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Growing Money on Trees in Latin America: Growth Rates for Cocoa 1961-2013 and Their Implications for Industry

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Abstract: Despite being the center of origin for cocoa, cocoa cultivation and use, Latin America witnessed only modest increases in output, area harvested and yields for this commodity during the last half century. However, these long-term trends mask a diverse array of booms, then busts for cocoa in many parts of the region. Recent years have seen a run-up in international prices, the diffusion of improved varieties and the launching of various public-private alliances to improve cocoa productivity, quality and incomes. This paper analyses these and other important developments at both the regional and country level over the last five decades. In so doing it seeks to provide a more nuanced assessment of regional developments for cocoa as well as highlight important implications for industry.

Key words: Production · Area · Yields · Technology · Prices · Trade

INTRODUCTION

As the global economy moved into the new millennium, the planet´s growing appetite for more, higher quality and more exotic foods and food products became increasingly more evident [1, 2, 3]. Changing tastes and preferences combined with falling tariffs and barriers to trade meant that many developing countries were eager to explore avenues to better position themselves to take full advantage of these emerging trends [4, 5, 6].

Cocoa stands out as one of various agricultural commodities attracting renewed attention for a number of reasons. With an estimated five to six million producers in developing countries [7], annual global trade in cocoa and cocoa-based processed products (e.g., cocoa butter, paste, as well as chocolates) is measured in the US$ billions [8]. Moreover, as growing demand repeatedly exceeded available supplies [9, 10], cocoa prices rose from less than US$ 800/mt in 2000 [11] to hit a 30-year high of US$3, 625 in January 2010 [12]. They then fell back to roughly US$ 2, 300/mt in Feb 2012 as harvested volumes increased and demand momentarily weakened. Despite the latest gyrations, more recent (Nov 2015) market data show prices at roughly US$ 3100/mt with a robust outlook for the years ahead [7, 13, 14].

Noteworthy factors driving the growth in demand include the growing appetite for chocolate and chocolate-flavored products by middle class consumers in developing countries, especially in China, Brazil and India [8, 15]; from 2008 to 2011, for example, China grew from the 12th to 9th largest importer of cocoa paste and from the 15th to 9th largest importer of cocoa powder and cake [7]. On the supply side, prices for cocoa have also been bolstered by recurrent uncertainty regarding production in the West African countries — in particular Ivory Coast, but including Ghana and Nigeria, where over 70% of annual global output is harvested [8]. While recent assessments seek to refute pessimistic notions about the future outlook for cocoa production in these countries, they go on to acknowledge the decline in cocoa production in Asia [13, 16]. Added to that is the concern about the possible impact of climate change on cocoa production in West Africa in the not too distant future [17]. The combined effect has contributed to renewed interest in cocoa in Latin America (LAC), the center of origin for the commodity for several additional reasons.

A number of LAC countries have identified cocoa as having unrealized potential to help diversify agricultural exports, capitalize on the rise in international prices, reduce greenhouse gas emissions and help preserve

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bio-diversity [18, 19, 20, 21, 22, 23]. They also see cocoa production as a way to generate higher incomes for the low-income households that frequently dominate domestic production systems and spur opportunities for increased value-added off the farm all of which are contingent upon increases in productivity and improvements in quality [15, 24, 25 26, 27].

While several recent studies have examined prospects for cocoa in LAC, these reports typically have focused on the entire region [13, 16, 28] without including much country-level analysis. Moreover, they tend to examine trends in absolute production rather than growth rates over time, their evolution and the possible implications for future prospects for output, area and yields. Alternatively, a number of previous papers have studied the cocoa sector in individual countries and/or their principal growing areas in some detail [24, 29, 30, 31, 32], but given their focus have done so with little regard for comparing domestic results with those for other countries. Among other limitations, these studies typically present a series of national statistics without comparing different domestic sources, much less so country data with that made available by international sources, their possible differences, or their magnitude, let alone the possible reasons for such discrepancies.

In light of these considerations, this paper seeks to:

- Consolidate the historical data and related studies on cocoa in LAC so as to quantify the growth rates in production, area and yields over the last five decades, pointing out major patterns otherwise obscured by calculations for a given time period and delineate the principal contributing factors;
- Analyse the major differences for these performance indicators for the five major cocoa-producing countries the region, attempting to clarify their underlying causes and in so doing provide a more nuanced assessment of regional developments;
- Benchmark future prospects for cocoa in LAC in light of current trends and emerging tendencies;
- Highlight important implications for industry; and,
- Identify some key topics for future research.

DATA SOURCES AND ANALYSIS

In order to identify and then analyse average annual compound growth rates (ACGRs) in cocoa production, area harvested and yields in Latin America over the last half century, this study follows the method first presented in Scott [33] then further developed in Scott, Labarta and Suarez [34]. To that end, the paper utilizes FAO times-series data for these key indicators first to calculate annual averages for the beginning (1961-63) and the end (2011-13) of the period and then to calculate the ACGRs over the entire fifty years, first for the region as a whole and then for particular countries in different sub-regions, *e.g.*, Brazil andean region. The study uses FAO data to serve as a common source of information for LAC and for comparing across countries within the region. Subsequently, ACGRs were also calculated over the first (1961-63 to 1986-88) and second (1986-88 to 2011-13) halves of the times-series in an initial attempt to determine if these growth rates were slowing down or speeding up.

A second dimension to this study involved tracking the rate of change in the ACGRs for production, area harvested and yields on a continuous basis during the last five decades. In other words, as referencing a particular set of years (e.g., 1984-86) or a given sub-set of time periods is arbitrary, this study also estimated, then analysed the evolution of the growth rates themselves. ACGRs therefore were calculated using all the annual data for every ten-year period beginning with 1961-71 at first the regional and then country level (e.g., for Brazil, Ecuador, Mexico, Peru). In other words, growth rates were calculated on a moving ten-year basis, *i.e.* 1961-63 to 1971-73, 1962-64 to 1972-74 and so on up to 2001-03 to 2011-13. These growth rates were then plotted to observe the changes in their trajectory over the last five decades, examined to compare the shifting relative importance of growth rates for area versus those for yields in relation to those for production and used to estimate an overall trend for each of the three variables first for LAC as a whole, then for the major cocoa-producing countries in the region.

A third key component of this study was the associated "wall-to-wall" field work [35] involved in ferreting out and then analyzing not just previously published documents but also the so-called "gray" or unpublished literature that examined some aspect of cocoa production, area and yields in one or more LAC countries in recent years. In that regard, this study does not pretend to provide an exhaustive treatment of all the topics considered or the results reported on related to the evolution of output, area and yields for cocoa in Latin America, particularly given the long history of production in the region [29, 36, 37, 38]. Instead, it attempts to synthesize the major findings of earlier studies as a means

of helping to explain the trends that have been quantified or interpret the growth rates presented and in so doing provide a more substantive analysis of regional developments for cocoa production, area and yields.

REGIONAL GROWTH RATES

Cocoa production in LAC increased by over 400, 000 metric tonnes (mt) or 125% during the last fifty years as output increased at an annual average growth rate of 1.7%/yr to reach 730, 000 mt/yr by 2011-2013 (Table 1) with an estimated annual value of US$ 1.90 billion.[1] Notwithstanding, 90% of that increase took place in the initial 25-yr period from 1961-63 to 1986-88 as ACGRs rose to over 3%/yr, then spiked to nearly 4%/yr (Fig. 1). After regional cocoa production reached a momentary peak of 688, 000 mt in 1989, output steadily declined to 449, 000 mt in 2002, i.e., by some 239, 000 mt or 35% as ACGRs fell to -4%/yr during this time, before subsequently recovering, then expanding to recent levels of over 5%/yr. Hence, the 50-yr growth rate in production obscures three distinct tendencies embedded within the two sub-periods: the rise in output from the early 1960s to the mid-to-late 1980s, the declining growth rates through to 2003 and then the up-turn in growth rates until 2013 (Fig. 1).

Area harvested in cocoa in LAC stood at 1.68 million hectares (ha) in 2011-2013 as its evolution mirrored, albeit not entirely, that of production (Table 1). Area harvested surged in the period 1961-63 to 1986-88, going from 1.04 to 1.46 million ha as the ACGRs rose to over 3%/yr. After then rising to 1.64 million ha in 1995, area contracted by 249, 000 ha or 15% to 1.39 million ha by 2003 as ACGRs fell to --1%/yr before subsequently rebounding to current levels. Hence, for LAC as a whole, growth rates for area harvested slowed considerably over the last quarter century (Table 1), although even those tendencies mask major fluctuations within the latter period and at the sub-regional level (Fig. 2).

As production and area harvested in cocoa in LAC expanded over the last half century, average yields showed only modest improvement to less than 500 kg ha^{-1}. This outcome was the result of sharply countervailing trends during the last five decades and across the region. While regional yields ratcheted upward from an average of 312 kg ha^{-1} during 1961-63 to reach 499 kg ha^{-1} in 1984-86, they then plummeted to 302 kg ha^{-1} in 2000-2002 before recovering to 436 kg ha^{-1} in 2011-13 [39]. Furthermore, growth rates for cocoa yields fell in noteworthy fashion in Brazil and to a lesser extent for the Caribbean Region over the last quarter century (Table 1, Fig. 3), but these developments were partly offset by noteworthy improvements in productivity elsewhere in the region during the same period.

Two initial observations about these growth rates for cocoa in Latin America are in order. Firstly, trends in output followed, albeit with a lag, the quasi-cyclical evolution of international cocoa prices (Fig. 4). As prices trended upward from the early 1960s to late 1970s, output expanded. Once they continued to fall from the mid-1980s to the late 1990s [11, 40], production, albeit with certain exceptions, contracted considerably. After prices rebounded beginning in 2000, so did output.

Secondly, as cocoa is a perennial tree crop, growth rates in area harvested in Latin America --generally speaking-- have been much less volatile than those for yields or production (Table 1, Fig. 1-3). From that perspective, other factors besides simply prices: weather conditions (e.g., excess rainfall, drought, hurricanes), the incidence of pests and diseases, age of the trees, soils and soil management, macro-economic and political stability, also assume importance in terms of their potential influence on harvesting rates and ultimately yields, on production. Noteworthy exceptions to this observation as applies to the last half century would be Mexico and Peru where growth rates for area far exceeded those for yields (Table 1).

Within Latin America cocoa production and area harvested remains highly concentrated. Five countries: Brazil, Dominican Republic, Ecuador, Mexico and Peru accounted for 80% of regional production and 86% of area harvested in 2011-13 versus 79% of production and 81% of area in 1961-63. These same five countries produced 91% of the increase in production and generated 95% of the expansion in area harvested over the last five decades as well. Moreover, as will be indicated in greater detail below, with the noteworthy exception of Peru, commercial area harvested *within* these same countries is also highly concentrated in a remarkably small number of geographic locations. Conversely, 25 of the region´s 33 countries produce little (<10, 000 mt/yr) or no cocoa (Table 2). As a consequence of these disparate patterns and trends across counties in the region, the relative importance of the major cocoa-producing countries has shifted with Brazil declining and most notably Ecuador and Peru increasing their respective shares of regional output (Fig. 5).

[1]FOB equivalent using an average annual price of US$ 2, 600 mt of cocoa for the three years using World Bank data, http://www.worldbank.org/en/research/commodity-markets

Table 1: Average annual growth rates for cocoa in Latin America, 1961-2013

	2011-2013			Growth rate[a]								
				Production			Area			Yield		
Region/country	Production (000 mt)	Area (000 ha)	Yield (kg ha^{-1})	1	2	3	1	2	3	1	2	3
Latin America[b]	730	1, 676	436	2.9	0.4	1.6	1.4	0.5	1.0	1.5	-0.1	0.7
Brazil	253	685	369	4.0	-1.7	1.1	1.4	0.2	0.8	2.6	-1.9	0.3
Andean Region[c]	298	657	502	2.7	2.5	2.6	1.7	1.0	1.4	0.9	1.5	1.2
Ecuador	162	397	407	2.3	3.0	2.6	1.5	0.9	1.2	0.8	2.1	1.4
Peru	63	91	694	6.9	6.2	6.6	6.7	4.8	5.8	0.2	1.4	0.8
Colombia	42	103	405	5.1	-0.8	2.1	4.6	-0.1	2.2	0.4	-0.8	-0.2
Mexico	82	117	702	2.1	2.1	2.1	0.3	1.9	1.1	1.9	0.2	1.0
Caribbean Region[d]	79	192	412	0.0	1.6	0.8	1.6	0.1	0.8	-1.5	1.5	0.0
Dominican Republic	65	152	428	0.5	1.9	1.2	2.6	0.2	1.4	-2.0	1.8	-0.2
Central America[e]	17	23	647	-1.4	2.3	0.4	-1.5	-0.7	-1.1	0.1	2.9	1.5
Guatemala	12	4	2, 916	6.1	7.1	6.6	3.8	0.7	2.2	2.3	6.4	4.3

[a] 1 = 1986-88 vs 1961-63; 2 = 2011-13 vs 1986-88; 3 = 2011-13 vs 1961-63 where the average annual growth rate is calculated as follows

$$\left[\left(\frac{\text{Ending 3 - year average}}{\text{Benginning 3 - year average}}\right)^{\frac{1}{\text{Number of year between beginning and end mid-points}}} - 1\right] * 100$$

[b]For this study, Latin America includes Brazil, the Andean Region, Mexico, the Caribbean Region, Central America each defined below as well as Argentina*, Chile*, Guyana**, Paraguay*, Suriname** and Uruguay*. [c]Andean Region consists of Bolivia**, Colombia, Ecuador, Peru and Venezuela***. [d]Caribbean Region is made up of Antigua & Barbuda*, the Bahamas*, Barbados*, Cuba**, Dominica**, Dominican Republic, Grenada**, Haiti**, Jamaica**, St. Lucia**, St. Kitts & Nevis*, St. Vincent & the Grenadines** and Trinidad & Tobago**. [e] Central America consists of Belize**, Costa Rica**, El Salvador**, Guatemala, Honduras**, Nicaragua** and Panama**.

* according to FAOSTAT (2015), these countries reported producing no cocoa during 2011-13

**according to FAOSTAT (2015), these countries reported producing less than 10, 000 mt of cocoa during 2011-13

***according to FAOSTAT (2015), these countries reported producing more than 10, 000 mt and less than 50, 000 mt of cocoa during 2011-13

Source: FAOSTAT (accessed November 2015) and calculations for this study.

Table 2: Distribution of cocoa-producing developing countries by region, 2011-13

	Region			
Production (000) mt/yr	Africa[a]	Asia[b]	Latin America[c]	Total
0 or no data	34	43	8	85
> 0 <10, 000	2	9	17	38
> 10, 000 < 50, 000	3	2	3	8
> 50, 000 <250, 000	1	0	4	5
>250, 000	4	1	1	6
Total	54	55	33	143

[a]For this study, Africa consists of North Africa that in turn is made up of Algeria*, Egypt*, Libya*, Morocco*, Tunisia* and the Western Sahara*; West Africa that includes Benin**, Burkina Faso*, Cameroon*****, Cape Verde*, Chad*, Côte d´Ivoire*****, Gambia*, Ghana*****, Guinea**, Guinea-Bissau*, Liberia***, Mali*, Mauritania*, Niger*, Nigeria*****, Senegal*, Sierra Leone*** and Togo****; Central Africa that is made up of Burundi*, Central African Republic**, Congo**, Equatorial Guinea**, Dem. Rep. of the Congo**, Gabon**, Rwanda* and Saõ Tomé and Príncipe**; East Africa that consists of Djibouti*, Eritrea*, Ethiopia*, Kenya*, Seychelles*, Somalia*, Sudan* (FAO does not yet report separate data for Sudan and the Rep of South Sudan, Tanzania** and Uganda***; and Southern Africa that consists of Angola**, Botswana*, Comoros**, Lesotho*, Madagascar**, Malawi*, Mauritius*, Mozambique*, Rep. of South Africa*, Swaziland*, Zambia* and Zimbabwe*.

[b] For this study, Asia is made up of South Asia that consists of Afghanistan*, Bangladesh*, Bhutan*, India***, Maldives*, Nepal*, Pakistan* and Sri Lanka**; West Asia that includes Bahrain*, Cyprus*, Iran*, Jordan*, Kuwait*, Lebanon*, Occupied Palestinian Terr.*, Oman*, Qatar*, Saudi Arabia*, Syria*, Turkey*, United Arab Emirates* and Yemen*; Central Asia that is made up of Armenia*, Azerbaijan*, Georgia*, Kazakhstan*, Kyrgyzstan*, Tajikistan*, Turkmenistan* and Uzbekistan*; East Asia that consists of People's Rep. of China*, Dem. People's Rep. of Korea*, Rep. of Korea* and Mongolia*; Southeast Asia that includes Brunei Darussalam*, Cambodia*, Indonesia******, Lao's People Dem. Rep.*, Malaysia**, Myanmar*, Philippines**, Singapore*, Thailand**, Timor-Leste** and Viet Nam*; and, Oceania that includes Fiji**, Kiribati*, Nauru*, Papua New Guinea***, Samoa**, Solomon Islands**, Tonga*, Tuvualu* and Vanuatu**.

[c] See Table 1 for details about the classification of countries in Latin America.

* according to FAO, these territories reported producing no cocoa during 2011-13

**according to FAOSTAT (2015), these countries reported producing less than 10, 000 mt of cocoa during 2011-13

***according to FAOSTAT (2015), these countries reported producing more than 10, 000 mt and less than 50, 000 mt of cocoa during 2011-13

****according to FAOSTAT (2015), these countries reported producing more than 50, 000 mt and less than 250, 000 mt of cocoa during 2011-13

****according to FAOSTAT (2015), these countries reported producing more than 250, 000 mt of cocoa during 2011-13

Source: FAOSTAT (accessed November 2015) and calculations for this study

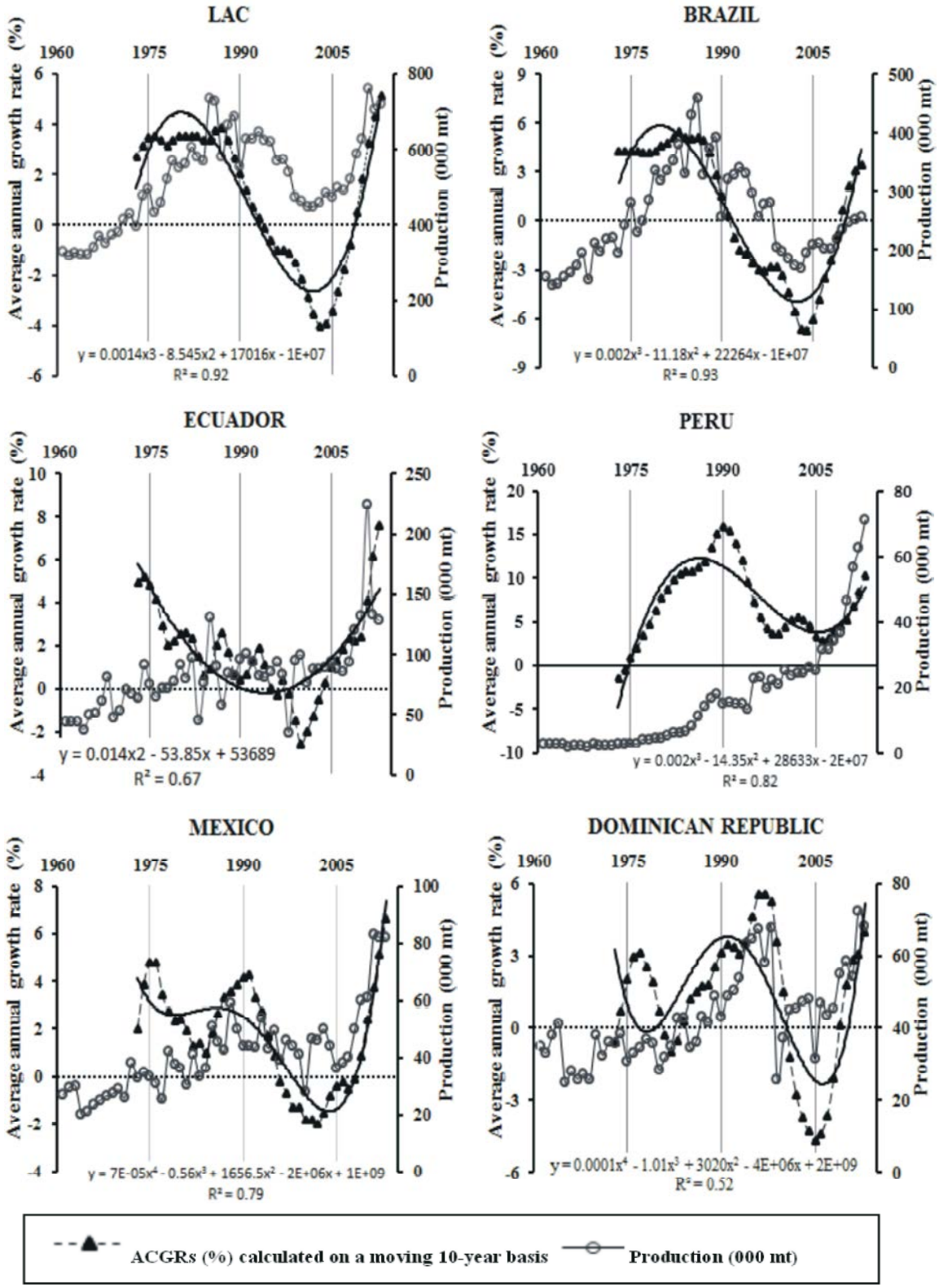

Fig. 1: Evolution and growth rates for cocoa production in LAC, 1961-2013
Source: FAOSTAT and calculations for this study

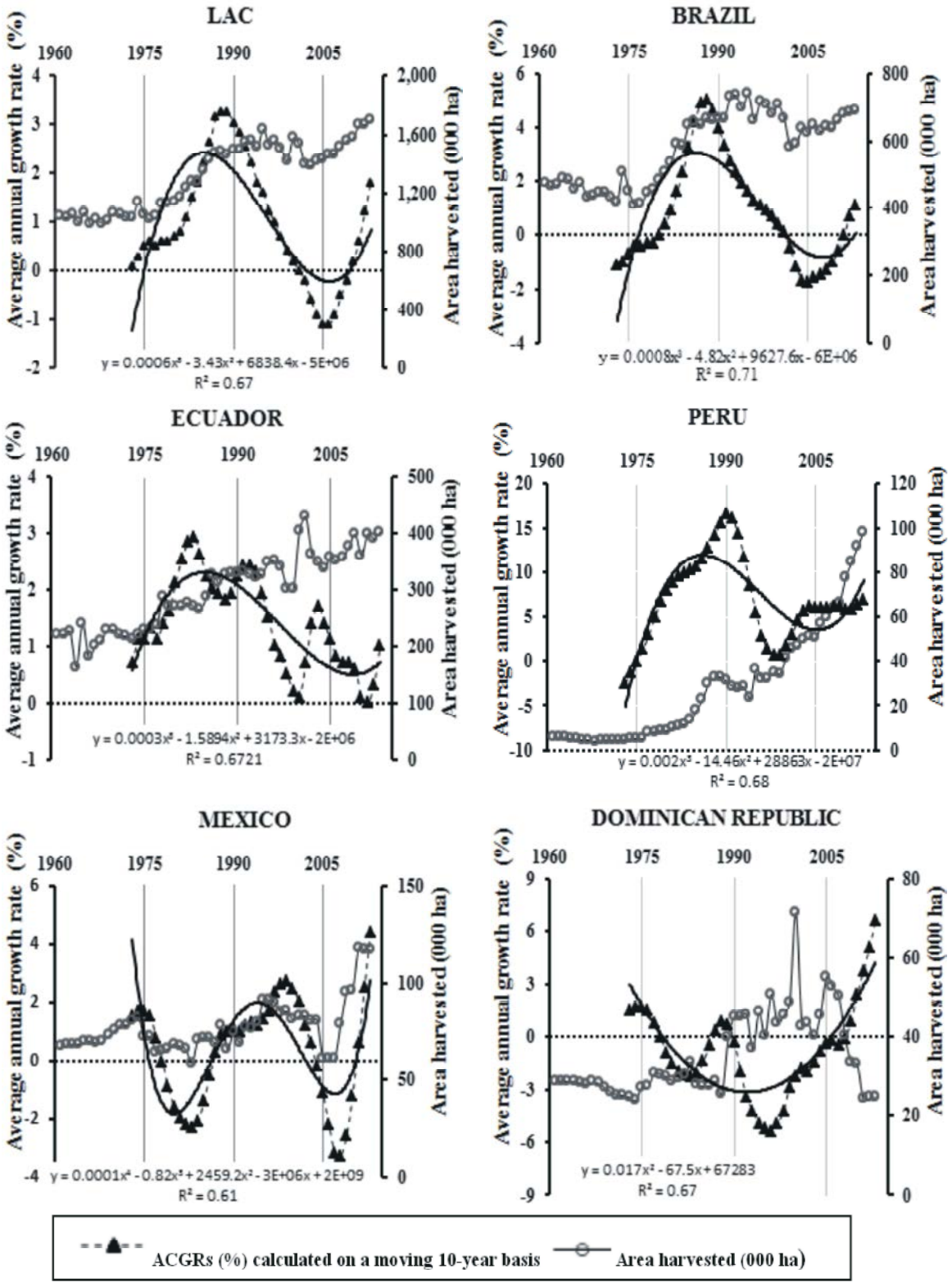

Fig. 2: Evolution and growth rates for cocoa area in LAC, 1961-2013
Source: FAOSTAT and calculations for this study

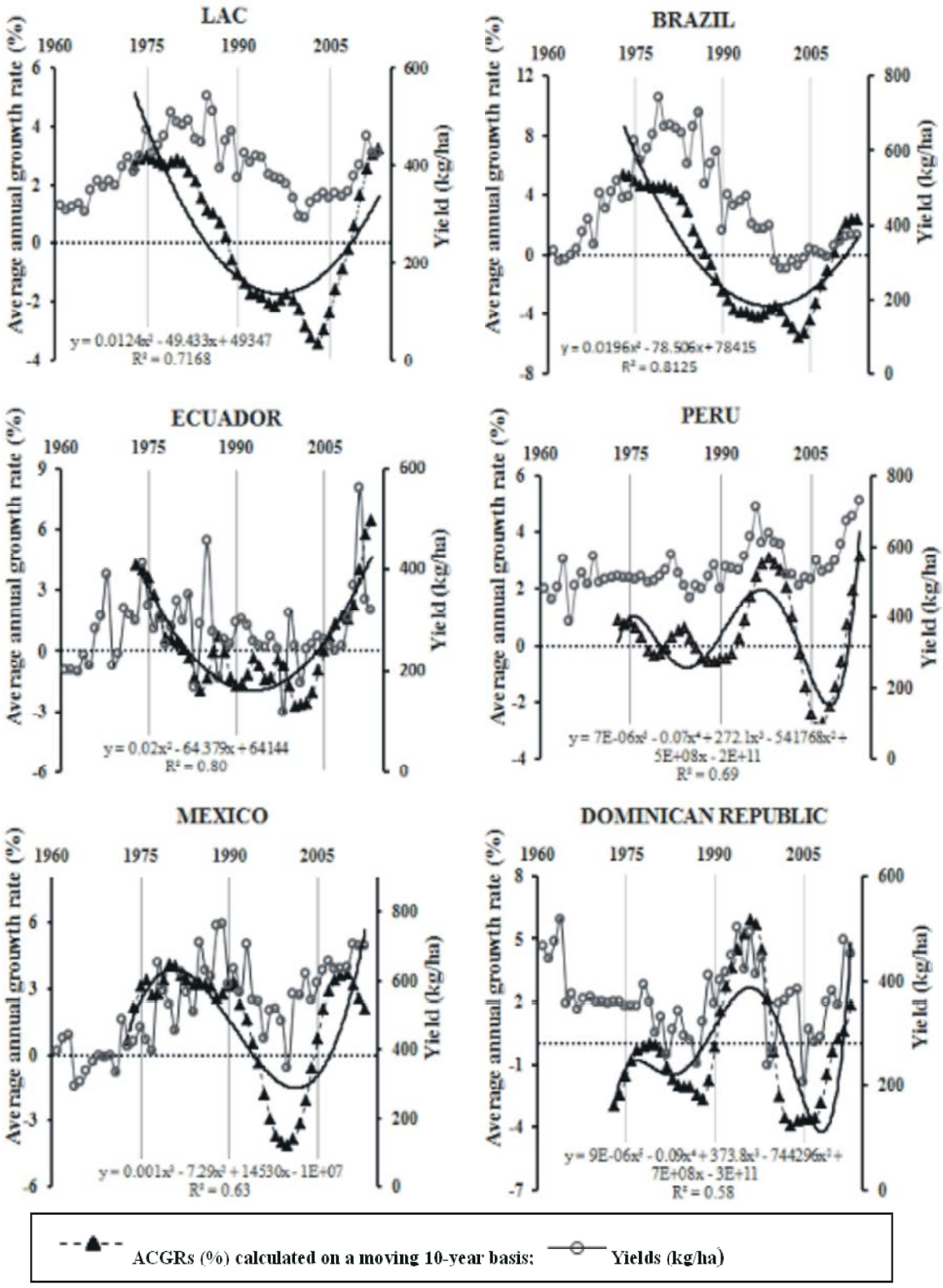

Fig. 3: Evolution and growth rates for cocoa yields in LAC, 1961-2013
Source: FAOSTAT and calculations for this study

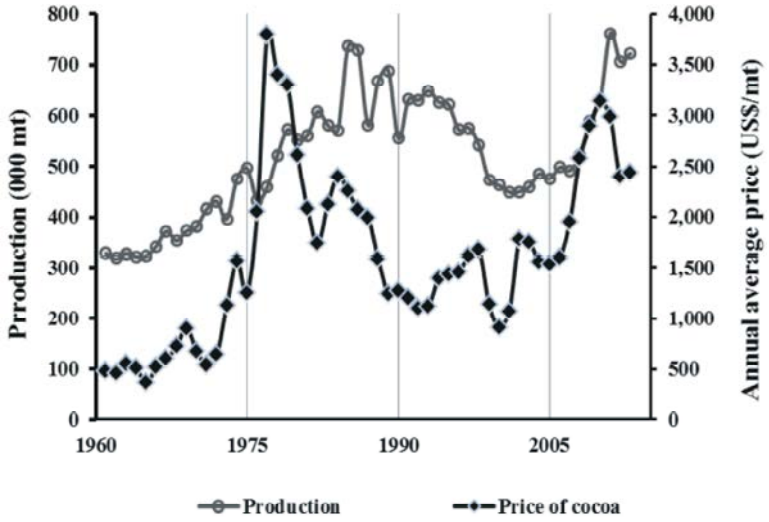

Fig. 4: Annual cocoa production in LAC and international prices (US$/mt), 1961-2013
Source: FAOSTAT and Global Economic Monitor (GEM) Commodities, World Bank

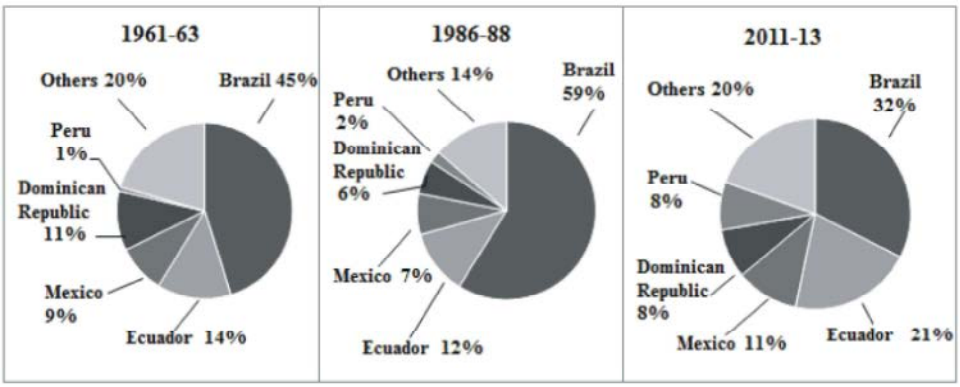

Fig. 5: Shares of average regional cocoa production for selected years, 1961-2013
Source: FAOSTAT and calculations for this study

Cocoa Versus Other Major Crops: While cocoa yields have improved in LAC over the last decade or so (Fig. 3), productivity increases for palm oil, coffee and rubber world-wide have been much faster world-wide since 1970 [13]. This comparison is all the more noteworthy on a regional basis where cocoa yields and their respective growth rates have lagged behind those for other industrial crops (Table 3).

Yields comparisons are even more dramatic when comparing cocoa with the major food crops (Table 3). And more dramatic still if one compares the *area* in cocoa versus the major food crops. Alternatively, these trends suggest that there may well be greater upside for cocoa technically speaking. Moreover, the run-up in average yields in Peru in recent years, for example, suggests that such improvements --and more-- are certainly technically feasible with available technology (Fig. 3).

COUNTRY-LEVEL ANALYSIS

A third tendency within the evolution of cocoa production and area harvested in LAC has been the highly differentiated degree and nature of volatility across countries within the region. For example, during the last half century, cocoa production in Peru increased fairly steadily upward from 2, 600 mt/yr in 1961 to 71, 000 mt/yr in 2013 as ACGRs for production remained positive throughout the entire period (Fig. 1). By way of contrast, Ecuador saw annual cocoa output rise from 44, 000 mt in 1961 to 97, 000 mt in 1982, then implode to 45, 000 mt in 1983, to jump to 131, 000 mt in 1985 only to fall to 58, 000 mt in 1987. In short, these patterns appear to reflect the diverse growing conditions, levels of output and area harvested, incidence of pests and diseases among other factors found in the region. They also underline the need

Table 3: Average annual growth rates for selected crops in Latin America[a], 1961-2013

	2011-2013			Growth rate[b]								
				Production			Area			Yield		
Crop	Production (000 mt)	Area (000 ha)	Yield (mt ha^{-1})	1	2	3	1	2	3	1	2	3
Industrial crops												
Sugarcane	964, 357	13, 123	73.5	3.4	2.9	3.1	2.5	2.1	2.3	1.1	0.7	0.9
Oil palm	14, 886	945	15.7	3.6	2.9	3.2	4.6	6.4	5.5	0.2	0.8	0.5
Coffee	4, 961	5, 403	0.9	0.5	1.2	0.9	-0.5	-0.6	-0.6	1.1	1.9	1.4
Rubber	347	245	1.4	2.9	7.1	5.0	17.6	4.6	10.9	-12.5	2.4	-0.3
Cocoa	730	1, 676	0.4	2.9	0.4	1.6	1.4	0.5	1.0	1.5	-0.1	0.7
Food crops												
Maize	134, 045	31, 371	4.3	3.1	3.7	3.4	1.1	0.6	0.8	1.9	3.2	2.5
Cassava	31, 415	2, 515	12.5	1.0	0.1	0.6	1.2	-0.1	0.5	-0.2	0.3	0.0
Rice	27, 518	5, 635	4.9	3.3	1.6	2.4	2.4	-1.4	0.3	1.2	3.0	2.1
Wheat	24, 129	8, 068	3.0	2.9	0.4	1.6	1.2	-1.1	0.0	1.6	1.6	1.6

[a] See Table 1 for details about the countries in Latin America

[b] See footnote [a] Table 1 for the formula utilized for these growth rates.

Source: FAOSTAT (accessed November 2015) and calculations for this study

for an analysis of growth rates in production, area and yield at the national level.

Brazil: While Brazil's cocoa has been commercially harvested since at least 1820s, subsequent decades witnessed a series of recurrent booms, then busts due to an array of countervailing factors [36]. These would include rapidly expanding international demand and emerging national production capabilities from the late 1800s up until the late 1910s. From then on up until the 1950s, national output continued to expand, albeit at variable rates, as it witnessed a series disease outbreaks –most notably black pod, years of excessive rainfall, the fall in prices due to the Great Depression in the early 1930s and then again at the end of World War II and the evolution of cocoa cultivation to other parts of the world, most notably Ecuador and Ghana, formerly the Gold Coast [29]. In the wake of these developments, some observers have postulated that the observed output patterns for Brazilian c ocoa reflect a series of different long-term (1900-1987) and/or short-term cycles (1900-1947) driven by a combination of demand and supply considerations ranging from international price movements to changes in government programs and policies to plant physiology in shifting cocoa cultivation itself [29]. Some of these cycles and their underlying causes have overlapped into the present.

After the drought of the century in the early 1960s and a fall in international prices led to a return to output levels for cocoa in Brazil of 30 years previously [29], the subsequent cocoa boom of the mid-1960s to mid-1970s characterized by growth rates of over 4%/yr during a quarter century (Table 1) carried over into the mid-1980s as national output peaked at 459, 000 mt (Fig. 1) [39]. Driving forces behind the surge in production from 1963 to 1975 were a combination of a spectacular upturn in cocoa prices [40] and favourable rainfall patterns followed from 1975 forward to 1986 by an expansion of area planted facilitated by government planning and technical support [29]. The results manifest themselves in the rapid growth rate in yields reaching over 4%/yr (Table 1, Fig. 3). They rose from 315 kg/yr in 1964 to peak at 742 kg/yr in 1979—a surge all the more noteworthy as area harvested went from 407, 000 ha in 1976 to over 656, 000 ha in 1986 [39], i.e., average yields more than doubled even as area expanded by 60% over the same period.

In 1987, national cocoa output came crashing down with a devastating outbreak of witches´ broom disease [41, 42]. As the impact of the disease spread, average yields steadily shrank from 664 kg ha^{-1} in 1986 to 270 kg ha^{-1} in 2003 (FAOSTAT, 2015). Consequently, production imploded to 170, 000 mt/yr over the same 16-year period with growth rates all turning sharply negative reaching -6%/yr during that time (Fig. 1 and 3).

Particularly hard hit was the state of Bahia [29] where cocoa cultivation was first introduced in 1746 [38]. Its Atlantic rainforest region traditionally harvests the hardier, albeit less flavourful, cocoa variety of Amazonian origin or related hybrids and accounts for some 80% or more of national area harvested and 60% or more of production [43]. Only a relatively minor share of output is harvested in the Amazon states of Pará (14%) in the northeast and Rondônia (4%) in the far western Amazon, as well as Espiríto Santo (4%) to the south of

Bahia [44], although the percentages harvested in each state have varied in recent years according to different sources [45].

The witches´ broom calamity not only led to a drastic fall in production but also the bankruptcy of many of the 1, 000 ha cocoa plantations that had been common in the cocoa sector for decades in Bahia [42]. Instead, many landless acquired access to their own parcels such that they and other, established small farmers came to occupy an important space in the newly emerging profile of agricultural systems for the commodity in the cocoa-growing zones of southern Bahia [41]. According to some observers, these new, less experienced entrants complicated efforts to spur a rebound in output as trees were cut to make money from timber and pastureland undermining soil fertility [42]. Hence, even though Brazil´s cocoa production exceeded FAO [46] projections of 210, 000 mt in 2010 by 12% to 235, 000 mt, the 256, 000 mt harvested in 2013 still remained 45% below the 459, 000 mt of cocoa harvested in 1986, or twenty-seven years previously [39].

In light of the slow recovery of cocoa production, recent Ministry of Agriculture projections forecast a 15.7% decline in output to 2023/2024 [47] thereby reinforcing repeated concerns about the need for more imports [10] to meet the booming demand for chocolate [15, 28]. Partly for that reason at least two large multinational have financed programs to: 1) reinvigorate cocoa cultivation amongst 4, 000 smallholder farmers in southern Bahia [48] through better cultural practices such as pruning and the use of fertilizer; 2) plant over 20 million disease-resistant cocoa seedlings in Pará [15, 49]; and, 3) stimulate greater cultivation of cocoa in Espiríto Santo. At the same time, the Ministry of Agriculture has undertaken initiatives to reinvigorate the cocoa sector and to support small cocoa producers more generally. In that same spirit, both the federal Chamber of Deputies and state of Bahia legislators have proposed offering incentives to growers to grow cocoa in the shade of at least 40 native Atlantic forest trees per hectare, or the so-called *cabruca* sustainable cocoa cultivation system employed by growers for over two hundred years, intended to help conserve the biodiversity of the rainforest and enhance the quantity of cocoa harvested annually [22, 23, 43, 50]. In Bahia, over 150, 000 ha of susceptible varieties have been renewed with disease-resistant clones developed by the Cocoa Research Centre [45]. While these various initiatives have contributed to a 30% increase in average yields nationwide from in 2001 to 372 kg ha^{-1} in 2013, productivity nonetheless remains half the 742 kg ha^{-1} obtained in 1979 suggesting ample room for continued improvement.

Ecuador: A long, proud tradition of cocoa cultivation in Ecuador dates to Spanish Capuchin friars reportedly planting local varieties as long ago as 1635 [37]. Cocoa was exported from Guayaquil as far back as the early 1700s [36]. By the early 1800s, proceeds from the sale of cocoa reportedly helped finance the Independence movement [25]. By the late 1800s, early 1900s, Ecuador once again surpassed Brazil as the world´s largest cocoa exporter as the coastal countryside became essentially a cocoa monoculture [36]. The economic crisis of the 1930s and the land reforms of the 1960s forced the large cocoa haciendas to be divided into parcels that were sold to small landholders [51].

Since the early 1960s, annual cocoa output in Ecuador has been highly erratic, ranging from a low of 35, 000 mt in 1998 to a high of 224, 000 mt in 2011 [39]. As such, the evolution of Ecuador´s annual cocoa output over the last half century is perhaps best characterized as a series of recurrent spikes followed by sharp declines occurring with varying frequency (Fig. 1).

Most notably, production was particularly hard hit by the heavy rainfall that accompanied the El Niño of 1982-83 when output fell from 97, 000 to 45, 000 mt, then again in 1997-98 when a similar phenomenon led to a similar drastic decline from 83, 000 to 35, 000 mt. As a result, cocoa exports fell from 71, 100 mt in 1996 to 12, 135 mt in 1998, but then rebounded to 63, 600 mt in 1999 [52]. Given these and similar developments over the last five decades, growth rates for cocoa production in Ecuador have followed an equally erratic path (Fig. 1). With the aforementioned observations about volatility duly noted, Ecuador´s cocoa sector has been remarkably resilient. The country notched the second highest growth rate in production of any of the major cocoa-producing countries in the region over the last half century (Table 1).

A reported 12% of the economically active population in Ecuador is involved in cocoa production, with 90% of the cocoa produced on land holdings less than 50 ha --with more than 30% of these are farms smaller than 10 ha [51]. Over 80% of Ecuador´s cocoa area harvested is currently located in the southern, semi-arid coastal provinces of Manabí, Los Ríos and Guayas [32]. As much of Ecuador´s cocoa growing area sits exposed to the variable weather patterns of the eastern Pacific, the upcoming 2015-16 cocoa harvest [21] is once again threatened by El Niño-driven developments with ICCO

(International Cocoa Organization) estimating a 6.6% decline in output [13]. Cocoa cultivation in the Amazon provinces accounts for around another seven percent of total area [32]. Such ecological considerations would help to at least partly explain the series of shortfalls reported on in Ecuadorian statistics between annual area harvested and area planted. For the period 2008-2014, these averaged 100, 000 mt/yr less, or 20% of the annual national total [32]. Despite these sustained differences on an annual basis in recent years and although growth in area harvested slowed considerably in the last quarter century, Ecuador still accounts for nearly 25% of the total regional area harvested in cocoa in LAC (Table 1, Fig. 5).

The other major factor that contributed to the yearly shortfalls in area harvested versus area planted—all the more noteworthy given the highly favorable prices on the international market—would be the recurrent pest outbreaks affecting the more vulnerable, prized local cocoa varieties of Cocoa Nacional [53] such as *Arriba Superior Época* (ASE) that accounts for 37% of production followed by the hybrid Criollo clone *Colección Castro Naranjal* (CCN)-51 with 36% [54].[2] Other *Arribas* cultivated include *Arriba Superior Selecto* (ASS) (20 percent) and *Arriba Superior Summer Selecto* (ASSS) (seven percent) [32]. Such devastating outbreaks punctuated the history of Ecuadorian cocoa repeatedly from the late 1800s up to the late 1940s [16, 30] and have continued on up to the present as the agricultural economy shifted its primary focus away from cocoa first to coffee and then bananas. The incidence of pest infestation has been compounded by less-than-optimal crop management, an aging stock of cocoa trees, a shortage of disease-resistant planting material and the attractiveness of switching to other, more remunerative crops as some small farmers seek to maximize benefits from an array of farm commodities rather than focus exclusively on cocoa [51]. These considerations have been offset by new, larger plantations opened up by local agribusiness firms combined with the spread of CCN-51 and other disease-resistant material that together largely account for the growth rate in yields over five times the regional average during the last 25 years (Table 1, Fig. 2).

A related inconsistency, more difficult to reconcile, concerns the differences between national figures for annual production in recent years and those reported by FAO. The former reports national cocoa output reached 224, 000 mt in 2013 while FAO lists 129, 000 mt [32, 39]. Time will tell if revised data made available by either or both sources closes the gap between the two sets of statistics. In the interim, thanks to higher prices and government incentives, Ecuadorian authorities anticipate becoming the world's fourth largest cocoa-bean producer by 2016 [21, 32].

In the midst of these various developments, Ecuador has successfully positioned itself as the world´s largest producer/exporter of fine and aromatic cocoa beans accounting for some 65% of the global market of 200, 000 mt/yr [9, 56]. This category of product has attracted considerable interest and debate [16] as global demand for cocoa shows increasing signs of diversifying with niche markets opening up for those beans with particular quality characteristics, in particular fine flavor that includes an array of traits such as exceptional aroma, that cater to the tastes and preferences of discriminating, high-income consumers willing to pay premium prices [8, 13, 28]. Moreover development projects in Ecuador have shown that small cocoa producers can reap noteworthy benefits from improvements in various dimensions associated with their participation in the value chain for that type of cocoa [57]. These range from better crop management (e.g., pruning), to improved fermentation, drying and sorting of beans by variety and direct sale to buyers abroad.

With that highly lucrative segment in mind, the Ministry of Agriculture, Livestock, Aquaculture and Fisheries (MAGAP) launched the National Cocoa Program intended to revitalize smallholder cocoa production by pruning 20 million cocoa trees and new plantation establishment [32]. These efforts have been reinforced by an series of campaigns by different multinationals, e.g., Nestlé´s cocoa campaign that led to the distribution of over 45, 000 *Arriba* fine cocoa highly productive plants amongst 1, 000 farm families between 2009-2012 [58] in keeping with the firm´s global commitment to more sustainable cocoa cultivation through among other things pruning, expanding and improving fertilizer use; improving postharvest practices such as fermentation and drying; and helping eradicate child labor [59, 60]. Despite these and other efforts, recent studies, industry representatives and research specialists interviewed for this study observe that maintaining cocoa quality in Ecuador has been undermined by the recurrent tendency of growers to mix varieties in the lots for sale [53] contributing to inconsistent control in fermenting and drying of beans [56].

Peru: Although cocoa has been growing in Peru for millennia [61] and was reportedly first given a social use

[2]By mixing hybrids in the Ecuadorian city of Naranjal, with the best disease resistant and highest yielding cocoa cultivars at his disposition, Homero Castro Zurita developed his 51st cocoa hybrid named 'Colección Castro Naranjal 51' in 1965 [55].

before anywhere else on the planet some 5, 000 years ago in the northern Amazon in an area straddling the border with Ecuador [62], the crop only assumed commercial importance in the 1930s with the advent of colonization of the Amazon region [30]. Cocoa remained a minor commodity for decades. During the 1980s and 1990s annual output did rise from 4, 000 to over 22, 000 mt/yr as commercial interest in cocoa grew, spurred on by alternative development projects initiated to eradicate coca cultivation tied to trade in illegal drugs [63].

Since 1999 annual cocoa output more than tripled to 71, 000 mt, albeit still less 2% of annual global production [39], with Peru becoming the ninth largest producer worldwide [31]. Area harvested expanded from 41, 000 ha to over 96, 000 ha between 2000 and 2013 [64] with an estimated 60% located in the "high" jungle above 600m [61].[3] Farm households engaged in cocoa cultivation stood at 30, 000 around 2006 [30], rising to an estimated 45, 000 in 2013 [66] and to as high as 90, 000 currently [27]. The outcome of these various developments were double-digit growth rates in production and area harvested in cocoa- the highest in all of LAC and over four times the regional averages (Table 1, Fig. 1-3).

The bulk of the increase in area a reported 26, 500 ha between 1999 and 2007 alone, consists of 16, 700 ha planted in the San Martin Region [30, 67]. Area under cocoa cultivation expanded an additional 27, 300 ha between 2008 and 2012 with 16, 900 ha in San Martin, 6, 400 ha in Ucayali and 4, 000 ha in Huanuco Regions respectively [63]. Nearly all of the earlier expansion consisted of CCN-51 introduced in Peru through alternative development programs and characterized by some chocolate connoisseurs as tasting "acidic and dirty" [14]. However, according to industry representatives contacted for this study, CCN-51 produced in Peru has a distinctively different flavor profile from that harvested in Ecuador. Possible reasons for this distinction between Peruvian and Ecuadorian CCN-51 would include the former is produced on small farms in agroforestry systems exposed to the fruits and other flora found in the mega-diverse Amazonian jungle as opposed to the monoculture cultivation that according to census data dominates the semi-arid, Ecuadorian coast [67]. In addition, a number of public sector agencies and other multi-lateral and bi-lateral development programs devoted considerable time and effort training growers in improved agronomic (and to a much lesser extent postharvest) procedures, the organization and management of produce associations and carried out a steady series of cocoa promotion initiatives in foreign markets as well as domestically [68].

With the rapid expansion of cocoa plantings in San Martin, over the last 15 years the concentration of national cocoa cultivation shifted from areas in Peru's southwestern Amazon region clustered along the lower slopes and at the base of the Andes to equivalent locations in the northern part of the country. San Martin alone now accounts for nearly 45% of national cocoa output with Cusco, Ayacucho and Junín regions producing another combined 38%. As a result, commercial area harvested in Peru tends to be both more geographically dispersed (i.e., less concentrated in a single state or region) and ecologically diverse (i.e., with cultivation on the coast as well as the high and low jungle) than in any other country in LAC.

In the wake of these various initiatives, the sharp up-turn in cocoa prices and the growing global recognition of Peru as a source of quality fruits, vegetables and other industrial commodities, e.g. coffee [5, 69], at least three large (>1000 ha) corporate cocoa initiatives began expanding area cultivated in cocoa in the low (< 500 m) jungle in the San Martin, Ucayali and Loreto Regions [70, 71, 72]. Two of these firms have come under sharp criticism for their cutting of primary rainforest for plantation-style cultivation of CCN-51 [73, 74]. A third has opted for growing a mix of fine flavor varieties in agroforestry fashion as well as buying and processing cocoa produced by other, typically small growers [27].

Among the various recent initiatives adopted by non-producers aimed at establishing and maintaining grower-supplier loyalty in the fierce competition to procure raw material, some processor/traders offer their affiliated farmers an elaborate set of services (e.g. zero interest loans, tool loans free of cost), philanthropic activities (rebuilding local schools), education and health programs beyond an equally extensive array of cocoa production technical assistance and training initiatives as an integral part of their respective business models [75]. Others employ their own agronomists to provide technical support to their affiliate growers as well as promote social programs aimed to eliminate child labor, ensure field workers are paid a fair wage and abide by certification requirements in producing, processing and handling of cocoa beans [76].

In addition to the private trading companies, producer cooperatives have facilitated the expansion in

[3]The figures reported here are from FAOSTAT presumably based on annual MINAGRI data; according to Huamanchumo [65], the 4th National Agricultural Census data indicate national area harvested in cocoa was over 144, 000 ha in 2012. Reconciling these two markedly different estimates and their implications for reported average yields is a topic for future research related to Peru´s cocoa sector.

area harvested, productivity and quality enhancement by facilitating diffusion of disease resistant planting material; supporting reforestation schemes involving organic production of harvestable timber to reduce erosion, provide shade cover for cocoa and serve as the basis for the eventual sale of carbon bonds to complement the income from cocoa sales; and helping grower- members capture the benefits of from higher prices and those made possible through certification schemes [65, 77]. Over the last ten years Peru has reportedly become the world´s second largest exporter of organic cocoa and was among the world´s largest exporters of Fair Trade cocoa [78, 79]. Of the 62 producer cooperatives world-wide that currently form part of the Fair Trade USA cocoa network, 16 are in Peru [79], up from just three in 2005 [80]. Moreover, according to UTZ representatives contacted for this study, Peru's UTZ certified cocoa bean exports rose from 513 mt in 2010 to 11, 836 mt in 2013 and then 16, 233 mt in 2014. The combination of new area under cultivation, high-yielding varieties and improved cultural practices together have propelled growth rates in productivity well above the regional average over the last fifty years with yields now 50% higher than the average for LAC as a whole (Table 1, Fig. 3).

Mexico: Long before the arrival of the Spanish conquistadores, cocoa had versatile uses for the Aztecs and even more so for the Mayas. These varied from the key ingredient in a drink for royalty, to a form (beans) of currency, to the focal point of cultural and religious ceremonies, to a unit of taxation, to medicinal applications [81, 82]. The word “chocolate” itself derives from Aztec cuisine and in turn is derived from the Nahuatl word *xocotl;* the Mayans cultivated cocoa trees and used the beans to make a frothy drink called *xocotal* that according to archeological findings dates back to groups living in the lowland areas adjacent the Gulf of Mexico in the southern part of the country as long ago as 1750 BC [81]. Reportedly the world´s first known cocoa plantations were cultivated by the Mayans in southern Mexico (Yucatan) around 600 AD, perhaps earlier [16, 52]. In Mexico today, cocoa in the form of chocolate remains a popular drink and a key ingredient in a number of popular food offerings. Despite its rich history and current use particularly in Central and Southeastern Mexico in the preparation of festive dishes served on holidays and at family reunions, cocoa has remained somewhat incongruously a relatively minor crop in terms of total production [83].

Since the early 1960s, the evolution of cocoa output in Mexico can be roughly divided into three periods. Output first meandered from 28, 000 mt in 1961 to top out at 59, 000 mt in 1988 [39] riding the boom in cocoa prices well past its peak in the late 1970s [11]. From then on, production fell back to a low of 28, 000 mt in 2000 as the global cocoa boom went bust in the 1990s [40]. From 2000 to present, output recovered, rising first to 40, 000 in 2007 and from there to 82, 000 mt by 2013 [39] as international prices surged upward calling forth greater supply. In that regard, it is noteworthy that national sources report figures considerably lower those than those indicated by FAOSTAT, e.g. FAOSTAT reports 50, 000 mt in 2008 versus 27, 548 according to SIAP [39, 84]. Similarly, Fundación Cacao México reports that output fell from 46, 700 to 24, 700 mt between 2001 and 2009 due to a combination of an outbreak of moniliasis, the aged stock of cocoa trees and poor cultural practices [85]. Yet, FAOSTAT data indicate production actually rose to 60, 000 mt during this same period [39]. With that qualification, according to FAOSTAT data, growth rates for cocoa output in Mexico have averaged 4.4% over the last half century (Table 1).

Some 70% of cocoa production in Mexico is harvested in the southeastern gulf state of Tabasco [84]. Nearly 29% grown in Chiapas followed by Oaxaca and Guerrero accounting for the other 1%, although cocoa is found on a very small scale in other locations as far north as Veracruz. In that context, the recent run-up in production has apparently been catalyzed by a rebound in the growth rate for area harvested (Table 1, Fig. 2), albeit according to FAOSTAT data, apparently in function of the surge in international prices since 2000. Notwithstanding, knowledgeable observers point out that the development of the crop has been plagued over the years by recurrent pest and disease outbreaks; the small, undercapitalized scale of production; as well as the economic returns possible from cultivating alternative commodities [29].

After yields peaked at 762 kg ha^{-1} in 1986, they subsequently collapsed to 346 kg ha^{-1} in 1993, only to rebound to 702 kg ha^{-1} by 2013 [39]. These gyrations are reflected in the growth rates for yields (Table 1, Fig. 3). They rose strongly in the first quarter century as the rapid rise, then fall in prices discouraged further planting and seemingly stimulated greater productivity to survive the downturn. The subsequent rapid expansion in area in recent years apparently came in response to the recovery, then surge in international cocoa prices [11], although recent grower survey results suggest that the prices actually received by cocoa farmers may not reflect those prevailing in international markets due to their geographic isolation, limited negotiating skills, among other factors [26]. Those latter considerations aside, the growth in cultivation appears to have spread so quickly

and extensively that it came to include less productive parcels and/or less experienced growers.

In light of these recent tendencies, the combination of a long, rich history of cocoa embedded in the Aztec and Mayan civilizations, rising global demand for cocoa and the apparent potential to produce more and better quality beans have motivated the launching of a series of public-private development initiatives in the last few years in support of the country´s 37, 000 cocoa growers [85]. Project goals include increasing productivity and raising smallholder incomes through the renovation of tree stock, the introduction of disease-resistant varieties and the certifying of eco-friendly cultural practices with the support of multinationals such as Hershey´s, Mars and Ecom, as well as the World Economic Forum [86]. Among the benchmarks listed in the Mars-supported project is the distribution of 500, 000 cocoa plants amongst 800 growers in Chiapas and Tabasco over 10 years while the project supported by Hershey´s anticipates distributing another 150, 000 cocoa plants in collaboration with the National Institute for Forestry, Agricultural and Livestock Research (INIFAP).

Dominican Republic: Cocoa was reportedly introduced into the island of Hispaniola in the late 16th, early 17th century [87], although other studies report this took place in 1665 [24]. More recently, cocoa production in the Dominican Republic has dominated trends in the Caribbean over much of the last 50 years (Table 1). Output reached 41, 000 mt in 1964 only to fall to 25, 000 mt the following year. As the sector then trended upward, it suffered similar, albeit less severe drops in 1974-75, 1979-80 and 1984-85 before reaching 43, 000 mt in 1987 [39]. The similar ends points of the first quarter century thus explain the meager (0.5%) growth rate during this period, but mask the recurrent fluctuations and belie the sector´s resiliency.

The annual growth rate in production accelerated noticeably (2.0%) in the last quarter century even though output was particularly hard hit by Hurricane George in 1999 [24, 52] falling from 68, 000 mt in 1998 to 26, 000 mt the following year [39]. The country was struck again in 2004 by Hurricane Jeanne with production imploding from 48, 000 mt in 2004 to 31, 000 mt in 2005 before rebounding sharply and then accelerating to the 50-yr high of 72, 000 mt in 2012.

Area harvested in cocoa rose from 75, 000 ha in 1961 to peak at 179, 000 in 1987 [39], jumping from 129, 000 ha in 1986, then falling back to 130, 000 ha in 1988 in the process, or the year after Hurricane Emily passed over part of the country. It is noteworthy that area harvested continued to expand into the late 1980s even as international cocoa prices plunged off their highs in the late 1970s [11]. In that regard, Berlan and Bergés point out that it was precisely in the late 1980s that leaders of the national cocoa-growers´ confederation in collaboration with German technical assistance made the strategic decision to pivot towards targeting the market for high quality, certified organic cocoa instead of continuing to produce conventional cocoa often sold at below market price due to poor fermentation and drying practices [24]. In effect, the rapid growth rate for area harvested (2%/yr) accompanied by declining yields from the early 1960s to the late 1980s (Table 1) gave way to a period of much greater attention to improving quality and productivity combined with gaining access to new markets [88].

Some 50% of the total area harvested in cocoa in the Dominican Republic is concentrated in the Northeast and Central regions [87] with the majority of cocoa producers consisting of small farms cultivating less than five ha in agroforestry fashion [24]. There are no large cocoa plantations in the Dominican Republic as exist elsewhere in LAC, e.g., Brazil and Peru, although one large private firm owns a reported 5, 000 ha of land devoted to cocoa production. Instead, the farm structure of the cocoa sector is characterized by small units managed by aging cocoa farm heads of households. In addition, rural-urban migration leading to a shortage of labor in the countryside combined with the highly seasonal nature of work requirements and income flows have together raised questions about the sustainability of the prevailing system [24].

Despite these various constraints, the Dominican Republic´s cocoa sector has come to occupy a far more visible place in the international market for this commodity that its modest area harvested might otherwise suggest due its aggressive pursuit of differentiating itself as a supplier of fine and aromatic, certified organic and Fair Trade cocoa. In that regard, ICCO classified Dominican Republic cocoa as 40% fine and aromatic in their latest designation for different countries [13]. The Dominican Republic´s organic cocoa exports have risen from 929 kg in 1999 to 5, 200 kg in 2000 [89] and then to 8, 000 mt in 2006 to 15, 000 mt in 2009 [90]. During 2011-2012, the Dominican Republic was among the world´s leading countries of Fairtrade cocoa exporting 11, 200 mt [91], shipping double the quantities of Peru and three times that of Ecuador as part of its overall commercial strategy of catering to specialized buyers willing to pay higher prices for beans with both environmental- and socially-friendly characteristics.

CONCLUSIONS

Despite being the center of origin for cocoa, cocoa cultivation and use, Latin America witnessed only modest increases in output, area harvested and yields for this commodity during the last half century. A marked decline in production and area began in the late 1980s and persisted until the early 2000s, primarily because of the prolonged downturn in international prices combined with the implosion of production in Brazil due the spread of witches´ broom disease. As prices have risen sharply since then, production and area have rebounded, however unevenly in many parts of the region.

Masked by these long-term regional trends are a number of developments that speak more to the resiliency, if not dynamism of cocoa cultivation in different countries across the region. Peru in particular, but also Ecuador, Mexico and the Dominican Republic saw sharp increases in the growth rates for production in recent years as growers tried to take full advantage of the run-up in international prices, the diffusion of improved varieties and the various public-private alliances that sprang-up to improve productivity, quality and incomes for the vast majority of small farm households that dot the cocoa sector in LAC.

Beyond the trends themselves and how they evolved, an analysis of cocoa production and area in LAC points to the high degree of geographic concentration. Not only do just five countries alone account for over 80% of output and over 86% of area planted, the trend has been for that concentration to increase over time. More noteworthy still is the pattern of concentration *within* those same five countries. Just 11 growing areas: southern Bahia in Brazil; the coastal provinces of Manabí, Los Ríos y Guayas in Ecuador; San Martin, Cusco, Junín and Ayacucho regions in Peru; the state of Tabasco in Mexico; and, the Northeast and Central zones in the Dominican Republic together account for over 75% of regional output. Only Peru has witnessed any considerable shift in the central locus of production. Peru also stands out as the country with the greatest ecological diversity with cocoa grown in the high and low Amazon region as well as on the semi-arid coast. Having said that, some 90% of cocoa production in Peru takes place east of the Andes-unlike all the other major cocoa-producing countries whose major growing areas are situated on or near the coast, in effect adding an additional transport expense to the costs of exporting any beans.

While countries such as Brazil, Ecuador and the Dominican Republic have engaged in commercial cocoa production for nearly two centuries, others such as Peru have a much more recent history in this type of endeavor. In that regard, some observers consider the long tradition in some established cocoa-producing countries as harder to build on in terms of innovation (e.g., the adoption of better cultural practices such as pruning) than working in a sector or growing region where for the farmers involved, cultivating the crop in itself is an innovation. Hence, they may be more inclined to embrace changes needed to improve productivity, quality and incomes. Recent experience in LAC suggests that such success is possible in either set of circumstances, but that that requires both a holistic approach to both activities on and off the farm as well as a longer-term commitment than the more typical 3-5 year, project-based effort.

Given the prevailing trends in LAC and in West Africa, various private firms, both national and multinational, are actively engaged in multiple initiatives in different parts of LAC to improve productivity, quality and gain sustained access to necessary supplies to meet their raw material requirements. This trend suggests that those enterprises that are not proactive run the risk of losing whatever competitive position they may have had up to that point. Having said that, the aggressive pursuit of differentiation raises questions about the possible repercussions in one or more of these niches should the array of regional efforts carried out in relative isolation all prove to be successful in increasing supply.

Some key topics for future research would include quantifying the potential impacts of climate change, their distribution across different ecologies and some estimate of the benefits and costs of these weather-related developments. A related topic would concern how the value chains that link producers to final users in these different zones might attempt to mitigate any negative impacts of climate change while at the same time take fuller advantage of the changes in supply and demand that are already underway. The incidence of contamination of cocoa and cocoa-based products from various sources, e.g. pests, pesticides [8] and in particular from heavy metals such as Cadmium in the soil and water that may be utilized for cocoa production has also attracted increasing concern [31, 92]. Food regulations scheduled to go into effect in major European cocoa-importing countries in 2019 would ban the sale of chocolate products that exceed the specified limits; hence, the call for more research on the source, presence and mitigation of these contaminants not only in LAC but in other cocoa-producing regions as well [13].

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REFERENCES

1. CREM, 2013a. Cartografiado de tendencias del CBI de café, cacao y te. CBI (Centre for Business Intelligence)-Ministry of Foreign Affairs, The Hague.
2. CREM., 2013b. Ficha informativa del producto de CBI: Cacao en Suiza. CBI (Centre for Business Intelligence)-Ministry of Foreign Affairs, The Hague.
3. Wilkinson, J. and R. Rocha, 2009. Agro-industry trends, patterns and development impacts. In: Agro-industries for development, Eds., da Silva, C., D. Baker, A. Shepherd, C. Jenane and S. Miranda-da-Cruz. Wallingford: CAB International and FAO (Food and Agricultural Organization of the United Nations), pp: 46-91.
4. Reardon, T. and C.P. Timmer, 2012. The Economics of the Food System Revolution. Annu Rev Resour Econ, 4: 1-41.
5. Scott, G., 2014. Agregando Valores a las Cadenas de Valor. Rae., 54(1): 67-79.
6. Webber, C.M. and P. Labaste, 2010. Building Competitiveness in Africa´s Agriculture. Washington, D.C.: International Bank for Reconstruction Development.
7. WCF (World Cocoa Foundation), 2014. Cocoa market up-date, April 2014. WCF, Washington, D.C.
8. Afoakwa, E.O., 2014. Cocoa Production and Processing Technology. Boca Raton: CRC Press, pp: 329.
9. CBI (Centre for Business Intelligence), 2013. CBI Product fact sheet: fine flavour cocoa in Europe. CBI-Ministry of Foreign Affairs, The Hague.
10. Nieburg, C., 2013. Third time unlucky: Cocoa deficits to hit prices in 2014? Confectionary news.com December 16. Available at: http://www.confectionerynews.com/Commodities/ Third-time-unlucky-Cocoa-deficit- to-hit-prices-in-2014 Accessed 13 November 2014
11. Pay, E., 2009. The market for organic and Fair-Trade cocoa. Study part of the FAO project GCP/RAF/404/GER. Trade and Markets Division, FAO (Food and Agricultural Organization of the United Nations), Rome.
12. WCF (World Cocoa Foundation), 2012. Cocoa market up-date, March 2012.WCF, Washington, D. C.
13. Pipitone, L., 2015. Nuevas tendencias en el mercado internacional de cacao: Oportunidades para el Perú como productor de cacao fino y de aroma. Powerpoint presentation, ICCO (International Cocoa Organization), 22 October, Lima.
14. Schatzker, M., 2014, November 14. Chocolate: Can science save the world´s most endangered treat? Bloomberg.com.
15. Cargill, 2014. A thriving cocoa sector for generations to come. The 2014 Global Cocoa Promise report. Cargill Cocoa and Chocolate. Schiphol. Available at: http://www.cargillcocoachocolate.com/wcm/groups /public/@ccc/@all/documents/document/na31657361.pdf Accessed 16 November 2015
16. Dand, R., 2011. The International Cocoa Trade. 3rd edition. Oxford: Woodhouse, pp: 648.
17. Läderach, P., A. Martinez, G. Schroth and N. Castro, 2013. Predicting the Future Climatic Suitability for Cocoa Farming of the World's Leading Producer Countries, Ghana and Côte d'Ivoire. CLIMATIC CHANGE, 119(3-4): 841-854.
18. Canales Martinez, M., 2014a. Documento de alineamiento estrategico de la cadena de cacao y chocolate 2014-2018. MINAGRI (Ministerio de Agricultura y Riego), Lima.
19. Donovan, J., 2006. Diversification in international cacao markets: Opportunities and challenges for smallholder cocoa enterprises in Central America. A consultancy report prepared for RUTA, CATIE, Turrialba.
20. Gama-Rodrigues, E.F., P.K. Ramachandran Nair, V.D. Nair, A.C. Gama-Rodrigues, V.C. Baligar and R.C.R Machado, 2010. Carbon storage in soil size fractions under two cacao agroforestry systems in Bahia, Brazil. Environ Manage, 45: 275-283.
21. Güilcapi, M.L., 2015. National system of quality improvement and cocoa traceability. Sabor Arriba, September: 10.
22. Sambuichi, R.H.R., D.B. Vidal, F.B. Paisentin, J.G. Jardim, T.G. Viana, A.A. Menes, D.L.N. Mello, D. Ahnert and V.C. Baligar, 2012. *Cabruca* Agroforests in Southern Bahia, Brazil: Tree Component, Management Practices and Tree Species Conservation. Biodivers Conserv, 21(4): 1055-1077.
23. Schroth, G., A. Jeusset, A. Da Silva Gomes, C. Tavares Florence, N.A. Pinto Coelho, D. Faria and P. Laderach, 2014. Climate Friendliness of Cocoa Agroforests is Compatible with Productivity Increases. Mitigation and Adaption Strategies for Global Change, 1: 1-14.

24. Berlan, A. and A. Bergés, 2013. Cocoa production in the Dominican Republic. Report of findings commissioned by Green and Black´s. Manchester University, Mondelçz International, Cocoa Life, Manchester.
25. Blare, T. and P. Useche, 2014. What does it mean to be socially responsible? Case study on the impact of the producer-plus-program on communities, women and the environment in Ecuador. MEAS (Modernizing Extension and Advisory Service) case study # 11. Available at: www.measextension.org/meas-offers/case-studies Accessed 13 November 2015.
26. Fluck, C., 2014. Closing the gap between current and potential conditions in the cocoa production industry comparing Colombia and Mexico, M.S. thesis, Faculty of Management and Governance, University of Twente, Enschede.
27. Yturrios, J., 2015. Alianza Cocoa Perú. Experiencia de ampliación de áreas de cocoa fino y de aroma (Huánuco, Ucayali, San Martín). Powerpoint presentation. Seminar: Avances y perspectivas del cocoa peruano para el mundo: Pequeño agricultura ante grandes retos. 01 October, 2015. Lima.
28. EuroMonitor, 2014. Global trends and developments in cocoa ingredients (World), EuroMonitor, London.
29. Cazorla, I.M., L.P. Dos Santos Filho, A. Gasparetto and Ceplac, 2010. Cocoa harvest shortfalls in Bahia Brazil: short- and long-term factors. In Cocoa cycles: the economics of cocoa supply, Eds., Ruf, F. and P.S. Siswaputranto. Cambridge: Woodhouse Publishers, pp: 75-87.
30. IICA (Inter-American Institute for Cooperation in Agriculture)., 2009. Situación y perspectivas de la cadena del cacao-chocolate en el Perú, IICA – MINAG, Lima.
31. Technoserve, 2015. Building a sustainable cocoa value chain in Peru. Technoserve, Lima. Available at: http//www.technoserve.org/files/downloads/case-study-building-a-sustainable-and-competitive-cocoa-value-chain-in-peru.pdf Accessed 01 November 2015
32. Vega, H. and M.J. Beillard, 2015. Ecuador cocoa update and outlook. USDA (United States Department of Agriculture), Quito/Washington, D.C. GAIN report No. EC15002.
33. Scott, G., 2011. Growth Rates for Potatoes in Latin America in Comparative Perspective: 1961-2007. Am J. Potato Res., 88(2): 143-152.
34. Scott, G., R. Labarta and V. Suarez, 2013. Booms, Busts and Emerging Markets for Potatoes in East and Central Africa 1961-2010. Potato Res., 56(3): 205-236.
35. Scott, G., 1995. Wall-to-wall fieldwork: secondary data collection for food systems research. In Prices, products and people: Analyzing agricultural markets in developing countries, Ed., Scott, G. Boulder: Lynne Rienner Pub and International Potato Center (CIP), pp: 167-185.
36. Erneholm, I., 1948. Cacao Production of South America. Historical development and present geographical distribution, Ph.D. thesis, University of Gothenberg, Gothenberg, C.R. Holmqvists Boktryckeri.
37. Jürgen Pohlan, H.A. and V. Diaz Pérez, 2010. Growth and production of cocoa. In: Encyclopedia of Life Support Systems (EOLSS): Soils, Plant Growth and Crop Production. Vol. III, Ed., Verheye. Oxford: EOLSS publishers, pp: 1-10.
38. Keithan, E., 1939. Cacao Industry of Brazil. Econ Geogr, 15(2): 195-204.
39. FAOSTAT., 2015. Cocoa production. Available at: http://faostat3.fao.org/download/Q/QC/E Accessed November 2015
40. Ul Haque, I., 2004. Commodities under neoliberalism: The case of cocoa. G-24 Discussion paper series. UNCTAD (United Nations Conference on Trade and Development), Geneva. G-24 Discussion, pp: 25.
41. Alger, K., 1998. The Reproduction of the Cocoa Industry and Biodiversity in Southern Bahia, Brazil. In the proceedings of the Shade Grown Cocoa Workshop organized by the Smithsonian Migratory Bird Center, Panama, March 1998. Available at: file:///F:/USB%207/Cocoa%20trends%20LAC/The%20Reproduction%20of%20the%20Cocoa%20Industry%20and%20Biodiversity%20in%20Southern%20Bahia, %20Brazil%20-%20Smithsonian%20Migratory%20Bird%20Center.htm. Accessed 10 November 2015.
42. Silberner, J., 2008, June 14. A not-so-sweet lesson from Brazil´s cocoa farms. National Public Radio. Available at: http://www.npr.org/templates/story/story.php?storyId=91479835 Accessed. 17 November 2015.
43. Pekic, V., 2014a, July 30. Back to the future: Brazilian federal bill re-discovers sustainable *cabruca* cocoa bean production. Confectionery News. Available at: http://www.confectionerynews.com/Processing-Packaging/Brazil-protects-sustainable-cabruca-cocoa-bean-production.
44. IBGE (Instituto Brasilero de Geografía e Estadística)., 2015. Available at: http://seriesestatisticas.ibge.gov.br/series.aspx?no=1&op=0&vcodigo=PA01&t=lavoura-temporaria-area-plantada#P1.

45. Lopes, U.V., W. Reis Monteiro, J.L. Pires, D. Clement, M. Macoto Yamada and K. Peres Gramacho, 2011. Cocoa Breeding in Bahia, Brazil Strategies and Results. Crop Breeding and Applied Biotechnology, S1: 73-81.
46. FAO (Food and Agriculture Organization of the United Nations)., 2003). Medium-term prospects for agricultural commodities. Projections to the year 2010, FAO, Rome. Available at: http://www.fao.org/docrep/006/y5143e/y5143e00.htm#Contents Accessed 13 November 2010.
47. Pekic, V., 2014b. October 13. Uncertain future for Brazilian cocoa production. Confectionery News. Available at: http://www.confectionerynews.com/Commodities/Brazil-s-cocoa-production-to-fall-next-decade Accessed 16 November 2015.
48. Cargill, 2011. Bringing back cocoa in southern Bahia, Brazil. Available at: http://www.cargill.com/connections/bringing-back-cocoa-southern-bahia-brazil/index.jsp Accessed 16 November 2015
49. Schroth, G., E. Garcia, B.V.W. Griscom, W.G. Teixeira and L.P. Barros, 2015. Commodity Production as Restoration Driver in the Brazilian Amazon? Pasture Re-agro-forestation with Cocoa (Theobroma cocoa) in Southern Pará. Sustain Sci. DOI 10.1007/s11625-015-0330-8.
50. Rice, R.A. and R. Greenberg, 2000. Cacao cultivation and the conservation of biological diversity. Ambio, 9(23): 167-173.
51. Blare, T. and P. Useche, 2013. Competing Objectives of Smallholder Producers in Developing Countries: Examining Cacao Production in Northern Ecuador. Environ Econ, 4(1): 71-79.
52. West, J. (Ed.)., 2001. South America, Central America and the Caribbean. Regional Surveys of the World. 10th edition. London: Europa publications.
53. Quingaisa, E., 2007. Estudio de caso: Denominación de origen "Cacao Arriba", FAO/IICA, Quito.
54. Vanek Smith, S., 2015. February 19. Ecuador´s answer to the global cocoa shortage. National Public Radio. Available at: http://www.npr.org/2015/02/19/387420709/ecuadors-answer-to-the-global-cocoa-shortage Accessed 09 November 2015.
55. Emenius, C., 2012. Livelihood and transition to certified cocoa production in the Peruvian Amazon-gendered responsibilities in Irazola, Master´s thesis, Rural development and natural resource management, Swedish University of Agricultural Science, Uppsala.
56. Van Der Kooij, S., 2013. Market study of fine flavour cacao in 11 selected countries. Revised version. Royal Tropical Institute, Copenhagen.
57. Fernandez-Stark, K., P. Bamber and G. Gereffi, 2012. Case 2: Promotion of the organic cacao value chain amongst small producers in Esmeraldas and Napo, Ecuador. In Inclusion of small- and medium-sized producers in high value agro-food chains, Duke CGGC (Center on Globalization, Governance and Competitiveness), Durham, pp: 30-32.
58. Nestlé, 2012. Growing sustainable fine cacao. Country: Ecuador. Available at: http://www.nestle.com/csv/case-studies/ AllCaseStudies/Sustainable-fine-cocoa-growing-Ecuador Accessed 10 November 2015.
59. Nestlé, 2015a. Nestlé cocoa plan. Available at: http://www.nestle.com/csv/rural-development-responsible-sourcing/nestle-cocoa-plan Accessed 10 November 2015.
60. Nestlé, 2015b. Cocoa tree rejuvenation in Ecuador. In Nestlé in society Creating shared value and meeting our commitments 2014, pp: 104. Available at: http://www.nestle.com/asset-library/documents/library/documents/corporate_social_responsibility/nestle-csv-full-report-2014-en.pdf Accessed 10 November 2015.
61. Motamayor, J.C., P. Lachenaud, J. Wallace da Silva e Mota, R. Loor, D.N. Kuhn, J.S. Brown and R. Schnell, 2008. Geographic and Genetic Population Differentiation of the Amazonian Chocolate Tree (*Theobroma cocoa L*). PLOS One, 3(10): 1-8.
62. Olivera Núñez, Q., 2014. Arqueología Alto Amazónico. Lima: Apus Graph Ediciones, pp: 260.
63. Chemonics, 2012. Transfoming communities, transforming lives. USAID/Peru Alternative development program III final report. Chemonics, Lima.
64. Canales Martinez, M., 2014b. Análisis del mercado nacional para cacao fino de aroma y las industrias derivadas como chocolate y cosmética. Programa Proambiente GIZ, Lima.
65. Huamanchumo De la Cuba, C., 2013. Análisis de la cadena de valor del cacao en la Región San Martin, Perú, Swisscontact, Tarapoto.
66. Programa ProAmbiente GIZ., 2014. Plan estratégico del clúster Nor-Amazonico de cacao fino de aroma en base del espacio interregional Amazonas-San Martin, ProAmbiente GIZ, Lima.

67. INEC (Instituto Nacional de Estadística y Censos)., n.d.. Compendio Estadístico 2013, INEC. Quito.
68. IICA (Inter-American Institute for Cooperation in Agriculture), 2010. Escuelas de campo para agricultores de café y cacao- experiencias y lecciones aprendidas en la selva central, IICA, Lima. Available at: http://orton.catie.ac.cr/repdoc/A5997E/A5997E.PDF Accessed 20 September 2014.
69. Gómez, R., 2008. Agricultura comercial moderna en el Perú: el caso de la agricultura de exportación no tradicional (1995-2007). In: SEPIA (Seminario Permanente de Investigacion Agraria). XII: Perú: el problema agrario en debate, Eds., Damonte, G., B. Fulcrand and R. Gómez, R. Lima: SEPIA.
70. Gestión, 2014. December 02. United Cacao apunta a liderar mercado global con proyecto de 3250 hectáreas en Perú. Lima.
71. ICRAF (World Agroforestry Centre)., n.d. Influencia de la producción y comercialización de cacao certificado y no certificado en aspectos ambientales, económicos y sociales de la región Ucayali-Perú, ICRAF, Lima.
72. United Cacao, 2014. Admission statement. United Cocoa, Grand Cayman.
73. EIA (Environmental Investigation Agency), 2015. Deforestation by definition. EIA, Washington, D.C.
74. Hill, D., 2015, April 18. Can Peru stop "ethical chocolate" from destroying the Amazon? The Guardian. Available at http://www.theguardian.com/environment/andes-to-the-amazon/2015/apr/17/can-peru-stop-ethical-chocolate-destroying-amazon Accessed 15 May 2015.
75. mpf (Machu-Picchu foods)., 2015. Available at: http://www.mpf.com.pe Accessed 15 September 2015
76. Mejia, J., 2015. Amazonas Trading Peru. Powerpoint presentation. Seminar: Avances y perspectivas del cacao peruano para el mundo: Pequeño agricultura ante grandes retos. 01 October 2015. Lima.
77. Higuchi, A., 2011. Marketing performance of the cocoa cooperatives in the Peruvian jungle the Acopagro cooperative case study, Ph.D. Department of Agriculture and Resource Economics, Graduate School of Bioresource and Bioenvironmental Science, Kyushu University. Fukuoka.
78. FAIR TRADE USA, 2011. 2010 Almanac. Oakland: Fair Trade USA.
79. FAIR TRADE USA, 2013. *2012 Almanac*. Oakland: Fair Trade USA.
80. AVSF (Agronomes et Vétérinaires Sans Frontieres)., 2013. El desarrollo cocoatero peruano. Estrategias para promover y fortalecer la cadena productiva del cocoa, AVSF, Lima.
81. Attolini Lecón, A., 2011. Cuentas, Dares y Tomares del Cacao: Delicia, Convite, Rito Mesoamericano. Aspectos Antropológicos. Revista Digital Universitaria, 12(4): 1-22. Available at: http://www.revista.unam.mx/vol.12/num4/art38/art38.pdf Accessed 19 November 2015
82. Khodorowsky, K. and R. Hervé., 2001. The little book of chocolate. Paris: Flammarion, pp: 120.
83. SIAP (Sistema de Información Agroalimentaria y Pesquera)., 2015a. La historia del cacao México. Available at http://www.siap.gob.mx/siaprendes/contenidos/3/02- cocoa/contexto-4.html Accessed 11 November 2015.
84. SIAP (Sistema de Información Agroalimentaria y Pesquera)., 2015b. Producción agrícola: Cacao. Available at: http://www.siap.gob.mx/cierre-de-la-produccion-agricola-por-estado/ Accessed 11 November 2015.
85. Fundación Cacao México., 2015a. Cocoa en México. Available at: http://www.cocoamexico.org/?page_id=1051 Accessed 19 November 2015.
86. Fundación Cacao México., 2015b. Proyecto Mars. Available at: http://www.cocoamexico.org/?page_id=1402 Accessed 20 November 2015
87. Ikei, 2010. Estudio de benchmarking del sector de cacao entre República Dominicana y Colombia. Estudio de mercado. AIRD (Asociación de Industrias de República Dominicana), Santo Domingo.
88. Fernandez-Stark, K. and P. Bamber, 2012. Competitividad de pequeños productores de cacao orgánico de la Confederación Nacional de Cocoacultores Dominicanos (CONACADO). Duke CGGC (Center on Globalization, Governance and Competitiveness), Durham. DR-S1007.
89. FAO (Food and Agriculture Organization of the United Nations)., 2001. World markets for organic fruits and vegetables, Economic and Social Development Department, FAO, Rome.
90. Dominica on line., n.d. Productives sectors: cocoa. Available at: http://www.dominicanaonline.org/portal/english/cpo_cocoa.asp Accessed 26 November 2015
91. FLO (FAIR TRADE INTERNATIONAL)., 2013. Monitor the Scope and Benefits of Fair Trade. 5th edition. FLO, pp: 127.
92. Mite, F., M. Carrillo and W. Durango, 2010. Avances del Monitoreo de Presencia de Cadmio en Almendras de Cacao, Suelos y Agua de Ecuador. In XII Congreso Ecuatoriano de la Ciencia de Suelo, 17-19 November, Santo Domingo. Available at: https://app.box.com/s/ypon3kded0ro48krfuji5sb8s7sh2mq8 Accessed 03 December 2015.