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Food laborers as stewards of island biocultural diversity: reclaiming local knowledge, food sovereignty, and decolonization

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Creating nutritious and ecologically regenerative food cultures depends on the local knowledge of food system laborers. Food producers in small island developing states center socioecological interdependence in their livelihoods and, as such, conserve biocultural diversity. Amid burgeoning health, economic, and climate crises brought on by colonialism, reclaiming food sovereignty requires a critical and embodied scientific approach, one that considers *what* traditional ecological knowledge is and *who* creates and sustains it. This study positions laborers as the primary sources of knowledge in island food systems; discusses declines in nutrition and agrobiodiversity as consequences of food labor loss; and proposes laborers' stewardship as essential to regenerating self-determination. Using critical quasi-ethnographic methods, this report synthesized primary data from narrative interviews in Guam (Guåhan, $n = 13$) and Puerto Rico (Borikén, $n = 30$), two former colonies of Spain and current territories of the United States, as specific examples of place-based knowledge production, interwoven into critical discussion of broader literature in this space. Our findings show that local food laborers combine intergenerational, ecosystem-specific knowledge with robust human value systems, negotiating across competing economic, cultural, and ecological needs to sustain livelihoods and regenerate biodiversity. As well-connected nodes in family and community networks, laborers serve as the scaffolding on which compassionate and relational care can thrive. Trade policies and the market dominance of transnational food corporations have severely reduced local food production in favor of food import dependence in islands, aggravating labor shortages and augmenting food insecurity. Through waves of out-migration and cash remittance, social care relationships have become monetized, reinforcing mass-produced food consumption and dietary diversity loss as islanders, both at home and in the diaspora, transition to an industrialized diet. The loss of local labor similarly poses threats to agrobiodiversity, with export-oriented agribusiness simplifying landscapes to streamline extraction. This study demonstrates that to reclaim food systems in Guam, Puerto Rico, and similar island settings, laborers must be valued as stewards of cultural and agrobiodiversity and can be integral to efforts that preserve cultures, agroecosystems, and health.

KEYWORDS

labor, local knowledge, food culture, biodiversity, nutrition, colonialism, small island developing states, food systems

1. Introduction

The means to create and sustain a diverse set of nutritious, culturally desired, and ecologically regenerative foods is dependent on the traditional ecological knowledge of laborers. For the peoples of small island developing states—living in longstanding hotspots of geologic and meteorological volatility (Thomas et al., 2020)—the work entailed in producing food reflects cultural wealth and safeguards biological diversity. International development agendas have often emphasized small islands' fragility, pointing to burgeoning health, economic, and climate crises in rhetoric that reifies cataclysm, exoticizes traditional lifeways, and promotes foreign aid dependence (Baldacchino, 2017). Little attention is paid to the colonial and neo-colonial activities decidedly producing such crises (Plahe et al., 2013; Marrero and Mattei, 2022) and even less so to island peoples themselves, working in and adapting to their new social, economic, and natural environments. To truly conserve biocultural diversity in small island food systems, a critical and embodied scientific approach is needed—one that asks not only *what* traditional ecological knowledge is but also *who* holds it, with what power, and with what desire to continue holding it amid existential threat.

Laborers—including local and Indigenous peasants (campesinos), smallholder farmers, fisherfolk, artisans, landless farmworkers, and caregivers—are the primary producers of island food cultures (e.g., Kelly and Wallman, 2014), relying on highly-specialized livelihood practices in diverse and often challenging environs. The traditional ecological knowledge held by laborers is intergenerational and ecosystem-specific and, as such, has been touted for its capacity to promote nutrition, agrobiodiversity, and climate resilience (Shaffril et al., 2020; Vogliano et al., 2021). The worth of island food cultures, however, extends past its utility. As stewards of human-nature relationships, island food producers create robust value systems that center socioecological interdependence, cohesion, and conservation (Kueffer and Kinney, 2017). Their toil is wealth inherently, valuable beyond wage (Ferguson et al., 2022) and the toolkits of top-down, technocratic environmentalism (Kelman and West, 2009). Yet, in post-industrial and increasingly out-migrating island landscapes, this wealth cannot survive without economic revival.

Hegemonic epistemologies largely frame islanders as victims of crisis, utilizing longstanding deficit models of knowledge production (Campbell, 2009) and overlooking nascent efforts to reclaim food sovereignty (Connell et al., 2020). Some food systems research calls for uplifting traditional knowledge but often falls into the trap of co-opting “the local”, with resulting policies reinforcing inequalities and harm (Lemke and Delormier, 2017). Addressing this gap necessitates decolonizing and reclaiming knowledge production in small islands. In the midst of change, laborers are not powerless; they understand and respond to disaster and disease acutely, intergenerationally, and cyclically—not as unexpected shocks but as the very reason iteration in socioecological systems exists in the first place (Beyerl et al., 2018; Talubo et al., 2022). Thus, in exploring island biocultural diversity, labor in islands can be interrogated not as “in crisis” but *in flux*, cultivating new forms of wisdom dynamically. With the objective of decolonizing and reclaiming knowledge production in small island developing states, this research aimed to (1) conceptualize food laborers as

the primary safeguards of traditional ecological knowledge in food systems, (2) identify losses to dietary and agrobiodiversity resulting from losses in labor, and (3) propose stewardship as the means of regenerating livelihoods and self-determination.

2. Methods

In this contribution, we focused on two cases studies on labor as it relates to biocultural diversity: Guam (Guáhan) and Puerto Rico (Borikén). Considered small island developing states, these territories provided key insights into food system dynamics in the context of ongoing coloniality. Guam and Puerto Rico have been territories of the United States (US) since 1898, both ceded by Spain, who colonized the islands for more than 300 years. More recently, food systems in both cases have largely been shaped by US-American economic and political interests. This offered a strategic and critical entry point for this research: health and environmental change phenomena are created by long histories of imperialism, and contemporary experiences of these phenomena are shaped by legacies and continuations of colonial structures (O'Lear, 2016; Hickel, 2020; Sultana, 2022). For example, in 2020, 20% of the ~154,000 people residing in Guam lived in poverty, and an estimated 22% of households were receiving food assistance from the federal government (US Census Bureau, 2022). In Puerto Rico, having just under 3.2 million residents, 41% of individuals lived in poverty and 44% of households reported use of food assistance (US Census Bureau, 2020). In both locales, these contrasted the far lower levels (10 and 11%, respectively) found in the mainland US and speak to ongoing structural disparities.

Synthesizing a robust literature base with primary data from qualitative research in Guam and Puerto Rico, this study offers both an overview and specific, place-based examples of the central role laborers play in small island food systems, traditionally and in modernizing contexts, highlighting mechanisms by which dietary and agrobiodiversity are lost, and considering pathways to safeguard local and Indigenous knowledge. We drew on territorial, place-based examples to nuance dynamics of local knowledges and practices with persisting colonial structures, highlighting resulting tensions and implications for biocultural systems. Findings were structured as a critical quasi-ethnographic report, interweaving current scientific theory, novel contributions from narrative interviews carried out in Guam and Puerto Rico, and our own analytical interpretation. Critical ethnographic methods were chosen because they challenge normative colonial-capitalist modes of knowledge production and, by doing so, investigate cultural dynamics as acts of resistance and collective agency (Foley, 2002). Although fieldwork was carried out in a relatively short timeframe (2–3 months), data collection was immersive, in-depth, and relational, facilitating more immediate application of findings through community partnerships (Murtagh, 2007).

Published evidence was amassed from both peer-reviewed and gray literature (e.g., dissertations, books, and reports) via Google Scholar to ensure completeness in these under-researched settings. As an interdisciplinary endeavor, articles throughout the natural and social sciences (e.g., nutrition, conservation, anthropology, political ecology, and global development) were screened by title and abstract for relevance before inclusion as full-text reports.

Search terms included small island(s), small island developing states, labor(er)(s), local knowledge, traditional ecological knowledge, subsistence, smallholder farmer(s), farmworker(s), fisheries, ecosystem(s), food sovereignty, food system(s), culture, local, dietary diversity, nutrition, biodiversity, agrobiodiversity, colonialism, markets(s), wage economy, care (giving), cooking skills, social network(s), and stewardship.

Primary data from Guam was generated and collected during fieldwork conducted in 2016. Case study design was employed and included quasi-ethnographic methods, collecting empirical material through both qualitative interviews and informal sources (Ritchie et al., 2013). Opportunistic and convenience sampling was used to recruit research participants among actors in local food initiatives, identified based on expressed interest or active involvement in production, processing, selling, or consumption of food grown in Guam. To amplify representation across the food sector, various types of individuals and organizations (e.g., cooperatives, non-profit organizations, for-profit farms, educators, and vendors) were identified to form a network of contact. Chain referral across the network was then used, which allowed sampling, research aims, and level of community involvement to be largely participant-driven, evolving according to local contexts and needs (Brounéus, 2011; Ritchie et al., 2013). An explicit focus on localizing food and prominence in the community (based on word-of-mouth and reach) were identified as important considerations for participation by community partners, given the project's emphasis on immediate and actionable community-based research translation. From an initial screening of 32 individuals, 13 participated in the study, including farmers, educators, restaurateurs, and food cooperative members.

Participants were scheduled for 1-h semi-structured narrative interviews, held in English with one primary researcher. An interview guide was developed based on findings from previous work on local food systems as well as input from local actors. The guide focused questions on consumer food access and producer capacities within the local food sector including resource distribution, structural factors (e.g., climate change and US military operations), and future visions or goals. The semi-structured nature of the interview encouraged spontaneous participant reflection and storytelling (Brounéus, 2011). All interviews included discussion about goals and challenges each actor faced, with participants able to share personal and family histories, or point to sociopolitical events, as illustrative of current food conditions in Guam. Interviews were recorded and transcribed *verbatim*. In addition to the transcripts, empirical material also consisted of reports and existing datasets (e.g., from food production and public health international organizations, local non-governmental groups, and government agencies), news articles (online and in print), and informal observations and conversations (e.g., at academic conferences, educational events on agriculture or culture, and tours of different facilities) (Ritchie et al., 2013).

Detailed descriptions of study design and interview processes for data obtained in Puerto Rico are published elsewhere (Marrero et al., 2022). Briefly, a concurrent mixed methods research design was employed in a non-probabilistic, purposive sample of 30 agricultural workers in 2019, 2 years after the occurrence of Hurricane María. Two-hour interviews were conducted with participants and included a quantitative questionnaire

(collecting sociodemographic data, farm characteristics, food product inventories, and hurricane-related risks) and narrative interview, moderated by a trained English- and Spanish-speaking researcher. This analysis used data from the narrative interviews, composed of open-ended questions on resource access, social support, and agricultural sector development, offered in an unstructured format to encourage participant storytelling.

Data from both Guam and Puerto Rico were anonymized, and inductive interpretive thematic analysis was carried out separately until saturation was reached. Interpretive analysis was carried out abductively, relying iteratively on theory, empirics, and an analytical framework as well as discussion with key research participants to code data and organize them into thematic results. This analytical approach allowed for participants' latent interpretive frameworks to surface, including common experiences and underlying meaning-making processes. Raw data and derived themes from both sites were then queried for subject matter on labor shortages, traditional food production practices, and personal experiences in modernized economies. Selected quotes were balanced across and summarized key findings common to both sites; highlighted important, place-specific ecological and cultural features; or exemplified similar concepts in broader small islands literature. Research findings were shared with participants and others in a stakeholder or community report. Work conducted in Puerto Rico was approved by the Institutional Review Board of Harvard TH Chan School of Public Health and Ponce Health Sciences University (Protocols IRB19-0034 and 1903007592). This ethnographic analysis, including data from Guam, was designated as exempt (IRB22-1368). All participants provided written or oral informed consent.

3. Findings: results and critical discussion

3.1. Wisdom and diversity in food systems labor

Local and Indigenous knowledge combines grounded skills in “visible” natural resource use with “invisible” values and belief systems, including interdependence, gratitude, and self-determination (Huambachano, 2019). Wisdom refers to the ability to negotiate across these potentially competing biocultural relationships to meet various economic, cultural, and ecological needs (Jacques and Jacques, 2012). In studying wisdom, we conceptualize “food laborers” as knowledge bearers and creators of both autonomous livelihoods (for self) and compassionate care (for kin, community, and nation), serving as catalytic actors at the center of socioecological systems. Thus, labor in traditional food production extends both to those *creating* and *sharing* food and, thus, involves smallholders, fisherfolk, landless farmworkers, homemakers, and caregivers. Although these roles are often interconnected or performed jointly (and fluctuate between paid and unpaid spheres), we make these distinctions to emphasize radical inclusivity of what it means to work and care for others, especially where hegemonic gender, race, and class divisions prevail. Together, interrelations in socioecological

systems sustain social cohesion and nature conservation. As well-connected nodes in familial and community networks, laborers serve as the scaffolding on which compassionate, relational social environments thrive, fostering food-giving, shared meals, and reasserted cultural and national identity (Paponnet-Cantat, 2003; Pollock, 2009).

Smallholder farmers, formal landowners of small plots (typically 5–20 acres or less) (Lowder et al., 2016), are critical contributors to localized food systems. In Puerto Rico, most farms (84%) are owned by individuals and families and 49% are considered small (USDA NASS, 2020a). In Guam, about three-quarters (71%) of farms continue to be owned by Indigenous CHamoru peoples and 89% are small (USDA NASS, 2020b). Labor in food systems also extends to temporary and informal waged workers, men and women who, often as immigrants and with their families, work on lands and with tools not their own. An estimated 100,000–300,000 undocumented Dominican migrants work throughout the Puerto Rican food system as farmhands, domestic workers, and street vendors (Ferguson, 2003). Among the 8,230 registered farmers on the island, 22% operate land that is rented or worked on for others (USDA NASS, 2020a). A similar prevalence (33% of a total 264 registered farms) is observed in Guam (USDA NASS, 2020b). Smallholders often move in and out of these “landowning” and “landless” roles, diversifying incomes by maintaining their own farms while also serving as farmworkers on larger landholdings.

Absent in these censuses are fisheries and the appreciable number of gardens, backyard plots, foraged forests, and other household food sources outside the formal economy (Gould et al., 2017). Contributions of the domestic sphere are immense yet seldom recognized as paramount to food availability, access, and quality. Homemakers and caregivers, often women who care for children, aging parents, and others in the family and community, labor and contribute to food security in their own right (Trees and Dean, 2018). From grocery stores, public lands, gardens, and farm stands and into kitchens, caregivers transform raw agricultural products into desired cultural foods, demonstrating love and cultivating wisdom and sustenance in food preparation. Together, these dimensions of labor highlight the critical and often neglected roles that marginalized groups (e.g., women, farmworkers, Indigenous peoples, and migrants) play in food production (Patel, 2009).

3.1.1. Labor as knowledge in forests, on coasts, and at sea

Labor in subsistence agriculture and fisheries is most easily distinguished by its plurality and epistemology—work that learns from manifold weather patterns and terrains. In the challenge of adapting to diversity, landscapes become part of social worlds “through the everyday ritual of movement and labor”, creating familiarity, order, and meaning (Daynes and Williams, 2018, p. 90). As described by a mid-sized farmer in Puerto Rico,

“On the coast, they regularly work vegetables, plantains, and fruits. [Here], in the countryside, we work plantains, *yautía*—everything that has to do with roots, which are hardier products, stronger for the climate [and] bacteria.” (P2)

Because island landscapes (mountainous, volcanic, and otherwise) are diverse and often ill-suited for large-scale agriculture, multiple sets of small-scale, context-specific food traditions arise. Localized food harvesting and sharing practices in islands, as a result, are a reservoir of biocultural diversity, with geographically-bound food cultures transforming across time (e.g., intergenerationally) and space (e.g., via inter-island voyaging) to meet societal needs. In the process, wisdom and its values develop and are passed down, strengthening human-nature interdependencies as sources of physical and spiritual nourishment. In Puerto Rico, smallholder farmers time harvests of crops to supply traditional foods (e.g., *pasteles*) needed for holidays and festivals (Avilés-Vázquez, 2014), with rituals of meaning-making grafted onto material necessity. Farmers, as a result, diversify crop production beyond those cultivated for market to varieties for community consumption, distributing risk as consumer demands fluctuate (or, similarly, as likelihood of disaster rises and falls) (McMillen et al., 2017; McGuigan et al., 2022).

Central to these traditional modes of smallholder agriculture is equitable land access and collective mutual aid. In the Pacific, communal land ownership remains high (45–98% of total land mass), protecting land access even for relatively impoverished households (Mitchell et al., 2014). Through well-integrated kin networks, smallholder farmers mobilize social capital and pool together equipment, cash, and other material resources. Relational mutual dependence, in turn, facilitates labor-intensive agroecological practices (e.g., composting, intercropping, terracing, and contour plowing) (Avilés-Vázquez, 2014; Suzuki and Tachihara, 2014). As an act of reciprocity, food sharing is paramount, with farmers often giving unsold produce to workers, family, neighbors, and friends. As one farmer reflected,

“Guam’s other name is Guåhan, which means ‘we have,’ and if you look around this island, there is a lot of food here. There are a lot of resources in the jungle. [...] The concept of selling things was not in [us]. We would just rather give it.” (G1)

Among Indigenous CHamoru societies, food and recipe sharing remains an important practice in social gatherings like *fiestas*, with long histories of oral tradition and hospitality toward friends and strangers (San Nicolas, 2021).

Deeply rooted in tradition, farmers and fisherfolk operate in increasingly modernizing economies and, as such, “engage in multiple livelihoods, occupying intermediate/ambiguous positions between a traditional subsistence depending on local ecosystems and a ‘modern,’ proletarian subsistence, engaged with larger labor markets” (García-Quijano, 2009, p. 4). The wisdom held by workers, then, has also adapted and expanded to reflect what has been called a mixed subsistence-market economy; beyond social and ecological worlds, laborers’ knowledge must now also be responsive to wage, built environments, and market demands (Busilacchi et al., 2013). Despite alternative sources of wage, many fisherfolk desire to maintain a lifestyle at least somewhat dependent on fishing, highlighting the satisfaction that comes from serving as providers for their families and communities (García-Quijano, 2009). In the Puerto Rican context, “even fishers who

migrate to work in the mainland US keep the possibility of fishing alive, monitoring changes in fisheries at home [...] and keeping their memories of and attachment to home ecosystems” (García-Quijano, 2009, p. 7). This affective knowledge, which creates familiarity and attachment to place, also sustains diversity in nature. On coasts and at sea, marine ecosystems near islands remain some of the most diverse and bio-productive in the world, seafood that is mostly consumed locally (Zeller et al., 2006).

3.1.2. Knowledge as dexterity and desire in the domestic

Informal and less labor-intensive food production lies closer to the home, carried out in gardens and “covered” greenhouses. In Puerto Rico, home gardening originated in the Taíno (the predominant pre-colonial Indigenous tribe in the archipelago) use of *conucos*, gardens that were both supplementary food sources and grounds for experimentation to determine local robustness in various crop varieties (Avilés-Vázquez, 2014). Home gardens remain a source of readily accessible and affordable foods throughout the Caribbean and Pacific (Guell et al., 2021). These compact and less strenuous modes of production also bridge important gaps in labor access. A young mother and greenhouse farmer in Puerto Rico discussed how her work facilitated gendered roles as both caregiver and income generator:

“Everyone gets surprised that I like the earth or that I like to plant. And then they see that I have the greenhouse and that it is very big and looks very pretty like that, all planted. [...] And [since I am] a woman, they tell me, ‘Really, you do all that?’ [But] this is what I want to do, and it is easy for me. I have the girls, [my daughters,] that can be there [in the greenhouse], or they can stay here in the house.” (P5)

Wisdom that interrelates food production with caregiving, in turn, ties people to place, precipitating in communities a nostalgic devotion to the ecologies that sustain them.

Once caught, foraged, or harvested, foods in traditional production systems are brought into the domestic (if not already produced in home gardens or backyard plots) by homemakers and caregivers, who take diverse raw materials and, through inherited knowledge and dexterity in cooking, increase that diversity as a wide array of traditional meals. Traditional cooking practices are attentive to what foods are seasonally available from the field, sea, social networks, and marketplace—and align skills to effect utilization, processing, and storage. As one CHamoru farmer shares,

“We plant the[se heirloom seeds] because, traditionally, this type of corn is used to make different traditional dishes, tortillas and *titiyas*, which is influenced by Spanish but has sustained our people for a couple of hundred years before those imports came over. [...] So, we take them, we dry them out, we store some of the seeds, [and] we pass them out to visitors.” (G4)

Titiya (CHamoru tortilla-like flatbreads) preparation involves extended families coming together to husk corn, often telling stories and passing down traditional food processing knowledge

(Flores, 2021); collective preparation of traditional food similarly occurs across Puerto Rican households. Mutual dependence, as knowledge in gathering food resources outside the monetized market economy, is also needed. The Chuukese, a fast-growing Micronesian migrant group in Guam, rely on networks of care among family and community members to obtain adequate food and overcome high food prices, a form of informal aid particularly relevant to food security in Guam’s increasingly cash-reliant foodscapes (Jugo, 2020). Once foodstuffs are gathered, creating and sharing meals in a colonized food system is motivated just as much by taking tender care of a child, neighbor, or aging parent as it is by a defiant desire to prevail. As a Puerto Rican farmer described,

“People help each other [by] making communal kitchens. [With] everybody distributing [food], there is an atmosphere of overcoming.” (P27)

Traditional cooking skills are inextricably linked to women and the domestic sphere and are a product of desire (Mookerjee, 2019), an experience—alongside taste, food preferences, and culinary traditions—typically deemed superfluous in hegemonic nutrition and public health discourse (El-Tom and Cassidy, 2021). In colonial ontologies, human appetite (palatability and pleasure-seeking) is characterized as a dysregulated, dysfunctional impulse—a “craving” that must be resisted or else blamed for disease (Veit, 2013). In a feminist and culturally-imbedded epistemology, however, desire is paramount to food production (Mookerjee, 2019), encapsulating a longing beyond what *is* for what *could be* and what must be, therefore, brought forth. In this way, appetite presupposes labor. Crafting a meal requires skill and dexterity in transforming foodstuffs into food cultures, hinging upon a desire for more than the raw materials of the natural world. Thus, instead of a lack of control, human appetite demonstrates the capacity to live in control—receiving (what is), adapting (what could be), and transforming (what we bring forth) our natural ecologies to cook and feed others. Relational experiences like joy, meaning, creativity, and caregiving through food, as anti-colonial exercises, similarly reclaim desire as an act of utopian world-building, resisting tropes of irretrievable cultural loss (Sultana, 2022).

3.2. Loss of labor and land, loss of self

Foreign corporate and governmental involvement has introduced drastic political-economic change in small islands, largely shifting labor away from subsistence in favor of export-oriented agribusiness, industrialization, and tourism (Mitchell et al., 2014). Declines in local agricultural productivity in islands can be traced back to periods of agricultural intensification; currently, arable yet uncultivated lands previously sustained large-scale plantations of copra, sugarcane, and other non-nutritive cash crops, first introduced by Europeans colonizers and bolstered by slavery for benefit in global trade (Marrero and Mattei, 2022). Local and Indigenous smallholding communities—largely dispossessed of their lands (or else enslaved to work on them), unable to produce food, and ultimately accustomed to consume imported products—learned to seek out new livelihoods in the form of wage, remittance, and foreign aid. In militarized islands like Guam, work

in the government sector, and congruent shifts in land use toward military bases and business districts, dominated this transition (Marutani et al., 1997).

After the collapse of plantation economies in the early twentieth century, localized traditional agriculture and fisheries were not necessarily revitalized. Today, laborers in islands largely participate in the colonially-introduced wage economy, both at home and in the diaspora; as described by a small-scale polyculture and hydroponic producer in Puerto Rico,

“There are no personnel available because everybody is working—that, or they left for the US. So, there is a shortage, and for the few [farmworkers] we can find, we are grateful.” (P14)

In Guam, agriculture has been associated with “pulling weeds under the hot sun” among youth (Marutani et al., 1997), a generational disenchantment with the profession. An educator in the local food sector observed,

“We have this mentality [of], ‘I do not want to do that, it is hot!’ [...] If we could increase our agricultural workforce, we could increase our production by far. [...] But being Westernized really changed our thoughts on what is a good job and what is a respectable job.” (G6)

With farm work disintegrated from cultures and ecosystems, labor (like land and food sources) has become a commodity, easily replaced by alternative income sources.

Today, farm labor shortages, indeed, are a direct result of relatively low compensation, with day laborers looking to other sectors for less exploitative working conditions and more stable income (Li, 2011). The introduction of food aid and other government assistance programs has also “raised the local price of agricultural labor by giving people an alternative means of subsistence” (Rudel et al., 2000, p. 391). To compensate, modernized agricultural systems capitalize on intra-island and often undocumented migration to obtain “cheap” labor—able to do so by privileging standardized, technoscientific models of production reliant on agrochemicals and mechanization instead of local knowledge. Along with unfair compensation and wage theft, undocumented migrant laborers are particularly vulnerable to discrimination, hazardous living conditions, and poor social service access (Ferguson, 2003; Ball et al., 2011); they also disrupt families and social networks (Castles and Ozkul, 2014) and reinforce gendered inequities in unpaid work (Chattier, 2019). Without robust labor protections, low-paying farm work and its enablers (e.g., foreign labor and land dispossession) reify planter colonialism and perpetuate cycles of poverty, racism, and injury. In the few islands where agriculture remains economically-viable, high-value production of fruits, vegetables, livestock, and seafood is typically controlled by multinational corporations for export, doing little to support local livelihoods, food security, or self-determination (Murray, 2001).

Laborers in small islands, as a newly-formed proletariat, have had little control over these and other food system transformations—yet they experience their economic, health, and environmental consequences acutely. In Puerto Rico, industrial

power and pharmaceutical plants (dependent on tax incentives and erected on former sugarcane plantations) have created an unstable coastal job market prone to downsizing and layoffs, with many workers falling back to fishing during “off-hours” for food and supplemental income (García-Quijano, 2009). Among coffee plantation farmers in the rural mountains of the interior, periodic food insecurity is increasing (Iverson et al., 2019), a “hungry farmer paradox” which worsens after extreme weather events and propagates rural abandonment (Rodríguez-Cruz et al., 2022), elaborated on by a local farmer in reference to Hurricane María:

“The hurricane destroyed the coffee zone. [...] Those people in the center are dying of hunger, putting it tragically. [And if] they are not dying of hunger, they are leaving of hunger from this, our central mountain range.” (P27)

In Guam and other Pacific islands, militarization and foreign resource extraction (in the form of mining, logging, and commercial fishing) have polluted local ecologies and, as a result, eradicated traditional food and water sources (Spencer et al., 2020). Along with limiting local food production, land dispossession has disrupted a variety of traditional lifeways, a pattern of biocultural loss that continues today. A Guam farmer described plans for the development of a military firing range on a CHamoru cultural site, “a place where we have a lot of Latte Stones” (ancient cultural artifacts) and a wide variety of native plants, utilized as food and medicine for millennia (G4). Lands are the sites where culture and biodiversity entangle, an interdependence that is threatened when traditional land stewardship is lost. Together, colonialism and environmental change in island food systems diminish local food cultures and economies, spur out-migration, and drive farm labor shortages. Ultimately, without laborers as the central, grassroots organizers of agroecosystems, place-based cultural knowledge deteriorates and, with it, food and agrobiodiversity declines.

3.2.1. Declines in dietary diversity

When agroecosystems are well-balanced, traditional diets are the foundation of optimal diet quality and nutritional status. Although long impacted by colonial political and cultural forces, interacting geographies (rural and urban), cultures (traditional and modernized), and trade dynamics (local and imported) form a multidimensional space of food habits, in which dietary traditions can in fact survive. Amassing evidence at this convergence, traditional, locally-sourced diets in small islands have been reclaimed and are largely composed of minimally processed roots, fruits, vegetables, and other foods of plant origin (Marrero and Mattei, 2022). They are high in fiber and essential micronutrients (Shintani and Hughes, 1994; Colombet et al., 2021) and are often supplemented by seafood, seeds, and poultry, thus containing adequate levels of high-quality protein and unsaturated fats (Kawarazuka, 2010; Charlton et al., 2016). Importantly, most foods in a traditional diet are derived from local polycultures, foraging, artisanal fishing, and other small-scale labor. Among the 30 smallholders sampled in Puerto Rico, a total of 38 unique agricultural products were reported as cultivated largely for home consumption, including a variety of citrus fruits, beans, peppers, pumpkins, herbs, and root vegetables (Marrero et al., 2022).

Dietary diversity, characterized by daily consumption of a target number of food groups (Verger et al., 2019), is benefitted by diversified local food production and is a key predictor of micronutrient adequacy and low chronic disease risk in island settings. High dietary diversity is a result of high farm diversity in Fiji, for example, where many households co-produce traditional starchy roots (e.g., taro and cassava), leafy greens, and other vegetables (O'Meara et al., 2019); when used for home consumption instead of income, these foods mitigate risk of micronutrient deficiencies, even among impoverished and multigenerational homes. Agrobiodiversity is similarly associated with high dietary quality, a human-ecosystem symbiosis that is lost in agriculturally poor, import-dependent food supplies (Burlingame et al., 2019; Marrero et al., 2021; Vogliano et al., 2021).

Food market access in island settings, in contrast, has been associated with lower dietary diversity, with highly processed, energy-dense food imports in grocery stores and fast-food restaurants supplanting the greater variety of whole fruits, vegetables, seeds, and lean animal protein available locally (Haynes et al., 2020). With an estimated 80 and 95% of food imported in Puerto Rico and Guam, respectively, a structural dependence on food imports decreases dietary quality and has been implicated in the islands' high rates of chronic disease (Hosey et al., 2009; Marrero et al., 2021). One farmer described the poor quality of food typically available in supermarkets, saying,

“The imported eggs come, like all produce, [from] miles and miles away. By the time it gets here, it is picked early, [and] it is not the full nutritious product.” (G4)

Dishes in social activities have decreased in nutritional quality (Paulino et al., 2008), with the “Americanization” of diets visible as nonperishable, highly-processed and energy-dense table spreads (Hammond and Perez, 2021). In Puerto Rico, losses in cooking skills and knowledge have similarly diminished local food purchasing in favor of food imports (Avilés-Vázquez, 2014). Transnational food corporations exploit island populations by dumping these cheap, hyperpalatable food products, blind to local environments, cultures, and health (Hughes and Lawrence, 2005).

Losses in local agricultural productivity and resulting food import dependence aggravates farm labor shortages—knowing they will be unable to compete with low-priced imports, many farm owners are unwilling to offer fair wages to workers (Gould et al., 2015), who consequently seek out employment in industry and other sectors. As described by a smallholder farmer in Puerto Rico,

“Now construction here is paying—they raised the minimum to 15 dollars—so to recover all of those people that previously worked in agriculture will be complicated.” (P29)

Losses in farm labor reduce the capacity for both wild and farm-produced foods to be harvested in a timely and efficient manner, instead propagating as much as 25–30% of post-harvest food loss and reducing local fresh fruit and vegetable availability (Kumar and Underhill, 2019). Waves of out-migration also result in fractured mutual exchange relationships (Smith, 2016) and, through remittance, recreate them to rely on transnational cash flows (Dalsgaard, 2013). Ultimately, the monetization of

social capital reinforces mass-produced, commercialized food consumption and dietary diversity loss, a nutrition transition toward a global, industrialized diet among islanders both at home and in the diaspora (Hughes and Lawrence, 2005).

3.2.2. Losses to agrobiodiversity

Losing the traditional ecological knowledge of laborers also threatens agrobiodiversity. Species evenness is higher in small-scale farms cultivating traditional crop varieties, who are more likely to employ crop diversification and rotation than their industrial counterparts (Sander and Vandebroek, 2016; Sardos et al., 2016). As a collective, farming communities, composed of many small polycultures with high crop divergence, similarly improve species richness (Jarvis et al., 2008). Even when cash cropping intensifies, biodiversity can be preserved, with farmers likely to spare endemic tree species, for example, that provide ecosystem goods (e.g., foods and medicines) and services (e.g., shade, nitrogen fixation, and erosion control) (Ticktin et al., 2018). Importantly, the biodiversity benefits of smallholder agriculture do not end at the farm gate; through carbon sequestration, soil stabilization, and watershed protection, small-scale farmers contribute to the conservation of habitats throughout adjacent non-farmland areas (Idol et al., 2011; Iverson et al., 2019). A farmer in Guam with four decades of experience shared that they had turned to traditional no-till practices, recognizing the superiority of CHamoru methods in regenerating healthy agroecosystems:

“Like any good commercial farmer back in the day, we had a tractor and a plow and, you know, plowed up the ground; and it looked great, worked great. But then over the years, [...] you have consumed a lot of time and a lot of fuel to do nothing, and you have degraded your soil. Every time you do that, you kill everything in the soil; the biological activity stops or slows down.” (G3)

As evidenced, industrialized agriculture *simplifies* landscapes to streamline extraction, converting complexities in nature into atomized resources for state and corporate interests (Jacques and Jacques, 2012). The globalized production of ultra-processed foods is a key driver of agrobiodiversity loss (Leite et al., 2022). In this agro-industrial complex, laborers are “removed from intimacy with the soil, their labor, their traditional cultures, languages, values, technologies, and lifeways” (Jacques and Jacques, 2012, p. 2983). The skills and knowledge base laborers use to enrich biodiversity are similarly lost, replaced by production that instead responds to market interests. As a farmer in Guam explained, fast-growth crops are preferred and,

“It is only going to be the same crops that are already being grown because they have the higher margin that can pay for that. Other, less profitable crops, you just rule that out.” (G3)

In modernized and aid-dependent agricultural systems, small farmers increasingly respond to pro-industry government incentives (helping overcome otherwise prohibitive start-up investments) (Department of Economic Development

and Commerce, 2019), turning to novel technologies like hydroponics to boost economic productivity and reduce labor costs (Cassidy et al., 2020). Controlled-environment technologies may alter the very fabric of labor dynamics in the agricultural sector, potentially reducing labor shortages in the first place (Azzaretti and Schimelpfenig, 2022). Crucially, however, there are island-context-specific drawbacks, including extensive energy requirements (problematic in areas with fragile non-renewable energy infrastructures) and the need for highly-specialized technical expertise. Relying on artificial inputs and a built, largely sterilized environment, the production scheme also stands in stark contrast to more eco-integrated agroforestry, agroecology, and other agrobiodiverse modes of food production (Joy, 2021). These latter issues, at their core, highlight how technocratic, top-down agricultural solutions can fail to leverage culture- and place-based knowledge and ecosystem services, repeating one-size-fits-all approaches of the industrial monoculture era. They also persist in devaluing labor—the central organizing tenant of extractive-capitalist-colonial agricultural schemes (Jacques and Jacques, 2012).

As the initial entry points and ongoing strategic geopolitical holds of colonial expansion, small island nations are, arguably, at the most advanced stages of agrobiodiversity and biocultural loss, offering a glimpse of futures fully devoid of subsistent human-nature relationships. In this post-industrial era, for example, where laborers in islands primarily work in tourism and other urban service sectors, a spontaneous re-naturing of abandoned lands has occurred. In the last half century, Puerto Rico has experienced an unparalleled rate of reforestation, unaided by human intervention and largely occurring on steep, previously tobacco- and coffee-producing lands (Rudel et al., 2000). Although auto-regenerative ecosystems on islands may sound appealing, passive conservation will likely not restore endemic biodiversity after centuries of intensive human environmental change (e.g., invasive species) (Woinarski, 2010). It also does not ensure that lands will not again be colonized, perpetuating injustice through, for example, conservation efforts that strictly limit land access (Grove, 1996) or foreign-owned real estate development (Hinojosa and Meléndez, 2018). Instead of total abandonment, restoring symbiotic human-ecology relationships through stewardship—in which subsistence farming communities leverage local knowledge to re-diversify food-giving landscapes—can simultaneously bolster livelihoods, enhance food security, and conserve biological diversity.

4. Implications: stewardship as the way forward

Recognizing the *who* behind the what, how, and why of food systems, it is apparent that reclaiming food cultures demands personifying traditional ecological knowledge because, ultimately, knowledge actualizes power—a power held by and for people (Borda, 1988; Haverkamp, 2021). In the pursuit of self-determination and under colonial and climate duress, bolstering food sovereignty interrogates and reconstructs lattices of power, a notion otherwise absent in common conceptualizations of food security (Patel, 2009; Ferguson et al., 2022), and centers

laborers as the rightful and most fundamental protectors of food and biocultural diversity (Claeys, 2015). Labor has historically preserved the wisdom of how to produce healthful, ecologically-viable food because laborers have been most deeply and enduringly rooted in their social and ecological contexts—and remain engaged when climates and economies fall apart. Especially in island landscapes, fundamentally altered by colonial-capitalist extraction, food laborers persist at the intersection of cultural and biological diversity, creating and sharing food through care work in fields and homes and safeguarding knowledge for livelihoods and self-determination.

Considering the enduring centrality of laborers in relational, agroecological food systems, we position stewardship as the active process through which biocultural diversity can be preserved. Stewardship is a caretaking of the earth; as a central tenet of subsistence, stewardship preserves and restores the gifts of natural landscapes as they are used for sustenance by humans, which “remain local, do not need economies of scale to be of service”, and are diverse, with “a family or village [able to] hedge their bets against changes or failures” (Jacques and Jacques, 2012, p. 2984). Heterogeneous income generation is likely a prerequisite of this vision, especially in islands, where out-migration to the mainland for economic opportunity is now commonplace. Without more equitable integration into the marketplace, including acceptance of diversified income streams by government regulation (Avilés-Vázquez, 2014), laborers and their craft will not return from the diaspora. But livelihoods and living wages are not enough. Economies exist within and are products of cultures, which themselves exist within and are products of natural environments. Based on our findings, we conceptualize laborers in island food systems as creating and stewarding biocultural diversity by maintaining nested, synergistic relationships between nature and communities, leveraging local resources, agroecological practices, traditional ecological knowledge, and cultural values to do so (Figure 1). Through the valuing of interdependence and self-determination, labor as stewardship resists isolating economic productivity in colonized small island food systems and, instead, galvanizes food sovereignty and decolonization (Saiz-Álvarez and Palma-Ruiz, 2019).

Decolonial activism—including demands for the end of land grabbing, food dumping, wage exploitation, tenure insecurity, and disaster capitalism—is a crucial first step of this reorganization; along with challenging powers that be, collective organizing dissolves artificial divides between workers and consumers, rural and urban communities (Minkoff-Zern, 2014; Mitchell et al., 2014), revealing a truer interdependence of *people* across food systems to generate solidarity, resistance, and self-determination. In a food sovereignty sense, the values of autonomy and reciprocity underpin this “neo-traditional” food system, one that harkens to embodied histories but situates them in ever-evolving modernity, both self-generated and imposed. In reclaimed mixed economies, for example, stewarded ecosystems can serve multiple, ethno-economic roles (e.g., subsistence, sector development, and tourism) directed by and for local peoples (Baker et al., 2015); agritourism ventures combine these approaches and, in islands, have been employed to preserve food biodiversity (Bernó, 2020). As resistance to colonial import dependencies, islanders have also organized around equitable trade policies, including those that reduce prices

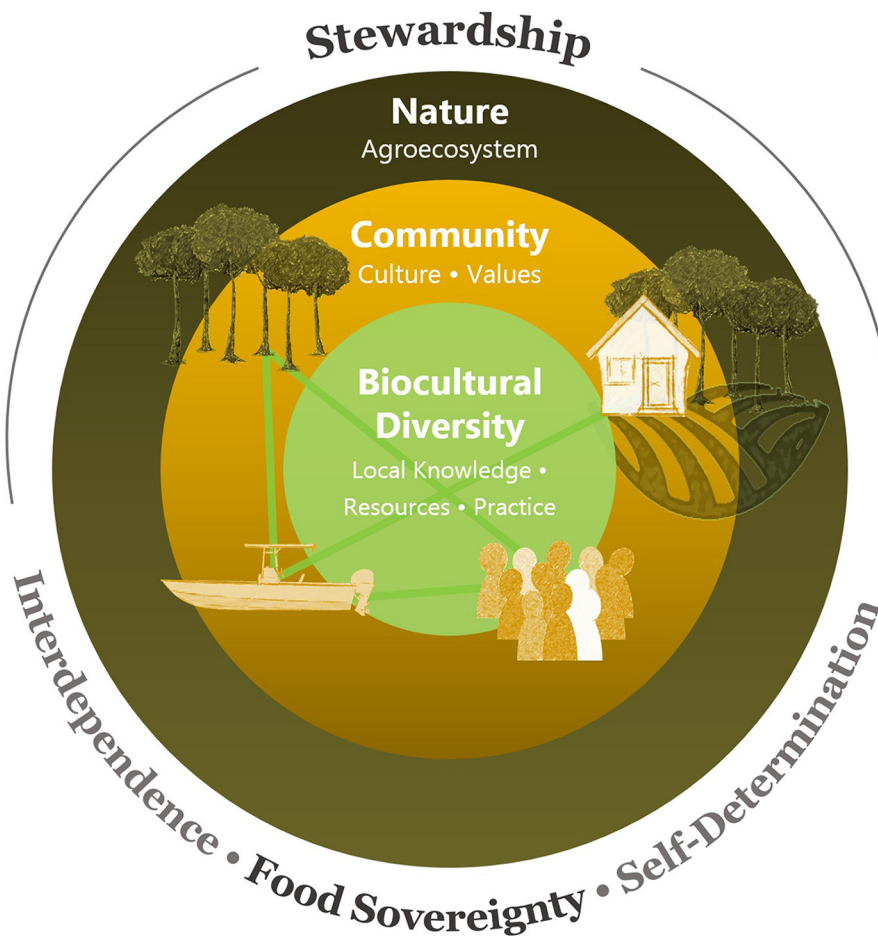


FIGURE 1

Laborers in food systems steward biocultural diversity by maintaining nested relationships between nature and communities, leveraging local resources, agroecological practices, traditional ecological knowledge, and cultural values to do so. Through the valuing of interdependence and self-determination, labor as stewardship galvanizes food sovereignty and decolonization.

and augment healthful food availability (Paddock and Smith, 2018). Increasing local production of fresh fruits, vegetables, seeds, and root crops are central to this goal. In Guam, farmers have already begun shifting from commodities (e.g., rice and field corn) to high-value specialty crops, with local consumers willing to pay for fresh fruits and vegetables that, otherwise, often arrive damaged or spoiled on cargo ships (Marutani et al., 1997); from 2007 to 2018, the proportion of farms selling fruits and nuts rose by 22% on the island, while sectors like livestock rearing stagnated (USDA NASS, 2020b). These transformations, guided by autonomous farmers' decision-making, demonstrate grassroots adaptation at work—a small, but perhaps viable goal.

Stewardship as the guiding principle of food system reclamation centers people and their power, not only to navigate complexity in agroecosystems but also to *care* for that complexity. In this mode of being, stewards safeguard “valuables”, things of importance in their natural and social worlds, and do so through embodied *values*, wisdoms, and collective memories. Laborers, as stewards of biocultural diversity, are not reduced to their economically productive capacity; they are, instead, caregivers, responsive and responsible for remembering place-based and intergenerational knowledge. Along with informal organization

in smallholding communities, codifying stewardship into institutionalized governance will be diverse and decentralized; instead of seeking out optimal agricultural products or practices, bolstering local food production should instead strengthen the interactions *between* the actors safeguarding those products and practices, enabling networks of diversity and innovation (Saint Ville et al., 2015). Likewise, documenting traditional ecological knowledge in small developing island settings should not itself be a process of extraction, whereby global health interests add to their arsenal of “resource management” tools in the name of sustainable development. Unlike disembodied abstraction toward best practice, protecting socioecological systems means understanding that there is no such thing as an ultimate “best” in diverse and ever-changing environmental contexts. Instead, ways of knowing are as dynamic and relational as the peoples and places in which they are created.

5. Conclusions

Food laborers leverage traditional ecological knowledge, robust value systems, and networks of care to sustain livelihoods,

nutrition, and biodiversity. As integral to domestic and community-based food production, they serve as the scaffolding on which compassionate and relational care can thrive. Trade policies favoring food import dependence and large-scale corporate activity have severely reduced local food production in small island developing states, aggravating labor shortages and augmenting food insecurity. Through waves of out-migration and cash remittance, social care relationships have become monetized, reinforcing mass-produced food consumption, poor diet quality, and food cultural loss. Deficits in food labor similarly pose threats to agrobiodiversity, with export-oriented agriculture and fisheries simplifying landscapes to streamline production. To reclaim food systems in Guam, Puerto Rico, and similar island settings, laborers must be valued as stewards of biocultural diversity. Future research is needed to elucidate actionable steps by which such stewardship can be safeguarded, protecting food laborers and their livelihoods through, public policy, business activities, and civil society action. These interventions must center participatory approaches, so that priority-setting at household and community levels effectively guide governance and accountability.

Embedded in networks of individuals, communities, and organizations seeking to advance food sovereignty, this research sheds light on the lived experiences of food laborers in Guam and Puerto Rico, narratives that exist for their own sake and, simultaneously, critically inform broader discourse around coloniality in food systems research. This non-probability sampling approach may engender self-selection bias and limit the representativeness of our findings. Nonetheless, while limited to two US territories, with distinct globalization experiences from other small island developing states, our findings reflect similar trends in nutrition, sustainability, and cultural loss in island communities across the Pacific and Caribbean. In these settings, the goal of food system reclamation can center local knowledge as the fertile grounds on which the flux of nurture and decay comes alive (Haverkamp, 2021); it stresses that knowledge production and its praxis are most aptly wielded by the people seeking their own means of self-determination.

Data availability statement

The datasets presented in this article are not readily available because of concerns for participant privacy. Requests to access the datasets should be directed to amarreroherandez@fas.harvard.edu.

Ethics statement

The work conducted in Puerto Rico was approved by the Institutional Review Board of Harvard TH Chan School of Public Health and Ponce Health Sciences University (Protocols IRB19-0034 and 1903007592). The ethnographic analysis, including

data from Guam, was designated as exempt (IRB22-1368). All participants provided written or oral informed consent.

Author contributions

AM conceptualized the research question, searched and synthesized the literature, collected, analyzed, and interpreted data obtained in Puerto Rico, and wrote the manuscript. CN took part in conceptualization, collected, analyzed, and interpreted data obtained in Guam, and contributed to the manuscript. JM supervised research and contributed to the manuscript. All authors have read and approved the final manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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