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# Ex post evaluation of technology diffusion in the African palm oil sector: The Caltech expeller in Cameroon, Benin, and Liberia

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ABSTRACT

This study is a post-project evaluation of three development projects promoting the same technology but implemented at three different times and locations over a period of thirty years, from 1984 to 2014. The technology in question is a small, portable palm oil expeller invented in Cameroon in the 1980 s. The technology was designed to increase the productivity of small farmers and create employment opportunities by increasing local capacity for small-scale palm oil processing. The expeller was subsequently promoted in Benin and Liberia over a period of nearly two decades. This evaluation is based on archival research of institutional records, data from impact surveys of technology users in all three countries during the project periods, and field research in Liberia in 2011 and 2013. The study analyzes and evaluates the social, economic, and environmental impacts of the expeller over the long term, comparatively, across a broad geographic area. In terms of social and economic impacts, the technology consistently increased incomes for farmers and small enterprises. The use of the technology altered relationships of production, particularly with regard to the role of women in palm oil processing and their control over resources. Environmental impacts of the technology are geographically dispersed and include increased water usage and pollution. Ultimately the technology in question has also contributed to political impacts over time by exacerbating conflicts between small farmers, palm oil corporations, and governments. This study confirms that comparative, longitudinal evaluation research can reveal important dimensions of development impacts.



## 1. Introduction

A major problem associated with measuring and explaining the impacts and sustainability of international development activities involving technology diffusion is that data collection is halted once a project has ended and it becomes a financial challenge to implement longitudinal research. Impact evaluation frameworks fit short project timescales that are often five years or less and provide detailed information about the beginning phases of processes of technological change. The incremental and cumulative impacts of diffusion and adoption may occur over decades rather than years, slowly yet inexorably contributing to widespread social transformations. For example, the long-term impacts of policies and programs guiding international development efforts in the 1970 s and 1980 s can only now begin to be objectively assessed in terms of social, economic, and environmental sustainability. In many instances, the profound gap in knowledge concerning the long-term and spatially diffuse impacts of technology for development is due to a lack of post-project evaluations. This research problem has vexed development experts for many years. According to Hyman and Corl (1984), performing a post-project (*ex post*) evaluation of technology projects can contribute to development planning and decision-making by indicating whether technologies have continued to be used in a project area or even spread to other places without external assistance. Such studies may assist in the design of complementary projects in the project area and replications elsewhere, help to identify people adversely affected by the project, or mitigate unintended environmental impacts. More importantly, post-project evaluations may inform more nuanced and effective decision making to meet both short and long-term policy and program goals. Although institutional interest in post-project research has increased over the past decade there remains a strong need for empirical evidence of the sustainability of development policies and practices to inform results-based programming.

This study uses a post-project evaluation framework to analyze and explain the social, economic, and environmental impacts of a series of projects that took place over a thirty-year period. Drawing

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on data from three projects that used the same technology diffusion and economic development strategy, the study moves beyond evaluating a single development activity to compare impacts across projects, and over time, with the goal of elaborating more strategic lessons for the theory and practice of development (Bebbington, 2003). The findings could contribute to more nuanced policy and decision-making, particularly for agencies and institutions promoting technology diffusion. The findings of this study are particularly relevant to agencies and institutions supporting smallholder farmers and small businesses as a means of stimulating economic development. What are the medium- and long-term social and environmental impacts of agricultural technology change and do they complement or compete with the economic goals of such projects? What about the political ramifications of promoting technologies innovated for smallholders rather than for the interests of global agricultural corporations? As this study will suggest, the political impacts – rather than social and environmental impacts – of technology policies and programs for development can ultimately undermine the intended results of assisting smallholder farmers.

Between 1984 and 2014, the U.S. Agency for International Development (USAID) funded three separate development projects in Cameroon, Benin, and Liberia to promote the diffusion of a low-cost technology intended to benefit small-scale palm oil producers. Using a commercial approach to technology diffusion, the goal of the projects was to establish localized supply chains in the palm oil producing regions in each of these countries to promote the diffusion of a mechanical palm oil expeller. The three projects were implemented by three different development institutions in three countries during different periods of time, yet the implementation strategy and evaluation methodology guiding the projects remained consistent to the extent that comparison across projects is feasible. The chronological sequence of the three projects over a period of thirty years and the spatial distribution of the project activities across a subregion in Africa provides a unique opportunity to evaluate the short-, medium-, and long-term impacts of technology diffusion in the oil palm sector. Rather than analyzing only the immediate impacts during the project period, this study explains the lifecycle of the technology after project termination and withdrawal of subsidized assistance.

The first project to promote the small-scale palm oil expeller began in 1984 in Cameroon (Hyman, 1988, 1990, 1992). The United States government provided funding to Appropriate Technology International (ATI) and its partner Association for the Promotion of Community Initiatives in Africa (APICA) to assist Cameroonian farmers to add value to their oil palm crops. An international engineering team created small-scale palm oil expellers for individuals and small businesses, designed to increase processing efficiency (Fig. 1). The project trained local metal fabrication shops in the manufacture and commercialization of the technology, and provided ongoing technical support until the program in Cameroon ended. USAID later funded two more country-based programs to promote the palm oil expeller. One was in the Republic of Benin from 1998 to 2003 called the Benin Oils Project and implemented by EnterpriseWorks Worldwide/Appropriate Technology International (Adégbola, Singbo, Ahouansou, and Savi, 2003; ATI/Benin, 2002; Savi, Adégbola, & Akplogan, 2004). The next program was in Liberia from 2008 to 2014, where two projects, the Liberia Smallholder Oil Palm Revitalization Project (LSOPRP) and Smallholder Oil Palm Support (SHOPS), were implemented by Winrock International (Winrock) under subcontracts to the International Institute for Tropical Agriculture (IITA) and ACDI/VOCA, respectively (Bishop, Ben Diallo, and King 2010; Bishop 2014) (Fig. 2 and Table 1).

Thirty years later farmers in Cameroon farmers and entrepreneurs continued to purchase and operate the palm oil machine

**Fig. 1.** Promotional demonstration of the vertical Caltech expeller in Liberia; Source: Varney Seasay 2010.

invented during the initial project (Nchanji, Tataw, Nkongho, & Levang, 2013; Nkongho, Nchanji, Tataw, & Levang, 2014). In southern Benin, a large and successful agricultural fabrication shop in Porto Novo is still manufacturing and selling the expeller and local engineers were recently working on complementary technologies to boost its utility (Godjo, personal communication May 16, 2012). In Liberia, 480 machines were sold between 2008 and 2014 (Bishop et al., 2010; Bishop, 2014). USAID funded a second phase of the Smallholder Oil Palm Support project from 2015 through 2018, implemented by ACDI/VOCA (ACDI/VOCA, 2018). Through a combination of efforts on the part of appropriate technology practitioners, metal fabricators, and technology users, the palm oil expeller has been widely diffused throughout a broad geographical region. The technology has circulated for a period of thirty years, for much of that time without any type of subsidized development aid.

Given the persistence of the technology over a span of decades and the wide area of diffusion, it is important to analyze the social, economic, environmental, and political impacts related to its use in order to understand whether the program funders and implementing organizations achieved their intended outcomes. In response to the early call from Hyman and Corl (1984), this study also helps to identify people adversely affected by the project and locates unintended environmental impacts not captured in previous studies concerning the technology. This research also reveals important political dimensions of technology diffusion that were in fact predicted well in advance and yet have only become apparent after several decades of use.

## 2. Evaluation methods

The broad scope of this study required a suite of mixed methods that included a review of literature, communication via Skype and email with technology manufacturers and researchers in Cameroon, Benin, and Liberia, and ethnographic fieldwork and a series of impact evaluation surveys in Liberia for primary data collection.

The theory of sustainable technology adoption that guided the three projects under study was based on the commercial approach to development, expressed most famously by E.F. Schumacher in *Small is Beautiful* (1973). In essence, local and decentralized manufacture and commercialization of locally viable technologies is assumed to stimulate the growth of small enterprises and local economies. In the case of the Caltech expeller, local metal fabrication shops received training in the manufacture of the machines and received assistance in marketing and commercialization. Donating the expellers as charitable gifts to individuals or groups