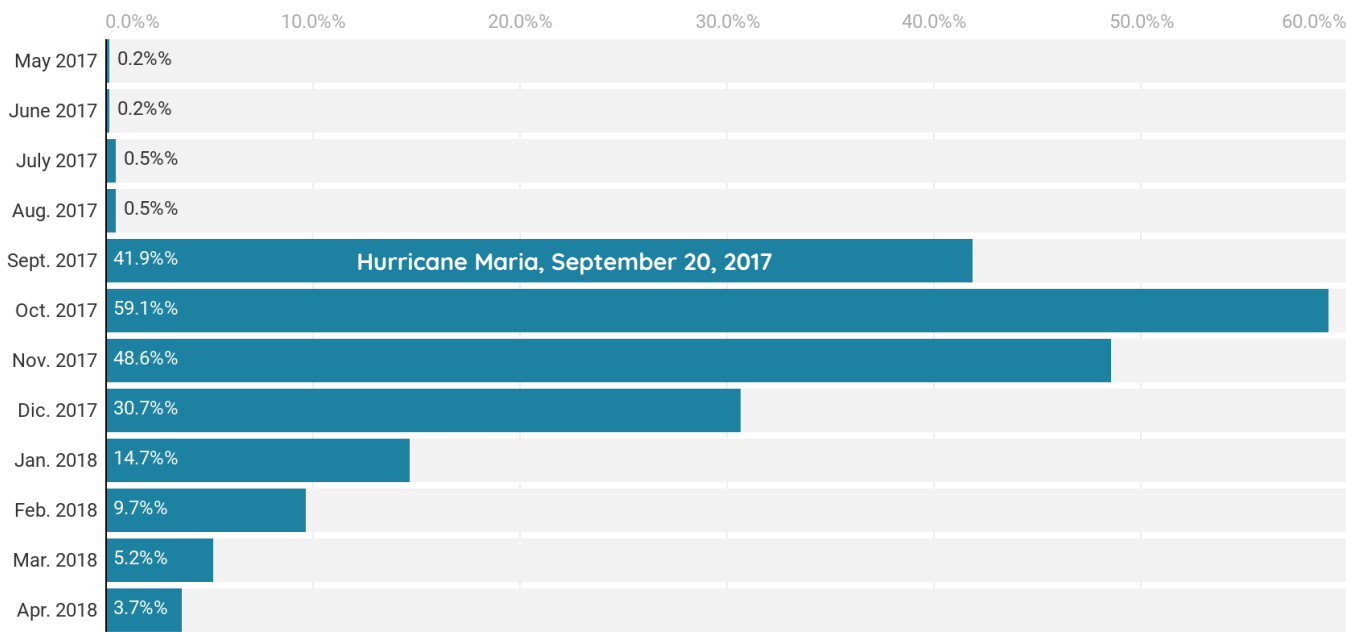


Hurricane Maria making landfall in Puerto Rico on September 20, 2017 (Source: NOAA, 2017)

Climate Change Perceptions

- Data suggest that Puerto Rican farmers are psychologically close to climate change. Meaning that they are aware of how vulnerable they are to impacts related to it (see graph above). 94.7% of our respondents agreed or strongly agreed (hereafter collectively “agreed”) that the global climate is changing, and 93.2% agreed that average global temperatures are increasing.
- 86.8% agreed that anthropogenic activities are a significant cause of climate change, and 94.4% of farmers agreed that the effects of climate change are being felt today. While 94.1% agreed that Puerto Rico will be affected by climate change, and 85.9% agreed with the statement that climate change will mostly affect places far away from Puerto Rico.
- 34.4% of farmers agreed that there is scientific uncertainty about climate change’s potential impacts to agriculture.
- 23.1% of the participants felt uncertain that the occurrence of strong hurricanes in the Atlantic is related to climate change.

Percentage of Farmers' Who Reported Food Insecurity by Month



Food Security

- Farmers were asked to report the months in which they faced a struggle to acquire food or a shortage of it. Data suggests that in the year before the survey, between May 2017 and April 2018, farmers faced an average of 2.15 months of food insecurity, with 70.1% reporting at least one month of food insecurity.
- Data indicates food insecurity increases are associated with Hurricane Maria. In the months prior to the hurricane, fewer than 1.0% of respondents reported being food insecure in any given month (see graph above).
- During and after Hurricane Maria, food insecurity rates increased significantly. 41.9% reported food insecurity in September, 59.1% in October, 48.6% in November, and 30.7% in December 2017.

Preparedness

- 93.2% agreed that their farms are vulnerable to future extreme weather events such as Maria.
- 75.6% of farmers feel that they have the capacity to modify their agricultural practices to prepare for potential future events like Hurricane Maria, and 82.9% feel motivated to do so.

- 66.6% of our respondents agreed that they prepared for Hurricane Maria
- 53.0% reported having insurance to cover their farms.

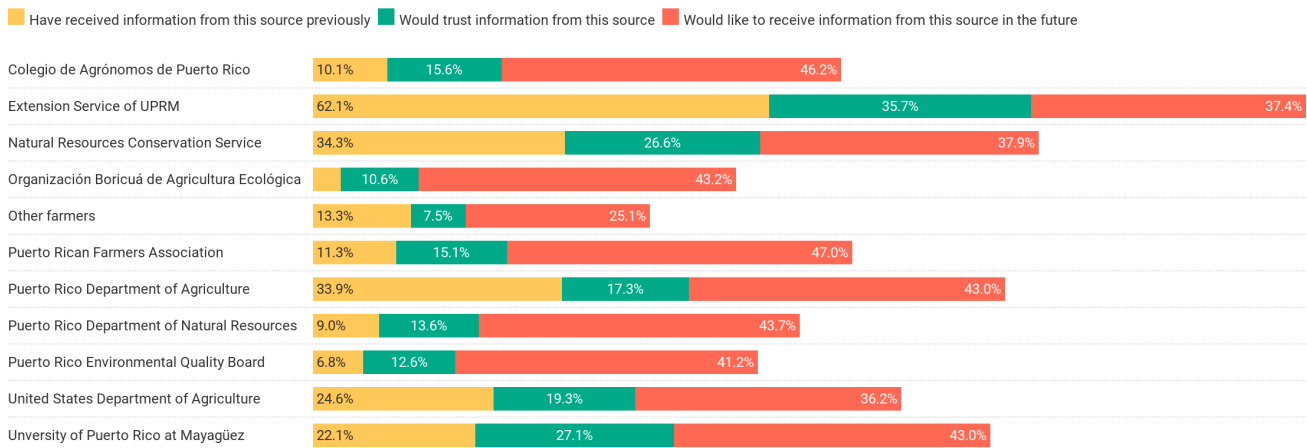
Current & Future Agricultural and Management Practices

- The most frequent agricultural practices currently in use by farmers are: Integrated disease management (24.4%), crop rotation (21.2%), and diversifying crops (19.6%).
- The agricultural/management practices that farmers indicated they would be very likely or likely to adopt in the near future are: Diversify crops (78.2%), integrated disease management (74.8%), and acquire insurance or improve the insurance plan they have (67.2%).

Public Policy

- 6.1% of participants agreed that the Puerto Rican government provides sufficient funds to help farmers prepare for extreme weather-related events.
- 13.5% agreed that Puerto Rico has the necessary policies to protect and support local agriculture, and 11.8% agreed that food imports in Puerto Rico are not an obstacle for local agriculture to increase its access to the Puerto Rican market.

Farmer's Informational Sources Regarding Climate Change Adaptation



Farmer Information Sources

- Farmers received climate-related information most frequently from Extension Services of UPRM (62.1%). Other sources include the Natural Resources Conservation Service (NRCS) (34.4%), the Department of Agriculture of Puerto Rico (33.9%), and the United States Department of Agriculture (USDA) (24.6%).
- Farmers indicated they would like to receive climate change information from a different set of organizations, including the Puerto Rican Association of Farmers (47.0%), *Colegio de Agrónomos de Puerto Rico* (46.2%), the Department of Natural Resources of Puerto Rico (43.7%), and *Organización Boricúa de Agricultura Ecológica* (a Puerto Rican agroecological organization) (43.2%).

Further Steps in our Analysis

Future research will explore the statistical relationship between drivers and barriers to adoption of adaptation practices, climate perceptions, hurricane resilience and food security outcomes. Furthermore, an analysis of the impacts' extent on specific agricultural sectors in Puerto Rico will be carried out. Future surveys are planned to continue to work with the UPRM Extension Service and these farmers over time.

This research will also contribute to a nascent body of literature focusing on how islands' agricultural systems can become more resilient and resistant to future and ongoing impacts related to climate change.

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Notes

[1] See: (1) Ascertainment of the Estimated Excess Mortality from Hurricane María in Puerto Rico (Project Report) by the Milken Institute of Public Health, The George Washington University.

[2] See: (1) Ingreso Bruto de la Agricultura de Puerto Rico 2014/2015, Departamento de Agricultura de Puerto Rico; and (2) Puerto Rico en un resurgimiento agrícola (El Nuevo Día, 2016).

[3] See: (1) Natural Resources Conservation Service, Caribbean Area (<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/pr/home/?cid=NRCSSEPRD1350825>); (2) Departamento de Agricultura de Puerto Rico (2017, 2018).

[4] See: (1) Small Islands (Nurse et al., 2014) in Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

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