The case for preserving agricultural land area in Puerto Rico and green-energy projects

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Puerto Rico presents an interesting case scenario for current and potential food production. After the 1950s, the island experienced a dramatic structural transformation from an agricultural to an industrial-based economy. The process involved population migration to cities and a gradual abandonment of agricultural lands in rural areas (Rudel et al., 2000; López et al., 2001; Martinuzzi et al., 2006). For example, in 1964 the agricultural land area was estimated at 1,595,866 acres and in 2018 at 474,332 acres (USDA-NASS, 2018) (Figure 1). This dramatic reduction amounts to an agricultural land-area loss of about 70% of that in 1964. In the last five years Puerto Rico lost 94,534 acres, part of which was associated with inventory loss due to Hurricanes Irma and María. The Puerto Rico *2015 Plan de Uso de Terrenos (2015 PUT)*[1], separated near 636,000 acres of land area for agricultural production. The current agricultural land-area inventory suggests that a major part of the agricultural land area that was identified and separated in the *2015 PUT* will now never be available.

At present, Puerto Rico has one of the highest land-area carrying capacities in the Caribbean with 3.4 people/ha-total area and 15.7 people/ha-agricultural land area (Table 1). The consistent decrease in agricultural land area in Puerto Rico has occurred as a result of urban expansion into agricultural areas, and agricultural land-area abandonment and reversion to secondary forests (López et al. 2001; Pares-Ramos et al. 2008; Yuan et al. 2017). Although potential working lands could reach as high as 42% of the land-area (Gould et al. 2017), current agricultural land area in Puerto Rico is 22% of the total land area (USDA-NASS, 2018). This proportion is lower than most countries with greater land area in the Caribbean and Central America, which have similar crops, flora, fauna, landscape characteristics and climate (Figure 2), and for the continental United States in general.

[1] 2015 Puerto Rico Land-Use Plan. Junta de Planificación de Puerto Rico. 2015. Reglamento conjunto para la evaluación y expedición de permisos relacionados al desarrollo y uso de terrenos. 1090 p.

Prior to 2017, Puerto Rico was estimated to import 80% of its food supply (Comas-Pagán, 2009) making its food security vulnerable to fluctuations in global food prices, shortages, climate phenomena and climate change. Puerto Rico's economic stability, food security and availability of fresh and quality products can be enhanced by maintaining or increasing land-area for agricultural production and by increasing agricultural productivity. Agricultural intensification through sustainable nutrient management practices can reduce the agricultural footprint and maintain ecologically sensitive areas (Cassman and Grassini, 2021). Preliminary work by Baez et al. (2021) demonstrates that Puerto Rico could easily be self-sufficient in selected commodities of major consumption. The agricultural sector in Puerto Rico has a very important role in the local economy, even with a gross agricultural income at the farm level estimated at near $900 M. Agriculture contributes to direct and indirect employment. Current estimates suggest that agricultural activities could support up to 50,000 jobs in the local economy. The Puerto Rico dependence on imported food supplies makes the island vulnerable to natural disasters and global economy market fluctuations and dependent on the US Government for food-aid transfers.

It is unknown the current land-area dedicated to green energy solar and wind projects. Estimates range from 2,100 to 4,200 acres of land area. Sotomayor-Ramírez et al. (2015) described the negative impact of wind-energy project in Santa Isabel municipality on high-valued agricultural land-area. Preliminary evidence suggests that there may be as many as 16 solar energy projects in the pipeline, projected to generate near 1,800 MW-AC (Siemens Industry, 2019). The agricultural land-area that could be directly impacted could be as much as 13,500 acres. Puerto Rico needs to achieve a greater proportion of energy generation on green energy and decrease dependence on fossil fuels. Yet, agricultural land-area cannot be sacrificed for green energy generation as this will further exacerbate Puerto Rico's dependence on imported food and aid transfers from the federal government, among other negative consequences.

Various studies recommend the siting of photovoltaic equipment on rooftops to provide the bulk of energy demand in Puerto Rico (Telos Energy, 2020; O'Neill-Carrillo et al. 2018; Mooney and Waechter, 2020). The advantages of on-site, rooftop solar or solar installations close to the point of use are many. They include the use of existing sprawling housing development and commercial rooftops to avoid further impacts to open spaces, agricultural land and ecologically sensitive areas. Rooftop solar eliminates the need for large investments in transmission infrastructure. It avoids transmission losses. Grid maintenance costs are reduced and impacts to tropical forests and vegetation as a result of tree cutting and pruning are minimized. The on-site solar alternative doesn't require establishing extensive easements or servitudes on private property while helping to lower temperatures within the structures and providing protection to the buildings. Rooftop solar installations add value to the structures and promote local wealth. Distributed renewable generation on rooftops creates greater reinvestment in the local economy than utility-scale projects. It enables ratepayers to become producers or 'prosumers' of energy.

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Figure 1. Trends in agricultural land area in Puerto Rico from 1964 to 2018. Source USDA-NASS.

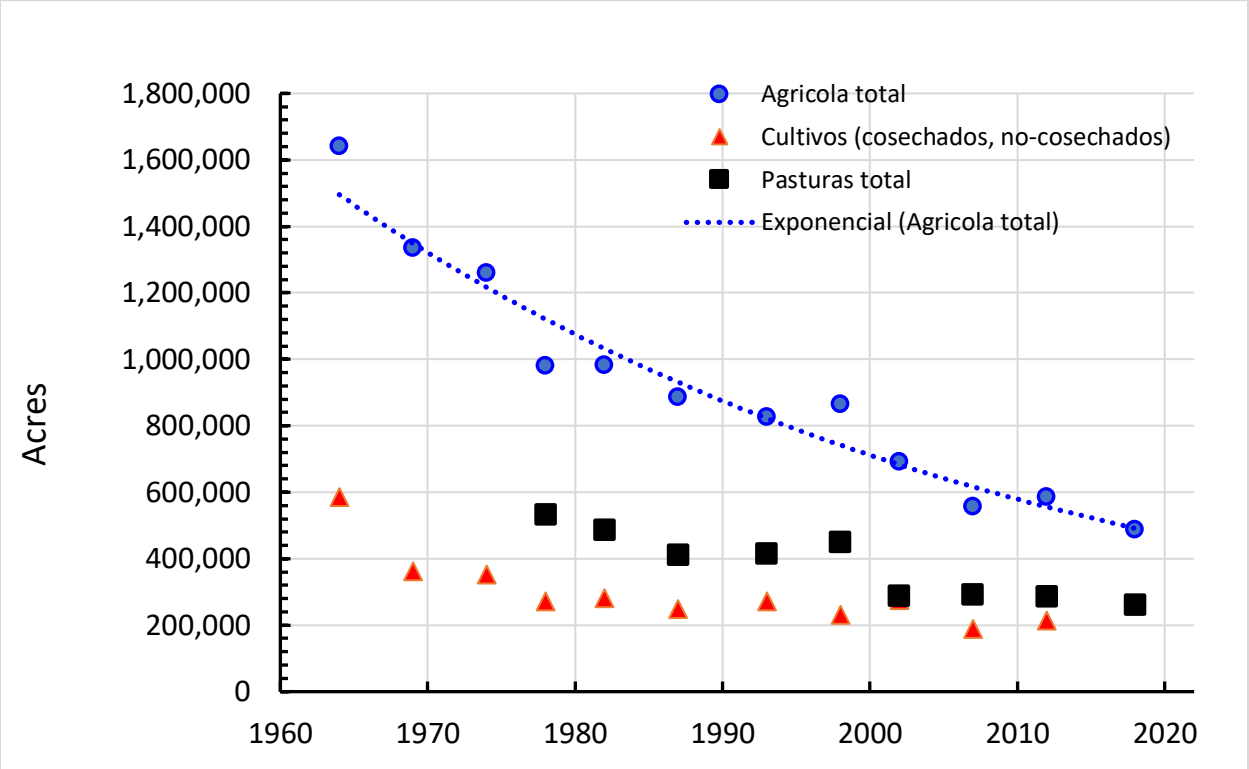

Table 1. Carrying capacity of major of Caribbean area countries with greater land area.

Country or territory	2018 Population	people/ha-total area	people/ha-total agric area
Cuba	11,338,134	1.1	1.8
Haiti	11,123,178	4.0	6.0
Dominican Republic	10,627,141	2.2	4.5
Puerto Rico	3,039,596	3.4	15.7
Jamaica	2,934,847	2.7	6.6
Trinidad and Tobago	1,389,843	2.7	25.7
Guadeloupe	399,848	2.4	7.7
Bahamas	385,637	0.4	27.5
Martinique	375,673	3.5	12.5
Barbados	286,641	6.7	28.7
Netherlands Antilles (former)	277,483	3.5	34.7
Saint Lucia	181,889	3.0	17.2
Grenada	111,454	3.3	13.9
Saint Vincent and the Grenadines	110,211	2.8	11.0

Figure 2. Total land area and land under agriculture, and proportional land area under agriculture and cropland in the ten Caribbean area countries with greatest land area.