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Does a cassava research-for-development program have impact at the farm level? Evidence from the Democratic Republic of Congo

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ABSTRACT

This paper evaluates the impact of a cassava research-for-development program on farm level outcomes. The program was implemented in the Democratic Republic of Congo from 2001 to 2009. We apply propensity score matching, Rosenbaum bounds on treatment effects, Altonji et al. method of selection on observables and unobservables and endogenous switching regression to farm survey data collected during the 2009 cropping season. We use these methods to test whether the R4D program has a statistically significant effect on outcomes of interest and if these are not driven by selection on unobservables. Using propensity score matching, we find statistically significant positive effects on household participation in cassava markets, adoption of improved varieties and crop management practices and household food adequacy; and no statistically significant effects on yields and profits. The results show that bias due to selection on unobservables is not severe enough to invalidate the impact estimates. Bias may still be a problem that is present in the analysis. But there is evidence that it is not substantial. Although the program does not have a statistically significant positive effect on yields and profits, the significant program effects on market participation, variety adoption, and food adequacy merit further promotion of the program since these positive outcomes tend to be pre-conditions for realizing long-term yield and profit benefits.

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Introduction

There is increased pressure on agricultural research organizations, especially in sub-Saharan Africa, to demonstrate that research investments pay off and have impact at scale on development outcomes, including poverty reduction, household food adequacy, nutrition and sustainable management of natural resources (Renkow and Byerlee, 2010). There has been a shift among agricultural research organizations in Africa in the last 15 years towards organizing and implementing research at a large scale by directly incorporating into the research process the simultaneous development of farmers' organizations; extension and delivery systems for new varieties, soil fertility, crop management and processing technologies; agricultural input and output marketing systems; farmers' organizations; and rural credit complemented with capacity building. This has congealed into what is now known as the agricultural research-for-development (R4D) approach (Lynam, 2004).

There are policy debates whether R4D programs work when applied to non-tradable rural food staples such as cassava (Lynam, 2007; de Janvry, 2009). Past studies of agricultural research impact assessment have focused on varietal improvement using economic surplus and cost-benefit-analysis to estimate rates-of-return on research investments (Alston et al., 2000; Evenson, 2001; Renkow and Byerlee, 2010; Byerlee and Bernstein, 2013). Cassava is under studied in the literature (Maredia and Raitzer, 2010). Therefore a better understanding of its impacts could make a contribution to this debate. A review of the social sciences in the Consultative Group on International Agricultural (CGIAR) research by Barrett et al. (2009) reported that most ex post impact assessment studies are of low quality and credibility with respect to their evidence. The analysts recommended measuring direct ex post impact on development outcomes using rigorous state-of-the-art methods to credibly identify causal effects attributable to the research being evaluated.

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In this paper we contribute to the literature on treatment effects of R4D programs by gathering credible evidence for impact or lack of impact for a R4D program in the context of a low income developing country. We use as a natural experiment the emergency response to the outbreak of the cassava mosaic disease (CMD) program that was implemented at a large scale in the Democratic Republic of Congo (DRC) from 2001 to 2009. The program used the R4D approach. We test for the overall impact of the R4D program on farm level outcomes.

We focus on three research questions: (a) Does the R4D program have a statistically significant effect on household participation in cassava markets? (b) Does the R4D program have a statistically significant effect on the adoption of improved variety and crop management technologies? (c) Does the R4D program have a statistically significant effect on plot-level cassava yields, profitability (i.e. gross margins) and household food adequacy? We apply propensity score matching, bounds on treatment effects and endogenous switching regression to farm survey data collected in 2009 to estimate impacts and assess the importance of selection on unobservables. We find that controlling for observables that the program has statistically significant positive effects on household participation in cassava markets, adoption of improved crop varieties and crop management practices and household food adequacy. The program does not have a statistically significant effect on yields and gross margins. Bias may still be a problem that is present in the analysis. But there is evidence based on the tests that it may not be a substantial issue in this case.

Overview of the emergency response to the outbreak of the cassava mosaic disease program

Cassava is the staple food and wage good in the Democratic Republic of Congo (DRC). Cassava accounts for more 70% of annual crop area. Cassava provides around 55% of the calories in the diet (FAO, 2010). In 1996 a new more virulent Ugandan strain of the East African Cassava Mosaic Virus (EACMV-Ug) was detected. By 2000 the disease had spread to most cassava-producing regions. Because widely planted varieties had no resistance, it was likely that the outbreak would lead to widespread crop losses and cause household and national food insecurity.

The emergency response to the outbreak of the cassava mosaic disease (CMD) program was started in 2001. The goal was to increase farmers' income, household food adequacy and nutrition and reduce poverty. The program was supported through a multi-donor basket funding.

The program was implemented in two phases. The first phase was implemented from 2001 to 2006. The first phase targeted western provinces of Bas Congo, Kinshasa, and Bandundu because there was war in the eastern part of the country. The second phase lasted from 2007 to 2009. The program was expanded to the central and eastern provinces: Equateur, Province Orientale, Katanga, Kasai Oriental, Kasai Occidental, Maniema, Nord-Kivu, and Sud-Kivu. Phase 1 focused on rehabilitation of cassava production through multiplication and distribution of clean planting material of existing released cassava varieties and development of new varieties with resistance to the viral disease and acceptable consumer traits and improved crop management technologies. Phase 2 focused on improving livelihoods through rehabilitation of cassava production, crop improvement, crop management and post-harvest management.

The program was implemented using what is now labeled the R4D approach. This was based on horizontal and vertical integration of different public and private organizations linked through common platforms. This involved bringing together different organizations into public–private partnerships to move towards integrated research within an evolving division of labor. The organizations included the Programme National Manioc (PRONAM) within the Institut National pour l'Etude et la Recherche Agronomiques (INERA), the International Institute of Tropical Agriculture (IITA), the South-East Consortium for International Development (SECID), the Food and Agricultural Organization of the United Nations (FAO), Centre d'Appui pour le Development Integral de Mbankana (CADIM), PACT-Congo, community-based organizations (CBOs), federated farmers' associations and village level farmer groups. The platforms promoted networking, capacity-building and skill development of different actors to implement integrated research and interventions at a large scale.

The partnerships facilitated the integration of different research components and development interventions among different organizations who previously were working separately. The research components were integrated through the simultaneous development of a system for introducing and screening elite EACMV-Ug resistant materials from IITA in Nigeria and the East and Southern Africa Research Centre (ESARC) in Uganda; rapid multiplication by tissue culture (*in vitro* micropropagation); intensive nucleus field multiplication and distribution of disease free planting material of improved varieties; development of new recommendations for crop management and integrated pest management; development of post-harvest processing techniques, product diversification and fortification of cassava products; development of processing machinery and equipment fabrication and backup services supply system; and development of farmers' organization to reduce transaction costs to access foundation planting materials, markets and micro credit. The interventions were based on the approach developed and tested by IITA and national cassava programs in several countries starting in the mid-1990s.

In-depth interviews with participants revealed four stages by which interventions had impact at the farm household level (Fig. 1).

These span the spectrum of research inputs-activities-outputs-outcomes-impacts pathway. During the first stage, IITA and INERA used on-station and on-farm participatory research trials to screen and adapt technologies and implemented multiplication and distribution of breeder and foundation planting materials. The research products were made available to SECID, FAO, CADIM, and PACT-Congo. These organizations implemented rapid multiplication and distribution of disease-free planting materials system at a large scale using a quality control system of primary and secondary nurseries to ensure that large quantities of planting materials were supplied to farmers for establishing their crops and promoted adoption of the improved technologies. In addition, the Bureau Central de Coordination (BECECO), a government clean seeds multiplication and distribution program funded by the World Bank, supported cassava healthy planting material multiplication and distribution and farmer training. CBOs and farmer groups implemented tertiary nurseries and downstream delivery of planting materials to farmers through village level multiplication plots.

The sites for nurseries for multiplication of disease-free planting materials of improved varieties and deployment of research products were organized into clusters of 3–5 villages. The villages targeted for the R4D program were purposefully selected based on the incidence and severity of pests and the CMD disease, shortfalls in production of cassava, food insecurity, hunger, starvation and vulnerability of households. These tended to be located in remote geographical areas characterized by unfavorable rainfall, temperature and soil conditions and poor infrastructure. Within these target areas villages were selected based on presence of government extension services, CBOs and farmers' associations with experiences in implementing agricultural activities in the local areas and field technicians to provide technical backstopping. Within the target villages, farmer groups were selected based on cohesiveness,

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