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# Destruction By Chocolate


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# Destruction by Chocolate

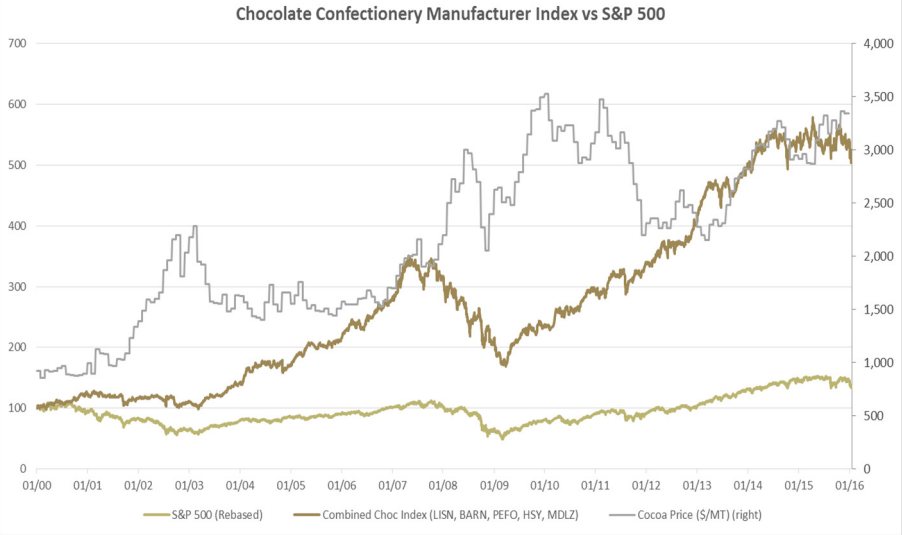
A typical Western consumer is likely to munch his or her way through 5.5 bars (35g) or their equivalent, of chocolate per week: 286 bars annually and many more if that consumer resides in Belgium. Ten cacao trees somewhere in the world will have to be planted to produce the raw cocoa products (powder and butter) that make these 286 bars equivalent so appealing. At current levels of production, for every 72 new Western consumers (consuming 3.3 kg per capita of cocoa beans equivalent annually), a hectare of land, and possibly forested, somewhere in the tropical belt, must be planted with cacao trees. Since the start of this century nearly 2.5m new hectares of cacao have been planted – equal to 180m new Western consumers, but likely these were not Western consumers, but Chinese, Indian, Indonesian and other new consumers from across the Emerging Market countries. Consumption levels amongst EM consumers are only a fraction of Western levels (100g-200g per capita), but their growing appetite for chocolate is powering the strong earnings and stock market performances of the leading chocolate confectionery stocks. As these new consumers increase their appetite for cocoa based products, more and more land across the Tropics will need to be planted with cacao trees unless efficiency levels are raised. The problem with the production of cocoa is that currently it relies on inefficient farming methodologies. Methodologies that have not changed in hundreds of years: unlike other tree crops that have benefitted from the development of modern high yielding cultivars and agronomy techniques to realise their genetic potential, more than 90% of the global cocoa crop is produced by smallholders on subsistence farms with unimproved planting material. Whereas yields (metric tonnes) of oil palm fruit harvested per hectare across the world have increased by 33% in the first 13 years of this century, global cocoa yields have flat lined at circa 0.4mt/ha. Unless cocoa yields increase or consumers eat fewer chocolate bars, more tropical forest will be planted for cocoa. This is not sustainable.

| World Average Cocoa Yield | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| World Production (ICCO) (m MT) | 3.08 | 2.87 | 2.88 | 3.18 | 3.55 | 3.38 | 3.81 | 3.43 | 3.74 | 3.59 | 3.63 | 4.31 | 4.09 | 3.94 |
| World Harvested Area (FAO) (m Ha) | 7.61 | 7.15 | 6.97 | 7.69 | 8.51 | 8.60 | 8.51 | 8.64 | 9.56 | 9.44 | 9.51 | 10.07 | 10.09 | 10.01 |
| World Average Cocoa Yield (MT/Ha) | 0.40 | 0.40 | 0.41 | 0.41 | 0.42 | 0.39 | 0.45 | 0.40 | 0.39 | 0.38 | 0.38 | 0.43 | 0.41 | 0.39 |

*Source: ICCO, FAO*

To meet the voracious appetite for chocolate products amongst the world's wealthier consumers more than 5m hectares have been converted to cocoa plantations in the past 35 years – an area approximately the same size as countries such as Costa Rica, Togo or the Slovak Republic, and bigger than the Netherlands, Switzerland or Denmark. Some 3 million hectares of this expansion has occurred in Africa, the source of more than 70% of world cocoa. In the first 12 years of this century alone, 1.275m new hectares of African land were planted with cacao trees, an increase of 25% in harvested area, but over the same period African cocoa yields expressed as metric tonnes per hectare, have expanded by less than 7%. This has meant that for every extra tonne of cocoa beans produced in Africa to meet the global demand for chocolate products, another 2.2 ha of land have had to be planted with cacao. Some reports suggest that the increased focus on cocoa production in the world's top producer country Ivory Coast (40% of the global crop), has led to wide scale illegal farming of its protected forest areas: destruction by chocolate.

**Chocolate Confectionery Manufacturer Index vs S&P 500**



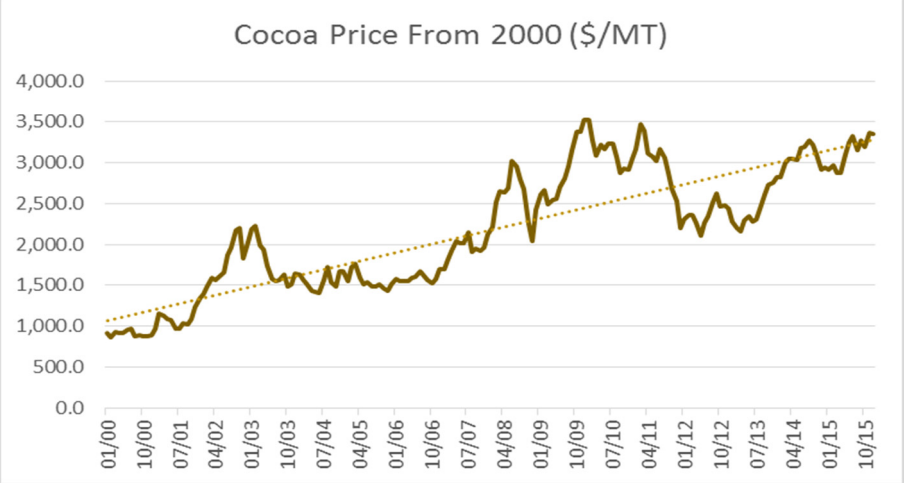

*Source: Hardman Agribusiness, Reuters Eikon, World Bank*

The leading names in the global chocolate confectionery, cocoa processing and cocoa trading sectors have invested hundreds of millions of US$, some sources suggest billions of US$, in projects to improve the outcomes for African cocoa farmers, but the African cocoa sector is structurally blighted and disappointing regional yield growth has been dwarfed by growth in area harvested. Numerous initiatives have been launched in the name of sustainability: CocoaAction and Cocoa Horizons Foundation being just the most recent, but judging by past performances, these initiatives, while worthy in their aims, appear to have their greater impact on social welfare issues and brand projection, than in the drive for sustainable cocoa production.

While the African sector has risen thus far to the challenge of meeting demand growth, albeit by relentless expansion of the production area, the Asia/Oceania cocoa sector appears locked in a near terminal spiral of decline, led by the region's largest single producer country, Indonesia. Since the end of the 20th century total Asian production has fallen by 130,000mt or 24.4%, yet over the same period the harvested area has reportedly more than doubled; there is doubt about the accuracy of the Indonesian harvested area data. Like the African cocoa sector, the Asian sector is almost entirely dependent on smallholder producers, there being little evidence of a developed and progressive professional agro-industrial producer element in either region.

In the context of the data for production growth and yield efficiency in these two producer continents representing some 80% of world supply, it is not surprising that the price of traded cocoa in the international commodity markets has trekked firmly upwards, counter to the trend in soft commodities more generally.

**Cocoa Price From 2000**

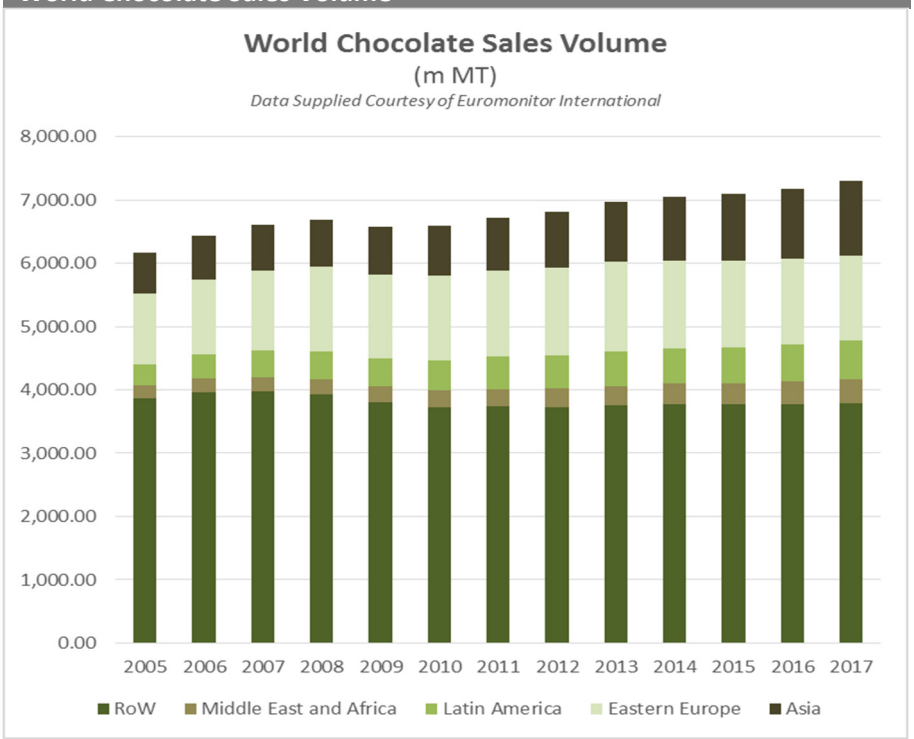



*Source: World Bank*

Consumers and traders of cocoa beans have good reasons to question the security of long term supply from both the African and Asia/Oceania regions. Only in the Americas, is there strong current evidence of a robust cocoa production sector with a new vision for the cultivation of the commodity.

The Euromonitor projections shown in the chart below confirm that consumption of chocolate has been growing steadily since 2005. Whether the consumer research agency's projections for the period to 2017 will be met will depend partly on economic outcomes over the period, but the data for the industry all point to a steady swell of demand.

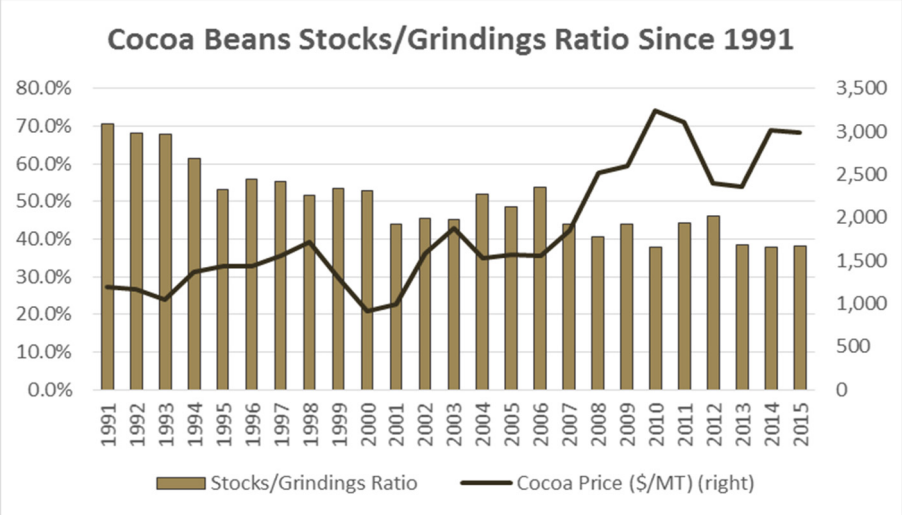
**World Chocolate Sales Volume**




*Source: Euromonitor*

In the chart below the same messages about steady demand growth and sputtering supply growth are confirmed by the industry stock: grindings ratio. The ratio has fallen steadily from 70% in 1991 to circa 38%-40% in recent years. Demand is growing faster than supply. For the downstream sector the possibility of a supply shortfall is a looming nightmare. Variously ascribed to a number of leading brands and processors, including Mars Inc and Barry Callebaut, media reports reference the possibility of a deficit of as much as 1 million metric tonnes by 2020. ICCO believes that this is scaremongering and projects a deficit of only 100,000mt. Behind the debate about the size of an *apparently* inevitable supply deficit, and through the fog of sometimes doubtful data for harvested area, there emerge stark regional messages. Asian cocoa production is in a spiral of decline, African cocoa production cannot be described as sustainable and only in the Americas is a vibrant, progressive cocoa culture developing which offers the hope of a sustainable and reliable supply of high quality cocoa.

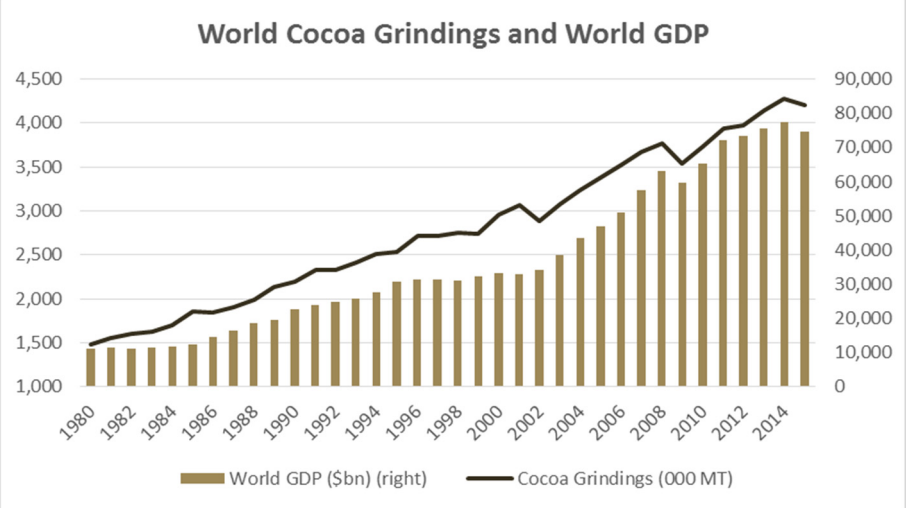
**Cocoa Beans Stocks:Grindings Ratio Since 1991**




*Source: ICCO, World Bank*

With global consumption of cocoa products strongly correlated with the growth in GDP, the supply / demand pressure may be about to ease if the global economy is heading into recession. However as we detailed in 'Giant On A Pinhead' (May 2014) a sophisticated global FMCG sector with a brand value in excess of $350bn depends on a commodity supply chain that is faltering at source.

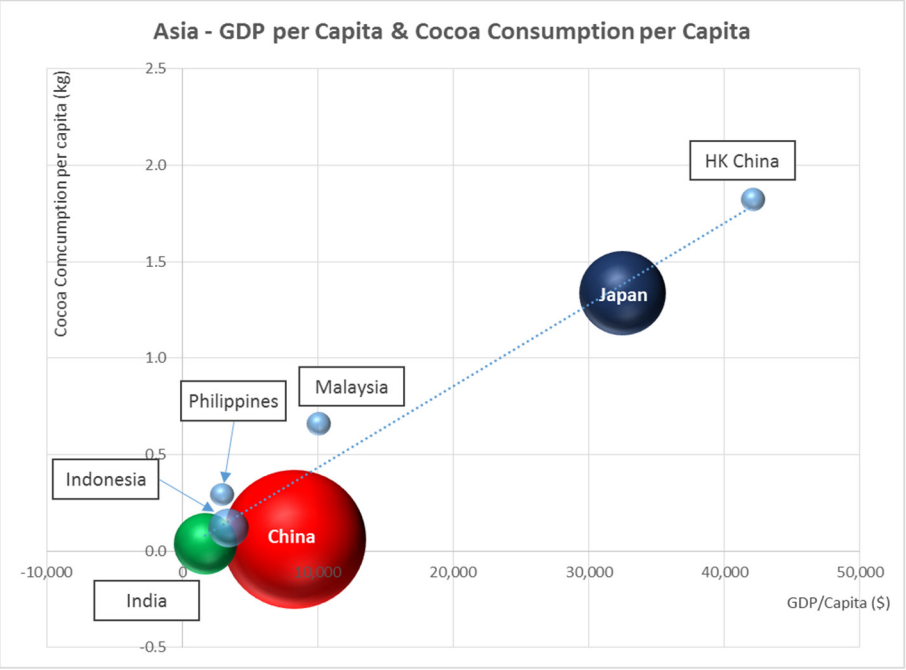
## World Cocoa Grindings and World GDP




*Source: ICCO, World Bank*

In no other important commodity or business sector is there such a fragile balance between security of commodity supply and downstream brand performance. This fragility has increased with the emergence of the big new economies in Asia, Latin America and FSU. A billion or more new consumers of chocolate confectionery have entered the market across countries such as China, Indonesia, India, Brazil and the FSU. In the process the demand these consumers have generated has exposed the critical weaknesses of a cocoa supply sector dependent for maybe 95% of the global crop, on the world's poorest farmers, using agri-techniques that would not have looked out of place in the 17th century. If per capita demand in India and or China approaches the same level as Malaysia, the output of another Ecuador will be required. Should demand from these countries grow to Japanese levels of per capita consumption then the combined output of Ecuador and Brazil would need to double.

## Asia – GDP per Capita & Cocoa Consumption per Capita




*Source: ICCO, IMF*

Against this background of uncertain supply and gathering growth in demand, a valuable and efficient downstream consumer goods sector is vulnerable to supply shocks and potentially spiralling commodity prices. However amidst the traditionally smallholder dominated upstream end of the cocoa supply chain, an ambitious and progressive professional producer sector is emerging in the Latin American region with its focus in Ecuador. Gone is the romance (and uncertainty) of multi-colour cocoa pods being gathered by traditional farmers in the humid depths of the tropical rainforests, this new breed of professional cocoa farmer is focused on technical and commercial efficiency and they are investing private capital in the business of reliably producing high quality sustainable cocoa.

This report details the starkly contrasting state of cocoa production across three continents and concludes that the future of cocoa production is being designed in Latin America today, where the crop is being re-imagined.

# A Vicious Circle – African Cocoa

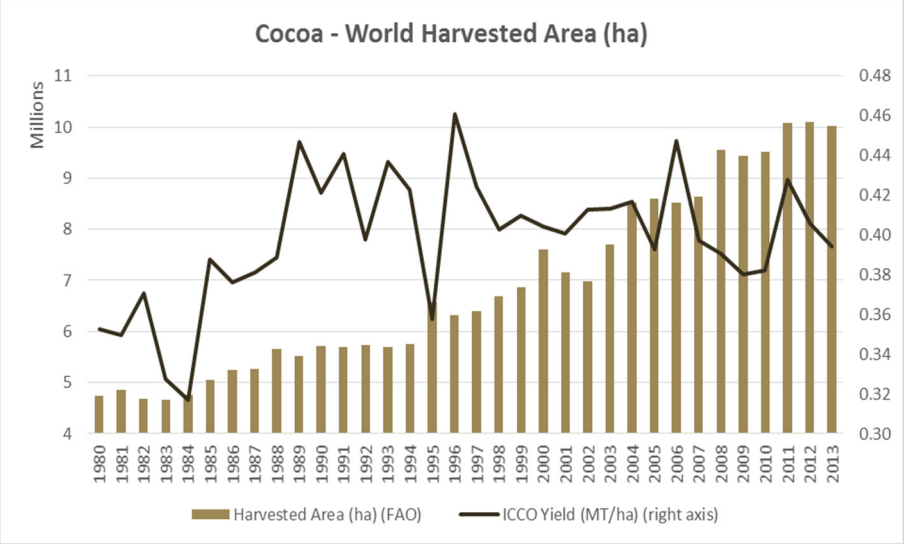
Mr Laurent Pipitone, Director of the Economics and Statistics Division, International Cocoa Organization (ICCO), noted in conversation with HAB that for the African cocoa production sector "the path to leave a vicious circle and enter a virtuous circle has probably not been yet found despite all the past 10-year efforts made by the industry (which started to implement activities at production level only very recently) and the governments". Readers will observe in the data presented below that in the first 12 years of this century, the harvested area reported for African cocoa expanded by more than 1 million hectares, but by contrast yields of dry beans per hectare have broadly flat lined. As Mr Pipitone also noted to HAB "…probably the scale all these efforts made is too limited compared to the scale of the problem… ".

## Unsustainable Cocoa

It is often stated in media articles relating to cocoa production that the world is facing a looming supply deficit of up to 1 million tonnes of beans, a scenario due to unfold sometime around 2020. The prediction has been variously ascribed to Mars, Barry Callebaut and even ICCO, although the latter agency has been very clear to state that 1 million tonnes is the stuff of scaremongering, that the deficit is likely to be closer to 100,000 mt. The premise of a supply deficit has grown out of the evidence for stronger growth in demand than for supply.

At the heart of the concern over the adequacy of future supply has been the steady decline in production volumes from Indonesia and the difficulty of improving production yields across West Africa's 2m plus small holder cocoa farms. While many hundreds of millions of US$ have been committed by the leading brands and processors to boosting the incomes of small holder cocoa farmers around the world through agronomy training and field support programmes (see Hardman Agribusiness Giant On A Pinhead, May 2014, pages 43-45), the stark evidence from the data that are publically available, is that small holder yields (expressed as metric tonnes of dry beans per hectare), remain stubbornly low. The chart below pairs the steep increase in planted area: under 5 million hectares in 1980 to 10 million in 2012, with a yield gain of only 11%-12%. Even this modest improvement over the period of 32 years may overstate reality; reliable data for planted and harvested area in the world's number one producer, Ivory Coast, is believed to be unknown, such is the predation of 'illegal' development in Ivory Coast's protected forests.

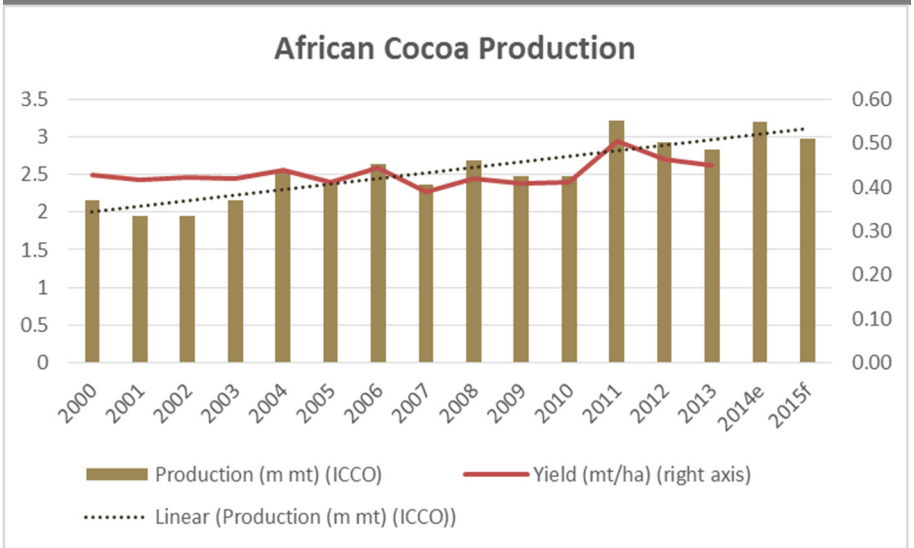
## Cocoa – World Harvest Area




*Source: ICCO (Cocoa Production), FAO (Harvested Area)*

The data for the world's most important producer region, Africa, illustrate a steady growth in production and cultivated area, but unmet by any significant progression in production efficiency.

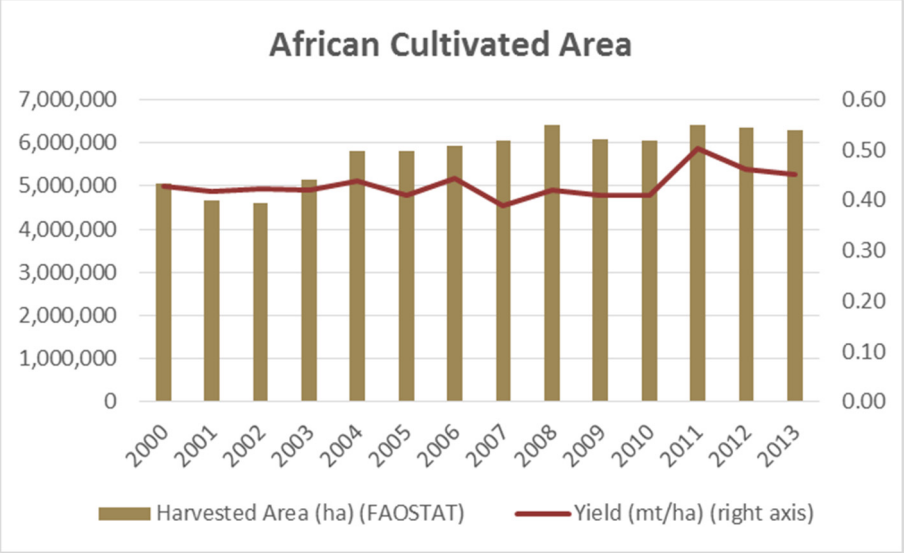
## Cocoa – African Cocoa Production




*Source: ICCO (Cocoa Production), FAO (Harvested Area)*

While reliable, current data for planted and harvested area are difficult to access, often because they do not exist, the chart below indicates that within the first 13 years of this century the African cultivated area has increased by some 1.275 million hectares, yet yields remain below 0.5mt/ha. As noted elsewhere in this report, the area under cultivation for cocoa in Africa is likely higher than the FAOSTAT data indicate; in Ivory Coast for example the FAOSTAT data has not altered since 2011(at the time of writing this report) when the harvested area was shown at 2.5m ha, notwithstanding unofficial reports of significant area expansion.

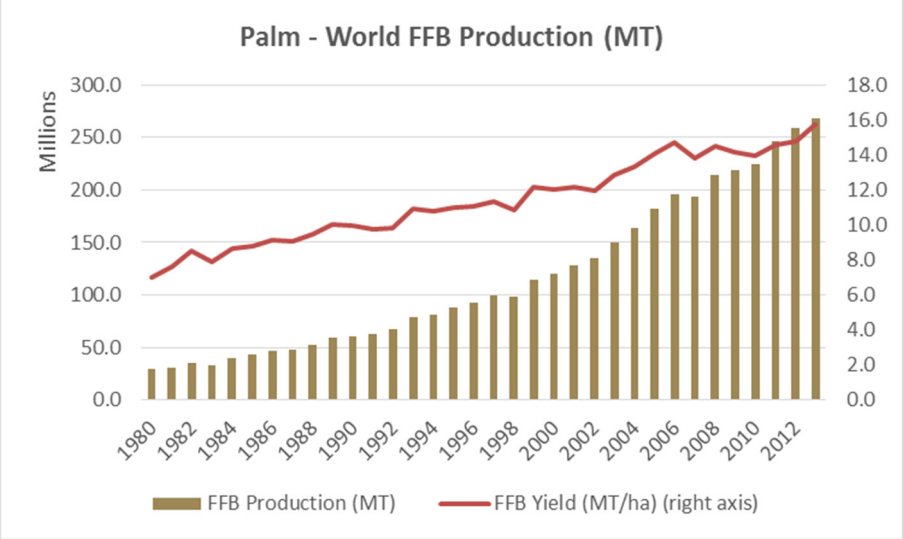
**Cocoa – Africa Cultivated Area**




*Source: ICCO (Cocoa Production), FAO (Harvested Area)*

By contrast the palm oil sector has a record of both production and efficiency expansion.

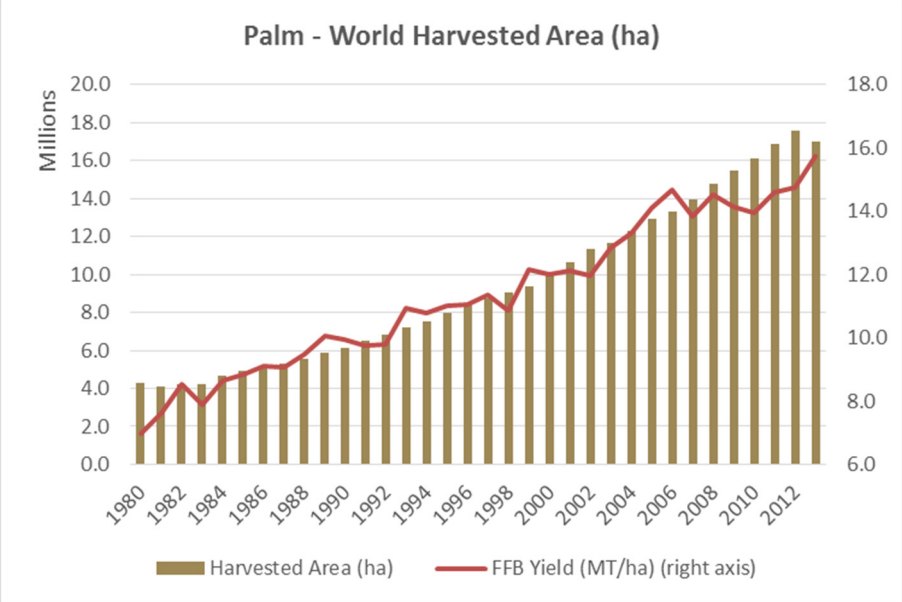
**Palm – World FFB Production**




*Source: FAOSTAT*

Since 1980 production has risen more than fivefold, with yields per hectare more than doubling over the same period.

**Palm – World Harvested Area**




*Source: FAOSTAT*

Many of the major chocolate brand owners, (Mondelēz and Nestlé may be exceptions), have committed to using 100% sustainable and/or certified cocoa by 2020. Mars, Hershey and Ferrero are both amongst the largest users of cocoa products in the world and 3 of the leading names committed to using only sustainable cocoa by 2020. The definition of sustainable will be important, but on the face of the data for African production and noting the slow progress being made in boosting agricultural efficiencies, it will be difficult to claim that a system of production that requires ever more land to meet demand, is in fact sustainable.

## African Cocoa – Structurally Blighted

A cumbersome land ownership system that prevents many small holders from owning bankable title in the land they farm and which prevents consolidation of less successful farms by their more efficient rivals, combines with structural fragilities in the four leading African producer countries, spanning logistics and an ageing cohort of cocoa farmers, to paint a bleak outlook for the future of cocoa production in Africa.

| Country | Reported Age of Cocoa Farmer | Source | Average Life Expectancy | Source | 2014 Logistics performance index: Quality of trade and transport-related infrastructure (1=low to 5=high) | Source |
|---|---|---|---|---|---|---|
| Cameroon | 63-70 | Cameroon Cocoa and Coffee Interprofessional Council (CCIC) | 54.59 | World Bank | 1.85 | World Bank |
| Ghana | 55 | Dr. Francis Kofi Oppong, Deputy CEO Cocobod | 60.95 | World Bank | 2.67 | World Bank |
| Ivory Coast | 51 | CNN Freedom Project, April 3, 2015 | 50.4 | World Bank | 2.41 | World Bank |
| Nigeria | 60+ | USDA/Agrimoney | 52.11 | World Bank | 2.56 | World Bank |

While the Index readings for Logistics in 3 of the countries shown above are middle ranking, the status of logistics in the isolated rural areas where cocoa is typically cultivated are likely to be significantly below national averages. Poor roads and pervasive racketeering were reported to be hardships endured by Ivory Coast cocoa farmers in an article published by IRIN, 7th November, 2012. It noted that "extortion from soldiers and police at illegal road-blocks set up between the cocoa-growing

zone and ports in the south can cost the cocoa sector as much as $19.5 million per year" citing the then newly formed administrative body, the Conseil du Café Cacao (CCC).

The age of farmers, especially relative to average life expectancy (as detailed in the table above) is a primary cause of concern for stakeholders in the African production system, especially as it has been proving difficult to attract a younger generation of farmers to the sector. A factor behind the reluctance of younger people to enter the cocoa sector may be the complexities of land ownership in West Africa. The respected publication 'Cocoa Barometer' 2015, edited by Mr Antoine Fountain (www.cocoabarometer.org) noted in the USA Edition of the publication that "*There is a direct responsibility of cocoa growing nations to address the issue of land tenure...Land-ownership is often a precondition for membership in official farmer organisations and for participation in training activities...necessary to apply for bank credit ...".*

The publication also observed that:

- "Over the past decades, the size of cocoa farms has decreased, raising the question whether there is a size below which cocoa farming is no longer economically viable."
- "*... many farmers have unsure tenancy rights on the land*".

## *Ivory Coast – The World's Largest Producer Country*

HAB has found it difficult to access credibly assembled data for the planted cocoa area for the world's leading supplier, Ivory Coast. The country, which supplies 40% of the global crop, does not appear to have an accurate record of how many hectares are planted to cocoa or harvested for cocoa from year to year. The most recent official data we could find were from FAOSTAT: it records 2.5m ha harvested from 2011-2013. When we asked ICCO whether it had these data the organisation replied: "*We do not have official data on area harvested in CDI. We believe that the most recent census conducted was the cocoa and coffee producers census in 1999 (MINAGRI/DSDI) and the National Agricultural Census in 2001 (MINAGRI/DSDI)*".

In 2001 the harvested cocoa area for Ivory Coast was given by FAOSTAT at 1.77m ha, down from 2.0m ha in 2000 and 2.176m ha in 1997/8. At that time the average farm was reported to be some 4 ha in size and the sector had been responsible for 14% of the country's deforestation: "*Reflections on a Durable Cacao Production System: The Situation in the Ivory Coast", by Koffi N'Goran IDEFOR-DCC*. FAOSTAT data are sourced typically from official government data – but this can vary in reliability from one country to another. If it were not for research reports from credible institutions to the effect that illegal cocoa planting is rampant in the 'protected' forests of Ivory Coast, it might be possible to accept that the harvested area had not changed greatly from the 2.5m ha notified in 2011. An interesting statistic was contained in an article by Javier Bas in the Financial Times, on cocoa farming in Ivory Coast (28th May, 2010). Bas observed that "Ivory Coast has about 2 billion cocoa trees" and noted that Nestle was proposing to spend some $100m replanting 12 million of these trees over the ten years to 2020 – a mere 0.6% of the total. In a typical agro-industrial plantation planting densities are in the region of 1,111 trees per ha. In very modern intensive plantations with drip irrigation systems, densities can be 1,400 trees per ha or more. In shade systems however densities are lower at 300-400 trees typically while in Brazil's Atlantic Coast cabruca system densities can run to 724 trees per ha. We do not have data for the mix of shade and full sun orchards in Ivory Coast, but assuming an average density similar to Brazil's cabruca system, then at 2bn trees this would have given a planted area of 2.76m ha...in 2010.

| Year Ending 30th September | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014E | 2015F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ivory Coast** | | | | | | | | | | | | | | | | |
| Cocoa Beans (m mt) ICCO data | 1.41 | 1.21 | 1.27 | 1.32 | 1.41 | 1.29 | 1.41 | 1.23 | 1.38 | 1.22 | 1.24 | 1.51 | 1.48 | 1.45 | 1.75 | 1.79 |
| FAOSTAT area harvested (m ha) (2000-2011) | 2.00 | 1.78 | 1.88 | 2.00 | 2.05 | 2.19 | 2.28 | 2.37 | 2.30 | 2.18 | 2.15 | 2.50 | *2.55* | *2.61* | *2.67* | *2.73* |
| Change | 5.3% | -11.1% | 5.8% | 6.4% | 2.5% | 7.0% | 4.0% | 4.0% | -3.1% | -5.4% | -1.2% | 16.1% | *2.31%* | *2.31%* | *2.31%* | *2.31%* |
| Yield (mt/ha) | 0.70 | 0.68 | 0.67 | 0.66 | 0.69 | 0.59 | 0.62 | 0.52 | 0.60 | 0.56 | 0.58 | 0.61 | 0.58 | 0.55 | 0.65 | 0.66 |

*Italicized data for 2012-2015 planted area are HAB estimates based on average growth 2000-2011*

*Source: ICCO, FAOSTAT*

Just as reliable, current data are hard to find for harvested area, so too it is difficult to form an accurate picture for the number of farms and farmers engaged in cocoa production in Ivory Coast. Various internet sources including the humanitarian news service, IRIN, have estimated the number of Ivorian cocoa farms at around 900,000. That conclusion is supported by dividing the planted area (HAB estimate 2.67m ha) by 3.0ha per farm – the generally assumed size for West African cocoa farms. On a well-managed professional, but traditional plantation style cocoa farm in Ecuador say, we would assume a labour requirement of 1 x FTE per 4 ha. Without modern estate design and mechanised or partly mechanised solutions for field and tree maintenance, African farms will typically require more labour – perhaps involving 1.5-2.0 FTEs per ha of cocoa harvested.

The production data for Ivory Coast in the table above for 2013/14 may not be entirely accurate; it is widely believed that some 80,000 mt of beans were smuggled into Ivory Coast from Ghana so that farmers and traders could take advantage of better prices and a stronger exchange rate in Ivory Coast. Smuggling is certainly a well recorded tradition across the region. Estimates obtained by Reuters from four European traders for smuggled volumes of cocoa beans out of Ghana in 2014, ranged from 40,000 to 80,000 tonnes of beans, while exporters in Ivory Coast put the figure at between 50,000 and 60,000 tonnes. The Reuters article quoted Edward George of Ecobank, noting that he had spoken to officials from Ghana's marketing board, Cocobod: "The lowest estimate we heard was 60,000 tonnes. The highest was 100,000 tonnes, and that was from Cocobod." If we assume that Ivory Coast's 2014 deliveries were swollen by say 80,000 mt of Ghanaian beans then yield per ha for the 2013/14 year may have been nearer to 0.62 mt/ ha than 0.65mt/ha as shown in the table above. The weighted average production over the 15 year period shown above outturns at circa 0.62mt/ha. If the data for 2000 and 2001 are correct, Ivorian production efficiency may not have improved at all over the first 15 years of this century.

However if the harvested area is somewhat larger than has been estimated, then the yields/ha indicated in the paragraph above may still be too high. Consider the remarks from the September 2013 report, "*Fading Forests and Forced Evictions: Risks and Challenges in Managing Côte d'Ivoire's Protected Lands", published by Center for International Conflict Resolution, School of International and Public Affairs, Columbia University*: "There is no official estimate on how much forestry land there is currently in Côte d''Ivoire. Different data was given to researchers within Ministries and NGOs. The Ministry of Environment and Sustainable Development mentioned that there were 2 million hectares of forestland left *(Abidjan, 17 June, 2013).* The Ministry of Water and Forests said 3.5 million hectares were left *(Abidjan, 17 June, 2013).* Environmental organizations like SOS Forêt, estimated that only 1.7 million hectares were left *(Abidjan, 31 July 31, 2013*)".

The Suedwind-Institute notes "Without any cadastre it will not be possible to get exact figures. Additionally there seem to be different types of protected land in Ivory

Coast: “classified” is one expression you read quite often. “National Park” is another. Where is it allowed to plant cocoa trees? Is it possible to de-classify former classified forests?” Founded in 1991 to promote economic, social and environmental justice, the institute undertakes research in economic relations and promotes development policy in Germany.

In March 2015, researchers from The Ohio State University and Universite Felix Houphouet-Boigny, published data indicating that in 23 protected forest areas of the country, 75% of the land had been converted to cocoa cultivation – and in many cases full-sun cocoa. W Scott McGraw, Professor of Anthropology at The Ohio State University noted: “we were stunned by the scale of illegal cocoa production. It is now a major cause of deforestation...”. Thirteen of the protected areas were reported to have lost their entire primate populations while another five had lost half of their species. Amongst the species thought to have become extinct is Miss Waldron’s Red Colobus monkey. The report noted that migrants from outside Ivory Coast (Burkina Faso in particular) had moved in to the forests and turned to farming to survive. They were reported by the research teams to have settled in the protected forests, meeting no resistance from government agencies and that once settled the migrants had cut down areas of forest to plant cocoa. In a country torn apart so recently by civil war, removing farming families from these forests risks igniting old grievances.

These reports raise a valid question: is the production of cocoa in Ivory Coast impacting on the size and health of the country’s protected forests and in turn driving a number of its plant and animal species to extinction? Without reliable data for harvested area, the suspicion builds that increased production of cocoa in Ivory Coast continues to rely heavily on increased planted area, and not primarily on increasing yields.

In August 2013, Ivory Coast's Parliament approved new laws to ease access to citizenship for millions of foreigners and improve state regulation of land ownership, two issues which have been at the heart of more than a decade of political and civil unrest. Immigrants from Ivory Coast's arid neighbours, Burkina Faso in particular, flocked to the country following independence in 1960, drawn by former President Felix Houphouet-Boigny's promises of land for anyone willing to develop it for agriculture. This open-door policy is credited with establishing Ivory Coast as the world’s most important cocoa grower, producing some 40% of the global crop. However, the citizenship status of millions of immigrants and their children was left unclear. Reportedly, the 2002 civil war that divided the country between a rebel-held north and loyalist south was instigated because of discrimination against northerners and foreigners. Changes to the laws on nationality and land tenure were conditions of the first peace agreement signed between the government and the rebels in 2003. The effect of the August 2013 legislation was to enable foreign-born residents living in Ivory Coast since before independence to become citizens along with their descendents. In the same session, the Ivorian Parliament also voted to extend by 10 years a grace period for the implementation of a 1998 law meant to codify land transactions. Typically, land sales in Ivory Coast are managed according to traditional customs, and the 1998 law was intended to give them legal weight, but it was never applied. The resulting vagueness surrounding land sales, coupled with the requirement that landowners must be Ivorian citizens, was therefore a flashpoint for conflict, especially in Ivory Coast's western cocoa growing districts.

Without reliable and up to date data for the harvested area, we cannot form an accurate picture of cocoa yield / ha development in Ivory Coast. With such data as we do have, it would appear that productivity per ha has stalled, and on a best case basis it is unchanged since the start of the century, but there is significant evidence

to suggest that the harvested area may be bigger than has been estimated and that with the production data distorted by smuggling, on a worst case basis, Ivorian yields may struggle to top 0.6mt/ha.

### KKO International / Solea: A Corporate Development

In October 2015 KKO International raised Euro 10.0m by way of a share flotation on the French and Belgian Alternext markets. KKO's 100% owned Ivorian cocoa production business, Solea, is an unusual development within the African cocoa production sector: a new agro-industrial plantation venture. The company reports that 800 ha of the land bank have been planted, and that it proposes to plant 3,000 ha by the end of 2017. Solea expects a first harvest in autumn 2015. The company reports that it has begun work on the development of the remaining hectares including forest clearing, planting, road building, camp construction, the installation of irrigation facilities and the provision of electricity.

#### An Ambitious Project

The yield targets look ambitious to HAB: Solea is targeting yields of up to 5.0 mt/ha with new tree stock, developed by the Ivory Coast National Agriculture Research Centre. The planting material Mercedes is described on the company website as "...a result of years of breeding cocoa trees, and blending them with Ivorian varieties to make them more resistant to diseases including black pod". Mercedes also is reported to have a shortened maturity period of some 18 months.

#### *Planting Material*

HAB's understanding is that Mercedes is a compound "variety" of cocoa hybrids, descending from elite trees (among ancient French selections) but of undocumented parents. As Mercedes is sexually reproduced, and the parent trees are not known, its level of resistance to problems like CSSV (cocoa swollen shoot virus) is unpredictable, and so too, one would suppose, will be yield outcomes. The use of seedling cacao is now eschewed by the professional producers in Latin America, in favour of clonal material.

#### *High Tech Approach*

The company is proposing to use a 'smart irrigation / fertigation system' (Israeli technology) to deliver soluble fertilisers in irrigation water, including urea and potassium sulphate, (1g fertiliser for 1L water). The company describes the system used as a micro-irrigation or drip irrigation system that is reportedly more efficient than conventional irrigation technologies. Advantages are given as:

- More even distribution of water
- Lower wastage of water
- Reduced soil erosion
- Management of optimal leaf humidity.

This reportedly provides plants with improved absorption of the fertiliser which can be administered to suit the needs of the plant. KKO's Solea plantation is located in Bocanda. The company website describes the region as having "a multitude of rivers" and that "rainfall levels are generally high". In the context of rainfall levels that are 'generally high', it may be difficult for management to produce optimal results with its smart irrigation system. Other producers using smart irrigation systems tend to choose cultivation sites which give them the greatest control over the drivers of production. With generally high levels of rainfall it may be difficult for Solea to control leaf humidity and to manage the fertigation programme as desired.

### Objectives

Worthy goals of the Solea project include:

- maximisation of yield coupled with minimal wastage and pollution
- to become one of the world's largest producer of cocoa and a preferred partner for the chocolate industry
- to produce high-quality cocoa beans consistently throughout the year
- to develop a corporate socially responsible business model in which wealth creation is shared with the local communities
    - wages are described as "well above the local average"
    - land leases are paid in the form of a 5% share of revenues.

### Efficiencies

Solea's website notes that it employs "...an average of 1 worker per hectare, with the provision of some 800 jobs today,"... a number that will increase in parallel with the plantation surface to reach around 3000 people by 2017". These employment levels contrast markedly with the efficiency levels now being achieved on professional estates in Latin America: 3.4ha/FTE according to a survey conducted by HAB in 2014.

### Sustainability

Solea notes on its website that it "has an active programme for reforestation, responsible usage of pesticides and fertilizers, usage of renewable energy and active waste management." Solea also notes that it is in advanced stages of achieving accreditation from Rainforest Alliance. The company states that Rainforest Alliance "*acknowledges that the [Solea]plantation meets comprehensive standards for sustainable agriculture that protect lands, waterways, wildlife habitat and the rights and well-being of workers, their families and communities*".

### HAB Comment

Solea has established ambitious targets for itself. It has identified 5mt/ha dry beans as its productivity target, the achievement of which is to be supported by the use of smart technology for the efficient distribution of water and nutrients to the cocoa trees – notwithstanding that it operates in a relatively high rainfall area. Five mt/ha is level of production that exceeds the ambitions of even the most advanced estates in Latin America (at whole estate level). Solea is seeking certification for its sustainability initiatives and it is determined to be a model corporate citizen by paying wages above the local average and by basing land lease payments on a share of revenues. Moreover it appears to have made a promise to employ one person for every hectare planted. Additionally Solea is seeking to become a 'preferred' trading partner for the 'chocolate industry'. Investors will be hoping that the cost of production is appropriately offset by the price received for the company's cocoa beans. With African beans not classified currently as Fine or Flavour beans (excluding those from Sao Tome and Madagascar), Solea will be depending on bean quality (including fermentation profile) and on sustainability to earn it a premium over the international traded price of cocoa beans.

Mr Laurent Pipitone, Director of the Economics and Statistics Division, International Cocoa Organization (ICCO) observed to HAB that "the introduction of commercial plantations" [into the African cocoa sector]" could be seen as a positive development... because it has the capacity to bring technology into farming that would be used as example by smallholders".

## *Ghana – The Second Largest Producer in The World*

According to Dr Francis Kofi Oppong, Deputy Chief Executive of Cocobod, and specifically responsible for 'Agronomy and Quality Control', the Ghanaian authorities surveyed circa 66% of the area planted to cocoa between October 2006 and September 2015, for a total area surveyed of 1,800,778 ha. Based on the area surveyed, Dr Oppong advised HAB that it is possible to project that the total area planted to cocoa in Ghana at 2,737,577 ha. The survey has revealed that 556,783 ha are planted with over-aged (> 30 years) trees or infected with CSSV (Cacoa Swollen Shoot Virus), and therefore unproductive. This suggests that of the total projected planted area the unproductive portion (due to age or disease profile) may be in circa 846,432 ha. If these projections based on the area surveyed are correct, then the estimated productive area of cocoa in Ghana would outturn at 1,891,145 ha. Dr Oppong noted to HAB that if the calculations also included the 10,651 ha of 2013 and 2014 plantings (that are yet to come into production, and a further 50 million seedlings distributed for planting in 2015 then the area planted (not harvested) for cocoa, would likely reach 2.0 million ha.

The number of farmers thought to be growing cocoa in Ghana is variously given as circa 630,000 to 720,000 (various internet references including Fairtrade Foundation). The two data sets imply an average farm size of between 2.6 ha to 3.0 ha which is consistent with regional data.

| Year Ending 30th September | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014E | 2015F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ghana** | | | | | | | | | | | | | | | | |
| Cocoa Beans (m mt) ICCO data | 0.44 | 0.40 | 0.34 | 0.50 | 0.74 | 0.60 | 0.74 | 0.61 | 0.73 | 0.66 | 0.63 | 1.03 | 0.88 | 0.84 | 0.90 | 0.74 |
| FAOSTAT area harvested (m ha) (2000-2012) | 1.50 | 1.35 | 1.195 | 1.50 | 2.00 | 1.85 | 1.84 | 1.46 | 1.82 | 1.60 | 1.60 | 1.60 | 1.67 | 1.74 | 1.81 | 1.89 |
| Change | 15.4% | -10.0% | -11.5% | 25.5% | 33.3% | -7.5% | -0.8% | -20.3% | 24.6% | -12.2% | 0.0% | 0.0% | *4.26%* | *4.26%* | *4.26%* | *4.26%* |
| Yield (mt/ha) | 0.29 | 0.29 | 0.29 | 0.33 | 0.37 | 0.32 | 0.40 | 0.42 | 0.40 | 0.41 | 0.39 | 0.64 | 0.53 | 0.48 | 0.49 | 0.39 |
| *Italicized data for 2012-2014 planted area are HAB estimates* | | | | | | | | | | | | | | | | |
| *Italicized data for 2015 planted area are Ghanaian sources* | | | | | | | | | | | | | | | | |

*Source: ICCO, FAOSTAT*

In contrast to the data previously discussed for Ivory Coast, the Ghanaian data (see table above) point to yields per hectare being increased sharply between the 2000 and 2011 seasons, but the 2014/15 cocoa year witnessed an unexpected reversal for the Ghanaian cocoa sector. No single reason accounts for the severity of the country's production decline. Indeed the steady increase in output from 1999/2000-2010/2011 may, on the basis of the data above, have peaked in the 2010/11 season. The FAOSTAT data for planted area is erratic: 1.35m ha (2001) and 2.0m in 2004. Using Dr Oppong's projected productive area of 1.89m ha suggests that 2015 season yields per ha may have been as low as 0.39m. Reviewing the production data for the 2013/14 year, and adding back in the 80,000mt of beans reported smuggled through Ivory Coast would provide a total production of almost 977,000 mt. But on the basis of 1.891m ha of productive cultivations, yield per ha outturns at 0.517mt/ha. While yields of 0.5mt / ha plus contrast well with the 0.29mt/ha recorded for the 1999/2000 year, the absence of any progression since 2011 points to the difficulties associated with raising productivity in the African sector. In this context it is interesting to consider the reasons given by various actors in the Ghanaian sector for the sharp and unexpected underperformance of the sector in 2014/15.

Cocobod reportedly made support payments to farmers later in the 2014/15 year than necessary if farmers were to invest in their cocoa orchards. According to articles in Ghanaian newspapers and anecdotal remarks by farmers to various HAB contacts, "*promised services like free pesticides didn't arrive at farm level*". While the farmers

waited for Cocobod distributed farm inputs, diseases ruined a portion of the crop. Farmers reportedly cut back on the use of pesticides and fertilisers and also the labour required for tree / orchard maintenance and even harvesting. As one NGO field worker commented to HAB: *"... they know that higher yields...come with more labour*" but "*if there is no additional family labour available...*" would it be economically rewarding for them to hire in labour when there is no guarantee about the price that they will receive. These reports, and indeed the events that have characterised the 2014/15 Cocoa Year in Ghana, point to the fragilities of supply out of Africa. Poor farmers, with limited or zero access to commercial finance, and dependent on their small subsistence farms for food and income, must take hard decisions about their investment of time and resources into the cocoa crop on an annual basis. This decision may be taken (conceivably) for existential reasons and not just economics. NGO's (like SÜDWIND e.V.), working with Ghanaian cocoa farmers have reported that "many farmers don't adopt better agriculture practices even if they have access to farmer field schools - or don't go to the farmer field schools even if they are accessible...." because "they know that they would have to invest to implement better agricultural practices" but "they don't have the investment capital".

## *Nigeria*

FAOSTAT data for 2012 puts the area harvested for cocoa in Nigeria at 1.19m ha – an increase in area of 66.6% since 1999 (0.745m ha). Against ICCO forecasts of 190,000 mt of beans for the 2014/15 Cocoa year this would suggest yields of only 0.15mt/ha if the planted area was increased in line with annual average growth rates this century.

| Year Ending 30th September | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014E | 2015F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Nigeria** | | | | | | | | | | | | | | | | |
| Cocoa Beans (m mt) ICCO data | 0.17 | 0.18 | 0.19 | 0.17 | 0.18 | 0.20 | 0.21 | 0.22 | 0.22 | 0.24 | 0.24 | 0.24 | 0.25 | 0.24 | 0.25 | 0.19 |
| FAOSTAT area harvested (m ha) (2000-2012) | 0.97 | 0.966 | 1.03 | 1.00 | 1.06 | 1.09 | 1.10 | 1.36 | 1.35 | 1.35 | 1.27 | 1.24 | 1.20 | 1.22 | 1.24 | 1.27 |
| Change | 29.8% | 0.0% | 6.6% | -2.7% | 6.0% | 2.5% | 1.4% | 23.1% | -0.8% | 0.4% | -6.0% | -2.5% | -3.5% | *1.94%* | *1.94%* | *1.94%* |
| Yield (mt/ha) | 0.17 | 0.18 | 0.18 | 0.16 | 0.17 | 0.18 | 0.19 | 0.16 | 0.16 | 0.18 | 0.18 | 0.19 | 0.20 | 0.20 | 0.20 | 0.15 |

*estimates*

*Italicized data for 2015 planted area are Ghanaian sources*

*Source: ICCO, FAOSTAT*

The data above reveal that Nigerian cocoa production has remained at very low levels of efficiency without any obvious improvement over the past 15 years. It is widely acknowledged, especially within Nigeria, that the country's focus on the oil industry has been to the significant detriment of its agricultural sector. With oil revenues now plummeting, the national authorities are keen to encourage investment in agriculture with its capacity to absorb rural unemployment. In this context it is reported that the government has been distributing disease resistant planting materials, fertilisers and agricultural chemicals at subsidised rates along with agronomic training to improve farming practices. Reuters reported that Agriculture Minister Akinwumi Adesina "aims to boost production to 1 million tonnes a year by 2018" Business News, Fri Sep 5, 2014 'Nigeria nurtures its once-unloved cocoa industry as prices flourish'.

The data in the table above indicate that Nigeria harvests cocoa over some 1.3m hectares, whereas the country is estimated to have around 3 million hectares suitable for cultivation of the crop. The national authorities apparently recognise the importance of new planting materials with Reuters (see reference above) citing Leila Dongo, director at Cocoa Research Institute of Nigeria as noting that new planting

materials “will increase output more than three times from what farmers had before". But as with many other countries in Africa, Nigerian farmers may struggle to cope with the demands of high yielding varieties, and may not be prepared to take the risk of extra investment in time and effort when weak infrastructure and poor facilities could ultimately rob them of the value of the crop.

## *Cameroon*

The data for Cameroon present a very similar picture to that of Nigeria. Production per hectare has remained stubbornly in the region of 0.3mt/ha and perhaps declining if the harvested area has continued to increase at the average annual rate for the period 2000-2010. The harvested area data include abrupt increases and decreases (note the period 2000-2005) and then a significant ramp up in harvested area (50%+) in the period 2006-2010.

Cameroon’s Inter-Professional Council on Cocoa and Coffee (CICC) has targeted the tripling of national production within a decade, but this goal is being hampered by the failure to modernise ageing plantations (some trees are reported to be over half a century or more in age), and to attract young farmers to the sector. As the data in the table above confirm, Cameroon's cocoa output has been erratic, with the results attributed to weather, disease and sub-optimal farming practices. According to the National Cocoa and Coffee Board (NCCB), losses due to disease and pest run at 30%-40% of the annual crop. NCCB General Manager Michael Ndoping was reported by APA to have commented that “increased fertiliser use, sustainable farm management and quality control could easily add 50% to crop yield”.

| Year Ending 30th September | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014E | 2015F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cameroon** | | | | | | | | | | | | | | | | |
| Cocoa Beans (m mt) ICCO data | 0.12 | 0.13 | 0.13 | 0.14 | 0.16 | 0.18 | 0.17 | 0.17 | 0.19 | 0.21 | 0.21 | 0.23 | 0.21 | 0.23 | 0.21 | 0.23 |
| FAOSTAT area harvested (m ha) (2000-2012) | 0.37 | 0.36 | 0.34 | 0.45 | 0.49 | 0.40 | 0.44 | 0.55 | 0.59 | 0.60 | 0.67 | 0.67 | 0.67 | 0.72 | 0.78 | 0.85 |
| Change | -0.1% | -2.1% | -6.7% | 33.2% | 8.9% | -18.4% | 10.0% | 25.0% | 7.3% | 1.7% | 11.7% | 0.0% | 0.0% | *8.10%* | *8.10%* | *8.10%* |
| Yield (mt/ha) | 0.31 | 0.37 | 0.39 | 0.31 | 0.33 | 0.46 | 0.39 | 0.31 | 0.31 | 0.35 | 0.31 | 0.34 | 0.31 | 0.31 | 0.27 | 0.27 |
| *Italicized data for 2012-2014 planted area are HAB estimates based on average annual growth rate this century* | | | | | | | | | | | | | | | | |

*Source: ICCO, FAOSTAT*

The Cameroon cocoa sector, like much of the African sector, needs investment in new planting material. In 2009 the government announced that it would invest some $10m on seedlings of new varieties with the establishment of nurseries in the growing regions, but progress is reported to have been slow with observers noting a lack of ‘carry through’ on the part of the authorities. Reports from within the country speak of ‘stagnation’, ‘crisis’ and the need for complete restructuring of the sector: *Reuters Business News, Mon Jun 9, 2014 ‘Ageing farmers, low-yield crops hurt Cameroon's cocoa ambitions’.*

## *Conclusion*

With Ivory Coast accounting for some 40% of the global cocoa crop and Ghana another 20%, the data for agricultural efficiency, in terms of yield per hectare, for these two producer countries, do not support the premise that the African production sector can sustainably meet the steady growth in world demand for cocoa.

| Year Ending 30th September | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014E | 2015F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dry Cocoa Beans | Mt/ha | Mt/ha | Mt/ha | Mt/ha | Mt/ha | Mt/ha | Mt/ha | Mt/ha | Mt/ha | Mt/ha | Mt/ha | Mt/ha | Mt/ha | Mt/ha | Mt/ha | Mt/ha |
| Cameroon | 0.31 | 0.37 | 0.39 | 0.31 | 0.33 | 0.46 | 0.39 | 0.31 | 0.31 | 0.35 | 0.31 | 0.34 | 0.31 | 0.31 | 0.27 | 0.27 |
| Ghana | 0.29 | 0.29 | 0.25 | 0.33 | 0.37 | 0.32 | 0.40 | 0.42 | 0.40 | 0.41 | 0.40 | 0.64 | 0.55 | 0.52 | 0.56 | 0.39 |
| Ivory Coast | 0.70 | 0.68 | 0.67 | 0.66 | 0.69 | 0.59 | 0.62 | 0.52 | 0.60 | 0.56 | 0.58 | 0.61 | 0.58 | 0.56 | 0.65 | 0.66 |
| Nigeria | 0.17 | 0.18 | 0.18 | 0.16 | 0.17 | 0.18 | 0.19 | 0.16 | 0.16 | 0.18 | 0.18 | 0.19 | 0.20 | 0.20 | 0.20 | 0.15 |
| All Africa | 0.43 | 0.42 | 0.42 | 0.42 | 0.44 | 0.41 | 0.44 | 0.39 | 0.42 | 0.41 | 0.41 | 0.50 | 0.46 | na | na | na |
| All Africa Harvested Area (ha) | 5,061,657 | 4,656,969 | 4,612,573 | 5,146,176 | 5,808,813 | 5,795,494 | 5,938,230 | 6,042,425 | 6,403,608 | 6,067,315 | 6,063,314 | 6,397,265 | 6,337,218 | na | na | na |
| All Africa Production mt) | 2,161,000 | 1,947,000 | 1,951,000 | 2,158,000 | 2,550,000 | 2,379,000 | 2,641,000 | 2,360,000 | 2,687,000 | 2,484,000 | 2,486,000 | 3,224,000 | 2,929,000 | 2,836,000 | 3,198,400 | 3,051,200 |
| *Data:* | | | | | | | | | | | | | | | | |
| *ICCO: Production* | | | | | | | | | | | | | | | | |
| *FAOSTAT: Harvested Area* | | | | | | | | | | | | | | | | |
| *Cocobod: Harvested Area* | | | | | | | | | | | | | | | | |
| *Cameroon & Nigerian Cocoa authorities: planted area* | | | | | | | | | | | | | | | | |

*Source: ICCO, FAOSTAT*

Ghana's production blip in 2014/15 has shaken the global downstream sector's confidence in the country and the reports detailed herein give support to concerns that growth in cocoa output in Ivory Coast is perhaps heavily dependent on the planting of new areas – reportedly often in protected forests with consequential and negative impact on the country's once rich diversity of flora and fauna. In respect of both Nigeria and Cameroon the data above indicate that no progress has been achieved in terms of yield efficiency during the first 15 years of this century, while unsustainable area expansion has exceeded 66% for Nigeria and 80% for Cameroon. Both cocoa cultures are hampered by aged orchards and ageing farmers. While governments in both countries have targeted the cocoa sector for development, critics point to a lack of 'carry through' and farmers complain of being handicapped by poor infrastructure.

In the words of Laurent Pipitone, Director of the Economics and Statistics Division, International Cocoa Organization (ICCO), "there is a long way to go for African cocoa".

## A Postscript on Sustainability

In May 2014 CocoaAction was officially convened by the World Cocoa Foundation as secretariat to the initiative. This important initiative was described as an "unprecedented alignment among the world's largest cocoa and chocolate companies to coordinate their cocoa sustainability efforts". Not surprisingly, the initial focus for the initiative was to be Ivory Coast and Ghana – the two largest producers in the world. The central strategic thrust of CocoaAction was:

- "to coordinate and align the cocoa sustainability efforts of the world's largest cocoa and chocolate companies"
- "to increase their impact and contribute to building a rejuvenated an economically viable cocoa sector for no fewer than 300,000 cocoa farmers and the communities where they live, by 2020"
    - This included identifying best practices in promoting cocoa sustainability and scaling them through joint investments and aligned actions and in sharing lessons about what works in driving sustainability in cocoa production
    - The initiative stated that a key objective is for farmers to "see their productivity increase by at least 100%".
        - In the context of the data presented in this section of our report, a gain of 100% in productivity within 5 years would be a remarkable achievement.

CocoaAction was introduced to the world as "a commitment to a shared strategy and objectives" and as a "holistic approach based on combined productivity-enhancing and community development interventions". The governments of Ghana and Ivory Coast formally endorsed CocoaAction as the industry's aligned effort to support their national cocoa sustainability plans.

At the heart of the CocoaAction programme are 6 core development proposals including community development initiatives, a certification initiative and the four proposals detailed below:

1. **Planting material** – to substantially scale up effective supply and delivery models of improved planting material
2. **Fertiliser** – to ensure a competitive supply of good quality fertiliser at affordable prices including access to financing
3. **Extension Services** – to be more efficient and effective in training good agricultural practices
4. **Government & Donor Alignment** – pooling of expertise and resources

The signatories to the initiative included:

- ADM
- Armajaro
- Barry Callebaut
- Blommer
- Cargill
- ECOM
- Ferrero
- The Hershey Company
- Mars Inc
- Mondelez International
- Nestle
- Olam

Old sector hands note that some billions of USD have been invested in the African cocoa sector during this century, but they note that this has largely been spent on people – only some on the cocoa production sector itself. Certainly the production of cocoa has expanded with demand but yield development has been slow indeed and area expansion in Africa has apparently (based on reported harvested area) been relentless. A 'joined up' initiative that coordinated the activities of all the interested parties makes great sense.

Then in September 2015 Barry Callebaut the world's largest processor of cocoa announced the launch of the Cocoa Horizons Foundation, an independent non-profit organization. The mission of the Foundation is to improve the livelihoods of cocoa farmers and their communities through the promotion of sustainable, entrepreneurial farming, improved productivity and community development.

Barry Callebaut announced that the Foundation had two focal points:

1. training farmers in good agricultural practices and supporting them with materials and innovative financing solutions
2. working with rural communities to improve education opportunities, support child protection, empower women, and provide safe water and basic health services.

The company noted that the Cocoa Horizons Foundation was to serve "as a new platform for chocolate companies and other contributors to invest in sustainable cocoa".

The objectives chime closely with those of CocoaAction. The initial annual operational budget was indicated at some CHF 10 million, and intended to increase over time. But it is noteworthy that Barry Callebaut spelt out how the Foundation was to be financed:

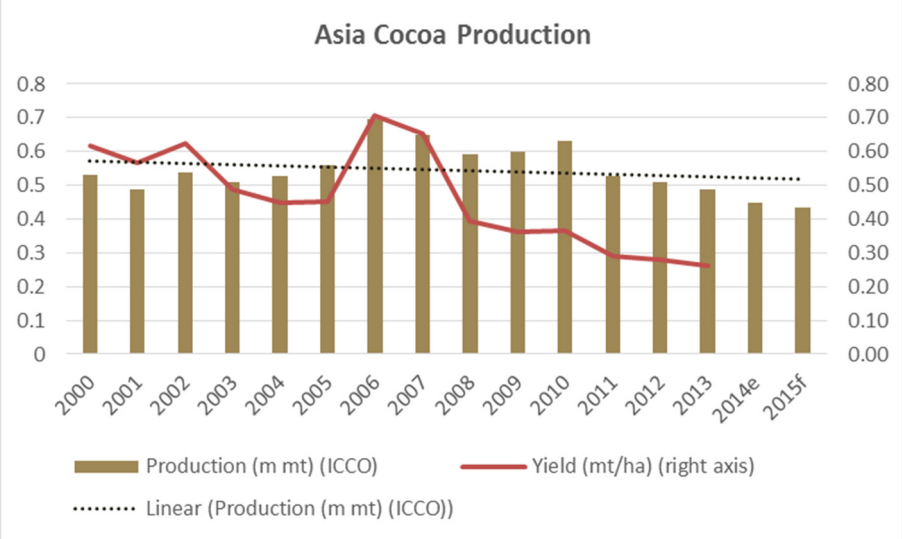
1. via the purchase of Barry Callebaut's sustainable HORIZONS cocoa and chocolate products
2. contributions from donors and customers inspired to support the mission of the Foundation
3. Barry Callebaut's contributions as part of its CHF 40 million Cocoa Horizons sustainability initiative launched in 2012.

The Barry Callebaut website page on Sustainability makes one brief reference (towards the bottom) to the company being a signatory to the CocoaAction initiative. Barry Callebaut is demonstrably an important and committed stakeholder in the cocoa production sector but the investments made by the company in the support of sustainability and of community development are also a projection of its brand: it is explicit that the cash for the work of the Foundation comes from Barry Callebaut and its customers. This is only commercial sense. Whether the 12 signatories to CocoaAction can align to realise the fulsome objectives of that joint initiative, whilst promoting individual initiatives, remains to be seen.

# Uncertain Future For Asia Region (incorporating Oceania) Cocoa

The chart below details an alarming truth: Asian cocoa production has been falling more or less steadily for 10 years. Yields per hectare have also plummeted as the chart makes equally clear. Once reported as high as 0.7mt/ha, yields are now projected at 0.24mt/ha. The severity of this decline may be overstated however: there are suspicions that the harvested area reported for Indonesia is exaggerated. But however the data are analysed the image is of a sector in decline, and in particular this is true for Indonesia.

**Asia Cocoa Production**




*Source: ICCO, FAOSTAT, Hardman Agribusiness*

To the question what is the future of Asian cocoa, the answer largely lies in the outlook for Indonesia and the trend is not encouraging. As in Africa, the leading brands and processors have committed reportedly significant resources to improve the outcomes of small holder farmers engaged in cocoa production across the region (and in Indonesia in particular), yet total production for 2014/15 is forecast at less than 76% of the outcome in 2000. In the same period, the reported area harvested has apparently more than doubled. Even adjusting for suspected over counting in Indonesia would still leave the harvested area 56% larger than in 1999/2000.

| Asia & Oceania Harvested Area FAOSTAT Data | 2000 Harvested Area (ha) | 2001 Harvested Area (ha) | 2002 Harvested Area (ha) | 2003 Harvested Area (ha) | 2004 Harvested Area (ha) | 2005 Harvested Area (ha) | 2006 Harvested Area (ha) | 2007 Harvested Area (ha) | 2008 Harvested Area (ha) | 2009 Harvested Area (ha) | 2010 Harvested Area (ha) | 2011 Harvested Area (ha) | 2012 Harvested Area (ha) | 2013 Harvested Area (ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indonesia | 749,917 | 765,405 | 776,901 | 961,107 | 1,090,960 | 1,167,046 | 905,730 | 923,968 | 1,425,216 | 1,587,136 | 1,651,539 | 1,732,600 | 1,852,900 | 1,774,500 |
| Papua New Guinea | 98,000 | 93,100 | 90,650 | 98,000 | 97,000 | 110,000 | 120,000 | 120,000 | 132,000 | 145,000 | 130,000 | 159,000 | 129,000 | 135,000 |
| India | 16,185 | 15,740 | 16,130 | 21,893 | 25,157 | 27,811 | 29,471 | 30,341 | 31,885 | 34,049 | 46,300 | 56,500 | 63,000 | 66,000 |
| Malaysia | 75,766 | 57,963 | 48,035 | 44,800 | 41,612 | 33,398 | 31,326 | 28,209 | 20,622 | 20,561 | 11,911 | 20,848 | 11,748 | 13,728 |
| Philippines | 12,077 | 11,997 | 11,525 | 10,846 | 10,845 | 10,719 | 10,354 | 9,985 | 9,751 | 9,538 | 9,463 | 9,584 | 9,338 | 9,431 |
| Solomon Islands | 6,000 | 5,000 | 7,000 | 11,000 | 10,000 | 11,700 | 9,000 | 10,000 | 10,000 | 10,600 | 12,500 | 15,100 | 12,000 | 12,000 |
| Vietnam (HAB estimate) | | | | | | | | | | | | | | 22,000 |
| Vanuatu | 3,000 | 1,600 | 2,300 | 3,000 | 1,700 | 1,800 | 3,250 | 2,600 | 2,500 | 2,500 | 2,600 | 2,000 | 2,500 | 2,650 |
| **Sub-total for 7 Largest Countries** | **960,945** | **950,805** | **952,541** | **1,150,646** | **1,277,274** | **1,362,474** | **1,109,131** | **1,125,103** | **1,631,974** | **1,809,384** | **1,864,313** | **1,995,632** | **2,080,486** | **2,035,309** |
| **As % of Total Asia & Oceania Harvested Area** | **101.0%** | **99.0%** | **99.0%** | **99.3%** | **99.4%** | **99.5%** | **99.4%** | **99.4%** | **99.6%** | **99.6%** | **99.6%** | **99.7%** | **99.7%** | **100.0%** |
| **Total** | **951,153** | **960,679** | **962,153** | **1,158,181** | **1,284,537** | **1,369,782** | **1,115,862** | **1,131,722** | **1,638,939** | **1,816,335** | **1,871,274** | **2,002,423** | **2,087,337** | **2,035,744** |

*Source: FAOSTAT*

So even with an increased harvested area of at least 56%, the production of cocoa in Asia as forecast for 2014/15 at 0.402m mt will be down 24% on the reported production for 1999/2000, and 42% down on the peak level (for this century) reported for the 2005/6 year. Indonesian output peaked in the same year at 585,000mt; for 2015 ICCO is forecasting Indonesian production to decline to 320,000mt for a fall of 45% in 10 years. Making up 84% of regional production in 2006, Indonesia will likely represent a little below 80% for 2015.

| Year Ending 30th September | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014E | 2015F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt |
| Indonesia | 0.42 | 0.39 | 0.46 | 0.41 | 0.43 | 0.46 | 0.59 | 0.55 | 0.49 | 0.49 | 0.55 | 0.44 | 0.44 | 0.41 | 0.38 | 0.32 |
| Papua New Guinea | 0.05 | 0.04 | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 | 0.04 | 0.05 | 0.04 | 0.04 | 0.04 | 0.04 |
| India | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 | 0.02 |
| Malaysia | 0.05 | 0.04 | 0.03 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 |
| Philippines | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 |
| Solomon Islands | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 |
| Vietnam | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vanuatu | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other Asia * | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | *0.00* | *0.00* | *0.00* |
| **Total Asia** | **0.53** | **0.49** | **0.54** | **0.51** | **0.53** | **0.56** | **0.69** | **0.65** | **0.59** | **0.60** | **0.63** | **0.53** | **0.51** | **0.48** | **0.45** | **0.40** |
| Change (%) | | **-8.5%** | **10.3%** | **-5.2%** | **3.3%** | **6.5%** | **23.9%** | **-6.6%** | **-9.0%** | **1.2%** | **5.9%** | **-16.9%** | **-2.9%** | **-5.0%** | **-7.8%** | **-10.0%** |
| **Change 2000-2014 (%)** | | | | | | | | | | | | | | | **-16.1%** | **-24.5%** |

*Source: ICCO Production Data/Hardman Agribusiness*

Only two other Asian countries generate much excitement amongst sector watchers: Papua New Guinea and Vietnam. There remains hope also that the Philippines will make good (to some extent) on its ambitious plans to revitalise its cocoa production sector.

While it is undoubtedly one of Asia's more hopeful cocoa producers, PNG's production levels are also down on peak (by 29%). In the face of devastating attacks by Cocoa Pod Borer, a regional pest, the country has demonstrated resilience and its beans are recognised for their quality and even for flavour. 90% of PNG's exports are designated Fine or Flavour beans by ICCO. Agmark Ltd, a producer and trader of PNG cocoa is frequently credited with providing the PNG cocoa sector with strong leadership in agronomics and quality control, and for being a prime mover in the development of a cocoa culture in the country.

The pattern of declining annual production of cocoa from Asia region is one of the factors shaping concerns about a global cocoa supply deficit occurring in the approach to the 2020s. The data for Asia/Oceania yield per ha are the worst of the three cocoa producing regions and this stark reality has raised the concern that the agronomic skills and producer commitment necessary to sustain production in Indonesia have been lost.

| Asia Harvested Area FAOSTAT Data/ ICCO Production Data | 2000 Harvested Area (ha) | 2001 Harvested Area (ha) | 2002 Harvested Area (ha) | 2003 Harvested Area (ha) | 2004 Harvested Area (ha) | 2005 Harvested Area (ha) | 2006 Harvested Area (ha) | 2007 Harvested Area (ha) | 2008 Harvested Area (ha) | 2009 Harvested Area (ha) | 2010 Harvested Area (ha) | 2011 Harvested Area (ha) | 2012 Harvested Area (ha) | 2013 Harvested Area (ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indonesia | 749,917 | 765,405 | 776,901 | 961,107 | 1,090,960 | 1,167,046 | 905,730 | 923,968 | 1,425,216 | 1,587,136 | 1,651,539 | 1,732,600 | 1,852,900 | 1,774,500 |
| Yield per ha (mt) | 0.56 | 0.51 | 0.59 | 0.43 | 0.39 | 0.39 | 0.65 | 0.59 | 0.34 | 0.31 | 0.33 | 0.25 | 0.24 | 0.23 |
| Papua New Guinea | 98,000 | 93,100 | 90,650 | 98,000 | 97,000 | 110,000 | 120,000 | 120,000 | 132,000 | 145,000 | 130,000 | 159,000 | 129,000 | 135,000 |
| Yield per ha (mt) | 0.48 | 0.42 | 0.42 | 0.43 | 0.40 | 0.43 | 0.43 | 0.39 | 0.39 | 0.41 | 0.30 | 0.30 | 0.30 | 0.30 |
| India | 16,185 | 15,740 | 16,130 | 21,893 | 25,157 | 27,811 | 29,471 | 30,341 | 31,885 | 34,049 | 46,300 | 56,500 | 63,000 | 66,000 |
| Yield per ha (mt) | 0.37 | 0.44 | 0.43 | 0.37 | 0.37 | 0.33 | 0.35 | 0.34 | 0.33 | 0.35 | 0.28 | 0.26 | 0.21 | 0.23 |
| Malaysia | 75,766 | 57,963 | 48,035 | 44,800 | 41,612 | 33,398 | 31,326 | 28,209 | 20,622 | 20,561 | 11,911 | 20,848 | 11,748 | 13,728 |
| Yield per ha (mt) | 0.59 | 0.60 | 0.52 | 0.80 | 0.82 | 0.86 | 1.08 | 1.16 | 1.49 | 1.09 | 1.27 | 0.36 | 0.34 | 0.22 |
| Philippines | 12,077 | 11,997 | 11,525 | 10,846 | 10,845 | 10,719 | 10,354 | 9,985 | 9,751 | 9,538 | 9,463 | 9,584 | 9,338 | 9,431 |
| Yield per ha (mt) | 0.57 | 0.68 | 0.55 | 0.52 | 0.53 | 0.52 | 0.55 | 0.53 | 0.53 | 0.54 | 0.53 | 0.51 | 0.52 | 0.51 |
| Solomon Islands | 6,000 | 5,000 | 7,000 | 11,000 | 10,000 | 11,700 | 9,000 | 10,000 | 10,000 | 10,600 | 12,500 | 15,100 | 12,000 | 12,000 |
| Yield per ha (mt) | 0.43 | 0.38 | 0.42 | 0.36 | 0.44 | 0.39 | 0.51 | 0.44 | 0.41 | 0.46 | 0.40 | 0.42 | 0.39 | 0.39 |
| Vietnam (HAB estimate) | | | | | | | | | | | | | | 22,000 |
| Yield per ha (mt) | | | | | | | | | | | | | | 0.10 |
| Vanuatu | 3,000 | 1,600 | 2,300 | 3,000 | 1,700 | 1,800 | 3,250 | 2,600 | 2,500 | 2,500 | 2,600 | 2,000 | 2,500 | 2,650 |
| Yield per ha (mt) | 0.33 | 1.50 | 0.37 | 0.43 | 0.56 | 0.50 | 0.40 | 0.54 | 0.48 | 0.60 | 0.58 | 0.83 | 0.48 | 0.75 |
| Yield per ha Total Asia & Oceania Area (mt) | 0.55 | 0.51 | 0.56 | 0.44 | 0.41 | 0.41 | 0.62 | 0.57 | 0.36 | 0.33 | 0.34 | 0.26 | 0.24 | 0.24 |

*Source: FAOSTAT, ICCO, Hardman Agribusiness*

Yield per ha expressed in tonnes of dry beans looks to have declined across Asia & Oceania by some 56% since the start of this century. The data for harvested area may be wrong, and in particular, wrong for Indonesia. Sector sources advise HAB that the Indonesian harvested area may be overstated by as much as 0.5m ha (Marc Donaldson / On The Ball Consulting / Singapore). Adjustment for this overstatement would elevate projected 2014/15 yields to 0.32 mt/ ha across the Asia/Oceania region, implying a decline of 42% in average productivity over the first 15 years of the century. If the data are adjusted further to remove the effect of Malaysia's dramatic decline in output, the decline across the region has been in the order of 38%. The decline in output from the Asia / Oceania cocoa region has been a major factor in the changing profile of global cocoa production and it can be linked primarily to Asian small holder farmers abandoning cocoa in favour of palm oil and rubber production and to the effects of pest and disease. Cocoa Pod Borer, Black Pod and Vascular Streak Disease, which attack up to a third of the annual crop, are key challenges across the region.

The picture which evolved from our researches of the Asian cocoa sector, is that cocoa as a crop failed to compete for land and capital within the management suites of the region's plantation companies due to the difficulties associated with its cultivation, high labour requirement relative to palm oil and rubber production, and due to the historic volatility of the cocoa price. The Asian cocoa producer sector is therefore fundamentally driven by small holder farmers – and this is overwhelmingly the case in Indonesia where HAB has been able to identify only two agro-industrial cocoa production initiatives. Asia therefore contrasts markedly from Latin America region where a vibrant corporate cocoa sector is developing new plantations and new approaches to the farming of cocoa.

At a government level in many Asian countries (Indonesia and Malaysian in particular) the crop was apparently not considered to be sufficiently important to warrant the same sort of support that has characterised the palm oil sector for example. A striking contrast to this can be seen today in Vietnam where the government is encouraging, with some evident success, the development of the cocoa sector. In Papua New Guinea also, the authorities have worked with other agencies including NGOs and the private sector to support a sustainable cocoa production sector. Across the region, the Philippines and Indonesia, being often cited examples, government pronouncements do not seem to be adequately supported by proactive policies and material commitments.

## Indonesia

Indonesia is the third largest cocoa growing region in the world with some 1.775m ha down to cocoa in 2013 according to FAOSTAT data (although there is some doubt as to whether this is an accurate estimate). Other sources as noted above believe that the reported area is overstated by perhaps as much as 500,000 ha.

| Asia Harvested Area FAOSTAT Data/ ICCO Production Data | 2000 Harvested Area (ha) | 2001 Harvested Area (ha) | 2002 Harvested Area (ha) | 2003 Harvested Area (ha) | 2004 Harvested Area (ha) | 2005 Harvested Area (ha) | 2006 Harvested Area (ha) | 2007 Harvested Area (ha) | 2008 Harvested Area (ha) | 2009 Harvested Area (ha) | 2010 Harvested Area (ha) | 2011 Harvested Area (ha) | 2012 Harvested Area (ha) | 2013 Harvested Area (ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indonesia | 749,917 | 765,405 | 776,901 | 961,107 | 1,090,960 | 1,167,046 | 905,730 | 923,968 | 1,425,216 | 1,587,136 | 1,651,539 | 1,732,600 | 1,852,900 | 1,774,500 |
| Yield per ha (mt) | 0.56 | 0.51 | 0.59 | 0.43 | 0.39 | 0.39 | 0.65 | 0.59 | 0.34 | 0.31 | 0.33 | 0.25 | 0.24 | 0.23 |

*Source: FAOSTAT/ICCO*

Even adjusted for say an overstatement of 0.5m ha, the Indonesia harvested area would still have expanded by more than 73% since 2000, but with production shrinking over the same period by nearly 100,000mt. The stark decline in Indonesian output has raised concerns that the country is losing its 'cocoa culture'.

| Year Ending 30th September | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014E | 2015F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt |
| Indonesia | 0.42 | 0.39 | 0.46 | 0.41 | 0.43 | 0.46 | 0.59 | 0.55 | 0.49 | 0.49 | 0.55 | 0.44 | 0.44 | 0.41 | 0.38 | 0.32 |

*Source: ICCO*

The average smallholder farm typically ranges from 0.5 ha to 3.0 ha and cocoa yields range reportedly from 200kg to 800 kg/ha. Significantly more than 90% of the crop is most likely produced by smallholder family farms with over 400,000 farming families (in total) being involved in the production of cocoa in Indonesia. Estimates range from 60% -75% for the portion of the crop produced in the Sulawesi region, where cocoa farming is the principal income for hundreds of thousands of families. The remaining Indonesian cocoa production takes place in North Sumatra, West Java, and Papua, with some small production areas in Bali, Flores, and other islands including the Malukku Islands where Olam International is rehabilitating an estate of some 3,400 ha.

Indonesia's main locations of cocoa production are:

1. Sulawesi
2. North Sumatra
3. West Java
4. Papua
5. East Kalimantan

In 2009 the Indonesian authorities introduced a five-year cocoa revitalization programme to boost production through intensification, rehabilitation and rejuvenation activities, covering a total area of 450,000 hectares. The sector is reported to suffer from aging trees, first planted in the 1980s, unimproved planting material and poor farm upkeep. The government has a history of introducing ambitious targets and programmes to support the achievement of these targets, but which (reportedly) are not followed through.

## *Agro-industrial Cocoa Production*

### London Sumatra

London Sumatra (Lonsum) operates cocoa plantations in East Java, North Sulawesi and North Sumatra. According to the company's website the total cocoa plantation area (across the three sites) was 2,539 ha at end of 2013. Lonsum has been an active member of the Cocoa Sustainability Partnership (CSP) since 2012. There are unconfirmed rumours that Lonsum is proposing to expand cocoa production to 10,000ha. Lonsum itself simply confirms that it is looking to expand the area under cultivation.

HAB understands that the Lonsum cocoa orchards have an average age of about 12 years. In 2014 total production was reported at some 1,920mt, suggesting circa 0.76mt/ha. Lonsum advises that it is operating a semi-shade system of cocoa cultivation and that it is providing employment for around 2,000 staff. This would indicate a ratio of 1.27ha: 1 FTE. Unless these staff are also employed in developing further planted areas, this ratio would indicate an out grower production model.

Established in 1906 by the British firm Harrisons & Crossfield Plc, Lonsum evolved to become one of the world's most renowned plantation companies, with almost 100,000 ha of planted oil palm, rubber, tea and cocoa plantations spread across Indonesia's four largest islands.

## *Olam International Ltd*

In May 2014 Olam announced that it proposed to invest some US$61.0 million to establish a new cocoa processing facility in Indonesia. With an initial capacity of 60,000 metric tonnes, the facility is expected to produce cocoa butter, cocoa cake and high quality cocoa powders. Olam intended for the plant to primarily grind Indonesian beans sourced through the company's 'traceable cocoa network', which includes the 32,000 farmers who form the core of its sustainable supply chain in Indonesia, as well as beans from its own 3,420 ha plantation on Seram Island (part of the Malukku Islands between Sulawesi and Papua) acquired in 2013. Additionally the company proposes to supply beans from its farm-gate network across West Africa.

The company announced that the investment was in line with its 'Cocoa Strategy': the integration of its global cocoa bean supply chain capabilities with processing capacities in selected origins to address 'the growing outsourcing trend by confectioners', and the rising global consumption demand for cocoa products, particularly in Asia. The cocoa processing plant was scheduled to commence operations in early 2016, but industry sources have questioned whether this will happen.

## *Small Holder Support Initiatives*

### Cargill

The US firm has been sourcing Indonesian cocoa since 1995. The company has deepened its involvement in the Indonesian cocoa sector with an investment of over

US$100m in a 70,000mt/pa cocoa processing facility in East Java. Opened in December 2014 the Gresik plant is expected to produce Cargill's Gerkens cocoa powders along with cocoa liquor and butter.

Cargill established a Farmer Field Training School in the South Sulawesi province in 2012 which has reportedly trained 8,041 farmers to a standard where they can gain independent sustainable certification through either UTZ Certified or Rainforest Alliance. The trader plans to extend farmer training to other regions in Indonesia over the next few years. The training is designed to help farmers to improve yields, enhance the quality of the cocoa they produce through fermentation and ultimately increase their incomes. With up to 50% of the Indonesian cocoa crop reportedly lost to pests and disease, there will be a particular focus on best practice in pest and disease control. Additionally Cargill is seeking to help form 50 farmer organizations in the Bone district, which will be expected to play a role in the administration and marketing of the cocoa crops.

Cargill has established 25 demonstration plots to show farmers how to use fertilizer appropriately and to demonstrate grafting techniques that can be used to rehabilitate unproductive trees and rejuvenate plantations. Together with government officials, and under the supervision of Cargill's field officers, the company has set up nurseries at every demonstration plot to distribute seedlings to farmers that are part of the Cargill training programme.

### Nestle

Nestlé's involvement in the Indonesian cocoa sector began several years ago with the donation of accelerated propagation technology to the Indonesian Coffee and Cocoa Research Institute (ICCRI). Nestlé has deepened this involvement: at November 2013, the Nestlé Cocoa Plan is reported to have created some 100 farmer groups and trained more than 3,000 farmers in Good Agriculture, Nutrition, Environment and Business Practices.

## Papua New Guinea

Growing conditions are near to ideal for cocoa in parts of Papua New Guinea (PNG) and yet in this country also, production levels have been volatile. After peaking at some 59,000mt in 2008/9, ICCO is forecasting just 42,000 mt for the 2014/15 cocoa year.

| Year Ending 30th September | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014E | 2015F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt | m mt |
| Papua New Guinea | 0.05 | 0.04 | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 | 0.04 | 0.05 | 0.04 | 0.04 | 0.04 | 0.04 |

*Source: ICCO*

PNG's cocoa production has declined over the last decade as a result of a range of factors including inadequate replanting, (with many trees over 40 years old), and of course Cocoa Pod Borer (CPB). Production in East New Britain was reported (by Business Advantage PNG) to have collapsed by 82% between 2008 and 2012 due to CPB which has hit many cocoa producing regions in Asia. Traditional yields are typically in the range of 0.3-0.4mt / ha, but with better management, yields of more than 1mt/ha are reported to have been achieved.

Until the outbreak of CPB, East New Britain in Papua New Guinea was the chief source of cocoa in the country, with annual production of more than 25,000 tonnes. More than 80% of cocoa farmers were reported to have abandoned their plantations between 2008 and 2012, and sought work elsewhere. By 2013, only 4,000 tonnes were produced in the province. The fight back has involved significant investment in

time, research and training, involving Agmark and PNG Cococa & Coconut Institute Ltd (CCIL), the industry R&D facility, joined by PNG Sustainable Development Ltd and the World Bank, (through the Cocoa Board's Productive Partners in Agriculture Projects (PPAP)). In 2014 the World Bank approved US$30 million for projects in six provinces. The NGIP-Agmark Farmer Partnership has planted more than 234,000 cocoa seedlings on 1,172 smallholder farms in East New Britain, according to Agmark Managing Director, John Nightingale, (as reported by Business Advantage PNG). Nightingale further noted that the plan is to plant another 234,000 cocoa seedlings, and to develop the concept of rotational replanting of the cocoa crop throughout the Agmark farmer networks, and to continue with this 'farming systems' approach to redeveloping the industry sustainably, utilising currently available Public Private Partnership funding, and other co-partner investment funding as it becomes available.

Included amongst the measures taken under the PPAP scheme are:

- the introduction of the new and hardier poly-clonal hybrid seedling selections from CCIL
    - noted for their ability to withstand the CPB and various diseases
    - reported to have the potential to more than double the cocoa yield for farmers
- A new training facility has also been built by Agmark at the company's Tokiala plantation
    - where farmers are taught management of cocoa including the management of the effects of CPB.

Nightingale claims that research at Tokiala has demonstrated farmers could get 2.5 tonnes per hectare, if they adopted the "Five Simple Steps' of an intensive management strategy promoted by the slogan 'Every Pod, Every Tree, Every Week' developed by the company. Smallholder blocks previously have been on average producing only 0.4 tonnes per hectare. Another strategy has been to appoint 'lead farmers', whose role is to lead and influence other farmers on the best practice crop cultivation, and how to manage cocoa farming as a sustainable business.

Management techniques including pruning, good block sanitation, weekly harvesting and burial of infected pods and pod husks, are thought to be able to break the life cycle of CPB. These cultural control measures can reportedly mitigate as much as 80% of the impact of the CPB infestation effects; and, when supported with a managed low impact target spraying insecticide programme, based upon a pod counting system developed by Agmark, this can reportedly achieve 95% -98% control. Research, funded by the Australian Centre for International Agricultural Research, is additionally seeking to identify strategies that will enable growers to produce cocoa in a high risk CPB environment. Business Advantage PNG reported that some 1,000 of East New Britain's 23,000 growers are taking part in the trial which is resulting in higher yields.

### *NGIP Agmark Group*

The Agmark export business depends on smallholder producers and its proprietary estates and managed land. In East New Britain, Agmark's Farmer Supply Group includes more than 1,000 farming households. The total is sub-divided geographically into individual cluster groups of varying size. By way of example, the Tokiala cluster group has 395 producers. The Farmer Supply Group approach has been designed with traceability and certification in mind. In Madang Province, Agmark has a Farmer Supply Group of over 600 producers, again with geographically located cluster groups. This is what the company calls a 'Contract Producer' group

under the Fairtrade certification standard. The group was to have its first Fairtrade audit during the 3Q 2015.

## Philippines

The Philippines is a country with significant agricultural assets and a climate suitable for cocoa. Yet the harvestable area was put at only 9,431 ha in 2013 by FAOSTAT and national output appears to have ranged narrowly from 4,500 mt to 6,000 mt over the past 4-5 years, a number that does not quite tally with Cocoa Foundation of The Philippines, (CocoaPhil) estimate of a 12,000mt national crop.

| Asia Harvested Area FAOSTAT Data/ ICCO Production Data | 2000 Harvested Area (ha) | 2001 Harvested Area (ha) | 2002 Harvested Area (ha) | 2003 Harvested Area (ha) | 2004 Harvested Area (ha) | 2005 Harvested Area (ha) | 2006 Harvested Area (ha) | 2007 Harvested Area (ha) | 2008 Harvested Area (ha) | 2009 Harvested Area (ha) | 2010 Harvested Area (ha) | 2011 Harvested Area (ha) | 2012 Harvested Area (ha) | 2013 Harvested Area (ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Philippines | 12,077 | 11,997 | 11,525 | 10,846 | 10,845 | 10,719 | 10,354 | 9,985 | 9,751 | 9,538 | 9,463 | 9,584 | 9,338 | 9,431 |
| Yield per ha (mt) | 0.57 | 0.68 | 0.55 | 0.52 | 0.53 | 0.52 | 0.55 | 0.53 | 0.53 | 0.54 | 0.53 | 0.51 | 0.52 | 0.51 |

*Source: FAOSTAT/ICCO*

Some years ago the authorities set a target of 100,000mt of domestically produced cocoa by 2020. According to our sources it may be possible for the country to achieve 25,000 to 30,000 mt by 2020, if so, that would be a remarkable turn round on the current level of 5,000mt-6,000mt annually. Cacao production in the Philippines is currently a smallholder activity and mostly concentrated in the Davao City region in the Southern part of the Philippines. The region is popular for tree crops as it is apparently outside the typhoon belt. According to CocoaPhil, 77% of the 12,000 mt of national production comes from this region. Before the Agrarian Reform Law was passed, cocoa was produced on large plantations running to hundreds of hectares.

CocoaPhil advises that it is promoting new development of the crop in the Luzon region where the organisation is encouraging farmers to inter-crop coconut plantations with cacao. So far, Camarines Sur and Norte in Bicol region, Quezon province, Pangasinan, Mindoro Oriental and Occidental, Isabela, Cagayheran, Palawan, Romblon, Bulacan, Batangas, Bataan, Laguna, Rizal and other provinces in Luzon have begun to introduce the crop and CocoaPhil reports that some farmers are rehabilitating their old trees. CocoaPhil reports that all this activity is largely at the behest of the private sector with "a very minimal assistance from the government". CocoaPhil is conducting monthly training on:

- sustainable cacao planting
- insect pest management & disease monitoring
- harvesting
- fermentation and drying techniques
- the organisation also seeks to connect farmers with buyers.

The land reform laws have made it difficult today to establish large estates, and there are additional sensitivities where projects involve the ancestral lands of indigenous peoples. However we are aware of at least one initiative to establish a significant cocoa plantation of up to 5,000ha on Mindanao, but so far it is has not progressed beyond an out grower programme covering (reportedly) some 5,000 ha. CocoaPhil states that it wants to encourage the Indigenous People who have thousands of hectares of ancestral land to take up cocoa farming. It is currently working with tribes and communities including in the Southern Sierra Madre Wildlife Centre run by Miriam College. In other areas it is seeking the help of local priests to spread the message about the opportunities for planting cacao.

## India

The Indian land holding system, as it applies to agricultural land, was implemented to protect India's peasant farmers, but one of its effects has been to make large scale industrial farming difficult to impossible. Cocoa production appears to be largely in the hands of traditional smallholder farmers and farming co-operatives including groupings such as Manarcadu Social Service Company (MASS) and Indian Organic Farmers Producer Company Ltd (IOFPCL). The Indian upstream cocoa producer sector, much of which was developed with the support and direction of Cadbury, may largely exist today to supply Mondelēz.

Before 1965, cocoa was unknown to India as a commercial crop. The Indian chocolate and related industries were totally dependent on imports of cocoa beans. Cadbury (now Mondelēz) initiated cocoa cultivation in India through a demonstration farm at Chundale in Wyanad district of Kerala in 1965. Cadbury identified Kerala as the most suitable region for growing cocoa in Southern India (annual rainfall approaches 3000 mm, the temperature varies from maximum 40 degrees C to minimum 18 degrees C), and commercial cultivation of cocoa got underway during the mid-1960s. The absence of a cocoa culture was apparently a major brake on development and this is reported to have stalled Kerala's development as a source of quality cocoa for several decades. In the 1990s, Cadbury supported the introduction of cocoa to the East and West Godavari districts, where cocoa is cultivated as an inter-row crop with coconut.

The traditional complaint of confectioners who source Indian cocoa has been that farmers were more likely to uproot their cocoa orchards to plant rubber than expand cocoa production. One factor is that harvesting takes place around the rainy season when bean moisture levels are high, but farmers are paid on dry weight, and this is reported to be as source of disgruntlement. Additionally with harvests taking place in very damp and humid conditions there is a reported problem with quality. The development of the sector, including much of the scientific research into the development of cocoa cultivation in India, has been at the initiative of Cadbury. The company claims that tree productivity is now at 1.1kg of beans pa, which would equate to circa 1.2mt /ha in a typical 1,111 trees/ha plantation. Densities in India will be lower (perhaps around 800 trees per ha) as cacao is inter-planted with coconut (typically).

In 2012 FAOSTAT put harvested area in India at an estimated 55,000 ha and ICCO is estimating national production at circa 16,000 mt in 2014/15. Yet when inaugurating a national seminar on cocoa cultivation in January 2015, (sponsored by the University of Agriculture and Horticultural Sciences (UAHS), Shivamogga, and the Directorate of Cocoa and Cashew Development (DCCD)), Mr S.K. Malhotra, Horticulture Commissioner, stated that "concerted efforts are essential to expand the area under cocoa cultivation in India". The Commissioner noted that the total annual production of cocoa in India stood at 17,000 mt (a little higher than ICCO's estimates) against national demand for 30,000 mt.

| Asia Harvested Area FAOSTAT Data/ ICCO Production Data | 2000 Harvested Area (ha) | 2001 Harvested Area (ha) | 2002 Harvested Area (ha) | 2003 Harvested Area (ha) | 2004 Harvested Area (ha) | 2005 Harvested Area (ha) | 2006 Harvested Area (ha) | 2007 Harvested Area (ha) | 2008 Harvested Area (ha) | 2009 Harvested Area (ha) | 2010 Harvested Area (ha) | 2011 Harvested Area (ha) | 2012 Harvested Area (ha) | 2013 Harvested Area (ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| India | 16,185 | 15,740 | 16,130 | 21,893 | 25,157 | 27,811 | 29,471 | 30,341 | 31,885 | 34,049 | 46,300 | 56,500 | 63,000 | 66,000 |
| Yield per ha (mt) | 0.37 | 0.44 | 0.43 | 0.37 | 0.37 | 0.33 | 0.35 | 0.34 | 0.33 | 0.35 | 0.28 | 0.26 | 0.21 | 0.23 |

*Source: FAOSTAT/ICCO*

The authorities want to see wide expansion of the area under cocoa cultivation, which would be supported with the distribution to farmers, (by way of private

nurseries), of high yielding Indian hybrids. The Commissioner noted that the government wanted to see the confectionery sector supporting the programme with:

- 'buy-back agreements' with cocoa farmers and farmer co-operatives
- study and research on diversification of their product portfolio
    - including the use of spices and fruits
- research on processing and fermentation of cocoa.

As the dominant player (with an unrivalled distribution network) in the Indian chocolate confectionery market (market share rumoured over 65%), Cadbury is thought to buy the very largest proportion of the Indian crop. Siddhartha Mukherjee, a director of Mondelēz India Foods Private Limited was reported to say "today we source a third of our cocoa requirement from India..." swissinfo.ch.

## Vietnam

Since the early years of this century the planted area in Vietnam has expanded from just a few thousand ha to an estimated 22,000 ha today. Small family farms, mostly growing Trinitario varieties as a component in mixed crop farming systems characterise the Vietnamese sector. By 2013 the country was able to produce 5,000 mt of cocoa and it is planned to have 50,000 ha planted by 2020. The Mekong delta region, also known as 'Little Venice', is the major cocoa-producing region in Vietnam. Cocoa was introduced into Vietnam in the 19th century by French colonists who began planting the crop in the 1800s. However it was supplanted by coffee, cashews, pepper and other, then more profitable crops. Briefly for a period in the 1980s, entrepreneurs from the USSR attempted to grow cocoa in Vietnam. The country has a highly suitable climate and fertile soils for growing cocoa, however these factors notwithstanding there was little cocoa production in Vietnam before the 21st century. In 2000, the Ministry of Agriculture and Development announced a long-term programme to stimulate cocoa production in Vietnam. In 2004, Mars, Cargill and the Dutch Government collaborated on a development programme to stimulate growth in the sector. The Dutch government provided financial support, Cargill set up the supply-chain infrastructure and Mars gave technical consultancy. In 2005 the government set up a task force with responsibility for co-ordinating a development strategy working with state authorities, researchers, purchasers, donors and farmers. About the same time cacao seeds were planted through a public-private partnership led by the non-profit organization ACDI-VOCA partnering with Mars.

The Vietnamese government has made clear that it will make use of all financial assistance from international organizations for developing cocoa production. The USDA has given US$4 million in aid for the Vietnamese cocoa farmers through Cocoa Program, and the US Agency for International Development (USAID) has provided Vietnam with US$800,000 to help the country's cocoa sector development. Also the Dutch government has contributed 650,000 Euros to the development of the Vietnamese sector.

# High Tech Cacao – A Spotlight on Latin America

In contrast to Africa and Asia, the Latin American region (Latam) has both developed and retained an active professional agro-industrial cacao plantation sector, albeit that it is small relative to the smallholder sector, even in this region. HAB estimates that the total harvested area under the management of agro-industrial / professional farming enterprises, is between 8%-10%, with the greatest number of enterprises and land under management in Brazil (circa 15% of total area). Typically Ecuadorian and Brazilian agro-industrial plantations have been funded with family wealth and managed by their proprietors or by professionally trained managers. Now this model is being expanded across the region, by established regional professional cocoa producers, and also by a new breed of developer, some local but many foreign, including corporations, entrepreneurs and specially conceived investment funds. Investment funding for the production of cocoa in the most favourable growing regions for cacao in Latam is being attracted by the vibrant cocoa culture that is developing in the region, and by the investment grade status of countries such as Colombia and Peru, which offer a range of fiscal incentives to agri-investors, without limitation on foreign ownership, and by the abundance of affordable labour in a number of countries in the region.

Within the Latam region (in particular) the production of cocoa is being re-imagined: a small group of highly experienced managers of successful and established regional cacao plantations, together with a number of the incoming developers, are applying new agri-technologies and evolved cacao agronomics to the cultivation of the crop. Their goal is to standardise a set of agronomy principles, adaptable for specific site conditions, which will support the production of high quality cocoa beans within a commercially acceptable yield range.

## Latin America: A Vibrant Cocoa Culture

In Latin America, more than anywhere else in the tropical belt, alongside traditional small holder cultivation, a culture of relatively large scale privately owned agro-industrial cacao plantations has been in development since the 19th century and possibly longer. Such plantations are predominantly to be found in Brazil and Ecuador but with the model also now occurring in Colombia, Nicaragua and Peru. Investors in, and developers of cacao plantations are attracted to the Latam region because of its deep reservoir of planting materials, its natural suitability for the cultivation of cacao and because of its established culture of cocoa production.

### A Growth Century

Between 2000 and 2015, the America's region has increased total production by almost 99%. As the table below illustrates, total production increased by 73% over the period 2000-2012 for the top 7 producing countries accounting for some 95% of total regional production, while the reported area harvested increased by only 3%. The FAO data for harvested area will be subject to all the same frailties as the data for other regions, dependent as the FAO is on the provision of reliable data from government agencies. However, in the main producer countries of Latam region there are frequently both well established Ministries of Agriculture and national support agencies for the cocoa producer sector to provide accurate field data.

Yield per ha has expanded by 67% since the start of this century and yet yields are still low per ha overall, reflecting the relative sizes of the smallholder sector (circa 90%) compared to the professional estates in the context of total land under

cultivation for production of cocoa. The significant increase in yield (67%) since the start of this century, contrasting with only a small area increase (3%), speaks volumes for the progressive nature of the Latam cocoa sector.

With significant new investment for development of cacao cultivation across the region, and with a focus on 'high tech' production methodologies, the growth rate for the next 15 years may exceed the period 2000-2015 – perhaps significantly. HAB has identified new capacity (initiated since 2011) amounting to almost 50,000 ha, either under development or in planning and strongly likely to be developed. Even without further new developments these projects have the potential to boost Latam's total production by circa 125,000 mt annually *if* this new capacity can achieve the 2.5mt / ha dry beans standard that modern Latam plantations are demonstrating can be achieved with professional farming on a well designed plantation.

| Americas Harvested Area FAOSTAT Data | 2000 Harvested Area (ha) | 2001 Harvested Area (ha) | 2002 Harvested Area (ha) | 2003 Harvested Area (ha) | 2004 Harvested Area (ha) | 2005 Harvested Area (ha) | 2006 Harvested Area (ha) | 2007 Harvested Area (ha) | 2008 Harvested Area (ha) | 2009 Harvested Area (ha) | 2010 Harvested Area (ha) | 2011 Harvested Area (ha) | 2012 Harvested Area (ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brazil | 705,965 | 665,809 | 582,315 | 590,945 | 638,825 | 625,384 | 647,135 | 628,928 | 641,337 | 635,975 | 660,711 | 680,484 | 684,333 |
| Yield (mt/ha) | 0.18 | 0.24 | 0.21 | 0.28 | 0.26 | 0.27 | 0.25 | 0.20 | 0.27 | 0.25 | 0.24 | 0.29 | 0.32 |
| Ecuador | 402,836 | 429,547 | 363,575 | 348,434 | 336,358 | 357,706 | 350,027 | 356,658 | 376,604 | 398,104 | 360,025 | 399,467 | 390,176 |
| Yield (mt/ha) | 0.24 | 0.21 | 0.22 | 0.24 | 0.35 | 0.32 | 0.34 | 0.35 | 0.31 | 0.34 | 0.42 | 0.40 | 0.51 |
| Dominican Republic | 139,373 | 125,786 | 125,787 | 125,787 | 125,787 | 153,219 | 153,219 | 153,219 | 157,000 | 153,219 | 153,219 | 153,219 | 150,943 |
| Yield (mt/ha) | 0.27 | 0.36 | 0.36 | 0.36 | 0.37 | 0.20 | 0.30 | 0.27 | 0.29 | 0.36 | 0.38 | 0.35 | 0.48 |
| Mexico | 81,023 | 83,037 | 83,130 | 80,903 | 80,879 | 61,477 | 60,866 | 60,934 | 79,000 | 95,000 | 96,000 | 118,000 | 117,000 |
| Yield (mt/ha) | 0.45 | 0.46 | 0.48 | 0.52 | 0.54 | 0.59 | 0.56 | 0.53 | 0.35 | 0.24 | 0.28 | 0.18 | 0.24 |
| Colombia | 83,138 | 80,165 | 83,406 | 86,784 | 73,674 | 80,650 | 77,320 | 86,937 | 90,959 | 95,167 | 95,641 | 99,205 | 102,902 |
| Yield (mt/ha) | 0.45 | 0.47 | 0.44 | 0.44 | 0.50 | 0.46 | 0.48 | 0.35 | 0.42 | 0.38 | 0.42 | 0.35 | 0.42 |
| Peru | 41,284 | 45,735 | 46,820 | 49,787 | 50,879 | 50,313 | 56,732 | 59,835 | 63,626 | 66,335 | 77,192 | 84,174 | 91,497 |
| Yield (mt/ha) | 0.58 | 0.53 | 0.50 | 0.49 | 0.51 | 0.48 | 0.55 | 0.52 | 0.51 | 0.55 | 0.56 | 0.65 | 0.66 |
| Venezula | 56,644 | 53,706 | 55,162 | 50,802 | 55,662 | 53,836 | 51,825 | 56,927 | 50,194 | 45,000 | 53,712 | 54,679 | 56,291 |
| Yield (mt/ha) | 0.25 | 0.26 | 0.29 | 0.34 | 0.29 | 0.29 | 0.38 | 0.30 | 0.38 | 0.46 | 0.34 | 0.31 | 0.32 |
| **Sub-total for 7 Largest Countries by Harvested Area (ha)** | **1,510,263** | **1,483,785** | **1,340,195** | **1,333,442** | **1,362,064** | **1,382,585** | **1,397,124** | **1,403,438** | **1,458,720** | **1,488,800** | **1,496,500** | **1,589,228** | **1,593,142** |
| Yield (mt/ha) | 0.24 | 0.28 | 0.27 | 0.31 | 0.33 | 0.31 | 0.32 | 0.29 | 0.31 | 0.31 | 0.33 | 0.34 | 0.40 |
| Growth in Harvested Area 2000-2012 | | | | | | | | | | | | | 5.5% |
| Growth In Production (mt) | | | | | | | | | | | | | 74% |
| Growth in Yield/ha | | | | | | | | | | | | | 65% |
| *Source: Annual Production Data Courtesy of ICCO* | | | | | | | | | | | | | |

## Invented In Ecuador

Now the largest producer of cocoa in the Latin American region, and the source of the best known cacao variety in the world, CCN-51, there is some substance to the claim made by Ecuador's experimental cacao farmers that they are leading a 'high tech' cocoa revolution in the region. Of course Ecuador/Latam region is not alone in striving for a 'high tech' cocoa culture: in Madagascar, in Papua New Guinea, in Brazil and in Israel (a centre for smart irrigation technologies), agronomists and planters are also working with new cultivation models for the production of cocoa: Israeli agriculturalists and agribusiness developers are taking ideas for cacao cultivation, developed in Israel, and rolling them out in the tropical belt, including in Ecuador. "Invented in Ecuador" is a claim that might reasonably be made for Latam's 'High Tech Cocoa', by a small cadre of Ecuador's most ambitious and innovative professional cacao plantation managers. These agronomists and plantation directors are focused on plant morphology:

- height (2.0-3.0 metres)

- number of branches (3-5 branches)
- height above ground for first branches
- leaf to pod ratio.

Roberto Mollison of Naturisa and La Chola manages his plantations on the basis of linear metres of fruiting branches per hectare with circa 24,000 metres the current standard. Mechanisation of pruning and field maintenance are now standard practice on modern Ecuadorian plantations including at La Chola and Andres Guzman's Hacienda Victoria. An important emerging trend is the application of smart irrigation systems (typically Israeli technologies) complete with fertigation and chemigation capacity for fully automated crop management. Modern producers are striving for estate level productivity at or in excess of 2mt/ha dry beans.

## *Profile of Hacienda La Chola*

Hacienda La Chola is located in an area known as the Santa Elena Peninsula, near the Cerecita commune and some 70 kilometers west of Guayaquil. This region is a focus for the production of cocoa and according to APROCAFA some 5, 000 ha are planted with cacao. Farms are typically between 100 ha to 200ha – large by the standards of world cocoa production.

Comprising some 730 hectares of which 485 are planted with cacao, La Chola also cultivates 85 ha of mangoes and it conserves a tract of tropical dry forest. La Chola estate is built around four albarradas (natural reservoirs of freshwater) and 6 irrigation stations. Water is pumped through a computer controlled irrigation system to feed the crops based on plant/crop need. La Chola and other farms in the region chose to grow cacao almost counter-intuitively: cacao is a plant of the wet, humid tropical rainforests, but these farmers chose to grow the crop in a region characterised by dry tropical forest, with rainfall occurring in as few as 3 months of the year. The dry weather conditions, (accompanied by water for irrigation) provide an important benefit for the farming of cacao: a significantly lower incidence of the fungal diseases that attack the trees in humid climates.

The genesis of Ecuador's 'Hi-Tech' cacao culture can be traced back to 1965 when Homero Castro, the man credited with the discovery of self-compatibility in some cacao varieties created the original hybrid between a cross of IMC 67 x ICS 95 and O1, an accession of his own. Out of the offspring, he selected the best plant: CCN-51 (Collection Castro Naranjal 51). Two years later (1967), Castro asked César Amador, (grandfather of Sergio Cedeño) if he would plant the new clone on the "Hacienda Sofía". César agreed to trial one hectare and HAB is informed that most of those trees are still alive today. In 1989, César's grandson, the agronomist Sergio Cedeño, a graduate from Zamorano University in Honduras, (from which Roberto Mollison also graduated), began the first large scale planting (300 ha) with CCN-51 at "Hacienda Cañas". This was at the time a ground-breaking trial – no other planter had planted the variety on such scale previously. Sergio Cedeño is reputed to be a talented planter and agronomist beyond cacao: reportedly Dole has twice ranked Mr Cedeño as the best banana grower in the world.

Another well respected Ecuadorian cacao planter, Eduardo Crespo, also adopted CCN-51 on the "Hacienda San Jacinto". Both Eduardo Crespo and Sergio Cedeño have trialled the variety at varying densities, with different pruning regimes and with gravity driven irrigation systems. Roberto Mollison furthered this work when in 1998 he adopted new irrigation technologies, applied his own soil management principles and pruning regime on the Agrotropical farms: Rio Lindo Alto, Bajo and Clemencia. In 2008, Mr Mollison moved to La Chola farm (Via a la Peninsula) which is located in

a dry tropical forest. At La Chola Mr Mollision began to increase the use of mechanization with newly designed equipment for field maintenance and crop protection. By 2012 mechanized pruning had also been introduced to La Chola. Mr Mollison has been adopting and adapting mechanized crop and field management systems in use in Ecuador's orchard sector, and used by him in the management of limes and mango plantations. These farming businesses have also adopted advanced management principles. Roberto Mollison advises that on his farms KPIs have been in use for 20 years. He is an advocate of Harvard University's Michael Porter's theories of Competitive Strategy and Competitive Advantage.

Looking ahead the challenge for this new breed of high tech cacao farmers is to achieve 3.0mt-4.0mt/ha. In the context of this most traditional of agricultural sectors, these initiatives have the potential to disrupt the present supply model, creating strikingly different production models.

The production of cocoa – spread throughout the tropical belt from Central America to Oceania – is not a 'joined up' sector. Pockets of activity taking place in one region are not guaranteed to be reported in another; language can be a barrier. The support initiatives of the big downstream actors are not run in unison. And even within countries and regions, innovation on one farm, may be narrowly communicated. This is a sector which, even at the professional end of its spectrum, is dominated by smaller enterprises; it boasts no large corporate producers. Even the professional farms are small businesses by regional or global terms and certainly small compared to their peers in the international palm oil and rubber plantation sectors. A growing corporate segment in the Latam region and the clustering of these companies in specific regions is already encouraging and disseminating a culture of best practice that can serve as a model for farmers in other regions and countries.

This pattern is especially evident in one region of Ecuador, spanning the provinces of Guayas, Santa Elena, Pinchincha, Imbarura, Bolivar and Los Rios, a cluster of high tech cacao farms is evolving. Centred in the West of the country and extending from an area south west of Guayaquil and north to the city of Ibarra, near the Colombian border, this group of innovative cacao farmers has opted to cultivate the crop in the dry tropical conditions of the region. Further incentive to farm in the region has been provided by the development of Ecuador's water transfer systems in the region. The Chongón-San Vicente system will transfer water from the Chongón river to the San Vicente reservoir through a 50km underground tunnel, providing irrigation water to some 7,700ha in the Javita river valley. However, the Chongón-San Vicente project is the first of six mega-hydro projects being developed by the government. Others include the Chone multipurpose plan, the Río Daule-Vinces water transfer system and the Bulubúlu, Cañar and Naranjal rivers flood control projects. The Rio Daule-Vinces water transfer project aims to transfer water from an intake on the Daule river to the Vinces, Pueblo Viejo and Colorado rivers. The water will then be diverted to local streams, where irrigation infrastructure will be built to supply 215,000ha. Once completed, the water transfer will allow the area surrounding the Guayas river delta to carry out two crop development cycles rather than one. The Ecuadorian authorities believe that this irrigated land could become one of the most promising agricultural resources in Latin America given the strong farming traditions and infrastructure in the region.

## *Ecuador – Centuries of Cocoa Culture*

Ecuador's cacao sector is able to draw on centuries of experience with the crop. The renowned English botanist and cacao specialist Ernest Cheesman postulated that the species originated in the Upper Amazon near the Colombian-Ecuadorian border. (Cheesman EE (1944), Notes on the nomenclature, classification and possible

relationships of cocoa populations. Trop Agricult, 21: 144–159). Ecuadorian culture insists that by the time of the Spanish Conquests in the 15th Century, cacao was already being cultivated along the country's Pacific Coast. In the 1830s various wealthy families took up the production of cocoa on farms called "Grandes Cacaos" mostly in the cantons of Los Rios Province. By the 1890s the country was exporting cocoa to the world with production in excess of 40,000 mt / pa. However during the first quarter of the 20th Century, the Ecuadorian cocoa sector was struck by Witches' Broom (*Moniliophtora perniciosa*), and cocoa production declined by around 70%. In the aftermath of this disease outbreak, Ecuador imported foreign varieties of cacao, many of them from Venezuela. These varieties were interbred with the Ecuadorian varieties (Nacional) in order to strengthen disease tolerance and to boost yields. Critics argue that this invasion of foreign cacao DNA has very nearly consigned Ecuador's Fine or Flavour variety Arriba Nacional, to the history books. More recently there has been considerable research invested in recovering the fine flavour varieties of Ecuador after they were progressively lost during the era of hybridization. Today, varieties which meet the definition of "Arriba Nacional " are able to command a premium on the world market. The deeply respected expert on Ecuadorean cacao, Jeffrey G Stern (http://jeffreygstern.com/about/) notes that "a truly valid definition of Arriba or Arriba Nacional, when applied to Ecuadorian cacao, includes Nacional beans sourced in parts of the Province of Guayas, the Province of Los Ríos and a small fraction of the Province of Bolívar".

During the second half of the 20th Century, Ecuador's crown as regional leader was usurped by Brazil which by 1986, (before the devastation of the country's cocoa sector by Witches' Broom), was producing nearly 460,000 mt of cocoa annually (FAOSTAT). Today however, Ecuador has regained the region's leader role with the largest production amongst its peers.

| International Cocoa Organisation World Production Data | | | | |
|---|---|---|---|---|
| **Year Ending 30th September** | **2000** | **2013** | **2014E** | **2015F** |
| | m mt | m mt | m mt | m mt |
| **Ecuador** | **0.10** | **0.19** | **0.23** | **0.25** |
| Brazil | 0.12 | 0.19 | 0.23 | 0.23 |
| Peru | 0.02 | 0.07 | 0.08 | 0.08 |
| Dominican Republic | 0.04 | 0.07 | 0.07 | 0.07 |
| Colombia | 0.04 | 0.05 | 0.05 | 0.05 |
| Mexico | 0.04 | 0.03 | 0.03 | 0.03 |
| Venezuela | 0.01 | 0.02 | 0.02 | 0.02 |
| Haiti | 0.00 | 0.00 | 0.01 | 0.01 |
| Nicaragua | 0.00 | 0.00 | 0.00 | 0.00 |
| **Top 9 Producers** | **0.37** | **0.61** | **0.72** | **0.74** |
| Other Americas | 0.02 | 0.01 | 0.01 | 0.01 |
| **All Americas** | **0.393** | **0.623** | **0.726** | **0.747** |

*Source: ICCO*

The Ecuadorian cocoa sector also benefits from the support of three strong national bodies: APROCAFA (Association of Producers of Fine and Aroma Cacao), INIAP (The National Institute of Agricultural Research) and ANECACAO (Association of National Cocoa Exporters). These agencies have all been instrumental in the development of the modern Ecuadorian cocoa sector.

Established by Ministerial Decree in 1996, APROCAFA is an association of cocoa producers. The association is strongly linked with the advancement of CCN-51 and with the evolution of the country's "High Tech Cacao Culture". The association's principal objectives are to promote the cultivation of high-quality cocoa, improve farmer productivity, to promote research and technology transfer, and to encourage

sustainable farming. The association also has a remit to encourage the development and production of Ecuador's national varieties including the Arriba Nacional lines and also CCN-51. It is noteworthy that the association includes three of Ecuador's most innovative planters: Eduardo Crespo, Roberto Mollison, and Sergio Cedeño.

The National Institute of Agricultural Research (INIAP) was established in 1959 to support the development of agriculture in Ecuador. INIAP has established a number of experimental stations across the country's different regions in order to perform scientific research and to transfer knowledge and technologies in support of the agri-production sector. ANECACAO was established to "support the entire agro-industrial and commercial chain of Ecuadorian cocoa from bean-to-bar producers and exports, in order to maintain the position of leadership in the global markets..." Not only does the association monitor international traded prices for cocoa, it undertakes analysis of the global markets for cocoa and cocoa based consumer goods and provides technical assistance to Ecuadorian producers, disseminating knowledge and techniques developed by INIAP and APROCAFA. Technical training workshops are run for farmers and ANECACAO's trained quality specialists focus on the provision of guidance for post harvest quality management. The national authorities have also been supportive of the sector with the promise of 100 million new trees for farmers by 2020 with 10 million already distributed within 2014.

### *Management for Excellence in Cocoa Production*

With its deep history of cacao cultivation and its well developed professional farming sector, (historically supported by private wealth and now also by financial investors) the Ecuadorian cocoa sector, has produced a cadre of highly experienced, professional cacao plantation managers. With two or more decades of experience with the crop, these individuals are a rare breed within the cocoa sector. Names like Ing. Andres Guzman Baquerizo of Hacienda Victoria, Ing.Sergio Cendeno Amador of Las Canas, and Roberto Mollison of Agrotropical/Naturisa S.A., and La Chola have been instrumental in the establishment, development and management of some of Ecuador's most respected cacao estates. This culture of management excellence has enabled Ecuador to develop leading production efficiencies. At Hacienda Victoria, south west of Guayaquil, plantation director Andres Guzman has introduced Enterprise Resource Planning (ERP) and Key Performance Indicators (KPIs) as components of the management for excellence in cocoa production.

Today the Ecuadorian labour efficiency standard is one full time equivalent (FTE) worker for every 4 hectares to cover pruning, fertiliser regime, weed control and harvesting. However with increased mechanisation, managers are hoping to push efficiencies much further in the future, with the goal to achieve one FTE to manage 10 hectares. Andres Guzman postulates that 10 Ha/worker is 'thinkable' in very well established irrigated plantations on flat land, under highly mechanized farm management, and with well trained and productive staff working on per unit pay. For example, it has been postulated that cacao farms established with smart irrigation / fertigation / chemigation capacity could be managed on the basis of 6-7 ha: FTE.

In a 2014 survey of the professional sector across Latin America, HAB found the average for all professional plantations in the region was closer to 3.4ha per FTE. The range indicated by managers across professional estates was 2 ha: 1 FTE to 4 ha: 1 FTE. At the rate of 2 ha/FTE, it would be assumed that the plantation was fully reliant on manual labour. The rate of 4 ha/FTE appears to be representative of well managed cacao farms.

*Source: A mini-tractor and pruning arm managing CCN-51 tree height and morphology in Ecuador. Photograph supplied by Roberto Mollison.*

## *Investment Heavy Model*

Research conducted by HAB indicates that the cost per ha to develop a modern cacao plantation in Latam ranges from circa $13,000/ha (without irrigation) to $18,000/ha with irrigation. Suitable land with legal title is likely to be in the range of $1,500 to $5,000 per ha across the region with irrigation systems adding another $3,000-$3,500 per ha. A further $12,000-$15,000/ha comprises planting costs and costs to maturity at 3 to 4 years (from planting the seed in the nursery), assumes labour in the range of $350-$500 per month. In the case of corporations the costs shown/estimated are at plantation level: i.e., excluding local and offshore SG&A, but including all direct plantation costs and labour. At this level of investment, it is critical that there is a high degree of confidence in the economic feasibility of the project including, perhaps most importantly, estate productivity.

## *Estate Productivity*

For three models of yield curve development see table below comparing HAB's model with a mature Ecuadorian estate, a Peruvian estate under development and a Colombian irrigated project now under development also.

| CCN-51 Yield/Tree Age (mt dry cocoa beans/ha) | Seedling Year | 1st Year In Field | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Ecuadorian Estate | 0 | 0 | 0.40 | 0.80 | 1.60 | 2.20 | 2.50 | 2.50 |
| HAB CCN-51 Model | 0 | 0 | 0.25 | 0.80 | 1.20 | 1.65 | 2.10 | 2.50 |
| Peruvian Estate | 0 | 0 | 0.25 | 0.50 | 1.20 | 1.60 | 1.90 | 2.30 |
| Colombian Irrigated Project | 0 | 0 | 0.00 | 0.84 | 1.20 | 1.80 | 2.20 | 2.50 |

*Source: Hardman Agribusiness*

Only the Ecuadorian example provided above is based on actual and recorded yields from a mature plantation – but not necessarily at (whole) estate level. The other examples are all based on planned / forecast performances. In Ecuador today, the achievement of 2.0-2.5mt/ha dry beans at estate level is possible, but not always attained. One seasoned manager commented to HAB that the key word remains 'potential'. CCN-51 has the potential to achieve up to 3.0mt/ha, just as modern varieties of oil palm have the potential to yield near to 40mt/FFB/ha – but the reported average for oil palm productivity (at estate level) is rarely more than 24mt/ha and more commonly 21-22mt/ha. Nor can it be assumed that cacao will produce in a steady state for a long period beyond its peak production year as oil palm does. There is a growing, but not universal consensus that intensively managed cacao peaks between years 6-10 where after production begins to decline. The production of cocoa has a way yet to go before yields in excess of 2.0mt/ha at maturity can be assumed to be the norm as an average yield in commercial plantations.

Tree density per hectare is under review in a number of new plantation developments. The Colombian project detailed above is proposing to work with circa 1,400 trees per ha, other high tech projects are proposing 1,300 trees per ha. Traditional models based on 833-1,111 trees / ha are being considered alongside densities up to 1,800 trees per ha or more, supported by irrigation. HAB has found that even more traditional planters, operating semi-shade plantations, may plant between 1,300 and 1,800 trees per ha, dependent on cultivation site conditions, cultivar and pruning regime.

Across the region's professional farms, we have found a range of productivity outcomes extending from under 1mt/ha in semi-shade system plantations to 3.75mt/ha in modern irrigated, full sun plantations – but not yet at (whole) estate level. At estate level 2.0mt/ha - 2.5mt/ha appears to be the current level of peak efficiency amongst mature well run estates as an average over a number of years. Individual fields are regularly reported to exceed this level, up to and beyond 3.0mt/ha. However, at estate level, over a period of years, 2.0mt - 2.5mt/ha appears to be a more reliable indicator of what is currently achievable.

*Source: a professional irrigated plantation of CCN-51 (age circa 18 years) growing in the Peninsula region of Ecuador; photograph supplied by Roberto Mollison. These trees are reportedly yielding between 2.0-2.5mt dry beans annually.*

A key component in the quest for optimal productivity is tree morphology and management of each tree's output of energy into pods versus foliage. Pruning has developed as a critical agronomic discipline for the management of yield and the management of disease. Optimal airflow within the trees, between the trees and rows, and avoidance of self-shading, are amongst the first laws of disease management.

In Ecuador and across the Latam region professional farms are working with research institutions (such as INIAP Ecuador, CEPLAC Brazil, Fedecacao Colombia, CATIE Costa Rica, CRS / University of the West Indies Trinidad) and with downstream players like Mars Inc, to develop agronomic methodologies targeting a minimum 3.0 mt / ha as a realistic and achievable model.

## *Sun versus Shade*

Modern plantations typically work on a full sun model. Even the use of shade species to protect newly planted seedlings in their first years is being obviated by the practice of retaining seedlings in the nursery for much of their first year.

*Source: A modern full sun Ecuadorian plantation (La Chola) featured on the APPROCAFA website home page*

In particular the use of shade species, as a key component of plantation architecture, has been obviated by the use of sophisticated irrigation systems on modern cacao plantations. There is a considerable divergence of opinion on this subject with some planters arguing that a partial shade system not only makes compelling sense for environmental reasons, but also because monocultures degrade soil fertility and may contribute to climate change with the elimination of natural species, thus denying production from such cultivations the description sustainable. The high tech approach to growing cocoa on savannah lands in low rainfall zones, avoids the risk of species loss, but certainly soil fertility can only be managed with sensitive soil management and fertilisation programmes.

## *Development of New Commercial Varieties*

What happens at estate level also needs to be supported by professional breeding firms and research institutes. Important commercial crop sectors require underpinning with ongoing research and development of planting materials with the objective of bringing out new improved varieties on a regular basis. As with any form of crop, a planter's first decision in establishing a new cacao plantation is to decide what genetics will work best on that site. Historically, across the cacao sector, decisions were based on word of mouth, inspection of 'mother trees' and on information supplied by agencies like the World Cocoa Foundation (WCF). HAB believes that the supply of proven planting material (supported by long series, scientifically recorded field data), across the different producer regions, needs further strengthening.

The Latam region is home to the richest diversity of cacao germplasm on the planet and the region's cocoa farmers are relatively well supported by breeding and development agencies with histories often extending back into the first half of the 20$^{th}$ century. Amongst the best known cacao breeding stations in the Americas, are CRS in Trinidad and Tobago, CATIE in Costa Rica, INIAP in Ecuador and CEPLAC in Brazil. The region has strong agricultural traditions and the cocoa breeding agencies in the leading producer countries are symptomatic of the importance attaching to agriculture. The germplasm collections of International Cocoa Gene Bank in Trinidad

and of CATIE in Costa Rica have been designated as 'universal collection depositories'. Large collections of primary material are also reported in Colombia, Ecuador, French Guyana, Venezuela and Brazil. (*The Agronomy and Economy of Important Tree Crops of the Developing World – K.P. Prabhakaran Nair*).

Additionally the French agricultural research institution, CIRAD supports producers in the region through its regional partnerships, by developing scientific and technical innovations aimed at ensuring a sustainable cocoa economy and by its research activities in the development of a range of more productive and/or better quality planting materials.

## *Disease & Pest Management*

One seasoned planter, (BK Matlick), for many years the plantation director of the former Hershey experimental farm in Belize, noted to HAB that prudent crop forecasts would qualify potential dry bean yields with crop losses due to pest and disease. The Hershey cacao orchard was stocked with Fine or Flavour varieties from the Central American and Caribbean region.

Beginning with relatively small losses of 5%-10% in the immature years of an orchard, BK Matlick advised HAB to discount crop potential by 20% for pest and disease losses in the mature years. Indeed crop losses due to pest such as cocoa pod borer in Asia and Oceania, and diseases such as Witches' Broom and Frosty Pod in the Americas and Black Pod worldwide, can devastate cocoa crops, damaging up to 70% of the potential harvest. The Black Pod fungus, *Phytophthora palmivora* is reputed to cause yield losses of 20%-30% annually across the global cocoa crop (ICCO). *Phytpthora megacarya,* reported only in Africa, is even more damaging.

Disease and pest management is therefore a critical component of commercial cocoa production. Ecuadorian estate managers report having restricted losses due to *Moniliophthora perniciosa* (Witches' Broom) and *Moniliophthora roreri* (Frosty Pod) to 8%-9% by the operation of integrated disease management plans. Field staff must be trained to spot disease and pest outbreaks and to respond appropriately when they encounter such outbreaks. Pruning and the removal of diseased pods form an essential component of cacao cultivation. On modern estates, disease and pest control is also implemented by tree / estate design to encourage optimal airflow between branches, trees and rows, crop protection regimes and irrigation controls.

## Fine or Flavour Cocoa

Today some 81% of the world supply of fine or flavour cocoa is produced in the Americas & Caribbean area, with Ecuador the largest single producer and exporter. HAB estimates that Ecuadorian beans make up 54%-55% of the total world production. PNG, Dominican Republic and Peru are the next largest producers accounting for another 35% of world supply.

| ICCO *AD HOC* Panel on Fine or Flavour Cocoa Recommendation Under Annex 'C' of The ICCO Agreement, 2010 Producing Countries Exporting Either Exclusively or Partially Fine or Flavour Cocoa September 2015 | Percentage of Crop Exported Deemed to Be Fine or Flavour Beans | 3 Year Average Total Cocoa Beans Export (2011/12-2013/14) (mt) | Estimated Supply of Fine or Flavour Beans (mt) | Comments |
|---|---|---|---|---|
| Belize | 50% | na | na | 2015 Recommendation |
| Bolivia | 100% | 250 | 250 | |
| Colombia | 95% | 5,254 | 4,991 | |
| Costa Rica | 100% | 276 | 276 | |
| Dominica | 100% | 60 | 60 | |
| Domincian Republic | 40% | 64,890 | 25,956 | |
| Ecuador | 75% | 176,085 | 132,064 | |
| Grenada | 100% | 808 | 808 | |
| Guatemala | 50% | na | na | Recognised but not yet recommended |
| Honduras | 50% | na | na | Recognised but not yet recommended |
| Indonesia (East Java) | 1% | 152,139 | 1,521 | |
| Jamaica | 95% | 360 | 342 | |
| Madagascar | 100% | 8,390 | 8,390 | |
| Mexico | 100% | 891 | 891 | |
| Nicaragua | 100% | na | na | 2015 Recommendation |
| Panama | 50% | na | na | Recognised but not yet recommended |
| Papua New Guinea | 90% | 38,141 | 34,327 | |
| Peru | 75% | 32,919 | 24,689 | |
| Saint Lucia | 100% | 13 | 13 | |
| Sao Tome & Principe | 35% | 2,717 | 951 | |
| Socialist Republic of Vietnam | 40% | na | na | 2015 Recommendation |
| Trinidad & Tobago | 100% | 381 | 381 | |
| Venezuela | 95% | 5,679 | 5,395 | |
| **Total (Where Applicable)** | | | **241,306** | |
| Average World Crop (2011/12-2013/14) (mt) | | | 4,136,633.333 | |
| **Estimated Fine or Flavour Beans as % of World Crop** | | | **5.8%** | |
| **Estimated % of World Crop of Fine or Flavour Beans Produced in Americas and Caribbean** | | | **81.3%** | |

Sources: ICCO Ad Hoc Panel on Fine or Flavour Cocoa, 18th September, 2015
Estimates: Hardman Agribusiness

The international chocolate confectionery manufacturing sector classifies cocoa beans according to the variety of cacao tree by which they have been produced. For this purpose three broad varietal definitions exist:

1. "Noble" *Criollo* (producing fine or flavour beans)
2. The common *Forastero* (producing bulk beans)
3. The hybrid of the *Criollo* and *Forastero* – *Trinitario* (producing fine or flavour beans)

Until the 19th Century the *Criollo* was the dominant variety, but as plantations developed so too did pathogens, and *Criollo* proved highly vulnerable to pest and disease attack. However the beans from *Criollo* trees were noted for their distinctive

and complex flavours reportedly recalling caramel, nuts, citrus and red fruits. Originating in Trinidad & Tobago, the *Trinitario (Criollo x Forastero)* hybrid has also won recognition for its flavour notes including spice and fruits. By contrast *Forastero* trees produce beans considered to be strong in flavour, bitter and acidic in profile. It was *Forastero* trees that prospered best in West Africa. Confusingly, Ecuador's Arriba Nacional is considered to derive from *Forastero* trees, although it should be noted that this is a revision of an earlier determination that these were in fact *Criollos*.

The market for Fine or Flavour cocoa is small and highly specialised with shorter supply lines and greater traceability. Until recently consumer tastes were successfully met with confectionery produced from bulk beans – typically 'filled' chocolate products. However an upsurge in demand for fine dark chocolate, partly because it is deemed to be healthier with a lower sugar content and absent of dairy products and partly due to modern consumer tastes ('millennials' are considered to be more concerned with flavour, experience and provenance than with affordable comfort treats), is driving growth in demand for Fine of Flavour cocoa. Fine or Flavour cocoa is used mainly in the production of dark chocolate (for which cocoa percentages are rising: bars can now be as high as 80% cocoa and sometimes even 100% (some of Hotel Chocolat's Rabot 1745 collection for example). ICCO reports that increasing demand for Fine or Flavour cocoa has driven up premiums for the beans and HAB can confirm some buyers paying more than 2x the international traded price for bulk beans for high quality fine or flavour beans of known provenance.

HAB has noted that new plantations in the Latam region are typically being designed on the basis of 30% - 40% Fine or Flavour varieties and 60%-70% bulk bean varieties – typically CCN-51. The rationale of this mix is to blend optimal yields from high yielding varieties like CCN-51 with an element of price protection built into the future revenue mix from the supply of Fine or Flavour beans. However, some planters are challenging the assumption that Fine or Flavour cacao varieties cannot match the yields, disease resistance and pollen compatibility of workhorse varieties like CCN-51. Andres Guzman of the highly respected Hacienda Victoria in Ecuador is now planting modern varieties of Fine or Flavour cacao, proven in field trials for crop output. Orchards are being planted at the standard density of 1,111 trees per hectare or greater and these new varieties are also reported to be self pollinating unlike many older varieties. Mr Guzman notes that these orchards can be managed in very much the same way as an orchard producing so called bulk beans including a prescribed pruning regime and utilisation of smart irrigation technologies.

### *Development of New Plantations*

The Latam region is a current hotspot for the development of new cocoa producing plantations. HAB has identified approaching 50,000 ha of new capacity that is either substantially in development or highly likely to be developed by credible actors. This activity is being led both by established regional actors in the cocoa value chain and by foreign developers. Some are investor developers, encouraged by the supply and demand fundamentals underpinning the steady rise in the price of cocoa. Others are agribusiness focused corporations sensing an opportunity to parlay project development skills, access to funding and advanced agricultural technologies against the development of profitable and valuable sustainable cocoa production businesses.

To date these initiatives do not include any from the major plantation companies. Most of the world's leading plantation companies are to be found in Asia where cocoa has been tried but rejected on the grounds of unreliable yields and its significant sensitivity to pest and disease. But with the price of palm oil trading more

than 30% below the 10 year average, and cocoa continuing to push higher (towards the January 2010 high of $3,520/mt), it would not be surprising if some of Asian plantation companies reviewed their historic antipathy for the crop.

### New Projects in Development with Capital Raised

HAB has identified at least 9 new projects (commenced since 2011) and currently under development across the region. These are to be distinguished from projects that are mature and producing cocoa, albeit with expansion plans, as many now have. Together these projects have raised more than $70m in funding over the past 4 years and are to be found across Colombia, Ecuador, Nicaragua and Peru.

### 1. United Cacao Ltd - $27m development capital and 1,700 ha planted

United Cacao Ltd (UCL) – a Peruvian cocoa production business listed on the London Alternative Investment market (AIM) (December 2014) and the The Bolsa de Valores de Lima (BVL) (October 2015), is developing a 3,250 ha plantation in the Loreto region of the Peruvian Amazon (the indigenous heartland of cacao). Peru's Loreto State, thought to be one of the origin sites of wild cacao, offers an ideal traditional environment in which to produce high quality cocoa, with an optimal distribution pattern for rainfall, humidity and temperature range and excellent sunshine values. Coupled with zero rated taxation for cocoa production in the state until 2048 and an abundant pool of economically priced agricultural labour, the Loreto region provides a great deal of support for a new cacao plantation.

In many ways UCL has been a trailblazer for the development of large scale new plantations in the region, and indeed elsewhere. The project was conceived back in 2011 and HAB estimates that the company will have planted some 2,000 ha in early 2016 with the remainder planted by 2017. Planting began in late 2013, following land purchases during the period 2011/12 and the commencement of land preparation in 1H 2013. Over the last two years UCL has demonstrated that is possible to develop/plant a modern cacao plantation at the rate of circa 800 ha to 1,000 ha per year. Development costs per hectare are approximately US$12,500 (without investment in irrigation technologies).

The plantations are circa 15 minutes by road from the riverside town of Tamshiyacu with a population of approximately 5,000. From Iquitos, with a population of circa 450,000, the plantations are about 30 minutes by speedboat on the Amazon River. Iquitos itself is serviced by three airlines flying to and from Lima throughout the day.

HAB estimates that UCL is now the largest single cocoa producing estate in the Latam region, a few hundred hectares planted ahead of Grupo Quirola in Ecuador (1,532 ha planted) and Agricola Cantagalo in Brazil (1,430 ha). This modern plantation is following a full sun, rain fed model with CCN-51 at its centre, and Fine or Flavour varieties comprising a proposed 30% of the completed estate. Planting densities are based on 1,111 trees per hectare for both CCN-51 and Fine or Flavour varieties. The planting material includes both high yielding CCN-51 (70%) and fine flavour varieties (30%) including:

- IMC-67: 'Iquitos Mixed Calabacillo' (IMC) series, which have been traced to the Marañon River basin in the Peruvian Amazon close to Iquitos. The variety has been at the heart of the research and breeding efforts of Trinidad's Cocoa Research Unit for more than 70 years. According to Wood and Lass (1985, p.83) the original IMC genetic material was collected by F.J. Pound on an island in the Amazon opposite Iquitos (capital of Loreto state) during Pound's 1937-38 expedition to the Amazon in search of cocoa populations with resistance to Witches' Broom disease.

- ICS-1: the Imperial College Selections (ICS) consist of 100 clones selected by research explorers F.J. Pound & E.E. Chessman, the most notable being ICS-1 (reportedly the first and still one of the most widely-used cultivars for grafting hybrids). They were selected by F.J. Pound from 1933 to 1935 on behalf of the (then) Imperial College of Tropical Agriculture in Trinidad (which is now the St Augustine Campus of the University of the West Indies). According to Johnson et al "Field Guide to the ICS Clones of Trinidad" Pound made his selection of ICS clone material by surveying tens of thousands of trees. He monitored trees in farmers' fields for two years, and he conferred with growers and researchers at Trinidad's Department of Agriculture.

- TSH-595: the Trinidad Select Hybrids are a series of clones developed in Trinidad by English-born botanist William Freeman who worked as a research officer for Trinidad's Cocoa Board, where he bred improved cocoa clones and hybrid seedlings during the period from 1956 to 1978. The TSH clones are "highly regarded for their superior yield, excellent flavour and resistance to diseases".

- Sacha Gold: An Ecuadorian variety developed by Cimarron Cocoa Estates is a relatively newly cocoa clone – thought to be a mutation from a deliberate hybrid crossing in Ecuador – and reportedly with superior flavour, yield and disease tolerance characteristics. Cimarron Cocoa Estates has been working with some 40,000 trees since 2005 during which time the variety's tolerance to known disease threats and its yield capacity have reportedly been very exciting. Cimarron Estates advise that Sacha Gold can achieve up to 4x typical per tree productivity (4 kg of dry cocoa beans per tree versus 1 kg). The material is described as producing beans with a distinctive 'Arriba' flavour and having a better morphology for plantation farming than CCN-51.

With average whole plantation yields targeted at 2.5mt/ha at maturity (years 8 from planting), UCL is planning on its average yields conforming to or bettering, the agricultural performances of the established modern Ecuadorian estates.

Borrowing from the palm oil sector, UCL is seeking to develop a strong out grower / 3rd Party supply source amongst small farmers and land owners in the vicinity of its plantations. The company has therefore established a programme to provide a market based financing mechanism to encourage the farming of cacao amongst the communities surrounding its estate in Tamshiyacu (Programa Alianza Producción Estratégica Cacao) or PAPEC. HAB estimates that by the end of 2015, 200 hectares of cocoa will have been planted on the farms of 176 local smallholders. During 2016 UCL has targeted an additional 500 ha of PAPEC plantings involving an additional 350 participants. In all UCL is targeting a programme totalling 3,250 hectares with several thousand participants. Under the PAPEC, UCL extends the necessary supplies, fertilizer and seedlings to qualified small farmers. These agricultural credits are not a donation but documented as a loan which is ultimately repaid from future cocoa harvests. The company undertakes to purchase wet beans from the PAPEC participants and then to process those beans in its fermentation facilities ensuring top quality fermented and dried beans for UCL customers.

UCL has attracted more than US$27m of equity and equity-linked funding of which approximately $21m in equity and US$6m in convertible bonds. On 27th October 2015, it completed a subscription for $6,080,000 of 7.00% secured convertible bonds, maturity date of 30th June 2019. Since listing on AIM 3rd December 2014 at

128 pence per share (raising approximately US$10m at the time), UCL has traded up to 252 pence.

### 2. Andean Cacao - $10m of equity capital raised

A Bogota based international group focused on the management of agricultural assets is developing a tropical tree crop investment strategy for Colombia and Peru. The group is well advanced in the process of identifying some 5,000 ha of savannah type freehold land proposed for an irrigated cocoa plantation. The land is to be geographically diversified across Colombia's core agricultural regions. Andean Cacao Ltd (ACL) has acquired and begun development of the first 550 ha of the proposed project. The group's agricultural strategy for achieving yields in excess of 2 mt/ ha, is centred on high density planting, with 1450 trees per ha. This initiative, which aims to produce fully sustainable cocoa, is seeking the involvement of certification agencies at an early stage. ACL has additionally initiated a parallel small farmer programme designed to support the growth of high quality cacao in the region.

### 3. Forest Finance

The German sustainable agro-forestry group owns and manages two small plantations of some 150 ha near Tarapoto in San Martin, Peru as well as in Bocas del Toro, Panama. Forest Finance plans to extend the planted area in Peru to 1,000 ha. Additionally the group would like to develop a 2,000 ha estate in the Dominican Republic on the borders of an organic cocoa co-operative. Development funding in the region of $24m may be required for a rain fed, partial shade plantation. Forest Finance with its partner Forest Finest Consulting has experience of cocoa across a number of countries including Peru, Dominican Republic and Panama.

### 4. Agro Nica Holdings $13.9m of development capital raised

A consortium of parties including US and French interests is developing a 2,500 ha cocoa estate in Nicaragua, but with the ambition to build a cocoa production platform of up to 10,000 ha. The company is believed to be seeking additional funding of some $60m-$70m for plantation development in Nicaragua and elsewhere in the Latam region.

Phase I encompasses a development of 2,500ha of cacao on the 3,000 ha La Rosita estate in the North Eastern region of Nicaragua, with all first phase planting expected to be finished by year-end 2016. The business plan anticipates purchasing an additional 8, 000 – 9,000 ha across 2 – 4 geographically distributed properties to spread weather & disease risk.

The company's first capital raise was closed at $13.9m in 2014. HAB understands that ANH, having established a plantation infrastructure, is now in the process of rolling out a planting programme at the rate of 1000+ ha annually. A nursery has been established to test various hybrids and has a 1.5mm plant annual volume capability. Mr Giff Laube (most recently manager of technical operations for a Central American premium cocoa grower), is Cocoa Operations Director for ANH, who works closely with Clement Poncon on cocoa planting, fermentation optimization, and species selection. ANH, which has its own clone garden, is working with varieties supplied by CATIE, some of which are derived from original stock from United Fruit Company. The planting material includes CC, CCN, ICS and PMCT varieties. The cocoa clones developed when UF was active in Central America are reportedly of a good flavour and disease resistant. They are grown alongside varieties developed by CATIE. HAB is advised that the venture employs between 250 to 500+ people, depending on the specific farm activities and planting phase.

ANH sponsors include the Poncon family, Nicaragua's largest coffee producers, who are seeking to expand and diversify their farm production operations into high margin, fine cocoa production to be exported to multinational off-takers. The Poncon family boast more than 40 years of agricultural experience in Nicaragua with both coffee and other crops and with this background ANH (and its Cacao Oro brand) is seeking to become recognised for the production of high quality, certified sustainable cocoa. ANH intends to attain sustainability certifications from groups such as Rainforest Alliance and UTZ. ANH also has a strategic relationship with ECOM Agroindustrial, reportedly the 3rd largest cocoa trader worldwide, with experience in origination, distribution, processing, and marketing. This marks an extension of the Poncon family's 20-year relationship with Ecom in respect of coffee supply.

The ANH project is being strongly promoted on the basis of the cocoa expertise established by the Poncon family, which has been growing cocoa at La Cumplida nursery (40 hectares of cacao). It is envisaged that ANH will contract with SMS (an Ecom subsidiary: Sustainable Management Services) to supply genetic material and provide technical assistance in all aspects of cocoa production for the planned expansion into the Andean Region of South America.

In Nicaragua, ANH is very focused on sustainability and it is to seek certification from both Rain Forest Alliance and UTZ with the process intended to commence in 1H 2016. To that end, the company has commissioned two ecological studies on land degradation in the Atlantic zone and the effect on land restoration through an agro-forestry model. As first steps to certification and based on the two studies ANH has received 'avals' from both INAFOR (Nicaraguan Forestry Institute) and SERENA (Secretary of Natural Resources) to develop its cocoa plantation under an agro-forestry model.

### 5. Alfred Ritter GmbH

Located in RAAS, Ritter Sport Nicaragua S.A. is developing a 1,517 ha estate of which 412 ha were planted in 2013 and 2014 (300 ha). We understand that the company is planting local Trinitario varieties: 482 ha are scheduled for planting in 2015, 448ha in 2016 and 175ha in 2017. In keeping with the pattern of its peers in Nicaragua, this will be a partial shade system without the necessity for irrigation. Cocoa will be inter-cropped with forestry species.

### 6. Grupo Osterling, AQUIFARM SAC

Grupo Osterling, a family owned Peruvian holding company, is developing a cacao plantation (Aquifarm S.A.C.) in Honoria district, Puerto Inca Province (Puerto Inca Province is the largest of eleven provinces of the Department Huánuco) of up to 1,850 ha, of which some 150 ha are reportedly planted. The information received by HAB indicates that this is being developed as a traditional cacao plantation rather than as a high tech farming model.

### 7. LR Group/Bean & Co

Bean & Co Global is a UK company, (affiliated to the Israeli LR Group), with an ambitious strategy to produce sustainable cocoa, on a large scale, across the tropical belt. Bean & Co's team has more than three decades of global agricultural development and expertise in tropical agronomy including planting and cropping, irrigation and fertilization, phyto-sanitary protection, harvest and post-harvest, processing, and marketing & distribution. The company has developed a high tech production proposition based on a tightly managed agronomic regime applied to relatively high density cacao plantations supported by smart irrigation technology. Initially, Bean & Co's focus will be on the Latam region; it has already acquired existing operations in Ecuador with approximately 400 ha of productive plantations and is operating an additional 500 ha of green field plantation in Nigeria.

### 8. Xoco Fine Cocoa Company - $8.3m equity capital raised to date

Xoco Fine Cocoa Company is developing an out grower based cocoa production business across a number of Central American countries. Currently boasting a planted area of up to 1,200 ha, Xoco is a privately held company focused on supplying high- end cocoa beans to chocolatiers in Europe (principally) and elsewhere. The company operates in Honduras, Guatemala and Nicaragua, and is currently looking at more projects in the Americas. The business was begun in 2007, when the founders travelled through Central America in search of 'gourmet' cocoa beans. Xoco selected the best of these as "mother trees", and then undertook what it describes as "the largest cocoa grafting operation in history". Over time, several hundred out grower farmers have entered into exclusive partnership contracts with Xoco, and have planted their fields with Fine or Flavour cocoa tree varieties raised in Xoco nurseries. Typically, the farmers invest 20% - 30% of their land in planting cocoa trees. Xoco claims to guarantee all the farmers a 'good deal' and provides technical assistance for the productive lifetime of the trees. Xoco is headquartered in San Pedro Sula, Honduras.

### 9. Guacamayas Project

Covering an area of 480ha, (leased land), the Guacamayas Project in Colombia is being developed by a regional downstream confectioner and a regional impact investment fund. Some 350ha were reported to have been planted during 2014. The remaining area was expected to have been planted in 2015. Trees, comprising 60% CCN-51 and 40% aromatics are planted at a density of 920/ha. Plantains provide short term shade and Gmelina long term shade. Management of the project was originally in the hands of a regional plantation management company.

## Rethinking Cacao Agronomy

What is striking about the evolution of the cultivation of cocoa is that it has progressed so slowly – even on professional estates, the management of the crop has, until the last 20 years or so, differed mostly from small holder cultivations on the basis of scale and rigorousness of applied agronomy. However, during the latter part of the 20$^{th}$ Century, certain planters, mostly in Latam, but also in Oceania, began to trial diverse agronomic techniques and styles of cultivation. This process likely has much further to go and we are now learning of planters who are completely reimagining the cultivation of the crop. Some proponents of ultra high density plantations (in excess of 2,000 trees per ha) are proposing no branching below 2 metres with a focus on trunk production.

In some cases, planters are seeking semi-arid environments with rainfall down to 500mm annually and low humidity (to avoid the plague of fungal diseases), with the

crop planted in relatively high densities and supported by smart irrigation/fertigation/chemigation systems.

*Source: Photograph supplied to HAB of a modern cacao plantation using a NETAFIM smart irrigation system in South Bahia, Brazil with reported yields of up to 5mt/ha.*

5 mt / ha is viewed by most planters as very much the upper limit of what is possible with the crop and then operating in ideal conditions. The proponents of high tech irrigation system controlled cacao plantations are proposing to develop plantations in semi-arid regions where it is possible to have control over almost all the drivers of crop development. While 3.5-4.0 mt/ha is within experience, (albeit not at estate level) and thus grasp, this would once have been viewed as a freak bounty, or something to be achieved in one corner of a plantation or in selected, carefully tended fields, this range has become the goal of 'high tech' cocoa producers. Indeed agricultural output in the future will need to meet these targeted yields as the development costs for these large scale irrigated projects are substantial (as discussed below) and can readily nudge up to $20,000/ha.

In only a few cases do these planters have more than 20 years of experience with the crop, a handful has 30-40 years, but these planters are few indeed and include names such as Angelo de Sá of Agricola Cantagalo in Bahia, Brazil and Graham McNally of Agmark Ltd in Papua New Guinea. What is interesting is that this cadre of experienced and experimental planters is prepared to challenge all the traditional assumptions about the cultivation of cacao.

For example: rotational planting from years 8-12 is a radical idea in the context of a more traditional sector assumption of 30-40 years of economic life once planted. This concept, now being applied by Graham McNally of Agmark in PNG, assumes that cacao trees that are 'pushed' to perform in terms of yield will likely produce peak yields early in their lives and will then need to be replaced /re-grafted with fresh material if targeted agricultural and economic goals are to be consistently achieved. If correct, this theory will have implications for development planning and long term estate management, in order to produce a stable pattern of yield performance over the life of the plantation. In principle, once the plantation renewal cycle has been put in place, annual replanting at up to 10% pa may allow the plantation platform to maintain a very long term economic life. Other high tech projects advise HAB that 20 years is considered to be the maximum economic lifetime of trees. What is clear

from our research is that there is a wide difference of opinion and approach regarding the economic lifetime of cacao trees, but there is developing a growing sense that cacao plantations need to be designed with an inbuilt and progressive replanting / re-grafting programme to take advantage of improved genetics as soon as proven material becomes available.

Replanting/replenishment strategies would be given further coherence if they were based on the routine invigoration of the plantation with new and or improved commercial planting materials which provided greater resistance to common pathogens and pests, larger crops and more effective economic management. Under this scenario, it may be possible to raise yield expectations over the life of a plantation as the planting material is progressively upgraded. Readers will understand that for such a system to be successful it will require both professionalism of management and highly trained field staff. Andres Guzman's introduction of Enterprise Resource Planning (ERP) and Key Performance Indicators (KPIs) as tools in the professional management of cocoa production businesses has specific relevance within such a model. Moreover such a farming system requires that the production of cocoa is economically self-sustaining, (that it can withstand volatility in price) in order to provide the cash flow and or access to the finance required to benefit from the availability of consistently upgraded planting materials.

# Appendix

## Breeding & Development of Commercial Cacao Varieties

The breeding and development of cocoa has been mostly undertaken by national agencies within the cocoa producing countries. Typically these activities have been centred on dedicated breeding stations. The traditional objectives have been to develop cocoa clones that are adapted to the specific climatic conditions, and the pest and disease profile of the country concerned.

Perhaps not surprisingly given that it is the region of origin for the species, the greatest intensity of research and breeding of cacao appears to be in the Americas. Three of the agencies in the region are associated with influential cacao collections: IC3, TSH and EET. Two of these agencies are considered to house the largest collections of cacao germplasm in the world. In Africa and Asia the picture is different: germplasm collections are thinner, and there appear to be fewer celebrated commercial varieties. The regional focus on both those continents looks to be countering major pests and disease: Cocoa Pod Borer in Asia and CSSV in Africa, and for both continents the role of international support agencies looks to have a greater importance than in the Americas.

HAB anticipates that if the current revival of interest in the development of large scale commercial cacao plantations is sustained, and the professional sector becomes central to the growth of secure supply of cocoa commodities, then more professional breeding farms may also develop. This will be a lengthy process however. The relatively underdeveloped state of the commercial cacao sector today can perhaps be partly ascribed to a lack of confidence in planting materials, amongst plantation businesses in many parts of the world. The success of CCN-51 has been based on its greater reliability in providing farmers with targeted yields. Graham McNally of Agmark (PNG) commented to HAB: “It is not sufficient for the product literature to detail how the variety will perform in years 3-5, a grower needs to know how it will produce along the various stages of its commercial life – out to 20 years”.

### Americas

Amongst the best known cacao breeding stations in Central and South America and the Caribbean region, are CRS in Trinidad and Tobago, CATIE in Costa Rica, INIAP in Ecuador and CEPLAC in Brazil. The region has strong agricultural traditions and the cocoa breeding agencies in the leading producer countries are symptomatic of the importance attaching to agriculture. These agencies are important repositories of cacao germplasm and knowledge of the crop. In each case detailed herein, these national, or regional breeding and development agencies have long histories, having been established in the period 1940-1959. The germplasm collections of International Cocoa Gene Bank in Trinidad and of CATIE in Costa Rica have been designated as ‘universal collection depositories’. Large collections of primary material are also reported in Colombia, Ecuador, French Guyana, Venezuela and Brazil. (*The Agronomy and Economy of Important Tree Crops of the Developing World – K.P. Prabhakaran Nair*).

Cacao scientists believe that the Amazon region likely contains significant germplasm wealth that has not yet been discovered. While the sector conveniently classifies planting material as deriving from one of three or four groups or families of

*Theobroma cacao*, genetic differences have only been discovered for the ancient *Criollos,* traditional *Trinitarios* and some traditional lower Amazon *Forasteros*.

## *The Cocoa Research Section, Trinidad and Tobago*

The Cocoa Research Section (CRS) of the Research Division in the Ministry of Food Production is located on the La Reunion Estate at Centeno. The La Reunion Estate comprises 200 ha of commercial/research cocoa fields. In Trinidad and Tobago, research into cacao has developed out of the ground-breaking work undertaken in the first half of the 20th Century by some of most celebrated names in cocoa research including Dr. F.J. Pound and Dr V. Quesnel and W.E. Freeman. The CRS is noted for the development of the Trinidad Selected Hybrids (TSH cocoa varieties), the successors to the earlier Imperial College Selection (ICS). These TSH varieties are reported to show high resistance to disease, are early fruiting, have a low pod index and display excellent fine or flavour characteristics. The TSH varieties are often cited as a highly suitable genetic base for cacao breeding activities. http://www.agriculture.gov.tt/divisions-and-units/102-cocoa-research-section.html

The Imperial College of Tropical Agriculture was a predecessor institute to the University of the West Indies. Cocoa was an important component of the Trinidadian economy in the 1930s and the national authorities had established a research programme to promote the sector and safeguard it from Witches' Broom disease. The famed cocoa specialist, Dr F.J. Pound undertook significant research in Trinidad and Tobago in the years 1930 to 1935 and then extensive surveys of indigenous cacao species in Ecuador and the Upper Amazon between 1937 and 1942 to find genotypes resistant to Witches' Broom disease. By 1955 the Regional Research Centre for cocoa had been established which became the Cocoa Research Unit in 1963. Material gathered during Dr Pound's extensive surveys gave rise to the Imperial College Selections (ICS). The International Cocoa Genebank, Trinidad maintains a database of physical, chemical and sensory traits of 30 clones developed originally by the Imperial College. These Imperial College Selections (ICS) are amongst the best known cocoa genetic selections available in the world. Noted for the desirable economic traits, (including disease resistance, high cocoa butter fat content, flavour, high yield & genetic diversity) available within this collection of cacao, the ICS has been widely used in cocoa breeding programmes. The original Imperial College Selection (ICS) clones have been progressively replaced on many farms by newer commercial varieties (Trinidad Selected Hybrids) produced by the Ministry of Agriculture, Land and Marine Resources (MALMR) through the breeding programme pioneered by the late W.E. Freeman. These hybrids are reported to have increased resistance to diseases and highly favourable agronomic traits. The University of the West Indies website notes that "all of the commercial and superior TSH clones distributed to farmers have...been subjected to sensory analysis at the Cocoa Research Unit".

In the 1980s, the European Development Fund provided the resources for these diverse collections to be brought together at a professional managed central site: The International Cocoa Genebank, Trinidad (ICG, T). The University Cocoa Research Station maintains and manages a renowned collection of some 2,300 accessions representing the three, possibly four , known major cacao groups (*Criollo, Forastero, Trinitario* and *Refractario*)* with new clones being added as they become available. This gene bank has been designated by Bioversity International as a "Universal Collection," one of two such cacao repositories in the public domain. The ICG, T collection is thought to attribute 70% of its germplasm to Pound's collections in Ecuador and Peru. (*The Agronomy and Economy of Important Tree Crops of the Developing World – K.P. Prabhakaran Nair*).

- Several other sub-groups fall under the Forastero family, the best known of which are the Amelonado (melon shaped fruits) varieties found in Africa. This was the predominant Amazonian variety established in Africa in the 19th century and due to its self-compatibility it has become the core of African breeding stock.

- While Zhang et al sought to provide genetic evidence for the *Refractario* as a specific family, there is debate about this amongst cocoa botanists. Some insist that the *Refractario* group is no more than a name for a group of cocoa individuals / Forasteros, which showed a certain disease tolerance.

### *CATIE, Costa Rica*

CATIE: The Tropical Agricultural Research and Higher Education Center, is a regional centre dedicated to research and graduate education in agriculture, and the management, conservation and sustainable use of natural resources. Its members include Belize, Bolivia, Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Venezuela, the Inter-American Institute for Cooperation on Agriculture (IICA) and the State of Acre in Brazil. CATIE's cacao germplasm collection: the International Cocoa Collection of CATIE (IC3) was initiated in Costa Rica in 1944 as part of the strategy of the Inter-American Institute for Cooperation on Agriculture (IICA) to promote the distribution and exchange of germplasm for valuable tropical crops. It is described as including "a significant representation of the broad genetic diversity that the species possesses in tropical America". According to the CATIE website, IC3 contains nearly 1,200 clones of cacao (*Theobroma cacao*), mainly from tropical America, which is the centre of origin and diversity of the species. The collection also includes clones obtained in Africa, Asia and Oceania and other cultivated species of the genus *Theobroma* such as *T. bicolor* (pataste) and *T. grandiflorum* (cupuaçu), or wild species such as *T. angustifolium, T. mammosum*, *T. microcarpum, T. subincanum, T. simiarum* and *T. speciosum.* The genus *Herrania*, which is the genus most closely related genetically to *Theobroma*, is represented by seven species: *H. albiflora, H. baloensis, H. cuatrecasana, H. nycterodendron, H. nítida, H. purpure* and *H. umbratica*. The collection is enriched annually by introducing clones from the quarantine station at the University of Reading and from other reliable sources.

The CATIE collection is described as a "potential source of clones with...features, such as resistance to pests and diseases, high polyphenol contents, resistance to extreme conditions, short stature...".. Noting the important commercial qualities of its germplasm, CATIE states that conservation of the CATIE collection is a priority "for solving many of the present and future problems that affect the crop". CATIE makes its collection available for:

- genetic enhancement studies of various kinds
- propagation material for breeding programmes
- the establishment of commercial plantations in different countries.

With the collaboration of the Department of Agriculture of the United States (USDA-ARS), every tree in the collection has been or will be confirmed using DNA techniques. The material is being screened to identify any duplicates, mixed specimens, or specimens that do not correspond to the original type.

http://catie.ac.cr/en/products-and-services/collections-and-germplasm-banks/international-cocoa-collection

The IC3 has also been designated a universal collection depository. According to K.P. Prabhakaran Nair (The Agronomy and Economy of Important Tree Crops of the Developing World), the CATIE collection is heavily based on commercial selections from the former United Fruit Company and their clones and derivatives from Costa Rica along with similar material from other countries in the region and Criollo lines.

### *The National Agricultural Research Institute (INIAP), Ecuador (Instituto Nacional Autónomo de Investigaciones Agropecuarias)*

INIAP was founded in 1959 to support the development of agriculture in Ecuador, since when it has established a number of experimental stations across the country's different regions in order to perform scientific research and to transfer knowledge and technologies in support of sustainable agri-production sector. INIAP is renowned for the development of what is known as the Estación Experimental Tropical (EET) clones/ cocoa selections. The development process reportedly commenced in the period 1940s-mid 1950s when farm inspections across the cacao growing parts of the country yielded up superior specimens based on yield performance and pest and disease resistance. After a lengthy period of evaluation and selection INIAP released a selection of cloned materials in the 1970s that became recognised as the country's Nacional type. Included in this selection are the clones: EET-103, EET-96, EET-95, EET-64, EET-48 and EET-19.
http://www.iniap.gob.ec/web/

#### Propagation of Clonal Materials

In respect of clonal propagation, production appears to be rather informal. There appears to be no licensing system or scrutiny of clonal nurseries. We have been informed that there are as many as 300 nurseries in Ecuador offering CCN-51, however professional farmers we spoke with mostly seek to source from Sergio Cedeño's "Hacienda Cañas". The Cañas nursery is certified by AGROCALIDAD (Ministry of Agriculture ) and has been supplying cacao planting material for some 20 years. It is not too surprising, with more than 300 nurseries, that it is rumoured there are different "versions" of CCN 51 available. In a professional nursery the propagation of specified clonal material should be simple: well trained grafting staff will be able to identify different varieties of bud wood by their various vegetative characteristics (vigour, leaf colour, distance between single buds etc).

##### Cimarron Cocoa Estates Cía. Ltda.

Cimarron Cocoa Estates (Cimarron) is supplying a new cacao selection under the name Sacha Gold, which has attracted a great deal of interest from growers. Sacha Gold is under evaluation on a number of plantations across the region.

The original 'Super Tree' selections were Trinitario, fine flavour cacao discovered in Orellana, Ecuador in 2005 by Mr BK Matlick, formerly the plantation director of the Hershey Experimental Cacao Farm in Belize. Led by Mr George Loquvam the development of Sacha Gold (for commercial use) commenced in 2007. Cimarron began with eight, and then nine trees, field trialling them over a period of 5 years. Two of the selections were considered superior to their peers in the group and these are the basis for the material now on offer. The clonal materials are grafted onto CCN-51 rootstock. Reportedly the final selections exhibit excellent tolerance to Frosty Pod and Witches' Broom, with early production, high yields, and fine flavour characteristics. Cimarron notes that it has recorded productivity up to 3mt/ha at years 5-6 with high density planting (1,430 pl/ha). The company is targeting up to 4kg per tree (compared with a standard 1kg) but per tree yields will be influenced by planting density and agronomy regime. Cimarron advise that Sacha Gold can be planted in climatic zones with high rainfall and also in dry zones, supported by irrigation.

### *CEPLAC, Brazil*

CEPLAC is the Brazilian government's cacao research and extension agency and it manages the country's cacao germplasm library. The upper reaches of the Amazon are thought to be the point of origin for the species and the CEPLAC bank of germplasm has been developed by CEPLAC scientists searching for and collecting wild accessions within the Amazon. These specimens are evaluated, and if they are found suitable, then they are introduced to CEPLAC's breeding programmes. Accordingly the agency is the country's primary source of improved cacao varieties.

The agency works with a number of sector actors to fulfil its objective of strengthening the Brazilian cacao sector including Cargill with whom it has distributed more than 5 million seeds within Pará State alone since 2009.

## Africa

A challenge for breeders of cacao in Africa is the threat posed by the Cocoa Swollen Shoot Virus (CSSV), a resurging viral disease that seriously impacts on West African cocoa production. CSSV specialists from Africa are working with the International Cocoa Quarantine Centre at Reading (UK) to enhance collaborations that focus on CSSV and mealy-bug-vector interactions with the aim of developing effective detection, breeding, and other management strategies. Like their counterparts in the Americas, the breeding and development agencies in the Africa producer countries have (in many cases) significant histories – most of which were established pre 1950. However, only the CNRA of Ivory Coast is strongly associated with a specific variety – the Mercedes variety, but Ghana's Cocobod operates a dedicated Seed Production Division. The agencies present a mixed picture, with Nigeria's for example attracting significant local criticism – and interestingly Nigeria's cocoa sector appears to have achieved no progress in yield efficiency over the last 15 years.

### *The Institute of Agricultural Research for Development (IRAD), Cameroon*

IRAD is a government institution established in 2002 to manage agricultural research. IRAD's remit is to implement research focused on Cameroon's priority sectors for development, which includes cacao.

### *Cocoa Research Institute of Nigeria*

The Agricultural Adviser to the Colonial Office, Dr. H.A. Tempany, established the West African Cocoa Research Institute (WACRI) in 1944, with a sub-station at Ibadan, Nigeria. The Cocoa Research Institute of Nigeria (CRIN) was subsequently established in Oyo State by the Federal Government of Nigeria through the Nigeria Research Institute Act of 1964. CRIN was established to promote and improve the productivity of cocoa and its production in Nigeria. For the past 2-3 years the CRIN has been wracked by staff protests and complaints against the management and investment priorities of the agency.

### *Ivory Coast National Agriculture Research Centre*

The National Centre for Agricultural Research (CNRA) is the country's main agricultural R&D agency, accounting for two-thirds of the total research capacity and over three-quarters of its agricultural R&D investments. CNRA research is mainly funded by the private sector through the Inter-Professional Fund for Agricultural Research and Extension (FIRCA); CNRA also uses internally generated resources to fund its research.

Plant breeding and associated biotechnologies are implemented in 40 programmes divided into two main crop-groups. The cash crop group comprises mainly cocoa,

coffee and kola nut, while the food crop group is more interested in rice, maize, millet and sorghum. Current priorities include: breeding for quality traits, favourable environments and biotic stress. The CNRA has produced the 'Mercedes' variety, a reportedly high-yielding cocoa cultivar. Mercedes is a compound "variety" of cocoa hybrids, descending from elite trees (amongst original French selections). As Mercedes is sexually reproduced, and the parent trees are not known, its level of resistance to problems like CSSV (cocoa swollen shoot virus) is unpredictable, and so too, one would suppose, will be yield outcomes. The use of seedling cacao is now eschewed by the professional producers in Latin America, in favour of clonal material.

According to the FAO the main limiting aspect in plant breeding programmes has been an inadequate laboratory infrastructure to carry out experiments using advanced plant breeding techniques. Another important constraint has been the limited access to national public and/or private genetic resources. And with only 30% of breeders trained to doctorate level, the training of new agronomists/ breeding scientists is a cause for concern.

### *The Cocoa Research Institute (CRIG) of Ghana & COCOBOD Seed Production Division*

The Cocoa Research Institute (CRIG) of Ghana is the successor of the Central Cocoa Research Station of the Gold Coast Department of Agriculture, established in 1938 on the recommendation of the Agricultural Adviser to the British Minister of State for the Colonies. At that time cocoa production in the Eastern Region, the origin of the Ghanaian sector, was declining due to pest and disease outbreaks and the station was set up to investigate these problems and to introduce control measures.

After independence in 1957, the Cocoa Research Institute of Ghana (CRIG) was established and was subsequently placed under the management of the Ghana Cocoa Board. CRIG has 35 trained scientists and 175 technical staff. The organisation can now boast more than 50 years of research achievements with that work now extended by a cocoa research station at Bunso. Today the Ghana Cocoa Board (COCOBOD), through its Seed Production Division (SPD), produces and supplies cacao seeds to Ghanaian farmers. SPD's remit is to multiply and distribute the best quality planting materials in adequate quantities. The organisation is therefore responsible for maintaining, improving and expanding Cocobod's seed gardens. SPD is also responsible for clonal propagation of new materials. The organisation has an explicit mandate to breed new cocoa varieties which it does using a variety of techniques including clonal budding and hand pollination.

SPD raises hybrid cacao seedlings at its breeding stations for distribution to farmers for the rehabilitation of old farms and the establishment of new ones. It has cacao seed gardens located in the Eastern, Western, Ashanti, Central, Brong Ahafo, and Volta Regions of the country.

### *The African Cocoa Breeders Working Group (ACBWG)*

The African Cocoa Breeders Working Group (ACBWG) is supported by the WCF African Cocoa Initiative (WCF/ACI), a programme supported by WCF and its industry partners and the U.S. Agency for International Development (USAID). The group originally evolved from the CFC/ICCO/Bioversity project 'Cocoa Germplasm Utilization and Conservation' in 2003 and received support from USDA and Mars Inc. through a project to improve breeding using molecular approaches in 2007. It subsequently became a thematic sub-group in the Sustainable Tree Crops Program (STCP), receiving support form a number of donors including USAID and WCF.

With support from Mars Inc. and the World Cocoa Foundation (WCF), the African Cocoa Breeders Working Group (ACBWG) met in Reading (UK) in 2013 to discuss progress made by regional projects originally launched through this collaborative network. Breeders from Cameroon, Côte d'Ivoire, Ghana, Nigeria and Togo met with scientists from the University of Reading, the International Centre for Agricultural Research and Development (CIRAD), the International Institute for Tropical Agriculture (IITA, Ibadan, Nigeria), and the University of Arizona, as well as representatives from Mars Inc., Mondelēz and Nestlé, together with administrators from the WCF and Cocoa Research UK.

Since ACBWG was created in 2003, its members have met every year (generally in Africa), to exchange ideas on how to accelerate progress of the national breeding programmes, and also to prepare regional projects. The 2013 meeting was divided in two sessions: the first discussed progress in each country on germplasm evaluation, and the second addressed germplasm utilization/breeding. The meeting at the University of Reading was scheduled to facilitate collection of budwood from the International Cocoa Quarantine Centre (ICQC) and to return it to each of the participating countries. This germplasm is to be used as a source of genetics to improve key phenotypic traits. During the meeting it was agreed that a database should be created and hosted at a new website to report on both the value of the germplasm, as well as on the breeding results from crosses among current and newly collected germplasm. The resulting databases will be hosted at a website managed by the International Cocoa Germplasm Database (ICGD) team under the umbrella of the International Group for Genetic Improvement of Cocoa (INGENIC).

## Asia

We have received anecdotal reports of concerted breeding activity in Papua New Guinea (where there is reported to be some good commercial varieties), Philippines (where Mars has carried out some important development work) and Indonesia – some of which has been led by global downstream actors, some by local actors. However across the region germplasm collections are narrower than in the Americas (which is only to be expected) and the focus of breeding looks to have been directed to developing resistance to pest and disease, and in particular to the Cocoa Pod Borer. There is very little publically available and accessible information about the breeding and development agencies of the major producer countries across the region.

### *The Asia-Pacific Cocoa Breeders Working Group (APCBWG)*

Cocoa breeders in the Asia-Pacific region meet annually under the auspices of INGENIC to share knowledge and to develop collaborative activities in developing new planting materials. The Asia-Pacific Cocoa Breeders Working Group (APCBWG) comprises researchers from CCI (PNG), CPCRI (India), ICCRI (Indonesia), MCB (Malaysia), NLU (Vietnam), USM (Philippines) and Mars Inc.

With financial support from WCF, the group has set up trials at each institute to evaluate the performance of interesting planting materials exchanged by the partner institutes and this is reported to have resulted in the selection of some promising clones. A second collaborative activity has been set up to assess pod husk hardness, which is likely to be a key factor in resistance to Cocoa Pod Borer, a pest that causes heavy losses in many parts of the region

## International Cocoa Germplasm Database & International Cocoa Quarantine Centre

Movement of germplasm from one country to another, or in particular from one continent to another is tightly regulated: dread images are conjured up of the spread of SSW to South America or Frosty Pod to Africa. Reading University in the UK has provided an invaluable service to the sector by the operation of a cocoa quarantine station in the UK, where clonal material is observed over a lengthy period for detection of pest and disease. The International Cocoa Quarantine Centre (ICQC) website notes that currently it has some 370 clones available for exchange with more undergoing quarantine. The site for the facility includes more than 1000m2 of greenhouse space and a hydroponic growing system.

The current quarantine procedure involves a two year visual observation period to check for latent viral infections. Research is underway to improve and accelerate the quarantine process using new technologies. Strict quarantine procedures include:

- virus indexing over a two-year period
- weekly observation by staff
- six-monthly inspections by independent experts in pathology, entomology and virology
- an annual inspection by the UK Department for Environment, Food and Rural Affairs (Defra).

ICQC supplies budwood material to over 20 institutions around the world. Most of the material under test by Reading derive from the International Genebanks in Trinidad (CRC) and Costa Rica (CATIE), but materials have also been received from the wild and from other National collections.
http://www.icgd.reading.ac.uk/quarantine.php

(For further reference regarding safe movement of cacao germplasm, see the link below to the International Plant Genetic Resources Institute (IPGRI) - now Biodiversity International:
http://www.bioversityinternational.org/fileadmin/user_upload/online_library/publications/pdfs/360.pdf)

## INGENIC - The International Group for Genetic Improvement of Cocoa

INGENIC was created in 1994 and operates as an independent group sponsored by different institutions. It promotes the exchange of information and international collaboration on cocoa genetics and improvement of cocoa planting materials. The membership includes some 223 members, representing 35 developing and developed countries.

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