Article

Not peer-reviewed version

When the Sugar Runs Out: Transitioning Agricultural Systems and Their Effect on Dietary Diversity in Yaguajay, Central Cuba

Victoria Constanza Ramenzoni *, Vanessa Vázquez Sánchez, Diana Valdés Massó, Armando Rangel Rivero, Daily Yanetsy Borroto Escuela, Daniel Hoffman

Posted Date: 19 April 2023

doi: 10.20944/preprints202304.0573.v1

Keywords: sustainability transitions; diets; agroecology; food system resilience; climate change

Article

When the Sugar Runs Out: Transitioning Agricultural Systems and Their Effect on Dietary Diversity in Yaguajay, Central Cuba

Victoria C. Ramenzoni [1,*], Vanessa Vázquez Sánchez [2], Diana Valdés Massó [3], Armando Rangel Rivero [2], Daily Borroto Escuela [4] and Daniel Hoffman [1]

[1] Center for Childhood Nutrition Research, Rutgers University, New Brunswick, NJ; victoria.ramenzoni@rutgers.edu
[2] Museo Antropológico Montané, Universidad de La Habana, Cuba; vanevaz@fio.uh.cu
[3] Hospital Miguel Enríquez, La Habana, Cuba
[4] Caguanes National Park, Centro de Servicios Ambientales de Sancti Spíritus, CITMA, Cuba
* Correspondence: victoria.ramenzoni@rutgers.edu

Abstract: The past years have shown the widespread vulnerability of agro-food systems and rural diets to external perturbations such as wars, climate events, and pandemics. Experiencing numerous obstacles, Cuba constitutes an example of success in the transition to agroecological sustainability models. This article characterizes how processes of agricultural change, local development, and industrial degrowth have impacted food availability and dietary diversity among rural livelihoods in the municipality of Yaguajay, Sancti Spíritus, for the past forty years (1980s-2020s). It integrates findings from focus groups, repeated nutritional surveys, and interviews carried out between 2016 and 2022 among residents of the towns of Yaguajay and La Picadora. The goal is to identify effects and response strategies within agro-food systems of rural populations. Distinguishing between periods of abundance and shortage, our findings show two counterpoints: intensive sugar monocrop cultivation which resulted in high dietary variety; and economic crises in 1990s and during the last period of the pandemic, which have led to significant dietary adjustments. The article concludes underscoring the importance of comprehensive assessments of dietary strategies to elicit what agroecological transitions mean for local realities and of the value of food consumption and small-holder production experiences to understand the limits to sustainable transformations.

Keywords: sustainability transitions; diets; agroecology; food system resilience; climate change

1. Introduction

The year 2003 saw the closing of the last sugar mill in Yaguajay, Central Cuba. Once a lively municipality with over one third of its population directly employed by the sugar industry, the region was rapidly reconverted into ranching and different types of farming, including small-scale, organic, and commercial production [1–3]. This shift in agricultural practices was nothing short of revolutionary for thousands of households, which saw their livelihoods profoundly changing in under two years. Beyond a reconversion of the working force and the introduction of sustainable development programs in quick succession, local communities once again experienced instabilities and swings in dietary practices. The sugar productive conglomerate, locally known as "complejo agroindustrial azucarero" or *complejo*, was the primary and often unique source of income for many families. While changes in diets are an expected after-effect of any agricultural transition process, scarce attention has been paid in rural studies to the nature of dietary strategies among Cuban farmers. This is a surprising outcome for at least two different reasons.

First, in a developing nation such as Cuba, which has been signaled as an example to follow toward the adoption of agricultural sustainability models under strenuous political and economic circumstances, scarcity is frequently documented and recognized by the government as a direct result

of the long-standing embargo [4]. Lack of access to foreign markets has severely impaired the ability of the country to obtain key agricultural staples such as seeds, fertilizers, spare parts, and diesel that are crucial for self-sufficiency in the production sectors. As a result, Cubans have seen severe food shortages in the 1990s, and more presently, with events such as the Coronavirus 19 pandemic, the strengthening of sanctions by the Unites States government, and the loss of tourism. For example, retrospective studies of weight changes and morbidities from 1980 to early 2010s discovered an average loss of 4 to 5 kg across the adult population as an aftermath of the economic crisis that followed the dissolution of the Soviet Union in 1991 [5]. The reduction of foreign trade during the years 1991-1995, resulted in a 75% contraction of imports to the values of 1989. Agricultural production saw a decline of 47%. Decreases in the availability of fuel and food items inaugurated multiple cycles of inflation and led to 34, 6% dip in consumption at the household level [6]. In fact, Franco et al. showed that between 1988 and 1993 occurred a decrease of per capita daily energy intake from 2,899 to 1,863 calories. Other authors indicate that the impact was immediate and grave, with reduction in protein intakes between 37% and 42 % for the same period, and important deficits in vitamin B1 [6–8]. Simultaneously, the proportion of physical active adults increased from 30 to 67% [9]. Driven by the shortages in diesel, public transportation receded, with people relying on biking and walking for transport. Sustained weight losses and changes in activity levels in the 1990s were considered important factors explaining changes in the prevalence of diabetes and coronary pathologies towards the early 2000s. Most importantly, findings reflected a change in the composition of diets, suggesting a shift in nutritional strategies in the population. In comparison to 1980, diets at the beginning of the crisis showed a higher number of carbohydrates from sugar cane and rice, and reductions in the proportion of fat and protein, with a lower consumption of animal products [9]. In fact, to substitute the scarcity in animal protein the state instituted the rationing of 7 eggs and 2 pounds of fish per adult per month [6]. To many, these solutions remained insufficient. Thus, because of the 1990s, which is known as the "special period", food security emerged as an issue of concern for the revolutionary government [8].

Overall, and despite the many challenges, Cuba was able to recover its economy by early to mid 2000s. The country exhibited in 2009 a prevalence of population malnourishment well below 3% and no presence of severe or chronic child malnourishment, a fact that distinguishes the nation from other Latin America countries. Whereas diets have been described as meeting nutritional goals according to the United Nations, food practices show a low range in terms of consumption breadth and a reliance on private outlets to meet demand [10]. Given the large investment that Cuba has made on attaining alimentary sufficiency through numerous policies that center on food security such as the rationing and distribution of key food groups to its population at large, understanding the trade-offs and allocations that rural households have faced during economic and agricultural production transitions can shed important insights to public health and nutritional experts. This is a task that remains pending within rural populations in Cuba.

1.1. Dietary Studies and Agricultural Production in Cuba

A growing number of studies now exists on dietary trade-offs in urban centers such as Havana or within a national perspective [11–15]. Yet, only the latest 2010-2011 National Survey of Risks Factors and Prevention Activities of Non-Transmissible Diseases coordinated by the National Institute of Hygiene, Epidemiology, and Microbiology (*Instituto Nacional de Higiene, Epidemiología y Microbiología INHEM*), The National Bureau of Statistics (*Oficina Nacional de Estadísticas, ONE*), and the National Institute of Nutrition and Dietary Hygiene (*Instituto de Nutrición e Higiene de los Alimentos, INHA*) included rural populations (Vázquez Sánchez et al., 2018). More general comparisons at the regional level can be found for six clusters of provinces as outlined in the Ethnographic Atlas of Cuba compiled between 1980 and 1990. The document sought to assess the changes brought by the Revolution in the traditional dietary composition and habits of populations by contrasting two rural surveys, one from 1957 and another from 1988 [17]. Although rich in details, these works do not inform on the specific strategies that farmers rely upon to deal with periods of scarcity or increased availability. Strategies of households refer here to the deliberate planned actions

that seek to address changes in socioeconomic and environmental conditions that endanger the domestic unit's survival [11,18]. Thus, we rely on this notion to capture those practices that are adopted to procure resources during times of crises and to secure the reproduction of the family [19,20].

Second, over the past few years the urgency to foment societal transformations that can support economic, social, and ecological sustainability in food production practices has become dire [21,22]. Within calls for change, agricultural production systems which are responsible for a third of total greenhouse gas emissions [23,24] have been at the center of discussions [25,26]. Modifications in agricultural techniques involving as land use, fertilization, and crop selection, have been proposed to increase the amount of carbon stored on soil and vegetation. Organic agriculture and agroecological practices, which do not rely on industrial pesticides or agrochemicals and employs small-scale farming strategies such as crop rotation and minimum soil tillage, have been found to have a stronger potential for climate change mitigation when compared to conventional cultivation methods [27–29]. However, organic production can result in lower yields per hectare for some crops, creating the need for extensive land use to meet agricultural demand [30,31]. It can also increase production costs and, ultimately, consumer prices as it is more labor intensive than conventional farming.

Underscoring a wide range of socioeconomic concerns associated with organic agriculture that include certification and market dynamics, scholars have explored the benefits and intricacies of organic production systems [32,33]. Cuba has been one of the preferred case-studies as the country was forced into transitioning its agricultural production to organic farming [4,34,35]. With the decline of the Soviet bloc in the early 1990s, the island lost access to export markets for placing its primary commodity: sugar and derived products. Most significantly, Cuba was no longer able to procure key utilities such as chemical fertilizer, animal feed components, and technology that were needed to support its large-scale agricultural sector. This transition is heralded as successful in terms of social, ecological, and economic standards and it is captured by sustainability indicators such as the Human Dimension Index or the Sustainable Society Index [36]. To some, Cuba has become as "an antidote to the hyper-commercialized and industrial food systems of the Global North" [37]. The crucial element behind this positive shift is the mix of strong institutional and policy frameworks that continue to scaffold Cuban development priorities and strategies [38,39].

A more nuanced view of the agricultural sector, however, illuminates other dimensions of the transition that can be lost in broad-scale policy analysis [40,41]. For example, even when the country embraced organic regimes to an unprecedented historical extent, the growth in smallholder farming, peri-urban and urban agriculture, and the state sponsored production cooperatives was not without obstacles [42,43]. The process of decentralization was gradual and seemingly disruptive of former practices, requiring extensive participation of social movements and actors such as universities, and the spearheading of a grassroots approach to development [37,44,45]. In addition, the transformation of the agricultural system only seems to have gained traction after the deactivation of the sugar monocrop industry in the early 2000s [35,46]. As sugar factories were shut down and the island lost access to food imports from other Socialist countries, a large section of the population reverted to small-scale farming and ranching as a way of sustenance. The shifting from technological agriculture to sustainable production reflected a new reality: lack of mechanization and industrial inputs, scarcity in oil, decreasing imports of food items, and no access to financial markets. Rather than a choice, for agricultural workers the transition to an organic and agroecological practices was of necessity [4]. Smallholder farms, however, only expanded after the introduction and incentivization of usufruct policies that transferred state-idled lands to private individuals and cooperatives in 2008 [2]. In 2013, about 70.8% or 4,5 million hectares of Cuba's arable land were in the hands of non-state parties, with roughly half of it under cultivation [47]. By 2016-2017, the percentage of land under non-state tutelage increased to 80%, 49 % of which represented three types of cooperatives (*Unidades Básica de Producción or UBPC; Créditos y Servicios*, or *CCS*; and *Producción Agropecuaria* or *CPA*), and 29% individuals under usufruct [48]. The process of political transformation of the agricultural system continues with

 doi:10.20944/preprints202304.0573.v1

significant steps made in 2012 and 2019 as a result of the new Cuban constitution, and more recently, the coronavirus 19 pandemic [49].

Presently, the largest producer of foodstuffs is to be found family-based agriculture [50], suggesting the need to explore this sector further to assess food security. Unfortunately, rural household experiences and decisions among Cuban farmers are not often documented in the academic literature [but see 37,51]. A small number of studies have looked at smallholder properties in Sancti Spíritus, the province where the current research takes place [1,50]. Machado and Fernandez, and Moon et al. have also generally characterized some of the challenges seen in La Picadora, one of the communities focused on our long-term research program [37,52,53]. None of these works, however, have delved into the complexity behind household dietary trade-offs, a shortcoming that reflects the paucity of data in terms of rural nutrition beyond state publications and the national 2010-2011 census of Risk Factors, and the challenges of conducting long-term fieldwork. These challenges have but increased in the past year, with impacts of the Ukrainian invasion and the ongoing U.S. treasury embargo producing dire shortages of food and commodities and high prices [54]. Scarcity and the loss of the tourism industry, the main source of revenue for the state, has once again forced thousands to migrate in record numbers [55,56].

In this article, we aim to investigate the impacts of recent agricultural transformations in food availability, dietary composition, and labor activities within two different population clusters: La Picadora, a rural farming community, and a group of urban fishermen from the town of Yaguajay, in Central Cuba. Part of a transdisciplinary approach including ecologists, social scientists, and biological anthropologists, we rely on longitudinal data collected between 2016 and 2022 to interpret previous findings with more recent information. To that end, the article describes the main dietary conditions, trade-offs, and challenges experienced by households of an ongoing agroecological transition that began in the early 1990s. We focus on this region due to its former importance in agricultural and industrial sugarcane production, its distance from major urban centers such as Santa Clara or Havana, and its high level of reliance on manual labor for subsistence.

2. Materials and Methods

2.1. Study Site

The rural community of La Picadora is in the municipality of Yaguajay, province of Sancti Spíritus, Central Cuba. Comprising about 80 households (215 people), up until the early 2000s most inhabitants worked in the three sugar mills and a fertilizer plant, with only a small fraction of the population completely devoted to small-scale agriculture. Presently, the community relies primordially on farming, ranching, and tourism as sources of employment. Like elsewhere in Cuba, there are different modalities that organize agricultural production in La Picadora including CCS, CPA, and the UBPC. There are also private smallholders which do not take part in any of the cooperatives. Despite some farmers concentrating on a particular crop such as sorghum for large scale production, each household grows a set of diverse cultigens including tubers and root vegetables (boniato, malanga, and yuca), grains (maize, rice, beans, and coffee), fruit trees (papaya, guayaba, mango, avocado, and bananas), and produce (garlic, onions, cucumbers, squash, tomatoes, carrots, and green leafy vegetables). An agricultural calendar, which has seen important alterations due to climate related events such as drought, flooding, hurricanes, and changes in average temperatures, loosely systematizes activities. The recent pandemic did not affect farming operations and sanitary provisions such as social distancing was followed.

The town of Yaguajay is about 20 kilometers northwest of the community of La Picadora and is located in proximity to coastal lagoons and shallow bays. Its inhabitants are predominantly employed in services and in agricultural tasks. Unlike La Picadora, households also rely on artisanal fishing as a complementary source of sustenance. There is an association that congregates about 47 active fishers which operate in nearshore areas out of Playa Vitoria, Yaguajay's docking pier, and occasionally beyond the nearshore cays. The level of dependence on fishing varies, with only a

 doi:10.20944/preprints202304.0573.v1

handful of individuals fully dedicated to commercial fishing activities and most of the sample self-defined as opportunistic fishers.

Over the past forty years, the towns of La Picadora and Yaguajay, have been at the center of rapid agricultural change. Because the majority of residents in both communities, participated in large-scale sugarcane industry, they were equally vulnerable to agricultural policies that regulated production and suffered major transformations in their way of living. In the next subsections, impacts from two agricultural transitions are identified at the domestic level. Complemented by historical sources, interviews and focus group discussions provide direct evidence of the effect of these transitions in diets and activities.

2.1. Data Collection Methods

Part of a larger project seeking to explore rural adaptation in rapidly changing environments, this study was designed to compare the communities of La Picadora and Yaguajay to observe variation in dietary and energetic patterns among different households given the diversity of occupations. The research team includes researchers from Montané Anthropological Museum at Universidad de La Habana, Caguanes National Park, and Rutgers University. Ongoing activities began in 2016 and were interrupted during 2017 due to the passage of hurricane Irma which brought significant damage [57]. While research was reestablished in 2018, the Coronavirus 19 pandemic restricted travel to the region between 2020 and 2021.

The article complements previous findings reported elsewhere [16,58–60] with new information obtained through informal interviews, additional surveys, and 2 focus groups conducted in 2022 (see Table 1 for detail). Repeated nutritional surveys, carried out initially in 2017 and 2018, and then in 2022, sought to assess diet composition among both populations and across time. The survey tool accompanied anthropometric measurements (not reported here) and was designed after the questionnaire used by the former Cuban National Institute of Nutrition and Dietary Hygiene (*INHA*). The adapted instrument considers weekly consumption patterns of seven basic food groups (grain and tubers; vegetables; fruits; animal protein, meats, and beans; dairy; fats or other sources of fat; and sugars). Other two modules within the instrument included the assessment of food frequency consumption for the past week for breakfast, lunch, afternoon, and dinner, and ways of preparing, consuming, and storing food as well as cultural practices such as parties and food sharing. In the first implementation in 2017, a total of 19 male farmers and 14 male fishers participated in the survey. In March 2018, following the passage of Hurricane Irma in 2017, 28 individuals from the previous dietary survey repeated the nutritional assessment and participated in a reduced form of IPAQ, the International Physical Activity Questionnaire. In the third implementation in 2022, questionnaires were administered only among 16 male farmers from the previous sample. Finally, in 2022, focus groups (n: 5) and interviews (n: 25) sought to explore issues related to environmental change, extreme events exposure and impacts, agricultural activities and fishing, dietary availability; and, more recently, dietary changes, the nature of physical activities, and labor. Findings informed the development of more precise instruments to assess energetics. In November 2022, an expanded sample of 40 rural workers participated in a physical activity 48-hour recall and wore accelerometers to measure energetic expenditure. These results will be discussed in future publications. In this manuscript, we focus on findings from discussions, interviews, and dietary and activity surveys from 2016 to 2022.

Following responsible research practices and ethical protocols from Universidad de La Habana, consent was requested before survey administration and to participate in discussions, interviews, and anthropometric or energetic measurements. When possible, discussions and interviews were recorded. Each group discussion had a duration of approximately 75 minutes and took place in the town hall of La Picadora or in the offices of Caguanes National Park in Yaguajay. Interviews lasted anywhere from 10 to 60 minutes. All recorded exchanges were later transcribed and analyzed with NVivo 12. Survey data on diets and 48-hour activity recalls were analyzed with factorial, parametric, and non-parametric statistical techniques.

 doi:10.20944/preprints202304.0573.v1

Table 1. Detail of research activities.

Activity	Year	Sample Size	Themes	Location
Interviews (exploratory)	2016	7	Fisheries and agricultural work	La Picadora and Yaguajay
I. Focus Group Discussion	2017	15	Climate change, environmental threats, agricultural calendar	La Picadora
II. Focus Group Discussion	2017	15	Climate change, environmental threats, fishing calendar	Yaguajay
Nutritional Surveys	2017	33	Dietary composition and frequency; anthropometry.	La Picadora (19) and Yaguajay (14)
Interviews	2018	7	Extreme events (post hurricane impacts in fishing and agriculture)	La Picadora and Yaguajay
III. Focus Group Discussion	2018	21	Extreme events (post hurricane impacts in fishing)	Yaguajay
Physical Activity Survey (IPAQ)	2018	28	Labor intensity post hurricane, anthropometry.	La Picadora (18) and Yaguajay (10)
Interviews	2022	11	Extreme events recovery	Yaguajay
Nutritional Surveys	2022	16	Dietary composition and frequency, anthropometry.	La Picadora
IV. Focus Group Discussion	2022	8	Dietary change and physical labor	La Picadora
V. Focus Group Discussion	2022	8	Extreme events, environmental impacts, agricultural and fishing changes	La Picadora
48-hour Activity Recall Surveys and Energetic expenditure measurements[1]	2022	40	Activity recall 48 hours, physical activity measurement with accelerometers	La Picadora

[1] Not presented in this article.

3. Results

Reflecting a mix of Spanish, African, and Caribbean influences, the composition of rural Cuban diets shows a relative low level of variation in terms of ingredients and types of preparation [61]. The revolution, while creating important changes in consumption of items such as tasajo, dried salted beef or fish, and introducing other less common items such as yogurt or butter, did not essentially alter the character of traditional cuisine [17,62]. As a result, daily meals in rural areas such as Yaguajay are predominantly characterized by rice, black beans, and pork, the latter when available, which are complemented with a small portion of *viandas*, including tubers, root vegetables, and green beans, and salad. The most important meals are breakfast, lunch, and dinner, with occasional snacks in the afternoon.

Access to foodstuffs is mostly determined by seasonality and income as well as the existence of family plots, gardens, and/or livestock. In La Picadora, most households have a long history of farming along with lime production and timber extraction. Sharing and exchanges of food items are

 doi:10.20944/preprints202304.0573.v1

very common among neighbors and extended family members. As of recent, there is a farmer's market that has begun operating by the side of the main municipal road on Saturdays. In Yaguajay, on the other hand, respondents do not necessarily consider themselves as farmers, but as salaried workers with different occupations. Food is usually obtained from the local state-run markets or stores, from the local *organopónicos* or urban organic farms, by the cultivation of home gardens, or through bartering. As it is the case for all Cubans, the state guarantees access to basic foods through a ration program known as "la libreta" [40]. Depending on age, each Cuban citizen can get essential food items at subsidized prices in monthly or even bi-monthly installments. Items include rice, sugar, bread, beans, and some sort of animal protein such as eggs, chicken, or fish. Rich protein foodstuffs such as milk, meat, and eggs are also provided to individuals who require special diets due to medical conditions. The list of foods subsidized has, however, decreased over time along with the quantities that can be purchased [53]. Availability of certain products is also tied to general macroeconomic conditions and general demand, making some of the items in la *libreta* virtually inexistent. In fact, many respondents mentioned that the quantities that are guaranteed through the system barely meet the needs of a family over a ten-day period, and that products like fish have not been available for years. It is no surprise, then, that the sharing and exchange of foods has such an important role in both communities. Discussions about the availability of certain foods or their scarcity are elements of normal conversation, with respondents often narrating the difficulties and obstacles they must surmount in their search for food [51,53]. The situation has deteriorated further in the past year with the war in Ukraine and the continuous pressure of the blockade creating shortages in items like oil and flour, animal protein, and dairy [54]. Unfortunately, environmental factors tied to climate change and extreme events are also posing significant challenges to the nutrition of rural households. In addition to an increase in the frequency of tropical storms and episodes of salinity intrusion, farmers must contend with extended drought, higher temperatures, and floods, which have resulted in the loss of crops, fruit trees, and cattle [40,59]. Depending on age, each Cuban citizen can get essential food items at subsidized prices in monthly or even bi-monthly installments. Items include rice, sugar, bread, beans, and some sort of animal protein such as eggs, chicken, or fish. Rich protein foodstuffs such as milk, meat, and eggs are also provided to individuals who require special diets due to medical conditions. The list of foods subsidized has, however, decreased over time along with the quantities that can be purchased [53]. Availability of certain products is also tied to general macroeconomic conditions and general demand, making some of the items in la *libreta* virtually inexistent. In fact, many respondents mentioned that the quantities that are guaranteed through the system barely meet the needs of a family over a ten-day period, and that products like fish have not been available for years. It is no surprise, then, that the sharing and exchange of foods has such an important role in both communities. Discussions about the availability of certain foods or their scarcity are elements of normal conversation, with respondents often narrating the difficulties and obstacles they must surmount in their search for food [51,53]. The situation has deteriorated further in the past year with the war in Ukraine and the continuous pressure of the blockade creating shortages in items like oil and flour, animal protein, and dairy [54]. Unfortunately, environmental factors tied to climate change and extreme events are also posing significant challenges to the nutrition of rural households. In addition to an increase in the frequency of tropical storms and episodes of salinity intrusion, farmers must contend with extended drought, higher temperatures, and floods, which have resulted in the loss of crops, fruit trees, and cattle [59].

3.1. Diets in Transition

Interviews and conversations allowed us to reconstruct two major moments or transitions in the implementation of agricultural programs. The first transition comprises sugar monocrop intensification and state centralization and occurred from the late 1970s to early 1990s. During this period the region saw an expansion and mechanization of its three complejos azucareros Obdulio Morales (known as Narcisa), Aracelio Iglesias (Nela) and Simón Bolívar (Vitoria). Along with industrialization, the area experienced losses in agricultural diversity and deforestation. In the 1980s, hydrological changes and the drainage of the final residual swamp forests extended cane fields to the

 doi:10.20944/preprints202304.0573.v1

line of coast. The second transition began in the 1990s with the Third Agrarian Reform that led to the decentralization and diversification of agricultural practices [43]. The process decanted in the dismantling of sugar mills in the early 2000s and the expansion of agroecological and local development models in the municipality [63,64]. As a result, a highly qualified working force of more than 3,000 engineers, mechanics, and specialists along with the permanent agrarian workers who tended to the sugar plantations lost their jobs [65]. Whereas a large proportion of those unemployed turned to agriculture, close to one quarter of the working-age population found employment in the tourism sector [66]. To facilitate the finding of alternative means of subsistence, the Cuban state maintained average salaries for up to six or seven years after the closing of the mills incentivizing education at all levels. The process of reorganization of sugar production was known as "Tarea Álvaro Reynoso". Former sugar workers completed their elementary or high school diplomas and became lawyers, accountants, technicians, teachers, and agricultural engineers. Once the Álvaro Reynoso program came to an end, many found employment in agriculture. Old sugar cane fields were turned into rangelands and cooperatives were established to organize production. Furthermore, access to higher education created an outflow of migration of the available and now highly qualified working force to other provinces. New jobs in tourism and migration contributed negatively to the ageing group of agricultural smallholders in Yaguajay who continued to produce essential foodstuffs for the district. Nowadays, La Picadora produces a myriad of different crops including rice, beans, produce, tubers, and coffee and seasonal vegetables such as tomatoes, lettuce, carrots, and onions.

Matching the two agricultural transitions outlined above, interviewees and focus group participants from both locations made a clear distinction in the quality of dietary diversity between the time during which complejos ran agricultural production in the district before the fall of the Soviet Union, and what followed to the closing of the mills in the mid 2000s and the incentivization of usufruct in non-cultivated state lands. They also recognize episodes of scarcity brought about the 1990s economic crisis and the changes introduced by the adoption of agroecological policies. More recently, interviews mentioned food shortages because of climate related factors such as hydrological drought, flooding, and hurricanes.

3.1.1. Periodization of Agricultural Transitions and Dietary Oscillations

1. Diets and labor before 1989/1990

The period that followed the revolution, and specifically, the 1980s were described by interviewees as a time of bounty. The USSR provided an extensive market for sugar, financing the transformation of the sector into a modern agrotechnical industry. As part of these technological exchanges with socialist countries such as Bulgaria, Czechoslovakia, and Mongolia, Cubans received items ranging from fridges, engines, and cars, to canned fruits and meats. The island provided in return sugar, citric products, and nickel, along with non-skilled and qualified workers and medical professionals. Thus, it was not unusual to find Cubans working in Eastern Germany and Czechoslovakia or touring Moscow, Hungary, and Bulgaria as part of cultural programs. During these years, sugar factories in Yaguajay, were complex conglomerates that included, beyond extensive cane fields, living quarters, mechanical workshops, and agricultural and ranching lands. This was termed a "distrito cañero" and referred to the agglomeration of population settlements with industrial buildings. Workers were divided into different teams according to their tasks and received a salary and incentives. This type of organization of production activities was not unique to the municipality, it was also replicated with some minor adjustments in other provinces.

As part of an arrangement with the groups of labor known as "centros de trabajo", the workers had arduous days of planting, tending, harvesting, transporting, and processing cane. The central had its own food production groups known as "brigadas de autoconsumo" (self-sufficiency brigades) responsible for farming, processing, and the obtainment of the necessary food for all employees. The central also provided access to workers to what was known as the "cuota cañera", a big sac of products that included a rice, canned products, rum, cigars, and even soap that operated as an incentive and allowed households to buy subsidized foods at a marginal price. In fact, some of the respondents described the sac as "una salvajada", an excess of items that were shared beyond close

family, friends, and neighbors. As a result of exchanges and their work in the sugar sector, rural households became acquainted with the famous Russian meat, a can of boiled beef which sometimes included pork or ham, along with sardines and anchovies, black bread, borscht, candied peaches, lichi, boiled vegetables, and milk from local producers. In some cases, the *cuota* was calculated to last for the most intensive periods of labor such as the harvest. However, because the availability and variability of products was determined by foreign trade relations, there was a list of more common items that were locally consumed and could not be bought through the program such as tubers, vegetable roots, or butter. In those cases, households exchanged products, bartered, or purchased desired foodstuff in informal markets. Respondents also mentioned that during agricultural labor they received breakfast, lunch, and snacks. The food in the fields was very good and reflected what was available at the time. The tradition of cultivating sugar introduced an important habit among farmers and salaried workers: the consumption of sugar in all diverse variants such as *guarapo* (sugarcane juice), molasses, and even stalks from the plant. The stalks, which were frequently chewed while conducting field labor, left a permanent imprint in the form of tooth decay and wear. Among interviewees, for example, 75% of farmers mentioned that they had regularly consumed sugarcane stalks throughout their childhood and as adults. Some of them also recalled the habit of skinning the stick of cane with their teeth ("pelar la caña con los dientes"), which explains observed dental deterioration. In all, rural households had several sources or means to access low-price foodstuffs: through small scale production or barter, through the national ration system, by purchasing independently in state markets, and the cuota cañera. As a farmer indicated, "se comía bien… uno trabajaba mucho pero siempre había… se vivía como ricos" (they lived like wealthy people, work was hard but there was always food, they ate well).

2. The Special Period (1990-1999)

The year 1989 marks the beginning of change in diets, with canned goods replaced by fresh meat and produce when available. This period lasted until 1991 when the crisis deepened and access to foodstuffs became arduous. Items such as milk, chicken, beef, and oil completely disappeared from local bodegas, also known as state stores [67]. The *cuota cañera* shrank and other rationing systems considerably reduced their inventory and the proportion subsidized to a handful of products. Despite challenges, farmers and sugar industry workers found alternative strategies to survive. After a long shift in the central, many reverted to agricultural labor extending crops and planting surfaces. They began cultivating in the little land that could be found around their houses, in gardens and former wastelands. They bartered and sold whatever excess they produced in informal markets. Clothes and goods were also traded, long-term storage facilities built, and food processing and conservation techniques such as preserves were improved. Some ventured into manufacturing their own laundry and toiletry products. Other strategies among farming households included poli-cultivation and crop diversification, the planting of short-term crops, the joining of production cooperatives, the cultivation of animal fodder, and the participation in agricultural fairs. Not surprisingly, the implementation of strategies depended on access to land among other resources. As one of the respondents indicated, despite adversity they still managed to eat. The days of past bounty seemed like they never happened.

In the meantime, in late 1992 and 1993 the state introduced a process of reorganization of the sugar industry into smaller farms or UBPCs (*Unidades Básicas de Producción Cooperativa*), representing about ten to 15% of the original extension [68]. In this new form, farms oversaw managing production through the liberalization of the ownership of agricultural means, with exception of the land [69]. The UBPC had now the tasks of securing total production goals as well as attaining self-sufficiency in food, implementing agroecological techniques, and of growing a wider variety of seasonal crops [70]. A similar process of de-statization of livestock production was introduced in former *rancherias* and dairy centers, which now became small farms holding ten to 60 cows, or 1.2 to 2 cattle per hectare. The decline in productivity experienced in those years meant a decrease of almost 60% in total crops. With scarcity endangering the health of the population, thousands of dairy cows were re-directed to slaughter. Almost half of all grasslands in the island were covered by invasive species like *marabú* (Dichrostachys cinerea) and the average daily production of liters of milk per cow fell from 6.1 in

1990 to 3.1 in 1992 [69], a value that has not yet improved according to respondents. To recover the sector, more attention was paid to the generation of alternative production inputs such as organic pesticides and fodder, along with a revitalization of *organopónicos* or urban farms. However, as some respondents indicated, the solutions that were implemented were to a large extent of a centralized nature and disregarded local particularities.

For example, some of the variants that self-sufficiency brigades were responsible for growing in *complejos*, did not match dietary habits. As a result, produce was sent elsewhere or left to rot. It would take several more years before the country was able to bounce back to production levels modestly approaching those of the late 1980s. In this light, the record crop of tubers in 1999 indicated the change in agricultural varieties [68]. Progressively, as the situation improved and with the deactivation of the industrial conglomerates, rural households began applying for newly available agricultural parcels. Access to land was recognized by respondents as a key buffer to scarcity, allowing for the cultivation of staples that could be traded for essential items. Simultaneously, the country invested significant effort in developing the tourism and services sector in a bid to increase the inflow of foreign capital and currency [71]. Changes affected the municipality when the neighboring province of Villa María opened an international tourism hub in the early 2000s that offered salaried jobs.

As it was noted, the special period had a remarked effect on women which were historically those responsible for household nutrition [67,72]. In urban areas such as Havana or Santiago, the need for resources led many to open *paladares*, small restaurants which are increasingly ran by women. In addition, women began preparing and selling snacks on the street or in their houses, working as vendors going door-to-door and trading key foodstuffs, or even commercializing the "bolsa Negra", a gathering of items bought directly from state workers at discounted prices [51,73]. According to interviewees and accounts from the literature, this return to the domestic sphere of production remained to a large extent informal. Shortages in electricity and scarcity of petrol and kerosene resulted also in prolonged domestic tasks [74]. Women had to rely on timber or wood, coal, and diesel to cook. As water pumps stopped working, women had to contend with obtaining clean water for preparing foods, drinking, bathing, laundry, and cleaning. The absence of common ingredients, or the shutting down of state-sponsored diners, cantinas for workers, and cafeterias in schools, also created stressors for household heads who had to devise inventive ways of coming together with a complete meal. In the countryside, while options for alternative employment were much limited and tourism virtually inexistent, women had access to gardens and orchards that helped provide for family needs. Beyond food, lack of goods extended to hygiene and cleaning products, linens and clothes, shoes, sanitary towels, toothpaste, and domestic appliances.

To meet these needs, households became creative. For instance, lemon juice was used for toiletries and shampoo. Support among neighbors and friends allowed households to cook together, exchange items such as coffee for beans or rice for medication, or even collaborate in production activities. The high level of solidarity in agricultural labor distinguishes La Picadora from other towns in the region [64,75]. In fact, many respondents mentioned the importance of working together and helping each other beyond the formed cooperatives as a key factor in overcoming challenges. Considering these arrangements, during this time participants alluded to the high prices of foods which made any purchase in markets almost prohibitive. Local networks of neighbors and family would constantly share information regarding the availability of products in local stores or among other households to facilitate access. Beyond the search for better prices, in private domestic settings strategies also included the careful planning and reallocation of resources to primary needs such as food, the prioritization of the nutrition of elderly, children, and sick, the skipping or reduction in portions in meals, and the fixing of wardrobe items and shoes.

3. Post-Sugar Monocrop (2000s-2020).

In the early 2000s when activities from the sugar industry largely ended, the municipality put forth a strategy to achieve nutritional self-sufficiency, boost agricultural production, and expand forestry programs. New plans were launched to develop the dairy industry which included the introduction of water buffaloes along with traditional livestock. The strategy sought to increase production of fruits and vegetables in about one third in comparison to the previous years, with other

 doi:10.20944/preprints202304.0573.v1

staples like rice and grain crops expected to grow between 4 and 5% [76]. As a result, three state-run *empresas* were created with 9 cooperatives specifically focused on agriculture and livestock (CPAs) and 21 UBPCs also concentrated in food production. Infrastructure was built to optimize pig rearing as a source of animal protein, and smaller farms were dedicated to poultry. The Cuban Food Ministry also incentivized freshwater aquaculture providing support for species like Claria (Claridaee family) and Tilapia (Cichlidae family) to be grown in dikes and ponds throughout the province. Finally, the community of La Picadora developed an agrotourism business in 2015 that houses foreign tourists on a regular basis. Most households participate in the effort by providing services such as cooking or sharing agricultural resources to support the visitors. Earnings are shared equally [37,60].

In terms of dietary diversity, our surveys from 2017 showed that ingestion of rice occurred among farming households every day (see Table 2). Bread and crackers were consumed by approximately 80% of the sample daily, and *viandas* by 60% of respondents. Close to 40% households made use of other vegetables such as spinach or lettuce, and 42% also consumed fruits. These figures are roughly similar among fishing households in Yaguajay, which reported a higher use of vegetables and fruits. However, differences arose when observing the sources of animal protein in both diets. Only 33,3 % of fishing households consumed pork between two to three times a week. Comparatively, among farmers, the proportion was 81,2% for pork in the same frequency, with 50% of the sample also consuming chicken and processed meats twice or three times weekly. The latter was rarely consumed among fishing households. On the other hand, fish was seldom eaten in La Picadora. Yet, close to 82% of the households in Yaguajay relied on fish at least once a week, with 31% of homes consuming this food daily. Eggs were also used daily in preparations by 47% farming households and 36% fishing households. There was also a relatively higher consumption of dairy, about twice the amount, for products such as milk and cheese among respondents in Yaguajay. In addition, fishing households relied on vegetable fat, while farmers on animal fat in their preparations. The whole sample exhibited a high ingestion of sugary drinks like sodas on a daily frequency.

In all, despite the higher use of marine and coastal products, fishing household diets captured a mix of traditional rural cuisine. For example, the preferred food for parties and special events continued to be pork both slow-roasted or in different kinds of preparations such as fricassee; in conjunction with a small portion of raw vegetables, boiled yucca with a garlic and vinegar dressing, and *congris* (the mix of black beans and rice). Regarding cooking techniques, vegetables and *viandas* tended to be consumed raw or boiled. Like pork and different meats, fish were fried, baked, or roasted. There was also consumption of highly processed meats such as sausages or croquettes, which can also be made of chicken and fish. The availability of these kinds of preparations varied depending on what is sold at the state *Acopio* store or available through the market. The same is to be said for flour-based products such as bread and crackers.

4. Post-Sugar Monocrop (2000s-2020).

Nowadays, as elsewhere in the island, rural households are experiencing food shortages. Despite government efforts, agricultural and aquaculture outputs remain insufficient to meet local needs and imports have dwindled [77–79]. During recent conversations, farmers discussed the low level of milk productivity that is reported among livestock, and shortages in the availability of animal protein, flour, and grain. While international sanctions continue to severely limit access to global markets, some of the difficulties affecting the agricultural sector in the long run are to be found in the interaction of low government investment, anthropogenic degradation, and climate related pressures such as extreme events and prolonged droughts. Heat stress, water scarcity, and hurricanes have particularly affected cattle, fruit trees, and rice [57,59]. Over the next century, the region is expected to experience significant losses in hydrological resources [80,81], which may aggravate the current economic situation.

In comparison to 2017, our repeated survey from 2022 (see Table 3) elicited some potential modifications in diets in La Picadora reflecting the new conditions. Preliminary findings show overall decreases in the frequency of consumption of a total of fifteen food items, including pork, meat derived products and entrails, eggs, dairy, maize, sweets, and flour-based products, such as bread, pasta, and crackers. This finding matches what was reported during conversations in focus groups

 doi:10.20944/preprints202304.0573.v1

and interviews. A decrease in the use of vegetables and an increase in the daily consumption of fruits was mentioned by participants and is also observed partially in the dataset. Probably, the most important finding is the significant decline in the consumption of pork and its partial replacement by chicken and/or fish. The decline in pork is also seen as an increase in the use of animal and vegetable fat, showing processes of substitution as well as changes in frequency of previously marginally employed items such as fish. Consequently, whereas decreases in foodstuffs dominate findings, increments in the use of *viandas* including produce and tubers and processed meats are also observed. As it was indicated in the case of fruits and chicken, they are now consumed with a higher weekly frequency which may indicate processes of replacement of more expensive foods. To sum up, while in 2017 the most frequently used items included grain and pork, in 2022 the composition of meals changed to grain and chicken along with other less popular foodstuffs. The replacement of what are seen as culturally important items like pork by lesser valuable ones is done out of necessity and is perceived as negative by interviewees.

According to respondents, the observed dietary changes are not just explained by preferences or environmental stressors, but by the domestic economic situation, the deacceleration in tourism visits due to the pandemic, financial volatility, and by the lack of access to foodstuffs in general. In fact, a reduction in alimentary imports and mounting economic deficit produced by low export levels [82] may account for the diminished consumption of dairy products such as powdered milk, deserts, and milk-based puddings, and store-bought foods such as sugary drinks, cookies, and sweets as shown in the survey. It is important to observe that respondents compared the special period to present days, with current conditions being described as a bit worse than in the past ("estamos más apretados", we are more pressed). Despite difficulties, some rural households were still able to maintain a traditional "Cuban" diet including pork two or three days of the week. Such finding is not necessarily surprising given the relatively low variation in foodstuffs that characterize this cuisine and the high level of internalization that certain ingredients have in culinary practices. As a positive note, the continuation of the traditional rural cuisine that is to a large extent homogeneous across the Cuban provinces provides mechanisms to implement nutritional programs in a cost-effective and uniform way [83]. On the other hand, persistence of this traditional "Cuban" diet may suggest the thesis that this constitutes a population with high levels of consumption of sugars and carbohydrates when animal protein availability decreases. Without government support and protection of key foodstuffs like milk in ration programs, the country may place below recommended standards for dairy or micronutrient ingestion. Continuous research is needed to evaluate this hypothesis and the role of what is known as the "Cuban" cuisine in undermining new alternative dishes and preparations.

Overall, we observe that current strategies, the set of deliberate actions seeking to maintain the family unit during times of stress, vary according to access to land, foreign currency, collective work and participation in cooperative groups, and the partaking in state-funded ration systems beyond la *libreta*. Most actions are centered around securing the necessary resources to meet household needs, but also may involve issues related to improving living conditions such as housing. In terms of food, the search for better and more economical prices for subsistence items predominates, with values much lower in the countryside or in rural areas. The ability to trade and barter has become essential, which explains the more recent opening of an agricultural market in La Picadora.

Table 2. Diet comparison between residents of La Picadora and Yaguajay in 2017 (values in percentages).

Yaguajay (N: 14 fishing households)	**Never**	0	21	0	7	0	7	0	0	64	0	43	7	21	57	0	0	29	43	21	0	29	14	0
	Rarely	0	43	14	43	7	7	21	15	36	21	21	7	57	29	14	0	0	21	21	0	36	7	0
	1 Wk	0	21	7	29	7	0	0	23	0	14	29	7	14	14	0	0	0	7	7	7	0	7	0
	2/3 Wk	0	7	0	21	36	29	14	38	0	50	7	21	7	0	36	0	0	7	21	7	0	29	14
	4/5 Wk	0	0	0	0	7	14	7	8	0	0	0	29	0	0	14	7	7	0	0	0	0	14	21
	Daily	100	7	79	0	43	43	57	15	0	14	0	29	0	0	36	93	64	21	29	86	36	29	64
La Picadora (N: 19 farming households)	**Never**	0	21	0	0	0	5	0	0	68	5	16	16	84	32	0	0	42	26	21	42	5	5	16
	Rarely	0	37	5	21	0	16	5	0	26	0	11	58	16	21	0	0	5	5	11	0	5	11	5
	1 Wk	0	5	0	32	6	11	5	5	0	37	21	21	0	32	5	0	5	5	5	5	0	21	0
	2/3 Wk	0	32	0	42	11	21	11	74	5	42	42	0	0	11	26	5	5	32	42	21	5	16	0

doi:10.20944/preprints202304.0573.v1

	4/5 Wk	0	0	11	0	22	5	37	21	0	16	11	5	0	5	21	5	11	11	11	11	11	11	5.5
	Daily	100	5	84	5	61	42	42	0	0	0	0	0	0	0	47	89	32	21	11	21	74	37	68
	Item	Rice	Maize	Bread	Pasta	Vianda	Vegetables	Fruits	Pork	Rabbit	Chicken	Processed Meat	Fish	Shellfish	Entrails/Viscera	Eggs	Grains/Beans	Milk	Yogurt	Cheese	Vegetable Fat	Animal Fat	Sweets/cakes	Sodas/Drinks
	Food Group	Group 1				Group 2		Group 3	Group 4									Group 5			Group 6		Group 7	

Table 3. Diet comparison between 2017 and 2022 among farming households in La Picadora (values in percentages).

La Picadora (N: 16 farming household	**Never**	0	29	13	6.2	0	6.2	0	6.2	100	6.2	13	25	94	56	6.2	0	56	31	19	0	6.2	38	56.2
	Rarely	0	21	0	44	6.2	25	19	25	0	6.2	19	31	6.2	38	0	0	6.2	25	25	0	6.2	0	12.5
	1 Wk	0	14	0	25	0	19	6.2	25	0	6.2	38	31	0	6.2	0	0	0	13	19	0	0	0	12.5
	2/3 Wk	0	36	6.2	19	13	25	19	44	0	69	31	13	0	0	50	6.2	13	19	25	0	0	31	18.8

doi:10.20944/preprints202304.0573.v1

ds) 2022	**4/5 Wk**	0	0	6.2	6.2	6.2	6.2	0	0	0	13	0	0	0	0	25	0	0	0	13	0	0	25	0
	Daily	100	0	75	0	75	19	56	0	0	0	0	0	0	0	19	94	25	13	0	100	88	6.2	0
La Picadora (N: 19 farming households) 2017	**Never**	0	25	0	0	0	6.2	0	0	75	6.2	19	19	94	38	0	0	44	31	25	44	6.2	6.2	18.8
	Rarely	0	38	6.2	19	0	19	6.2	0	19	0	13	56	6.2	19	0	0	6.2	6.2	6.2	0	6.2	6.2	0
	1 Wk	0	6.2	0	31	6.7	13	6.2	6.2	0	21	13	25	0	31	6.2	0	6.2	6.2	0	6.2	0	19	6.2
	2/3 Wk	0	31	0	44	13	19	6.2	81	6.2	50	50	0	0	13	31	6.2	6.2	31	50	25	6.2	19	0
	4/5 Wk	0	0	13	0	27	6.2	38	13	0	13	6.2	0	0	0	19	0	13	6.2	13	6.2	6.2	6.2	6.2
	Daily	100	0	81	6.2	53	38	44	4.5	0	0	0	0	0	0	44	94	25	19	6.2	19	75	44	68
	Item	Rice	Maize	Bread	Pasta	Vianda	Vegetables	Fruits	Pork	Rabbit	Chicken	Processed Meat	Fish	Shellfish	Entrails/Viscera	Eggs	Grains/Beans	Milk	Yogurt	Cheese	Vegetable Fat	Animal Fat	Sweets/cakes	Sodas/Drinks

doi:10.20944/preprints202304.0573.v1

Food Group	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	

doi:10.20944/preprints202304.0573.v1

 doi:10.20944/preprints202304.0573.v1

4. Discussion

The article presents a detailed exploration of rural diets among two clusters of residents (farmers and fishers) in two communities of Yaguajay, Sancti Spíritus, Cuba. Analysis of interviews, focus groups, surveys, and additional historical sources indicate that rural communities in central Cuba have undergone two different transitions in the adoption of agroecological practices. The first period comprises sugar monocrop intensification and state centralization (1970s to early 1990s), while the second transition began in the 1990s with decentralization and diversification of agricultural practices. As a result of these changes and a forbidding economic blockade, households have suffered different instances of nutritional vulnerability. To improve conditions, the Cuban state has responded through numerous policies that have fostered industrial degrowth in the sugar sector and have scaffolded the expansion of an organic agricultural and ranching system through education and rural development. Yet, it is in the nature of self-constituted cooperatives, small-holder state support, and social reciprocity that coping and adaptation strategies are to be found. As suggested by cultural studies of food and dietary practices, familiarity with how local actors may access, produce, and exchange food stuffs can provide essential knowledge on the inner workings of societies, creating avenues for intervention [84]. Most importantly, within the Cuban context such information can help elicit limitations or shortcomings in state-driven agroecological policies. As many insular Caribbean countries are engaging with climate resilient development frameworks, rural coping strategies adopted in Cuba can also shed light on the need to adopt precautionary or mitigating measures that can increase the success of proposed adaptations [85]. To that end, in this section we analyze the diversity of tactics adopted and what they mean in terms of reforming a traditional agricultural production system into a sustainable sector.

Beginning as early as the 1600s, sugar cultivation has constituted one of the most important economic undertakings in Yaguajay. Also known as a livestock producing region, sugar monocrops came to dominate all agricultural activities after the revolution, with long-standing influences on dietary habits and culinary practices. Whereas conditions were highly satisfactory in the 1980s according to interviews, political and economic crises largely compromised households' sufficiency in the 1990s. The triumph of the revolution in attaining better living conditions, including major housing and health programs for all Cubans, was tested for the first time by widespread shortages. Memories of the challenges and strategies that households adopted in the early 1990s remain very much present among interviewees. For example, some of the actions discussed included the careful planning and reallocation of resources to meet essential needs, the prioritization of vulnerable population sectors, meals reduction or skipping, collective work practices, and information sharing. The economic crisis led the government to the adoption of agroecological solutions, with some recoveries observed towards the end of the twentieth century.

After sugar mills and other industrial centers were discontinued in the early 2000s, the population of Yaguajay began to feel additional economic pressures that led to the reintroduction of small-scale diversified agriculture, house gardens, ranching and livestock practices, and tourism. Changes in production in the mid 2000s and 2010s had additional consequences for dietary habits, with increases in the use of green leafy vegetables, seasonal crops, and fish in comparison to the traditional cuisine. These modifications are shown in the first 2017 survey. More recent instabilities brought in by hydrological drought, extreme events, the coronavirus pandemic, and the war have also led to significant alterations in consumption patterns, with decreases in the use of pork and the introduction of dietary substitutions.

In all, nutritional oscillations in the past four decades speak of the challenges faced by rural households. Most importantly, dietary changes paint a picture of how processes of agroecological transitions rely heavily on individual ingenuity and flexibility to achieve success. The abilities of small actors, such as household heads, work groups, and cooperative leaders to adjust or to innovate under uncertain conditions are in this specific case supporting and accommodating major transformations. To some extent, the Cuban state has been able to recognize the significance of empowering these smaller actors through educational policies and extension activities. However,

state support has not been enough to buffer some of the costs associated with agroecological models that may require substantial changes in the productive sector. In conjunction with economic and financial barriers that limit options, high levels of precarity have compounded perceptions of insecurity among rural homes as interviews elucidate.

As an illustration of the increasing importance of individual actors, the type of strategies adopted during the special period and more recently suggest the progressive involvement of household members in income generating activities independent from state employment. The ability to juggle between different sources of money allows some households to improve the likelihood of meeting their needs, however, it is subjected to both external and internal factors beyond control. In the first case, macroeconomic conditions and state policies can create very unstable configurations that difficult access to foods. For example, the reduced variety of imports in the context of rationing, with fixed schedules and distribution stores, result paradoxically in unpredictable timing and locations for the supply of eclectic items. In the municipality of Yaguajay we observed during the weekend, long queues on gas station stores not just to buy gas but also to purchase chicken or a handful of other products at best such as beer or diapers. While items trickle down through the distribution chain like a broken faucet, as some respondents voiced, the ability to prepare a full meal depends on long distance travel and money. Referenced by Moon et al., economic pressures critically shape access as well as consumption patterns in La Picadora [53]. Despite individual or cultural preferences, and continuous efforts at procuring a "decent meal", farmers eat what is available indicating that subjective appreciations are subordinate to concrete productive realities. And even when agricultural production may dictate what is available, other needs may cause households to forfeit consumption of desirable items to address more pressing needs related to economic contraction and isolation from the world market. Thus, in a municipality that has been devoted to agricultural and livestock production for at least five centuries, some of the common shortages include pork meat, eggs, butter, oil, and flour along with locally grown items such as boniato.

In addition to identified strategies, findings regarding the persistence of the Cuban cuisine mirror what other researchers have discovered elsewhere in the island [11,13,51]. The rationing system, which provides citizens with subsidized foods according to what is available at the time, has helped in the long run to homogenize cuisines, ultimately weakening local food production systems with a higher variety [51,53]. This is captured in our interviews and conversations with household members from La Picadora describing the need to consume non-traditional products such as fish croquettes, instead of chicharrones and roasted pork, as a negative experience. It also signals an interesting byproduct of the special period, where culinary preferences and local cultural identities associated with food reemerged after two decades of revolutionary policies that sought the standardization of alimentary practices [72].

Discussed among respondents, the decline in dietary diversity that is experienced now is probably felt more keenly in urban centers where agricultural cultivation is limited in its capacity (urban gardens are reduced to .25 hectares per person) to offset scarcity. Despite repeated efforts by the Cuban government to implement nutritional substitution policies and liberalize non-commercial imports of foods and medication [49,86,87], in early August 2022 it was estimated that close to 80% of the food consumed in the island was imported [88]. This ranks Cuba as the second largest importer behind Panama, a position of high vulnerability to price fluctuations and disruptions in logistics and transport [54]. Recent analyses have suggested that shortages and high prices are the result of a stale underdeveloped food production system that cannot provide for all [89]. The current loss of revenues associated with weakened tourism due to the pandemic restriction also underscores important limitations in the Cuban industrial system and provides a glimpse of the structural crisis permeating agricultural production [89]. The concentrated focus on service industries and construction to the detriment of agriculture and manufacture capacities—between 2017 and 2021 state investment in agriculture was a mere 2,8%, when hotel and real state received 50% of the budget—has contributed to both food insecurity and scarcity [90]. Most importantly, it has aggravated the energetic crisis that has affected mechanized labor in the municipality. With frequent blackouts and interruptions in the flow of electricity that last between 6 to 8 hours per day, farmers have increasingly relied on animal

traction for agricultural labor. In this same light, many have observed a worrisome inflation trend throughout Latin America, and specially in Cuba, that endangers nutritional health among lower income households [91]. The slow recovery perceived in labor markets and the economic degrowth experienced due to the Coronavirus pandemic interact with food insecurity to create the conditions for migration [55]. Compounded with this situation is an aging population that has very limited access to foreign capital [46,68], and must rely on manual labor to meet essential needs.

As this case study seeks to illustrate, comprehensive mixed methods assessments of dietary strategies are key tools to elicit the local realities of agroecological transitions. Experiences of food consumption and production, oscillations in food sufficiency, and nutritional vulnerability among rural households are clear examples of how challenges in adopting sustainable transformation models may evolve over time in a process of fits and starts. It is important that climate resilient development programs consider the dynamic nature in which adaptation decisions are made, and how many of these coping strategies are not only a result of perturbations but are the foundation in which transformational change happens [92–94]. Unpacking the decisions made at the smallest scale of production, comprehending the trade-offs and limitations that the most vulnerable experience in the struggle to make a living in a damaged planet, is an essential task in designing an inclusive future [85].

5. Conclusions

Distinguishing between periods of abundance and shortage, our findings show two counterpoints: 1) a wider variety of dietary options available during intensive sugar monocrop cultivation and, 2) food scarcity experienced during the early 1990s, and more recently, during the last period of the pandemic, which has resulted in nutritional and activity adjustments. Comprehensive assessments of dietary strategies are key to elicit what agroecological transitions mean for local realities and the value of experiences of food consumption and production to better understand the limits to sustainable transformation models.

Author Contributions: Conceptualization, V.C.R., V.V.S. and D.H.; methodology, V.C.R. and V.V.S.; formal analysis, V.V.S. and D.V.M..; investigation, V.C.R., V.V.S., D.V.M., D.B.E. and A.R.R..; resources, V.C.R., V.V.S.; writing—original draft preparation, V.C.R.; writing—review and editing, V.C.R., V.V.S., D.V.M., A.R.R., D.B.E. and D.H.; visualization, V.C.R.; supervision, V.C.R., V.V.S. and D.H.; project administration, V.C.R., V.V.S.; funding acquisition, V.C.R. and D.H. All authors have read and agreed to the published version of the manuscript.

Funding: This research was partially funded by Rutgers University Global Programs, Gaia Global Grant, including data collection and APC.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and following Universidad de La Habana ethical and research approval processes.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.
Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy concerns.

Acknowledgments: We want to thank community leaders from La Picadora and Caguanes National Park for their support in conducting the research.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

References

1. Domínguez González, A.Z.; Torres Martínez, M.; Puerta de Armas, Y.G. *Experiencias En La Protección de La Biodiversidad y El Desarrollo Sostenible En La Provincia de Sancti Spíritus*; Ministerio de Ciencia, Tecnología y Medio Ambiente: La Habana, 2012; ISBN 978-959-287-033-8.
2. Nova González, A. *El modelo agrícola y los Lineamientos de la Política Económica y Social en Cuba*; Nuevo Milenio, 2020; ISBN 978-959-06-1948-9.

3. Ramenzoni, V.C. Co-Governance, Transregional Maritime Conventions, and Indigenous Customary Practices Among Subsistence Fishermen in Ende, Indonesia. *Front. Mar. Sci.* **2021**, *8*, 1011, doi:10.3389/fmars.2021.668586.
4. Rudel, T.K. Cuba: Agro-Ecological Farming After the Soviet Collapse. In *Shocks, States, and Sustainability*; Oxford University Press, 2019; pp. 91–112 ISBN 978-0-19-092101-9.
5. Franco, M.; Bilal, U.; Orduñez, P.; Benet, M.; Morejón, A.; Caballero, B.; Kennelly, J.F.; Cooper, R.S. Population-Wide Weight Loss and Regain in Relation to Diabetes Burden and Cardiovascular Mortality in Cuba 1980-2010: Repeated Cross Sectional Surveys and Ecological Comparison of Secular Trends. *BMJ* **2013**, *346*, f1515, doi:10.1136/bmj.f1515.
6. López Gonzalez, M.E.L. A 30 años del Periodo Especial en Cuba y las enseñanzas de la historia - Intervención y Coyuntura 2020.
7. Álvarez, A.G.; Cruz, B.A. El Modelo Agropecuario y Su Vínculo Con El Acceso a Los Alimentos: La Experiencia Cubana (1959–2019). *Int. J. Cuban Stud.* **2020**, doi:10.13169/intejcubastud.12.1.0076.
8. Nayeri, K. Book Review: Sustainable Agriculture and Resistance: Transforming Food Production in Cuba Fernando Funes, Luis García, Martin Bourque, Nilda Pérez, and Peter Rosset; Oakland, CA: Food First Books, 2002, 307 Pp., $18.95 (Paperback). DOI: 10.1177/0486613407305320 Accepted October 22, 2006. *Rev. Radic. Polit. Econ.* **2007**, *39*, 446–450, doi:10.1177/0486613407039003160S.
9. Franco, M.; Orduñez, P.; Caballero, B.; Tapia Granados, J.A.; Lazo, M.; Bernal, J.L.; Guallar, E.; Cooper, R.S. Impact of Energy Intake, Physical Activity, and Population-Wide Weight Loss on Cardiovascular Disease and Diabetes Mortality in Cuba, 1980-2005. *Am. J. Epidemiol.* **2007**, *166*, 1374–1380, doi:10.1093/aje/kwm226.
10. Cruz, B.A. Acceso a Los Alimentos En Cuba: Prioridad, Dificultades y Reservas Para Mejorar. *Econ. Desarro.* **2020**, *164*.
11. Escalante Lara, Z.B. La Economía Doméstica Cubana Frente al Período Especial: Estrategias económicas y diversificación ocupacional frente a la crisis. Tesis de Licenciatura, Universidad Autónoma de México, Faculta de Filosofía y Letras.: México., 2006.
12. Juárez, N.H. Cambios en la producción y consumo de viandas en Cuba. *Rev. D'ethnoécologie* **2013**, doi:10.4000/ethnoecologie.1445.
13. Mulet Pascual, M. Alimentación y Análisis Nutricional En La Habana Bajo El Prisma de La Etnocontabilidad : El Caso Comparativo de Las Familias Vázquez y López. *Cah. Am. Lat.* **2017**, 125–146, doi:10.4000/cal.4547.
14. Palomino, M.L.; Ambrós, Z.A.; Amable, O.G.; Fuentes, A.J.M. Estado de los conocimientos y comportamientos sobre alimentación de las personas atendidas en un consultorio del Programa del Médico de Familia. *Rev. Cuba. Aliment. Nutr.* **2018**, *28*, 9.
15. Porrata-Maury, C. Consumo y Preferencias Alimentarias de La Población Cubana Con 15 y Más Años de Edad. *Rev Cuba. Aliment. Nutr.* **2009**, *19*, 87–105.
16. Vázquez Sánchez, V.; Rangel Rivero, A.R.; Alcolea, S.P.; Rodríguez, Y.A.D.; Ramenzoni, V. Estado nutricional y composición corporal de campesinos y pescadores ocasionales del municipio Yaguajay, Sancti Spíritus, Cuba. *Nutr. Clínica Dietética Hosp.* **2018**, *38*, 134–139.
17. Núñez González, N.; González Noriega, E. Algunas transformaciones en las comidas tradicionales de la población rural cubana. *Rev Cuba. Aliment Nutr* **2001**, *15*, 139–145.
18. Ellen, R.F. *Modern Crises and Traditional Strategies: Local Ecological Knowledge in Island Southeast Asia*; Berghahn Books, 2007; ISBN 978-1-84545-312-1.
19. Comas, G.; Poy, S. Capacidades de subsistencia y estrategias económicas de los hogares durante etapas de expansión y crisis. Una mirada dinámica de la pobreza. *Entramados Perspect.* **2020**, *10*, 35–63.
20. *La familia en el México urbano: mecanismos de defensa frente a la crisis (1978-1992)*; Selby, H.A., Murphy, A.D., Lorenzen, S.A., Cabrera, I., Castañeda, A., Selby, H.A., Eds.; Regiones; Consejo Nacional para la Cultura y las Artes: México, 1994; ISBN 978-968-29-6020-8.
21. Gomiero, T. Organic Agriculture: Impact on the Environment and Food Quality. In *Environmental Impact of Agro-Food Industry and Food Consumption*; Elsevier, 2021; pp. 31–58 ISBN 978-0-12-821363-6.
22. Sijpestijn, G.F.; Wezel, A.; Chriki, S. Can Agroecology Help in Meeting Our 2050 Protein Requirements? *Livest. Sci.* **2022**, *256*, 104822, doi:10.1016/j.livsci.2022.104822.
23. FAO *Emissions Due to Agriculture. Global, Regional and Country Trends. 2000-2018.*; Food and Agriculture Organization, United Nations: Rome, 2021;

24. USDA Climate Change Available online: https://www.ers.usda.gov/topics/natural-resources-environment/climate-change/.
25. Firbank, L.G. Commentary: Pathways to Global Sustainable Agriculture. *Int. J. Agric. Sustain.* **2012**, *10*, 1–4, doi:10.1080/14735903.2012.621747.
26. Gomiero, T.; Pimentel, D.; Paoletti, M.G. Is There a Need for a More Sustainable Agriculture? *Crit. Rev. Plant Sci.* **2011**, *30*, 6–23, doi:10.1080/07352689.2011.553515.
27. Goh, K.M. Greater Mitigation of Climate Change by Organic than Conventional Agriculture: A Review. *Biol. Agric. Hortic.* **2011**, *27*, 205–229, doi:10.1080/01448765.2011.9756648.
28. Gomiero, T.; Pimentel, D.; Paoletti, M.G. Environmental Impact of Different Agricultural Management Practices: Conventional vs. Organic Agriculture. *Crit. Rev. Plant Sci.* **2011**, *30*, 95–124, doi:10.1080/07352689.2011.554355.
29. Scialabba, N.E.-H.; Müller-Lindenlauf, M. Organic Agriculture and Climate Change. *Renew. Agric. Food Syst.* **2010**, *25*, 158–169, doi:10.1017/S1742170510000116.
30. Lorenz, K.; Lal, R. Environmental Impact of Organic Agriculture. In *Advances in Agronomy*; Elsevier, 2016; Vol. 139, pp. 99–152 ISBN 978-0-12-804773-6.
31. Verdi, L.; Marta, A.D.; Falconi, F.; Orlandini, S.; Mancini, M. Comparison between Organic and Conventional Farming Systems Using Life Cycle Assessment (LCA): A Case Study with an Ancient Wheat Variety. *Eur. J. Agron.* **2022**, *141*, 126638, doi:10.1016/j.eja.2022.126638.
32. Crowder, D.W.; Reganold, J.P. Financial Competitiveness of Organic Agriculture on a Global Scale. *Proc. Natl. Acad. Sci.* **2015**, *112*, 7611–7616, doi:10.1073/pnas.1423674112.
33. Meemken, E.-M.; Qaim, M. Organic Agriculture, Food Security, and the Environment. *Annu. Rev. Resour. Econ.* **2018**, *10*, 39–63, doi:10.1146/annurev-resource-100517-023252.
34. Acevedo-Suárez, J.; Gómez Acosta, M.I.; Joy, T.; Pérez, B. Agricultura Urbana y Periurbana En Cuba. In; 2014; pp. 323–339 ISBN 978-84-92928-36-1.
35. Altieri, M.A.; Funes Monzote, R. *Monthly Review*. January 1 2012,.
36. Cabello, J.J.; Garcia, D.; Sagastume, A.; Priego, R.; Hens, L.; Vandecasteele, C. An Approach to Sustainable Development: The Case of Cuba. *Environ. Dev. Sustain.* **2012**, *14*, 573–591, doi:10.1007/s10668-012-9338-8.
37. Moon, K.R.; Ward, J.R.; Rodriguez, J.V.; Foyo, J. La Picadora: A Case Study in Cuban Agroecotourism. *Int. J. Cuban Stud.* **2021**, *13*, doi:10.13169/intejcubastud.13.1.0008.
38. Anonymous Proyecto de plan estratégico para Cuba (2021-2024) 2020.
39. Luna, M.V.; Alfonso, A.C. El Derecho Alimentario en Cuba. *Rev. Cuba. Aliment Nut* **2008**, *18*, 84–93.
40. Fernandez, M.; Williams, J.; Figueroa, G.; Graddy-Lovelace, G.; Machado, M.; Vazquez, L.; Perez, N.; Casimiro, L.; Romero, G.; Funes-Aguilar, F. New Opportunities, New Challenges: Harnessing Cuba's Advances in Agroecology and Sustainable Agriculture in the Context of Changing Relations with the United States. *Elem. Sci. Anthr.* **2018**, *6*, 76, doi:10.1525/elementa.337.
41. Saunders, A.; Luukkanen, J. Sustainable Development in Cuba Assessed with Sustainability Window and Doughnut Economy Approaches. *Int. J. Sustain. Dev. World Ecol.* **2022**, *29*, 176–186, doi:10.1080/13504509.2021.1941391.
42. Guevara, M. de los A.A. Cuba: reforma y transformación agraria. La crisis de los noventa y el proceso de desestatalización de la agricultura. *Rev. IDeAS* **2009**, *3*, 6–29.
43. Joseph, T.W.R.; Joseph, L.C.R. La cuestión agraria cubana aciertos y desaciertos en el período de 1975-2013: la necesidad de una tercera reforma agraria. *Polis Rev. Latinoam.* **2017**.
44. Nelson, E.; Scott, S.; Cukier, J.; Galán, Á.L. Institutionalizing Agroecology: Successes and Challenges in Cuba. *Agric. Hum. Values* **2009**, *26*, 233–243, doi:10.1007/s10460-008-9156-7.
45. Rosset, P.M.; Machín Sosa, B.; Roque Jaime, A.M.; Ávila Lozano, D.R. The Campesino-to-Campesino Agroecology Movement of ANAP in Cuba: Social Process Methodology in the Construction of Sustainable Peasant Agriculture and Food Sovereignty. *J. Peasant Stud.* **2011**, *38*, 161–191, doi:10.1080/03066150.2010.538584.
46. Funes Monzote, R. Farming like we're here to stay: the mixed farming alternative for Cuba, [publisher not identified]: Wageningen, 2008.
47. Nova González, A.; González-Corzo, M.A. Cuba's Agricultural Transformations. *J. Agric. Stud.* **2015**, *3*, 175, doi:10.5296/jas.v3i2.7547.
48. Nova González, A. La agricultura en Cuba: Transformaciones, Resultados, y Retos. Presented at the Association for the Study of the Cuban Economy, Cuba, 2018.

49. Rodríguez, A. El agro cubano aún no se recupera pese a reformas económicas Available online: https://apnews.com/article/noticias-af655f3a3b09c02e17c83096b8038fda (accessed on 24 September 2022).
50. Borràs Escayola, M.; Fernández, L.; Suárez-Hernández, J. Evaluation of Socioecological Resilience in Six Farms of the Sancti Spiritus Province, Cuba. *Pastos Forrajes* **2021**, *44*, 1–11.
51. Garth, H. Alimentary Dignity: Defining a Decent Meal in Post-Soviet Cuban Household Cooking. *J. Lat. Am. Caribb. Anthropol.* **2019**, *24*, 424–442, doi:10.1111/jlca.12369.
52. Machado, M.R.; Fernandez, M. Orion Magazine - This Cuban Town Has A Sustainability Lesson to Share Available online: https://orionmagazine.org/article/cuba-la-picadora-agroecology-sustainability/ (accessed on 24 September 2022).
53. Moon, K.R.; Ward, J.R.; Rodriguez, J.V.; Foyo, J. Food Access, Identity, and Taste in Two Rural Cuban Communities. *Gastronomica* **2022**, *22*, 66–78, doi:10.1525/gfc.2022.22.1.66.
54. CEPAL, U. *Balance Preliminar de las Economías de América Latina y el Caribe 2022*; Comisión Económica para América Latina y el Caribe (CEPAL). Naciones Unidas.: Santiago, 2022; p. 177;.
55. Augustin, E.; Robles, F. 'Cuba Is Depopulating': Largest Exodus Yet Threatens Country's Future. *N. Y. Times* 2022.
56. Nodarse Venancio, M. U.S.-Cuba Relations: The Old, the New and What Should Come Next. *WOLA* 2022.
57. Ramenzoni, V.C.; Besonen, M.R.; Yoskowitz, D.; Sánchez, V.V.; Rangel Rivero, A.; González-Díaz, P.; Méndez, A.F.; Escuela, D.B.; Ramos, I.H.; López, N.V.H.; et al. Transnational Research for Coastal Wetlands Conservation in a Cuba–US Setting. *Glob. Sustain.* **2020**, *3*, e19, doi:10.1017/sus.2020.14.
58. López Castañeda, L.; Vázquez-Rodríguez, J.; Ramenzoni, V.; Yoskowitz, D.; Rangel Rivero, A.; González-Díaz, P.; Vázquez-Sánchez, V.; Delgado-Pérez, A.; Borroto, D. Cambios Ambientales Percibidos Por Pescadores Artesanales Residentes En Yaguajay, Sancti Spíritus, Cuba. In *Pescadores en México y Cuba: Retos y oportunidades ante el cambio climático*; Urrea Mariño, U., Alcalá, G., Eds.; Instituto Politecnico Nacional, Unas Letras Industria Editorial: Merida, 2020.
59. Ramenzoni, V.C.; Borroto Escuela, D.; Rangel Rivero, A.; González-Díaz, P.; Vázquez Sánchez, V.; López-Castañeda, L.; Falcón Méndez, A.; Hernández Ramos, I.; Valentín Hernández López, N.; Besonen, M.R.; et al. Vulnerability of Fishery-Based Livelihoods to Extreme Events: Local Perceptions of Damages from Hurricane Irma and Tropical Storm Alberto in Yaguajay, Central Cuba. *Coast. Manag.* **2020**, *48*, 354–377, doi:10.1080/08920753.2020.1802198.
60. *La Picadora: People and Nature in a Rural Cuban Community*; Vázquez Sánchez, V., Rangel Rivero, A., Eds.; Montané Anthropological Museum, University of Havana, Fernando Ortiz Foundation, 2018; ISBN 978-959-7249-09-2.
61. Ramírez, I.S. Del Funche al Ajiaco: La Dieta Que Los Amos Imponen a Los Esclavos Africanos En Cuba y La Asimilación Que Éstos Hacen de La Cocina Criolla. *An. Mus. América* **2009**, *16*, 127–154.
62. Núñez González, N.; González Noriega, E. Antecedentes etnohistóricos de la alimentación tradicional en Cuba. *Rev Cuba Aliment Nutr* **1999**, 145–150.
63. Boffill Vega, S.; Calcines Díaz, C.M.; Sánchez Cid, A. Modelo De Gestión Para Contribuir Al Desarrollo Local, Basado En El Conocimiento Y La Innovación En Cuba. *Ing. Ind.* **2009**, *XXX*.
64. González, E. de la C.Z.; Massip, A.M. Las redes de innovación agrícola. Una vía para el desarrollo productivo y sostenible en Cuba. *Agrisost* **2019**, *25*, 1–8.
65. Morales Rodríguez, G. La zafra del turismo. *Cuba Profunda* 2015.
66. Anonymous Centrales en tiempo muerto. *Cuba Profunda* 2015.
67. Holgado Fernández, I. *Encuentro*. 1998, pp. 221–228.
68. Funes Monzote, R. Sustainable Agriculture and Resistance: Transforming Food Production in Cuba. *undefined* **2002**.
69. Pérez, R. La Ganadería Cubana En Transición. *Catauro Rev. Cuba. Antropol.* **2012**, *13*, 30–44.
70. Álvarez Sarduy, J. El proceso de redimensionamiento de la agroindustria azucarera cubana y su impacto en las cooperativas cañeras. Master Thesis, Universidad de La Habana: Habana, Cuba, 2005.
71. Spagnolo, L.; Munevar, D. Inequidad salarial en Cuba durante el Período Especial. *América Lat. Hoy* **2008**, *48*, doi:10.14201/alh.1361.
72. Bobes, V.C. Las Mujeres Cubanas Ante El Periodo Especial: Ajustes y Cambios. *Debate Fem.* **2001**, *23*, 67–96.
73. Garth, H. *Food in Cuba: The Pursuit of a Decent Meal.*; Stanford University Press, 2020;
74. Pérez Izquierdo, V. Impacto Del Período Especial En La Vida Cotidiana de La Mujer Cubana, En La Década de Los Años 90. In Proceedings of the Mujeres Contra el Bloqueo; Havana, 2002.

75. Martínez Massip, A. Innovar redes de difusión de innovación para la productividad agropecuaria del municipio Camajuaní. Doctoral Dissertation., Universidad de La Habana, Departamento de Sociología.: Habana, Cuba, 2018.
76. Boffill, S.; Suárez, J.; Reyes, R.M.; Luna, C.; Prado, D.; Calcines, C. Programa Integral Para La Producción de Alimentos En El Contexto Del Desarrollo Local.: La Experiencia Del Municipio Yaguajay, Cuba. *Pastos Forrajes* **2009**, *32*, 1–1.
77. Anonymous En Yaguajay hoy no se puede comer pescado fresco del mar Available online: https://www.cibercuba.com/noticias/2019-05-13-u196554-e42839-s27061-yaguajay-hoy-no-puede-comer-pescado-fresco-mar (accessed on 28 September 2022).
78. Anonymous Incumplen plan de captura de pescado en embalses de Sancti Spíritus Available online: https://www.cibercuba.com/noticias/2022-11-24-u1-e199370-s27061-incumplen-plan-captura-pescado-embalses-sancti-spiritus (accessed on 28 December 2022).
79. Anonymous Piden esfuerzos a ganaderos tuneros para suplir déficit de leche en polvo Available online: https://www.cibercuba.com/noticias/2022-01-07-u1-e43231-s27061-piden-esfuerzos-ganaderos-tuneros-suplir-deficit-leche-polvo (accessed on 9 September 2022).
80. Alcolado, P.M.; Arellano, D. Lecciones Aprendidas En La Implementación Del Manejo Integrado Costero: Las Experiencias Demostrativas Del Ecosistema Sabana-Camagüey, Cuba. *Rev. Comun. Científicas Técnológicas* **2016**, *1*, 1–7.
81. Cutié Cancino, V.; Lapinel Pedroso, B. *La Sequía En Cuba, Un Texto de Referencia*; Monografía Proyecto 1/0P-15/GEF; Instituto de Meteorología, Centro del Clima, Centros Meteorológicos Provinciales, 2013; ISBN 978-959-300-053-6.
82. Anonymous Cuba Es El País Más Dependiente de Las Importaciones de Alimentos, Después de Panamá Available online: https://embed.tumblr.com/widgets/share/button?notes=right&locale=es_ES&canonicalUrl=http%3A%2F%2Ftumblr.com%2Fwidgets%2Fshare%2Ftool%3FcanonicalUrl%3Dhttps%3A%2F%2Fwww.14ymedio.com%2Feconomia%2FCuba-dependiente-importaciones-alimentos-Panama_0_3438256147.html& (accessed on 30 December 2022).
83. Porrata-Maury, C.; Hernández-Triana, M.; Abuin, A.; Huergo, C.C.; Pianesi, M. Caracterización y evaluación nutricional de las dietas macrobióticas Ma-Pi. In Proceedings of the CENENT; Unpublished: Havana, 2012.
84. Contreras Hernández, J.; Gracia Arnaiz, M. *Alimentación y cultura: perspectivas antropológicas*; Ariel España, 2005; ISBN 978-84-344-2223-0.
85. Pörtner, H.-O.; Roberts, D.; Tignor, M.; Poloczanska, E.S.; Mintenbeck, K.; Alegría, A.; Craig, M.; Langsdorf, S.; Löschke, S.; Möller, V.; et al. *Climate Change 2022: Impacts, Adaptation and Vulnerability Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*; Cambridge University Press: Cambridge, UK and New York, NY, USA., 2022;
86. Anonymous Importación de alimentos a Cuba; Trámites en Cuba. 2022.
87. Delgado, D. El Gobierno Cubano Presenta Un Plan de Soberanía Alimentaria | Protección Del Medio Ambiente Available online: https://www.greentechcuba.com/es/el-gobierno-cubano-presenta-un-plan-de-soberania-alimentaria (accessed on 30 December 2022).
88. EFE, R. Cuba flexibiliza la importación de alimentos con fines no comerciales Available online: http://quepasamedia.com/noticias/vida-y-estilo/bolsillo/cuba-flexibiliza-la-importacion-de-alimentos-con-fines-no-comerciales/ (accessed on 30 December 2022).
89. de Miranda Parrondo, M. Cuba: entre los vaivenes de una política económica fallida y los problemas irresueltos Available online: https://jovencuba.com/vaivenes-politica-economica-fallida/ (accessed on 30 December 2022).
90. de Miranda Parrondo, M. La Crisis Estructural de La Industria No Azucarera En Cuba. *Crisis Estructural Ind. No Azucar. En Cuba* 2022.
91. Capote, R.A. Perspectivas para la Economía de América Latina y el Caribe en 2023 y crecerán - Cuba en Resumen 2022.
92. Balvanera, P.; Calderón-Contreras, R.; Castro, A.J.; Felipe-Lucia, M.R.; Geijzendorffer, I.R.; Jacobs, S.; Martín-López, B.; Arbieu, U.; Speranza, C.I.; Locatelli, B.; et al. Interconnected Place-Based Social–Ecological Research Can Inform Global Sustainability. *Curr. Opin. Environ. Sustain.* **2017**, *29*, 1–7, doi:10.1016/j.cosust.2017.09.005.

93. Fazey, I.; Moug, P.; Allen, S.; Beckmann, K.; Blackwood, D.; Bonaventura, M.; Burnett, K.; Danson, M.; Falconer, R.; Gagnon, A.S.; et al. Transformation in a Changing Climate: A Research Agenda. *Clim. Dev.* **2017**, *0*, 1–21, doi:10.1080/17565529.2017.1301864.
94. Sharpe, B.; Hodgson, A.; Leicester, G.; Lyon, A.; Fazey, I. Three Horizons: A Pathways Practice for Transformation. *Ecol. Soc. Vol 21 Iss 2 P 47 2016* **2016**, 47, doi:10.5751/ES-08388-210247.