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RETURNS TO OILSEED AND MAIZE RESEARCH IN UGANDA

By

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BACKGROUND: As a result of political instability and poor macroeconomic policies from 1972-86, Uganda underwent a dramatic reversal of the agricultural and structural transformation process it had achieved in the 1960s. By the time Uganda opened up again to the international community after the fall of Amin, its economy was on the verge of total collapse, and it had suffered a near total breakdown of agricultural research, seed multiplication, output markets, input distribution networks, and extension services. Virtually no new agricultural methods or technologies were introduced between the late 1960s and early 1990s.[1] Worse, many productivity-enhancing technologies fell into disuse during this period, leaving Ugandan yields much lower than those of other developing countries with similar agro-ecologies. National fertilizer consumption fell from 1.4 kg/ha in the 1960s to 0.2 kg/ha in the 1990s. Farmers in Eastern and Northern Uganda, where animal traction had been well established for 50 years, suffered tremendous losses of livestock as a result of the political instability and were suddenly forced back into hand hoe cultivation. The result has been a vicious circle of low input/low productivity agriculture that has proved very difficult to break.

Beginning in the late 1980s, USAID, in collaboration with the Government of Uganda (GOU), began rehabilitating the physical infrastructure at several research stations and strengthening human capital for food crop research, extension, and university teaching. Maize, sunflower, and soybeans were selected as the primary focus of research activities. USAID also provided a small amount of funding for groundnut and sesame research in the early 1990s. In late 1992, these programs also began to receive funding under the World Bank-funded Headstart for Agricultural Research and Extension project (HARE).

Unlike other economies where consumers depend on a single staple, staple food crops in Uganda are highly varied and regionally concentrated. They include, in order of importance, cooking bananas, cassava, sweet potatoes, beans, millet, maize, sorghum, and groundnuts. Sesame, sunflower and soybeans occupy a small area in comparison to the staples above, but area is expanding in response to increased domestic and export demand for edible oils. Sesame has attracted considerable attention in recent years as a potential “non-traditional” export. In the early 1990s, sesame was the third largest foreign exchange earner, following the traditional “cash crops” of coffee and cotton.

[1] This summary presents information as of the date of the original studies (1991-92).

OBJECTIVES AND METHODS: The Ugandan studies had three principal objectives: (1) to determine the rate of return to investments since 1986 by USAID and GOU in soybean, sunflower, and maize research; (2) to determine the potential returns to future investment in research on each of the major oilseeds in Uganda (soybean, sunflower, groundnut, and sesame); and (3) to systematically consider the impact of other aspects of the technology transfer system (extension, input markets, and product markets), as well as key fiscal policies, on returns to oilseeds research.

The steps followed for the rate of return analysis included: (1) calculation of benefits both with and without research, including determination of the area and yield levels for traditional and improved technologies; (2) analysis of incremental production costs per year attributable to adoption of the technology; (3) calculation of annual research and other related costs, including rehabilitation, training, and extension; (4) calculation of the annual net benefit, the incremental gross benefit minus total costs; (5) deflation of the stream of annual incremental net benefits to reflect the real value in constant prices; (6) calculation of the internal rate of return (ROR); and (7) sensitivity analysis to test the stability of the ROR and the relative importance of its various components, e.g., price, yields, adoption.

Key data for the ROR analysis were obtained through a combination of primary data collection (for information on yields and production practices) and a review of secondary sources. Information on the effect of marketing and other institutions on technology adoption was obtained through secondary data and in-depth interviews with key informants at different levels of the subsector, including researchers, extension agents, traders, policymakers, processors and producers.

RESULTS: The first new maize, soybean and sunflower varieties were released in 1991: these were the first variety releases in Uganda in over 20 years. They included (1) Longe 1, a medium-maturity, open-pollinated maize variety, resistant to streak and Northern Corn Blight, with a yield advantage over local varieties ranging from 25% (zero inputs) to 400% (with fertilizer and good management); (2) Nam 1, a medium-maturity, high-yielding, non-lodging soybean variety that is highly resistant to shattering; and (3) New Sunfola, a sunflower variety with an estimated 10-20% yield advantage and 25% more oil content than "traditional varieties" of Russian and Kenyan origin.

Much of the groundnut and sesame germ plasm and research results were lost or destroyed during the political insecurity in Northern Uganda between 1987-89. Current groundnut research efforts focus on the development of varieties resistant to rosette virus disease. Several varieties have been developed and are now being tested in multi-locational trials. In 1991, efforts to reestablish the sesame germ plasm bank were begun, and cross-breeding work was resumed to improve yields and reduce shattering. Intercropping trials with millet and maize, work on seed rate recommendations, and on-farm trials were also initiated in the early 1990s.

ROR to Maize, Soybean and Sunflower. Because the new varieties under consideration were only released in late 1991, the ROR to maize, sunflower, and soybean is a hybrid between ex post and ex ante analysis. The analysis uses known costs and projected benefits. An investment is considered profitable if the ROR equals or exceeds the opportunity cost of capital (assumed to be 10-15% in Uganda).

The projected returns to investments in maize and sunflower were very profitable for both maize and sunflower for the period 1985-2006. The RORs ranged from 27-51% (maize) and 10-66% (sunflower), depending on costs included in the calculation and assumptions about yield, the inclusion of hybrid as well as open-pollinated sunflower varieties, and prices. Returns to soybean research were lower, ranging from -6 to 20%, and were unprofitable in most scenarios. In sensitivity analyses, the maize ROR was fairly robust to changes in assumptions about costs, yields and prices. The high ROR to sunflower research, however, is very sensitive to the ability of the research station and the national seed scheme to multiply and distribute hybrid sunflower seed in addition to New Sunfola. During the late 1980s, a number of promising imported hybrids were tested that doubled or tripled the yield of local varieties and Sunfola. The hybrids also had an oil content of 50% under farmer management. However, because of doubts about the Uganda Seed Project's ability to undertake hybrid seed production, research was redirected to the identification of suitable open-pollinated varieties, as a short-term solution until the seed problem was resolved.

A number of factors contributed to the lower returns to soybean investment. First, the direct cost of research on soybeans was high because of the complementary investments required for rhizobium production and promotion. Second, researchers have been unable to identify a variety that significantly increases yield while meeting the demand characteristics of the local market. The smaller size of Nam 1 makes it less acceptable to some consumers. Third, while edible oil can be extracted from soybeans using technology available in Uganda, the demand for soybean cake for livestock feed is very limited. Low per capita incomes constrain the demand for meat and dairy products and hence the demand for feed ingredients. Thus, the potential expansion of soybean production in Uganda will be limited by demand constraints.

ROR to Groundnut and Sesame. Because no new varieties had been released for these crops by 1992, the calculation of these RORs is purely an ex-ante analysis. The ROR calculation incorporates the known costs of research in recent years together with projected costs under the HARE project. The benefits, however, lie entirely in the future. This necessitates predictions concerning farmers' adoption response, market conditions, and institutional support for technology transfer.

The projected ROR to groundnut research from 1985-2006 is very high, ranging from 23-46%. The results are fairly robust to changes in assumptions regarding yield and adoption rates. The ROR to sesame research and related investments in the same period is also very high, ranging from 15-50%. However, these results are much more uncertain, since (unlike the other crops examined) there is no past experience with adoption of improved sesame varieties on which to base projections of future adoption. It is also not clear when the research system may be ready to release new varieties.

SUBSECTOR CONSTRAINTS TO TECHNOLOGY ADOPTION. The ROR analysis clearly demonstrated that even in Uganda, with its history of political instability, the potential returns to agricultural research are excellent for many commodities, even when the high costs of physical rehabilitation, training, and extension are included. However, the generally high returns to research need to be interpreted within a broader context. The profitability of research depends on technical improvements in other subsector stages, and improved coordination between different subsector stages, e.g., input production and distribution, product marketing, and processing. For example, a high ROR to sunflower and other oilseed research depends on a sustained increase in area and production. Farmers now limit sunflower area, complaining of low prices and the lack of markets for sunflower. At the same time, edible oil processors in Uganda complain bitterly about the lack of raw materials. The answer to this paradox is that processing throughput is constrained by lack of materials, resulting in a serious underutilization of production capacity and high unit costs of production for oil. Processors cannot simply raise prices to cover their costs of production because of the inflow of inexpensive Kenyan oil. High costs of processing are passed back to the farmers in the form of low farmgate prices offered for oilseeds. If sunflower yields remain low, the returns to oilseed production will be unattractive compared to alternative crops and raw material availability will continue to be a constraint. Development and dissemination of higher-yielding hybrids are potentially important ways to improve gross margins for farmers, increase their interest in producing sunflower, and break out of the vicious circle of low capacity utilization.

If Uganda is to realize the full potential gains from hybrid and improved open-pollinated oilseeds and maize varieties, a major effort will be required to establish an efficient and financially viable system of seed multiplication and distribution. Past government interventions have distorted the input supply sector, undermining the economic base, and deterring the private sector from responding to the farm level demand for goods and services. These distortions are gradually being dismantled, but greater efforts are required to promote the efficient operation of a competitive private seed sector.

UNCAPTURED BENEFITS: Not all positive impacts of agricultural research are easily captured by a ROR analysis that focuses primarily on benefits from increased production. For example, agricultural research on maize and oilseeds has important gender implications for the Ugandan farming system and the distribution of income within the household. All of the commodities examined are less firmly situated within the male sphere of influence than are the more traditional cash crops such as coffee, cotton, tea, and tobacco. Women participate fully in the production and marketing of maize and oilseeds.

Another benefit that is difficult to quantify is the extent to which research investments have not only led to an immediate research output, but have also strengthened the human capital base and institutional capacity of the country. Institutional and human capital developments are investments that will have positive payoffs far into the future and across a broad spectrum of commodities and research efforts. The history of research in Uganda illustrates very well the impossibility of turning research off and on. It takes only a short lapse in research support to result in massive losses in human and physical capital that will require painful and expensive new investments to overturn.

Finally, the prioritization of research efforts between different commodities has important regional equity implications. This is especially true for sesame and sunflower. Farmers in Northern Uganda have shown keen interest in expanding sesame and sunflower production in order to diversify their sources of income. Given the historical concentration of economic activities and development in the south, efforts to increase incomes in the northern region are of particular interest. The attention that the Ugandan government gives to economic development for this region could have implications for future political stability in the country.

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This paper summarizes two reports entitled: "The Rate of Return to Agricultural Research in Uganda: The Case of Oilseeds and Maize," International Development Working Paper No. 42, and "The Potential Returns to Oilseeds Research in Uganda: The Case of Groundnuts and Sesame," International Development Working Paper No. 45. They can be obtained by writing to:

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The papers are also forthcoming as a SD Publication Series technical paper, and can be obtained through USAID's development information system (CDIE). CDIE Reference No. PN-ABS-730 (IDWP 42). The CDIE Reference No. for IDWP 45 is pending.