ACP Science
and Technology II Programme

IFCIC — International Fine Cocoa Innovation Centre

One of the 2018 graduating classes of the 'Introductory Chocolate Making Course' at the Cocoa Research Centre, Trinidad.

SUMMARY OF RESULTS

An International Fine Cocoa Innovation Centre has been established showcasing a multi-pronged approach to the development of a sustainable cocoa industry. A 6-acre model cocoa orchard has been established to deliver training to cocoa producers. Information and technology services for farmers (DNA fingerprinting, quality certification, traceability, branding services), basic and advanced chocolate making training (>250 trainees), and technology and business incubation to support value addition have been operationalised. Chocolate making equipment was purchased to supply intermediate raw material to chocolatiers resulting in 59 new start-ups and micro, small and medium-sized enterprises, and a business cluster around the cocoa farming sector. Enterprises were exposed to public and regional markets through four World Cocoa and Chocolate Day Expos and other trade expos and fairs to assist in building their markets. The development of a cocoa breeding programme in Jamaica was also supported.

PROJECT IMPLEMENTATION PERIOD
March 2014 - August 2018

CONSORTIUM
- Cocoa Research Centre (CRC), The University of the West Indies (UWI), Trinidad and Tobago
- Caribbean Fine Cocoa Forum (CFCF), Trinidad and Tobago
- Jamaica Agricultural Commodities Regulatory Authority (JACRA, formally called Cocoa Industry Board, Jamaica
- Newer Worlds, United Kingdom

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PROJECT WEBSITE
www.facebook.com/cocoacentre

BACKGROUND

The cocoa sector in Trinidad and Tobago and the Caribbean has been in decline due to:
- lack of innovation in breeding, production, processing and the marketing system;
- lack of a technology transfer system to transfer information and new technologies from laboratory-to-farm-to-table;
- poor quality management systems among processors resulting in variable quality;
- aging farms and farmers, low productivity of farms, high production costs and labour shortages resulting in unviable business models;
- convoluted and long value chain resulting in farmers receiving disproportionately low proportions of the value chain (5%);
- inability of farmers to access the lucrative ultra-niche markets in the metropolises due to lack of branding, certification, traceability systems; and
- low levels of value addition and lack of a business sector around the cocoa farming sector.

The project applied the following hypotheses:
- The IFCIC facility established on a triple helix model (university-public-private partnership) will be able to develop smallholder innovations along the value chain, showcase them, provide training and technology services, support the development of policy and attract public and private sector investment to support industry development, thus becoming a technology transfer interface.
- Research and development will allow more nuanced approaches to cocoa orchard management and smallholder mechanisation resulting in improved yields and quality, and higher profitability.
- Branding, quality management, certification and traceability systems will allow farmers to directly access lucrative boutique markets ensuring farmers at least 30% of the market share.
- Master classes in value addition along with technology and business incubation supported by their exposure to markets through trade expos and fairs will allow start-ups and micro, small and medium-sized enterprises (MSMEs) to become successful businesses and export their produce to the lucrative tourism markets.

The project beneficiaries were: cocoa producers (farmers, farmers groups, private investors in the local and regional cocoa sector); cocoa value chain actors (cocoa processors, chocolatiers, bakers, chefs); public sector (ministries, committees, special purpose business companies); networks (Caribbean Cocoa Industry Network 'CocoaNext', Caribbean Fine Flavour Forum, Chocolate Guild); general public and consumers; academia.

IFCIC
International Fine Cocoa Innovation Centre

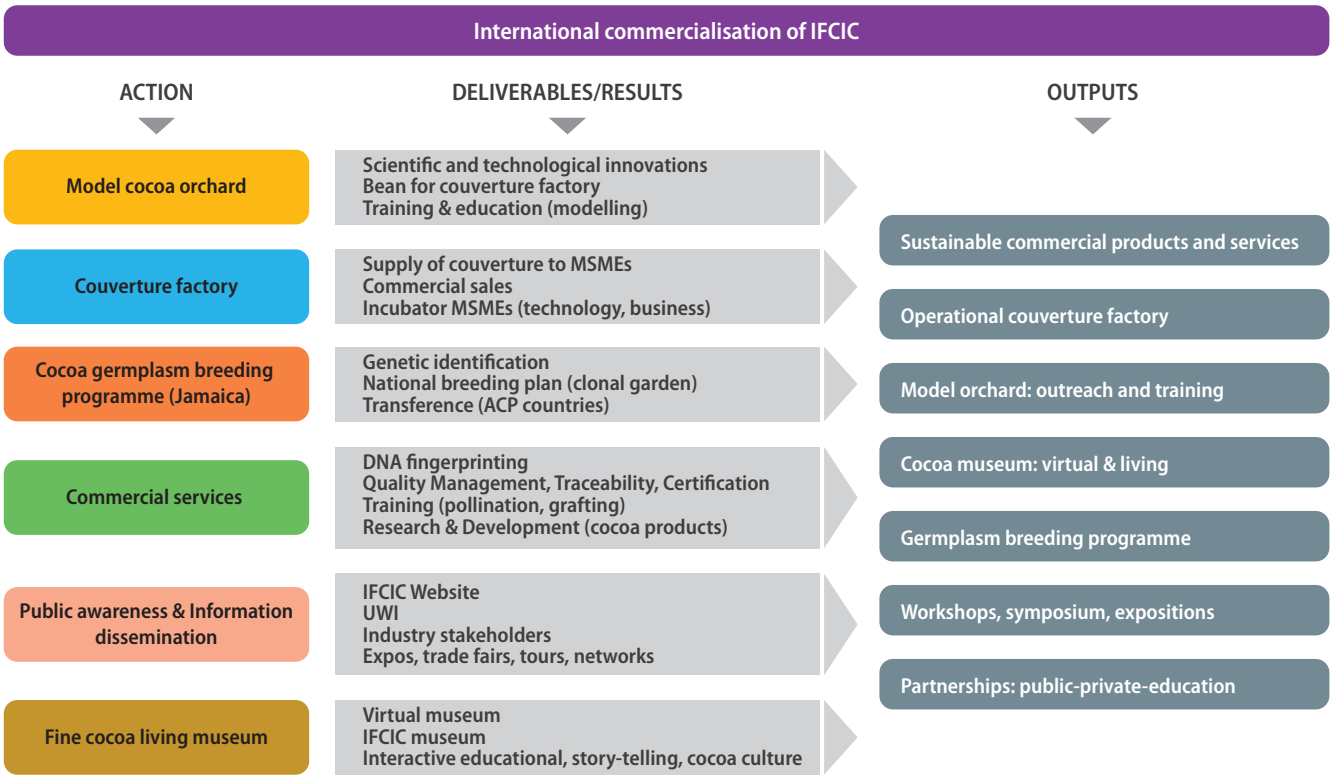
UWI

Cocoa Research Centre

Caribbean Fine Cocoa Forum
revitalise . retrain . realise . retain

EWER RLDS

METHODOLOGY



Model cocoa orchard

After a comprehensive literature review of best practices in existing model farms in Brazil, Australia, and Ecuador, a model cocoa orchard was constructed to demonstrate irrigation techniques, innovations in tree management, mechanised harvesting, pest and weed control, and post-harvest processing innovations.

Couverture factory

A fully-functioning fine chocolate factory producing couverture and other intermediate processed products as input feed for resident micro-, small- and medium-sized enterprises (MSMEs) chocolatiers will be functional in 2019. There have been workshops, seminars, and master classes based around chocolate making and other cocoa derivatives using innovative techniques and these will continue. Chocolatiers have also been trained through technical courses in quality along the Cocoa Value Chain, Introduction and Advanced Chocolate Making and Sensory Evaluation.

Cocoa germplasm breeding programme

In Jamaica, over 800 mother trees were identified and DNA fingerprinted to select a limited number for yield trials and clonal gardens. Staff from the Ministry of Agriculture and the College of Agriculture Science and Education (CASE), as well as several technicians from the Caribbean region were trained on conventional and modern breeding methods (DNA fingerprinting and molecular marker technology). Following the unintended introduction of the Frosty Pod Rot disease in Jamaica in 2016, new varieties with tolerance to this disease were sourced from the International Cocoa Quarantine Centre at the University of Reading (UK) and supplied to Jamaica.

Commercial services

- Superior mother trees from Jamaica and Trinidad and Tobago were identified with a Fluidgm DNA fingerprinting system.
- Branding of cocoa growing areas through Geographical Indication designation, as well as a farm-based branding (tree-to-bar) were applied.
- A quality certification service has been developed that allows sustainability, farm and quality certifications.
- Using genome-wide association studies (GWAS), molecular markers for important agronomical traits have been established, and once validated will allow for a global innovative molecular marker service.
- With a Near Infra-Red Reflectance Spectrometry (NIRS) service, a start has been made to develop a database of spectral fingerprints for cocoa from various parts of the world.
- A digital traceability service was developed to track cocoa beans throughout the production process, from the farm up to the manufacturer.

Public awareness & Information dissemination

The IFCIC website, in addition to cocoa specific information, contains technical bulletins, stories of cocoa estates, online training courses, audio visual promotional materials, the e-journal, and conference and symposia proceedings.

Fine cocoa living museum

An electronic museum has been set up, and will be developed into a physical facility showcasing the story of cocoa in Trinidad and Tobago. The physical facility will also serve as a tourist attraction. IFCIC will feature a visitor centre that will allow bean-to-bar tours for the public as well as a hub for other cocoa-based agrotourism facilities.

CocoaTown representation of bean-to-bar process.

RESULTS

Outputs

Stakeholders involved

- 800 farmers / cocoa producers.
- 10 private investors in the local and regional cocoa sector, government controlled / managed cocoa farms.
- 10 processors with fermentation and drying facilities.
- 260 chocolatiers, chocolate based cuisine chefs.
- 70 start-ups and MSMEs involved in cocoa-based value added products.
- 12 public sector organisations: local and international cocoa industry boards, government ministries, special purpose public sector boards, bureau of standards, financial entities, export import agencies, cocoa industry networks - CocoaNext and Caribbean Fine Cocoa Forum, Cocoa Research Centre Chocolate Guild, Partners in Conservation.

Capacity building

- Short courses (theory and practical): Agronomy (13), Chocolate making (36), Sensory analysis (6), Post-harvest (6), Molecular marker technology (4).
- Support to 59 start-ups in facility design, purchase of equipment, product development, food safety assessment and Standard Operating Practices (SOP) for laboratories, quality management systems and certification.
- People trained: Chocolate making trainees (239), Agronomy technicians (287), Sensory laboratory technicians (78), Post-harvest technicians (120), Molecular laboratory technicians and supervisors (36), Farmers (56), Cocoa value add producers (116), Start-up technologists (68).
- 2 online courses: Rehabilitation of cocoa fields; Risk analysis and mitigation.

Toolkits

- 9 databases: Agro-ecological zones, Risk and constraints, Base survey of cocoa industry in Trinidad Tobago 2017, Cadmium contamination of soils and beans, Soil fertility of cocoa soils, Flavour map of Trinidad and Tobago, DNA fingerprint, NIRS spectral fingerprint, Cost of production.
- 1 digital traceability platform.
- 8 videos: Cocoa Research Centre and IFCIC, Post-harvest processing, Bean-to-bar production, Quality Control and certification, DNA fingerprinting, Cocoa pollination, Climate change and cocoa yields, Genebank.
- 7 bulletins: IFCIC; Cadmium contamination and mitigation; Disease identification and management; Cocoa propagation, pruning and shade management; Quality management; Value addition; Post-harvest processing.
- 9 guidelines: Geographical indication based branding, Traceability of cocoa, SOP for quality laboratories, Quality certification of cocoa, SOP for DNA fingerprinting, Fidelity testing, Determination of ancestry of cocoa clones; Determining an effective population size for conservation; Determination of cadmium in cocoa beans and leaves.
- 3 protocols: DNA isolation for DNA fingerprinting, DNA fingerprinting using FLUIDIGM, NIRS analysis of cocoa samples.
- 2 manuals: Quality certification, Branding.
- 15 brand stories for farms.

Facilities

- 2 technology, 6 business and 1 cuisine incubators.
- Refurbished laboratory in compliance with certification standards.
- Refurbished greenhouses to support propagation.
- Chocolate factory (to be built in 2019).
- Model cocoa orchard to showcase innovations in propagation and tree management.

Crops

- Superior cocoa varieties identified in Jamaica through comprehensive DNA fingerprinting.

Technology services

- Global DNA fingerprinting.
- Branding support.
- Quality certification.
- Traceability.
- Molecular marker.

Documents

- 6 policy briefs: Labour policy brief, Cocoa Industry Research and development needs, National cocoa strategic plan and action plan, International cocoa flavour and quality standards, National and regional standards for cocoa quality, National and regional standards for cocoa products.

Visibility

- IFCIC website: https://ifcic.center/
- International conference papers.
- Annual World Cocoa and Chocolate Day Expos.

Publications

- Umaharan P. (ed), 2018. Achieving sustainable cultivation of cocoa. Burleigh Dodds Series in Agricultural Science. Cambridge, UK.
- Krähmer A. *et al.*, 2015. Fast and neat – Determination of biochemical quality parameters in cocoa using Near Infrared Spectroscopy. Elsevier Food Chemistry 181:152-159.
- Sukha D.A. (*in press*). Grading and quality of dried cocoa beans. Chapter 5 in 'Drying and Roasting of Cocoa and Coffee' (Eds. Ching Lik Hii and Flavio Meira Borem) CRC Press Series: Advances in Drying Science and Technology. [ISBN pending. Publication date - Spring 2019].
- International Symposium on Cocoa Research, Lima, Peru. 13-17 November 2017:
  - Ali N.A. *et al.*, 2018. Profiling fermentation progression and quality attributes of Trinitario and Refractario Cacao (*Theobroma cacao* L.) hybrid populations at the International Cocoa Genebank Trinidad (ICGT) – Opportunities for genetic branding.
  - Sukha D.A. *et al.*, 2018. Evidence for applying the concept of 'Terroir' in cocoa (*Theobroma cacao* L.) flavour and quality attributes.
  - Mahabir A. *et al.*, 2018. Identification of a core SNP panel for cacao identity and population analyses.
  - Lewis C. *et al.*, 2018. The genetic variation of cadmium (Cd) uptake and bioaccumulation in *Theobroma cacao* L.
  - Umaharan P. *et al.*, 2018. Supporting entrepreneurship and development within the fine/flavour sector using science technology and innovation – Case of the International Fine Cocoa Innovation Centre.
- Sukha D.A. *et al.*, 2017. The impact of pollen donor on flavor in cocoa. Journal of the American Society for Horticultural Science 142 (1):13-19.
- Sukha D.A. and Seguine E.S., 2015. Protocols for the preparation and flavour evaluation of samples and small-scale fermentation techniques. Chapter in 'Cocoa Beans: Chocolate and Cocoa Industry Quality Requirements', p. 71-92. Edited by M.J. End and R. Dand. CAOBISCO/ECA/FCC, Brussels, Belgium.
- David Gopaulchan D. *et al.*, 2019. Morphological and genetic diversity of cacao (*Theobroma cacao* L.) in Uganda. Physiol Mol Biol Plants.
- Motilal L.A. *et al.*, 2016. Association mapping of seed and disease resistance traits in *Theobroma cacao* L. Planta 244(6): 1265-1276.

RESULTS

Outcomes

- International interest for participation in the cocoa training courses at IFCIC.
- IFCIC able to showcase innovations in cocoa farming systems.
- IFCIC able to provide value addition support.
- IFCIC able to provide 5 technology services: DNA fingerprinting and molecular marker, Branding support, Certification of farm and product quality, NIRS spectral analysis, Digital traceability.
- IFCIC received the Vice-Chancellors Award for Excellence of the UWI's globally most impactful project.
- Strengthened fine cocoa sector (stakeholder networks and technology services).

Impacts

Usage

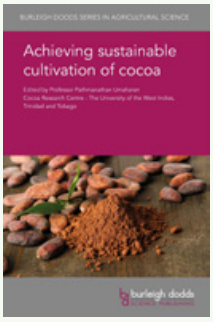
- IFCIC's public-private-university partnership model will be capable of enticing public and private investments.
- Commercial production of intermediary products for sale to MSMEs.
- IFCIC's factory outlet contains own branded chocolates and other value added products, and chocolates from start-ups.
- The IFCIC web portal transfers information to stakeholders and offers training programmes.
- The IFCIC facility will become a hub of public-private-university partnership activities, as well as a tourist attraction.
- Young farmers are increasingly interested in working in the cocoa sector and existing farmers report sustainable incomes.
- Private and public sector cocoa stakeholders are interested in CRC's services and research.
- Continued engagement with cocoa value chain stakeholders.

Policy implications

- Trinidad and Tobago is proposing IFCIC as one of five innovation centres to improve the economic diversification of the country with an expected rehabilitation of the cocoa industry.
- Jamaica is developing a Plan of Action for the control of Frosty Pod Rot.
- Adoption of the IFCIC Clonal Garden for replication across Jamaica depends on the Ministry's implementation of a wider national plan.

Sustainability

- CRC participates in the Australia-Caribbean Cocoa Knowledge-Sharing Symposium with the adaptability of the IFCIC Model Orchard practices.
- IFCIC will provide high quality intermediate cocoa products to farmers through the couverture factory.
- IFCIC will work with an international working group for standards to provide international training in sensory analysis and quality management.
- There is a worldwide interest in the global DNA fingerprinting service.
- IFCIC is developing a range of molecular markers to support breeders.
- IFCIC will offer commercial services (farming innovations, branding, certification, traceability, value addition) to improve farm yields and the cocoa value chain.



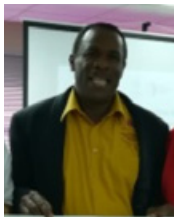
TESTIMONIALS

Mr. Clarence Rambharat, Minister of Agriculture, Land and Fisheries, Trinidad and Tobago

"Farmers should be fortunate to have some of the best minds in the industry at the Cocoa Research Centre of UWI. The Centre addresses many important issues to advance the industry and bring resources to our farmers, not to mention our cocoa knowledge bank. Examples are: improving cocoa production through the adoption of best practices, management of cocoa diseases, post-harvest processing and quality management and the critical importance of value added cocoa products."

Ms. Nikita Nath, Operations Manager, and Mr. Russell Nath, co-owner, Ortinola Great House (Ortinola), Trinidad

"Our estate has increased in productivity, quality and refinement. Having participated in the chocolate making courses and as incubatees, the estate launched its own chocolate brand and other value-added products: coca nibs, cocoa powder and 75% dark chocolate offerings, including the flavoured dark chocolate line. The Cocoa Research Centre was instrumental in getting us started. We look forward to continue working together to further develop our wonderful estate."



Mr. Christopher Paul, Chairman, Montserrat Cocoa Farmers Co-operative Society Limited, Gran Couva, Caroni, Trinidad

"Thanks to the CRC and IFCIC project our co-operative has attained a Geographic Indicator, Rain Forest Alliance Certification and direct export marketing of the area's fine flavour beans. The CRC innovated and provided a quality certification that assisted us to link with a buyer from Switzerland, which resulted in a 2.5 fold increase in price per tonne. These accomplishments led to our innovations being awarded as one of the top 10 smallholder innovations by FAO in 2018."

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