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THE IMPACT OF USAID SUPPORTED RESEARCH ON MAIZE AND OILSEEDS IN UGANDA 1986-2006

by

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1. BACKGROUND

The research for this assessment of the rate of return to agricultural research on maize, and oilseeds in Uganda was conducted as one of seven case studies under the Agricultural Research Impact Assessment add-on to the Michigan State University "Food Security in Africa" cooperative agreement with USAID.

The research was conducted with the assistance of three collaborating institutions in Uganda:

1. Makerere University; Faculty of Agriculture and Forestry (MUFAF)

2. The Ministry of Agriculture, Animal Industries and Fisheries (MOAAIF)

3. The Manpower for Agricultural Development Project (MFAD) of the Uganda AID Mission under whose auspices additional local currency resources were made available for transportation, enumerator salaries, and travel allowances. MFAD also provided access to administration and communications facilities.

The research design, data collection and analysis are the result of a joint effort between the author, who is the MSU in-country researcher, and three Ugandan consultants: Mr. Bernard Bashaasha, Ms. Elizabeth Balirwa, and Mr. Godfrey Turiho-Habwe. Both the Ministry and the Faculty assisted with the granting of release time to staff in order to allow them to participate fully in the research effort.

The impact assessment was designed from the outset as a two-stage study. The first stage is the assessment of the rate of return (ROR) to agricultural research in maize and oilseeds. This analysis will include both an ex post ROR study of maize, sunflower and soybeans plus an ex ante evaluation of the anticipated returns to research in sesame and groundnuts as well as research efforts currently in the pipeline for maize, soy, and sunflower. The second stage puts the ROR analysis into the broader context of a subsector analysis of the edible oils sector from production through marketing, and processing to final consumption.

2. THE UGANDAN CONTEXT

Uganda faces a important challenge in trying to organize agricultural research and support services to her smallholder producers. Uganda has undergone a dramatic reversal of the agricultural transformation process achieved in the 1960's, as a result of the macroeconomic policies and political climate of the 1972-86 period. Uganda currently stands closed to the starting point of the agricultural transformation process. The Ugandan economy is heavily dependent upon an agricultural sector that has largely reverted to subsistence production. Agriculture constitutes far and away the dominant sector in the economy. Fully 89% of the 1991 population of 16,582,700 are rural. Virtually all rural residents have some access to land use rights for cultivation. There are approximately 2.5 million smallholder farm households in Uganda and 80% of them have under 4 ha of farmland.

In 1990 agriculture contributed 53.3% of Uganda's Gross Domestic Product. Thirty percent of GDP is produced by agriculture in the non-monetary sector consisting of subsistence crops grown for home consumption. Even though agricultural production for the cash economy constituted only 23.6% of GDP in 1990, however, it accounts for 95% of Uganda's export earnings and over 40% of government revenues.

While official statistics report that food production per capita fell from its 1975 peak of over 1.4 tons per person to less than .9 tons in 1980 and has not yet regained its peak per capita level, Uganda is still 98.6% self sufficient in food. The one notable exception is in the area of edible oils.

In the 1960s and early 1970s, Uganda was self sufficient in edible oils. Substantial quantities of these cottonseed-based oils were exported to Kenya and Tanzania. A major factor which contributed to the collapse of the oil industry was the 1972 expulsion of the Asians who owned the national crushing capacity, and the subsequent nationalization of that industrial capacity. This was further exacerbated by the breakdown of the cotton marketing structures under the cooperative monopoly. Lack of operating capital, poor price incentives, and grossly inefficient management led to serious shortages of raw materials for crushing. Commercial edible oil production fell to negligible levels by the mid 70s and have only recently begun to rise as a result of efforts to develop sunflower as an alternative oil source. Uganda is still highly dependent on commercial cooking oil imports and American PL 480 commodity aid.

The challenge facing Uganda is to provide the necessary support services to turn Uganda's widely dispersed, extremely small scale, largely subsistence agriculture into an engine of economic development after 20 years of political strife and bad macroeconomic policies. If small farmers in Uganda are to be able to improve their standard of living, generate a larger surplus with which to feed a growing urban population, and contribute to foreign exchange earning through diversified exports, agricultural productivity must be increased.

Achievement of dramatic production increases through research is complicated by Uganda's highly diversified agricultural system. While research started as early as 1904 with the establishment of the Botanical Gardens in Entebbe, it concentrated on the traditional cash crops of coffee and cotton during the Colonial era. Research into food production only began in earnest after 1960. Staple food crops in Uganda are highly varied and regionally concentrated. They include, in order of importance, cooking bananas (matoke), cassava, sweet potatoes, beans, millet, maize, and sorghum. These crops together accounted for 93% of the land planted in food crops in 1988 (Ministry of Agriculture 1990). There is, therefore, no one leverage point where a major breakthrough can lead to broad transformation. This is in contrast to economies where most consumers depend on a single staple.

3. THE RESEARCH-STRENGTHENING EFFORT

Unlike other MSU case study countries, such as Kenya, where research has been ongoing since as early as 1921, in Uganda we are assessing a very recent set of research investments.

In 1984 USAID signed an agreement with Uganda to carry out various activities to strengthen the Ugandan capacity for both teaching and research in agriculture under the auspices of the Manpower for Agricultural Development project (MFAD). Maize, sunflower and soybeans were selected as the primary focus of the research activities. Direct investments in research, however, were delayed due to the political instability of the mid 80s. In 1986 after the massive disruptions of the civil war, research activities on all three of these crops were moved to Namulonge Research Station in line with government's intention to concentrate annual food crop research at Namulonge where adequate land was available and security could be assured.

MFAD concentrated on the physical rehabilitation of research facilities. In 1987 short-term consultants were brought in to advise the Ministry on the most efficient strategies for maize, sunflower and soybean research. In 1988 Dr. C. Simkins was appointed as the long-term technical advisor to the maize and soybean programs and local currency support for research activities began. In 1989 Dr. Robert Buker arrived as the technical advisor on sunflower.

The level of research investment in maize, sunflower and soybeans has been very low. Total expenditures including technical consultants, on-station and on-farm research, and support activities between 1987-1993 are summarized in Table 1 below.[1]

Table 1. Research Expenditures 1986-1992

MAIZE	
USAID Support	$335,000
Uganda Government	$196,500
Total	$531,500
SOYBEANS	
USAID Support	$407,500
Other BNF	$ 60,500
Uganda Government	$118,500
Total	$586,500
SUNFLOWER	
USAID Support (with EIL)	$854,500
Uganda Government	$ 92,000
Total	$946,500
GRAND TOTAL	$2,064,500

These expenditures reflect a well-integrated approach to the development of the maize and edible oils subsectors. This multi-faceted approach is illustrated in Figure 1.

In addition to direct funding of on-station and other research in maize, sunflower and soybeans, other aspects of the subsector also received support. The lack of indigenous rhizobia to promote soybean nodulation and nitrogen fixation was identified by a consultant as a major constraint to soy production in Uganda. The program to identify appropriate strains, establish production capacity at the University, and promote its use at the farm level has been quite successful. Its full costs are contained in the above estimates.

A separate project funded by USAID and implemented by Experiment in International Living (EIL) was designed to promote the development and adoption of appropriate technology for

village-level pressing of oilseeds. This effort has been important in providing an immediate incentive for producers to adopt the newly available high oil-content variety. In addition, the research staff took upon themselves the multiplication of seed both for use in a massive on-farm trials/demonstration effort and for sale to members of the South Bukedi Cooperative Union in order to promote higher capacity utilization of the Union's crushing plant. Every effort was made to jump start the process of getting new varieties directly into the hands of farmers. The costs of these efforts are included above.

Lastly, the sector was assisted by the Cooperative And Agri-Business Support Project (CAAS). This project made credit available to the both the Uganda Central Cooperative Union and to other Cooperative Unions and societies for a variety of efforts including the promotion of the edible oils sector. While its contribution is recognized, the fact that it was financed by PL480 edible oil food aid monetization and was made largely in the form of diversified loans that finance a wide range of cooperative activities makes it difficult to make the necessary cost allocation specifically to the edible oils sector.

4. ACHIEVEMENTS

Some of the accomplishments of these various activities are summarized in Table 2. The most important of these is the release of a new open-pollinated variety of each of the commodities in the fall of 1991. It should be noted that these are the first variety releases in Uganda in over 20 years. Seed multiplication through the Uganda Seed Scheme is already well underway. While commercial level production has been gearing up, the efforts to jump start the process through on-farm trials/demonstrations and seed distribution through EIL, cooperatives and private sector processors have had a significant impact in promoting the earliest possible adoption of the varieties.

While data regarding adoption and yields for first season 1992 have only just been received and have not yet been analyzed, preliminary indications are that the returns to the research investment to date are promising overall. In our estimation, the potential long range impact of agricultural research in Uganda can be summarized as follows:

MAIZE	-	highly promising
SOYBEANS	-	questionable due to constrained final demand
SUNFLOWER	-	promising

This impact, however, is dependent upon not only the achievements to date, but also the future release and adoption of additional varieties which are currently in the research pipeline. It is necessary, at this point, to diverge into a brief discussion of each commodity individually in order to explain in slightly more detail the objectives of the research effort and its expected impact.

5. MAIZE

While maize is one of the major staple crops in Uganda, maize area averages only about 340,000 ha. per year, or less than 8% of area under cultivation. Maize was grown primarily as a subsistence food crop up to the 1970s. Throughout the 1970s maize began increasingly to be produced for sale as marketing systems for cotton collapsed under poor cooperative management. This coincided with increasing urbanization and falling incomes. As a fast cooking, easily storable, low cost staple, maize meal met an increasingly important need in urban and institutional consumption. This trend towards production for sale was further enhanced by the barter trade agreements of the mid to late 1980s in which both maize and beans played a key role. The fact that in the absence of markets, maize can2 still be used to meet domestic subsistence needs has given maize a distinct advantage over cotton as a cash crop during the market failures of recent years. Overall, at present probably 60% of current maize production is sold on the market.

In Uganda maize is produced with very few improved inputs and yield is generally below 1.5 ton/ha (national average is as low as 900 kg/ha). Yields are restricted by nitrogen and phosphorus deficiencies in the soil and by the prevalence of maize streak virus which can reduce yields by up to 80%. Producers continue to grow more than subsistence needs even if prices are low in order to generate cash for essential consumer items. Hence, in a normal year they usually have at least a modest market surplus.

Prior to the 1991, Uganda had released only three maize varieties. These included: White Star and Western Queen which were released in 1960 and Kawanda Composite A released in 1971. White Star and Western Queen were recommended for the northern and western areas of Uganda, respectively. While White Star is still recommended for Northern Uganda because of its early maturity (115 days), seed has not been produced commercially for many years. Western Queen has apparently been discontinued (Sprague, op. cit.).

Kawanda Composite A (KWCA) has dominated the improved seed multiplication program since its release. KWCA was recommended for commercial production specifically during the long rains in the maize-growing areas because it is late maturing (133 days) and requires early planting. The degeneration of the variety due to the lack of maintenance breeding and breeder seed production has led to great heterogeneity at farm level. Complaints include high susceptibility to streak virus and blight diseases, excessive plant and cob height and hence severe lodging problems.

Serious effort to reassemble a new stock of maize germplasm began in 1987. In addition to local varieties which were collected from all over Uganda, materials were also obtained from international institutions such as IITA and CIMMYT, and from other national programs. The objective of maize research since 1987 has been to modify Kawanda Composite to reduce its maturity period, incorporate resistance to streak virus, and lower plant and ear height in order to reduce the threat of lodging. To accomplish this, KWCA materials which had been sent to IITA for incorporation of resistance to maize streak in the early 1980s were retrieved. (This was indeed fortunate since all of the original breeder materials had been lost in the chaos of the mid 80s.) These various resistant materials were tested at Namulonge and KWCA-SR was selected in 1988 as the best performer. In 1989 this material was crossed with a very short, streak resistant population (population 49) to form a new variety. As a result of the crossing and

subsequent reselection, the height was brought down by 69 cm, ear placement by 41 cm and maturity by 14 days. The result is a medium maturity variety (65 days to 50% silk) which is streak resistant and moderately resistant to Northern Corn Blight (Baguma, 1991). It yields 4.0 ton/ha on average under good management and exhibits a 15-25% yield improvement over traditional varieties even under zero input farmer conditions.

Because the initial crossing was done in 1989, the variety was first named Population 89, but this was changed to Longe 1 at the time it was presented to the variety release committee for consideration. Longe 1 was released in September 1991 and is now undergoing multiplication at the Uganda Seed Scheme farm in Masindi.

Despite Longe 1's advantages, it is nevertheless not as high yielding as two other varieties which are currently undergoing testing. These open-pollinated varieties, Gusau and Population 29, yielded 3-4 ton/ha during on-farm trials and 6-7 ton/ha on-station. Unfortunately they are not resistant to Northern Corn Leaf Blight (tolerance is only 25-30% depending on location). Hence Gusau in particular is currently restricted in its use to Kasese District where the incidence of blight is limited. Because of the yield potential of these varieties, however, researchers are striving to remedy the susceptibility problem. Gusau is being crossed with Population 42 Eto Illinois to incorporate blight resistance. It is hoped that a suitable new variety resulting from the cross of these two varieties will be sufficiently tested to present for release consideration in late 1994. Release will depend on the success of blight resistance incorporation and yield performance.

6. SUNFLOWER

Although sunflower was widely grown in many parts of Uganda by the 1960s, no significant research had been conducted on this commodity. The Ministry of Agriculture did not even begin collecting national sunflower area and yield estimates until 1989. Interest in sunflower production has risen rapidly in recent years, however, and the area planted to sunflower has increased from less than 5,000 ha in the early 1980s to over 38,000 ha in 1991.

Prior to 1991, no improved sunflower variety had ever been presented to the release committee for consideration. In most cases farmers were using seed retained from ornamental or confectionery varieties of Russian or Kenya origin which had been introduced in Uganda in the 1960s and 70s. Oil content of these seeds varied from 10 to 30%. The white seeded varieties have the lowest oil content, followed by the striped and black varieties, respectively; all have hard, thick shells. Sunflower varieties with thin seed coats are preferred for crushing because they cause less damage to the screw presses (Buker J.R and Denton G.W, 1991).

In 1988 a National Sunflower Program was launched at Namulonge Research Station. Serere had been the center for sunflower research years before, but germplasm collections were largely lost during the long period of turbulence and political instability.

In the first season of 1988, Serunjogi, Anyanga and Gahakwa set up sunflower variety trials with the objective of identifying the most promising of the imported hybrids when grown under Uganda conditions. Results from the trials indicated potential in four hybrids which the breeders felt safe to recommend for importation by MOA. Their average seed yields were

about 2000 kg/ha. Yields of at least 1300 kg/ha and an oil content of 50% were achieved under conditions of farmer management. The parent materials for one of these hybrids were obtained, and research on hybrid sunflower production is ongoing at Namulonge. Results suitable for presentation in a release application may be ready before the end of this year, but there are serious questions concerning the ability of the Seed Scheme to handle hybrid seed production.

Despite the potential returns to hybrid development, the research system was under pressure to identify a suitable existing open-pollinated variety for introduction as a short-term solution to the shortage of seed in Uganda. Trials were carried out on a number of Peredovicks of Russian origin and the Australian variety Sunfola introduced in Uganda in the late 1980s. While both the Peredovicks and Sunfola varied in height and maturity, Sunfola was determined to be the more promising. Reselection efforts were undertaken with the objective of developing a stable variety that could be quickly cleaned up and placed in the hands of the farmer within two years.

During 1989 and 1990 progeny selection and multi-locational on-station trials were conducted at the same time as on-farm trials were ongoing. In July, 1990 more than 1,000 kgs of reselected sunfola were harvested at Namulonge Research Station and this was distributed by MFAD to its on-farm trial program, the Uganda Seed Project, CAAS project (which was assisting the South Bukedi Cooperative Union) and EIL (which has a project to distribute a hand operated oil mill suitable for isolated villages). A seed multiplication effort was established by the South Bukedi Cooperative Union in Tororo, and as a result 10 tons of Sunfola seed was produced and sold to farmers in Tororo in 1991. In addition, EIL planted 2000 acres, Mitchell Cotts 27 acres, and the Seventh Day Adventists 60 acres all specifically for the purposed of seed multiplication. Seed was also provided for planting an unknown area on National Resistance Army farms, Catholic Church farms, and Church of Uganda farms (MFAD/MOA/MUFAF, Research Proposals, ID MOA 12, 1992).

The re-selected Sunfola was renamed New Sunfola and recommended for release in October 1991. It is estimated to have a 10-20% yield advantage over local striped varieties, and more importantly, to have a 25% higher oil content. Its thin shell and high oil content make it preferred for crushing and it commands approximately a 25% price premium on the market.

The release does not mark the culmination of the research effort, however. Currently the most promising variety in the pipeline is a breeding line called Record 11-1.7 of Tanzanian origin, which realized high yields and a more than 40% oil content in multi-locational trials. Record will be a highly promising open-pollinated variety if its variability can be reduced. Its yields on farmers' fields range from 800-1000 kg/ha compared to Sunfola's 700 kg/ha and it appears to be more resistant to bird damage.

Recurrent selection of the Record variety is also ongoing in order to ultimately achieve uniform characteristics in terms of yields, maturity period, height, head size, disease resistance, and seedling vigor. It is hoped that researchers will be ready to present a uniform reselected variety of Record for release in 1994. The recurrent selection method generally takes at least 6 seasons in order to realize the desired characteristics.

7. SOYBEANS

Soybeans were introduced in Uganda between 1908 and 1913. However, serious production did not occur until the 1940s when, due to a war time demand from Britain, cultivation reached 14,000 - 16,000 hectares. In 1950 soybean exports reached a record level of 4,314 tons before undergoing a decline after 1952. In the early 1980s production was minimal with an average of 5-6,000 ha under soybeans annually. Yields averaged less than 1 ton/ha (Hittle, 1987). Production has been expanding in response to the demands of the edible oil industry, however, reaching a record 37,000 ha in 1990 and an estimated 54,000 ha in 1991.

While one improved variety had been released in the early 1970s, due to the civil strife of the last 15 years soybean varieties, breeding lines and seed increases were lost. Many INTSOY trials were conducted in the 1970s but the results of these trials have either not been reported or reports have disappeared. Only one report, for trials conducted in 1976-77, is currently available.

When the soybean research program was revitalized in 1988, it had two broad objectives. The first was to select and develop soybean varieties of medium maturity (100-120 days) which are high yielding; non shattering; resistant to lodging, major pests and diseases; free nodulating; with good pod clearance and which can store well for at least 7 to 8 months. The second is to identify appropriate agronomic practices which will maximize the performance of commercial soybean production in Uganda. Breeding work, however, was given first priority.

As a result of the multi-locational screening program, ICAL 131, an INTSOY variety, was identified as the most promising. It is resistant to bacterial pustule and virus. It matures in 120 days. It does not shatter or lodge and it is higher yielding across location than Kabanyolo 1, the existing released variety. ICAL 131 demonstrated a 5-10% yield increment on average over Kabanyolo 1 across many seasons and locations. Responsiveness to inoculation with Bradyrhizobium japonicum has also been well documented.

Because of the superiority of ICAL 131 it was proposed to the national variety release committee in August 1989 and was given partial release under the name of Nam 1. Further seasons of trials confirmed its superiority and it was approved for full release in 1991.

Ongoing breeding work at Namulonge has already identified another variety, L73, which researchers propose to submit to the National Release Committee before the end of 1992. This variety has the advantage of being not only as high yielding as currently released varieties, but also being larger seeded and extremely shatter resistant no matter how long the crop stands in the field. Further cross breeding to try to incorporate the high yield capacity of certain international varieties which are black seeded with the desired seed color and size from their selection of elite materials is also under way. Researchers estimate that they will have a new variety for release consideration by 1995, and possibly in the hands of farmers for planting in 1997.

8. CONSTRAINTS

It must be stressed that the accomplishments of the research program so far have been achieved under severely adverse condition. When Uganda was opened up again to the international community after the fall of Amin, they found an economy on the verge of total collapse. The decline of the Amin years was exacerbated by the poor macropolicies and internal unrest of the early 80s. By 1986 Uganda had suffered a near total collapse of agricultural research, seed multiplication, output markets, input distribution networks, and extension services.

The break up of the East African Community in 1977 seriously jeopardized agricultural research in Uganda. The best research facilities in East Africa had been established in Nairobi, Kenya under the East African Community. Not only did the loss of collaboration opportunities demoralize Uganda breeders, but they suddenly had no access to such necessary facilities as cold storage, computer services, and multiplication facilities. Many of the accession lines of maize, and soybeans which had been evaluated over the years were only kept in the Kenyan stores. As a result, valuable breeding materials were lost and others became irreparably damaged as a result of the breakup of the community. The Ugandan research program was virtually paralyzed.

In addition, worsening relations between Uganda and Great Britain led to the suspension of aid to the Uganda Seed Project and local multiplication facilities deteriorated in the face of increasing foreign exchange shortages. Kawanda Composite B (a variation on the existing improved maize variety) was judged ready for release by 1977 but by that time facilities for multiplication were inadequate. The breeder seed for KWCB were not properly stored and were lost as a result.

Maize and soybean seed production declined dramatically from 1975-1982. The situation worsened during and after the liberation war when all stores, equipment, and records were looted. Research activities were at a standstill and no new breeder seed could be provided to the seed project. The Seed Project continued to multiply a limited quantity of certified seed but seed quality deteriorated rapidly as inspection and other quality control activities were suspended. The political instability in the Luwero triangle led to further destruction at Kawanda Research Station and eventual abandonment of the Station in 1985. This seriously delayed implementation of the EEC project to rehabilitate the Uganda Seed Scheme.

Domestic markets were disrupted by rapidly declining income levels and underfinanced attempts to create a Produce Marketing Board with monopoly control over maize, beans, groundnuts, soybeans, and sesame. By 1985 per capita incomes had fallen to only 59% of 1971 levels. The situation was much worse in the formal sector, where wages fell to 9% of 1971 levels. Civil servants were clearly unable to meet essential expenses with their salary and resorted increasingly to moonlighting, and petty corruption. Performance standards declined drastically in every department. Exports collapsed leading to a crisis in rural income generation. Cotton production fell to 2.8% of peak production levels due to gross mismanagement of the cotton cooperatives which held a monopoly on cotton processing and marketing. Even coffee production fell to 74.2% of its former level.

As a result the entire system was starting basically from zero in 1986. The Ugandan farmer today is producing at essentially the same level of productivity as he/she was twenty years ago.

Virtually no new agricultural methods or technologies have been introduced since the late 1960s. Far worse, many labor-reducing or productivity-enhancing technologies have fallen into disuse in recent years leaving Ugandan yields much lower than those of other developing countries with similar climatic conditions. National fertilizer consumption per area under cultivation has actually fallen from an estimated average of only 1.4 kg/ha in the 1960s to a mere .2 kg/ha at the present time, making it among the very lowest in the world. Total annual expenditure on agricultural inputs (fertilizers, implements and agricultural chemicals) is estimated at only $10-$15 per smallholder household. Farmers in those areas of Eastern and Northern Uganda where animal traction had been well established for nearly 50 years have suffered a massive loss of animals due to political insecurity. Suddenly they are forced back into hand hoe cultivation with all of its resulting labor constraints. Staple food production continues to be dependent upon traditional varieties produced from farmers' own retained seed year after year.

What results is a vicious cycle of low input/low productivity agriculture which is very difficult to break out of. This situation is illustrated in Figure 2.

The future of agricultural research and the potential for agricultural transformation in Uganda, however, is much brighter than its past. A major structural re-organization is currently underway which, if successful, will greatly strengthen the agricultural sector. This re-organization includes market liberalization in both the input and export markets, rehabilitation of the seed multiplication scheme with particular emphasis on making the scheme self accounting, and creation of the National Agricultural Research Organization which will be an independent parastatal organization capable of offering more competitive incentives to researchers and demanding greater accountability.

All is not yet rosy, however. Uganda is still plagued by various constraints that inhibit adoption of new technology and the achievement of significant research impact in the short run. Foremost among these constraints are external economic shocks such as the drastic fall in international coffee prices. Although Uganda is trying very hard to reduce its dependence on coffee exports by diversifying its export base, the fall in prices has resulted in severe foreign exchange shortages and further limited the already narrow tax base. These constraints have a direct impact on agriculture by constraining the budget allocation to agricultural support services. Uganda's taxation level is very low, at only 8.5% of GDP. The demands on this limited resource base are intense and as belt tightening measures have intensified under structural adjustment the allocation to agriculture has declined steadily in the past decade, falling from 12% of the budget in 1980/81 to a mere 4% in 1990/91. Uganda's central government expenditure on agriculture averaged just $3.4 per capita over the 1982/87 period, well below the $21 per capita average for a series of 10 Sub Saharan African countries during the same period.[2] Total government expenditure on agriculture in 1990 was only .5% of GDP.

The lack of finances for agricultural research has resulted in extremely low remuneration for agricultural researchers. In 1989/90 senior researchers received 10,500/= Ush per month in salaries and allowances (less than $250 per year). This is less than half of the average Kampala household expenditure on food alone for that same period.[3] Obviously, salaries fall far short of a living wage. Scientists are forced to devote considerable time and energy to simply staying alive. Motivation and productivity decline. Under such conditions, incentive allowances paid to researchers working on USAID funded projects have a tremendous motivating influence.

[1] The MFAD project also invested a great deal in physical rehabilitation of the Makerere University Faculty of Agriculture and several research stations as well as both long and short-term training of scientists. These investments in overall research capacity and institution building are not directly included in the expenditure estimates above, however, since they are spread out over a very wide range of commodity research programs as well as the university farm, support for improved teaching, and establishment of a masters program in Agricultural Economics.

[2] The ten countries include Botswana, Mauritius, Swaziland, Zimbabwe, Egypt, Kenya, Malawi, Togo, Ethiopia, Madagascar. World Bank Report No. 7988-UN1, "Nigeria - Strategy for Agricultural Growth", p. 79.

[3] While no official poverty level has been established for Uganda, the average household expenditure in Kampala for food alone was over 29,000/= Ush per month during 1989/90. Food expenditures constituted 48.9% of total Kampala household expenditure. Ministry of Planning and Economic Development. Report of the Uganda National Household Budget Survey (1989-90). Entebbe, Uganda, 1991. p. 1.01-4.

Perhaps even more corrosive to research productivity than low salaries is the uncertainty and lack of control over operating funds. Budget by crises has been the order of the day. Researchers who are entirely government funded have no idea from one month to the next whether funds will be available to carry out their work. For example, funds to all of the research stations were cut by 70% in the last quarter of the 1992/93 financial year. Research stations barely had enough funds to pay salaries. If it had not been for local currency funds provided through the MFAD project, an entire season of trials would have been lost in the field. It is very difficult for researchers to develop a sense of commitment and professionalism under such condition.

Adoption of the technology being evaluated in this study was hampered by two specific events. In 1988/89 there was a bumper crop of maize. The Produce Marketing Board which still held monopoly control over exports had been encouraging maize production to meet national barter trade agreement requirement, but was so undercapitalized that it was unable to buy the maize which it had agreed to supply. The bottom fell out of the maize market and farmers couldn't even give maize away. This severely dampened farmers' interest in participating in on-farm trials for maize in the following year and made fertilizer application highly uneconomic. The market situation improved greatly for all three crops during the following year when incentives for private sector exportation of "non-traditional" exports were initiated, but yields were very poor as a result of local drought conditions.

9. PARTICULAR CONSTRAINTS IN THE EDIBLE OILS SUBSECTOR.

The edible oils sector in Uganda faces a dilemma where processors complain bitterly of a lack of raw materials and at the same time farmers complain of a lack of markets for their sunflower and soybeans. The result is a serious under-utilization of production capacity resulting in very high costs of production to processors.

Processors, however, cannot simply raise prices to cover their costs of production. Market prices for oil are constrained by Kenyan price policy which virtually eliminated import duties and taxes on imported palm oil in the early 80s in order to maintain low urban consumer prices. This inexpensive palm oil comes across the highly porous Kenya/Uganda border, largely by-passing Ugandan taxation authority as well.

Furthermore, Ugandan consumers have proven very undiscriminating when it comes to oil quality. They are not generally willing to pay a price premium for lower cholesterol fats. This sets an effective ceiling on the retail price of oil on the Ugandan market. High costs of processing can only be passed back to the farmers in low farm gate prices offered for oilseeds. If yields remain low, the returns to oilseed production remain unattractive compared to alternative crops and raw material availability continues to be a constraint. This vicious cycle is illustrated in Figure 3.

This example illustrates the importance of taking a broader subsector approach to the analysis of returns to agricultural research. From this analysis it becomes clear that research to improve yields on sunflower is one potentially important way to break out of the low capacity utilization cycle. By improving gross margins to farmers it is possible to increase their interest in sunflower production. Since the crushing industry is highly competitive, it is very likely that improvements in profit margins resulting from higher capacity utilization will be passed back to farmers in the form of price increases thus reinforcing the possibility of an upward spiral in raw material availability. This is illustrated in Figure 4.

While raising yields through agricultural research is only one way to break the vicious cycle, it may well be one of the easiest ways to intervene positively in the subsector given the inherent difficulties Uganda has experienced in enforcing protectionist taxation measures. If soybeans are to become a major input for edible oil production, however, it will be necessary to overcome the current constraint imposed by the limited demand for livestock feeds, since the cake comprises a much higher proportion of the value of production than it does for sunflower.

10. OUTSTANDING ISSUES

Not all of the positive impacts of agricultural research are easily captured by a straight ROR analysis which focuses primarily on benefits from increased production. This is certainly true in the case of Uganda. Agricultural research on maize, soybeans and sunflower has important gender implications for the Ugandan farming system and the distribution of income within the household. All three commodities 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, soybeans and sunflower. In addition, NGO and micro-projects hoping to enhance women's income-generating capacity have frequently focussed on provision of intermediate technology and technical advice to women's groups to help them enter into both production and processing for the edible oils sector. This research effort will look more closely at this issue as part of the subsector study of phase two.

Another benefit which is difficult to quantify is the extent to which research investments have not only led to an immediate research output, but have strengthened institutional capacity, which will have positive payoffs far into the future and across a broad spectrum of research efforts.

To the extent that investments in technical advice, training, and rehabilitation are included in the costing of the research investment, they will result in a conservative estimate of the returns to research. The history of research in Uganda also 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.

Priority setting is especially difficult in a highly diversified production system like that of Uganda. In Uganda, many different commodities are important for the national farming system, and each one requires substantial funds in order to be able to make a significant impact, funding will always be a serious constraint. It is necessary to concentrate research investment in order to make real progress. Spreading the investment too thin will jeopardize the possibility of achieving results, but concentration on particular commodities will have serious regional equity implications. This is especially true for sunflower, for example. While sunflower is a relatively new crop, farmers in Northern Uganda have shown keen interest in expanding 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 region are of particular interest. It is unfortunate indeed that the on farm research in sunflower production sponsored by USAID coincided with the political insecurity in Northern Uganda during the 1986-1991, period making in very difficult to judge the acceptability of the newly developed technology in the area most likely to benefit from it in the long run. The importance that the Ugandan government places on economic development for this region, however, is clearly demonstrated by the recent efforts to initiate a major reconstruction project financed by the World Bank.

The edible oils sector in Uganda is at a potential turning point. Congruence tests which are often used as a basis for research priority setting may be inappropriate in this case. Past experience of the importance of various commodities in the agricultural sector may not be a good indictor of future performance in a changing national economy. For this reason, the Uganda case highlights the importance of a broad subsector perspective in evaluating the potential impact of agricultural research and in identifying key constraints and intervention points.

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Figure 1.

INTEGRATED APPROACH TO MAIZE AND OILSEED DEVELOPMENT

PHYSICAL REHABILITATION

Station Research

Rhizobium Development

On Farm Trials

Increased Maize & Oilseed Production

Seed Multiplication

Seed Distribution Manual Presses

Processing Promotion (Medium to Large Scale)

TRAINING

Table 2. ACHIEVEMENTS

- **Varieties Released**

  Maize = Longe 1
  Soybeans = Nam 1
  Sunflower = Sunfola

- **Yield Increases**

  Maize = 15-25%
  Soybeans = 5-10%
  Sunflower = 10-20%

- **On-Farm Trials 1988-92**

  Maize = 833
  Soybeans = 892
  Sunflower = 422

  Total = 2,147
  in 7 Districts

- **Rhizobium Production**

  Improves yield 25-45%

  1990-91 sold enough to inoculate 367 HA of soy
  Can produce enough for 2,000 Ha/yr in future

- **Seed Multiplication and Distribution**

  CAAS project distributed > 16 tons improved sunflower seed in 1992

- **Manual Presses & Seed Distribution by EIL**

  1990-92 sold 44 manual presses and distributed 5.7 tons of seed in 1992

- **Varieties in the Pipeline**

  Expected release 1993/94

- **Processing Promotion**

  Credit from PL480 funds

Figure 2.

VICIOUS CYCLE OF LOW INPUT LOW PRODUCTIVITY AGRICULTURE

Monopoly Markets
Low International Prices

Low Yield

Low Tax
Revenues

Low Income

Lack of Capital

Collapse of Input
Prod. & Marketing

Collapse of
Extension and Lack
of Information

High Input Prices

Low Input Use

Low Demand for Inputs

Figure 3.
VICIOUS CYCLE OF LOW PRODUCTION IN THE EDIBLE OILS SUBSECTOR

Low Capacity Utilization in Processing

Lack of Raw Materials for Crushing

High Production Costs in Processing

Low Gross Margins to Farmers

Narrow Profit Margins for Processors

Low Farm Gate Prices

Figure 4.
POTENTIAL UPWARD SPIRAL OF IMPROVED PRODUCTION IN EDIBLE OILS SUBSECTOR AS A RESULT OF AGRICULTURAL RESEARCH

Improved Capacity Utilization in Processing

Greater Supply of Raw Materials

Lower Prod. Costs for Processors

Higher Gross Margins for Farmers

Wider Profit Margins for Processors

Improved Yields Through Research

Better Producer Prices