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**Encouraging Adoption of Sustainable Agriculture**

About the size of New York state, Nicaragua is a sparsely inhabited country in Central America with a population of 6.2 million,<sup>1</sup> of which 59.3% is urban.<sup>2</sup> The country is a presidential republic with a Sandinista government under the leadership of Daniel Ortega, who has been in power since 2007.<sup>3</sup> Initially, Ortega's government's programs reduced poverty and led to high economic growth. Since the 2018 anti-government protests, the country has been plagued by political uncertainty.<sup>4</sup> Nicaragua's political turmoil, the effects of Covid, and the impact of Hurricanes Eta and Iota have led to a contracting economy.<sup>5</sup>

In Nicaragua, about 42.2% of the land is used for agriculture.<sup>6</sup> Agriculture accounts for 14.8% of the nation's GDP and employs 31% of the labor force.<sup>7</sup> The average farm size in Nicaragua is about 15 acres, while the average farm size in the US is 444 acres.<sup>8</sup> Although smallholder farmers own fewer than 8.6 acres, they grow 80% of basic grains.<sup>9</sup> Smallholder farmers produce 56% of the agricultural exports, including coffee, meat, peanuts, sugar, sesame, beans, and dairy products.<sup>10</sup>

The typical household has 4.9 people<sup>11</sup> and lives in one-story homes made of concrete-block or cement.<sup>12</sup> The typical diet consists of rice, beans, and corn tortillas. Cabbage salad, fried plantains, and yuca are consumed as side dishes.<sup>13</sup> Families get their food at the local markets called "pulperias." They commonly cook it in indoor wood stoves.

In Nicaragua, about 30% of the people work in agriculture, 15 % in industry, and 53% in services.<sup>14</sup> The average salary is about \$500 a month.<sup>15</sup> Education is free and mandatory through elementary school.<sup>16</sup> However, over 70% of Nicaraguan children drop out of school before they reach sixth grade.<sup>17</sup> Nearly 18% of the population is illiterate.<sup>18</sup> About 3.3 million people, or 58.3% of the population, are affected by poverty.<sup>19</sup> In rural areas, the number reaches 94%.<sup>20</sup>

Nicaragua's government runs the public health centers and clinics, which provide access to affordable medical care.<sup>21</sup> However, the rural populations are largely underserved. In the country, there are about 0.91 Physicians per 1000 people.<sup>22</sup> Rural areas have limited access to essential services and infrastructure such as water, electricity, communications, and paved roads.<sup>23</sup> This is more pronounced in vulnerable populations like indigenous and Afro-descendant communities.<sup>24</sup> However, the most impoverished families are often landless and headed by women.<sup>25</sup> About 17 percent of children under five suffer from chronic malnutrition, with the rate at nearly 30 percent in Nicaragua's Dry Corridor, a drought-prone area in the Northern Provinces.<sup>26</sup>

Conventional agriculture is responsible for a 7.7% rate of tree cover loss between 2001 and 2019.<sup>27</sup> This deforestation is primarily due to extensive livestock farming, the growth of African palm plantations, and sugarcane, which the government supports with tax breaks on agrochemical inputs, machinery, and exports.<sup>28</sup> Mining is also having an impact on pollution and forest loss.<sup>29</sup> Because the government has promoted mining and livestock, there is little political interest in protecting Nicaragua's forests.<sup>30</sup> Indigenous people who live in protected rainforest areas have been the most affected, losing their lands, forests, and livelihoods.<sup>31</sup>

Sustainable agriculture, which is mostly practiced by small and medium farms, was introduced to Nicaragua in the 1980s.<sup>32</sup> It involves practices such as intercropping, agroforestry, cover crops, and green

manure. Although the country enacted the Agroecological and Organic Production Law (765) in 2011, sending a strong message that it's embracing a sustainable agriculture legal framework, the government hasn't assigned a budget for agroecological initiatives<sup>33</sup> and has few incentives to adopt sustainable agriculture,<sup>34</sup> so there haven't been profound changes in the sector.<sup>35</sup>

The inadequate implementation of sustainable agriculture policies, along with political instability, economic contraction, lack of land rights, and limited access to funding, markets, education, and information, have hindered the adoption of sustainable agriculture. Constant extreme weather events have also hampered the transition.

With its tropical climate, Nicaragua is continually besieged by natural disasters, including hurricanes, floods, and droughts, which are setbacks in its development. It ranks 4th of 177 for countries most affected by extreme weather events worldwide.<sup>36</sup> In 2020, hurricanes Eta and Iota destroyed many crops and left thousands of people homeless and jobless.<sup>37</sup> A 2021 survey showed that around 15 percent of people were making plans to migrate because they couldn't make a living.<sup>38</sup>

To increase extreme weather resilience, wide-scale adoption of sustainable agriculture, is an urgent part of the solution to food security and nutrition. According to the World Bank, agricultural development is one of the most powerful tools to increase prosperity and food security. It has the most profound significant impact on the poorest sectors of society.<sup>39</sup> It found that investing in the agricultural sector is two to four times more effective in reducing poverty than a similar investment in another area.<sup>40</sup> A wide scale adoption of climate-smart agriculture would help meet the population's needs. Building food systems resilient to climate change restore soil fertility, capture carbon, clean the water, reforest the land, increase crop yields, incomes, resilience, and nutrition.<sup>41</sup>

In 2018 the Nicaraguan government requested an agricultural analysis from the Food and Agriculture Organization (FAO). The FAO found that investing in livestock, coffee, and basic grains would have the greatest impact on economic growth and poverty reduction.<sup>42</sup> The government seems to trust the FAO,<sup>43</sup> so the FAO would be the best organization to emphasize that adopting resilient food systems would help increase food security.

Nicaragua has had some successes with agro-ecology. The FAO, the International Center for Tropical Agriculture (CIAT), and local small-scale farmers developed the Quesungual agroforestry farming system, which considered the physical, social and economic conditions of the Dry Corridor to grow corn, beans and sorghum, vegetables and soybeans. Instead of slash and burn agriculture traditionally used in the area, farmers clear vegetation by hand, and crops are planted in between the trees. It has improved the soil, the yields have increased by 100%, and humidity levels in the Dry Corridor have increased 20%. The trees also decrease erosion and landslides.<sup>44</sup> However, only 40% of households in the community have adopted this method since the introduction of the practice 10 years ago. The project identified a lack of information as the reason adoption was not widespread.

With limited funds from the government, NGOs have been financing the majority of agroecological projects in Nicaragua.<sup>45</sup> Among the many NGOs present are the World Bank; the International Fund for Agricultural Development (IFAD) and the FAO. They are key to helping a significant number of people. Despite all the foreign aid, Nicaragua's land productivity is still the lowest in Central America, and it is 16% of Costa Rica's.<sup>46</sup> This highlights the many inefficiencies in productivity and the ample room for improvement.<sup>47</sup> Increasing intensification and optimization would lead to growth in the economy<sup>48</sup> and would mitigate climate risk.

One solution to wide-scale adoption of sustainable agriculture would be to find where the inefficiencies are and to optimize the resources available, taking into account the big picture: the governmental policies, the climate, the ecosystems, the culture, the pre-existing knowledge-base, the trading networks, the markets and prices of crops, the local needs and values, and the possible synergies. It would also involve examining the cost of trade-offs, cost and profitability analysis, and the roadblocks to adoption.<sup>49</sup> Taking

a participatory approach to the solution would help understand the hardships people experience and encourage ownership in the success of the projects.

The FAO in 2019 developed a Tool for Agroecology Performance, which they will be testing in Nicaragua in collaboration with many partners to quantify the progress farms have made transitioning to agroecology.<sup>50</sup> Because the FAO has the know-how to do systemic agricultural diagnostics, the FAO would be suited to lead a deeper analysis of the culture, the values and needs of the people, the markets, and synergies and integrate it into their framework to find the inefficiencies and to optimize agroecological activities. The FAO would outline the direction and variables of the highly localized research project. Then it would engage in a community sourcing model, allowing contribution and collaboration from the many local farmers and organizations, national and international NGOs, private enterprises, and the numerous universities worldwide doing research. Having this data would help NGOs to invest where the impacts will be most significant. The negative is that such a study is costly, it depends on collaboration, many of the data points are place-specific and might not be readily available.<sup>51</sup>

A second solution to wide-scale adoption of sustainable agriculture is to pay small-scale farmers for carbon credits. This would help address the need for funding in the adoption of sustainable agriculture. It is a win-win because industries can get the carbon credits, and small-scale farmers have a financial incentive to plant trees and make their farms more sustainable. In Nicaragua, a program is already in place through the CommuniTree Carbon Program. This project pays small-scale farmers to reforest under-utilized parts of their farms with native trees, which help the land capture moisture and combat drought. As part of the program, farmers receive payments of about \$2000 over ten years, adding up to 60% of the carbon credit price. Even though it sounds like a small sum, for farmers making \$2 a day, it is a large boost to their income.<sup>52</sup>

The trees are selectively harvested, producing timber that can be sold and diversifying farmer livelihood, giving farmers another income stream. Over 450 farmers have established forest plantations. The project, coordinated between local, Canadian, and Swiss non-profit organizations, is also developing a wood processing facility.<sup>53</sup> Catholic Relief Services has also partnered with CommuniTree and about 200 farmers.<sup>54</sup> CommuniTree is partnering to be part of one of Microsoft's carbon removal portfolios.<sup>55</sup> With approximately 300,000 small-scale farms in Nicaragua,<sup>56</sup> only a small fraction of farms are involved in carbon credits. Spreading the carbon-credit information to all the NGOs working in Nicaragua to encourage smallholder farmers to sell carbon credits to large corporations such as Microsoft would be a way to make this source of funding and reforestation more widespread. Some negatives are accessing the carbon market and the high cost of measuring the carbon capture and climate benefit.<sup>57</sup>

A third solution in adopting sustainable practices would be to encourage farmers to boost and diversify income streams and intensify land use by intercropping high-value crops such as turmeric, ginger, vanilla, cardamon, moringa, lemongrass, and hibiscus, which grow well in Nicaragua.<sup>58</sup> The intercropping with high-value crops would boost income and benefit the soil, the resilience, and the productivity of the farm. The negative is that establishing an intercropping program requires funds, seeds, training, and technical assistance.

Currently, most small farmers grow low-value crops and sell them at cheap prices to community cooperatives.<sup>59</sup> A fourth solution would be to establish community sourcing food hubs, where farmers bring multiple high and low value-crops and pool them together. These high-value non-perishable crops could be sold along with other staples, justifying transportation and logistics costs. These can be sold to groceries, wholesalers, and international customers. It is a practice that is gaining momentum with small and medium-sized farmers in the US.<sup>60</sup> Implementing this in Nicaragua would decrease logistics costs, increase incomes, and access to markets, and boost farmers' productivity.

Local and international organizations such as MAONIC, SwissAid, and USAid, could provide loans and training to local entrepreneurs to expand the cooperatives into processing and logistic centers to pull crops

together and then sell the larger quantities to local or international markets. These food hubs could also be a place to train farmers on better farming methods and sustainable agricultural practices. Establishing a food hub requires funds, training, and logistics.

The four solutions I propose are: analyzing inefficiencies and adopting a participatory approach, selling carbon credits to fund the transition, intercropping with high-value spices, and establishing community food hubs. These steps would facilitate the urgent adoption of sustainable agriculture in Nicaragua, and help increase food security and nutrition while mitigating the effects of climate change.

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