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# Coconut productivity in the Caribbean: Relational value chains in traditional farming \*

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## Abstract

In this paper, we exploit the new evidence derived from two original farm-level surveys in Jamaica and Guyana, to deepen our understanding of coconut production in the Caribbean region. We innovate on more traditional studies as we include into the analysis not only farm-level variables, but also some characteristics of the communities where farmers operate, the support they obtain from local and foreign organizations, and the organization of the value chain, in particular the relationships they develop with agents and buyers.

Our analysis shows that the type of workforce, whether occasional or permanent, and the existence of an irrigation scheme influence coconut productivity in Guyana and Jamaica. Primary education contributes to productivity to a larger extent than higher education. Support from organizations, both international and the Coconut Industry Board is also positively associated to productivity. In addition, selling to agents offers a positive productivity premium, probably due to the opportunity agents offer to get relevant information and technology. Thus, traces of a simple “relational” value chain, with a positive and useful role for interactions and exchange of tacit knowledge from buyers and agents, emerge from our study.

**Keywords:** Coconut, productivity, relational value chains, Caribbean countries.

**JEL codes:** D24, O13, Q12, O54

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## 1. Introduction and background

Coconut farming has been a traditional activity in many Caribbean countries, rarely reaching export markets, but often representing an easy and continuous income-generating activity for many households and small farmers. However, sometimes this activity has reached a more organized stage, with processing and product diversification, increasingly organized along regional value chains.

In this paper, we exploit the new evidence derived from two original farm-level surveys in Jamaica and Guyana, that allow us to deepen our understanding of coconut production in the region.<sup>1</sup> More specifically, we include into the analysis not only farm-level variables, like in other traditional studies, but also some characteristics of the communities where farmers operate, the support they obtain from local and foreign organizations, and the organization of the value chain, in particular the relationships they develop with agents and buyers. The latter evidence reveals that simple forms of value chains are operating, where the relational exchanges of information and knowledge appear to exert a positive influence on coconut farmers' productivity.

The paper is organized as follows. In section 2 we discuss the role that coconut farming plays in developing countries, and especially in the Caribbean. Then, we describe the organization of the value chain that is prevailing worldwide, and specifically in the Caribbean region. In section 4 we present some stylized evidence from our original survey, and in section 5 we apply an econometric model to explain productivity. The final section summarizes and concludes.

## 2. The Role of coconut in developing countries and in the Caribbean

Coconuts are perennial plantation crops suitable for smallholder farming due to their labor intensity and revenue stream throughout the year. Depending on the variety, a coconut tree produces from age 4 or 7 years to 60 years or more (Prades et al., 2016). Therefore, coconut trees are a major source of income for rural families in many tropical countries. Almost every part of the coconut tree can be used in either making commercial products or meeting food requirements. Since the 19th century, coconut has been a cash crop, with its main export products being copra (dried coconut kernel) and crude coconut oil (Mittaine and Mielke, 2012). As a food crop, coconut is a daily source of coconut milk, sugar, coconut water, fibers, fuels, raw or virgin oil for cooking and cosmetics, and construction elements. Some varieties are also used in traditional medicine (Prades et al., 2016).

For enhanced land productivity, and depending on market opportunities, coconut plantations are predominantly dual or multi-cropping systems where in the same coconut field other annual or perennial crops, such as pineapple, cocoa, coffee, root crops, banana, or fodder for livestock are intercropped (Nair, 2009). Coconut palm trees can be found growing over most of the islands and coasts of the subtropics and tropics under varying climatic and soil

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<sup>1</sup> This paper builds on the work carried out by the Caribbean Agricultural Research and Development Institute (CARDI) and the International Trade Center (ITC) within a EU funded Coconut Industry Development Project for the Caribbean, <https://intracen.org/our-work/projects/caribbean-development-of-value-added-products-and-intra-regional-trade-to-0> accessed 30.1.2023.

conditions. Global plantation area is estimated in 12 million hectares, with about 96% of the farmers ranging from 0.5 to 4 hectares. The remaining 4% consists of some industrial plantations, often inherited from the colonial period, where coconut palm trees are grown in monoculture on hundreds of hectares for copra production. These fields are mainly located in Southeast Asia (Indonesia, Malaysia), West Africa (Ivory Coast, Ghana) and Eastern Africa (Mozambique) (Prades et al., 2016).

According to FAO statistics, world coconut plantations produced just over 63,7 million tons of coconuts in 2021. Asian countries accounted for 86% of the global production, dominated by Indonesia (32%), the Philippines (28%), and India (27%) (FAOSTAT, 2019). In 2019, the Caribbean countries produced 645 thousand tons of coconuts, representing 1% of the estimated coconuts produced worldwide (FAOSTAT, 2019). Regardless of the size of production, coconut farming is typically carried out in poor organizations, typically smallholders concentrated in areas deprived of financial and technological resources.

Despite the limited relevance of Caribbean coconuts worldwide, the coconut palm serves a fundamental and multi-functional role in the Caribbean region. At the small-scale farming level, coconut is an important contributor to food security. At the industrial level, coconut value-added products are important sources of employment and income in rural communities. In the Caribbean region, the coconut industry produces a variety of products that are consumed regionally and internationally. These include fresh green nuts for water as well as dry nuts for copra, oil, milk, cream. Coconut oil is consumed as food, while a significant amount of production goes into the oleo-chemical industry for the manufacture of cosmetics, detergents, soap, and other products. Additionally, the shell and husk are used to produce fibers, charcoal, and various derivatives.<sup>2</sup>

Propelled by corporate strategies in food and beverages and the rising consumer market trends for health and wellness, the global and regional demand for fresh coconut is expected to steadily grow over the medium- to long-term (Abdulsamad, 2016). However, a limited supply of fresh coconuts (around the world and in the Caribbean) represents the critical constraint to industry growth. Many farming communities across the Caribbean face a variety of production problems such as pests and disease, aging coconut trees, and limited market access, which impact negatively their ability to derive a sustainable income from coconuts. Worldwide, a remarkable supply bottleneck is rooted in persistent low investment for years in now aging and unproductive coconut plantations. Following the decline of the copra oil industry in the 1980s, a little incentive was there for value chain actors to invest in coconut plantations until the market resurgence in the early 2000s.

Since the early 2000s, breakthroughs in processing technology and consumer awareness about the health benefits of coconut water have remarkably expanded markets beyond the tropics (Technavio, 2015b). A resurgent industry now, however, is struggling with declining supplies of raw material. Of high concern to the industry is also the inevitable slow replanting rate due to the restricted supply of seedlings. Research and development (R&D)

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<sup>2</sup> <https://www.cardi.org/commodities-themes-2/coconuts7/> accessed 24.1.2023.

related to planting materials has focused on producing hybrids that are inter-varietal crosses<sup>3</sup> (Abdulsamad, 2016). However, before the revival of markets in the late 2000s, the high cost of inputs has generally hindered the adoption of hybrids by smallholder farmers. In fact, hybrid planting materials are expensive and demand very intensive care, including fertilizer and pesticides, to exhibit the desired rapid fruit-bearing and increased nut yield (Perera, 2014).

### **3. Global Value Chains in the coconut sector**

The global demand for major coconut products amounted to approximately US\$4,7 billion in 2020, imported by the U.S. (19%), China (15%), the Netherlands (10,1%), Germany (9,9%), and Malaysia (9,4%) (UNComtrade, 2020). Demand for crude coconut oil is primarily driven by the refining industry, the Netherlands accounting for a third of global demand. This country is a regional hub for coconut oil refining in Europe, with Rotterdam and Amsterdam ports providing competitive maritime connectivity, and global oil processors.

Whereas fresh coconuts are primarily marketed in consumer markets through retailer channels in the importing countries, desiccated coconut is mainly used by the confectionery industry (Euromonitor, 2014). However, the overall size of the global coconut trade is certainly larger than what is reported by international trade databases. Moreover, these datasets do not maintain consistent and disaggregated trade data for coconut water, shell activated carbon, and coconut coir.

#### **The coconut global value chain**

The coconut global value chain (GVC) is at a critical juncture, characterized by a rapidly growing demand in global markets and a stagnant supply base in danger of collapse in origin countries. Market demand is rising for traditional and non-traditional coconut products across the three ‘chain strands’: coconuts-food chain, coconuts ‘sports drink’ chain, and coconuts-chemicals chain. The coconut GVC has a consolidated global industrial organization. Downstream, oligopolistic market structures are controlled by a handful of lead firms at the marketing and processing segments. Upstream, the market structure in growing countries has remained highly fragmented. Entry barriers to the market are remarkable at the downstream end of the value chain and are low or non-existent at the upstream segments. Therefore, trade transactions in the GVCs are mainly governed by buyers and the terms of those transactions reflect power asymmetries along the chain: lead firms coordinate the upstream segments of the supply chain and the conditions of market access (Abdulsamad, 2016).

At the regional and global levels, the firms coordinating the coconut value chain are brand manufacturers in packaged food, beauty and personal care, and beverage industries. Retailers, such as Kroger Co. and Costco Wholesale Corporation, have increasingly

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<sup>3</sup> Coconut trees are generally classified into tall and dwarf varieties. The first grow fast, are less care intensive, have longer productive life, can better sustain the forces of tropical storms, and are widely adopted by smallholders. The latter have short stature, are quicker to come to bearing and easier to harvest but are short-lived and require relatively intensive care to yield optimal output (Abdulsamad, 2016).

launched private brands of coconut products, particularly, coconut milk, cream, and virgin oil. These firms control the highest value-adding steps in the chain including marketing, branding and new product development (Abdulsamad, Frederick, et al., 2015). As brand product manufacturers, these firms market their products through different channels: food and beverage products are marketed through supermarket chains, whereas beauty and personal care products are marketed through specialized retail chains, including salon distributors; active cosmetics are for sale only through pharmacies (Euromonitor, 2015).

Lead firms both in the oleochemical and packaged food segments have outsourced ingredient manufacturing and the associated raw material sourcing to global commodity traders, such as Cargill, ADM, and Bunge, which are in a direct trade relationship with local lead firms and/or suppliers in origin countries (OMV, 2013). In the 1990s, leading U.S. and Europe-based firms, such as Unilever Group, Procter & Gamble Co., and Henkel AG & Co. restructured their supply chains to cope with the risk in global commodity markets (BCC Research, 2015). Manufacturing of basic oleochemicals was outsourced to large plantation firms in Southeast Asia that now dominate the industry. These outsourcing strategies have since resulted in the rise of large vertically integrated plantation firms, such as Wilmar International (BCC Research, 2015).

Similarly, in the food industry large commodity traders, such as Cargill and ADM, are now the major suppliers of Refined, Bleached and De-odorized (RBD) coconut oil to brand manufacturers. These intermediary actors supply coconut products in large volumes and under long-term supply contracts to large brand manufacturers such as Nestlé, Mondelez International, and Unilever (Abdulsamad, Frederick, et al., 2015; BCC Research, 2015).

The coconut GVC has a complex multi-product structure (Figure 1). Primary processing, usually involving hired labour, includes additional farm-level value-adding activities of de-husking, grading, and sorting coconuts for fresh market and industrial use in advanced processing. For oil production, primary processing also covers copra production which encompasses splitting the coconut shell and removing, cutting, and drying the kernel. Husks and shells, valuable by-products, usually forming 25 to 45% of the whole nut weight, can be marketed separately. Husks are used by the natural fiber and horticulture industries. Coconut shells are used in producing shell charcoal and activated carbon. Primary processing typically involves manual activities carried out at or near the farm, either by farmers or local traders. With a shelf life of nearly two months at temperatures 0-1 °C, it is possible to ship de-husked coconuts, without further processing, by refrigerated sea containers to any destination worldwide. De-husked coconuts are consumed fresh in producing countries and exported to high-priced niche consumer markets.

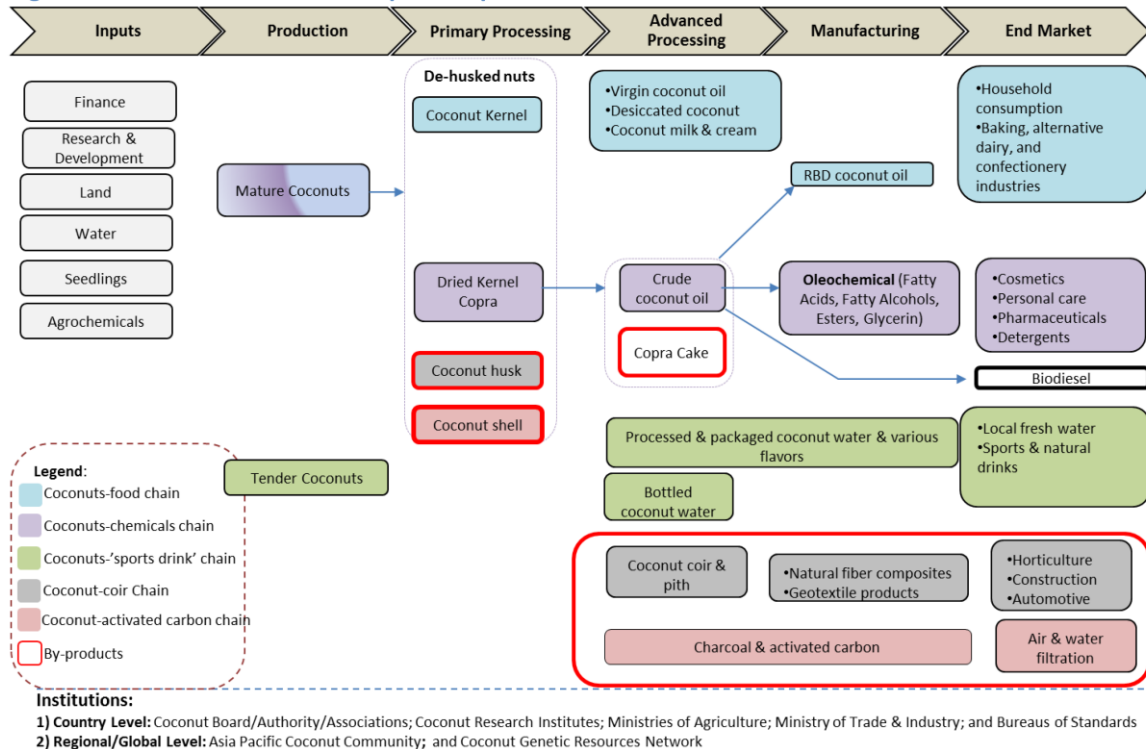
The downstream processing is the gateway to different market channels with coconut kernel and by-products used in multiple industries. Each of the three chain strands has a specific industrial organization, value chain structure, and set of lead firms.

In the coconuts-chemical chain, coconut oil, the traditional export product, is used as a feedstock in manufacturing oleochemicals. Consumer preference for ‘naturalness’ in personal care and cosmetic markets has expanded the demand for oleochemicals, which account for nearly 45-50% of coconut oil consumption worldwide (BCC Research, 2015).

In the coconut’s sports drink chain, coconut water has remarkably grown. Since the early 2000s, breakthroughs in processing technology and consumer awareness about the health benefits of coconut water have remarkably expanded markets beyond the tropics. Leading global brand manufacturers such as the Coca Cola Co., Pepsi Co. and Red Bull GmbH, as

well as niche players such as Vita Coco, have driven product and market development through their investment in coconut water products and brands.

**Figure 2: Coconut Value Chain: Input-Output Structure**



Source: Abdulsamad, 2016 (at p.16).

Growth in the coconut-food chain is also driven by non-traditional products, as well as “Alternative” dairy food and beverages. Similarly, launched in the early 2000s, exports of virgin coconut oil (VCO) from the Southeast Asian and Pacific countries, the main coconut growing region worldwide, have grown manifold (APCC, 2015b). Although the traditional Refined, Bleached and De-odorized (RBD) coconut oil has rebuilt its healthy profile in the edible oil markets, it has never recovered from the market collapse of 1970s-80s, and it lost sizeable market share to the other major competitors in the global vegetable oil market. Besides the three kernel-based chains, coconut by-products, i.e., coconut shells and husks, have also found niche markets in the activated carbon and coconut coir industries. Coir, extracted from the coconut husk, has also become a widely used input in geotextile, horticulture, and recently as a natural fiber in composite applications. Husks are, however, still largely wasted and are marginally processed into commercial products mostly in India and Sri Lanka (Abdulsamad, 2016).

The Caribbean countries play a rather marginal role in coconut GVCs, despite the importance that this product enjoys in their domestic economies. However, some forms of “regional” value chains are emerging, and they are briefly analyzed in the next section.

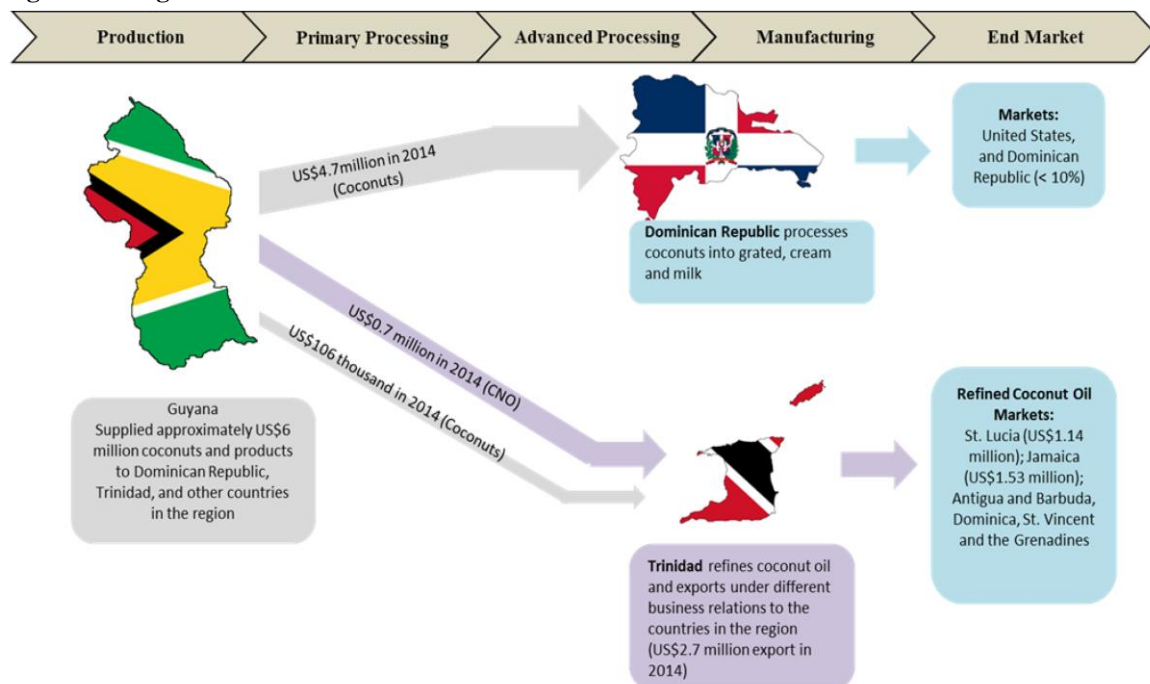


## The Caribbean regional value chain, with a focus on Guyana and Jamaica

An emerging coconut regional value chain, characterized by fragmented production networks involving vertically coordinated trade between the Caribbean countries, has driven regional and global trade expansion (Figure 2).

Two production networks, with the leading regional processor firms geographically located in the Dominican Republic and Trinidad and Tobago, and integrating Guyana as the regional supply ‘basket’ of raw materials, have developed since 2008 (Abdulsamad, 2016). The network coordinated by processors in the Dominican Republic produces desiccated coconuts, coconut milk, and cream for export to the U.S.. The other one, coordinated by the leading regional RBD oil processor, Trinidad Coconut Grower Associations Ltd (CGA), has integrated many Caribbean countries, including Guyana as an upstream supplier of raw materials, Trinidad as the leader in refining and packaging, and St. Lucia and Jamaica as major downstream consumer markets.

**Figure 2 – Regional Coconut Value Chain in the Caribbean**



Source: Abdulsamad, 2016 (p.27).

In this context, Guyana has emerged as the most important coconuts’ regional supplier over the last years. The country exported a range of coconut products with an estimated total export value of US\$6.6 in 2019, 8.1 in 2018, and 10.8 million in 2017 (UNComtrade, 2021).

The coconut value chain in Guyana has indeed undergone a profound structural transformation in the last few years. Driven by the regional and global markets, alternative products to copra, and copra oil, have enjoyed growing local and regional markets. Particularly, since 2009 de-husked coconuts have become a highly demanded export product in regional markets. At the same time, new market channels have also emerged for non-traditional products, such as coconut water and VCO for domestic and export markets (Abdulsamad, 2016).



The cumulative outcome of these market developments has since been a shortage of copra supplies to the local copra oil mills, culminating in their forced closure or far below capacity operations. Between 2009 and 2014, the export of crude coconut oil has consequently declined on average by 15% per year (Abdulsamad, 2016). While the coconut value chain in Guyana had to undergo a functional downgrading - a shift from coconut oil to unprocessed coconut exports - the farming communities have gained from the rising farm gate prices, that more than tripled over the period.

The destination countries of Guyana's exports are still extremely concentrated. The Dominican Republic and Trinidad & Tobago together accounted for over 90% of the total export value in 2017. The former is the main export destination for de-husked coconuts (81%) (UNComtrade, 2019). In contrast, exports to Trinidad & Tobago are diversified. Low-cost and regular boat transportation, directly linking the Pomeroon region, the main coconut producing region in Guyana with Trinidad & Tobago, explains the increasingly diversified coconut trade. Although Guyana started to export coconuts directly to the U.S. and Canada, these markets continue to account for relatively small shares of the total export value.

Jamaica, despite being a leading coconut producer in the region, engages in limited regional or extra-regional coconut trade. In 2019, production reached 103 million coconuts (FAOSTAT, 2021). However, exports are limited: 34 tons in 2017 (official data), 39 tons in 2018 (estimated), and 2 tons in 2019 (official data). The largest commercial segment, the fragmented bottling industry only consumes 2-3% of the reported annual coconut production (Abdulsamad, 2016). Jamaica is a net importer of coconut oil and it has consistently imported copra oil from Trinidad and Tobago (FAOSTAT, 2015).

In the Caribbean, Jamaica is the only country that has well-developed coconut R&D capabilities. The country managed to develop local hybrid varieties, such as Maypan, and started breeding new hybrid varieties (Abdulsamad, 2016). The local breeding capability helped create a relatively strong replanting program, particularly to restock the areas affected by the lethal yellowing disease (CIB, 2013). It has mitigated the lethal yellowing disease loss and obviously stabilized production in recent years.

The coconut value chain in Jamaica is highly fragmented. CIB, the leading commercial actor, annually consumes around one million coconuts, representing approximately one percent of total production (CIB, 2013). The bottling industry is otherwise dominated by many small enterprises directly transacting with smallholder farmers, estimated at around 8,000 (Abdulsamad, 2016). Low entry barriers have resulted in a growing number of small-scale bottlers, including many informal actors who underinvested for many years and lack capabilities in standard compliance and quality packaging. The market structure also drives strong localized competition. Many bottlers face an apparent shortage of supply because they lack the capability to coordinate large supply chains and/or run large-scale operations due to a lack of cold storage capabilities. VCO is an emerging new export product category. While there are big local/regional consumer brands and oil processors, they have currently no backward linkages with the coconut industry (Abdulsamad, 2016).

Although Jamaica's coconut value chain has exclusively focused on the domestic market, new entrants, especially large investors, are targeting exports. The new investments concentrate on developing VCO and coconut water processing plants involving vertically integrated business models and large plantations. Whereas Jamaica could potentially rise to become a leading regional exporter of coconut water, the country has not yet been able to

adequately leverage its extensive supply of dwarf and hybrid coconut supplies (Abdulsamad, 2016).

Whereas many of the countries in the Caribbean region are disadvantaged in terms of international transport costs, lead firms from the regional hub countries have successfully spurred market linkages to boost intra-regional trade. This phenomenon brings renewed attention to the centrality and the capability of lead firms in value chains in driving processes of change in responding to market dynamics at the regional and global levels. The strategies pursued by the regional lead firms in the Caribbean have strongly influenced the establishment and growth of coconut regional value chains. The rise of the production network, coordinated by the oil processor in Trinidad, has occurred with the simultaneous functional downgrading in the coconut oil industries of St. Lucia, Jamaica, and Guyana (Abdulsamad, 2016). Marketing capabilities and linkages with downstream market actors are critical determinants of competitiveness and access to high value markets (Abdulsamad, 2016).

#### **4. Data and settings of the study**

Primary data used in this paper were collected through surveys. A coconut farmers characterization survey was conducted in two Caribbean countries: Guyana and Jamaica by ITC and CARDI in 2016 and 2017.

The sample for the farmers characterization survey was designed following a participatory approach that involved local institutions and sector stakeholders. Project partners and value chain actors, gathered in a “National Stakeholders Platform”, identified the main areas of interest in the country for the development of the sector, and provided key information about farmers’ population, such as lists of farmers’ census, and land tenure information (ITC et al., 2016). All the collected information was then validated with project partners and sector stakeholders. The sample was designed following a simple random sampling method and convenience sampling, according to the country context .

The survey presents descriptive statistics on agricultural, institutional, economic, and social aspects at the farmer and household levels. Questions focused specifically on farming production system, market, finance, access to information, support received by different organizations, income-generating activities, and other land and farm characteristics. Specific geographical areas, with the most intense coconut cultivations, were chosen in each country. From each area, villages were selected in consultation with national officers in the coconut area where to carry out the survey. In each village, farms/holdings were randomly selected to answer a structured questionnaire.

In Guyana, the survey was implemented in three areas: Pomeroon (region 2), East Coast (region 4 and 5), and Linden (region 10) selected in collaboration with the National Stakeholders Platform. Pomeroon is the most important region of the country for coconut production, followed by the East Coast, that is also well connected to the country’s main export harbor. Linden is considered an area with large potential because of soil characteristics and the new growing processing industry in the region. The survey was

conducted among 125 farmers, representing 7% of the coconut farmer population in the Pomeroon area, 8% in the East Coast and 10% in the Linden area.<sup>4</sup>

The vast majority of farmers in the three selected areas (about 92% on average) own small plots of 10 acres or less (Table 1). Only in the Pomeroon region, some farmers own larger plots.

In Jamaica, the survey was implemented in four parishes: St. Thomas, Portland, St. Mary and Hanover. The Coconut Industry “National Stakeholder Platform” selected these areas because of the high concentration of coconut farmers and the processing industry’s increasing demand for raw material from those areas. Within each area, a random selection process allowed to identify the sample, that included 134 farmers in St. Thomas, that represent 5% of the coconut farmer population, 5.5% in Portland and St. Mary and 6% in Hanover.<sup>5</sup>

Also in Jamaica most farms operate on very small plots, but more farmers use medium- and larger-sized plots in comparison with Guyana.

**Table 1 – Size of Land Plots in Sample Farmers**

	<b>% of farmers with up to 10 acres</b>	<b>% of farmers with 10 to 20 acres</b>	<b>% of farmers with more than 20 acres</b>	<b>Total number of sample farmer</b>
<b>Guyana</b>				125
Pomeroon	82	11	7	50
East Coast	94	3	3	50
Linden	99	1	0	25
<b>Jamaica</b>				160
St. Thomas	83	11	6	40
Portland	78	14	8	20
St. Mary	87	6	7	40
Hanover	81	12	7	40

*Source:* Authors’ elaboration.

Whilst we acknowledge that the samples are not statistically representative of all small-scale farmers in the two countries, we maintain that they are sufficiently indicative and allow a deeper understanding of the productivity, input availability and market access of small-scale coconut farmers in Guyana and Jamaica.

Overall, coconut farmers located in Guyana and Jamaica have different characteristics (Table 2) The majority of the coconut farming households are male headed (78,4% in Guyana and 91% in Jamaica). At the time of the survey, the average head of household age was 53 and 61 years respectively in the two countries. In Guyana, about 40% of the selected farmers have secondary education, whereas 35% received tertiary education. In Jamaica, education levels in the sample farmers are higher, with 84% having secondary education, and 14% a pre-university or university education.

<sup>4</sup> The source of information on the coconut farmer population in Guyana is the Guyana National Agricultural Research and Extension Institute (NAREI).

<sup>5</sup> The sources of information on the coconut farmer population in Jamaica are the following: the Coconut Industry Board of Jamaica (CIB) and the Rural Agricultural Development Authority of Jamaica (RADA).

**Table 2 - Descriptive statistics of coconut farmers – Guyana and Jamaica**

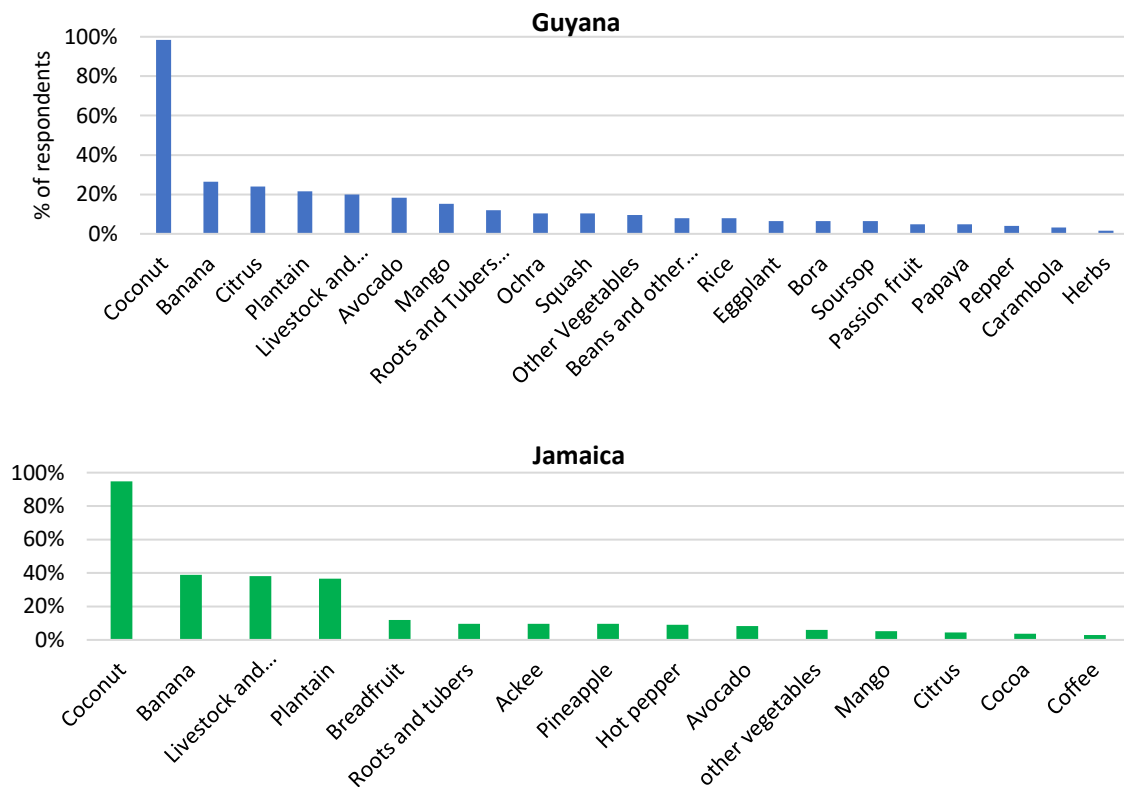
Variables	Definition and measurement	Guyana				Jamaica			
		Mean	SD	Min	Max	Mean	SD	Min	Max
Number of households	number				125				134
Household head is male	=1 if HH head is male	98				122			
Age of household head	Year of birth	1964	14.81	1940	1991	1956	4.95	1953	1960
Education of household head	title owned - dummy based on %								
No education		15				1			
Primary		12				1			
Secondary	1st cycle	33				17			
Secondary	2nd cycle	5				67			
Form	pre-university programme	9				8			
Tertiary	University (or Vocational college)	26				6			
Total coconut income	= total year revenue (USD)	11,191	15,752	360	75,600	5,533	12,169	80	110,000
Number of coconut plants	number per HH	756	3768	0	34960	300	626	0	4750
Cultivated coconut area (hect.s)	area cultivated with coconut	18	65.80	0.33	700	23.18	44.37	2	300
Access to irrigation	yes=1	0.73				0.12			

*Source:* Authors' calculations based on the coconut farmers characterization survey

Farmers in our sample own 18 and 23 hectares of cultivated coconut area on average, respectively, in the two countries (Table 2). The number of coconut plants owned on average by the household head is 756 in Guyana and 300 in Jamaica. There is seemingly little rental activity, and most of the owners cultivate the coconut plots themselves. The average annual coconut income amounted to 11,191 USD in Guyana and 5,532 USD in Jamaica. Over 70% of farmers in Guyana declared to have access to irrigation; this percentage falls to 12% in Jamaica.

Some interesting stylized facts on the farmers’ characteristics in the two countries emerge from the survey data (Figures 3-7). Figure 3 shows that, in both countries, farmers grow different products, but coconut is the main crop. Almost all the sample farmers in Guyana declare that coconut is the main product, followed by a variety of other products. Jamaica farmers appear to be a little more diversified, with coconut being the main product for 80 percent of them, with other products such as bananas, livestock, and plantain at about 40 percent.

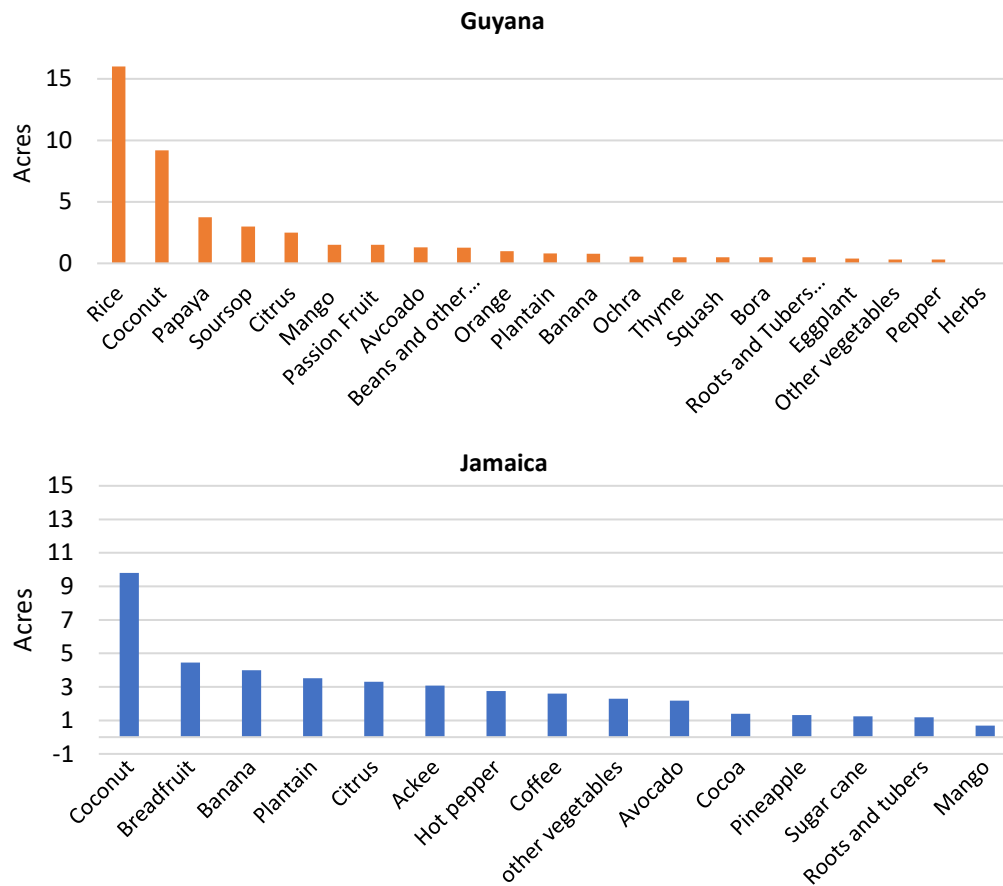
**Figure 3 - Main products cultivated** (frequency)



Source: Authors’ calculations based on farmers survey

Guyana farmers devote the largest amount of land to rice cultivation (16 acres), followed by coconut (Figure 4). In Jamaica instead, the largest number of acres (9.8) is used for coconut cultivation, more than twice of the acres allocated to the cultivation of other fruits.

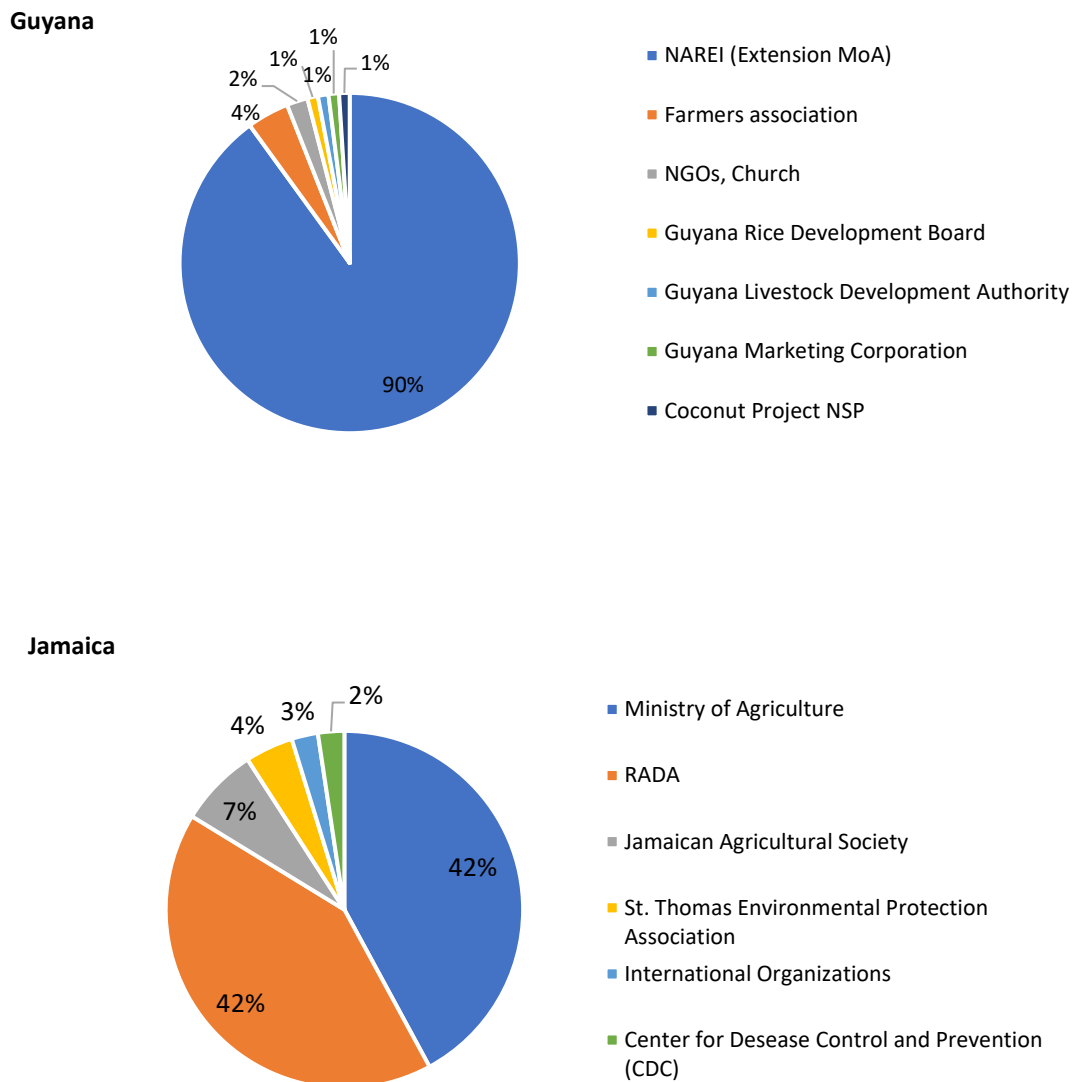
**Figure 4 - Average land under cultivation of different crops**



*Source:* Authors' calculations based on the coconut farmers surveys

A plethora of organizations - mainly national institutions – appear to support farmers in Guyana (Figure 5). However, 90% of farmers mainly ask for assistance from NAREI, which is an extension of the Ministry of Agriculture. On the other hand, the request for support from other organizations - such as farmers' associations, NGOs, the church, or other authorities - is marginal. In Jamaica, over 80% of farmers equally turn to either the RADA or the Ministry of Agriculture and to a lesser extent to other organizations present in the country, both national and international.

**Figure 5 - Organizations supporting coconut farmers**



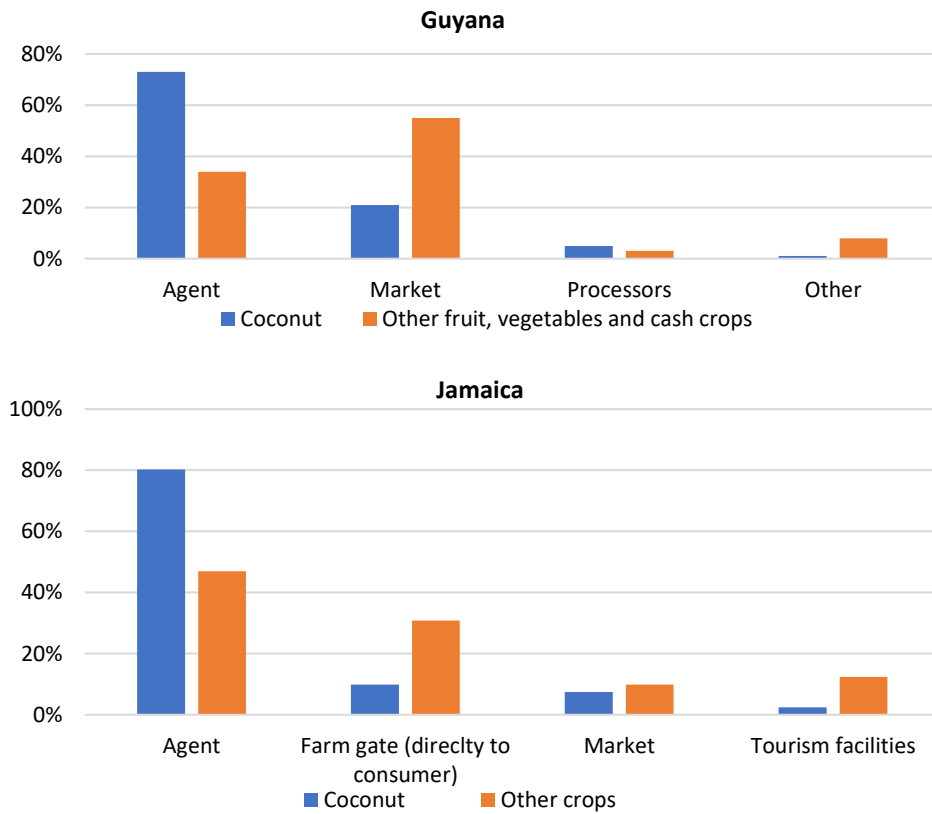
Source: Authors' calculations based on the coconut farmers surveys

In both countries, the main buyers of coconut are agents, 73% and 80% respectively, who gather coconuts from the farmers and sell them to traders and processors (Figure 6). Secondly, the farmers in Guyana sell coconut directly to primary markets, which is the preferred selling point for other agricultural goods produced by the farmers. The second preferred selling point in Jamaica is the farm gate, i.e., direct sales to consumers, followed by the market.

Farmers appear to use different sources of funding in the two countries: while in Jamaica the funds invested in the farm come exclusively from personal savings, in Guyana - although personal savings still represents a dominant share (86%), other sources, such as micro-credit and bank loans are also used (Figure 7).

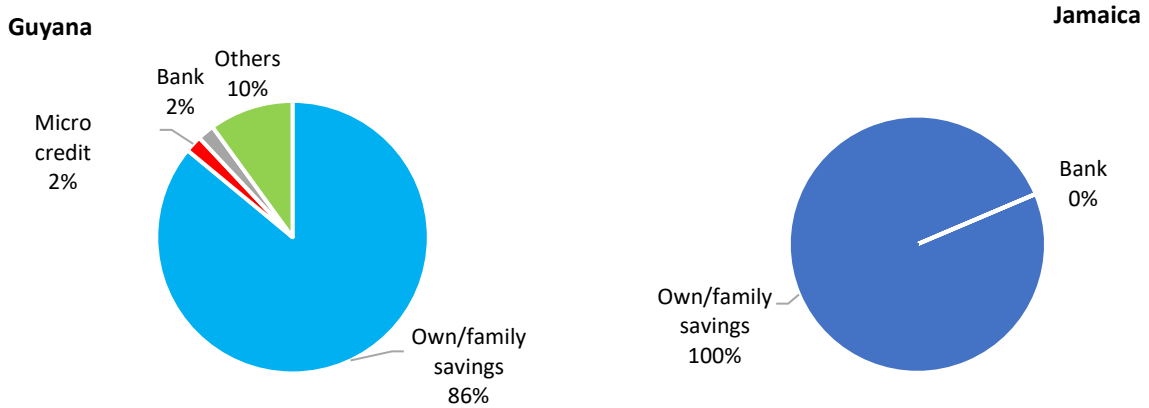


**Figure 6 - Selling Points**



Source: Authors' calculations based on the coconut farmers surveys

**Figure 7 - Farmers' source of funding**



Source: Authors' calculations based on the coconut farmers characterisation survey

## 5. Empirical analysis

In order to analyse the economic performance of coconut farmers and better understand the factors behind productivity performance, we perform an econometric exercise that regresses coconut productivity on some key variables suggested by the literature in the field.

Eq. 1 presents the productivity function:

$$Y_{ip} = f(V_i, X_i, Z_j) \quad (1)$$

where  $Y_{ip}$  is the farm-level coconut yields,  $V$  is a vector of inputs used by farmer  $i$  - that includes land, labor, and capital -  $X$  is a vector of individual characteristics and  $Z$  are community-level variables that can influence productivity.

We use a Cobb-Douglas production function estimated by ordinary least squares (OLS) to carry out this empirical analysis.<sup>6</sup> Our dependent variable is coconut yield, estimated as the average number of coconuts per palm.

The productivity function we estimate takes the following econometric specification:

$$\ln Y_{ip} = \alpha_1 + \alpha_2 \ln land_{ip} + \alpha_3 \ln workers_{ip} + \alpha_4 irrigation_i + \alpha_5 typework_i + \alpha_6 Z_{ij} + \delta_c + \varepsilon_{ip} \quad (2)$$

Where  $Y_{ip}$  is the annual coconut productivity in production  $p$  (i.e., numbers of coconuts over numbers of plants) for the farm  $i$ ,  $land$  is the acres of land cultivated per plant in production,  $workers$  is the total workforce (i.e., number of workers) per plant in production,  $irrigation$  is a dummy variable for the presence of an irrigation system as a proxy for technology (supplied by the industrial sector),  $typework$  is a variable that distinguishes different types of work (i.e., only family workers, occasional workers, permanent workers),  $Z$  is a vector of community characteristics (such as institutional support, selling points, access to credit),  $\delta_c$  is a country dummy variable that is equal to 1 for Guyana and 0 for Jamaica, and  $\varepsilon$  is the error term. Both the dependent variable and the continuous independent variables are in logarithms. Table 3 reports our estimates of coconut productivity.<sup>7</sup>

**Table 3 – Productivity measure: descriptive statistics**

Variable	N. of obs.	Mean	Std. Dev.	Min	Max
Coconut yield (average number of coconuts per palm)	185	164.45	341.53	2.50	2678.57

Source: Authors' elaboration on the farmer survey

<sup>6</sup> We are aware that classical linear regression models mainly rely on an exogeneity assumption that, if not respected, could lead to biased estimates due mainly to omitted variables (Wooldridge, 2002.). Unfortunately, due to data constraints (i.e., cross section data) this is the best possible alternative.

<sup>7</sup> In this sector, additional productivity measures could also include: *Land productivity* (average annual coconut production/land currently cultivated), and *Labor productivity* (average annual coconut production/total workforce).

We first estimate a base model where only the effect of production inputs on coconut productivity is considered (Table 4). Afterwards, we introduce in the base model individual attributes and community-level variables (see the results in Table 5).

The workforce matters in explaining coconut productivity: the workforce variable is positive and significant. Also, the type of workforce is important: the employment of personnel external to the family (that is the reference term) is expected to add qualified work to farming, regardless of whether occasional or permanent. A positive effect is also exerted by the irrigation scheme, perhaps one of the best technologies in the sector-country due to the rare use of intermediate inputs such as seed and fertilizers. In contrast, coconut productivity does not seem to depend on the size of the land used for coconut activity, although land is one of the most significant inputs into agricultural production. This seems to suggest that economies of scale would not be significant. Lastly, this productivity is - *ceteris paribus* - higher for Guyana than Jamaica.

**Table 4 - Coconut productivity: Base Model**

	<b>Dep. var. <math>Y_{ip} = \log(\text{coconut yield})</math></b>	<b>Base model</b>
<b>Production inputs:</b>	ln_workers	0.416*** (0.0799)
	ln_land	0.0771 (0.126)
	irrigation	0.655* (0.274)
<b>Type of work</b>	occasional but not permanent workers	0.682* (0.378)
	both occasional and permanent workers	0.511* (0.274)
<b>Country dummies</b>	1=Guyana, 0=Jamaica	0.999*** (0.279)
	constant	5.232*** (0.49)
	N.	149
	adj. Rsq.	0.415

Standard errors in parentheses: +  $p < 0.15$ , \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

We then introduce in the model many household and community characteristics. The results obtained in the base model are confirmed in the complete model. We first consider the “education” variable as a proxy for human capital to assess the importance of higher education on farm economic performance (Griliches, 1963). To this aim, we adopt a categorical dummy and distinguish five levels of increasing degree of education: primary, secondary (1st cycle), secondary (2nd cycle), form (pre-university program), and university (or vocational college). No education is the reference term. The results of model (1) in Table 5 highlight the importance and statistical significance of education as a factor affecting productivity. Primary education is positively associated with economic performance, whereas higher levels of education do not seem to be so important.

**Table 5 – Coconut productivity – Complete Model**

Dep. var. Yip = log(coconut yield)		(1)	(2)	(3)	(4)	(5)
<b>Production inputs:</b>	ln_workers	0.401*** (0.0937)	0.418*** (0.0918)	0.387*** (0.0845)	0.417*** (0.0857)	0.417*** (0.0805)
	ln_land	0.114 (0.141)	0.104 (0.128)	0.120 (0.132)	0.0868 (0.138)	0.0771 (0.126)
	irrigation	0.480* (0.282)	0.611** (0.273)	0.454* (0.271)	0.553* (0.303)	0.655** (0.276)
<b>Type of work</b>	occasional but not permanent workers	0.280 (0.446)	0.722** (0.365)	0.541+ (0.371)	0.661+ (0.421)	0.682* (0.381)
	both occasional & permanent workers	0.366 (0.327)	0.524* (0.274)	0.279 (0.279)	0.574* (0.319)	0.510* (0.281)
	<b>Farmers' Characteristics:</b>	primary	0.867*** (0.297)			
<b>Education:</b>	secondary (1st cycle)	-0.111 (0.357)				
	secondary (2nd cycle)	0.545 (0.424)				
	form (pre-university programme)	0.199 (0.414)				
	university (or vocational college)	0.166 (0.321)				
<b>Community Characteristics: Organizations</b>	Ministry of Agriculture		-0.034 (0.224)			
	Other Public Organizations		0.341 (0.600)			
	International Organizations		1.734*** (0.263)			
	Non-Profit Organization		-0.006 (0.393)			
	Coconut Industry Board		0.595+ (0.370)			
<b>selling points:</b>	farm gate			-0.493** (0.200)		
	market			-0.199 (0.463)		
	others			-0.286 (0.383)		
	processor			-0.0520 (0.477)		
<b>credit access:</b>	bank credit				0.887** (0.389)	
	microcredit				0.461 (0.348)	
	multicrop					-0.00681 (0.318)
	country (1=Guyana, 0=Jamaica)	1.211*** (0.368)	1.337*** (0.289)	1.466*** (0.276)	1.120*** (0.317)	0.999*** (0.280)
	constant	5.158*** (0.696)	5.048*** (0.517)	5.375*** (0.488)	5.241*** (0.537)	5.239*** (0.634)
N		119	149	139	120	149
adj. R-sq		0.444	0.426	0.434	0.392	0.411

Standard errors in parentheses: + p<0.15, \*p<0.10, \*\*p< 0.05, \*\*\*p< 0.01

In addition, we also take into consideration some community-level variables, that we expect to be relevant considering the nature of the coconut activity. The importance of this kind of support is widely recognized in the literature.<sup>8</sup> We introduce in the model the support received by farmers from several institutions and organizations, both national and international. More specifically, we use the “institutions” categorical dummy to proxy support from the following entities: Ministry of Agriculture, Other Public Institutions, International Institution, No Profit Organizations, and Coconut Industry Board. The case of no support is the reference term. Results (column 2 in Table 5) show that the support from institutions, mainly from international institutions (and Coconut industry board for Jamaica), positively and significantly affects farm-level productivity.

We then take into consideration the importance of market diversification. To this aim, we introduce specific variables to proxy different “selling points”, specifically: agent, farm gate, market, processor, other and restaurants/hotels. Each variable assumes a value of 1 if the farmer sells to this point more than 50% of his coconut production, 0 otherwise. Also in this case, we adopt a categorical dummy; the agent is the reference term.<sup>9</sup> The new specification suggests that selling at the farm gate hurts coconut productivity with respect to selling to agents (column 3). Selling to agents would offer a positive productivity premium, possibly because it offers better opportunities to get relevant information (and technology) and better adapt products and processes to the requirements of the final markets. This would suggest that a form of “relational” value chain would prevail in coconut farming, implying interactions and the transfer/exchange of tacit knowledge otherwise impossible to transfer, absorb, adapt, utilize by the farmer, as observed in other sectors (Pietrobelli and Rabellotti, 2007).

We also tested for the relevance of access to credit by considering different types of credit available in the two economies, namely: family, bank, and micro credit. Again, we use categorical dummies, where family credit is the reference term. Results convincingly suggest that bank credit offers a positive premium on productivity (column 4).

Lastly, we analyze how the practice of multi-cropping – producing coconut as well as other products on the same plot – affects coconut productivity. To this aim, we use a dummy (i.e., multi-crop) that is equal to 1 in case of multi-cropping and 0 otherwise (i.e., only coconut). Results in column 5 do not suggest any significant effect of multi-cropping on coconut productivity. This occurs despite the widespread traditional practice of growing coconut in the Caribbean: having some trees in the backyard and pick the coconuts when ripe. The practice of multi-cropping does not help productivity improvements, and it appears that also traditional coconut farming need dedicated attention to raise productivity levels.

In sum, the quantitative analysis shows that the type of workforce, whether occasional or permanent and the existence of an irrigation scheme influence coconut productivity in Guyana and Jamaica. The size of the plot does not appear to be relevant, suggesting that economies of

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<sup>8</sup> Scholars recognized that institutions play an important role in economic development (North, 1990; Knack and Keefer, 1997; Acemoglu et al., 2001, 2005; Dollar and Kraay, 2003; Rodrik et al., 2004). Previous works also suggest that institutions are important sources of comparative advantage and have long-standing impacts on international trade (see survey in Nunn and Trefler, 2013). Recent studies have suggested that institutional facilitation in international trade is one of GVC participation’s sources of advantage (Dollar and Kidder, 2017)

<sup>9</sup> No observations are available for restaurants/hotels.

scale would not be significant. Furthermore, primary education contributes to productivity to a larger extent than higher education. Most importantly to our aims, the support from institutions, mainly from international organizations (and Coconut industry board, but only in Jamaica) positively affects farm-level productivity. In addition, community-level variables also significantly influence coconut productivity. Notably, selling to agents offers a positive productivity premium, probably due to the opportunity agents offer to get relevant information and technology. Thus, traces of a simple “relational” value chain, implying a positive and useful role for interactions and the transfer/exchange of tacit knowledge from buyers and agents emerge.

## 6. Conclusions and policy implications

In this work, we analyzed the determinants of coconut farmers’ economic performance in the Caribbean region drawing on two original farmers’ surveys carried out in Jamaica and Guyana in 2017. They reflect the local conditions prevailing in specific subnational areas, as they were implemented in four specific parishes in Jamaica, and three regions in Guyana.

First, the analysis of data collected by the surveys offered some interesting stylized facts on the farmers’ characteristics in the two countries. It highlights that the vast majority of farmers in the two countries own small plots of land (10 acres or less), are male-headed, many (70%) with secondary or tertiary education. In both countries, farmers grow different products, but coconut is the main crop; mainly sell to agents, and get useful support from national and international organizations. Although funding comes mainly from personal savings, access to bank credit gives a positive productivity premium. Furthermore, coconut production is carried out through very simple, traditional technologies, and sometimes irrigation.

Second, the quantitative analysis showed that there are some key factors that positively affect the economic performance of coconut farmers, consistent with the literature. They are the type of workforce, the existence of an irrigation scheme, and primary education. Furthermore, one more factor that positively affects farm-level productivity is the institutional support, mainly from international institutions. Political decisions about domestic and international institutions—be it their creation, strengthening or weakening—have crucial implications for how farmers organize production and distribution in the value chain perspective.

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