THE POLITICAL ECOLOGY OF SHADE COFFEE: PERSPECTIVES FROM JAMAICAN BLUE MOUNTAIN FARMERS

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ABSTRACT

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Jamaica's Blue Mountains are heralded as one of the world's premier coffee growing regions. Previous ecological research in Jamaica has demonstrated that shade-grown coffee practices provide beneficial ecosystem services for farmers, yet most coffee farms in the Blue Mountains have very little shade. The socio-ecological factors that influence coffee cultivation choices in Jamaica have not been analyzed. By adopting a political ecology framework, the aim of this project was to unearth the political, economic and ecological drivers and constraints that inform and influence farmers' decisions for intercropping shade trees amongst their coffee plants. Semi-structured interviews were conducted on farm-sites in the three parishes of the Blue Mountains: Portland, St. Andrews and St. Thomas. Results from this project reveal that the human-environment interactions of coffee producers are impacted by the interplay of on-farm, on-island and global variables. This necessitates reframing the value of ecosystem services provided by shade trees into a cohesive argument that resonates with the specific regional socio-ecological needs of Blue Mountain coffee farmers. Priorities for change should include: encouraging communities to re-learn the benefits and applications of organic soil fertility

and the values of shade trees while exposing farmers to marketing research and strategies for pursuing conservation coffee niche markets.

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A typical coffee plant requires three years to reach the stage of fruit production (Wintgens 2004:5). On average, completion of a graduate degree in higher learning requires two to three years as well. If my Humboldt graduate degree were a coffee plant, I would find myself at plant maturation and ripe with fruit for the picking! But just as coffee requires nutritional inputs to generate fruit, so does my thesis require the inputs of numerous individuals to produce a final product. In Jamaica it is common to "give thanks" rather than say "thank you." It takes a village to write a thesis, and for that I am indebted to countless individuals.

I give thanks to my family; mom and dad you are my #1 cheerleaders and have always championed my causes. Thank you for instilling the confidence and determination necessary to tackle this project. Crissy, thanks for being a supportive sister, providing encouragement and for taking the time to proofread parts of this thesis.

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Throughout the history of the capitalist system, marginalized agricultural workers have demanded better prices for their crops, better working conditions and an improved quality of life. The coffee farmers of Jamaica's Blue Mountains are not an exception to this credo. I therefore dedicate this thesis to the many farmers who shared their narratives and cultivation techniques so that the global north may have a broader understanding of the financial disparities between coffee producers and coffee consumers.

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INTRODUCTION: GOING BANANAS

"Placed at the beginning of a political ecological tale, contradictions compel fascinating mysteries worthy of socio-ecological investigation" (Robbins 2011:95).

A few years ago Portland Parish coffee grower David Twyman chose to eradicate all bananas and plantain from his 34 ha coffee farm. Twyman's banana ban was in part fueled by a desire to remove a crop from amongst his coffee that he never had the opportunity to reap or taste; his plantains were the unspoken common property of his neighbors. Before extirpating the extant Musa species on his farm, Twyman announced to community members that anyone was welcome to take cuttings, suckers or full-grown plants. Subsequently, a crew of machete men slashed banana stalks and applied Roundup as a rapid remedy for fruit tree eradication. In the aftermath, Twyman's neighbors were angry that he had the gall to remove "their" bananas.

Besides the petty thievery of these starchy delights, Twyman's second reason for removing the bananas was because he alleged that they were leaching nutrients from the soil that could be better spent enriching his lucrative coffee. David admitted that the Twyman farm averages a low yield of boxes of coffee per acre and any avenue for increasing production would be attempted. David attributes low productivity to poor soil, a longer growing period (due to the misty, cool micro-climate of his altitude location) and incessant exposure to pests.

On another occasion we spoke with Milson Heath, a ½ hectare proprietor in St. Thomas Parish. Junior and I listened to his account while sitting beneath the shade of a dense banana and plantain canopy of a relatively young coffee farm. Heath was the first of many farmers to explain the multifaceted significance of intercropping bananas amongst coffee plants. He asserted that in times of need, one can eat plantain but one cannot do the same with coffee. From the omnipresent physical abundance of banana plants, it was obvious that he relied heavily on these fruits, not only as a staple food but also as a cash crop that could be sold "for some change" at the Morant Bay market. However, my field assistant and I noticed that all of banana and plantain plants were lacking any visible fruit. Milson clarified this phenomenon by recounting in his soft-spoken patois the damaging effects of last year's hurricane Sandy; as we later discovered this was also why virtually none of the farmers in this region of Mango Row had a crop of bananas.

Further inspection of Milson's raggedy coffee plants also revealed that Milson had never been properly trained in the art of coffee husbandry: his perennial bushes were malnourished, in desperate need of pruning and showing signs of paltry fruit bearing. Although for different reasons than David Twyman's, Milson Heath was also contending with low coffee berry yields, pests and inclement weather patterns in his fields.

These case studies provide a lens for viewing some of the disparate relationships that coffer farmers develop with their cultivated landscape. Combined, these narratives begin to demonstrate the complex nature of coffee cultivation in the Blue Mountains of Jamaica. The interconnected political, economic and socio-ecological factors revealed

by farmers will shed light on the compelling contradictions that influence shade cultivation within this coffee growing landscape.

REVIEW OF LITERATURE: THE EVER-EVOLVING SHADE COFFEE DISCOURSE

"Whether coffee should be grown under a shade canopy has been debated for as long as coffee has been cultivated" (Schroth et al. 2004:199).

Although unassuming in appearance with its pointed evergreen leaves and small berries, coffee is a tropical plant with ramifications on global and domestic scales. Topik brilliantly asserts, "there is no hint that coffee came from trees in poor, foreign lands" (Topik and Samper 2006:118). In equatorial regions, coffee production provides employment for approximately 26 million people (Talbot 2004).

Most likely attributed to the fact that coffee is the number one global agricultural export (Daviron and Ponte 2005; Talbot 2004), there are a vast array of publications concerning a glut of coffee topics. Within this field of inquiry, a significant amount of research has focused on the ecological merits of shaded coffee cultivation systems[1]. The majority of this information tends to emphasize the significance of ecosystem services, wildlife studies and agroforestry systems. Relatively few researchers have investigated the socio-ecological dimensions of shade cultivation (Jha et al. 2014; Toledo and Moguel 2012a). Beginning with an overview of the shade coffee discourse, this chapter will convey how interdisciplinary shade cultivation literature has evolved, reveal its

[1] Jha, et al. (2011, 2014) provide a comprehensive overview and introduction to the academic world of shade coffee literature.

shortcomings, and conclude with an examination of the theoretical frameworks with which my thesis aims to contribute to this area of inquiry.

Coffee is a perennial plant that can only be grown in moist, frost-free tropical and sub-tropical ecosystems (Wickizer 1951). *Coffea arabica* originated in the mountainous terrain of Ethiopia and the Boma Plateau of Sudan (Wrigley 1988). The arabica variety of coffee is generally considered to be a "highland crop" (Wickizer 1951:38) that evolved and physiologically adapted to grow and flourish within a shaded understory and in locations with "reduced luminosity" (Wintgens 2004:19). In part due to increased demand, coffee cultivators discovered that it is possible to grow this varietal in a full sun setting (Willson 1985).[2] The increased contact with the sun boosts photosynthesis and can ultimately lead to greater fruit production, at least over the short-term (Staver et al. 2001). However, when a coffee plant is exposed to higher light levels, it necessitates greater quantities of external inputs, often in the form of chemical fertilizers (DaMatta 2004), and the plants may succumb to plant stressors (such as desiccation) and suffer increased vulnerability to diseases and pests.[3]

The process of agricultural intensification, and the increased demand for coffee beans has led to greater quantities of shade-less farms (Rice 1999). Therefore, in many

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[2] This phenomenon is known as "coffee technification." See Perfecto, et al. (2009) for an excellent historical account of the industrialization of coffee production.

[3] It is not within the scope of this literature review to analyze the exact quantity of shade necessary in a coffee forest system. To date, the literature is inconsistent regarding the "ideal" percentage of shade that generates a high coffee berry yield while simultaneously encouraging biodiversity and discouraging pest and fungal productivity (Avelino, Willocquet, and Savary 2004; Beer 1987; Donald 2004; Soto-Pinto, Perfecto, and Caballero-Nieto 2002a).

cases "shade management was simplified in many areas and reduced to the use of only a few species, mainly fast-growing leguminous trees (notably various species of Inga, Erythrina, and Gliricidia) that rapidly sprouted after crown pruning, fixed nitrogen and could be propagated and managed easily" (Schroth et al. 2004:201).

As tropical deforestation increased in the global south, the scientific community's perceptions of agroforestry evolved; instead of viewing forested coffee cultivation systems as disturbed habitat, researchers began to focus on agro-ecosystems as beneficial landscapes for biodiversity (Donald 2004; Moguel and Toledo 1999; Perfecto et al. 2005; Philpott et al. 2008; Schroth et al. 2004). In the late 1990's conservationists began shifting how they conceptualized the shade coffee cultivation paradigm.[4]

In academic literature these results echo as glorious reasons for advocating ecosystem service approaches for coffee cultivation; as Katherine Ewel succinctly elucidates "describing how an ecosystem provides a product or service to society is an effective way of articulating why that ecosystem should be protected in some way, as well as providing a modest level of understanding into how the ecosystem functions" (2001:718). As a consequence, instead of eschewing coffee farms in the tropics, researchers began advocating ways to promote ecosystem services as a means for encouraging shade cover and tree diversity within coffee farms (Idol, Haggar, and Cox 2011; Johnson, Kellermann, and Stercho 2010; Kellermann et al. 2008b; Pagiola, Bishop,

[4] Because there are currently no domestic organic and/or shade coffee certification schemes for Blue Mountain Coffee, this literature excludes the analysis of these topics within shade coffee literature.

and Landell-Mills 2002; Perfecto et al. 2009; Swift, Izac, and van Noordwijk 2004). In the academic literature this reframing of the issue resulted in grounds for advocating ecosystem service approaches for promoting shade coffee cultivation (Swinton et al. 2007); as Katherine Ewel succinctly elucidates "describing how an ecosystem provides a product or service to society is an effective way of articulating why that ecosystem should be protected in some way, as well as providing a modest level of understanding into how the ecosystem functions" (Ewel 2001:718). Given the wealth of burgeoning information about beneficial ecosystem services for humans and the environment (Johnson 2000a; Kellermann et al. 2008a; McNeely and Schroth 2006; Perfecto et al. 1996, 2009), why aren't more coffee farmers more readily adopting shade cultivation practices?

A limited quantity of research has focused on micro and macro-level factors that influence a coffee farmer's adoption or retention of shade practices (Aguilar-Støen, Angelsen, Stølen, et al. 2011; Blackman, Ávalos-Sartorio, and Chow 2007; Borkhataria et al. 2012; Jha et al. 2011; Mendez 2008; Westphal 2008). Most recently the study of shaded coffee ecosystems and cultivation strategies has suggested incorporating qualitative methods and social science frameworks to foster an integrative type of research (Bacon, Mendez, and Fox 2008; Berkes, Colding, and Folke 2003; Jha et al. 2011; Mendez 2008; Sinclair and Walker 1998).

From the relevant literature, three primary themes emerged: livelihood strategies, local knowledge and shade perceptions (Aguilar-Støen, Angelsen, and Moe 2011; Albertin and Nair 2004; Borkhataria et al. 2012; Cerdán et al. 2012; Mendez 2008).

Within these groupings, there is a certain amount of overlap in the unit of analysis and the socioeconomic bias utilized for gathering and disseminating findings. Most academics researching this topic tend to use the household as the unit of analysis. In particular, several authors frame their arguments by investigating peasant family livelihood strategies (both on and off-farm); this camp of shade coffee experts suggests the diversification of livelihoods is a primary factor affecting land use dynamics (Aguilar-Støen, Angelsen, Stølen, et al. 2011; Muleta et al. 2011; Westphal 2002). Specifically, results from their analyses indicate that the role of livelihood strategies determines the quantity and quality of shade available on coffee farms (Aguilar-Støen, Angelsen, Stølen, et al. 2011; Mendez 2008; Westphal 2008).

From the literature surveyed, it can be noted that when authors employ a mixed methods approach for studying coffee systems, their predominant focus tends to center around a shade plant inventory combined with a socioeconomic benefits perspective (Jha et al. 2011; Muleta et al. 2011; Soto-Pinto et al. 2007; Toledo and Moguel 2012b). These authors also couch their arguments by surmising that socioeconomic pressures are the primary variables affecting coffee cultivation practices (Albertin and Nair 2004; Muleta et al. 2011; Soto-Pinto et al. 2007). By spotlighting these variables, it is possible to overlook nuanced and interacting factors affecting farmers' land use decisions.

Cerdán et al. (2012) assessed smallholder's local ecological knowledge of tree cover impacts on ecosystem service provisions. Similarly, counter to the socioeconomic rationale, Soto-Pinto et al. (2007) also deduced that local ecological knowledge usurps socioeconomic factors when making cultivation choices about shade management and

tree retention on coffee farms (2007). Albertin and Nair (2004) also emphasize the role of local ecological knowledge when making decisions about shade tree preference. Their study focuses on a quantitative approach for measuring and analyzing farmer preferences without examining external forces that may potentially impact farmer agency. However, the authors conclude that there is a paucity of research on the spectrum of variables and rationale for a farmer's goals and tree selection criteria (Albertin and Nair 2004). After all, "it is clear that farmers do not make individual decisions in a social vacuum" (Vanclay 1997:11).

Of the twelve formerly cited articles, only three focus on farmer perceptions about shade (Albertin and Nair 2004; Borkhataria et al. 2012; Muleta et al. 2011). Albertin and Nair (2004) conducted their research in the Nicoya region of Costa Rica. In their study site, all participants were actively engaged in shade coffee cultivation practices. Because of this, they examined the attributes farmers used to select shade tree species alongside their perceptions of shade tree roles. Farmer preferences were then juxtaposed with socioeconomic data to create a demographic typology that compared income with cultivation choices.

Muleta et al. (2011) is the only article pertaining to shade cultivation perspectives in Africa (interestingly, the rest focus on Central America, South America and Mexico). In a region predominantly containing shaded coffee gardens, they measured Ethiopian farmer perspectives about shade trees by focusing on their levels of traditional knowledge and perceived beliefs about socioeconomic benefits of shade trees (2011). In the field, these researchers distributed questionnaires that were aimed at uncovering how coffee

growers perceive the benefits of shade with an emphasis on shade characteristic preferences. In their conclusion they stated that the "overall impression of shade was quite positive" (2011:48).

Borkhataria et al. (2012) and Westphal (2008) and Mendez (2008) are the only authors that fused a socio-political and socioeconomic approach to survey farmer perceptions of shade. Borkhataria et al. (2012) conducted semi-structured interviews with Puerto Rican farmers within the context of a post-technification growing environment. They applied a mixed methods approach to investigate Puerto Rican coffee farmer attitudes about converting their sun cultivated coffee to an agroforestry system while simultaneously quantifying attitudes about conservation values. Their results reveal that farmers are interested in growing shade coffee and that farmer-government dependency influences the type of cultivation practice employed in the field. Their findings tend to reinforce and rely upon a government-based top-down approach for altering perceptions and behaviors. These solutions tend to overlook power imbalances and the place-specific cultural and ecological processes.

Westphal (2008) on the other hand, emphasizes the integration of social, economic and political drivers for investigating cultivation choices on Nicaraguan coffee farms. Her research does not center around shade cultivation perceptions per se, rather it looks at how institutions and structures affect livelihood strategies, which in turn influence associated tree choices on individual farms. "With this integrative perspective, it represents a contribution to the wider debate on inter-disciplinary methodologies within

the fields of small-scale agriculture, political ecology and related areas of research" (Westphal 2008:202).

Similar to Westphal (2008), Mendez utilized political ecology and agroecology frameworks to examine the "interface between agriculture, rural development and biodiversity conservation" of three coffee cooperatives in El Salvador (Mendez 2008:207). He assessed shade-tree management choices and soil quality on smallholder farms and discovered that biodiversity potential in coffee forest gardens was amenable to conservation needs (Mendez 2008). Although Mendez employed a robust, multi-scalar approach to inquiry, he focused exclusively on smallholders, which excludes perspectives about shade trees from mid-scale and plantation-size farm holders.

Collectively, the research from these authors illustrates the complexity of attempting to explain causal mechanisms for farmer shade-management preferences. Most importantly, the interdisciplinary research of Mendez, Westphal and Borkhataria also demonstrate that land care decision-making is heavily influenced by "the interconnections associated with changing global forces, local organizing practices, smallholders' livelihoods and shade coffee ecologies" (Bacon et al. 2008:342). Most recently, Jha, et al. (2014:419) confirm that "coffee vegetation management patterns are nuanced and often depend on farm size, available alternatives, national and regional politics, risk-avoidance strategies, and development funding."

In Jamaica, several deductive and mainly ecological inquiries have assessed the economic benefits of ecosystem services in shaded coffee farms (Davis 2013; Johnson 2000b; Johnson et al. 2010; Kellermann et al. 2008b; Railsback and Johnson 2014)

Specifically, within the country's Blue Mountains, the variables affecting socio-ecological relationships of coffee farms and the surrounding environment are poorly documented or understood. There exists a need to integrate social and ecological inquiry (Gartner et al. 2008) to increase biodiversity and encourage sustainable farming livelihoods.[5] Bosselmann (2012:80), states, "understanding the drivers of land use change is necessary in order to manage trees and forested areas in agricultural landscapes." With this in mind, the aim of this thesis is to answer the following question:

What are the socioecological, political and economic drivers and constraints that influence the cultivation of shade trees by coffee farmers in Jamaica's Blue Mountains?

This multi-faceted question generates numerous advantages for evaluating the human landscape patterns in the Blue Mountains. My interdisciplinary analysis will take into consideration "the processes that drive or mediate the spatial intensification range from fast processes of vegetative growth in ecosystems and of economic production in

[5] Academic literature from the late 1980's through the early 2000's places major emphasis on the detrimental impacts of soil erosion in the Blue Mountains (Barker 1993; Barker and McGregor 1988; Chai and Tanner 2010; Eyre 1987; Floyd 1970; McDonald et al. 2003; McGregor 1989; Weis 2000). Cumulatively, these articles reflect what political ecologist Paul Robbins (2011) would refer to as a classic example of the environmental degradation and marginalization theory. In a journal article about the Yallah's Valley Land Authority, Barry Floyd discusses a prime illustration of this theory. Floyd makes reference to a speech made by Sir Hugh Foot, former governor of Jamaica. In this address, the former governor refers to the "deplorable tendencies" of agriculturalists because their approach "to scatter in small uneconomic holdings, to scramble every man for himself, and to squander like a gambler the fertility of the soil" (Floyd 1970:64). This lens for analysis situates smallholder farmers as parasitic impostors and obfuscates any blame merited by large-scale plantation famers. It also illustrates an anthropocentric perspective in which humans are viewed as separate from their environment instead of as embedded in the socio-ecological system.

economies, to slow processes of geomorphological change and human cultural and political development" (Gunderson and Holling 2001:21). Therefore, the craft of extraction for this thesis is about discovering numerous parts and coherently linking them to generate a cohesive research framework for unearthing nuances about shade cultivation in the Blue Mountains.

In 1987 political ecologists Blaikie and Brookfield wrote the seminal text "Land Degradation and Society." In this book they delineated a framework for analyzing the disparities associated with land degradation and the marginalization of third world communities. Within this context, they developed their brilliant theory of "chains of explanation" as a means for analyzing the interconnected local, regional and global factors that affect smallholder decision-making processes. Similarly, in the field of social ecology (an offshoot of political ecology), Berkes, et al. (2003) propose a "nested systems" approach for analyzing multiple sources and scales of information about the particularities of human-ecosystem setting. Both of these approaches endorse the fusion of micro and macro variables affecting cultivation practices. Including these frameworks allows my research to include "the complex relations between political economy and patterns of resource use" (Grossman 1998:2).

Most importantly, this framework classifies farmers as part of the Blue Mountain landscape instead of as external threats that need to be extricated from this precious environment. Nevertheless, it is also important to acknowledge that even a "nested systems" framework is still rife with exclusions. Therefore, this thesis also integrates a

socioeconomic and political component by including a commodity chain analysis of Blue Mountain coffee production.

Bockel and Tallec (2005) describe a commodity value chain as "the full range of activities which are required to bring a product or service from its conception, through the different phases of production, delivery to final consumers, and final disposal after use" (2005:2–3). "The commodity chain can also be viewed as a series of transactions, beginning with the transfer of raw product to the first stage of processor, and ending with the sale of the finished product to the final consumer" (Talbot 2002:703). In the case of coffee, this commodity chain is rife with contradictions and injustices that often place less emphasis on regions of production. Countless books, and journal articles have been written about the many facets of the coffee commodity chain (Daviron and Ponte 2005; Fridell 2014; Ponte 2002a; Talbot 1995, 1997, 2002, 2004). These include: production, ecology, consumption, culture, etc. In the academy, there has been a strong focus on the abstract delineation of the coffee commodity chain. These accounts are disproportionately limiting because they do not take into full consideration *all* of social and ecological processes and the agents involved in the cultivation and transformation of *Coffea arabica typica* into a lucrative, finished product in the country or island of origin.

In particular, this type of political-economy lens fails to incorporate a bottom-up approach. As such, these frameworks are derived from an epistemology that has a top-down emphasis for constructing narratives that generally overlook the primary agent in coffee production: the farmer. Therefore, by integrating political ecology and a commodity chain analysis this thesis will explore reasons for the willingness, resistance

or inability of Blue Mountain farmers to grow shade-cover trees on their coffee plots or plantations. The following chapters will illustrate how these “human-managed production landscapes” (Robbins 2011:135) are situated within a complex nexus of political, economic and ecological factors.

SETTINGS

The Social Ecology of Coffee Production in Jamaica's Blue Mountains

"Jamaica is one of the names everybody thinks of in connection with coffee" (Marshall 1983:77).

Located in the western portion of the Caribbean, Jamaica is a relatively small island-nation of 10,900 km^2 (Evelyn and Camirand 2003). Approximately half of the island's terrain rises 300 meters above sea level. University of West Indies geographer Barry Floyd eloquently describes the landscape of this nation as "a rugged and highly dissected topography, with steeply sloping hillsides and sharply twisting valleys" (1979:7). As such, this telling terrain has direct ramifications for species diversity, and despite its relatively small size, Jamaica exhibits high rates of island endemism: 830 flowering plants, 20 bird species, 27 reptiles and 20 types of amphibians. However, primarily due to deforestation and development measures, many of these species are critically endangered (Armstrong 2013).

My study area focuses on the twenty percent of the Jamaican landmass that is classified as the "eastern highlands" region (Floyd 1979:6). Geo-politically, the Blue Mountains are comprised of three parishes: St. Thomas, Portland and St. Andrews. The canyons and rivers located within these parishes (specifically the Yallahs River Valley) provide crucial water reservoirs for the capital city of Kingston as well as farming plots for thousands of peasants (Barker and McGregor 1988). Towering dramatically above the

coastal lowlands, this portion of the island includes the John Crow and Blue Mountain chains. Within the Blue Mountains zone the "grand ridge" is the dominant landform that contains numerous peaks towering above 1800 meters, the highest of which, Blue Mountain Peak is 22263 meters (Hodges 2008). Incredibly steep, erodible slopes (often greater than 25°) are characteristic of these mountains (Barker and McGregor 1988; Chai and Tanner 2010; McDonald and Healey 2000; McGregor 1989). From an ecosystems perspective this zone is categorized as a tropical montane forest (WWF 2013). Most importantly, this environment and climate is amenable to the cultivation of *Coffea arabica*.

Throughout Jamaica, deforestation rates have accelerated since the early 1980's. With the aid of GIS and remotely sensed satellite data, researcher Lisa Tole (2001) discovered that between 1987-1992, land clearing occurred at an annual rate of 3.9%. For such a small island, these statistics of degradation have serious implications for watersheds, forest resources and smallholder peasant farmers. Similarly, Chai and Tanner (2011) demonstrated that human settlement and land use patterns in the Blue Mountains have shifted through numerous cycles throughout the last 150 years. Therefore, the tropical montane deforestation of Jamaica's highlands is not an isolated present day problem, but rather a system with recurring economic and ecological cycles associated with coffee production that can directly impact forest succession and species richness (Chai and Tanner 2011).

Land use patterns in Jamaica have shifted throughout the last three centuries based on global demand for tropical agricultural commodities. Following the collapse of

the plantation-based sugar economy of Jamaica's lowlands, coffee became a primary product of cultivation in the highlands (Delle 1998; Smith 1998). According to author Mary Langford, coffee was introduced to the Blue Mountains in 1728 (2008). By 1814 Jamaica was responsible for producing 30% of the global supply of coffee (Chai and Tanner 2011). During this plantation-cultivation era "monoculture husbandry was the norm on coffee" plots" (Barker and McGregor 1988:119). Large parcels of land were deforested and coffee was intensively planted in "tropical hillside farming systems" (Barker and McGregor 1988:118).

Consequently, "production methods were exploitative, with extensive areas of virgin high forest being turned over in shifting cultivation fashion to clear land for planting to coffee bushes. The result of this practice on steep slopes with loose soils and heavy rain was dramatic soil erosion and rapid depletion of soil fertility, from which these areas have yet fully to recover" (Floyd 1979:80).

The formal safeguarding of Jamaica's biodiversity did not occur until 1993. It is at this time that the Jamaican government established its first terrestrial park by setting aside approximately 78,105 hectares within the eastern highlands. The protected area was officially designated as the Blue Mountain and John Crow National Park (Tole 2001). The significance of this designation has recently been recognized internationally by UNESCO as a noteworthy cultural and natural world heritage site (UNESCO 2013). However, although a crucial milestone for the preservation of Jamaica's natural treasures (such as *Papilio homerus*, the Giant Swallowtail Butterfly and numerous endemic bird species), this national park comprises a relatively small portion of the entire mountain

ecosystem. Fortunately, in the Blue Mountains there is a certain amount of "natural protection afforded by steep terrain and inaccessibility" (Chai, Tanner, and McLaren 2009:2485). However, these authors caution that buffer areas adjacent to the park are at great risk to pressures of deforestation and agricultural land use. These authors warn that "forest clearance and fragmentation in the Blue Mountains is almost exclusively due to coffee and cash crop farming" (Chai et al. 2009:2489). Tony Weis states that "in the rush to clear land and plant coffee on the steeply sloped high elevations, few are able to invest the necessary time and labor to establish significant soil conservation measures, making their farms highly vulnerable to erosion" (Weis 2000:302).

The deleterious effects of erosion are compounded by unpredictable abiotic events such as hurricanes and tropical storms. Because many farmers remove competing vegetative cover from their coffee plots, the exposed soil is susceptible to "rain splash" that facilitates the loss of topsoil during intense tropical downpours (Barker and McGregor 1988:121). Jamaica experiences the direct impact of a hurricane's eye approximately every 25 years (Tanner and Bellingham 2006). In 1988 the trajectory of hurricane Gilbert passed directly over the island and left behind an aftermath of rampant destruction of the forested environment and high death tolls (National Hurricane Center 2012). This catastrophic event is historically recorded as Jamaica's worst natural disaster (Barker 1993). The Blue Mountains suffered severe damage from this natural hazard. Jamaican geographer David Barker estimates that approximately 70% of coffee farms in this area were decimated by hurricane Gilbert (1993).

De-mystifying the Political Economy of Jamaica's Blue Mountain Coffee

"The impact that people have on ecosystems depends as much on the socioeconomic and demographic factors that motivate human actions as it does on the ecological characteristics of an ecosystem" (Ewel 2001:719).

Coffee was the first food item to be traded globally (Frush 2008). Economists classify this agricultural good as a "discretionary-use" agricultural commodity because it is a luxury item that is not essential for human survival (Frush 2008). It is one of the most important commodities traded in the world (Ponte 2002a; Talbot 1995). Numerous books, journal articles and prose have been written about the many facets of coffee within its commodity chain including the production, ecology, consumption, and culture surrounding coffee. In the academy, there has been a strong focus on the abstract delineation the coffee commodity chain. These accounts are myopic because they do not take into full consideration *all* of processes and the agents involved in the cultivation and transformation of *Coffea arabica* into a lucrative, finished product.

Within the continental Americas, the political economy of coffee has been examined exhaustively. However, in regions where the volume of coffee production is low, sparse information is available; in particular the historically marginalized mountain landscapes of the Caribbean have been mostly overlooked. In Jamaica, the annual export of green coffee is approximately 800,000 kg (about 20 times less than Brazil's

production), and there has virtually no previously published research on the political economy of Jamaican coffee.[6]

Therefore, the aim of my approach is to proffer one version (of many) for the Jamaican Blue Mountain coffee narrative by analyzing the political and economic conditions that influence the modes of production of coffee in the Blue Mountains. The content is organized into four sections, each employing a commodity chains lens of analysis to describe the role of government institutions and the significance of Geographic Indications on Quality Standards and the international coffee markets. Collectively, this information will articulate the unique political and economic structure of Blue Mountain coffee to illustrate the salient variables that distinguish it from other coffee producing regions of the world.

Assessing the Domestic Jamaican Coffee Commodity Chain

"A mode of production is not simply a technology but a social organization of productive activity; and a mode of exploitation is a relationship of power" (Wood 1995:27).

Talbot notes that "one of the most important characteristics of tropical commodity chains is the central role of the ecology and the processing requirements of the specific

[6] To date, there is unpublished report prepared for the Jamaican Conservation and Development Trust delineating a "Conservation Coffee Feasibility Study" (Robinson 2006) and a project that examines "Biodiversity Conservation and Adaptive Collaborative Management in Jamaica's Blue and John Crow Mountains" (Gartner et al. 2008).

[coffee] crops" (Talbot 2002:706). From an ecological vantage point, coffee is a perennial plant that can only be grown in tropical and sub-tropical environments. Also, due to perishable nature of roasted coffee beans, once the fruit is harvested, dried and pulped, "processing" and value-adding (e.g. roasting) generally occurs in the global north. In addition, the bulk of caffeine consumption occurs outside of its country of origin (Ponte 2002b).

Consequently, northern caffeine-consuming economies are capturing more of the profit margin in the coffee commodity chain. Mancini states that "the concentration of market power in the hands of a few key players at certain points in the chain implies low incomes for the less concentrated parts of the chain" (2013:295). Economists advocate for a "forward integration" of coffee revenue within the nation where coffee was cultivated (Talbot 2002). In Jamaica, there exist few roasting facilities because most Blue Mountain coffee is shipped in raw, green bean form to Japan.

In coffee producing countries such as Jamaica, the buyer driven chain is disproportionately skewed to favor greater profit for transnational corporations. To counteract this power imbalance, transnational coffee boards such as the International Coffee Organization (ICO) "provide practical assistance to the world coffee economy" by regulating producing and importing countries (International Coffee Organization 2013b). Jamaica is not a member of the ICO.[7] Instead, this Caribbean nation administers these

[7] In an email discussing Jamaica's recent lack of participation with the ICO, professor John Talbot states, my guess is that the government decided that it couldn't afford it. We are broke and heavily in debt. And now that the ICOs don't regulate prices, producing countries don't get much benefit from belonging (Talbot 2014).

segments of the coffee commodity chain internally through a subsidiary of the government known as the Coffee Industry Board. Therefore, political processes are at the crux of the modern coffee production setting in Jamaica.

Coffee Industry Board & Partial Deregulation

"Coffee is a colonial commodity with a complicated past" (Jaffee 2007:39).

Examining the historical conditions that created and maintained the coffee environment in Jamaica are relevant for understanding the current coffee climate and the future trajectory of the coffee industry board. After the abolition of slavery by the British Parliament on all of its colonies in 1834, and the consequent collapse of Jamaica's sugar and banana industry, coffee cultivation began gaining momentum (Benghiat 2008; Smith 1998). However, due to the lack of standardized quality and fluctuating growing conditions, the Jamaican state had the foresight to begin regulating this crucial export crop (Benghiat 2008; Black 1990; Williams 1972). The roots of these settings date back to 1948 when the Coffee Industry Regulation Act legitimized government power to administer all of Jamaica's coffee agricultural sectors (Anon 1948).

In the eastern, mountainous region of Jamaica, cultivators became aware that the high altitude and misty climate of the Blue Mountains creates extremely favorable growing conditions for a smooth, low acid coffee bean (Wintgens 2004:74 & 817). Coffee grown in different regions of the island acquired varying degrees of value and importance. Because the "coffee product" from the eastern mountains became highly prized and

valued, the subsequent 1953 Coffee Regulation Act established geographic parameters for legally defining the "Blue Mountain" growing region. Specifically, this included mountainous regions above 600 meters in the parishes of St. Mary, Portland, St. Thomas and St. Andrews.

Consequently, the specific lexicon of the Coffee Industry Regulation Act played a major role in the establishment of many long-term implications for *how* coffee is grown in Jamaica. While farmers still maintain control and ownership of their land, the Jamaican government utilized the 1948 act to establish authoritarian control over most of the Jamaican coffee commodity chain. Specifically, it included the requirement that all Jamaican coffee growers must be registered with the Coffee Industry Board. The Coffee Industry Board also assumed responsibility for managing coffee plant nurseries, coffee exports, preparing coffee beans for market (management of pulperies and distribution centers), setting standards for coffee grading, control of exports and price setting. The CIB sets island wide prices for export coffee beans, regardless of smallholder farmer needs and poverty, thus reinforcing a marginalized peasantry (Weis 2000).

Unlike many other coffee producing areas of Central America, the political economy of Blue Mountain coffee marketing and exportation is still controlled almost exclusively by the Jamaican government's Coffee Industry Board (CIB).[8] Currently, "the Coffee Industry Board's principal role is to promote, regulate, monitor and guide the development of the coffee industry of Jamaica and to assure quality of Jamaican coffee"

[8] Daviron & Ponte (2005) provide an excellent overview of the disassembling of government controlled coffee commodity boards.

(Coffee Industry Board 2012). Ostensibly, this task is accomplished by overseeing licensing processes, and providing advisory services to the coffee industry.

In 1983 the CIB de-regulated certain sectors of its coffee commodity chain. Until this point, the CIB managed and owned all of the processing facilities where removal of coffee from its fruit flesh (pulping), drying and hulling occurred, and it was responsible for the purchase of all ripe coffee cherries from farmers. Following this partial deregulation of the CIB, private entities were able to apply for licenses to purchase raw beans from farmers, operate processing facilities and cultivate export markets abroad. As a Canadian-Jamaican coffee business man informed me, "the CIB verifies the grade and quantity of the coffee being shipped"(Gayle 2013) and all other aspects of the coffee commodity chain have been outsourced to private companies (Black 1990).

However, this neo-liberalization of the commodity chain still requires that *all* green coffee beans must be inspected and approved by the CIB before leaving Jamaica. Essentially, it is illegal to ship and market any quantity of raw Blue Mountain coffee without government consent. Exports of more than 10lbs of green coffee still require inspection and quality control from the CIB (Benghiat 2008; Black 1990). Regardless, the partial privatization of certain links in the coffee commodity chain disenfranchised small-scale growers; the leverage bestowed from de-regulation was conveniently tailored to enable coffee farmers that produce more than 10,000 boxes[9] of ripe cherry coffee to achieve "approved grower" status and qualify for processing and roasting licenses.

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[9] In Jamaica coffee is sold by the "box." This measurement is the equivalent to 27 kg of ripe coffee cherries.

Branding the Brew: The Blue Mountain Mystique

"Jamaica is the only producer in the world that ships without samples and sets its own price" (Black 1990:13).

In the commoditized world of global north coffee consumer culture, certain beans are extremely coveted. Coffee connoisseurs emphasize that a coffee bean's geographic point of origin imbues a terroir for which flavor profile, mode of cultivation and cupping characteristics are entirely unique. These consumers seek desirable cupping characteristics and defect-free coffee beans (Neilson 2005:201). "Jamaica is one of the names everybody thinks of in connection with coffee" (Marshall 1983:77); the Blue Mountains are heralded as one of the world's premier coffee growing regions. It is believed that the distinct climate and soil structure of the Blue Mountains coupled with the strict quality export standards enforced by the CIB yields some of the world's finest and exquisitely tasteful coffee beans (Benghiat 2008). However, due to its geographically confined region of production, this superlative bean is available in extremely limited quantities and will always be disadvantaged by economies of scale (Marshall 1983).

For coffee economies that are regulated by transnational organizations, "commodities exchanges provide an environment that makes it possible to establish global prices for commodities"(Frush 2008:13). However, because of the inelastic demand of Blue Mountain coffee conveyed by its trademarked appellation, this product is mostly excluded from the global economic coffee trade model.

"Better prices and a premium on quality make niche markets particularly attractive for farmers and countries seeking to escape that low-price, low-quality trap" (Gresser 2002:40). Neilson refers to this as "the ability of producers to capture the economic value of quality linked to the geographical embeddedness of production" (2005a:195). Thus, once "Blue Mountain Coffee" was established as a national and internationally renowned brand, the CIB could command much higher prices for their coffee beans. As such, Blue Mountain coffee is some of the most expensive sold in the global market; this high elevation coffee cultivated is often sold at a rate 20 times higher than standardized ICO market prices for beans grown in other tropical countries (Robinson 2006). However, because of the fame and high market prices of the Blue Mountain label, appellation piracy occurs (Teuber 2010).

In 2004 the WTO ratified the multilateral Trade-Related Intellectual Property Rights Agreement (aka TRIPS). This policy framework established the validity for geographic indications (GI's) to distinguish single origin products based on their higher standard and unique attributes (Hughes 2009). Therefore, a GI can be defined as a means for "protecting intellectual property associated with the origin and production method of a good" (Watson and Streatfield 2008). In Jamaica the CIB maintains control of the intellectual property rights (also known as geographic indications) for the branding of all coffee produced within the politically delineated Blue Mountain geographic region (Benghiat 2008; Hughes 2009; Teuber 2010). To date the Blue Mountain trademark is recognized in parts of Europe, Canada and the United States and Japan (Hughes 2009).

In order for roasted coffee to carry the Blue Mountain ® label, the beans must be grown in the geographically delineated region of eastern Jamaican within 610-1675 meters of elevation (Hughes 2009). By strategically branding Blue Mountain Coffee ® as an intellectual property, the Jamaican government has effectively created and maintained a perceived level of high quality and status for its export product. This feat is a paragon for emulation and as such, numerous African nations are attempting to cultivate their own GI's (Watson and Streatfield 2008). Although this branding/GI yields a higher price per pound, profit in the commodity chain is still the least for farmers. Also, as previously mentioned, Geographic Indication standards are not a buffer for name piracy because "the Jamaican government cannot control what happens to the beans once they leave the country" (Tennison 1985).

Good to the Last Drop: Japan & the Jamaica Connection

> *"Caribbean countries are most vulnerable to the globalisation process since their limited physical size does not allow them to enjoy economies of scale. This translates into higher than world prices for production of its principal products such as sugar, banana, citrus, coffee, spices and other fruits" (Courtman 2004:257).*

As a luxury item, coffee performs different roles in Japan and Jamaica. As a byproduct of rapid economic development and the "westernization" of Japan, this country's thirst for coffee has increased dramatically in the last forty years (All Japan Coffee Association n.d.). Conversely, the Jamaican economy continues to languish, and Jamaicans consume very little coffee per capita (International Coffee Organization 2013a).

It is not sheer coincidence that Japan imports the majority of the global Blue Mountain coffee supply. The complexity surrounding Jamaica's economic and political relationship with Japan includes numerous links owing to infrastructure development and foreign loan aid (Jamaican International Cooperation Agency 2002). These factors in part influenced what David Harvey would refer to as the "neo-liberal path" (2006:32) of Jamaica's economy and its dependence on foreign entities. Because of the steep, inaccessible geography and rudimentary processing facilities and crumbling infrastructure from devastating hurricanes in the Blue Mountains, foreign investments were seen as a means to improve the production, access and removal of coffee from the highlands (Jamaican International Cooperation Agency 2002; Lundy 1999). The downside to these investments is that they paved the path for green beans to leave the island, assuring most of the value-added links in the coffee commodity chain would continue to occur outside of the Jamaican economy.

In 1984 the Overseas Economic Cooperation of Japan (OECF) loaned the Jamaican government 5,941,000 yen to expand coffee cultivation (via deforestation) in marginal and/or erodible terrain (Lundy 1999). Japan's penchant for this gourmet coffee brew encouraged a direct trade for green coffee beans as a method of repayment (Black 1990). To date, "because the Blue Mountain coffee is a highly prized luxury good in Japan, demand is price inelastic and consistently exceeds available supply by a large margin" (Black 1990:5). Approximately 80-90% of dried Blue Mountain green coffee beans are purchased by Japan (All Japan Coffee Association n.d.; Benghiat 2008; Black 1990; Marshall 1983). Regardless of the specific figure, this market monopoly is fickle:

due to lack of a diversified market, if Japan's economy falters, so will Jamaica's coffee sector.[10]

Throughout the last four decades, the maintenance of a lucrative coffee export economy in Jamaica can be attributed in large part to extensive government backing. One could argue that the CIB exhibited brilliant providence in branding Blue Mountain coffee. Jamaica made moves economically and politically to position itself favorably (despite some of the geographical and ecological limitations imposed by being an island). But, these benefits have not been fully realized because of other institutional shortcomings (such as economic policies that allowed, or even encouraged value added links in the coffee commodity chain to occur outside of Jamaica). Nor do these policies encourage sustainable farming practices.

Moreover, socio-political inequities and power imbalances within Jamaica have not enabled greater profit margins to reach small-scale farmers. The current system favors expensive licensing geared towards large-scale farming. Consequently, small-scale farmers receive sub-par financial returns on their crops and are politically constrained from forming cooperatives. These marginalized growers are unable to directly export their coffee beans without direct (and costly licensing fees) intervention of the government. As my thesis will demonstrate, these interwoven elements have a powerful influence on a farmer's land use decisions regarding whether or not to cultivate shade coffee.

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[10] Statistics from the All Japan Coffee Association claim that in 2008, 1,030 metric tons of green beans were imported from Jamaica (All Japan Coffee Association n.d.).

FROM DISCOURSE TO DATA: RESEARCH METHODS FOR INVESTIGATING BLUE MOUNTAIN COFFEE FARMERS

"Evidence is data with a purpose." (Machi and McEvoy 2012:79)

As previously mentioned in the literature review, there is an abundance of quantitative-based studies that focus on the livelihood strategies of coffee farmers, their perceptions of shade coffee and the socioeconomic attributes of coffee agroforestry systems. However, an approach to data collection that numerically quantifies farmer attitudes can exclude perspectives that might otherwise be unearthed by a qualitative approach to information collection and analysis (Gibson and Brown 2009). For example, the use of in-depth descriptions facilitated by semi-structured interviews can serve as a catalyst for new insights and interpretations to emerge (Dey 1993; Gibson and Brown 2009).

By following the recommendation of Bernard (2001), data collection for this research focused on the individual farmers who cultivate coffee in the Blue Mountains. Through individual semi-structured interviews, my methods concentrated on the integration of micro and macro-level processes and factors that motivate Blue Mountain farmers to use shade methods or constrain them from doing so.

The layout of the interview guide that I employed in the field was in part, informed by the guidance of Sudman & Bradburn (1982) and, the order of questions was designed to encourage an "iterative flow of ideas" (Sudman and Bradburn 1982:182). To

ensure this exchange of information, the interview guide was divided into three sections: socio-economic, ecological, and socio-political questions (see appendix Semi-Structured Interview Guide). This approach was informed by a matrix of social ecology, commodity chains analysis, political ecology frameworks and previous literature from shade coffee studies. The chosen interview questions reflect the interdisciplinary theoretical perspectives contributed by my literature review (Berg and Lune 2011, Bernard 2001; Gray 2009; Newing 2010).

Fieldwork for this study was conducted in June and July of 2013 and January of 2014. Sixty-two semi-structured interviews were conducted within Saint Thomas, Saint Andrews and Portland parishes of Jamaica. These three coffee-producing regions were chosen with the intent of collecting a broad array of information about the range of conditions and contexts in which farmers cultivate coffee in the Blue Mountains. With the aid of local field assistant, Junior Carson, as a liaison, snowball sampling was utilized to gain access to interviews with coffee farmers from these regions (Bernard 2001:186).

The majority of these interviews included visits to each farmer's coffee parcel with a typical duration of twenty minutes to two hours (depending on respondent's willingness to engage in the questions). Participants were asked a mixture of open and closed questions designed to reveal farmer motivations and constraints for implementing shade cultivation techniques. Basic demographic and household primary data for each farmer was also collected. Information was archived through the use of field notes and digital recorders.

Audio interviews with respondents were transcribed and inputted to Atlas ti 7.0 for qualitative analysis. Codes were generated to categorize farmers' quotes from interviews. These codes were based on the integration of my theoretical frameworks: political ecology, social ecology framework and commodity chain analysis (Bockel and Tallec 2005; Bookchin 2007; Robbins 2011). Output from these code families (see appendix Atlas ti Coding Themes) was used to inductively extract themes and emerging patterns from the transcripts (Friese 2012; Miles, Huberman, and Saldaña 2014). Each interview was also categorized based on farm type and queries based on the conglomeration of multiple codes were run to retrieve data. This approach enabled me to construct a holistic narrative of the Blue Mountain coffee culture through the voices of its farmers.

Within the academy, a visual approach to data collection and dissemination is extremely underutilized. From the shade coffee literature surveyed, I noted that very few authors incorporated a visual sociology framework into their modes of analysis. For my research, I focused on the craft and aesthetics of photography so that it could complement my qualitative narrative. In so doing, I endeavored to capture the essence of how Jamaican Blue Mountain coffee farmers interact with their landscape. As a result, I was able to thematically classify photographs of cultivation patterns based on the coding categories generated in Atlas ti.

While conducting my field research, I also photo-documented the cultivation practices of 57 Blue Mountain farmers that I interviewed. Through this approach I had three primary objectives: to create a visual record of what Harper calls an

"environmental portrait" (2012:65), apply a "constructivist slant" (2012:20) for photographically exploring my thesis question, and most importantly, to utilize "photos as a bridge between researcher and subject" (2012:134).

In my case, I chose to leave behind not only footprints, but also photo-gifts as a gesture of appreciation to the communities that I studied in Jamaica. By bringing a portable Canon Selphy printer, I was able to present farmers with 4x6 prints of the images taken of them and their families on their coffee plots. Most importantly, I was able to share my love of photography with those who shared their love of farming with me.

The interview data were triangulated by comparing digital images taken in the field with participant observations, farmer primary data, species composition inventories for each farm, and information collected from coffee industry informants. Cross-checking results was intended to generate a fuller picture of the research setting (Newing 2010:115).

SOCIAL-ECOLOGICAL DRIVERS AND CONSTRAINTS AFFECTING SHADE COFFEE CULTIVAITON

I conducted 62 semi-structured interviews of farmers in the Blue Mountains, whose farms ranged from 300-1500 m in elevation (Figure 1). I was able to visit 57 farms cultivated by interviewees. Only four of the 62 farms visited were less than three years old and not yet producing coffee fruit. Approximately one third of the farmers surveyed were cultivating coffee on less than two hectares. Of the 57 visited farms, only one was exclusively organic. The remainder relied on one or several forms of agrochemicals for fertilization and control of insect, weed, and fungal pests. The properties that I visited were privately owned, leased, or in the case of one piece of land, illegally cultivated on land belonging to the crown.

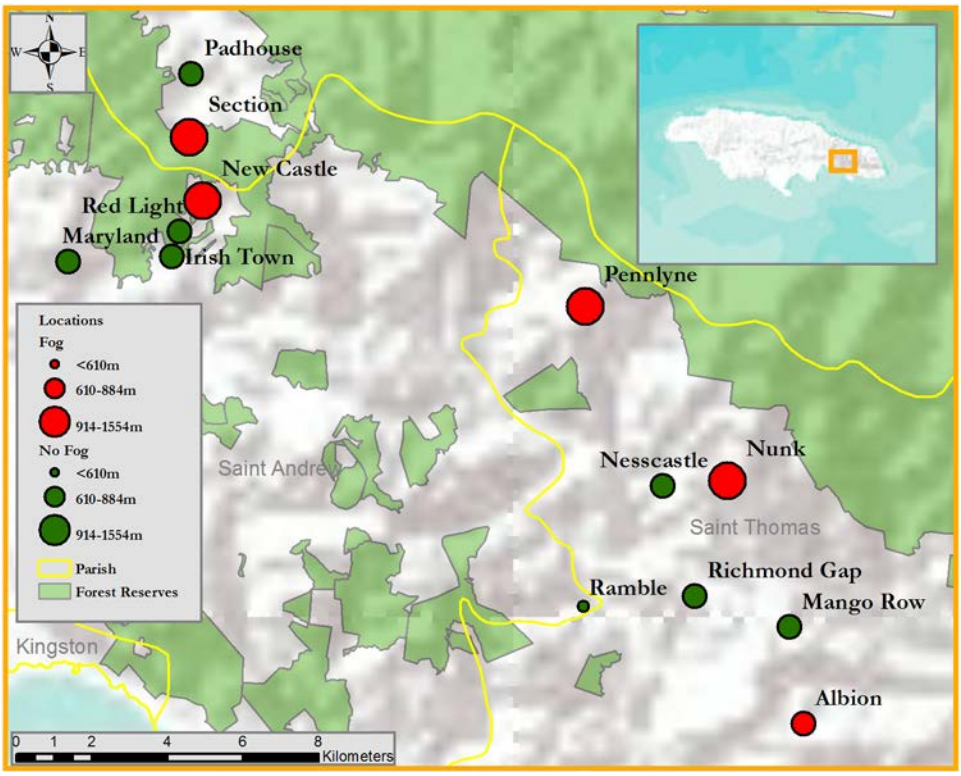


Figure 1 The Blue Mountain study region included communities from Portland, St. Andrews & St. Thomas parishes. In this map, these regions are classified by elevation and local farmer's perceptions of fog as a barrier for including shade trees on their property.

Salomon defines an ecosystem as "integrated system composed of a biotic community, its abiotic environment, and their dynamic interactions" (2009:16). This definition fails to categorize precisely what an "integrated system" constitutes and vaguely makes reference to the spatial "scale of scrutiny" (Salomon 2009:16). Chapin acknowledges that almost all "ecosystems are influenced, to a greater or lesser degree, by social processes" (2009:30). When taking into consideration the coffee landscape of Jamaica's Blue Mountains, this "integrated system" is constantly manipulated by human intervention. As a result, the incessant anthropomorphic presence within this mountain ecosystem creates a continuous flux amongst the abiotic and biotic components; when

farmers discussed ecological factors affecting shade cover, their responses were based on the interplay of abiotic and biotic factors associated with the physical geography of steep mountainous terrain. These attributes in turn had major influence on the coffee grower's land management techniques.

Abiotic Factors Affecting the Distribution of Shade Trees in the Blue Mountains

In coffee producing landscapes, "climatic conditions" and "site conditions" are cited as the most influential abiotic factors shaping the distribution of shade trees (Beer et al. 1997:140; DaMatta 2004). Throughout the Blue Mountains, the most often mentioned climatic conditions influencing the distribution of shade trees were regional microclimates based on slope aspect and cooler temperatures at higher elevations. The site conditions that were recurrent in our conversations about shade were: erosion control, and damage from hurricanes and tropical storms.

In the Blue Mountains of Jamaica as in other mountainous regions worldwide, farmers contend that "the use of shade is unnecessary in cool, humid, and cloudy highlands" (Schroth et al. 2004:202). Consistently I was told that the amount of shade cover on a coffee farm "depends on the area" (Figure 2). The majority of shade trees that I saw and photographed were on coffee farms at mid and lower elevation across all parishes (such as Mango Row, Cascade, Nesscastle, Maryland and Ramble, see Figure 1). These observations are consistent with the current theory of the effects of elevation on

coffee in general (Beet et al. 1997) and on empirical evidence from Jamaica specifically (Davis 2013).

Figure 2 Wallenford's 36 hectare sun coffee farm in Portland Parish. Most cultivators in this region claim that constant cloud cover reduces the need to have shade trees on their coffee farms.

At lower elevation locales it was explained to me that a canopy cover is necessary to shelter coffee shrubs from intense exposure to sun and heat because "sun burn da coffee cherry." The negative effect of excessive shade on yield was also recognized because "you can't just have it under shade or else you would get the coffee with a whole lot of leaf and no bearing." As such, in these regions where farmers utilize trees to buffer and filter sunlight, exposure to sunlight is managed by seasonally pruning and/or

selecting trees that are deciduous and discard their leaves when coffee berries need sunlight to expedite ripening.

In east and north facing slopes of the Blue Mountains where microclimates produce prolonged periods of cloud cover throughout the year (such as Nunk, Newcastle, Section and Albion), interviewees consider fog an abiotic constraint for including shade trees in their coffee farms (Figure 1, Figure 2 & Figure 3). Farmers from these areas claim that adding shade trees in fog zones prolongs the ripening period of coffee berries, which is undesirable “because [it] reduces the amount of sunlight for the amount of growth that the plant is able to do.” A large-scale coffee grower in Portland succinctly illustrated this line of reasoning by pointing to the cloudy skies and saying, “this is my shade.”

Figure 3 High elevation regions of the Blue Mountains are regularly shrouded in a fog blanket that reduces sun exposure to coffee farms. This photo was taken from Section in Portland parish. The average elevation here was 1200 meters.

The second major abiotic constraint discussed by coffee farmers is the reduced ambient temperature at higher elevations. In all parishes, interviewees expressed a very clear distinction between high and low elevation shade requirements. At lower elevations (below 1100 meters), many farmers explained that a managed shade canopy keeps the coffee berries from drying up and "burning." Whereas, the majority of high elevation (above 1100 meters) coffee farmers that we interviewed do not provide a canopy cover

for their coffee plants (except for one organic coffee farmer in Section). These cultivators expressed opinions such as, “I know in the mountains that I don’t need shade,” or, “you no really want no shade up here. Even right now you sit down in the sun and you get cold easy. Too much shade ya get no bearing. Cause the coffee not really want too much cold.” Once again, this perception, that at high elevations yield may diminish with too much shade is consistent with the literature (Beer et al. 1997; Soto-Pinto, Perfecto, and Caballero-Nieto 2002). However, Beer et al. (1997) assert this relationship is complicated by soil quality; shade can be beneficial even at higher elevations on poorer soils. In my interviews, this distinction was not articulated by Jamaican farmers.

At higher elevations, interviewees asserted that only young coffee plants need shade (predominantly in the form of bananas or nursery trees, Figure 4). Exceptions to this shade rule were only two informed farmers growing above 1100 meters that were intentionally including a diversity of trees. Their rationale was usually for environmental and/or conservation purposes because these growers were trying to market their coffee as organic/shade friendly.

Figure 4 This sun coffee farm in Pennlyne Castle, St. Thomas used bananas as "nursery trees" to shade young coffee plants and retained trees along its perimeter as windbreakers.

Evidence suggests that the consequences for reduced canopy cover on steep slopes is loss of topsoil and greater risk of erosion. As I discovered (Figure 5)[11], this abiotic factor is so widespread in the Blue Mountains that it is reflected in popular folklore; during an interview with a Saint Andrews farmer, I was recounted a local song:

> "Muddy water
> Muddy water
> Running, running to the sea
> Muddy water
> Muddy water
> Taking all my precious soil from me
> I will stop the likkle trickle with a barrier
> I will check the bigger rushes with a trench
> I will work and will not rest
> And will do my level best

[11] In the steep terrain of the Blue Mountains, the highest rates of erosion occur in the southern flanks of the Blue Mountains (McGregor 1995).

To stop muddy water from going to the sea…”

Figure 5 The physical aftermath of erosion was a sight that we commonly encountered throughout steep, deforested portions of the mountains.

Many farmers acknowledged that they were motivated to include trees on their coffee farms because they “keep the land from slipping.” Farmers that practiced erosion control rely on two strategies: shade trees with deep root systems and the construction of “contours” from pruned tree limbs and defunct banana plants (Figure 6). However, it was also mentioned that, “there’s a lot of people that don’t know the importance [of erosion control] when they see that muddy water rush in.”

Figure 6 "Contours," or naturally designed terraces help to dissipate the force of water on steep slopes after heavy rainfall. Cultivators in Mango Row showed us examples of using banana stalks as contours to create rows for the accumulation of soil and nutrients amongst coffee rows on steep mountain slopes.

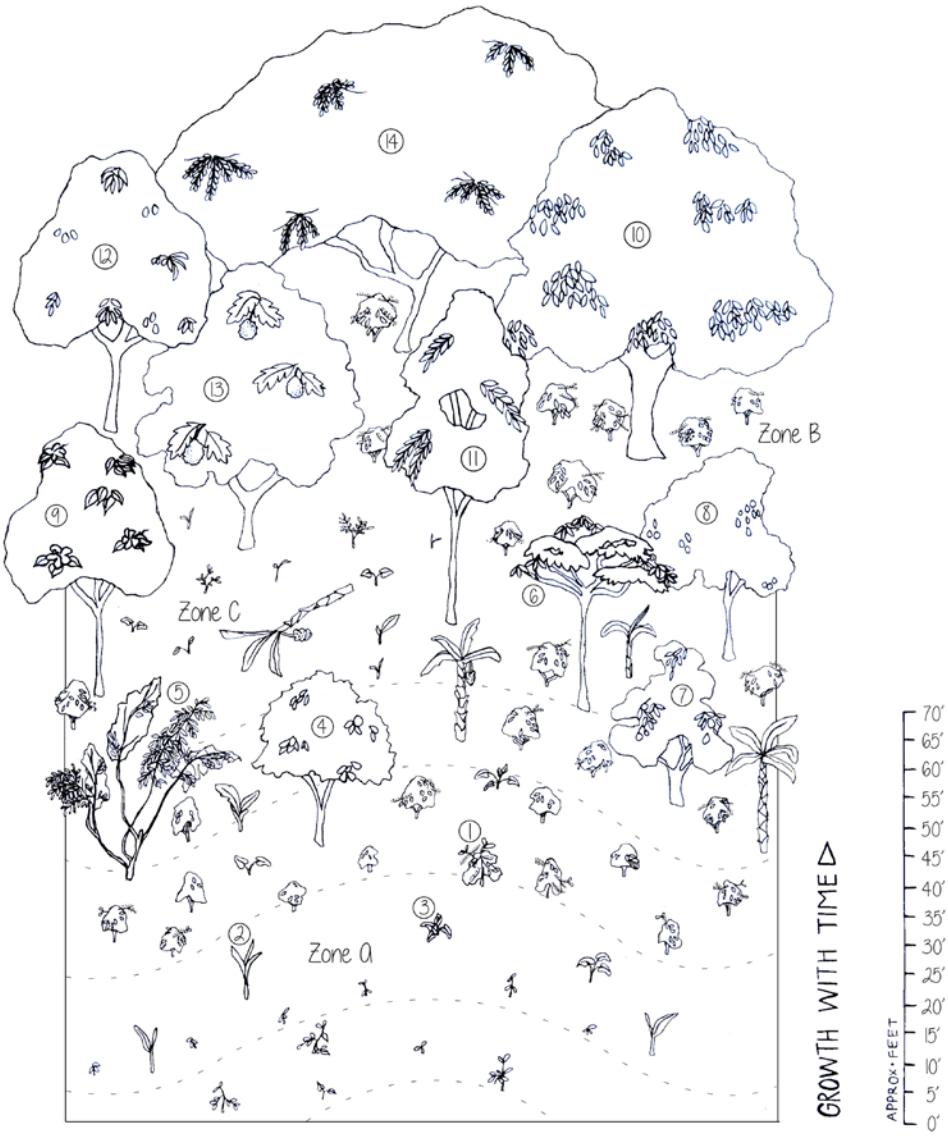
The omnipresent threat of hurricanes and tropical storms is a major driver for the cultivation of shade trees in coffee farms (Table 1 & Figure 8, zone c). To mitigate the detrimental effects of hurricanes and damage from strong wind, farmers are motivated to plant shade trees. I was told that "the shade keep off some of the breeze" (Figure 7). Even shadeless coffee farms in the Blue Mountains often include a narrow row of fast-growing trees along the perimeter of their property to buffer strong winds (Harvey, Tucker, and Estrada 2004). Therefore, we found use of shade trees as windbreaks agrees with previous findings in coffee agroforestry literature (Willson 1985:166).

Table 1 A list of the major hurricanes that have struck Jamaica (Relief Web 2014). Blue highlighted hurricanes were consistently mentioned by farmers as causing considerable damage to their coffee farms.

Major Hurricanes Affecting Jamaica	
YEAR	NAME
1988	Gilbert
2001	Iris
2004	Ivan
2005	Dennis
2005	Wilma
2007	Dean
2007	Noel
2008	Gustav
2010	Tomas
2012	Sandy

Figure 7 Located above 1200 m elevation, this sun coffee farm utilizes quick growing trees as property boundaries and windbreakers.

During the summer of 2014, I was repeatedly told that “hurricane Sandy mash up almost every farm.” Because of the extreme intensity of this hurricane, many coffee growers endured severe damage from landslides that eroded entire slopes and gullies. Wind gusts from this hurricane were so intense that significant quantities of fallen trees and limbs damaged coffee plants as well as the loss coffee berries from their parent shrubs due to strong winds (Figure 8). I was also told that the injuries to the coffee plants sustained from hurricane Sandy will negatively affect crop production for years to come. Farmers recounted that this magnitude of hurricane damage had not occurred since Gilbert in 1988. Nevertheless, in spite of this tree-related damage, farmers in regions that use shade explained that they would have to replant their fallen trees. For these farmers at lower elevation, this illustrates that the need for shade is outweighed by occasional damage from storms and fallen limbs.



Plant Succession in a Blue Mountain Coffee Forest Garden

#	Scientific Name	Approx. Height	#	Scientific Name	Approx. Height
1	Coffea arabica	4-7 ft	8	Blighia sapida	30 ft
2	Musa sp.	10-16 ft	9	Talipariti elatum	30-60 ft
3	Colocasia esculenta	2.5-3 ft	10	Magnifera indica	30-120 ft
4	Citrus sp.	15/35 ft	11	Cedrela odorata	33-98 ft
5	Gliricidia sepium	15-60 ft	12	Syzygium malaccense	39-59 ft
6	Cecropia obtusifolia	20-30 ft	13	Artocarpus altilis	40-85 ft
7	Persea americana	25-32 ft	14	Samanea saman	60 ft

Figure 8 Plant succession in a typical shaded Blue Mountain coffee forest garden below 1200 meters in elevation. Zone A depicts the initial planting stage of coffee shrubs. At this point (years 1-3), cash crops and small trees are planted amongst coffee rows. Zone B illustrates a mature coffee forest garden in which cash crops are removed and fruit and lumber trees are selectively pruned and managed for airflow and light penetration. In zone C abiotic disturbance from a hurricane is conveyed through downed trees. At this point in a farm's life cycle, farmers must re-plant some shade trees and replace damaged coffee shrubs.

Biotic Factors Affecting the Distribution of Shade Trees in the Blue Mountains

> "There is a disease taking the coffee about a couple of months ago and it is coming back. I don't know where that disease come from. What they call it, some leaf rust? They gave us some chemical and said to spray and I spray a lot and it's coming back again. Even if you spray and ya neighbor spray, it's a still come." –Summer 2013, Mango Row farmer

In the Blue Mountains, the dominant biotic factors driving or constraining shade distribution on coffee farms were: fungal disease, tree attributes that are favored for their ecosystem services and insect pests.

Subsequent to the farm damage from hurricane Sandy in 2012, coffee farmers throughout the Blue Mountains began experiencing massive outbreaks of *Hemileia vastatrix*, or coffee leaf rust. The majority of farmers that I interviewed were extremely concerned and alarmed by the widespread die-ff of coffee plants from leaf rust on their farms (Figure 9). From my interviews there was a lack of agreement as to whether shade trees reduce or increase outbreaks of leaf rust. Some believed that, "if it havn' a whole heap of shade and cluster up and sometimes you get a lot of disease, the leaf rust, ya undastand?" Whereas, others suggested, "not sure if sun helps with leaf rust."

Figure 9 This image from 2013 illustrates the damaging effects of leaf rust to a coffee farm in Portland Parish. In the aftermath of hurricane Sandy, this portion of the Blue Mountains was heavily affected by the "disease."

Regardless of farmers' convictions about leaf rust and its relationship with shade, respondents also had a little or no understanding of this disease's pathology. Specifically, farmer's were not aware that although reducing coffee berry yield short term, managed shade can suppress leaf rust (Avelino, Willocquet, and Savary 2004). Therefore, at this juncture in the spread of leaf rust throughout the Blue Mountains, it was difficult to determine whether or not the disease was perceived by farmers as a constraint for growing shade coffee. These misunderstandings of the leaf rust life cycle are under-acknowledged throughout most of the coffee literature (Perfecto and Vandermeer 2015). In their study of small scale Mexican coffee growers Segura et al. (2004) state that, "the low rate of adoption of coffee pest management technology by Soconuscan small farmers shows that there is still a conceptual gap between scientific knowledge developed at research institutions and the fulfillment of the farmers' need to solve their major pest

problems”(Segura et al. 2004:1498). For leaf rust, this gap could be attributed to the fact that extension services tend to place emphasis on a pest only when it becomes acute and widespread.

During on-farm interviews, less than six of the coffee cultivators with shade-trees made reference to ecosystem services generated by the species within their canopies. Due to these low numbers and the production practices used on most farms (such as clearing all brush from below coffee shrubs, using agrochemicals, removing shade, etc) it appeared that local ecological knowledge is underutilized in the Blue Mountains.

The majority of tree-crop interactions that provided ecological services to farmers were described as enhancing moisture maintenance and seasonal deciduous shade; these attributes tend to coincide with reasons cited by Soto-Pinto et al. (2007) and are described in Table 2. However, farmers were not aware of nitrogen fixing properties or the correlation between shade trees and beneficial pest reduction services by birds utilizing the canopy.

Table 2 Most commonly cited ecological benefits and disadvantages of Blue Mountain shade trees. Farmers did not make reference to nitrogen fixing properties of Gliricidia and Samanea.

LOCAL NAME	SCIENTIFIC NAME	BENEFITS	DISADVANTAGES
Banana & Plantain	*Musa sp.*	Adds to groundwater reservoir, easy to manage, grows quickly, provides money and food for farmer, leaves shelter young coffee plants, bears more when planted with coffee that is fertilized.	Easily damaged or razed by strong winds from tropical storms.
Breadfruit	*Artocarpus altilis*	Large leaves good for shade, possible insecticide value (study needed).	
Cedar	*Cedrela odorata*	Lumber; leaf-dropping season overlaps with period when coffee needs most sun for berry production.	
Citrus	*Citrus x*	Shade, food.	
Silky Oak	*Grevillea robusta*	Shade, lumber, windbreaks.	
Pimento	*Pimenta dioica*	Tall, allowing air to circulate between coffee shrubs and canopy cover.	
Lucinea	*Leucaena leuocephala*	Keeps coffee cool during dry season.	Abundant seeds enable rapid spread of saplings.
Mango	*Magnifera indica*	Tall shade, food.	
Ackee	*Blighia sapida*	Tall shade, food.	
Quick Stick	*Gliricidia sepium*	Grows rapidly, windbreaker, property boundary marker, leaf-dropping season overlaps with period when coffee needs most sun for berry production.	
Guango	*Samanea saman*	Lumber, grows high (enabling multi-layer tree canopy), spreading limbs allow air circulation between canopy cover and coffee shrubs; at night leaves close and allow dew to fall on coffee.	
Trumpet Tree	*Cecropia obtusifolia*		Large leaves create too much shade.
Pear (Avocado)	*Persea americana*	Food source.	
June Plum	*Spondias dulcis*	Leaf-dropping season overlaps with period when coffee needs most sun for berry production.	
Fig	*Ficus sp.*		Roots compete with coffee roots for nutrients.

Instead, insect infestation was not considered by most Blue Mountain farmers to be a major threat to coffee cultivation. Pests such as the coffee berry borer (*Hypothenemus hampei*) have, in recent years, been a major concern in Jamaican coffee (Martin-Wilkins 2012). Albeit a small amount, at lower elevations farmers mentioned that, "coffee yes, we need the shade but comes again with another thing: the insects like the shade also. So once you do that again you have to fight the insects with pesticide more than if it is sunlight." This perception is at odds with the published literature suggesting that insect pests are generally diminished at moderate levels of shade (Beer 1987; Soto-Pinto, Perfecto, and Caballero-Nieto 2002b; Vandermeer, Jackson, and Perfecto 2014; Vandermeer, Perfecto, and Philpott 2010). More specifically, ecological research in Jamaica has shown that insect-eating birds attracted by shade trees can help reduce insect pests and boost farm income in western parishes (Johnson et al. 2010), and to a lesser extent, in the Blue Mountains as well. This discrepancy underscores the inadequacy of dissemination through agricultural extension services. This political shortcoming is described in more detail in the following chapter.

POLITICAL DRIVERS AND CONSTRAINTS OF SHADE COFFEE IN THE BLUE MOUNTAINS

Agricultural Extension

"So we want the main thing: technical assistance. We want extension officers help with our fields. We ball for they money, yes. If we get more out of the crop, we still can make money." –St. Thomas Farmer

Generally, farmers' perspectives were that their government (in particular, the Coffee Industry Board) was not endorsing the cultivation of shade coffee. In Mango Row, whenever I asked, "*does the CIB encourage you to plant more shade trees,"* the type of response was, "no they don't really encourage us. But we know that planting shade is central. Because if you notice if you have coffee and just plant it on a plain, it didn't grab. And if you don't plant a major tree like that, it don't come to nothing."

The reach of extension services and support from the CIB appears to vary with farm size. Farmers with less than three acres of coffee crops consistently mentioned to us that they did not receive support from CIB extension officers; this absence of technical assistance was most evident on small farms where owners were unsure of how to properly cut back their coffee trees, garmandize or prune shade trees. Whenever I made the inquiry about extension services and the endorsement of shade trees, smallholder farmers responded: "CIB is only helping the bigga man." In contrast, a few cultivators with farms larger than five acres acknowledged their intermittent access to extension

officer services. The omnipresent frustration discussed by farmers was also compounded by the compulsory "sinking fund," or tax applied to each box of coffee berries sold to the coffee selectors. Farmers explained that the $91 Jamaican dollar tax deducted from the sale of a box of coffee is supposed to finance extension services. Although, as previously mentioned, "but them not come look upon your farm." In Nesscastle an older gentleman sarcastically explained to me, "look at the $91 dollars they getting for nothing."

Nonetheless, the larger farmers also readily complained about the lack of efficiency and presence of the CIB throughout their region. In Portland Parish a large scale farmer confirmed this by poignantly stating, "Why is there no research? I suspect they cut the funding, long term. It's not just last year. It's long term absence of funding. But I think it is more than simply funding. I think it's been a bit of a political thing. Agriculture is where we are coming from, not where we are going to." [12]

In Jamaica, the Rural Agricultural Development Authority (RADA) is an executive agency within the Ministry of Agriculture & Fisheries (Jamaican Ministry of Agriculture & Fisheries 2014). RADA provides training, seeds and tax breaks for agriculture-related projects. When prompted about the utilization of RADA services, many interviewees explained that they didn't have much incentive for registering with

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[12] According to an interview with a CIB employee, the Coffee Board's involvement with farmers has decreased since its partial de-regulation in 2002. Consequently, as of 2004, the CIB is solely responsible for the regulatory actions associated with coffee production and exportation. An informant from the private coffee sector explained to us that, "the [coffee] industry has been divested so that the government's role is almost insignificant. It's all been privatized." However, the market sector fails to compensate for the lack of political backing for extension services.

RADA. Interviewees felt that the time invested in forming regional chapters and attending meetings would instead be better spent on their farms.

Only three respondents mentioned the "field days" in which the CIB provides seminars and field techniques for coffee cultivation strategies. Numerous farmers complained that access to information is somewhat limited due to transportation logistics and financial constraints for attending workshops. However, in Mango Row I met an incredibly inquisitive and well-informed woman who took time to attend meetings and workshops sponsored by RADA and CIB (she was very knowledgeable about shade management). She explained to us, "we share a lot but some time people don't come because they are busy" and also that "we have a lot of workshops, not right now because a lot of things just die out." An examination of materials from the CIB on the benefits of shade (CIB 2012) indicates a recognition of current scientific knowledge. Thus, my results indicate that the failure of extension services to drive appropriate change in shade cultivation practices has more to do with inadequate dissemination and farmer access to CIB extension services than with inaccurate content or ineffective adoption.

The Ministry of Forestry also promotes tree plantings, and in some cases provides saplings and labor for shade trees on coffee farms, though these are often non-native species. From farmer interviews, we were also given the impression that interagency collaboration between the CIB, RADA and the Jamaican Forestry Department appears to be uncommon. Of the 62 farmers that I interviewed, two mentioned the Jamaican Forestry Department. Both of these farmers cultivate coffee in Portland and have capital

resources and farm five acres or more. One of these interviewees explained that she was taking advantage of the "private planting programme" to procure free native tree seedlings for her coffee farm[13].

However, the bulk of farmers that we met were uninformed about this tree program; paperwork and information for participating in this project is accessible on the worldwide web (Forestry Department 2013). Unfortunately, the majority of Blue Mountains farmers do not have access to internet or a printer to generate a copy of the "Private Planting Programme Application Form." Nor do these cultivators have the financial means to mail this form. Also, "due to circumstances beyond our control, requested species and/or quantities may not always be available at your desired planting time."

Guango (*Samanea saman*), blue mahoe (*Talipariti elatum*) and cedar (*Cedrela odorata*) are the only three native Jamaican species regularly regarded by farmers as useful for shading coffee plants (Figure 10). However, there are barriers for farmers to access guango and blue mahoe within St. Thomas. Farmers indicated a desire to plant guango. Yet, when inquiring about the absence of this endemic tree, we received some of the following answers, "me don't see these people really plant it as shade in the coffee. You would have to go out and get it," as well as,

> "guango is very good but we don't have a lot of guangos here."
> *"why"*

[13] This program is an offshoot of the "Trees for Tomorrow Project" which is in part funded by the Canadian International Development Agency (Headley 2003; Tecsult International Ltd. n.d.).

> "I don't know….from my father's days I haven't seen much guango around here."
> *"Were they cut down?"*
> "No we wouldn't cut them because the guango is a very good shade and them don't really hang low, they grow high. The guango tree is very cool and don't really make anything happen to the coffee because the tree they high so they can get a lot of ventilation and spread out."
> *Would you plant guango if you had access to it?*
> "we happy for some guango on this side because we have some ridges and gulleys which other trees easily wash away."

This dialogue illustrates that farmers would be willing to include guango on their farms. However, they do not have access to these trees. Access to native trees is in part impeded by a lack of extensions services and nurseries. Collectively, these issues underscore the point that access to existing services is a significant constraint on the cultivation of shade tree on farms in my study area.

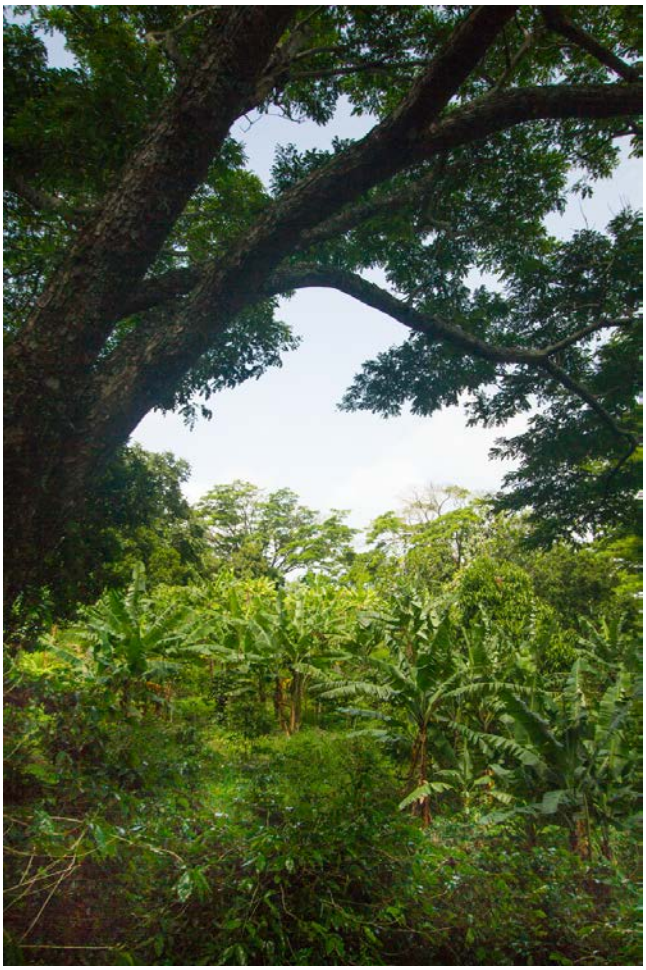

Figure 10 The large, towering guango tree (beneficial as a nitrogen-fixing tree) in this photo was referred to as the "mother tree" by its land steward. This Richmond Gap farmer utilized bananas and guango trees to shade and ventilate his coffee plants. On numerous occasions, the proprietor of this tree was offered money in return for its precious lumber. With pride and reverence, our guide always declined the offers.

Help and the Jamaican Fertilizer Fetish

The [second] most conspicuous constraint perceived by farmers in my study was soil fertility. The majority of interviewees mentioned that they could not effectively grow coffee without using synthetic fertilizer; in Mango Row almost every farmer vocalized a

need for "help" with chemical inputs after natural disasters. One farmer from St. Andrews went so far as to beg us for the money to purchase a bag of fertilizer.

In the aftermath of the damage caused by Hurricane Sandy, Fersan Fertilizer Company[14] donated 1,000 bags of fertilizer and the Jamaican government purchased 900,000 kilograms to donate to farmers in the most heavily affected regions of the island. Specifically, in St. Thomas, St. Andrews, Portland, St. Catherine, St. Ann and Clarendon (JIS 2012). Political backing viewed this fertilizer support strategy as a means "to assist farmers to get back into production in the shortest possible time" (JIS 2012). However, these short-term political solutions do not take into consideration the long-term repercussions of eroding mountainsides in deforested regions. This issue could be partially mitigated by providing native saplings adapted to withstand hurricanes.

In other coffee growing countries agricultural and environmental research has established that soil fertility on coffee farms can be maintained without synthetic fertilizers, by the application of organic inputs and the use of nitrogen fixing shade trees (Beer et al. 1997; DaMatta 2004; Perfecto et al. 2005; Rice and Ward 1996). Nevertheless, this reality was clearly under-recognized, again illustrating a shortcoming in political and informational support for farmers.

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[14] The majority of fertilizer used by Jamaican coffee growers is purchased from the Chinese company Fersan. Their product is imported from China and packaged in Kingston, Jamaica for sale throughout the island.

The Disease

> "Nobody will come out because coffee going to be on a low this year because there three factors: we had a hurricane last year, we have a disease that they call coffee rust but that wipe out a lot of the coffee. If you go on the Portland side it wipe out a lot of the coffee. So the production will be low this year." –St. Andrews Farmer

Compounding the inadequate dissemination of the benefits by extension services, the widespread occurrence of a fungal disease is causing concern that excessive shade could exacerbate the disease. Concern for this disease, called leaf rust and caused by growth of *Hemileia vastatrix*, has prompted some recommendations for a *reduction* in shade, especially at middle elevations. In addition, extension services are recommending the use of synthetic fungicides to combat the devastating disease (Figure 12).

Figure 11 In 2014 farmers were devastated. One gentleman explained, "when the disease just show it seems as if all was lost. All the leaf went, leave brambles and begin to dry up." The cumulative effects of coffee shrub damage and the nefarious leaf rust has generated a massive coffee bean shortage in the Blue Mountains.

In January 2014, during my second visit to Jamaica, the disease had become much worse (Figure 9 and Figure 11), and while revisiting farmers that I had interviewed the previous summer, I encountered a leaf rust poster near Hagley Gap that promoted the reduction of shade cover in coffee farms (Figure 12). A farmer in Albion (with greater than three acres of healthy producing coffee shrubs) confirmed the poster's message. She explained to us that extension officers from the CIB were encouraging her to eradicate trees from her property in order to prevent her coffee from becoming infested with leaf rust. However, this farmer valued the shade and fruit provided by her trees and refused to remove them from her property.

Avelino et al. (2004) suggest that whether utilizing shade or sun coffee cultivation, it important to acknowledge that both require different crop management strategies for controlling the spread of this disease. Strategies promoted by the CIB for mitigating the leaf rust epidemic in Jamaica are contrary to recommendations in scientific literature (Avelino et al. 2004; Soto-Pinto, Perfecto, and Caballero-Nieto 2002c). The reason for this occurrence is not clear.

Coupled with the endorsement of synthetic fertilizer application in coffee fields, a leaf rust pamphlet available on the CIB's website (CIB 2012) and the aforementioned poster, these pieces of information illustrate that at the institutional level, there exists a lack of understanding surrounding the pathology and spread of leaf rust as well as its complex relationship with shade management.

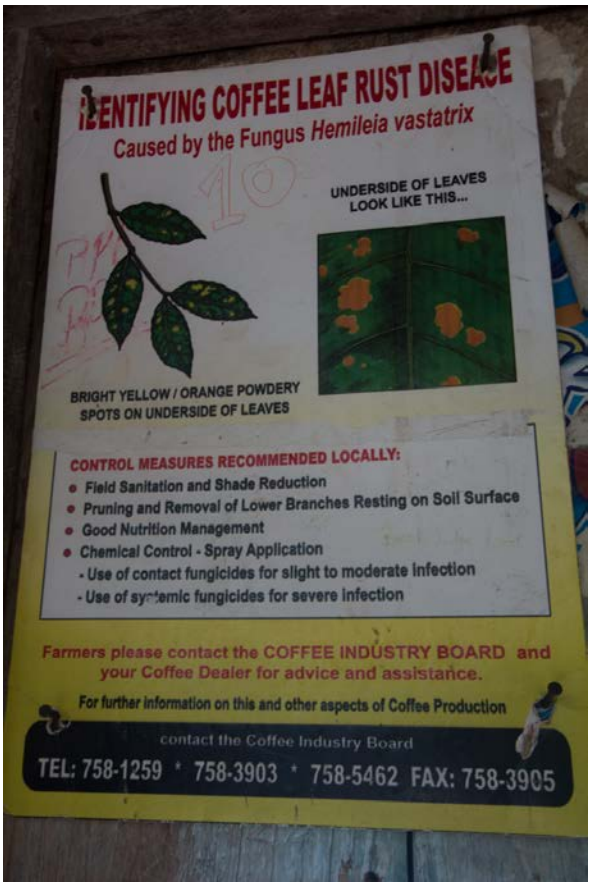

Figure 12 This CIB informational poster was photographed near Pennlyne Castle & Hagley Gap. Incidentally this area is also a higher elevation coffee producing region in the Blue Mountains where coffee is deemed of superlative quality and thus, growers receive more per box of coffee than lower elevation growers (as well as greater access to CIB extension officers).

Lack of Institutional Endorsement for Organic/Shade Coffee Certification Schemes

"Even organic is marginal. It's not worth it in terms commercially. Environmentally, yes, but commercially no." –St. Andrews Farmer

Only one of the interviewed farmers made reference to institutional support for organic coffee production. This organically certified coffee grower described to us that the Jamaican government is attempting a cursory approach to endorsing organic coffee production,

> "We have this Caribbean IDP project with JAMPRO because Jamaican Organic Coffee is in the national export strategy. I was on that task force. They said they will market it this way. I said to them 'you have to have product to market it this way.' And there are a lot of people planting coffee but as you can see, it is mostly clear cut. And they use round up."

According to the Jamaican National Export Strategy for Coffee,

> "farm practices have improved with increased utilization of natural fertilizers and pesticides. Further damage to the environment is not likely to occur with planned increase in output which will be based on improving yield (and not expansion of planted lands), while inter-cropping and other environmental practices are also to be pursued" (NES 2009:4).

This policy document does not acknowledge that commercial, organic options for fertilization and pesticide use are not commercially available in Jamaica.[15] Nor does it elaborate on the types of "environmental practices" that will be pursued. To date, this state-driven project exists in written form and has not been implemented. The CIB falls

[15] We visited the most popular farm store in St. Thomas' Morant Bay and observed the following coffee-related chemicals available for purchase: Suldan- Contact Insecticide, Roundup Ultra, Gramoxone- crop desiccant, Malathion- insecticide for borer beetle, Karate Syngenta, Dupont Kocide 2000, Sancozeb WP Dow Agro, Diazinon Insecticide, Dithane M-45 fungicide. Unfortunately we did not find organic options for treating coffee pests.

short in providing coffee growers with a range of knowledge concerning organic and shade coffee growing strategies.

ECONOMIC DRIVERS AND CONSTRAINTS OF SHADE COFFEE CULTIVATION IN THE BLUE MOUNTAINS

"Coffee is so expensive on the world market and as a farmer you can't find the money to take care of the coffee." –Richmond Gap farmer

While collecting socioeconomic data, I learned that not all respondents were full-time coffee growers. Two thirds of these cultivators relied on supplemental incomes to sustain their households. Fifty of the interviewees were male and the remaining 12 were females. Further, three fourths of the farmers were above the age of forty. Eight farmers confided that they were "throwin up da farm" (abandoning their coffee farms) because of a lack of financial incentive to continue cultivating coffee. Integrating these demographic variables with the evaluation of on-farm, on-island and global forces sheds light on the driving and constraining economic forces for shade coffee cultivation in the Blue Mountains.

The Land of Fruit Trees & Driving Forces for Shade Cultivation

"That's the beauty about Jamaica. Anywhere in Jamaica there is fruits." –Albion Coffee Farmer

Prior research reveals that the primary economic drivers for including shade trees on coffee farms throughout the world is some form of associated value for the trees in question and as a risk aversion strategy (Albertin 2002; Davis 2013; Perfecto et al. 1996; Rice 2011). Within the Blue Mountains, inflated costs for staple foods (such as flour, rice, bread, canned foods) encourages farmers to adapt food security mechanisms on their cultivated landscapes (Figure 8, Figure 13 & Figure 14). This risk avoidance strategy was explained as, "if you just plant coffee alone, when the coffee finish, there is nothing else there." Therefore, amongst farmers that planted trees on their coffee properties there was a general consensus that, "not wise to plant trees you can't harvest anything after." However, due to poor transportation infrastructure within the Blue Mountains (such as roads washed away from landslides, lack of reliable transportation for access to urban markets), the economic value of fruit products outside of the farm is often underutilized (Davis 2013), and the majority of fruit grown on coffee farms (that did not decompose in the field) is consumed by the primary household.

Figure 13 A typical ¼ hectare coffee garden with mango, banana, citrus, coffee and ground cover crops.

Figure 14 Bird's eye view of a coffee forest garden in St. Andrews. Sugar cane, citrus, bananas, guango, cedar and aroides species were present on this farm.

In my study sites, farmers below 1200 meters elevation explained that,

> "normally when you plant the coffee you would put in shades. You would put in special trees to put in shade. But because maybe the economical crisis you put in fruit trees for the shade. Staple crops for the shade."

Economic crisis has been magnified in the aftermath of hurricane Sandy in 2012. Farmers explained that they replaced damaged trees exclusively with timber and food-bearing trees; throughout St. Thomas we noticed that there were very few cacao trees amongst shaded coffee farms. When we inquired, it was explained to us that hurricane Gilbert razed all of these trees and that since then there was no strong economic incentive to replace most of them. This farmer also claimed that the financial return for cacao in Jamaica was too low and that this tropical product required more space.

Unlike Latin American coffee producing regions that include a diet centered around the consumption of corn, Jamaicans have an affinity for heavy, starchy meals. When put into perspective with the other most common fruit trees from our surveys in

Table 3, breadfruit and bananas are the only two shade trees that provide a starchy, filling nutritional content amenable to the Jamaican eating customs[16]. Bananas are preferred over breadfruit trees for several reasons: breadfruit requires several years of growth and development to produce fruit and necessitate more care and management. Of these two fruits, in my research area I found that overwhelmingly, when I asked farmers about "shade," in all regions and elevations gradients, the consensus from farmers was that bananas are the ideal shading tree (Figure 8 & Figure 15)[17]. Interviewees extolled the benefits of bananas by proclaiming it the "quick shade," ideal for planting amongst young coffee starts, as incredibly easy to propagate, source of surplus cash and for its ability to quickly produce fruits within ten months of planting.

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[16] The typical Jamaican meal of a Blue Mountain farmer is a heaping plate of rice (that is imported), with a dried salt fish (also imported) cooked in an unctuous gravy-style sauce with onions, tomatoes and heavily seasoned. This rice dish is generally accompanied by boiled or friends bananas or plantains.

[17] Conversely, in the Nicoya region of Costa Rica Albertin (2002) claims that Inga sp. are the preferred best shade species by farmers. Inga with banana is also by the far the most common in central and western Jamaica. In Africa the benefits and drawbacks of coffee-banana intercropping technique have also been described in Ugandan smallholder farming systems (van Asten et al. 2011).

Figure 15 Commonly referred to as “quick shade,” bananas are the preferred fruit plant for shading coffee shrubs in the Blue Mountains.

The farmers that I interviewed described the utilitarian values associated with lumber-producing trees and food-bearing trees (seeTable 3). Cedar (*Cedrela odorata*), the most widespread lumber tree we recorded on farms, is one of the few native trees that Blue Mountain farmers retain on their land when clearing and making room for coffee. These trees are valued as a long-term investment for selling or for household uses because the “boards make house and bed.” Conversely, the majority of fruit trees that we encountered on the farms are introduced pantropical species, some of which are unique to the Afro-Caribbean agricultural legacy in Jamaica (Carney and Rosomoff 2011).

Table 3 Fruit & timber trees most commonly mentioned for intercropping on Blue Mountain coffee farms.

LOCAL NAME	SCIENTIFIC NAME
Banana & Plantain	*Musa sp.*
Citrus	*Citrus sp.*
Ackee	*Blighia sapida*
Pear (Avocado)	*Persea americana*
Mango	*Magnifera indica*
Ethiopian Apple	*Syzygium malaccense*
Breadfruit	*Artocarpus altilis*
Jackfruit	*Artocarpus heterophyllus*
Peach	*Prunus sp*. (only above 1200 meters)
Cedar	*Cedrela odorata*
June Plum	*Spondias dulcis*

Figure 16 This young farmer's nascent coffee farm is interspersed with carrots, bananas, plantains and contours to minimize erosion on this steep deforested slope. Blue Mountain coffee farmers only intercrop staple foods during the first three years of a coffee plant's cycle. At this time, farmers are not generating a crop from their coffee and rely on small gardens to nourish themselves and their families. Once coffee bears fruit, shade trees are retained within the property.

The Fertilizer Trap & Economies of Scale: On-Farm Economic Constraints to Shade Cultivation

> "It's a known thing. Once you start fertilization you have to keep it going. It would be better if you don't start none at all and use natural way. It is easier to fertilize. If you grow coffee, you have to go to some sort of form of manual fertilization." --Richmond Gap Farmer

Pricing for a box of ripe coffee berries from the Blue Mountains depends on the elevation at which it was grown (Benghiat 2008). During the summer of 2013 coffee cultivation was dwindling at lower elevation (such as Mango Row, Ramble, Section and Albion). In these areas farmers were discouraged by lower prices they were being paid for their crop. Whereas, in Nunk, Pennlyne Castle and Section, the majority of arable land was under production. In these regions where farmers are paid more for their crops, I saw the least amount of trees. A farmer growing coffee in Nunk said that if he had access to more property he would expand his farm except that, " they [the government] put restriction on us, we can't cut no more land." This farmer was referring to government-sanctioned protected areas above five thousand feet.

For many medium (> 2.4 hectares) to large size coffee farms in the Blue Mountains we witnessed a delicate tipping point where shade trees become a barrier to profit and yield; as with other coffee growing regions, the belief that increased shade density reduces coffee berry yield was prevalent (Perfecto et al. 2005). Small farmers (<6 acres) felt that they were trapped in a low-income and low yield-conundrum; their slim profit margins have magnified this economic desperation and increased the fundamental need to rely on food-bearing trees.

Coffee production in Jamaica tends to strategically benefit large, technified, shade-free producers the most (Perfecto et al. 2009). Only four of the farmers that I interviewed had sufficient resources, appropriate licenses, and infrastructure to process their own coffee berries[18]. Because processing licenses are costly and require growers to produce at least 10,000 boxes of coffee, the remaining farms relied on privatized coffee buyers that are licensed by the CIB to purchase their ripe coffee berries. Locally, these berry buyers are referred to as "coffee selectors."

In this economic environment the coffee buyers in Jamaica choose not to pursue a market-based conservation strategy that includes nitrogen-fixing shade trees (e.g. a shade coffee label). From a market perspective, this fertilizer ideology is validated over agricultural innovation because a bag of imported agrochemicals generates more profit for coffee selectors and international companies. From industry informants and farmers I learned that licensed coffee buyers have sufficient liquidity to purchase agrochemical inputs at bulk rates, and resell this product with a markup to farmers through a credit based-system[19]. Farmers adapted this method of procuring nutritional inputs because "they wouldn't have to go in their pocket and pay cash for it" (Figure 17).

[18]Since the partial de-regulation of the CIB in 2001, the purchase of coffee berries is privatized. Prior to this, berries were purchased by the government-owned processing facilities and the now defunct Moy Hall Coffee Cooperative.

Figure 17 This sign was photographed in the Mango Row region of St. Thomas in January of 2014. Due to coffee berry shortages in the Blue Mountains, coffee selectors increased their purchase price. Upon selling to coffee selectors, farmers do not receive full payment for their coffee berries. Instead, coffee selectors distribute coffee money via a two payment system. This payment system was often perceived by farmers as a corrupt arrangement in which selectors accrue interest from withholding the second payment for long intervals. Chemical inputs purchased through coffee selectors is drawn out of the second payment.

To maintain constant yields, farmers must be able to provide the high nutrient demands required by coffee plants (Barham and Weber 2012). Overall, farmers throughout the study region mentioned low productivity on farms stemming from hurricane destruction, leaf rust and the inability to afford the mounting costs of inputs (Figure 18 & Figure 18). This decreased coffee berry yield was almost always correlated with the restricted access to fertilizer. It was described to me regularly that,

> "we just cannot maintain the coffee. If you don't get fertilizer, chemicals sprays it's not going to work out. Just going to get a few on the tree. In order to get big powerful berries, you have to give it food to get your yield back."

Figure 18 A St. Thomas farmer motions to a neglected portion of his farm where he can no longer afford to fertilize his coffee plants. “When things used to be good, I used to buy like 40 bags of fertilizer,” now he can only afford 20-25 bags. He claims that, “I just keep spending, spending, money going in, no money comin’ out.”

Figure 19 **A** Five acre commercial polyculture in St. Thomas with plantains, bananas, citrus, cedar and incredibly rocky soil. This farmer boldly looked me in the eye and stated “it takes courage to farm.” Confronted with pitfalls of hurricane damage, leaf rust and increasing costs for agrochemical inputs, this coffee grower claimed to be generating a minimal profit.

All manner of farmers groused that current costs associated with the cultivation of coffee outweigh the ability to generate profit from the sale of ripe berries. They voiced that the most expensive input for growing coffee is fertilizer. A large scale farmer added to this point by explaining that, “inputs are killing the small farmer.” Additionally, production costs are compounded due to a lack of collective bargaining power of small scale coffee growers, the “farm-gate” prices paid to them by coffee selectors was lower than the negotiated prices received by larger farms.

Yet despite this sentiment, the adherence to maintain soil fertility remains through the use of “inputs that are manufactured outside the farm” (Perfecto et al. 2009:80). As such, the majority of farmers that I interviewed were unaware of the nitrogen-fixing benefits of certain shade trees and leguminous plants. Instead, the application of fertilizers is perceived as the only means to maintain consistent levels of coffee berry production.

However, one organic farmer demonstrated to us that it is possible to reap a considerable coffee berry yield without the aid of agrochemicals. She was most adamant about this by stating that her neighbors felt they couldn’t farm coffee organically because, “it’s too difficult because he says he can’t get organic fertilizer or compost. But I say it’s not, because you make it.” Yet, less than ten farmers surveyed discussed the use of homemade compost remedies. The few who did compost had learned how to do so from other farmers or environmentalists. Ultimately, this situation begs the question: in the face of soaring costs for inputs, what keeps the majority of farmers from pursuing alternative, cheaper forms of soil fertility? Perhaps farmers feel that the amount of labor associated with organic farming outweighs the convenience of applying agrochemicals

or, technified production is so entrenched in the Blue Mountain coffee farming culture that farmers are unaware of alternative growing methods.

Moy Hall Cooperative & the Privatization of Coffee: On-Island Constraints to Shade Cultivation

"In Jamaica we are lacking communication and unity"--St. Thomas Coffee Farmer

Beuchelt and Zeller (2011) advise that certification schemes alone cannot curtail the low revenue from coffee. Instead, investments should be in the form of farm and business management skills. Blue Mountain interviewees explained to me that since the semi-deregulation of Jamaica's coffee sector, coffee selectors sometimes provide technical assistance and workshops as a recruitment incentive. However, these services did not include farm business and management skills nor do coffee selectors provide access to tree plantings or information about cultivating shade coffee.

In response, I asked many farmers if there were community-based programs to teach farmers about the merits of shade trees or conservation coffee niche markets. A long-standing coffee farmer in Richmond Gap recounted that during its early successful days, the now extinct Moy Hall Coffee Cooperative used to invest in trainings, equipment, and also provided member farmers with free shade trees.

Figure 20 Semi-shade portion of a six acre coffee farm in the Nunk region of St. Thomas parish. The pine trees on this farm were free plantings provided by Moy Hall and some were retained when the coffee was added to this property in 2001.

This farmer also explained to me that initially Moy Hall was "a factory that was built up by real cooperative spirit, by people." Farmers in St. Thomas recounted that during its final years of operation, the cooperative was administered by the upper echelon of Jamaica (instead of by local constituents). Because trade and marketing was passed over to the hands of the local elites, corruption and mismanagement that did not favor the needs of coffee growers ensued. The combination of embezzlement and physical damages to the factory from hurricanes caused accrual of extensive debt (Collinder 2011; JIS 2005). To resolve this financial dilemma, multi-lateral aid from EU was provided to resuscitate Moy Hall (Figure 21). However misallocation of these transnational funds failed and Moy Hall folded.

Consequently, since the collapse of Moy Hall, farmers are skeptical of cooperative business models. I was told that, "people are very, very cautious these days and some

don't want to get involved;" the majority of interviewees exhibited no desire to unite in cooperatives to cultivate a conservation coffee niche market. Therefore, coffee growers from this region do not benefit from producer-level benefits of sustainability certification (Blackman and Rivera 2011) or forward integration of the commodity chain so that they may capture more of the profit generated within the processing stages (Talbot 2002).

Figure 21 Moy Hall Entrance Sign that is situated in Cedar Valley, a small town in St. Thomas Parish. Once a prosperous coffee cooperative, the now defunct property of Moy Hall is a relic of inefficient use of multilateral aid.

The Asian Tiger & Global Constraints for Shade Coffee Cultivation

> "Sometime it hard fi you to access that market as a individual person. Because sometime like for instance, you take coffee from this brethren, you have to go look for dem type of people want shaded coffee." –St. Thomas coffee farmer

Jamaican farmers, government employees and coffee buyers adamantly believe and champion that their coffee is the world's most premier product. Farmers boasted

that, “the Japanese are experts... the world experts on coffee and they want the best.” Broad estimates cite that approximately 80-90% of dried Blue Mountain green coffee beans are purchased by Japan (All Japan Coffee Association n.d.; Benghiat 2008; Black 1990; Marshall 1983). Alas, this domestic pride for Blue Mountain coffee might in part foster a complacency that inhibits innovation and progress towards experimenting with and pursuing sustainable modes of shaded coffee certification. This mindset can also stifles the search for new niche markets that mirror current trends in consumer interests. After all, if Japan, the primary purchasing agent doesn’t specifically request shade coffee, farmers and buying agencies felt no need to challenge the status quo system.

Figure 22 Until recently, coffee berries from the “Juniper Peak” micro lot at Clifton Estates was sold exclusively to a Japanese company that roasted for Japan Air. The coffee grown in this plot is certified Rainforest Alliance. However, shade is located mostly along the periphery of this tract.

Several coffee sector informants mentioned a long-term plan to diversify their buyer's market. But relatively few specifically discussed organic or conservation certification schemes, such as the Rainforest Alliance certification. During my two visits to Jamaica I learned that niche coffee markets are in their early stages of development. Of the 63 farmers interviewed, only one was Rainforest Alliance- certified. This coffee grower explained that these models are tailored for cooperatives and larger producers that can afford high costs for certification. Because the generated profit is a marginal 3% for Rainforest Alliance coffee, he perceived this low percentage as insufficient incentive for the majority of large estate coffee farmers to pursue a certification scheme.

In Mango Row, a self-proclaimed shade & bird friendly coffee farm chose to roast and sell domestically to bypass the expensive costs of certifying. A third farmer that was producing internationally certified organic coffee in Portland also roasted all of her beans in Jamaica. However, she also complained of the high costs of maintaining individual certification and the inability for Jamaican coffee growers to form cooperatives to reduce certification costs.

It seems counterintuitive that after explaining all of the trials and tribulations associated with coffee farming that any logical person would wish to continue pursuing an almost profitless endeavor. This case was especially reinforced by a statement from a Richmond Gap farmer in which he acknowledged that, "coffee is so expensive on the world market and as a farmer you can't find the money to take care of the coffee." As such, we did encounter farmers who were so exasperated from not making money, that they were "thrown up" the farm, or intentionally abandoning their coffee. We also met small farmers that felt that you can "never have too much coffee. There is no limit to

how much they gonna take from you. Any amount you can produce, somebody is there to take it." The sentiment of a guaranteed market for coffee was shared throughout the three parishes that we visited.

As mentioned at the beginning of this section, the demographic variables of the interviewed farmers indicates that the majority of them been cultivating coffee on and off as a lifelong occupation. Therefore, these farmers have seen many price fluctuations in the selling price of Blue Mountain coffee. Unfortunately, as costs of production become inflated and fertilizing becomes more inaccessible to small scale producers hindered by oligopolistic market forces (Piyapromdee, Hillberry, and MacLaren 2013), the Blue Mountain landscape begins exhibiting symptoms of degraded soils, devastating landslides and overtaxed coffee plants that are extremely susceptible to leaf rust pandemics. As this vicious cycle generates a coffee bean scarcity and is compounded by rising prices for boxes of coffee, farmers gain a renewed hope that this tropical commodity will once again become a profitable agricultural endeavor (Figure 23). Although profit is currently fleeting, motivation to continue growing this tropical commodity stems from a sense of hope for an upswing in the market.[20]

[20] As of February 2015, the selling price for a box of Blue Mountain coffee berries had increased from $3500 (summer of 2013) to $9000 per box.

Figure 23 During our visit to this high elevation coffee farm in 2013, its cultivator explained that he had not used agrochemical inputs for over four years. However, during a subsequent visit in 2014, the owner's approach had changed: due to the increased price he was receiving per box of coffee and the availability of fertilizer upon a credit basis, that he was incentivized to begin using these products to boost output.

CONCLUSION

After each day of conducting interviews, my field assistant Junior and I would take advantage of the windy, pothole-laden drive down the mountain to our lodgings in Ramble to get to know one another and share ideas. During these long car rides we would listen to reggae music and debrief about our morning experiences in the field. After a month or so of this routine, Junior confided that most of our neighbors in Ramble believed that my social research project was ludicrous and a waste of money, time and resources. Several of these Jamaicans had openly expressed to him that they didn't see the utility in studying coffee farmers. These community members did not realize that my research sought to contextualize their neighbors' opinions within the political, economic and cultural backdrop that contributes to the environmental degradation associated with planting coffee without trees.

This startling discovery troubled me considerably at first, but then I began to realize that the perceptions of these community members mirror some of the negative perceptions within the academy about interdisciplinary social ecology research (Folke 2006). Most importantly, my situation illustrated that interdisciplinary research is not taken seriously by differing levels of society. This is especially true because, "adopting new ways of thinking is never easy" (Walker and Salt 2006:30). Furthermore, this scenario also validated the need for a "systems thinking" approach (Sayer and Campbell 2003) for integrating ecosystem services with current coffee management practices in Jamaica, because the concerns and complaints of coffee farmers reaffirm the disjunction between the knowledge production of ecosystem services by the academy and its

dissemination to the agricultural community. This was discovered because many farmers that we interviewed were unaware of beneficial ecosystem services such as nitrogen-fixing trees or pest-reduction services of insect-eating birds.

By choosing an interdisciplinary approach for framing my research question, I could not expect a singular answer or underlying reason to explain why farmers would choose to include or exclude shade trees on their coffee farms. Naively I had hoped for a silver bullet that would magically explain the phenomena that was studied (Fischer and Bliss 2008). Instead, my research reveals how the interweaving of on-farm, on-island and global scales produces the unique context of coffee cultivation practices in Jamaica's Blue Mountains (Table 4).

Table 4 Drivers and constraints that influence shade tree inclusion/exclusion on Blue Mountain coffee farms

What farmers think about having shade trees on Blue Mountain coffee farms			
Drivers		**Constraints**	
Ecological	Protection from strong sun (especially at lower elevation). Tree roots reduce erosion. Trees act as windbreaks.	**Ecological**	Shade may reduce yield in some microclimates. Shade may encourage pests & leaf rust.
Political	Free tree planting programs can be provided by government and aid agencies.	**Political**	Government provides insufficient agricultural extension services. Farmers too busy farming or don't have motivation/funds to attend government workshops. Lack of interagency collaboration to organize tree planting programs. Government endorses fertilizer and shade reduction to counter leaf rust. Hurricane relief aid often geared to short-term solutions (fertilizer) instead of tree planting programs. Government branding strategies offer no support for organic or shade-grown coffee.
Economic	Trees can provide food security & supplemental income. Trees can provide lumber & supplemental income.	**Economic**	There are no coffee cooperatives to help promote using trees. Farmers prioritize short-term yield over long-term sustainability of growing coffee under a shade canopy. Japan (primary consumer of Blue Mountain coffee) does not demand shade-grown coffee and/or organically certified coffee beans. Coffee buyers promote technified coffee production from which they profit from the sale of fertilizer to farmers. Most intermediary coffee buyers do not endorse or pursue conservation coffee niche markets.

My interviews and farm visits also demonstrated that the majority of shade trees on Blue Mountain coffee farms are not endemic "forest remnants" (Bentley, Boa, and Stonehouse 2004:242); rather, the composition of the landscape is a legacy of tropical agriculture commodity production (Harris et al. 2012). Deforestation from colonial and modern agricultural land use patterns combined with Jamaica's Afro-botanical legacy (Carney and Rosomoff 2011) played a major role in extirpating native species. My research also suggests that "environmental degradation is a highly tangible problem" in Jamaica's Blue Mountains (Roussopoulos 1994:133). Farmers explained this tangibility through their struggles with landslides and soil erosion, loss of soil fertility and mounting fungal outbreaks on their coffee plants. I also learned that coffee production in Jamaica, once a booming, cutting-edge industry, is evolving and deregulating[21]; as government cedes some control of the coffee commodity chain and private enterprise (that excludes cooperatively owned models) captures this control, small farmers and the environment benefit the least.

Unfortunately because of the political and economic structure of Jamaica's coffee sector, both government entities and the privatized market force perpetuate a technified coffee production ideology in which small farmers are paid the least amount of money for their coffee and simultaneously pay the highest prices for agrochemical inputs. Whereas,

[21] The link between IMF and World Bank sponsored structural adjustment policies and deregulation of the CIB merits further investigation.

large-scale coffee producers at higher elevations and with the least amount of shade trees that can potentially afford certification and licensing fees revealed that they are not very inclined to pursue these avenues because of a perceived marginal profit gain that outweighs effort.

Politically, planting shadeless coffee is further validated by the Coffee Board's (CIB) institutional endorsement for high input, industrial-scale farming. Reduced extension services and insufficient financial resources for sustainable coffee cultivation research serve to further perpetuate a sun coffee paradigm[22]. In the process of maintaining an exemplary geographic indication standard for the Blue Mountain coffee label, the Coffee Industry Board has committed minimal institutional energy towards developing ecologically sound strategies for producing shade coffee (be they extension services or certification schemes).

Because coffee cultivation plays such a large role in the Blue Mountains' agricultural sector, encouraging farming techniques that are less environmentally destructive and that incorporate agroforestry practices is of utmost importance. As previously mentioned in the social ecology section, evidence from interviews suggests that there is still a small reservoir of local ecological knowledge associated with the benefits of shade trees. Sadly, as my research demonstrates, the benefits of these ecosystem services are being stymied on several cultural, economic and political fronts.

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[22] At the time of publication, it was brought to my attention that the Jamaica Bureau of Standards along with the Jamaican Coffee Growers' Association are devising organic growing standards to be shared with Blue Mountain coffee farmers.

To date, the many research projects conducted in Jamaica's western and central coffee growing regions through Humboldt State University have attempted to disseminate the economic value of ecosystem services provided by birds through their role in reducing coffee berry borer beetle populations (Figure 24). However, the value of this research is not germane to regions in the Blue Mountains where the borer beetle is not a pervasive pest (Figure 25).

Figure 24 This color pamphlet was designed by Humboldt State University to convey the benefits of shade trees to Jamaican coffee farmers. Five hundred copies of this brochure were printed and the majority of these were distributed in the western portion of the island.

HOW CAN SHADE TREES ATTRACT BIRDS THAT WILL EAT PESTS AND BOOST FARM INCOME?

Recent research shows that birds can reduce damage by coffee berry borer by 50% in Jamaica. By controlling pests, birds can increase berry production and can boost farmer income by over $750 US per acre.

WHICH SHADE TREES ARE BEST IN JAMAICA?

TREES THAT INCREASE SOIL FERTILITY

- Inga (*Inga vera*)
- Guango (*Samanea saman*)
- Quick stick (*Gliricia sepium*)
- Lead tree (*Leucaena leucocephala*)

FRUIT & TIMBER TREES

- Cedar (*Cedrela odorata*)
- Mahogany (*Swietenia mahagoni*)
- Broadleaf (*Terminalia latifolia*)
- Mango (*Mangifera indica*)
- Breadfruit (*Artocarpus altilis*)
- Banana (*Musa sp.*)
- Star apple (*Chrysophyllum cainito*)

TREES ESPECIALLY ATTRACTIVE TO INSECT-EATING BIRDS

- Inga (*Inga vera*)
- Guango (*Samanea saman*)
- Quick stick (*Gliricia sepium*)
- Star apple (*Chrysophyllum cainito*)
- Figs (*Ficus sp.*)

HOW MUCH SHADE IS BEST?

Optimal shade conditions depend on elevation, local climate, and soil conditions. On poor soils in western Parishes, up to 50% shade (up to 40 trees per acre) is best. On good soils and/or in places with extensive cloud cover, 20-50% shade is best (10-40 trees per acre). Too much shade may increase the likelihood of fungal pests or reduce crop yield, but moderate amounts of shade increase crop production, help maintain soil fertility, increase farm longevity, and reduce pests.

Figure 25 Humboldt State University's attempt at outreach to convey to the general public the benefits of ecosystem services provided by shade trees. During my second visit to the Blue Mountains I distributed some of these brochures to farmers and they noted that Inga and lead tree do no grow in their regions and that coffee berry borer beetle isn't a major threat to their coffee production.

As my thesis indicates, understanding the interplay of the political, economic and socio-ecological drivers is critical for generating and implementing solutions. Therefore, the academy needs to find a formidable method of re-framing the value of ecosystem services provided by shade trees into a cohesive argument that resonates with the specific needs of Blue Mountain coffee farmers (). For instance, the majority of interviewees

expressed that they pursue a farming lifestyle because it enables them to be mostly autonomous within an oppressive system. Therefore couching the soil fertility and nitrogen-fixing shade tree line of reasoning through the lens of independence and economic self-sufficiency is one alternative.

These issues should address power imbalances, economic disparities and the contrasting abiotic and biotic requirements of varying elevations and microclimates throughout the Blue Mountains. As my thesis shows, there is a vested set of political and economic interests that support the current structure and which need to be modified if things are to improve. Solutions should implement multiple strategies that individually address the motivations and constraints discussed above (Table 4) while simultaneously looking forward to anticipate the future needs of coffee agroforestry in Jamaica.

Therefore, I recommend the next academic research priorities to include: field tests employing the scientific method to quantify the benefits of nitrogen-fixing trees and how those benefits interact with soil quality and elevation, coupled with adequate dissemination to farmers, and/or a participatory action research project with the objective of encouraging communities to re-learn the benefits and applications of organic soil fertility and the values of shade trees while exposing farmers to marketing research and strategies for pursuing conservation coffee niche markets.

Rice (2001) suggests that alternative trade organizations (ATO's) are a means for small farmers to capture a greater portion of profit from the sale of coffee. To empower small farmers, ATO's in Jamaica should include forward integration of the coffee

commodity chain so that growers can capture more of the profit generated within the processing stages (Talbot 2002). The collapse of Moy Hall coffee cooperative and the ensuing farmer skepticism illustrates that in order for these recommendations to be effective, projects must be transparently managed by and for the greater interest of the community.

Despite the lack of government infrastructure to implement sustainable conservation policies or the broad scale dissemination the benefits of ecosystem services to coffee farmers, I am grateful to have encountered several stewards of the land that place greater emphasis on the intrinsic value of conservation rather than the short-term value of generating profit; apart from the dominant patterns described throughout the results section, there were some admirable outliers. In Mango Row, an entire farming community gathered with me to discuss farming issues and seek out solutions to encourage greater collaboration. In Ramble and Section, two of the farms that I visited are growing coffee under shade canopies without the use of agrochemical inputs and marketing their products as organic and shade-friendly. And, my favorite uplifting experience was with an elderly gentleman in St. Thomas.

Three days before celebrating his 70th birthday, a Mr. Richmond Gap graciously gave us a tour of his coffee farm. This Jamaican agriculturalist had been cultivating coffee on his land for nearly thirty years. While we walked amongst his coffee shrubs, he began explaining to Junior and myself the symbiotic role of the guango trees. In order for the seeds of this tree to germinate, they require being ingested by an animal and

excreted onto the soil. He then pointed to several small saplings and told us that before the mad cow disease scare, cattle had freely grazed upon his property. We walked towards the periphery of his farm where we encountered an enormous guango tree, the largest I have observed to date. With its far-reaching limbs, the guango majestically towered above bananas, plantains and coffee shrubs. Our guide called this dazzling arboreal beauty the “mother tree” and recounted how numerous folks had approached him attempting to persuade him to chop down the tree and sell the lumber. With pride and reverence, he always declined the offers. On that memorable day we spent an hour in the cool shade of the guango’s canopy and were mostly speechless as we absorbed the magic of the Blue Mountain ecosystem.

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APPENDIX A: SEMI-STRUCTURED INTERVIEW GUIDE

SOCIO-ECONOMIC QUESTIONS (name, age, etc. beforehand)

- Do you drink coffee?
- What is the size of your farm?
- Do you own the land where you farm coffee?
- How long have you been farming coffee?
- How did you learn to farm coffee?
- Do you employ outside workers to work on your coffee farm?
- How do you think growing more shade trees would affect you financially?
- Does your coffee farm provide sufficient income to support yourself and/or your family?
  - If not, do you have any off-farm income?

ECOLOGICAL QUESTIONS

- What is the most challenging part about growing coffee?
- Is water scarcity an issue for your farming practices?
- What do you like most about your current farming techniques?
- How do you utilize trees on your property?
- What are your thoughts about shade grown coffee?
  - How do you manage your coffee plants? Do you include other plants around them?
  - Do you think that growing shade trees would affect coffee yield? How?
  - Do you plant specific types of trees exclusively to provide shade for your coffee plants?
  - What types of shade plants do you prefer?
  - Do you intercrop fruit trees amongst your coffee plants?
- What (if any) are the major pests that you deal with on your coffee farm?
  - If yes, what is your coping strategy?
- How much coffee does your plot produce?
- Do you use pesticides or fertilizers on your coffee plants?
  - If so, why?
  - What kind?

SOCIO-POLITICAL QUESTIONS

- What do you think about community owned coffee cooperatives?
- What is your relationship with the CIB/RADA?
- How do you feel about current coffee prices?
- Does CIB or any other portion of the Jamaican government encourage you to plant more shade trees?
- What kinds of government assistance are you provided with for growing coffee

APPENDIX B: ATLAS TI CODING THEMES

BANANA_Cash crop
BANANA_elevation
BANANA_Erosion control
BANANA_Fertilizer
BANANA_Food
BANANA_Hurricane
BANANA_Quick shade
BANANA_Windbreaker
BANANA_Young coffee
CIB_Field Days
CIB_Large Farm Assistance
CIB_Licensing
CIB_Trees & Shade
CIB-Extension services
CIB-Fruit trees
COFFEE CULTIVATION_Challenges
COFFEE CULTIVATION_Coffee Thieving
COFFEE CULTIVATION_coffee varieties
COFFEE CULTIVATION_Compost
COFFEE CULTIVATION_Contours
COFFEE CULTIVATION_Field Sanitation
COFFEE CULTIVATION_Floating
COFFEE CULTIVATION_Garmandize
COFFEE CULTIVATION_Green growth
COFFEE CULTIVATION_High Mountain Coffee
COFFEE CULTIVATION_Intercropping
COFFEE CULTIVATION_Learning to Cultivate
COFFEE CULTIVATION_Livestock
COFFEE CULTIVATION_Mulch
COFFEE CULTIVATION_Organic Coffee
COFFEE CULTIVATION_Pesticides
COFFEE CULTIVATION_Picking
COFFEE CULTIVATION_Production cycle
COFFEE CULTIVATION_Pulp
COFFEE CULTIVATION_Reaping
COFFEE CULTIVATION_Roasting
COFFEE CULTIVATION_roots
COFFEE CULTIVATION_Roundup
COFFEE CULTIVATION_Rows
COFFEE CULTIVATION_Steep Slopes
COFFEE CULTIVATION_Suckers
COFFEE CULTIVATION_Yield
COFFEE PLANTING STAGES_Cutback
COFFEE PLANTING STAGES_Farm history
COFFEE PLANTING STAGES_Planting schedule
COFFEE PLANTING STAGES_Replanting
COFFEE PLANTING STAGES_Young coffee
COFFEE SELECTORS_Agro-chemicals
COFFEE SELECTORS_Coffee Traders
COFFEE SELECTORS_Extension services
COFFEE SELECTORS_Gold Cup
COFFEE SELECTORS_Licensing
COFFEE SELECTORS_Mavis Bank
COFFEE SELECTORS_Payment system
COFFEE SELECTORS_Pick up schedule
COFFEE SELECTORS_Selector Position
COFFEE SELECTORS_Selector preference
COFFEE SELECTORS_Sherwood
COFFEE SELECTORS_Wallenford
DISEASE_American Leaf Spot
DISEASE_Borer Beetle
DISEASE_Leaf Miner Disease
ECOLOGY_Birds
ECOLOGY_Climate Change
ECOLOGY_Deforestation
ECOLOGY_Drought
ECOLOGY_Ecological Knowledge
ECOLOGY_Environmentalism
ECOLOGY_Forest Fire
ECOLOGY_Nitrogen fixing
ECOLOGY_Rain & Berry Drop Off
ECOLOGY_Reforestation
ECOLOGY_Soil Erosion
ECOLOGY_Soil Quality
ECOLOGY_Watershed
ECONOMICS_Box of coffee price
ECONOMICS_Boxes of coffee
ECONOMICS_Coffee as a Dream
ECONOMICS_Coffee Scarcity
ECONOMICS_Commodity Chain Perspectives
ECONOMICS_Cost of production
ECONOMICS_Cost-Benefits Analysis for Farming
ECONOMICS_Deregulation
ECONOMICS_Economies of scale
ECONOMICS_Farm Employees
ECONOMICS_Farm Loans
ECONOMICS_Foul manure
ECONOMICS_Fruit trees

ECONOMICS_GI-Blue Mtn Coffee
ECONOMICS_Guaranteed market
ECONOMICS_Help
ECONOMICS_Jamaican Coffee Commodity Chain
ECONOMICS_Japan
ECONOMICS_Low price
ECONOMICS_Mayol
ECONOMICS_Oligopsony
ECONOMICS_Partnership Work
ECONOMICS_Payment System
ECONOMICS_Pickers
ECONOMICS_Reduced annual return rate
ECONOMICS_Sinking fund
ECONOMICS_Throw up Farm
ECONOMICS_World market price
FERTILIZER_Cost
FERTILIZER_Dosage
FERTILIZER_Fersan
FERTILIZER_Fraud
FERTILIZER_Increased Production
FERTILIZER_Manure
FERTILIZER_Necessity
FERTILIZER_Trap
FERTILIZER_Trenching
HURRICANES_Coffee Damage
HURRICANES_Gilbert
HURRICANES_Relief
HURRICANES_Sandy
HURRICANES_Tree Damage
HURRICANES_Wind
LEAF RUST_Cutback
LEAF RUST_Dry Coffee
LEAF RUST_Geisha
LEAF RUST_Hurricane
LEAF RUST_Minimal damage
LEAF RUST_Problem
LEAF RUST_Shade
LEAF RUST_Spray
LIVELIHOOD STRATEGIES_ Lease Land
LIVELIHOOD STRATEGIES_Autonomy
LIVELIHOOD STRATEGIES_Captured Land
LIVELIHOOD STRATEGIES_Carrots
LIVELIHOOD STRATEGIES_Cash crops
LIVELIHOOD STRATEGIES_Farming Lifestyle
LIVELIHOOD STRATEGIES_Intercropping
LIVELIHOOD STRATEGIES_Other Employment
LIVELIHOOD STRATEGIES_Peas
LIVELIHOOD STRATEGIES_Risk aversion
LIVELIHOOD STRATEGIES_Separate farm
LIVELIHOOD STRATEGIES_Slash & Burn Ag
LIVELIHOOD STRATEGIES_Subsistence Farming
POLITICS_Agriculture
POLITICS_Bureaucracy
POLITICS_Colonial Legacy
POLITICS_Corruption-Government
POLITICS_Farm Worker Program
POLITICS_Forestry
POLITICS_infrastructure
POLITICS_Land Tenure
POLITICS_Marginalization
POLITICS_Nationalism
POLITICS_NGO's
POLITICS_RADA
POLITICS_Rainforest Alliance
POLITICS_Small Farmer
POLITICS_Structural Adjustment
SHADE_Airflow
SHADE_Ambiguity
SHADE_Bananas
SHADE_Berry Quality
SHADE_Cloud Cover
SHADE_Ecological Elements
SHADE_Economic Value
SHADE_Ecosystem Services
SHADE_Elevation
SHADE_Fruit Trees
SHADE_Mayol
SHADE_More Pests
SHADE_Nutrient Competition
SHADE_Partial Daytime
SHADE_Primary Shade
SHADE_Property boundaries
SHADE_Pruning
SHADE_Quantity
SHADE_Quick Shade
SHADE_Reduced Berry Production
SHADE_Removal
SHADE_Retention
SHADE_Seasonal
SHADE_Secondary Shade
SHADE_Sun Burning
SHADE_Sun Higher Yield
SHADE_Tall Trees
SHADE_Temporary
SHADE_Tree Preference
SHADE_Unnecessary

SHADE_Windbreakers
SHADE_Young Coffee
TREE_Achee
TREE_Apple
TREE_Blue Mahoe
TREE_Breadfruit
TREE_Cacao
TREE_Cedar
TREE_Citrus
TREE_Coconut
TREE_Eucalyptus
TREE_Gravilea
TREE_Guango
TREE_Immortelle
TREE_Jakfruit
TREE_Lucinea
TREE_Lumber Trees
TREE_Mahogany
TREE_Mangoes
TREE_Mulberry
TREE_Native Trees
TREE_Nona
TREE_Pear
TREE_Persimmon
TREE_Pimento
TREE_Pine
TREE_Plum
TREE_Quick Stick
TREE_Rose Apple
TREE_Silky Oak
TREE_Soapwood
TREE_Soursop
TREE_Spanish Elm
TREE_Stinking Toe
TREE_Sweetwood
TREE_Tambrin
TREE_Trumpet Tree
TREE_Water Oak