A 'Green Revolution' in the West African cocoa belt

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Over two-thirds of global cocoa production comes from small farms carved out of the humid forests of Côte d'Ivoire, Ghana, Nigeria, and Cameroon in West Africa. Cacao in West Africa was introduced in the late 1800s and the production of cocoa was, and still remains, largely a small-holder enterprise. Today, the large majority of West African cocoa farmers are aging and struggling with aging tree stocks on depleted soils that exhibit low and declining yields. In contrast, the rapid expansion of intensified cocoa production systems through the High Tech Program (HTP) of the Ghana Cocoa Marketing Board (Cocobod) over the last 10 years has resulted in productivity gains that appear to rival those of wheat during the Indian Green Revolution (Fig. 1).

Over the last 10 years, IITA and various stakeholders in the cocoa belt have been developing cocoa innovations and sharing knowledge through the Sustainable Tree Crops Program (STCP). The HTP is credited for having demonstrated the technical feasibility of a Green Revolution in the Ghanaian farm sector.

Structural overview of a Brown Revolution

Recent STCP studies attribute impressive yield gains over the last 10 years to a combination of factors. A three-fold increase in the global price of cocoa that occurred simultaneously with the establishment of Cocobod and the reform of producer price policy resulted in much higher producer prices as compared to the previous decade. Higher farm-gate prices combined with Cocobod subsidies on fertilizers and pesticides greatly improved the profitability of input use. In less than 10 years, fertilizer use in the Western Region of Ghana rose from less than 6% to over 80% of cocoa farmers. The increased use of fertilizer was the largest estimated factor that

Red-podded cocoa. Photo by IITA.

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contributed to productivity gains in the sector. Improved farmer access to fertilizers resulted from the liberalization of internal cocoa marketing. As a result of this reform, private licensed buying companies were allowed to compete for the purchase of the farmers' dried cocoa. The ensuing competition was not in terms of the farm-gate price paid (Cocobod sets a pan-territorial producer price) but rather in the supply of inputs including fertilizers to farmers. These inputs are most often provided as an in-kind loan linked to the future sale of the farmers' cocoa to the buyer. Another important factor underlying the productivity gains explained in Figure 1 has been the intensified control of cocoa pests and diseases achieved by the US$40 million in annual expenditures of the Cocoa Disease and Pest Control (CODAPEC) program.

Other innovations such as cocoa hybrids developed by the Cocoa Research Institute of Ghana (CRIG) were estimated to be four times more productive than locally selected planting materials but were only planted on a small proportion of farms. Likewise, farmer field school (FFS) training was received by only a small proportion of farmers but the mean output was 52% higher among those farmers as compared to those who did not receive such training, all other things being equal.

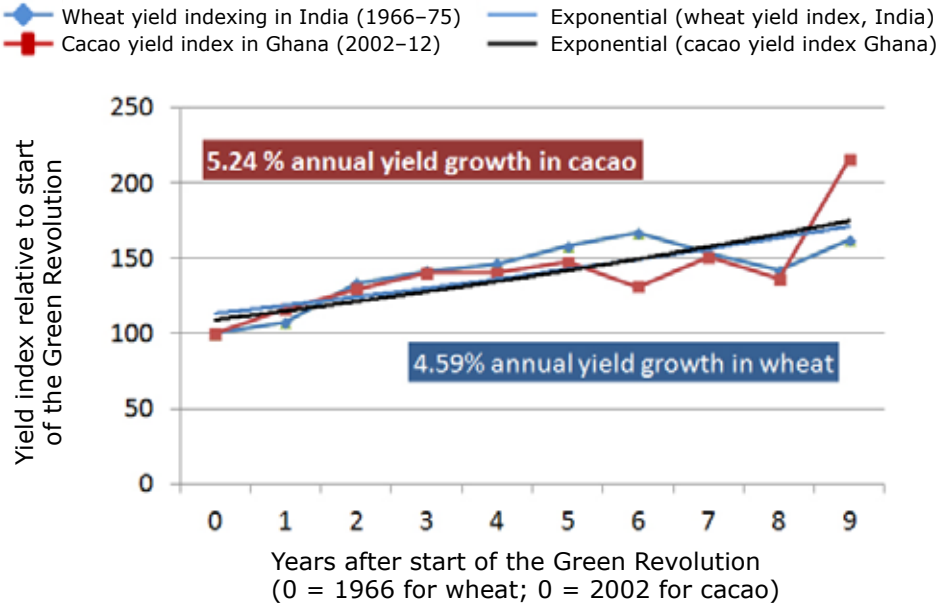

Figure 1. A comparison of yield growth per hectare during the initial phases of the Indian Green Revolution in wheat (1966 to 1975) and the Ghanaian Green Revolution in cocoa (2002 to 2011). Data source: FAOSTAT production statistics accessed online 16 February 2012.

Research will help bring about a Brown Revolution in West Africa. Photo by IITA.

In the light of these findings, cocoa productivity growth in Ghana can further increase by continued increases in fertilizer use and intensified pest and disease control, particularly outside the Western region. There is also much to be gained from improving farmer access to hybrid planting materials and to scaling up participatory farmer training approaches.

Among the lessons drawn from the first 10 years of the cocoa Brown Revolution are the critical importance of (1) a government-supported vision for the subsector; (2) supportive producer price policy; (3) affordable and unproblematic access to inputs; (4) profitable technologies; and (5) farmer training. As seen in Ghana, research has a critical role in developing and sustaining profitable technologies and in generating knowledge that small-holders are able and willing to act upon.

Agenda for sustainable intensification in West and Central Africa

Limited access of farmers to extension, fertilizers, and improved planting materials were among the major technical constraints revealed by a 2001/2002 baseline survey of the cocoa sector conducted by the STCP. While progress has been made in Ghana, there still remain the principal constraints to the achievement of a Brown Revolution across West Africa.

Improving access to improved planting material

Improving farmers' access to high-quality planting material has been the focus of the STCP-supported African Cocoa Breeders Working Group (ACBWG) since 2003. The working group collaborated with cocoa breeding programs of the US Department of Agriculture and Mars, and received regional backstopping and training from

STCP tools for the rehabilitation of West African cocoa farms

Cacao tree stocks in West Africa are mainly established from seeds procured from farmers' fields. This planting material lacks the disease tolerance and yield potential of the hybrid seed. Productivity is also affected by the old age of West Africa's tree stock. Replacing and rehabilitating the tree stocks of West Africa is fundamental to the achievement and long-run sustainability of a cocoa Brown Revolution.

The STCP has developed a Planting, Replanting and Diversification (PRD) training package to provide farmers the knowledge and technical skills needed to rehabilitate old cocoa farms or reclaim degraded areas using hybrids. However, a major constraint to hybrid adoption is a lack of access to hybrid seeds. To overcome this constraint, STCP introduced a Seed Brokerage System (SBS) for the collective acquisition of hybrid seeds by farmer field school groups from government production units. An initial evaluation of 375 randomly selected trainees revealed that the mean participant had successfully established 0.4 ha of hybrid cocoa seedling with an 81% seedling survival rate after two dry seasons. Approximately half of the surveyed trainees had replanted old farms while half had established new farms on degraded fallow land. The SBS also brokered timber seedlings for farmers desiring to include high-value timber (*Terminalia ivorensis* and *T. superb*) as permanent shade in their production system. The mean participant reported the successful establishment of 12 timber seedlings which is equivalent to 30 trees per hectare. Farmers favored the SBS innovation and are seeking its continuance.

IITA. The ACBWG has characterized cocoa germplasm from farmers' fields and research stations which has contributed to an understanding of the genetic diversity in West African cocoa germplasm. The study revealed mislabeling of cocoa germplasm in breeder collections and confirmed the low adoption of improved materials by the farmers in West Africa. The working group is currently using molecular breeding approaches to rapidly develop superior true-to-type genotypes with disease resistance and improved horticultural traits.

The delivery of existing improved planting materials to farmers remains a key constraint in West Africa. The low adoption of improved planting materials was thought to be due to poor awareness about the benefits of growing improved planting materials and high transaction costs in acquiring these materials. To address these constraints, the ACBWG joined the African Cocoa Initiative (ACI) of the World Cocoa Foundation (WCF) to demonstrate the performance of improved planting materials and best agricultural practices under farmers' field conditions and design and test innovative approaches that will increase adoption of improved germplasm. IITA provides technical support to the ACBWG in molecular breeding, develops training materials pertaining to replanting and rehabilitation of old and unproductive tree stocks, and provides assistance with seed brokerage systems developed and tested in Ghana by the STCP.

Integrated crop, pest, and disease management
The increased use of fertilizers and the intensified control of capsid insects by small-holders were the major factors underlying the productivity growth of the Ghanaian cocoa sector. The tonnage of granular fertilizer applied on cocoa rose from essentially zero in 2000/2001 to 130,000 t in 2009/2010. There is a need to develop diagnostic protocols for assessing nutrient balances, pest and disease pressure, yields, and economic returns that will lead to more profitable fertilizer and treatment recommendations tailored to the specificities of the farmers' local environment. IITA has developed such a protocol for the coffee-banana systems of Eastern Africa and proposes adapting this diagnostic to the cocoa sectors in Nigeria and Cameroon. Major economic losses are also caused by capsid insects, black pod fungal disease, and cocoa swollen shoot virus disease. An integrated program of soil, pest, and disease management research is required to keep these constraints under control.

Extension
The STCP farmer field school program was designed and developed by scientists from IITA and the national research systems of Ghana, Côte d'Ivoire, Nigeria, and Cameroon to address the extension constraint in 2003. Since then, more than 150,000 cocoa farmers have participated in FFS training. On average, the productivity gains following training have ranged from 15 to over 50% depending on the locality. The task, however, is not complete; evolution in knowledge and knowledge delivery technologies requires a continual effort to update and adapt extension approaches.

Conclusions

The technical and economic feasibility of Brown Revolution technology in the cocoa sector has been demonstrated. However, the long-run sustainability of the institutions and enterprises engaged in the generation and delivery of these technologies among all small-holder farmers is still an area of concern. Without bottom line profitability, small-holders will forgo inputs and revert to environmentally destructive practices which mine soil nutrients, result in unabated pest and disease losses, and lead to unnecessary deforestation. Research has a fundamental role to play in maintaining the profitability of these technologies.

Training of trainers for cocoa farmers in Ghana. Photo by IITA.