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Wild Food Harvest, Food Security, and Biodiversity Conservation in Jamaica: A Case Study of the Millbank Farming Region

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Harvesting wild food is an important coping strategy to deal with food insecurity in farming households across the Caribbean. The practice is tightly connected to the region's unique agrarian history, food heritage, traditional cuisine, and local knowledge of wild or semidomesticated plants. In Jamaica, small-scale farmers are the chief stewards of agrobiodiversity, and their food security and well-being are often dependent on wild food harvest. Yet, there is a paucity of empirical research on the relationship between wild food use, food security, and biodiversity conservation. In this paper, we use the knowledge and lived experience of rural farmers in a remote community (Millbank) at the edge of the Blue and John Crow Mountains National Park (BJMNP) to explore the relationship between wild food harvest and food insecurity within the context of protected area management. Specifically, we seek to (1) characterize different patterns of wild food harvest; (2) examine the relationship between food insecurity and wild food harvest, and (3) explore the implications of forest conservation measures for wild food harvest. Detailed interviews were conducted with 43 farmers to capture data on food insecurity, wild food collection, livelihood satisfaction, household characteristics, farming activities, livelihood strategies, and forest resource interaction. The Food Insecurity Experience Scale (FIES) was used to characterize food insecurity, while participatory techniques were used to develop indicators to assess the well-being of farmers. The results show strong evidence of a relationship between wild food harvest and food insecurity ($p < 0.001$). Overall, the findings support the importance of wild foods to the well-being of rural households and provide empirical evidence for its inclusion in food security, poverty, and biodiversity conservation policies.

Keywords: wild food, food security, traditional knowledge, protected area management, farming system, livelihood

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INTRODUCTION

Harvesting wild food is well-established as an important coping strategy to deal with food insecurity in rural households (Rao and McGowan, 2002; Hickey et al., 2016; Asprilla-Perea and Diaz-Puente, 2018; Erskine et al., 2019; Aceituno-Mata et al., 2021) and increasingly in urban areas as well (Bunge et al., 2019; Garekae and Shackleton, 2020). According to the FAO (2009), "wild species

and intraspecies biodiversity have key roles in global nutrition security" and often constitute a significant portion of the food basket of poor rural households (Bharucha and Pretty, 2010). The word "wild" is taken to mean that the plants and animals are not dependent on human intervention or management for survival (Heywood, 1999). In this study, we use Harris' (1989) definition of wild food as "existing along a continuum [or gradient] ranging from the entirely wild to the semi-domesticated, or from no noticeable human intervention to selective harvesting, transplanting and propagation by seed and graft" (Harris, 1989, p. 12). Despite the estimated one billion people worldwide who incorporate wild foods in their diets (Burlingame, 2000), there is a paucity of empirical research on the relationship between wild food use and food security.

Scientific evidence suggests that the use of wild food is context-specific and related to issues of food shortages (Quave and Pieroni, 2013; Redžić and Ferrier, 2014), food heritage and traditional cuisine (John et al., 2010; Guarrera and Savo, 2016), knowledge of nutritional and medicinal value (Alarcón et al., 2015), enjoyment (Schunko et al., 2015) and taste (Serrasolses et al., 2016; Aceituno-Mata et al., 2021), and availability (Kalle et al., 2020). Many wild or semidomesticated plants are neglected and underutilized on the basis of being perceived as "poor man's food" (Padulosi et al., 2014). While in many cases the use of wild food is an indicator of poverty (Sthapit et al., 2008; Bharucha and Pretty, 2010), this should not be overplayed, as farmers are often conscious of their nutritional benefits and prioritize them over other food items (Kalle et al., 2020). For example, Erskine et al. (2019) found that while there is a clear connection between poverty and wild food harvest, the associated nutritional and cultural value often offset social stigma. In some cases, the exotic nature and health benefits of wild food elevate its commercial value above propagated alternatives. In some areas, wild foods have been found to be of greater significance to food and nutrition security compared to garden food (Ulian et al., 2020).

The food security challenges facing Caribbean islands are well-documented (Fischer et al., 2005; Thomas-Hope, 2017; Ewing-Chow, 2021). The Caribbean is a net importer of food, "a paradise that cannot feed itself" (Ahmed and Afroz, 1996, p. 4). Food insecurity exists when individuals lack adequate "access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (FAO, 2001). Ewing-Chow, 2021 estimates that the food import bill for the region could increase to US$8–10 billion by the end of 2020. In 2018, food imports across CARICOM countries amounted to US$4.75 billion—a 44% increase since 2000 (US$2.08 billion). In Jamaica, approximately 78% of the 220,000 registered farmers cultivate <2 hectares. In 2018, these smallholders contributed $1.7 billion to Jamaica's Gross Domestic Product (GDP) (PIOJ, 2018). In that same year, the agriculture sector contributed 7.1% to GDP and supported 16% of the country's population (PIOJ, 2018). Yet, in 2019, the country's import bill was over $900 million (Stanberry, 2020).

Dietary transitions have paralleled epidemiological challenge in low-income countries (Popkin, 1998) and a decline in domestic food production across the Caribbean. While agriculture's contribution to GDP has diminished over the years, concerns with the growing rate of Non-Communicable Diseases (NDCs) and environmental change risks provide a strong impetus to support domestic food production as a health security strategy. The rise of chronic NCDs in Small Island Developing States (SIDS) increases sensitivity to shocks and stressors (Hassan et al., 2020). Some authors estimated that NCDs accounted for 30% of deaths after hurricanes Irma and Maria, 2017, Dorian, 2019, (Hassan et al., 2020). In some Small Island Developing States (SIDS), NDCs are a greater threat than sea-level rise (Connell, 2013).

Domestic food production is the pillar of local food heritage, which is central to culture and identity. This domestic food production system developed from provisions grounds that were first cultivated by the Maroons (groups of Africans who escaped slavery and established communities in the hilly interior). Subsequently, in an effort to reduce the costs associated with feeding enslaved people, plantation owners permitted their slaves to cultivate provisions grounds on the periphery of the plantations (Wynter, 1971; Mintz, 1989; DeLoughrey, 2011). The provision grounds food became the staples of the Afro-Jamaican diet and were supplemented by food harvesting and hunting of wild pigs and the Jamaica coney (*Geocapromys brownii)* (Parry, 1955; Barker and Spence, 1988; John et al., 2010). Castellano (2021, p. 25) designates these practices by which the Maroons survived as "guerilla foraging and gleaning." Parry (1955, p. 19–20) goes so far as to suggest that, "Without the institution of slave provision grounds, without the constant search for crops to stock those grounds, emancipation, in the form which it took in Jamaica, would have been economically and socially very difficult, perhaps impossible." Beckford (2012) posits that solutions to food security challenges facing the Caribbean should incorporate the (re)discovery of traditional foods for popularization and (re)inclusion in local diets. With reference to Jamaica, the author also observed a pattern of diminishing dietary diversity, alongside erosion of traditional and wild foods from local diets. Strengthening local food production systems would provide multiple economic and health co-benefits—as diseases such as hypertension and diabetes exert considerable pressures on Caribbean economies (Abdulkadri et al., 2009) and well-being.

Previous research on food security in the Caribbean have primarily focused on historical and contemporary institutional constraints on domestic food production (Campbell, 2011; Beckford, 2012; Saint Ville et al., 2017a,b) and agricultural innovation (Lowitt et al., 2015) in local food systems (Gumbs, 1981; Timms, 2006; Beckford and Campbell, 2013). There is a dearth of phenomenological research on food security and well-being among rural households across the region. Scholars from various backgrounds have converged on the idea that a lack of political will to support domestic food systems (Weis, 2004; Timms, 2009) and even marginalization and neglect (Barker, 1993; Borras et al., 2012) in some countries has resulted in multiple breadbasket failures across the region. There is also agreement on the idea that strengthening the role of marginalized people in rural areas provides multiple economic, health, and livelihood security co-benefits. Through the lens of traditional food systems and rural livelihood, this research focuses on the

relationships between harvesting wild food, food security, and biodiversity conservation.

TRADITIONAL FOOD SYSTEM AND FOOD SECURITY

In Jamaica, small-scale farmers play a key role in the development of nutrition-sensitive agriculture and food systems. The IFPRI (2020) defines a food system as "the sum of actors and interactions along the food value chain—from input supply and production of crops, livestock, fish, and other agricultural commodities to transportation, processing, retailing, wholesaling, and preparation of foods to consumption and disposal. Food systems also include the enabling policy environments and cultural norms around food" (p. 8). Traditional knowledge systems have been central to the evolution of local food systems, are unique and dynamic (Vandebroek et al., 2011) and encapsulates the shared histories and experiences developed and maintained by local people (Beckford and Barker, 2007). Small-scale farmers are the chief stewards of traditional food culture, which is central to local economies, livelihoods, and food security. Since the effectiveness of food system transitions are mediated by local knowledges, understanding these knowledge systems and the practices they inform, is essential for climate change policy, land use governance, and livelihood resilience (Gamble et al., 2010; Popke et al., 2016).

Traditional food forests and kitchen gardens are resilient agricultural systems that are still practiced across Jamaica. Food forests are also referred to as kitchen gardens (Hills, 1988; Brierley, 1991) and provide multiple cultural and social services while supporting a space for farmer experimentation (Beckford and Campbell, 2013). Food forests exhibit spatial and temporal transitions over time that are aligned with societal changes and are recognized as ecologically sound and sustainable farming systems. Food forests can also be conceptualized as spaces for farmer experimentation and a traditional knowledge product of ecological, biocultural heritage, and economic significance (Kalle et al., 2020). It is a classroom for farmer knowledge transfer, a playground for experimentation, and a repository of cultural and spiritual assets. A communal food forest is not just "an adaptive survival strategy among resource-poor farmers" (Thomasson, 1994, p. 4), for example, as a source of food in the immediate aftermath of a hurricane or tropical storm, but they are also important spaces for innovation and social learning among small farmers.

Local crops such as yam (*Dioscorea alata* L.), dasheen (*Colocasia esculenta* L. Schott), and breadfruit [*Artocarpus altilis* (Parkinson) Fosberg] (POWO, 2019) among others are identified as neglected and underutilized (Padulosi et al., 2014) with potential to provide multiple co-benefits to food security and the preservation of food heritage (Picking et al., 2019). In this study, we refer to food heritage in the context of food systems—defined as the "dynamic and complex bodies of know-how, practices and skills that are developed and sustained by peoples/communities with shared histories and experiences" (Beckford and Barker, 2007, p. 118). There is limited systematic research on the knowledge and use of wild food resources across the Caribbean. The focus has primarily been on the development of food crops for large-scale commercial markets, with limited attention to the development of conservation-based economies in rural areas.

Jamaican food is a rich blend of native and exotic crops introduced primarily by the Taino, African, Asian, and Europeans (Higman, 2008; DeLoughrey, 2011; Picking et al., 2019). In the Millbank farming region, the combined knowledge and practices from African and Amerindian ancestors has resulted in a rich biocultural heritage of local plant use—especially from the Blue and John Crow Mountains (BJCM) (Davis-Morrison and Barker, 1997). These mountains contain a rich array of endemic plants—one of the highest among world's islands for plant endemism (Davis et al., 1997). Bertzky et al. (2013) describe the BJCM National Park as an irreplaceable protected area for biodiversity conservation in the Caribbean. As Millbank's population decreased over time, abandoned food forests and provision grounds at the edge of the BJCM became a communal resource pool, providing a diverse range of ecosystem, cultural, social, and economic services.

The BJCMNP provides a range of different agroecosystem services that are crucial to farmers' well-being in the Millbank community. The community remains heavily reliant on the forest for resources beyond subsistence, such as bamboo for artisanal productions. The dependence on the forest's wild food reflects not merely a dependence for food but a sense of the nutritional value and perceived health benefits of more "natural" food. In some parts of the world, the diversity of wild food collected by households can be twice as much as cultivated crops (Hickey et al., 2016).

Against the background of structural weakness in the agricultural sector emanating from decades of structural inequities, coupled with the ecological novelties associated with climate change, Jamaica provides an ideal case for assessing the role of traditional food systems within the context of food security and biodiversity conservation. There is a paucity of research geared toward understanding food heritage and the sustainability of traditional food production systems in the Caribbean. A study of this nature is deemed desirable because of the increased role domestic food production is likely to play in the economic well-being of Jamaicans in general, and the livelihood security of resource-poor farmers in particular. It is anticipated that by doing this research, a valuable contribution will be made to the discussion on the role of wild and semidomesticated plants in the nation's food security policies and strategies.

METHODS

The research utilized both qualitative and quantitative data collection and analysis techniques. Composite indicators representing food insecurity and livelihood satisfaction were used to organize and explore patterns of wild food use in the study area. Questionnaire survey was the main method used to collect quantitative data, while key informant

interviews facilitated the acquisition of qualitative data. A census approach guided the collection of primary survey data. In-depth interviews were conducted with farmers ($n = 43$) to capture data on food insecurity, wild food collection, livelihood satisfaction, household characteristics, farming activities, livelihood strategies, and forest interaction. To complement the survey and acquire rich qualitative data, key informant interviews were also conducted with leaders of the Farmers Association (Bowden Pen) and senior members of the Millbank community. Complex challenges are best understood through open discourse (Gee and Green, 1998), and the qualitative interviews provided rich time-bound perspectives on the lived experiences of farmers in the Millbank community. The key informant interviews ($n = 11$) also provided farmers with a unique opportunity to discuss ideas, identify critical knowledge gaps, uncertainties, constraints to harvesting wild food, and other livelihood security challenges.

The FAO's Food Insecurity Experience Scale (FIES) was used to characterize food security, and participatory techniques were used to develop indicators to assess livelihood conditions. The FIES was developed under the FAO's Voices of the Hunger project in 2015 (Ballard et al., 2013). The project promoted the adoption of the FIES methodology by national governments as a simple tool that facilitates detailed analysis of food insecurity across different social, economic, institutional, and geographical factors. The FIES is relevant to the region as it is derived from the Latin American and Caribbean Food Security Scale and the US Household Food Security Module. The eight (Yes/No) questions reflect the three domains of food insecurity: changes in food quantity, uncertainty/anxiety, and changes in food quality (FAO, 2019). Based on the number of positive responses, an individual can be placed on a scale from food secure to severe food insecurity.

The FIES provides quantitative estimates of proportions of the population lacking access to nutritious and sufficient food as a result of a lack of money or other resources. The estimates are based on responses to eight questions that reflect conditions that shape access to food. The prevalence of undernourishment and severe food insecurity are the main indicators used to monitor progress toward the eradication of hunger (SDG indicator 2.1.1). The "State of Food Security and Nutrition in the World" reports for 2018 and 2019 incorporated the Food Insecurity Experience Scale (FIES) as a core indicator for monitoring SDG Target 2.1.2: the Prevalence of Moderate or Severe Food Insecurity (FAO, 2019). However, in both reports data were lacking for the Caribbean in all dimensions of the measure. In most cases, the Caribbean region is grouped with Latin America—thereby masking country-specific conditions.

Farmer survey data were combined with emergent themes from key informant interviews to assess key research questions. The aim of combining both methods is to facilitate a more in-depth assessment of the conditions and processes that shape food insecurity and livelihood satisfaction rather than a simple measurement of the concept. The overall design of the study enabled the researchers to gain a unique understanding of the food system challenges facing farm families in the study area.

Study Area

The Rio Grande Valley (RGV) is situated between the Blue and John Crow Mountains National Park, which spans over 41,000 hectares of forested land. The Rio Grande river system is one of the largest on the island. An estimated 25,000 inhabitants occupy the RGV (Statistical Institute of Jamaica, 2011). The watersheds of upper sections of the Rio Grande comprise one of the last remaining undisturbed stretches of tropical broad-leafed montane rainforest in Jamaica. The river separates the contrasting geologies of the two sides of the river which have resulted in a mosaic of complex of soil types. To the west are the steeply rising Cretaceous slopes of the spurs and ridges of the Blue Mountains, while to the east are the slopes of the Palaeocene limestone escarpment of the John Crow Mountains. The mountainous, deeply dissected topography of the upper Rio Grande is dominated by steep slopes, many of which exceed 30 degrees and are prone to erosion and mass wasting. The local environment is prone to multiple hazards including erosion, mass wasting, flooding and landslides from torrential rainfall. The Upper watershed region accounts for 40% of this population with the highest concentration in the Moore Town—considered to be the capital of the Windward Maroons. The Millbank community is situated on the edge of the forests within the buffer zone of the BJCMNP conservation area (**Figure 1**). The Upper RGV is exposed to hazards such as landslides and flooding that are accentuated by storm events. Livelihood systems in the area are primarily centered on agriculture. The natural and social history of the Blue and John Crow Mountains position the region as an important site for the examination of how global changes are manifest in rural agrarian societies and are mediated by traditional knowledge systems.

ANALYSIS

Profile of Wild Food Collectors

Of the farmers surveyed, 77% indicated that a member of their household harvests food. Similar to some regions in Africa, the most commonly harvested wild foods in the study area include fruits, roots and tubers and animal products (Hickey et al., 2016). Yam (*Dioscorea* spp.) is the most frequently harvested food, followed by banana and plantain, respectively, (Musa acuminata Colla and *Musa balbisiana* Colla), fruits, and hunting wild pigs, respectively. Of significance to the Millbank area is the yampie (*Dioscorea trifida* L.f.) crop which, unlike all other species of yam which were introduced into the region from Africa, is native to the Caribbean and Central and South America. Yampie was introduced to Jamaica by the Taino (Rashford, 1991) and was still being harvested by farmers at the time of this study. Our findings reaffirm the importance of yam to local and national food security (Beckford et al., 2011). While farmers mainly collect yam, banana, fruits, and hunt wild pigs from the forest, key informant interviews revealed a much wider range of food collected (**Table 1**) and ecosystem services provided by the forest (**Figure 2**). Using the Plants of the World Online database (POWO, 2019), a list of the wild foods (and common use) mentioned by farmers during the interview are presented in

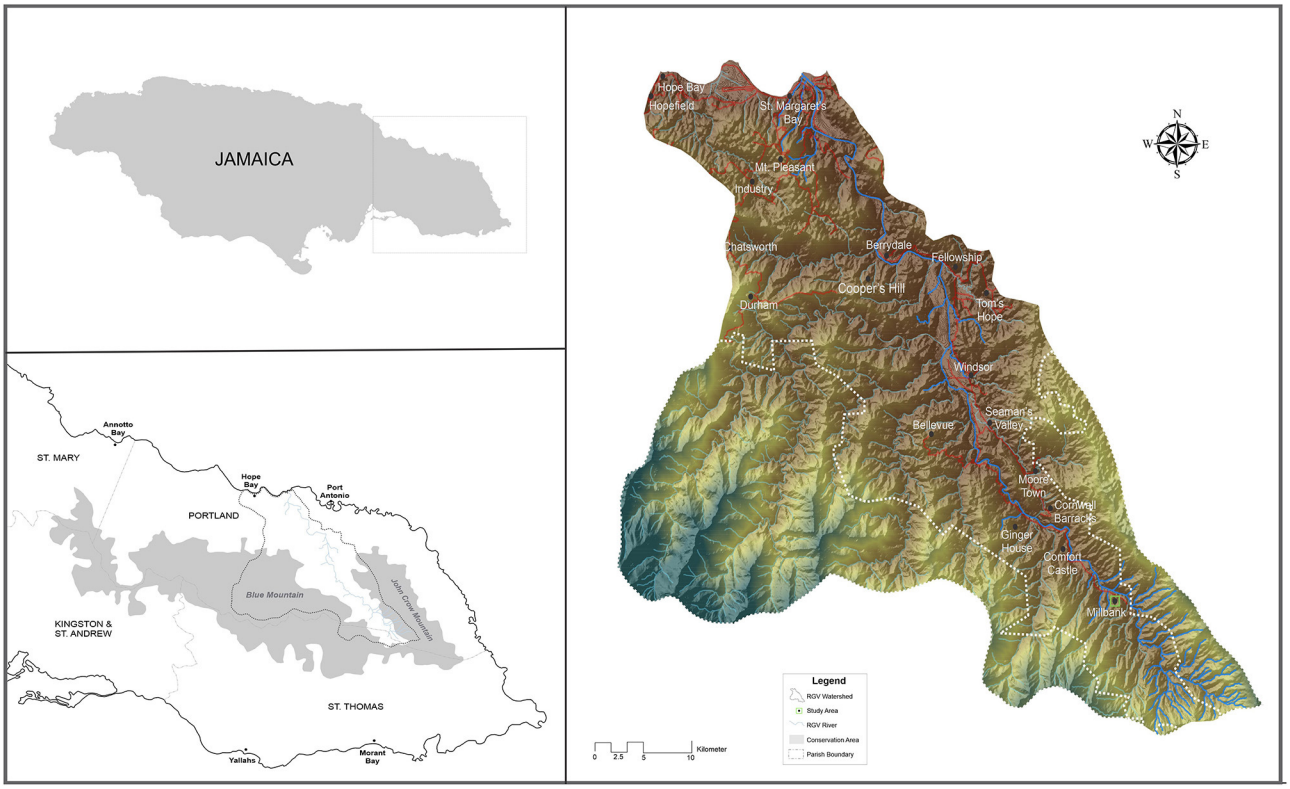

FIGURE 1 | Millbank, Upper Rio Grande Valley, Jamaica.

Table 1. These wild food sources most likely are harvested from land which was formerly cultivated but has since been abandoned and reverted to forest land.

Based on the main types of food harvested from the forest (and for analytical convenience), farmers can be described as either *specialized* or *multiple food* collectors. Specialized collectors are farmers who typically harvest one type of food from the forest, while multiple food collectors target more than one food type. Approximately 47% of the sample are multiple food collectors, 30% are specialized, and 23% are non-collectors. The median age of farmers (55 years) is used to separate farmers into younger and older age groups. Younger farmers account for 65 and 60% of the multiple food and non-collector groups, respectively, while older farmer represents 69% in the specialized category. The fact that farmers who collect multiple foods and non-collectors are predominantly younger farmers, and specialized collectors are mostly older farmers implies that age is an important consideration when characterizing use of wild food in the study area. The fact that older farmers are more specialized is unsurprising. One possible explanation is that older farmers might find it more physically challenging to traverse multiple (and distant) areas of the forest and may choose to focus on a specific area and crop.

Farmers reported that a concerning trend in the Millbank community is the declining number of women in the community. These demographic changes are known to impact farmers field decisions (Ji et al., 2017), and can shape patterns of wild food harvest. Women play a critical role in the preservation and transmission of culture in the RGV. One farmer explained that in the Millbank community, women are the chief custodians of traditional knowledge of medicinal plants, herbs and spices that are used for food and spiritual ceremonies. This is especially true as it relates to the preparation of authentic Jamaican food. As Picking et al., 2019 observed, it is the way foods (and drinks) are "prepared or combined…that distinguish[ies] them as uniquely Jamaican" (p. 104).

Socio-spatial characteristics of wild food harvest are also reflected in the distance traveled by farmers to collect food. On average, most of the farmers (37%) journey more than 3 miles into the forest for food. A slightly lower proportion (33%) indicated that they do not go beyond a mile in the forest for food. Approximately 81% of the specialized collectors operate within 3 miles of the forest, while 50% of the multiple food collector group typically traverse more than 3 miles into the forest (**Table 2**). In terms of the foods harvested, majority (63%) of the older farmers indicated yam, followed by banana and plantain (25%), fruits (8%), and wild pig (4%). Most farmers in the younger cohort also collect yam (42%) followed by banana and plantain (24%), fruits (18%), and wild pig (16%).

According to one of the farmers interviewed, the number of cultivated plots has declined over the years, but the use of the forest has increased—primarily as more farmers access wild food

TABLE 1 | List of wild food and fruits and their common uses.

Name of crop	*Family*	*Species name*	Common name	Common use	References
Yam	*Dioscoreaceae*	*Dioscorea alata* L.	Renta yam	• Food yams are used principally for the carbohydrate they provide.	Muzac-Tucker et al., 1993; POWO, 2019
		Dioscorea alata L.	St. Vincent yam	• Secondary metabolites such as steroidal saponins, diterpenoids, and alkaloids, which have been exploited for making poisons and pharmaceutical products.	
		Dioscorea trifida L.f.	Yampie yam		
Fruits	*Myrtaceae*	*Syzygium malaccense* (L.) Merr. and L.M.Perry	Otaheite Apple	• Edible portions possess antioxidant capacity. • Leaves have anti-inflammatory and antioxidant effect as well as cytotoxic properties. • The bark of the plant shows glycemia/cholesterolemia-lowering effects.	Batista et al., 2017; POWO, 2019
	Sapotaceae	*Manilkara zapota* (L.) P.Royen	Naseberry	• Primarily cultivated for its fruit, timber, and latex. • Used for its analgesic, anti-arthritic, anti-pyretic, anti-microbial, antioxidant, anti-tumor, hypoglycaemic, and hypocholesterolemic properties.	Moura et al., 2019; POWO, 2019
	Anacardiaceae	*Mangifera indica* L.	Mango	• The leaves, bark, fruit peel and flesh, roots, and flowers are used as anticancer, anti-inflammatory, antidiabetic, antioxidant, antibacterial, antifungal, anthelmintic, gastro-protective, hepato-protective, immunomodulatory, antiplasmodial, and antihyperlipemic agents. • Provides shade, shading trees are increasingly being recognized to benefit biological regulation in tropical agroforestry systems. • Useful as dyes, mosquito repellent, dental care, carpentry, and light construction.	Tscharntke et al., 2011; Ediriweera et al., 2017; POWO, 2019
	Sapindaceae	*Blighia sapida* K.D.Koenig	Ackee	• Heartwood of the mature trunks are hard and termite resistant, therefore ideal for furniture and other construction use. • The immature fruit are used to make soaps and the pod extract can be used in cosmetics. • Extract from flowers used cologne production. • Oil extracted from the seed has pesticidal properties and the crushed fruit can be used to poison fish. • Ackee has many folk medicinal uses. Repeated small doses of an aqueous seed extract have been used to expel parasites. Ackee pod poultice has been used for skin infections, ringworm, and liver spots. The ripe arils, with sugar and cinnamon, have been given as a febrifuge and as a treatment for dysentery. The bark mixed with pungent spices has been applied as an ointment to relieve pain. The crushed new leaves have been applied to the forehead to relieve severe headache while leaves crushed with salt have been poulticed on ulcers, and ackee leaf tea used as a cold remedy.	Mitchell et al., 2008; POWO, 2019
	Anacardiaceae	*Spondias dulcis* Parkinson	June plum	• Commonly used as a food source. • The astringent bark is used as an antidiarrheal. • Used in eyesight enhancement and eye infections. • Used to cure itchiness, internal ulceration, sore throat and inflammation of skin. • Used as an antidote. • The polysaccharide identified from the fruits pulp has eliciting activity on peritoneal macrophages. • Leaves of the plant has shown antidiabetic activity.	Islam et al., 2013; POWO, 2019
	Annonaceae	*Annona muricata* L.	Soursop	• Widely used in traditional medicine to treat illness such as diarrhea, dysentery and fever, pain, respiratory and skin illness, internal and external parasites, bacterial infections, hypertension, inflammation, diabetes, and cancer.	Coria-Téllez et al., 2018; POWO, 2019

(Continued)

TABLE 1 | Continued

Name of crop	*Family*	*Species name*	Common name	Common use	References
				• Also used for treating respiratory tract, heart, and kidney infections. • Used to treat animal bites and stings. • Used to control obesity.	
	Annonaceae	*Annona squamosa* L.	Sweet Sop	• Used as an insecticidal, antitumor agent, anti-diabetic, antioxidant, anti-lipidemic, anti-inflammatory agent. • Used in the management of diabetes and has antispasmodic activities. • Useful against heart failure, palpitations, and also aids in digestion. • The seeds are reported to have anti-parasitic activities (against lice). • Crushed leaves are applied on ulcers and wounds and a leaf decoction is taken in cases of dysentery. • A decoction of the leaves is imbibed either as an emmenagogue, febrifuge, cold remedy, digestive, or to clarify urine, while both the leaves or bark decoction is given as a tonic and to halt diarrhea. • The leaf decoction is also employed in baths to alleviate rheumatic pain.	Coria-Téllez et al., 2018; Zahid et al., 2018; POWO, 2019
	Sapindaceae	*Melicoccus bijugatus* Jacq.	Guinep	• Fruit pulp and roasted embryo used as a source of food. • Fruit pulp may have potential toxicological effects when consumed excessively or during periods of growth or high iron requirements.	Bystrom, 2012; POWO, 2019
	Sapotaceae	*Chrysophyllum cainito* L.	Star Apple	• Possesses strong antioxidant properties either *in vitro* or *in vivo*. Extracts from the leaves, stem bark, fruits, peel, pulp, or seed are also used in traditional medicine for curing diabetes and fighting against bacterial, fungal, and viral infections. • Leaf extract alone or in a complex formula exhibits anti-inflammatory responses by reducing hypersensitivity, acts as inflammatory markers, and has antinociceptive effects. • Leaf extract also increases wound healing speed and assists in regulating fat uptake. • Additionally, fruits show anticancer activity against osteosarcoma.	POWO, 2019; Doan and Le, 2020
Banana	*Musaceae*	*Musa acuminata* Colla *Musa acuminata* Colla *Musa acuminata* Colla	Robusta Lacatan Gros Michel	All parts of the banana plant have medicinal applications: Medicinal use • Flowers used to treat bronchitis and dysentery and on ulcers; cooked flowers are given to diabetics; • The astringent plant sap used in cases of hysteria, epilepsy, leprosy, fevers, hemorrhages, acute dysentery and diarrhea, and it is applied on hemorrhoids, insect and other stings and bites;	Cheesman, 1948; Kundapura Venkataramana et al., 2015; POWO, 2019
Plantain		*Musa balbisiana* Colla	Plantain	• The roots are administered in digestive disorders, dysentery and other ailments; • Banana seed mucilage is given in cases of diarrhea. • Young leaves are placed as poultices on burns and other skin afflictions; • The astringent ashes of the unripe peel and of the leaves are taken in dysentery and diarrhea and used for treating malignant ulcers; • Antifungal and antibiotic principles are found in the peel and pulp of fully ripe bananas; • A fungicide in the peel and pulp of green fruits is used as a fungicide in tomato production.	

(Continued)

TABLE 1 | Continued

Name of crop	*Family*	*Species name*	Common name	Common use	References
				• Used as a possible blood pressure regulator, inhibits gastric secretion and stimulates the smooth muscle of the intestines. Non-medicinal use • Banana and plantain fibers are used to weave ropes, mats and other textiles. Tannins present in ripe banana peel act as tanning agents in leather processing. • The pseudo-stem is often most valuable economically if it is chopped and left in a field for its organic matter content and numerous other benefits.	
Dasheen	*Araceae*	*Colocasia esculenta* (L.) Schott	Dasheen	• The pressed juice of the petiole is stypic, and may be used to arrest arterial hemorrhage. • It is sometimes used in earache and otorrhoea, and also as stimulant and rubefacient and also in internal hemorrhages. • Leaf juice is stimulant, expectorant, astringent, appetizer, and otalgia. • The juice expressed from the leaf stalks with salt is used as an absorbent in cases of inflamed glands and buboes. • Cooked vegetable contains mucilage and found to be an effective nervine tonic. • Decoction of the peel is given as a folk medicine to cure diarrhea. • Increases body weight, prevents excessive secretion of sputum in asthmatic individuals. • Juice from the corm is used in cases of alopecia. • Internally, it acts as a laxative, demulcent, anodyne, galactagogue and is used in cases of piles and congestion of the portal system; also used as an antidote to the stings of wasps and other insects. • The corm is used by people of the Munda tribe as a remedy for body ache.	Prajapati et al., 2011; POWO, 2019
Breadfruit	*Moraceae*	*Artocarpus altilis* (Parkinson) Fosberg	Breadfruit	• A multipurpose species that provides food, medicine, building materials, and feed. • Can be subjected to different types of culinary preparations, including; steaming, baking, or frying at the mature stage. • Can be transformed into flour or used for making cakes. • Its latex and bark are used as traditional medicine to treat sprains, sciatica, and skin diseases. • The trunk is used for construction. • Its leaves have traditionally been used to treat cirrhosis of the liver, hypertension, and diabetes. • The breadfruit has a high percentage of carbohydrates, mostly as starch, and a small amount of protein but of excellent quality. • Depending on the cultivar, bread flour contains excellent minerals, such as calcium, iron, potassium, magnesium, phosphorus, and sodium. • In addition to carbohydrates, breadfruit is also a rich source of fiber, vitamin C, and flavonoids. • While breadfruit is a valuable food resource, its current use is limited by the poor storage properties of its fresh fruits.	Soifoini et al., 2018; POWO, 2019

[a] *Voucher specimens were not collected.*

(which is defined by residents as food harvested from the forest which they have not specifically planted, but which have resulted from previous cultivation). Frequency of wild food harvest varies across the sample. Approximately 30% of the sample indicated that they rarely collect wild food from the forest, while 37% indicated that they collect wild food frequently or very frequently. Majority of the specialized collectors indicated that they visit the forest for food frequently (61%). Half of the farmers who

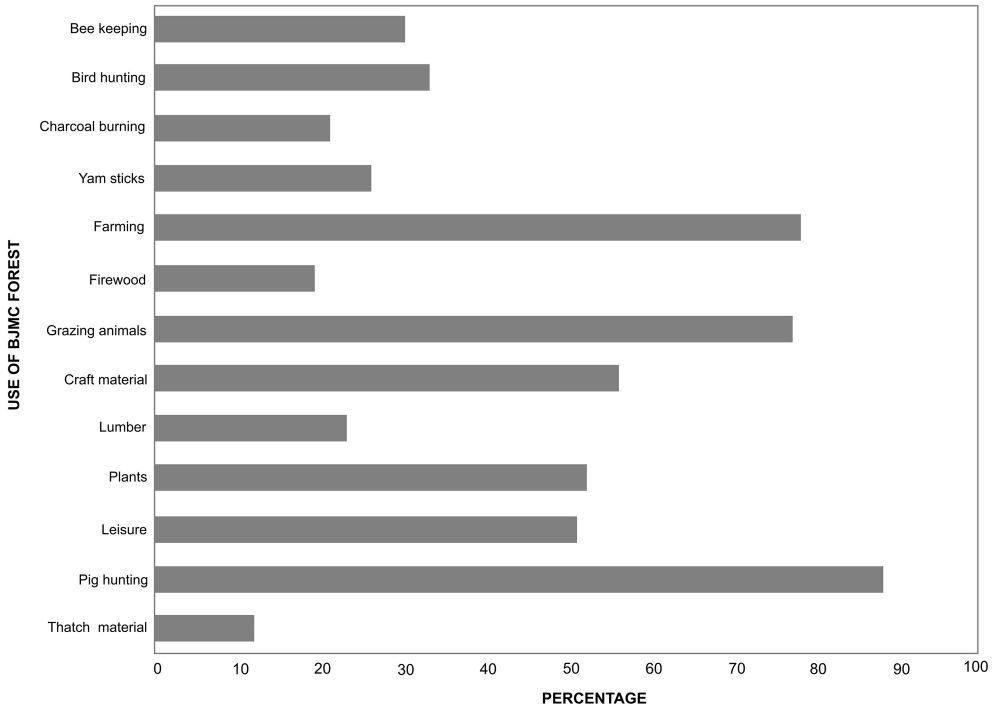

FIGURE 2 | Main provisional services of the BJCM reported by farmers.

TABLE 2 | Wild food harvest by distance and age.

Wild food harvest	Sample (%)	Distance (miles)			Age (years)	
		<1	1–3	>3	Younger	Older
Yam	94	36	32	32	52	48
Banana/Plantain	46	27	27	46	60	40
Fruits	27	22	33	45	78	22
Wild pig	21	43	14	43	86	14

collect multiple foods indicated that they rarely use the forest. In the Millbank area, farming and wild food harvest are mutually reinforcing activities. Replanting after harvesting wild food is an established rule among farmers, and it is not uncommon for farmers to take advantage of the rich forest soils to cultivate other crops.

In terms of seasonality, 53% of the sample indicated that they typically collect wild food between November and April. A few (10%) farmers also indicated the months of June and July which overlaps with the dry season and mid-summer dry spell, respectively (Curtis and Gamble, 2007). This is understandable since Millbank is one of the wettest areas on the island and traversing the forest during the rainy season could be challenging. Projected impacts of climate change on seasonality could disrupt patterns of wild food collection. Across the Caribbean, additional warming by 0.2–1.0°C, could lead to a predominantly drier region (5–15% less than present-day), and a greater occurrence of droughts (Taylor et al., 2018) along with associated impacts agricultural production and yield in the region (Gamble et al., 2017; Hoegh-Guldberg et al., 2019). These changes could undermine the climate-sensitive livelihood of wild food collectors and exacerbate food insecurity challenges (Campbell ea al., 2010; Gamble et al., 2017; McCubbin et al., 2017).

Most of the respondents (51%) indicated that wild foods account for <50% of their household income. A further 30% of that total stated that wild food contributed to <25% of their household income. Only 6% of the sample depend on wild food for >75% of their household income. Similar results were observed by Hickey et al. (2016) who conducted a global assessment of the economic contribution of wild food to rural livelihoods and found that while majority of the sampled households (77%) were involved in wild food collection, it only contributed 4% (average) of overall household income. Most of the wild food is consumed at the household level (42%).

Eighteen percent of the sample indicated that they harvest wild food for commercial purposes, while the remaining farmers indicated that they use wild food for both commercial and subsistence purposes. Fifty-four percent of the sample indicated that their household income is completely dependent on farming. Of this total, 85% depend on the forest for food. Regardless of specialization, most farmers (70%) indicated that wild food is very important to their survival. Multiple food collectors use a greater proportion of wild food for household consumption compared to specialized collectors. Of the total number of farmers who indicated household consumption as the main purpose for collecting wild food, 79% are multiple food collectors. Conversely, 67% of those who indicated sale as their main purpose are specialized collectors.

Collection of wild foods also cut across educational divides. All four of the farmers with post-secondary level schooling indicated that they collect food from the forest. Most of the farmers indicated that they have been collecting wild food from the forest for more than 15 years. While age did not emerge a good explanatory factor for wild food harvest, there is a slightly higher proportion (80%) of older farmers (defined as above the median age) compared to younger farmers (below the median age) 74%. Similarly, access to land does not seem to be an influential factor to the use of wild foods. Of the farmers who collect wild food, 52% have secure land tenure arrangements (owned, family land, and maroon property) while the others have insecure land tenure arrangements (capture/settled, rent-free, and leased). Only 12% of the sample indicated that they own the land on which they do most of their farming. Most of the farmers (37%) operate on family land (tenure system based on kinship ties), while the others operate on capture/settled (24%), leased (15%), rent-free (9%), and communal/Maroon land (3%). Forty-two percent of the sample indicated that they are cultivating more farmland compared to when they started farming. This could be related to increased land availability and improved marketing conditions.

Food Insecurity and Wild Food Harvest

The results of the FIES show that majority of the sample (47%) is moderately food insecure, 44% is either mildly insecure (25%) or food secure (19%), and 10% is severely food insecure. There is strong evidence of a relationship between wild food and food insecurity ($p < 0.001$). Most of the farmers (60%) who harvest wild food are either moderately (54%) or severely (6%) food insecure. This finding reaffirms the importance of wild foods to the food security of farmers in Millbank, but is incongruent with other observations (Hickey et al., 2016) on the connections between wild food extraction and self-stated food insecurity.

Analysis of the dimensions of the FIES and categories of wild food harvest reveal considerable variability across specialization (**Figure 3**). Of the eight questions, specialized collectors account for the highest proportion in three: farmers who were worried they would run out of food because of a lack of money or other resources (54%); those who were unable to eat healthy and nutritious food because of a lack of money or other resources (62%), and households that ran out of food because of a lack of money or other resources (43%). Multiple food collectors also accounted for the highest proportion of affirmations in three of the eight questions: those who ate only a few kinds of foods because of a lack of money or other resources (56%), those who ate less than they thought they should because of a lack of money or other resources (48%) and, those who were hungry but did not eat because there was not enough money or other resources for food (100%). Non-collectors, account for the highest proportion of respondents who went without eating for a whole day because of a lack of money or other resources (61%) as well as those who are food secure (75%).

Most (84%) of the specialized collectors and 60% of the non-collectors are either moderately insecure or food secure. Conversely, 80% of the multiple food collectors experience moderate to severe food insecurity. This finding reaffirms diversification as a risk-spreading strategy to cope with uncertainty. There was no statistically significant relationship between the frequency of wild food harvest and food insecurity. Likewise, the percentage contribution of wild food to household income is not a good indicator of food insecurity. Regardless of income contribution, 63% of farmers in the severely food insecure category indicated that wild food harvest is very important to their family—compared to 15% of those who are food secure. In terms of the use, 57% of those who are severely food insecure indicated they use wild food for both sale and household consumption. Of the farmers who are food secure, 67% indicated that they primarily use wild food for household consumption.

Farmers who are more food insecure tend to go further in the forest for wild food. More specifically, 83% of the farmers who travel more than three miles in the forest are either moderately or severely food insecure. Combined, there is a higher proportion of female farmers in the mildly insecure and food secure categories (55%) compared to male farmers (40%). None of the female farmers were found to be severely food insecure. Younger farmers (below the median age 55) are generally more food insecure than older farmers (above the median age 55). Of the total number of farmers in the severely insecure category, 75% are in the younger cohort. The opposite is the case for the food secure category with 75% falling in the older cohort.

Livelihood Satisfaction and Wild Food Harvest

Prior to the survey, semi-structured and informal interviews were conducted with farmers in the community to determine what is most important to their livelihood. The qualitative data from the surveys is reported elsewhere. We note this aspect of our data collection here to provide context of our broader research approach. Eight factors emerged from the discussion: (1) overall income from farming, (2) soil quality, (3) water availability, (4) ability to manage hazards (erosion, landslide, flooding and pest and diseases), (5) extension support received, (6) market for produce, (7) types of crops cultivated and; (8) ability to support family from farming. From these factors, a livelihood satisfaction scale (LSS) was developed to determine how farmers feel about these aspects of their livelihood. Farmers indicated their level of satisfaction (2 = satisfied, 1 = neutral and 0 = dissatisfied), which were then combined into a composite variable to reflect

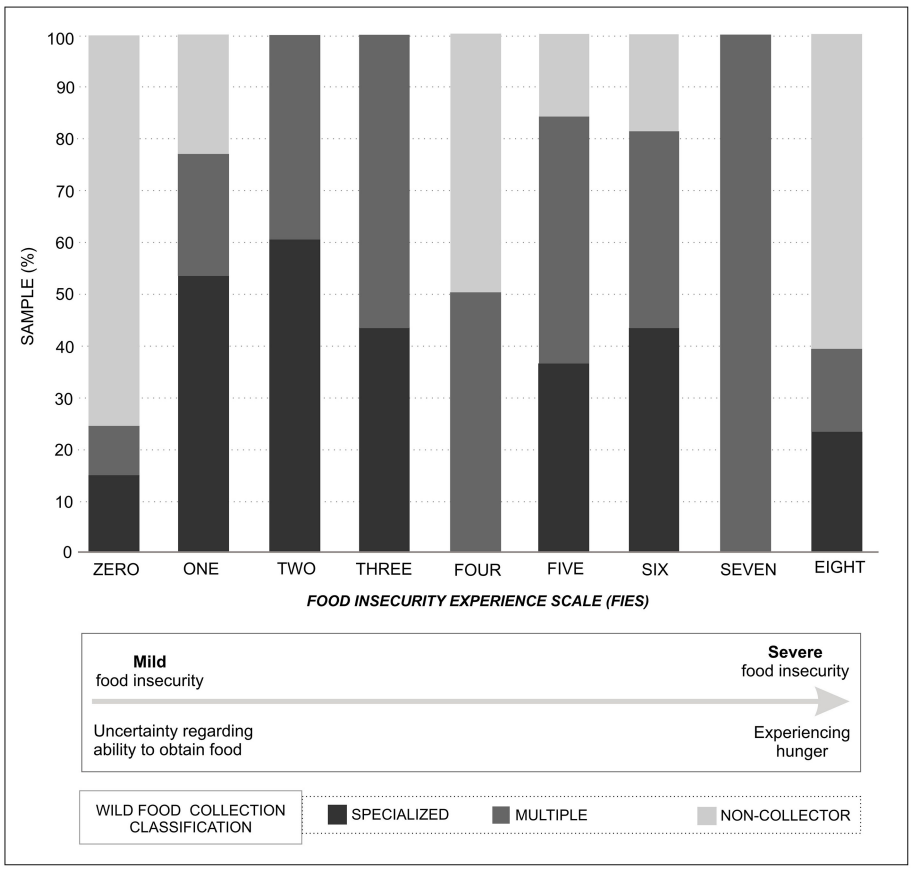

FIGURE 3 | Food Insecurity Experience Scale (FIES) and wild food harvest.

TABLE 3 | Livelihood satisfaction by wild food harvest and FIES.

		Wild food harvest (%)				Food insecurity (FIES %)				
		Specialized	**Multiple**	**Non-collector**	**Total**	**Secure**	**Mild**	**Moderate**	**Severe**	**Total**
Livelihood satisfaction	Low	17.4	60.9	21.7	100	21.7	17.4	43.5	17.4	100
		30.8	70	50.0	53.5	62.5	36.4	50	100	53.5
	High	45	30	25	100	15	35	50	0	100
		69.2	30	50	46.5	37.5	63.6	50	0	53.5
	Total	30.2	46.5	23.3	100	45	30	9.3	25	100
		100	100	100	100	100	100	100	100	100

overall livelihood satisfaction. The scores were normalized, and the median score was used to define high (above median) and low (below median) livelihood satisfaction. A slightly higher (54%) proportion of the farmers have low livelihood satisfaction compared to those in the high category (**Table 3**). There is no statistically significant association between wild food harvest and livelihood satisfaction. In part, this implies that the factors influencing wild food harvest extend beyond the livelihood domain to include intangible cultural attributes/values.

The importance of the forest to the well-being of the farmers in Millbank is reflected in the community rules and norms related to the use of forest resources. Seventy-five percent of the farmers acknowledge awareness of rules among community members regarding the use of the forest. The most common rules identified are related to the removal of trees and the use of agrochemicals. It is customary for farmers to replant food crops after harvest and to limit the use of agrochemicals. The predominant sentiment among the farmers is that farming activities have declined over the past two decades resulting in fewer, older, male farmers involved in small-scale shifting cultivation primarily for subsistence. Just over half (51%) of the respondents indicated that they practice agroforestry. Agroforestry is widely promoted

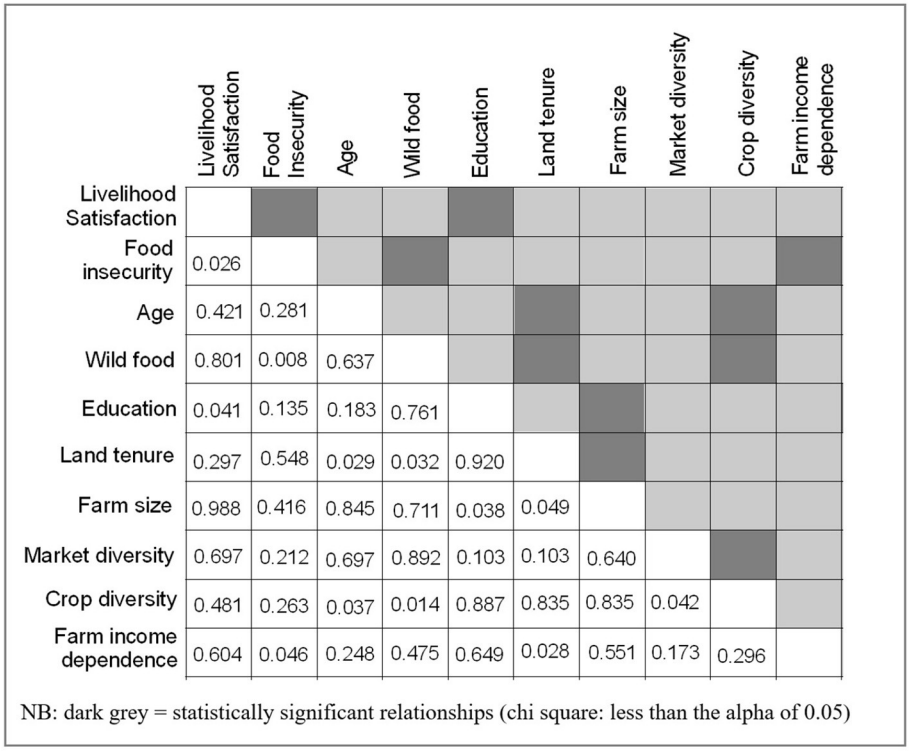

FIGURE 4 | Relationships between food insecurity, wild food harvest, livelihood satisfaction and key socioeconomic and agronomic factors.

across Jamaica as an ecosystem-based adaptation practice with sound conservation value and economic potential for small farmers (Davis et al., 2017).

Agrobiodiversity provides multiple co-benefits to food security in rural farming communities (Hickey et al., 2016; Asprilla-Perea and Diaz-Puente, 2018). In SIDS, biodiversity loss from traditional agroecosystems has been identified as one of the most serious threats to food and livelihoods security (Balzan et al., 2018). Agroecological approaches that included community planning, indigenous knowledge, attention to inequalities and a range of practices such as agroforestry, kitchen gardens, cover crops, polycultures, and forest conservation have been found to provide multiple co-benefits to food security, biodiversity conservation, improved well-being, and climate adaptation (Davis et al., 2017; Buckwell, 2019). Davis et al. (2017) found that the food security challenges facing Jamaican farmers can be alleviated by improved marketing of fruit tree products—which also provide multiple benefits to watershed management. Agrobiodiversity is one of the most important resources farmers have to combat climate change and food insecurity challenges.

All of the farmers who experience severe food insecurity exhibit low livelihood satisfaction. For farmers who are food secure or mildly food insecure, the difference in livelihood satisfaction is marginal (when the two categories are combined). Sixty percent of the farmers who are moderately and severely food insecure exhibited low livelihood satisfaction. There was no significant relationship between livelihood satisfaction and collection of wild foods. This implies that how farmers feel about their livelihood is independent of decisions to collect wild foods.

The survey results revealed strong evidence of an association between market diversity and crop diversity ($x^2 = 0.042$, $p < 0.001$) (**Figure 4**). During the qualitative interviews, one farmer noted that cultivating a wide range of crops is an important strategy to reduce risks associated with market failures—from a commercial standpoint. The main cash crops cultivated by farmers in the study area are dasheen (72%), banana and plantain (23%), and yam (5%). Farmers indicated that private exporters have established a relatively stable market for dasheen in the past 5 years or so. As such, most farmers in the area have increased production of the crop. The United States and Canada account for 98% of all dasheen exports from Jamaica. A small volume (2%) is processed locally for the production of chips (MICAF, 2020). Farmers in Millbank are primarily dependent on "higglers" (market purveyors) to sell their produce. Farmers often credit their produce to higglers, who are notoriously unreliable (deceptive in many cases) with payment. Diversifying crop production systems is therefore, an important risk minimization practice among farmers in Millbank. Farmers in Millbank still practice barter, and wild foods are often traded for food items such as rice, flour, sugar, and tin fish. This barter system exemplifies the degree of trust within the community—an invaluable resource to cope with hardship and uncertainty.

DISCUSSION

Our findings around the patterns of wild food harvesting and food (in)security are exploratory and provide the first insights on community level food foraging in Jamaica. These findings suggest that Maroon practices of food harvesting persist into the present and serve two functions: (1) wild food harvesting enacts a claim to the forest as a commons, preserving cultural traditions of Maroon ancestors; (2) wild food harvesting serves to ameliorate food insecurity among residents. In both of these ways, the forest is broadly imagined by residents as a space akin to tropical home gardens. We discuss both functions in turn.

Maroon Practices of Food Harvesting as a Cultural Tradition

As a satellite community of Moore Town, populated by residents with Maroon ancestry, the patterns of wild food harvest are inseparable from a Maroon ecology, the distinctive subsistence practices that are anchored in ancestral connections to the Blue and John Crow Mountains as lands bequeathed to present day Maroons for their use and protection (Favini, 2018; Connell, 2020; Castellano, 2021). Indeed, the Maroon communities of the Blue Mountains were given land grants in the mid-eighteenth century as part of treaties that the British signed with the Maroons to end an internecine period that had threated total ruin of the island's plantation economy. Given that Maroon communities came out of defiance to the system of slavery and were accorded territorial recognition by the British, we argue that the patterns of wild food harvesting serve as performative claims-making that asserts Maroon autonomy. Our reading here is supported by the key informant interviews we conducted and by a broader body of scholarship (Barker and Spence, 1988; Otuokon et al., 2012; Malm, 2018; Connell, 2020) including by Maroon scholars from the Upper Rio Grande Valley (Carey, 1997; John et al., 2010). This literature describes how African diaspora communities in the Americas see their provisions grounds and traditional haunts as Black commons that are symbolically and materially important to their sovereignty (Roane, 2018; Castellano, 2021; Williams et al., 2021). The "Black commons represents the elaborated sense of place outside mastery expressed through human-to-human connection within the delicate ecologies of the wider biosphere." (Roane, 2018, p. 244). The continued imagining and use of the forests as a Black commons extend the Maroon provisioning into the present and necessarily challenges the symbolic enclosure of the Blue and John Crow Mountains as National Park and World Heritage Site.

Overwhelmingly, the key informants we interviewed, described the forest as having this quality of the Black commons rather than just a space to access and produce food. The forest is a spiritual ecosystem rooted in their ancestrality and embedded in their memories, emotions, and overall subjective well-being. Therefore, the forest is more than an ecosystem providing food production services to the communities; it is a metaphysical space in which farmers position themselves as Afroindigenous. Our results show strong cultural and spiritual connections to the forest, which informs community-scale institutions and value systems. This sense of Afroindigeneity underlies the conception of the forest as a commons to be kept both for posterity and as a place for the ancestors to continue to provide for the community—their actions centuries ago started the ecological process that allows wild food today. These physco-social dimensions of wild food consumption induce a distinct "*affective atmosphere*" (Anderson, 2009). The reciprocal relationships between farmers, and between farmers and the non-human world, are normatively orientated toward symbiotic life.

Since these understandings are social constructions of nature rooted in the symbolic interactions of the farmers with the material forest, successful protected area management is possible only if managers pay attention to the interpretative scheme of the farmers. Or else, farmers and protected area managers will be concerned with two different landscapes and realities. On the one hand, farmers will be concerned with maintaining connections to place through wild food consumption, while managers will be concerned with curtailing perceived human degradation. Ancestrality and the sense of a commons inform farmers' perception of wild food consumption and forest use and shape their temporal and spatial sense of place that conservation measures cannot ignore. Where conservation managers might be interested in ecosystem services, nutrient flows, species synergies, over long-term timescales at scale of the forest, farmers experience the forest as an expansive and constantly renewing provider on which their wild food harvesting barely registers. The farmers' temporal-spatial understandings also account for the calculative rationalities about other livelihood choices.

Wild Food Harvesting as a Food Security Strategy

Beyond the social-cultural dimensions of the wild food harvesting, our findings suggest that the wild food harvests also serve a material purpose—it provides a food safety net for a poor rural community. This function also clearly also characterizes the original practices of fugitive foraging and the practice of keeping both slave and Maroon provisions grounds. Other studies have warned that broad generalizations should not be made about patterns of food (in)security between foraging/wild food harvesting communities and agriculturalists (Harris and Hillman, 1989; Benyshek and Watson, 2006; Erskine et al., 2019), our research suggests that at least in the case of Millbank, and we imagine, in the case of similar traditional Afro-Caribbean communities, levels of foraging are a meaningful indicator of food security. What our findings also suggests is that it is not potential food insecurity alone that influences wild food harvesting, the patterns of harvesting suggest that wild food harvesting is also based on anecdotal evidence (from oral histories and cultural traditions) about the nutritional potential of forage food stuff. So that even in times of nominal food security, wild food harvesting still features in the food economy because it does not only serve as a buffer against food insecurity but a de-commoditized contribution to diets. Food security and food sovereignty are, therefore, intertwined (Bunge et al., 2019). A belief that the wild food primarily harvested are of high nutritional content might also explain the spatial patterns of food

harvesters. Yam, banana, plantain, and wild pigs require high energy and time input to gather and prepare relative to cultivating crops and livestock production.

Given the location of the Millbank community on the edge of the Nation Park-World Heritage Site, accounting for both the subjective-symbolic and the functional-material purposes of wild food harvesting, will be key to successful biodiversity conservation measures and protected area management. Approaches that ignore the Maroon element of the local land-use history often will cause spatial injustices that undermine food and livelihood security, as well as cultural heritage.

Strengthening Domestic Food Systems

Recent environmental and technological transformations have reshaped global food systems resulting in novel health, food, and nutrition security challenges (FAO, 2019; IFPRI, 2020), which threatens aspirations for a world without food insecurity, malnutrition, and hunger (FAO, 2019) under the 2030 agenda for Sustainable Development. The Caribbean is now one of the world's most import-dependent regions (Weis, 2007). This is fuelled by a pervasive lack of consciousness about food—"a separation between the head and the belly of this society" (Lamming, 1996, p. 26). The prevalence of undernourishment and severe food insecurity are the main indicators used to monitor progress toward eradicating hunger (SDG indicator 2.1.1). The "State of Food Security and Nutrition in the World" reports for 2018 and 2019 incorporated the Food Insecurity Experience Scale (FIES) as a core indicator for monitoring SDG Target 2.1.2: the Prevalence of Moderate or Severe Food Insecurity (FAO, 2019). However, in both reports data were lacking for the Caribbean in all dimensions of the measure.

In most cases, the Caribbean region is grouped with Latin America, which decreases the "resolution" of the data—thereby masking country-specific conditions. The FIES, along with livelihood satisfaction and subjective well-being measures, are promising tools that can be leveraged to fill this research gap. The emergence of these tools reflects the increased recognition of identity, geography, and socio-cultural relationships in shaping food security outcomes. This study represents an initial step toward filling this research gap by utilizing the FIES and measures of livelihood satisfaction.

The underdevelopment of Jamaica's domestic food system is a product of limited institutional innovation and dietary transition to unhealthy foods. From as far back as the 1930s, negative attitudes toward local food (e.g., yam, banana, plantain) were reported among Jamaican society (Bailey, 1939). Cheap imported food flooded local markets, magnifying nutrition transition, and the vulnerability of small-scale farmers. In recent times, local food production has plummeted due to complex changes in Jamaica's political economy (Gamble et al., 2010; Popke et al., 2016). Ironically, the decline in local food production has occurred alongside numerous policies geared toward "revitalizing" the agriculture sector—even though in reality, food imports have increased. One of the repeated mistakes of agriculture development policy in Jamaica is the exclusion of small farmers' voice and values. To strengthen domestic food systems in Jamaica, sensitivity to local food knowledge is an absolute imperative. Local knowledge remains one of the most important resources available to poor farmers (Beckford, 2012; de Medeiros et al., 2021). In part, this research proposes a bottom-up approach to highlight the role of local knowledge in key food production systems that contribute to food heritage and farming households' livelihood security.

Contemporary migration patterns in the Millbank community contribute minimally to food production and food sovereignty. Remittances are primarily used to purchase imported foods such as rice, canned fish, and other processed food as substitutes for traditional foods such as yam and banana. This has contributed to the emergence of a social stigma associated with collecting wild foods and an ascription of superior socioeconomic status associated with the capacity to purchase imported food items. The transboundary risks associated with overdependence on food imports have been well-documented (Weis, 2004; Campbell ea al., 2010) and have been magnified by the COVID-19 pandemic.

Food Security and Local Land Use Planning

Amartya Sen's work in the 1970s was influential in the transition from production to consumption-centered food policies. Sen's analysis of household-level food-deficit shaped the reconceptualization of food access through the lens of entitlement. For many small farmers, farming is the only domain where they enjoy freedom and control to craft possibilities for alternative futures. Yet, small farmers in Jamaica are often caught on the wrong side of a systemic pattern of exclusion (Barker, 1993). In 2015, the Blue and John Crow Mountains were designated a UNESCO World Heritage Site based on its cultural and natural heritage. The management team of this National Park has already started to use this new prestigious status to boost the region's tourism appeal. New hiking trails are being developed, and the local Maroon culture is used to represent locals' lifestyle. For farmers in the Millbank area, the benefits of the new statues are less obvious. Local conservation-based economies should incorporate strategies to promote diversity of consumption possibilities to unlock multiple pathways toward zero hunger (SDG 2), good health and well-being (SDG 3), and responsible/sustainable consumption and production (SDG 12).

The possibility of wild food contributing to Jamaica's policies on food security and poverty is unexplored. This reflects the existing knowledge gap in general, and the quantification and valuation in particular. The economic, health, and biodiversity value of the services provided by Jamaican wild foods is fertile ground for future research. Valuation of wild food can put a price tag on the economic savings to governments (Hickey et al., 2016) and halt the disappearance of wild and biodiverse agricultural landscapes. Additionally, the wild food collection analysis in the Millbank area could be expanded to include freshwater wildlife and ecosystem. The river system supports a significant portion of the consumption diversity of households in the study area. In fact, in the 1780s, the Upper Rio Grande Valley communities were described as "fishing villages" (Agorsah, 1994). Based on our research and descriptions of places visited to harvest wild food crops, it seems that they are harvested from

abandoned farmland rather than from isolated farm plots located and actively managed in the forest. Further research is needed to verify these impressions but, if true, the implications are that harvesting wild food is not a threat to the forest ecosystem's physical integrity, as would be the case if farmers were actively clearing patches of forest to cultivate.

Promoting inclusive conservation measures can also disrupt intergenerational poverty cycles and associated food insecurities (IFPRI, 2020) in the study region. There is a need to "foster pro-poor and inclusive structural transformation focusing on people and placing communities at the center to reduce economic vulnerabilities and set ourselves on track to ending hunger, food insecurity and all forms of malnutrition" (FAO, 2019, p. 8). Conservation measures should incorporate socioeconomic and multicentric policy responses that are congruent with local knowledge systems to drive equity and resilience. In the Millbank area, these issues take on deeper cultural and spiritual significance due to historical customary access to forest land. The forest is symbolic as much as it is a material-physical space. The wild foods of the forest, are both material resources and socio-cultural patrimony. Protected area management is seen as the imposition or encroachment of an external value system. This is a tension between conservation of biodiversity or the preservation of traditional life.

CONCLUSION

The research reported here is the first to document wild food sources in the Caribbean region and explore issues relating to food security, agrobiodiversity, and protected area conservation. Whilst some of these food sources are derived from native and non-native species in the rainforest (such as fruits, medicinal plants, and wild pigs), the bulk of the wild food is obtained from land abandoned to farming, either in recent decades or over much longer periods. We suggest that this makes wild food sources in the Caribbean fundamentally different from those in other parts of the world, such as Africa and South America, where forested areas may form part of a long fallow system of shifting cultivation, in which forest plots are cleared for cultivation then later abandoned. In the Caribbean region, the margin of cultivation has fluctuated over the centuries as new forest lands were cleared for farming and small plantations, then abandoned as fluctuating economic circumstances rendered their operations marginal or non-viable. As a result, in forest areas such as the Blue Mountains and the margins of Cockpit country, there is evidence of former cultivation, in the form of food crops that have regenerated naturally (without agrochemicals), and these represent the bulk of wild food sources reported here. This is an important distinction. In Africa and Latin America, as fallow periods shorten, the integrity of the forest may come under threat as the land is cleared for agriculture, posing threats to forest conservation.

On the other hand, in the Caribbean region, wild food is harvested from long-abandoned farm plots. As far as we know, the forest areas where such food is harvested, are not actively "managed" so they pose no threat to the forest through forest clearance. The long history of dependence on the forest has resulted in a rich tradition of sustainably managing food resources in the forest. The high level of farmers' dependence on the forest's biological resources should position them at the center of local conservation planning.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

DC, AM, and DB: writing, data collection, and data analysis. TM and LS: data collection/editorial. LS, JT, and TW: data collection. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2021.663863/full#supplementary-material

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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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