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COMPLETION OF THE REPORT ON
“COCOA PRODUCTIVITY AND QUALITY IMPROVEMENT: A PARTICIPATORY
APPROCH”
SUMMARY OF THE PROJECT COMPLETION REPORT (PCR)

Note from the Secretariat:

The full Final Completion Report prepared by *Bioversity International* is available on the ICCO website:
www.icco.org/projects/Projects1.aspx?Id=vlk2230.

**COMPLETION OF THE PROJECT ON
“COCOA PRODUCTIVITY AND QUALITY IMPROVEMENT: A PARTICIPATORY
APPROACH”**

SUMMARY OF THE PROJECT COMPLETION REPORT

Introduction

1. A number of cocoa producing countries depend largely on cocoa exports for a significant proportion of their foreign exchange earnings, a source of income for the government through export taxes and duties to finance social and economic development projects. However, the sustainability of cocoa production is undermined by the spread of cocoa pests and diseases which are estimated to account for about 40% of global loss of cocoa production annually. The major cocoa pests and diseases are Mirids, Black Pod, Cocoa Swollen Shoot Virus (CSSV), Frosty Pod Rot, Witches' Broom, Cocoa Die-back disease and Cocoa Pod Borer (CPB). In addition, cocoa production face a number of constraints related to climatic changes, ageing of tree stock, soil fertility, land tenure and poor farm management practices. It should be noted that the cocoa market liberalization of the 1990s led to the deterioration in the quality of cocoa produced in several countries by creating an institutional vacuum, especially in Africa, as a result of the reform or abolition of state marketing authorities.

2. The project on “Cocoa Productivity and Quality Improvement: a Participatory Approach” was conceived to help to reduce the vulnerability of cocoa farmers to supply fluctuation and to perennial threats to production from pests and diseases as well as to improve productivity, yield and quality, thereby reducing production costs and enhancing the economic returns from cocoa production. To achieve this objective, the project was intended to develop and make available new cocoa varieties with higher productivity, stronger resistance to pests and diseases and better quality, thereby enhancing the competitiveness of cocoa production thanks to lower production costs and higher value of the product.

3. The project was implemented from June 2004 to May 2010 in Brazil, Cameroon, Costa Rica, Côte d'Ivoire, Ecuador, Ghana, Malaysia, Nigeria, Papua New Guinea, Peru, Trinidad and Tobago, United Kingdom and Venezuela. The total budget of the project amounted to about US\$10.5 million. This budget consisted of a grant of about US\$4 million from the Common Fund for Commodities (CFC) and a co-financing of about US\$3.3 million from CRA (UK), CIRAD (FRANCE), Guittard (USA), Mars Inc. (USA/UK), USDA, and WCF (USA). In addition, the participating countries provided a counterpart contribution in cash and kind amounting to US\$3.2 million. The project was co-ordinated by Bioversity International as the Project Executing Agency (PEA), while ICCO was the Supervisory Body. The project activities were implemented by the national research institutes in thirteen cocoa producing countries in Africa, Asia and Latin America and the Caribbean.

Project Rationale and Objectives

4. The project represented a major contribution to obtain more sustainable cocoa cropping systems through dissemination and validation of promising cocoa varieties with improved resistance to diseases and pests, good yielding capacity and quality traits. The project was a logical next step after the completion of the CFC/ICCO/IPGRI project on ‘Cocoa Germplasm Utilization and Conservation, a Global Approach’, that was implemented between April 1998 and March 2004 in ten

cocoa producing countries. The predecessor project carried out international clone trials; internationally coordinated hybrid trials; population breeding; germplasm enhancement; germplasm conservation, characterization and preliminary evaluation; and distribution and quarantine of interesting genotypes

5. The improvement of cocoa planting material is important to increase the efficiency and sustainability of cocoa farming systems and to reduce production costs. It also optimises the use of natural resources as well as to improve cocoa bean quality. This can be achieved through cocoa breeding. However, cocoa breeding is often criticised for the longer duration it takes to develop new materials and sometimes not responding adequately to the real needs of farmers. It should be noted that increase in efficiency and sustainability of cocoa breeding is best obtained through direct involvement of cocoa farmers in selection and validation of new varieties and through increased international and regional cooperation, building on existing efforts. This participatory approach was the main focus of the project. The participatory approach would speed up evaluation and use of new varieties especially under farmers' growing conditions as it will incorporate identification criteria used by farmers to select new varieties.

6. The participatory approach adopted in the project brought together many partners as necessitated by the regional nature of many cocoa production constraints (e.g. pests and diseases), and the genetic diversity of cocoa that is largest in the America while its use is largest in Africa and Asia. The need to distribute promising accessions through intermediate quarantine stations outside cocoa growing countries also encouraged more partnership and collaboration in the project.

7. The overall objective of project was to contribute to the welfare of the large number of smallholder cocoa farmers through higher and sustainable productivity levels of good quality cocoa at lower production costs. This could be achieved through selection, distribution and use of new cocoa varieties with improved yielding capacity, resistance to pests and diseases and quality traits. The use of improved cocoa planting material would make cocoa production more competitive and more attractive to new generations of cocoa farmers. It would also facilitate diversification of cocoa-based farming systems by reducing land, labour and cash requirements for cocoa production.

Main Project Activities and Expected Outputs

8. The project activities were divided into three main groups. The first main group of activities was the distribution of promising planting materials to farmers and on-farm validation through a participatory approach. The expected outputs of this group of activities were: characterization of farmers' use and knowledge of planting materials; distribution of promising planting materials to farmers and on-farm validation; establishment and evaluation of farmers' selections on-station; and stakeholder participation and capacity building.

9. The second group of activities involved the validation and distribution of promising cocoa varieties through enhanced international collaboration. The expected outputs were: selection and validation of varieties in on-going collaborative trials; validation of germplasm enhanced for resistance to Phytophthora pod rot, Witches' Broom and Monilia diseases; dissemination of collaboratively selected germplasm through intermediate quarantine to user countries; improvement and use of rapid resistance screening methods; identification of project materials with DNA markers and development of marker assisted selection; and training and exchange of project scientists between project sites.

10. The last main group of activities focused on the exchange of information and dissemination of results, with the expected output being the analyse of data and the dissemination of results.

Summary of Project Results

11. Most project activities were successfully implemented as planned albeit with some delays in some cases. The results of the project as related to the expected outputs mentioned above are summarised below:

- i. About 200 farms were surveyed in ten countries leading to the identification of almost 200 trees with high yield potential, pest and disease resistance and enhanced quality traits. The knowledge of farmers on their planting material was used for the identification and was documented and presented at an international workshop organized by the project.
- ii. 240 on-farm selection plots were established and varieties selected by breeders were compared with farmer selections.
- iii. A total of 85 ha of variety trials established in the predecessor project had been evaluated resulting in the selection of new varieties and their commercial distribution to farmers. The international clone trials established in eight countries during the predecessor project were also evaluated and the result showed that the average yield of local clone was higher than the average yield of the international clones. However, some of the International Clones out-yielded the local clones at few sites. Data analyses showed significant environmental effects of cocoa flavour, acidity and astringency and clone effects for floral flavour.
- iv. Regional Variety Trials (RVTs) were established in ten countries to exchange hybrid varieties with good yield potential and with resistance to diseases.
- v. Germplasm enhancement for resistance to Phytophthora pod rot that started during the predecessor project at the International Cocoa Genebank (ICG) in Trinidad was successfully completed. The project recorded 70% of trees that are resistant or moderately resistant to Phytophthora pod rot as against the 30% of original population of trees that was resistant to Phytophthora pod rot.
- vi. The so-called “CFC/ICCO/Bioversity Collection” selected during the predecessor project was sent to the Reading University intermediate quarantine facility, where it underwent virus indexing for two years. 80 clones from the collection had completed quarantine and had been distributed to cocoa producing countries in Africa.
- vii. The project validated the use of leaf disc and pod test for screening for resistance to Phytophthora pod rot in Côte d’Ivoire and Cameroon. Screening for resistance to Witches’ Broom and Monilia also provided remarkable results in Trinidad, Costa Rica and Ecuador.
- viii. Technical information on project activities were exchanged among the participating countries through four regional workshops and a final project evaluation workshop

was successfully conducted in Accra, Ghana from 31 May to 4 June 2010. Proceedings of all the workshops were published and distributed on CD-ROMs.

Main Project Achievements and Lessons Learnt

12. The results of the project, in relation to its objectives and expected outputs, clearly indicated that, in general, the project had achieved more than it initially set out to achieve. The project reinforced cocoa breeding programmes in 11 countries and numerous cocoa varieties were selected for further breeding in all the participating countries. Already, 55 new varieties have been selected for distribution to farmers in Brazil, Ecuador, Trinidad, Nigeria and Papua New Guinea.

13. A major achievement of the project was the adoption of a participatory approach that involved using farmers' knowledge on their planting material for selection of interesting trees to establish on-farm trial plots. This led to the identification of 1500 promising trees. In addition, more 100 selected genotypes were quarantined and distributed to user countries.

14. A significant success of the project was the achievement of unprecedented cooperation among cocoa research institutions in the participating countries, regional and international institutions as well as the private sector on breeding and development of new cocoa varieties.

15. The project enhanced institutional and human capacity through workshops and publication of scientific papers. Data generated from the project were used to obtain three PhD degrees and several MSc and undergraduate degrees. It is important to note that the project yielded some spin-offs as through participation in the project some institutions managed to secure funding for new projects in cocoa breeding and other cocoa related research areas.

16. Some technical and operational lessons learnt during project implementation included the lack of motivation of some farmers who participated in the on-farm trials and the use of grafting on basal sprouts (chupons) of adult cocoa trees in on-farm trials in Brazil which resulted in large within-clone variations in the trials. Regarding the second issues, it was concluded that, in future, it might be preferable to use seedling grafting and planting of the grafted seedlings in-between the old cocoa rows to obtain more regular stands. Another lesson from the project was the failure of early screening test for resistance to *Monilia* at three project sites.

17. One of the major operational lessons from the project involved its very complex operational system that brought together 14 institutions from thirteen countries to collaborate on project activities. However, the competency and efficiency of the Project Executing Agency (PEA) – Bioversity International - and of the International Project Coordinator resulted in the effective implementation and coordination of the project. The International Project Coordinator carried out regular backstopping visits to the participating countries to guide and advise the local authorities on project implementation.

Conclusions and Recommendations

18. In general, the project demonstrated that cocoa breeding for improved planting materials is best achieved through collaboration and exchange of information. The participatory approach adopted by the project allowed the direct involvement of farmers in the selection of new varieties.

19. In terms of concrete achievements, firstly, a number of cocoa varieties that are high yielding and pest and disease resistant have been released to cocoa farmers. In addition, a number of new and improved cocoa planting materials are being tested and validated on research fields for eventual release to farmers. Secondly, about 1500 promising trees from farmers' selection were compared with the best breeders' selections in on-station observation trials and in on-farm variety trials. The genetic diversity of more than 2000 farm selections in Africa was analysed. Thirdly, a number of varieties with high levels of resistance to major diseases were selected in the pre-breeding programmes carried out in the international cocoa germplasm collections. The transfer of selected germplasm to interested user countries was successfully carried out through intermediate quarantine facility at Reading University in the United Kingdom. Fourthly, screening methods for resistance to major cocoa pests and diseases have been validated and successfully adopted.

20. At the final project evaluation workshop held in Accra, Ghana, detailed and specific conclusions and recommendations arising from project implementation were agreed and published in the workshop proceedings. The workshop recommended that, to consolidate the results and achievements of the project, it was important to continue some project activities post project completion. These activities are: support for the on-farm variety trials in selected countries; evaluation of the Regional Variety Trials (RVTs); Quality Trait Loci (QTL) studies on two progenies established for this purpose in the Americas and in Africa; establishment and/or reinforcement of regional selection and breeding activities in Africa, Asia and Americas; continuation of the International Clone Trials at selected sites; further evaluation of materials for flavour quality; continuation of pre-breeding and breeding using selected germplasm and accessions in the Trinidad and Costa Rica collections; and optimisation of the value of the improved germplasm through characterization, evaluation, documentation and information sharing among partners.

21. The final project workshop also recommended new areas for collaborative activities to further enhance the on-going initiatives on cocoa breeding. These include: establishment of a new International Clone Trial with high yielding and disease resistant clones to study how different clones react to biotic and abiotic stresses; initiation of preventive breeding for alien pests and diseases; selection and breeding for quality aspects; the potential impact of climate change on performance of elite types of cocoa should be established; studies on optimal management of selected cocoa clones; establishment of community-based seed delivery systems and adaptation of multiplication methodologies; and create and support Regional Breeders' Group and breeding programme in the Americas, Asia and Africa.

22. Overall, the implementation and coordination of the project have been very successful, and it is estimated that its results will contribute to efforts at achieving a sustainable world cocoa economy that is mutually beneficial to all the stakeholders in the cocoa sector.