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APPENDIX 3. Socio-economic Working Paper 1

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Cotton Grower Survey, Pallisa and Kasese Districts, Uganda

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Summary

A structured questionnaire survey of 120 cotton-growers from Pallisa and Kasese districts of Uganda was administered during the 2002 cotton-growing season. Of the 120 growers sampled, 62 were demonstrating an improved technology package for cotton on one of their fields.

Growers in Pallisa had more land (including fallow) available than in Kasese but planted the same area to cotton. Growers in Pallisa had more physical assets, and a higher share of their cash income was earned off-farm. Growers with demonstration plots were generally better-off, and should not be used as a reference group for future adoption of new technology. Income from cotton in 2001 was higher Kasese than in Pallisa (182,000 and 64,000 shillings, respectively).

Intercropping cotton was common in Pallisa but rare in Kasese. Three-quarters of cotton fields in Pallisa were preceded by fallow, compared to under 5 % in Kasese. Few cotton fields received any manure. In both districts, cotton was weeded three-four times. The average number of chemical sprays was the same in both districts (two-three) but expenditure on sprays was much higher in Kasese than in Pallisa, perhaps because of higher retail prices. Most growers did not own sprayers.

Weeds, pests, and weather (ie. drought) were the most frequently mentioned factors limiting yields. Weeds were perceived as the most important factor in Pallisa, and pests the most important factor (after weather) in Kasese.

Farmers in Kasese relied primarily on extension workers for information on cotton, and less on their own knowledge or information from family and neighbours. The majority of non-demo farmers had heard and visited cotton demonstration plots, but fewer had attended field days. Most growers said they had been trained in safe use and handling of pesticides but stored pesticides in the home, did not use protective clothing, and did not burn or bury used containers.

Cotton in Pallisa was just profitable, with a cost-benefit ratio (CBR) of 2.00 when inputs were valued on a cash-cost basis. Cotton was not profitable when inputs were valued on a full-cost basis (CBR=0.94). Cotton in Kasese was highly profitable with a CBR of 6.78 when inputs were valued on a cash-cost basis. Cotton was also profitable when inputs were valued on a full-cost basis (CBR=3.26). Farmers in Kasese may have over-estimated yields, however. Sensitivity analysis showed that, at current cost-levels and with farmers' management practices, CBRs of 2.0 required average yields of approximately 200 kg/acre [494 kg/ha] when costs were valued on a cash-cost basis. CBRs of 3.0 required yields of approximately 300 kg/acre [740 kg/ha].

INTRODUCTION

Agriculture is expected to help eliminate poverty in Uganda through a strategy of commercialisation which links smallholders with markets and increases the share of household income from cash crops. Cotton is an important component of this strategy. Following price liberalisation in 1992, output has grown rapidly to reach 100,000 bales in 2002. In 1999, one in three communities planted cotton and one in five communities reported that the number of growers had increased since 1992 (Deininger and Okidi, 2001). Cotton contributes directly to the livelihoods of 300,000 smallholders in Uganda, with the potential to make even greater contributions in the future.

Improving yields of smallholder cotton will require widespread adoption of new management practices. IDEA demonstrated a technology package of improved practices in 15 districts in 2001. This package included zero tillage, herbicides, chemical fertiliser, and calendar spraying of pesticides. An evaluation reported significant increases in yields and net returns over growers' traditional management practices (Mweswiga, 2002).

IPM may further boost net returns by reducing growers' cash expenditure on control of pests, diseases, and weeds. A research programme to develop an IPM approach for smallholder cotton in Uganda was initiated in collaboration with IDEA in 2002. To provide baseline information for this IPM programme, a grower survey was conducted in the 2002A crop season. The specific objectives of the survey were to:

- Provide a socio-economic profile of households that grew cotton.
- Identify farmers' cotton management practices, particularly for pest and weed management.
- Assess the profitability of cotton under current management practices.
- Classify the various types of smallholders growing cotton.

This Working Paper contains the main results of the grower survey. The classification of various types of cotton growers will form the subject of a separate report.

DATA AND METHODS

In 2002 IDEA conducted cotton demonstrations in Pallisa district (central region) and Kasese district (southern region). Demonstrations in Pallisa were conducted in collaboration with the Iki Iki ginnery owned by the North Bukedi Company, and in Kasese with the Nyamatonzi Cooperative.

Pallisa lies in the Teso farming system. Farmers grow cotton-millet in rotation, along with a wide range of other crops. Round Iki-Iki we noted rice, maize, sorghum, sugarcane, sweet potato, cassava, sunflower, bananas, pigeonpea, beans, cowpeas). Traditionally, farmers opened land by ox-ploughs and cotton was weeded four-five times to help prepare a good seedbed for millet, the staple foodcrop. Theft and war have reduced cattle numbers and many farmers now use hoe cultivation. The long rains start in February and finish in July. There is usually a break of three-four weeks in the rains between the end of May and start of June. The short rains start in August and finish in November. Although shorter, these rains are continuous and more reliable. Farmers plant millet in February and harvest in July. This is followed by cotton, harvested in December.

Kasese lies in the montane farming system. Farmers grow foodcrops and coffee in the Rwenzori mountains while cotton is grown on the plains. Farmers usually rent fields for cotton, and return to the hills after the cotton harvest. Cotton is grown in large blocks, and some farmers employ migrant labour from neighbouring Bushenyi district. Short rains start in March and end in June. Long rains start in September and finish in January. Cotton is normally planted in August and harvested in December.

Sample selection

The sample design required a random sample of 30 demo and 30 non-demo cotton-growers from each of the two districts, or a total of 60 growers from each district. Thirty demo farmers from each site were randomly selected from a list of demonstration farmers prepared by each ginnery. Random selection of non-demo farmers was more restricted since they were scattered and time was limited. Non-demo farmers in Pallisa were randomly selected from a list of cotton growers in Iki-Iki sub-county surrounding the ginnery. In Kasese, where no listing was available, non-demo farmers were selected by interviewing the farmer cultivating the cotton field five fields distant from the demonstration plot. Consequently, non-demo farmers in Kasese covered a wider geographical area.

The final sample size is shown in Table 2. Demo farmers were slightly over-represented at both sites, but the number of non-demo farmers remained adequate for making comparisons based on standard tests of statistical significance.

Data collection

Data was collected using a formal, structured questionnaire, which is provided for reference in Appendix 1. Data was collected by local enumerators. The survey was administered between 15 November-10 December 2002. This was about one week before harvesting in Pallisa and three weeks in Kasese. Information relating to harvesting was not collected, and information on yields is based on farmers' expected yields rather than crop cuts.

SOCIO-ECONOMIC PROFILE OF GROWERS

Between districts

Natural assets

Table 3 shows that neither the area under cultivation or the area planted to cotton differed significantly between sample growers in the two districts. The total area available for cultivation was much higher in Pallisa (13 acres) than in Kasese (5 acres), however. Consequently, cotton-growers in Pallisa had more land under fallow (4.17 compared to 0.37 acres). Other important differences between districts included the significantly higher area of land rented in Kasese (1.83 acres compared to 0.90 in Pallisa)

Human assets

Household size did not differ between districts (Table 4). Age of household head did not differ between districts, but the level of education among household heads was significantly higher in Pallisa, where all but one had completed primary education. The proportion of households headed by women was significantly higher in Kasese.

The family labour-force available for land preparation, weeding, and harvesting of cotton was higher in Pallisa than in Kasese. This was due to higher participation rates for these activities by women and children, and in weeding cotton by adult males.

Physical assets

Ownership of physical assets suggested that households were marginally better-off in Pallisa, where significantly more households owned bicycles, farm stores, and radio-cassettes (Table 5). Similarly, households in Pallisa owned more oxen, cows, and chickens. Ownership of radios – an important source of information on cotton management – did not differ significantly between districts.

Income and food security

Households in Pallisa derived a greater share of income from off-farm sources (32 % compared to just 12 % in Kasese) (Table 6). Remittances ranked higher as a source of off-farm income in Pallisa than in Kasese, where income from wage labour ranked higher than in Pallisa. In terms of on-farm income, farmers ranked cotton above other crops and livestock. Similarly, farmers in both districts ranked cotton as their most important cash crop, followed by groundnuts, soya and maize (Pallisa) and coffee, groundnuts, and maize (Kasese).

Cotton production per household last season (2001A) was significantly higher in Kasese than in Pallisa (1011 compared to 499 kg), and gross income from cotton was therefore higher in Kasese (median values of 182,000 shillings compared to 64,000 shilllings in Pallisa).

Household food insecurity was lower in Pallisa (3 months) than in Kasese (4 months) (Table 7). The seasonal pattern of food deficit was quite different between the two districts. Food insecurity in Pallisa showed a single peak period between March-June, with most households self-sufficient in staple food for six months of the year. By contrast, food insecurity in Kasese showed two seasonal peaks (February-April and September-November), and no period of extended self-sufficiency. This suggests greater vulnerability to food insecurity in Kasese district.

Between demo and non-demo farmers

Significant contrasts between demo and non-demo farmers were found in both districts (Table 8).

- Demo farmers in **Pallisa** had larger areas under cultivation, planted to cotton, and under fallow. They were also more likely to own a bicycle, an ox-plough, a farm store, a tin-roof house, a radio-cassette, a TV and a telephone. They owned significantly more livestock (oxen, cows) and chickens. However, they had the same level of food security as non-demo farmers, buying their staple food for 2-3 months each year.

- Demo farmers in **Kasese** had the same area under cultivation, planted to cotton, and under fallow as non-demo farmers. They were more likely than non-demo farmers to own a bicycle, have a farm store, or a radio-cassette. They owned more oxen, goats, pigs, and chickens. But they had the same level of food security as non-demo farmers.

MANAGEMENT PRACTICES

To capture cotton management practices, the analysis in this section was made only for non-demonstration fields, excluding any farmers' fields with IDEA's cotton demonstrations.

General

Growers in Kasese cultivated fields roughly 90 minutes' walk from their homestead, compared to just 12 minutes' walk in Pallisa (Table 8). Soiltype in Kasese was almost exclusively black-loam, whereas soiltype in Pallisa consisted of both black- and red-loams. Growers in Kasese planted cotton mostly on the plain, while those in Kasese also planted cotton on upland fields.

As noted above (Table 3), renting was more common in Kasese, where the majority (67%) of fields were rented from others. Rental added considerably to the cost of cultivation, but average rents in Kasese (median value, 20,000 shillings/acre) were only half those in Pallisa (40,000 shillings/acre).

Intercropping was more common in Pallisa where 57 % of non-demo cotton fields were intercropped, the most common intercrops being beans, maize, or cassava.

Almost no growers applied manure or fertiliser to their cotton fields, but 70 % of cotton fields in Pallisa had reportedly been kept fallow for the previous two years. By contrast, fallowing was not a feature of cotton cultivation in Kasese.

Weed management

Tillage and weeding differed significantly between districts (Table 9). Land preparation in Pallisa was made predominantly using ox-ploughs, whereas in Pallisa land preparation was made with tractors and hoes. The mean number of weedings did not differ significantly between districts. Growers weeded each cotton field three or four times on average. However, the share of the area planted to cotton that was weeded more than twice was greater in Pallisa district (87 %) than in Kasese district (76 %). No significant differences were observed in the time of weeding. In both districts cotton fields were weeded on average three, seven, 11, and 14 weeks after planting.

Farmers were asked to list the three most *troublesome* (not necessarily the most common) weeds on their cotton fields. Growers gave local names for in Pallisa and in Kasese. Frequencies for weeds mentioned more than 10 times are reported in Table 9. In Pallisa, the three most troublesome weeds of cotton were reported to be *Iranda*, *Konete*, and *Lumbugu*. In Kasese, the corresponding weeds were *Endesta*, *Olutswamba*, and *Omisomi*. Samples may be collected to identify the species to which these names refer.

Pest management

Only one-quarter of cotton growers owned a knapsack-sprayer, with three-quarters relying on hired sprayers or borrowing from friends and neighbours (Table 10). The normal hire charge in Pallisa in 2002 was 500 shillings/day. The mean number of sprays/field did not differ significantly between districts, averaging three per season. However, the share of the area planted to cotton that received more than three sprays was significantly higher in Kasese (35 %) than in Pallisa (17 %). Total household expenditure on cotton spraying was significantly higher in Kasese (median value, 10,000 shillings) than in Pallisa (4000 shillings). Expenditure on pump hire was similar (4-5000 shillings/household).

Labour use for tillage, weeding and spraying

The share of hired and family labour used for cotton differed significantly between districts (Table 12).

Growers in Kasese relied primarily on family labour for most activities, whereas hired labour was widely used in Pallisa. Indeed, growers in Pallisa used significantly more hired labour for nine of the 10 field activities listed. Use of hired labour in Pallisa was highest for land preparation, with 44% of the area planted to cotton tilled exclusively by hired labour. This may reflect the hire of ox-ploughs by growers without their own oxen.

The higher share of hired labour used for cotton in Pallisa is puzzling in view of the greater availability of family labour for land preparation, weeding, and harvesting in Pallisa (Table 3).

Determinants of time of planting

Cotton yields are critically dependent on time of planting. Regression analysis was used to investigate socio-economic determinants of timely planting. Since planting date varied between districts, and variation within districts was significantly higher in Pallisa, the analysis was conducted only for Pallisa district.

Table 11 gives definitions of the variables used in the analysis. We hypothesised that cotton would be planted *earlier* on fields where: land was ox-ploughed; growers received seed on time; cotton was planted after fallow; where growers had more off-farm income to hire labour for planting; on farms belonging to demo-farmers; and on farms where more land was owned rather than rented. We hypothesised that cotton would be planted later where households had low food security, forcing them to work for others to earn cash in order to buy food.

The regression was estimated using OLS. The results show that the specification explained 21 % of the variation in the dependent variables (week of planting) and the DW-statistic showed no auto-correlation. Of the seven independent variables, only three were statistically significant at the 5 % level or above.

- Time of planting was significantly *later* on farms where a higher share of land was prepared by ox-plough (LPOXSHARE), indicating that cotton-growers that used draught power planted cotton later than those who used hoes. This was an unexpected result, but households with ox-ploughs have larger areas planted to cotton, which delays planting.

- Time of planting was significantly *earlier* where growers who reported that they had received seed on time (SEEDTIME).

- Time of planting was significantly *earlier* on farms with bigger areas where cotton followed fallow (CFALLOW).

The coefficient of the variable for household food insecurity (STAPLE) showed the expected positive sign but was not statistically significant.

Determinants of timely weeding

Since the variation in time of first weeding was limited, he analysis was made for second weeding. The analysis was made jointly for both districts because no significant difference in time of second weeding was found between districts (Table 9).

We hypothesised that second weeding would be given *earlier* on: farms with smaller areas planted to cotton; on fields weeded by hired labour; and on farms where farmers gave a high rank to weeds as a factor limiting cotton yields. We hypothesised that cotton would be weeded later on demo plots (which received herbicides), and where first weeding had been later. Finally we included a dummy variable to capture any residual differences between districts.

The regression was estimated using OLS. The specification explained 60 % of the variation in time of second weeding. The DW-statistic showed no autocorrelation. Four of the six independent variables were statistically significant at the 5 % level or better. Results showed that:

- Second weeding was significantly *later* on DEMO plots, since these received herbicides as part of the cotton technology package.

- Second weeding was significantly *later* on fields that belonged to farms with larger areas planted to cotton (AREACOTT).

- Second weeding was significantly *later* on fields with later first weeding (W1WAP).

- Second weeding was significantly *earlier* on fields belonging to farms where farmers gave a high ranking to weeds as a factor limiting cotton yields (RNKWEEDS).

The coefficient of the variable for hired labour (W2HIRED) showed the expected negative sign, but was not statistically significant.

GROWERS' PERCEPTIONS OF FACTORS LIMITING YIELDS

Growers were asked to rank and score the three most important factors limiting cotton yields on their fields. Factors were ranked 1-3, with 1 denoting most the important factor, and scored 1-10, with the most important factor scoring highest.

Ranks measure the perceived importance of constraints on a uniform scale (1,2,3 etc.), but scores measure the distance between the variables being ranked and therefore provide more information about the relative importance of each constraint.

Growers reporting

Weeds, pests, and weather were the three most frequently mentioned limitations on cotton yield in both districts. Weeds were mentioned more frequently in Pallisa, while pests were mentioned more frequently in Kasese. Among other constraints noted by growers, soil fertility was perceived as a more significant constraint on yield in Pallisa, while lack of inputs received significantly more mentions in Kasese. Only 12 growers mentioned diseases, perhaps because they had difficulty identifying them.

Ranks

Table 12 shows the mean ranks of each constraint on yield, for growers who mentioned that constraint. Among the three most frequently mentioned factors limiting yields, in Pallisa weeds came first, followed by pests, then weather. In Kasese, weather was ranked first, followed by pests, then weeds. Although fewer farmers mentioned this problem, lack of inputs received a high rank in both districts.

Significant differences in rankings between districts were found in the case of weeds, pests, and weather. Weeds and pests ranked more highly in Pallisa than in Kasese, and weather ranked more highly in Kasese. Among other constraints, there was no significant difference in the ranks given to lack of inputs, or soil fertility.

Scores

Among the three most frequently mentioned constraints, in Pallisa weeds and pests received a similar score (7.80 and 7.10, respectively) while weather received a much lower score (5.90). In Kasese, the relative weighting of constraints was more even. Weather received the highest score (8.21) followed by weeds (7.02) and pests (6.57). Once again, weeds were perceived as more important in Pallisa than in Kasese. No difference was found between districts in the score assigned to pests, but growers in Pallisa gave a much higher score to diseases (7.33) than growers in Kasese (3.67).

SOURCES OF INFORMATION

Extension workers were the most frequently mentioned source of information about cotton in both districts (Table 14). However, growers in Pallisa listed a much wider range of sources than in Kasese. These included radio,

friends/neighbours, own knowledge, parents/family members, and observing other fields. Significantly fewer growers in Kasese obtained information from the radio, from their own knowledge, or parents and other family members.

Among non-demo farmers, nine in ten had heard about demonstration plots, while seven in ten had actually visited one. However, only half had attended a field day associated with a demo plot. The proportion of non-demo farmers who had visited a demo plot was higher in Kasese district.

HANDLING OF PESTICIDES

Eight in ten growers in Pallisa and six in ten growers in Kasese claimed to have been trained in the safe handling of chemical pesticides. Demo farmers were significantly more likely to have received such training than others. However, few significant differences were found in handling pesticides between demo and non-demo farmers. Most growers applied pesticides without using any protective clothing. Many growers, particularly in Kasese, cleaned used containers in rivers or streams where the risk of pollution was high. Very few growers burned or buried containers after use, creating health risks.

COSTS AND RETURNS

Methods

Information on the profitability of cotton was obtained from a sub-sample of 80 growers. Since the survey was administered before harvest, labour and material costs of cotton harvesting were excluded from the analysis. This effect of this omission has been to reduce costs and inflate net returns.

To reduce measurement errors, farmers were questioned about their biggest field. Information was collected on the quantity of labour used (both family and hired). Accurate information on the quantity of hired labour proved difficult since some tasks like weeding may be contracted to a group of labourers, and farmers may not know how many were involved. However, employers can usually remember how much they paid. Figures for cotton yields are based on farmer estimates of expected yield for the field in question, not on scientific crop-cuts.

Benefit-cost analysis

Table 19 shows that:

- Cotton in Pallisa was only marginally profitable, with a cost-benefit ratio (CBR) of 2.00 when inputs were valued on a cash-cost basis. Cotton was not profitable when inputs were valued on a full-cost basis (CBR=0.94).

- Cotton in Kasese was highly profitable with a CBR of 6.78 when inputs were valued on a cash-cost basis. Cotton was also profitable when inputs were valued on a full-cost basis (CBR=3.26).

- Since average costs were similar in both districts, the difference in CBRs was due to differences in estimated yields, which averaged 700 kg/acre in Kasese compared to 200 kg/acre in Pallisa.

- Weeding required 24 days/acre of family labour in Pallisa and 14 days/acre in Kasese. This represented 59 % of total family labour on cotton in Pallisa and 36 % in Kasese.

- Valuing family labour for weeding at market rates, the total cost of labour for weeding averaged 31754 shillings/acre in Pallisa and 20566 shillings/acre in Kasese. This represented 43 % of total costs in Pallisa and 27 % of total cost in Kasese.

- The cost of chemical pest control (equipment and sprays) averaged 4632 shillings/acre in Pallisa and 7182 shillings/acre in Kasese. Including the cost of hired labour, and valuing family labour for spraying at market rates, the total cost of chemical pest control averaged 7497 shillings/acre in Pallisa and 12122 shillings/acre in Kasese. This represented 10 % of total costs in Pallisa and 16 % of total costs in Kasese.

- In terms of cash costs, expenditure on labour for weeding represented 23 % of total cash costs in Pallisa and 18 % in Kasese. Expenditure on pest control (hired labour, equipment, and sprays) accounted for 19 % of cash costs in Pallisa and 28 % in Kasese. Thus, weeding and pest control accounted for 42 % of total cash costs in Pallisa and 46 % of total cash costs in Kasese.

Sensitivity analysis

Given the lack of accurate figures for cotton yields, an analysis was made to determine the minimum yields required for acceptable CBRs for cotton in both districts. In this exercise, average costs were held constant while the CBR was allowed to vary. Yield figures were then derived for each CBR.

Table 20 shows that:

- On a cash-cost basis (excluding the cost of family labour), CBRs of 2.0 were obtained with yields of roughly 200 kg/acre in each district (193 kg/acre in Pallisa, 207 kg/acre in Kasese). CBRs of 3.0 would require yields of roughly 300 kg/acre, while CBRs of 4.0 would require yields of approximately 400 kg/acre.

- On a full-cost basis (including the cost of family labour), CBRs of 2.0 would require yields of approximately 425 kg/acre (425 kg/acre in Pallisa, 4229 kg/acre in Kasese. CBRs of 3.0 would require yields of roughly 650 kg/acre while CBRs of 4.0 would require yields of 850 kg/acre and above.

CONCLUSIONS

Socio-economic profiles

Growers in Pallisa district had higher levels of natural, physical, human, and financial assets than in Kasese. They had more land available for cultivation, allowing them to grow cotton after fallow. More of them owned assets like bicycles, farm stores, and ox-ploughs. They also owned more oxen, cows, and chickens. Generally they had a higher share of income from off-farm sources, and a higher share of off-farm income derived from salary and remittances rather than wage-labour. Household food security was similar in both districts, but was concentrated in a few months in Pallisa and more evenly spread in Kasese. Together, these findings suggest that cotton growers in Pallisa were better-off and less vulnerable than in Kasese.

Both cotton production and income from cotton in 2001 were higher in Kasese than in Pallisa. Since growers in these districts planted similar areas, this reflected differences in average yields. Growers in both districts ranked cotton as their most important cash crop.

Given their better asset-base, growers in Pallisa may be more prepared to take risks with new cotton technology than in Kasese. They are more likely to have money available for cash inputs like fertiliser, herbicides, and hired labour. However, they may be willing to tolerate low yields if they regard cotton as primarily a useful way of preparing fallow land for millet, the staple food-crop. The large share of fallow remaining in the farming system is surprising. This may discourage farmers from intensifying production through relying on purchased inputs like fertiliser. The high share of household income from off-farm sources suggests that households have diversified away from agriculture to earn cash income. Cotton would have to offer higher returns than these activities to be seen as an alternative source of cash income.

Growers participating in demonstration plots had more land, more family labour, and planted more cotton than others. They generally owned more physical assets, and more oxen, cows, and chickens. Demonstration farmers in Kasese were also better educated. There was no difference in household food security between demonstration and non-demonstration farmers, however. These findings suggest that demonstration farmers represented better-off households in the community. Since demo-farmers are not typical cotton-growers, they should

not be used as a reference group for assessing the adoption potential of new cotton technology.

Crop management

There were several important differences between districts in where cotton was grown, including landtype, soiltype, whether grown after fallow, or intercropped. In Pallisa, cotton was usually grown on red-loam soils after a two-year fallow, and intercropped. In Kasese, cotton was usually grown without fallowing on black-loam soils, and as a sole crop. The effect of these differences on yield has not been investigated but is likely to be significant.

Weed management practices were similar, with farmers in both districts weeding cotton 3-4 times a season at similar times after planting Tillage in Pallisa was made primarily using ox-ploughs, whereas in Kasese ox-ploughs were unknown and growers relied on tractors and hoe cultivation.

Pest management practices were also similar with growers spraying 2-3 times each season at similar intervals. In both districts, growers usually hired or borrowed spray pumps. The cost of chemical pest control was higher in Kasese, however. Given the similarity in pest management practices, this seems to have been due to the higher cost of chemical sprays in this more remote area of Uganda.

Time of cotton planting in Pallisa was significantly related to whether growers obtained seed on time, whether cotton was planted after fallow, and the share of land planted to cotton that was ox-ploughed. This suggests that timeliness can be improved by quicker seed distribution and increasing the supply of animal draught power for tillage. Land pressure that reduces fallow will delay cotton planting.

Timing of second weeding was significantly related to the area planted to cotton, and farmers' perception of the impact of weeds on yield, but was not significantly related to the use of hired labour, or to household food insecurity which might have reduced family labour supply for weeding. This suggests that growers that plant larger areas of cotton face a labour constraint on weeding, and face cash constraints on hiring labour.

Factors limiting yields

Weeds, pests, and weather were the three most frequently mentioned factors limiting cotton yields. Soil fertility was seen as more limiting in Pallisa, and lack of inputs as more limiting in Kasese. Few growers mentioned diseases as a yield constraint. Weeds were ranked as the most important constraint in Pallisa, where they also received the highest score. Pests were ranked as the second most important constraint in Kasese (after weather) and in Pallisa (after weeds). These

findings confirm the research focus on weeds and pests as primary yield constraints.

Sources of information

In both districts, information on cotton came primarily from extension workers. Unlike in Kasese, growers in Pallisa reported multiple sources of information, including friends/neighbours, observing others' fields, parents/family, and own knowledge. These findings confirm the depth of the existing knowledge base for cotton in Pallisa, and the lack of experience in Kasese, where cotton has been recently introduced.

The majority of non-demo farmers had visited a cotton demonstration, and half had attended a field day at a cotton demonstration. This suggests that cotton demonstrations are indeed reaching the majority of growers in these districts, but their effectiveness will require more research to determine what farmers are learning and how much they are putting into practice.

Profitability

With inputs valued on a cash-cost basis (excluding the cost of family labour), results showed benefit-cost ratios (CBRs) for cotton of 2.01 for Pallisa and 6.78 for Kasese. With inputs valued on a full-cost basis (including family labour), benefit-cost ratios fell to 0.94 for Pallisa and 3.26 for Kasese. Differences in benefit-cost ratios between districts were due to differences in average yields, estimated by farmers at 200 kg/acre in Pallisa and 700 kg/acre in Kasese. Reported yields for Pallisa seem reasonable for farmers' field conditions but the figure for Kasese is too high.

Sensitivity analysis showed that, at current cost-levels, CBRs of 2 required average yields of approximately 200 kg/acre when costs were valued on a cash-cost basis. CBRs of 3 required yields of approximately 300 kg/acre. This suggests that, with farmers' yields between 200-300 kg/acre, growers in both districts are receiving reasonable returns from cotton.

REFERENCES

K. Deininger and J. Okidi (2001). Rural households: Incomes, Productivity, and Non-Farm Enterprises, Pp. 123-175 in R. Ritva and P. Collier Eds. *Uganda's Recovery. The Role of Farms, Firms, and Government*. Kampala: Fountain Publlishers/World Bank.

E. Mweswiga (2002). An Assessment Report on the 2001 Cotton Demonstration Program Covering Nine Districts. UGCEA/ADC. Mimeo. February.

Table 1. Summary statistics for grower sample, Pallisa and Kasese districts, 2002.

Variable	Pallisa (n=60)	Kasese (n=60)	*Sig.-level (P <)**
Household size (no.)	6.23	6.73	.4000
Total area owned (acres)	12.73	5.00	.0060
Area planted to cotton (acres)	3.01	2.57	.2639
Female-headed households (no.)	8	16	.0679
Food insecurity (months)	2.64	3.62	.0054
Off-farm cash income (%)	32.3	12.1	.0000
Cotton production in 2001 (kg)	499	1011	.0003
Income from cotton in 2001 (Sh.)	137,350	234,414	.0065
Main factors limiting cotton yields (farmers reporting):			
Weeds	83	68	.0751
Pests	67	82	.0395
Weather	70	58	.2229
Soil fertility	32	17	.0615
Cotton fields intercropped (%)	54	12	.0000
Cotton fields manured (%)	4	0	.1097
Cotton fields planted after fallow (%)	70	2	.0000
Number of weedings	3.52	3.38	.3670
Number of sprays	2.58	2.80	.2410
Expenditure on sprays in 2002 (Sh.)	5921	14227	.0001
Expenditure on pump hire in 2002	4514	5772	.3218
Sources of information on cotton (%)			
Extension worker	65	85	.005
Radio	57	27	.001
Friends/neighbours	35	23	.177
Parents/family	57	15	.000
Own knowledge	58	2	.000
Non-demo farmers who have (%):			
- heard of demo plot	97	89	.5108
- visited demo plot	69	86	.0694
- attended field day at demo plot	52	64	.2560
Farmers trained in use of pesticides (%)	81	60	.0472
Costs of production			
- cash costs	33708	36158	
- full costs	74708	75158	
Yields (kg/acre)	200	700	
Gross returns	70000	245000	
Net returns			
- cash cost basis	36292	208842	
- full cost basis	-4708	169842	

Table 2. Sample cotton growers, Pallisa and Kasese districts, 2002.

District/sub-county	Demo-farmers	Non-demo farmers	Total
Pallisa District			
Iki-Iki	13	29	42
Kameluka	2	0	2
Bulangira	5	0	5
Kagumu	4	0	4
Kaderuna	6	0	6
Kibuku	1	0	1
Total	31	29	60
Kasese District			
Nyakiyumbu	5	7	12
Kisinga	5	1	6
Kyalumba	3	4	7
Kyondo	0	2	2
L. Katwe	8	8	16
Ihandino	0	2	2
Karambi	3	0	4
Bwera	8	3	11
Total	32	28	60

Table 3. Land use and crops among cotton growers, Pallisa and Kasese districts, 2002.

Variable	Pallisa (n=60)	Kasese (n=60)	*Sig.-level (*P <)**
Total area owned (acres)	12.73	5.00	.0060
Area cultivated (acres)	6.36	5.43	.2286
Area fallow (acres)	4.17	0.37	.0043
Area planted to cotton (acres)	3.01	2.57	.2639
Area under pasture	0.64	0.43	.5796
Area under trees	0.13	0.11	.8123
Area under forest/woodlands	0.05	0.02	.4356
Area wetlands	1.38	0.00	.0008
Area other	1.47	0.00	.0301
Main crops in season 2002B (acres)			
Cotton	182.5	168.0	
Coffee	0.0	109.50	
Beans	7.0	4.0	
Maize	30.0	10.0	
Cassava	79.0	11.5	
Sweet potato	10.5	0.0	
Banana	13.0	19.0	
Peas	11.0	0.0	
Rice	14.0	0.0	
Main crops in season 2002B (acres)			
Cotton	50.0	1.0	
Coffee	0.0	83.0	
Millet	84.5	1.0	
Maize	62.0	106.0	
Cassava	35.5	7.50	
Groundnuts	21.0	17.0	
Peas	15.5	0.0	
Sweet potato	10.0	0.5	
Rice	3.0	0.0	
Banana	4.50	14.5	

* By one-way ANOVA or Chi-square

Table 4. Human assets among cotton growers, Pallisa and Kasese districts, 2002.

Variable	Pallisa (n=60)	Kasese (n=60)	*Sig.-level (P <)**
Household size (no.)	6.23	6.73	.4000
Adult males	1.50	1.85	.1362
Adult females	1.77	1.62	.4719
Children aged 7-14	1.05	1.33	.2741
Children aged 0-6	1.92	1.93	.9626
Highest education of household head			
- None	1	14	.0194
- Primary	33	28	
- 'O' level	19	13	
- 'A' level	2	3	
- Above 'A' level	5	3	
Age of household head			
7-14	0	1	.3540
15-49	30	35	
50 +	29	23	
Female-headed households (no.)			
Yes	8	16	.0679
No	52	44	
Family labour force [a]:			
- land preparation	3.01	2.29	.0331
- weeding	3.43	2.38	.0031
- harvesting	3.45	2.72	.0472
Adult male participation rates for cotton (%)			
- land preparation	81.8	72.9	.2031
- weeding	89.8	75.1	.0179
- harvesting	89.3	79.9	.1681
Adult female participation rates for cotton (%)			
- land preparation	89.1	78.4	.0595
- weeding	95.6	80.1	.0015
- harvesting	95.6	82.7	.0080
Children (7-14) participation rates for cotton (%)			
- land preparation	50.6	17.6	.0004
- weeding	64.2	18.8	.0000

- harvesting	73.1	29.7	.0000

* By one-way ANOVA or Chi-square

[a] Labour weights: adult male, 1.0; adult female, 0.8; child aged 7-14, 0.5.

Table 5. Physical assets among cotton growers, Pallisa and Kasese districts, 2002.

Variable	Pallisa (n=60)	Kasese (n=60)	*Sig.-level (*P <)**
Asset ownership			
- Bicycle	48	26	.0001
- crib	18	2	.0002
- farm store	36	7	.0000
- tin-roof house	33	37	.2139
- motorcycle	2	0	.1638
- radio	33	27	.4648
- radio-cassette	20	7	.0079
- TV	4	0	.0493
- Telephone	4	0	.0493
Livestock owned			
- Oxen	0.58	0.05	.0011
- cows	1.86	0.60	.0296
- goats	2.88	2.25	.2418
- pigs	0.31	0.58	.2715
- chickens	12.29	5.29	.0212

* By one-way ANOVA

Table 6. Sources of income among cotton growers, Pallisa and Kasese districts, 2002.

	Pallisa district	Kasese district	*Sig.-level (P <)**
Sources of cash income: (%)	67.7	88.7	.0000
- Own farm	32.3	12.1	.0000
- Off-farm			
Ranking of off-farm cash income:			
- Wage labour	0.14	0.32	.0688
- trading/business	0.59	0.54	.7218
- salary	0.24	0.19	.2674
- remittances	0.50	0.19	.0016
Ranking of on-farm sources of income			
- Cotton	1.26	1.05	.0149
- Other crops	1.96	1.90	.5037
- Livestock	2.70	2.97	.0106
Ranking of crops by cash income:			
Cotton	1.26	1.05	.0149
Coffee	-	2.12	-
Soya	1.80	2.54	.0133
Maize	2.22	2.50	.0768
Groundnuts	1.75	2.33	.3304
Banana	3.00	2.67	.5447
Cassava	2.35	-	-
Rice	2.33	-	-
Beans	2.40	2.69	.1890
Cotton production last season (kg)	499	1011	.0003
Income from cotton last season (2001A) (Sh.)			
- mean	137,350	234,414	.0065
- median	64,000	182,000	

* By one-way ANOVA or Chi-square

Table 7. Household food security among cotton growers, Pallisa and Kasese districts, 2002.

Variable	Pallisa (n=60)	Kasese (n=60)	*Sig.-level (*P <)*
Months of food insecurity	2.64	3.62	.0054
Households buying staple food in:			
Jan	7	20	.0021
Feb	11	18	.0845
Mar	28	23	.5451
Apr	47	13	.0000
May	44	9	.0000
Jun	16	8	.0999
Jul	2	24	.0000
Aug	0	28	.0000
Sep	0	23	.0000
Oct	0	16	.0000
Nov	0	12	.0002
Dec	1	6	.0381

* By one-way ANOVA or Chi-square

Table 8. Socio-economic indicators for demo- and non-demo-farmers, Pallisa and Kasese districts, 2002.

Indicator	Pallisa district			Kasese district		
	Demo	Non-Demo	*Sig.-level (P <)**	Demo	Non-Demo	*Sig.-level (P <)**
Household size (no.)	4.61	3.86	.2421	4.41	3.76	.1876
Family labour force (no.)	4.58	3.11	.0052	3.75	3.14	.1970
Area cultivated (acres)	8.70	3.86	.0000	5.80	5.00	.3854
Area planted to cotton (acres)	3.98	1.97	.0018	2.56	2.55	.9543
Area fallow (acres)	6.69	1.47	.0433	0.30	0.45	.5625
Highest education of household head						
- None	-	1	.1710	3	11	.0573
- Primary	13	20		17	11	
- 'O'-level	12	7		7	6	
- 'A'-level	2	-		2	-	
- Above 'A'-level	4	1		3	-	
Age of household head:						
7-14	-	-	.0497	-	1	.4266
15-49	12	18		18	17	
50 +	19	10		14	9	
- FHHs (no.)	3	5	.3891	5	11	.0387
Area planted to cotton (acres)	3.98	1.97	.0018	2.56	2.55	.9543
Asset ownership						
- bicycle	30	18	.0002	19	7	.0042
- ox-plough	12	1	.0007	-	-	-
- ox-cart	-	-	-	-	-	-
- crib	10	8	.6317	2	-	.1725
- farm store	24	12	.0024	7	-	.0073
- tin-roof house	20	13	.0912	20	17	.7775
- motorcycle	2	-	.1572	-	-	-
- car/vehicle	1	1	.9085	-	-	-
- radio	18	15	.5221	17	10	.1354
- radio-cassette	16	4	.0013	6	1	.0613
- TV	4	-	.0417	-	-	-
- Telephone	4	-	.0417	-	-	-
Livestock owned (no.)						
- oxen	0.90	0.24	.0242	0.10	-	.0949
- cows	2.97	0.72	.0049	1.14	-	.1610
- goats	3.53	2.21	.1066	2.83	1.62	.0683

- pigs - chickens	0.47 18.60	0.14 5.79	.4380 .0198	0.93 7.21	0.19 3.15	.0033 .0124
Months of food insecurity	2.37	2.93	.1189	3.76	3.46	.6240

* By one-way ANOVA or Chi-square

Table 9. Management practices for cotton, Pallisa and Kasese districts, 2002 season.

(non-demonstration cotton fields only)

Variable	Pallisa (n=79)	Kasese (n=66)	*Sig.-level (*P <)**
Area planted to cotton (acres)	3.01	2.57	
Distance to field (mins.)	12	85	.0000
Soiltype (no. fields)			
Black loam	35	64	.0000
Red loam	35	0	
Sandy	9	2	
Landtype (no. fields)			
Valley	8	5	.0000
Upland	39	1	
Plain	31	59	
Hill	0	1	
Rented (no. fields)			
- Yes	12	44	.0000
- No	66	22	
Median rent (shillings/acre)	40,000	20,000	.0000
Intercropped (no. fields)			
- Yes	44	8	.0000
- No	33	59	
Intercrops grown (no. fields):			
- Beans	30	8	.0004
- Maize	18	6	.0271
- Cassava	10	0	.0027
- Groundnuts	1	0	.3590
- Banana	0	0	na.
- Soya	0	2	.1192
- Millet	4	0	.0638
- Sorghum	1	0	.3590
Fertilised (no. fields)			
- Yes	1	1	.8980
- No	78	65	
Applied manure (no. fields)			
Yes	3	0	.1097
No	76	66	
Fallow previous year (no. fields)			
- Yes	55	1	.0000
- No	24	65	
Fallow period (yrs.)	2	-	-

* By one-way ANOVA or Chi-square

Table 10. Tillage and weed management for cotton, Pallisa and Kasese districts, 2002.

(non-demonstration cotton fields only)

Variable	Pallisa (n=82)	Kasese (n=67)	*Sig.-level (*P <)*
Land preparation (acres):			
- Hoe	21.5	74.0	.0000
- Oxen	129.5	0.0	
- Tractor	0.0	74.5	
- Zero tillage	0.0	0.5	
Weedings (no.):			
Mean	3.52	3.38	.3670
Median	4.00	3.00	
Mode	4.00	4.00	
Frequency of weeding (acres)			
- One weeding	0.0	0.0	.0389
- Two weedings	19.5	35.0	
- Three weedings	47.0	40.5	
- Four weedings	66.5	65.0	
- Five weedings	13.00	8.00	
- Six weedings	4.00	0.00	
Timing of weeding (weeks after planting):			
- First weeding	3.06	3.42	.2879
- Second weeding	7.17	6.97	.6491
- Third weeding	11.11	11.40	.6175
- Fourth weeding	14.49	14.08	.6442
Most troublesome weeds (no. of times reported)			Na.
Iranda	40 (22.9)		
Konete	24 (13.7)		
Lumbugu	21 (12.0)		
Masanda	18 (10.3)		
Kalala	15 (8.6)		
Kifunya	11 (6.3)		
Endesta		37 (20.6)	
Olutswamba		27 (15.0)	
Omisomi		17 (9.4)	
Kinyamate		14 (7.8)	
Ekidodo		11 (6.1)	
Endagho		10 (5.6)	

* By one-way ANOVA or Chi-square

Table 11. Pest management for cotton, Pallisa and Kasese districts, 2002.

(non-demonstration cotton fields only)

Variable	Pallisa (n=82)	Kasese (n=67)	*Sig.-level (P <)**
Household owns sprayer?			
- Yes	15	13	.2639
- No	45	47	
Sprays/field			
Mean	2.58	2.80	.2410
Median	3.00	3.00	
Mode	3.00	4.00	
Frequency of spraying (acres sprayed)			
- One spray	10.00	21.50	.0000
- Two sprays	38.50	44.00	
- Three sprays	71.50	20.00	
- Four sprays	17.00	46.00	
- Five sprays	8.00	0.00	
Timing of spraying (weeks after planting)			
- First spray	5.09	4.89	.7156
- Second spray	8.08	8.32	.6722
- Third spray	10.41	11.84	.0546
- Fourth spray	11.42	14.05	.0096
- Total expenditure on sprays (2000B season)			
- Mean	5921	14227	.0001
- Median	4000	10000	
- Mode	2000	9000	
Total expenditure on pump hire (2000B season)			
- Mean	4514	5772	.3218
- Median	2000	4000	
- Mode	1000	4000	.

* By one-way ANOVA or Chi-square

Table 12. Labour use for cotton in Pallisa and Kasese districts, 2002A season.

(percent, demo and non-demo cotton fields)

Variable	Pallisa			Kasese			*Sig.-level (*P <)**
	Family	Hired	Both	Family	Hired	Both	
Land preparation	28.0	43.7	28.3	48.5	22.0	29.4	.0000
Planting	35.8	27.6	36.6	60.2	14.0	47.5	.0000
Weeding							
- First	38.3	34.9	26.8	51.7	22.0	26.2	.0207
- Second	36.8	29.7	33.5	48.3	23.3	28.3	.1034
- Third	43.7	25.1	31.3	59.1	19.4	21.5	.0241
- Fourth	29.7	29.3	41.1	55.1	17.9	27.1	.0000
Spraying							
- First	50.7	28.8	20.5	61.1	44.5	9.6	.0194
- Second	51.6	27.0	21.4	53.9	48.5	11.2	.0399
- Third	37.2	37.2	25.6	52.9	46.5	11.2	.0000
- Fourth	31.5	36.8	31.6	38.0	43.5	11.1	.0000

* By one-way ANOVA or Chi-square

Table 13. Definition of variables used in regression analysis in Tables 14 and 15.

Variable	Definition
Table 10	
WTPLCODE	Time of finishing planting (week, weighted by area planted)
LPOXSHARE	Area planted to cotton prepared using ox-plough (%)
STAPLE	Months buying staple food (no.)
SEEDTIME	Dummy variable if household obtained cotton seed in time (1=Yes, 0 otherwise)
OWNSHARE	Land planted to cotton owned by farmer (%)
SHAREOFF	Off-farm income as share of total household cash income (%)
CFALLOW	Area planted to cotton preceded by fallow (acres)
DEMO	Dummy variable for demonstration farmer (1=Yes, 0 otherwise)
Table 2	
W2WAP	Time of finishing second weeding (weeks after planting)
DEMOPLOT	Dummy variable for demonstration plot (1=Yes, 0 otherwise)
AREACOTT	Area planted to cotton in 2002 (acres)
W2HIRED	Dummy variable if field weeded with hired labour (1=Yes, 0 otherwise)
W1WAP	Time of finishing first weeding (weeks after planting)
DISTRICT	Dummy variable for district (1=Pallisa, 2=Kasese)
RNKWEEDS	Farmers' ranking of weeds as factor limiting cotton yields (1=highest, 3=lowest)

Table 14. Regression analysis of determinants of time of planting, Pallisa district, 2002.

Variable [a]	Coefficient	T-value	Sig.-level
Dependent			
WTPLCODE			
Independent			
Constant	+15.313	6.768	.0000
LPOXSHARE	+0.021	2.048	.0461
STAPLE	+0.360	1.173	.2467
SEEDTIME	-2.429	-1.757	.0854
OWNSHARE	-0.013	-1.030	.3081
SHAREOFF	-0.029	-0.138	.8910
CFALLOW	-1.073	-1.951	.0569
DEMO	+0.174	0.167	.8678
R-bar^2	0.21		
DW-statistic	1.86		

[a] for definitions, see Table 9.

Table 15. Regression analysis of determinants of time of planting, Pallisa and Kasese districts, 2002.

Variable [a]	Coefficient	T-value	Sig.-level
Dependent			
W2WAP			
Independent			
Constant	6.594	9.549	.0000
DEMOPLOT	+0.607	1.808	.0729
AREACOTT	-0.218	-3.452	.0007
W1WAP	+0.963	12.427	.0000
W2HIRED	-0.384	-1.127	.2620
DISTRICT	+0.013	0.042	.9664
RNKWEEDS	-0.633	-3.031	.0029
R-bar^2	0..60		
DW-statistic	1.52		

[a] for definitions, see Table 9.

Table 16. Growers' perceptions of factors limiting cotton yields, Pallisa and Kasese districts, 2002.

Factor	Pallisa (n=60)	Kasese (n=59)	*Sig.-level (*P <)**
Farmers reporting (no.)			
Weeds	50	41	.0751
Diseases	9	3	.0725
Pests	40	49	.0395
Soil fertility	19	10	.0615
Weather	42	35	.2229
Lack of knowledge	2	9	.0247
Lack of inputs	11	24	.0074
Rank[a]			
Weeds	1.70	2.24	.0003
Diseases	1.89	3.00	.0384
Pests	1.95	2.20	.0918
Soil fertility	1.84	1.30	.1063
Weather	2.08	1.67	.0325
Lack of knowledge	2.00	2.33	.6618
Lack of inputs	1.91	1.46	.1291
Score[b]			
Weeds	7.80	7.02	.0848
Diseases	7.33	3.67	.0213
Pests	7.10	6.57	.2935
Soil fertility	7.58	9.10	.1362
Weather	5.90	8.21	.0004
Lack of knowledge	6.50	6.89	.8723
Lack of inputs	7.18	8.71	.0839

* By one-way ANOVA or Chi-square

[a] Ranks 1-3, 1=highest
[b] Scores 1-10, 10 = maximum

Table 17. Growers' sources of information on cotton pest management, Pallisa and Kasese districts, 2002 season.

Source of information on cotton	Pallisa district	Kasese district	*Sig.-level (*P <)*
	(n=60)	(n=59)	
Extension worker	39	51	.005
Radio	34	16	.001
Friends/neighbours	21	14	.1772
Written material	6	3	.3106
Own knowledge	35	1	.0000
Looking at other fields	18	10	.0933
Parents/family	34	9	.0000
Other	6	6	.9755
For non-demo farmers:	(n=29)	(n=27)	
- Heard about demo plot	28	25	.5108
- Visited demo plot	20	24	.0694
- Attended field day at demo plot	15	18	.2560
- Know farmer with demo plot	26	25	.7001

* By one-way ANOVA or Chi-square

Table 18. Farmers' handling of pesticides, Pallisa and Kasese districts, 2002.

Indicator	Pallisa district			Kasese district		
	Demo	Non-Demo	*Sig.-level (P <)**	Demo	Non-Demo	*Sig.-level (P <)**
Trained in use of pesticides?						
Yes	27	20	.0714	21	12	.0472
No	3	8		8	14	
Where do you store pesticides after use?						
- in store	21	16	.1135	6	3	.1104
- in house	2	6		9	15	
- box/cupboard/shelf	6	2		8	6	
- in roof/ceiling	1	4		5	0	
- other	0	1		1	1	
Farmers using the following when handling/applying pesticides						
- gloves	2	1	.5737	-	-	-
- mask	1	-	.3214	-	-	-
- overalls	1	-	.3214	1	-	.3393
- gumboots	9	1	.0066	10	5	.2048
Where do you wash sprayers/containers after application is complete?						
- in field	6	5	.4101	11	14	.4436
- river/stream	-	2		3	4	
- home/compound	23	18		14	7	
- well/borehole	1	2		1	1	
- don't wash	-	1				
Where do you dispose of used containers?						
- burn/bury	3	3	.6777	8	8	.0341
- latrine	16	14		12	3	
- field	6	4		9	15	
- house	4	4		-		
- other use	1	4		-		

* By Chi-square

Table 19. Costs and returns for cotton in Pallisa and Kasese districts, 2002.

Description		District	
Costs	Units	Pallisa (n=31)	Kasese (n=48)
Family labour [a]	Days/acre	41	39
- costs [b]	Uganda shillings	41,000	39,000
Of which:			
Weeding labour	Days/acre	24	14
Costs	Uganda shillings	24000	14000
Spraying labour	Days/acre	1	2
Costs	Uganda shillings	1000	2000
Hired labour	Uganda shillings	29,076	28,976
Of which:			
Weeding	Uganda shillings	7754	6566
Spraying	Uganda shillings	1865	2940
Pest control			
- insecticide	Uganda shillings	2977	5271
- hire of pump	Uganda shillings	1655	1911
Total – full cost basis [c]	Uganda shillings	74708	75158
Total – cash cost basis [d]	Uganda shillings	33708	36158
Benefits			
Yield (seed cotton) [e]	Kg/acre	200	700
Price [f]	shillings/kg	350	350
Gross revenues	Uganda shillings	70000	245000
Net returns			
- Full cost basis [c]	Uganda shillings	-4708	169842
- Cash cost basis [d]	Uganda shillings	36292	208842
Cost-benefit ratio			
- Full cost basis [c]		0.94	3.26
- Cash cost basis [d]		2.01	6.78

Notes:

[a] Standardised to 6 hours/day using weights of 1.0 for adults and 0.5 for children (aged <=15).
[b] using market wage rate of 1,000 shillings/day
[c] including cost of family labour
[d] excluding cost of family labour
[e] median, based on farmers' estimate of expected yield

[f] official producer price at start of the buying season (November, 2002).
1 US $ = 1875 Uganda shillings (November, 2002).

Table 20. Sensitivity analysis of costs and returns for cotton, Pallisa and Kasese districts, Uganda, 2002.

Case	Description	Yield (kg/acre)	Total variable cost (Sh/acre)		Gross benefits (Sh/acre)	b (S
			Labour	Materials		
A	*Allow CBR to change and hold labour and material costs constant (cash-cost basis)*					
	Pallisa	193	29076	4632	67416	3
	Pallisa	289	29076	4632	101124	6
	Pallisa	385	29076	4632	134832	1
	Kasese	207	28976	7182	72316	3
	Kasese	310	28976	7182	108474	7
	Kasese	413	28976	7182	144632	1
B	*Allow CBR to change and hold labour and material costs constant (full-cost basis)*					
	Pallisa	425	70076	4362	148876	7
	Pallisa	638	70076	4362	223314	1
	Pallisa	851	70076	4362	297752	2
	Kasese	429	67976	7182	150316	7
	Kasese	644	67976	7182	225474	1
	Kasese	859	67976	7182	300632	2

Appendix 1: Case Studies

"Low prices discourage production"….John Lugungo, Pallisa

Sixty-year-old John Clestom Lugungo of Kirume village Iki-Iki sub-county, Pallisa District is married to two women who have borne him five children. The family has been growing cotton ever since the 1950s. They assert that cotton has been beneficial to their household because:

- Cotton cultivation helps in preparation of a fine seedbed for other crops especially millet.
- Cotton's many leaves contribute to nutrient recycling.
- Over the years cotton has provided them with income to help meet household cash obligations as well as paying school fees for their children.
- Cash earnings from cotton were used to acquire goats for the home. Currently they own 3 goats, 2 cows and 4 turkeys.

The crop is currently regarded as the second most important contributor of cash in the household where beans were cited as number one and maize number three. The low price offered for seed cotton was cited as the main reason discouraging increased cotton production. Last year the cotton was sold at 250 shillings/kg, this year the indicative price has been set at 350 but according to the farmer a good price should range between 500 – 600 UGX. The cotton is sold to private buyers who often use faulty weighing scales further compounding the problem of low revenues from the crop. Cotton production is labour intensive hence the prevailing low prices do not adequately reimburse us for the time and energy put into cotton growing. Since once can not eat the seed cotton, the low prices offered make one to regret why they did not plant food crops which they could eat in case the prices are not favourable. For cotton you have to dispose of it as it causes a danger of catching fire.

Cotton is planted in lines using a spacing of about 60 x 15 cm and thinned to two plants per hill. Pests and weeds are the two major causes of yield loss on this farm.

Boll worms and termites were the two pests the farmer acknowledged having noticed affecting their cotton crop. They spray three times to control the pests and the decision to spray is partly influenced by wilting of some plants, presence of many flies in the cotton field and at a latter stage flower abortion. The first spraying is done immediately after the first weeding, second spray comes at flowering stage and the third spray is done to protect the new flowers emerging from the second flowering phase.

Weeding is the most labour intensive activity as the crop has to be weeded at least three times. Couch grass locally called *Lumbugu*, *Commelina Spp* locally called *Enada* and *Usanda* in that order of importance were cited as the most notorious weeds.

Land preparation, spraying and marketing are largely a domain of men while women take care of planting, thinning, weeding, harvesting and sorting.

"Our only true cash crop" ….. Abdul Nsenye, Pallisa.

Thirty five-year-old Nsemye Abdul of Katira village, Kakoli parish Iki-Iki sub-county, Pallisa District is married to one wife and lives with 10 other dependents. Abdul is working as a manager for a petrol station but he is also pursuing a bachelor's degree in Business Administration from the Islamic University in Uganda (IUIU) at Mbale. Abdul started growing his own cotton about 18 years ago when he was still living in his late father's home and has grown the crop ever since. He doubles as a cotton trader during the marketing season. Abdul noted that a he has realised several benefits from cotton:

- Cotton paid for my education
- Cotton helped to build my father's house, and even helped pay for my mother's marriage.
- Cotton enhances seed bed preparation for better production of other crops especially millet.
- Marketing of cotton coincides with the December festive season and goes on up to start of school calendar. The liquidity assured by cotton during the festive season helps the household head to provide for the home thereby minimising quarrels in the home due to failure of the husband to buy nice food items as well as garments for the wife and children.
- Proceeds from cotton grown on the farm as well as those from dealing in cotton enabled construction of an Iron roof house where the family stays.
- As a trader I am assured of some income every year from cotton.

The crop is currently regarded as the most important contributor of cash in the household followed by maize and beans. The disadvantages associated with cotton we highlighted as:-

- Absence of market for Fifi
- Cotton production is labour intensive especially weeding and sorting.
- Low prices discourage growers. A good price of about 500 UGX would minimise the effects of the first two disadvantages.

Despite these disadvantages, Abdul is not ready to quit cotton production arguing that it is the only true "cash crop" in the area with food crop being sold due to difficulties. Cotton ensures a source of cash because a household has no immediate alternative use for it other than selling it.

Cotton is planted in rows at a spacing of 3ft x 1ft and thinned to 2 plants per hill. Though Abdul has been advised to plant cotton in May, he argues that experience has taught him that cotton planted in July performs better due to changes in the weather pattern in the area. Cotton yields have experienced a downward trend moving from 700-800kg/acre in the 1970s, to 500-600 in the 1980s and 300-400 in the 1990s to date.

Bad weather especially long dry spells, weeds and pests in that order of importance were cited as the three most important causes of low cotton yields.

The cotton crop is weeded three times. Couch grass locally called *Lumbugu*, Black Jack locally called *Okalala* and *Commelina Spp* locally called *Irada* in that order of importance were cited as the most notorious weeds in cotton production.

Spraying varies from two-three times. Abdul does not see symptoms which influence his decision to spray but he does not know the causes of the symptoms whether insect pests or diseases. The symptoms include: falling of flowers; deformed leaves; yellowing of leaves; holes in leaves; wilting/withering of some plants; and the presence of many flies in the cotton field.

"No longer our main cash crop"…. Mugerwa Wilson, Pallisa

Thirty seven-year-old Mugerwa Wilison of Kabyonga village, Kakoli parish Iki-Iki sub-county, Pallisa District is married to one wife and God has blessed them with three children. Wilson stopped his studies in primary four and resorted to farming. He started growing his own cotton in 1989. Since then he only skipped growing the crop in 1993 due to sickness. In addition to growing cotton, he engages in its trading during the marketing season.

Wilson noted that he has realised several benefits from cotton enumerated as follows:

- He bought land using proceeds from cotton
- Bought two heads of cattle. The animals multiplied to four, then he sold two of them and used the proceeds to buy an additional piece of land. Currently he has a total of six acres, two cows, two goats and two chickens.
- Cotton contributes to soil fertility as it has plenty of leaves, which drop in the fields and decompose.
- Marketing of cotton coincides with the December festive season and goes on up to start of school calendar. Seasonality of the incomes comes at a time when their many pressing cash needs.
- Proceeds from cotton grown on the farm as well as those from dealing in cotton enabled construction of a three-roomed, iron-roofed house where the family stays.
- Cotton provided the start-up capital for him to engage in cattle trading.

The crop is still an important contributor of cash in the household though other crops take first place with regards to bringing in cash income to the household. The disadvantages associated with cotton we highlighted as:

- Cotton production is labour intensive and costly to produce
- Price is low. At least the farmer should receive per kg 700 UGX of his seed cotton.

Despite the disadvantages, Wilson says that because he is not educated he has to engage in cotton production in order to make ends meet.

Cotton yields have shown little change over the years having been 350 in 1998 decreasing to about 300 kg per acre in 2001. Weeds, pests, and unfavourable weather especially long dry spells in that orders of importance were cited as the three most notorious causes of low cotton yields.

Weeding is done four times using the hand hoe. He acknowledged having heard about herbicides but does not use them because of the fear that they destroy the soil. The most notorious weeds in cotton production were (in order of importance), couch grass locally called *Lumbugu*, *Jojokele* and *Commelina Spp* locally called *Irada*.

Spraying is normally made four times at three-week intervals. Wilson noted that he observes green insects on the brackets and presence of flies on the leaves and this influences his spraying. He does not count the insects or know for certain that they are the causes of yield loss.

"A stable cash income"…. Emmanuel Kasitu, Kasese

Thirty two-year-old Emmanuel Kasitu has to migrate from Katalemba village, Kalonge parish Kyalumba sub-county, Kasese district to the low lands where he rents land for his cotton production. Emmanuel who has never entered a classroom has three wives and a total of 12 children, the oldest being 15 years. He has been growing cotton for the last 10 years and every year he leaves his family in the mountains to come down to the plains to grow cotton. Cotton provides income to meet household cash obligations and Emmanuel cited having constructed an iron roofed house, bought five acres of land in 1998 and a bicycle using proceeds from cotton.

Asked whether he considered abandoning cotton production, Emannuel declared that instead would like to increase cotton production. Despite the fact that the prices are low and the crop is labour intensive, it generates more stable revenue unlike the food crops (maize or beans) whose prices can fluctuate to as low as 50 shillings/kg.

Cotton is planted in rows at a spacing of 3ft x 1ft and thinned to 3 plants per hill. It is intercropped with beans as well as some maize scattered here and there. Cotton yields have started to go up due to change in management practices as he got advice from extension workers. Now he applies pesticides to control pests and uses good spacing.

Weeds and pests in that order of importance were cited as the most important causes of low cotton yields. Weeding cotton is normally done five times while spraying is normally done four times though he may spray twice if he does not have the money to purchase pesticides.

He sprays largely because this is a routine activity that has to be done on cotton. Nevertheless he is also influenced by presence of black small insects similar to those found on beans, as well as the boll worms (green) and red cotton stainers which turn cotton into inferior grade called FiFi. The first spray is done after the first weeding, the second spray just before flowering, and the third spray at the time of square formation. The fourth spray is given at the time of boll formation and this is intended to stop insects from boring into the bolls.

Emmanuel has rented four acres for cotton this year at a 10000 shillings/acre. Water for spraying is sourced from a long distance. It takes almost 90 minutes to get to the stream and back to the field. Sprayers are hired at a rate of 1000/= shillings per acre. They at times receive credit from traders to manage the crop; the traders are in return paid using the cotton but valued at lower prices.

The hidden costs of cotton production… Adrea Bisongo, Kasese

Fifty four-year-old Adrea Bisongo, educated up to primary four, has been growing cotton from 1967 until the present day. Adrea is the father of 27 offspring. He owns two acres of land in the mountains where he lives in a family of 13 people (himself, two wives, and 10 children). The family owns three goats, one rabbit and five chickens. Every year he leaves his family in the mountains to come down to the plains where he rents land to grow cotton. This season he rented 3 acres of land at a rate of 10,000 shillings/acre.

Adrea notes that the cotton crop has been instrumental in providing for the welfare of his family. Specifically the benefits were cited as follows:

- Cotton provides income to meet household cash obligations including clothes, and household utensils.
- He gets the money to pay graduated tax from cotton.
- He was able to build an iron roofed house using proceeds from cotton
- Cotton enabled him to meet the school dues for his children.

He cited low prices as the only issue that dismayed him with regards to cotton. He says he continues to engage in cotton production because cotton gives him better returns compared to other crops.

He grows cotton as a sole crop planted at a spacing of 3ft x 1.5ft and thinned to 3 plants per hill. He notes that yields were about 500 in the 1970s before declining to 400kg/acre in the 1980s and early 1990s. In the last couple of years, cotton yields have increased to 600kg/acre. He attributes the increase in yield to the fact that he started spraying his cotton which was not the case in the 1970s and 1980s.

He cited a number of constraints affecting his cotton production. First on the list is the issue of lack of food to eat in the low lands. Since he only migrates alone at the time of cotton production leaving his family and all the food at home, he finds it difficult to get enough food in the low lands where food items are sold. In order to make ends meet he often resorts to sale of labour. This is compounded by distance to the water source. At his age walking three miles one way to the water source only serves to increase his drudgery. Finally, they have to rent the land and at times of poor yields and low prices, he may end up only getting enough money to cover the rent.

Weeds and pests were cited as the most important limitations on yield. Weeding cotton is normally done five times using the hand hoe. while spraying is normally done three times. He acknowledged having heard about herbicides and he knows that they are available in Kasese town but cited lack of money as the reason for not using them. Couch grass locally called *Olutswamba*, *Cynodon Spp* locally called *Omuhanga Bogho*, *Bidens Pilosa* locally called *Omusoni* as well as another weed locally called *Nyabalasa* were cited as the most notorious weeds in cotton production.

Adrea normally sprays three times. He sprays largely after noticing some insects on the cotton. He cited seeing brownish worm like insects on the squares, presence of black small insects on the leaves, as well as yellow insects on the leaves. Sprayers are hired at a rate of 1000/= shillings per acre.

Adrea is aware about the presence of a cotton demonstration plot and has visited it. But he is not aware of the treatments applied to the plot though he recognised that the cotton in the demo exhibited fast growth and stems were strong and vigorous compared to his