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Harnessing Opportunities for Productivity Enhancement for Sorghum & Millets (HOPE): Baseline Survey, Uganda

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Abstract

A survey was conducted in 2015 to provide baseline information for HOPE project activities for finger millet in Uganda. The sample comprised 94 treatment and 96 control households from Serere and Lira districts. The majority of treatment households (52%) had adopted improved varieties of finger millet in the main season (March-July), compared to just 10% of households in the control group. Farmers' top three trait preferences were for high yield, early maturity/drought resistance, and marketability. About 60% of finger millet production was sold. Farmers' top three perceived constraints on finger millet related to marketing, including low prices, price fluctuations, and high transport costs. Decisions about crop sales and use of income from the sale of finger millet were not made exclusively by men but mostly shared. About one-third of households in the treatment group had participated in project activities and received small seed packs. Gross margin analysis showed that, on a full-cost basis, improved varieties were profitable (UGX 130,000 /acre) while local varieties were unprofitable (UGX -530 /acre). On a cash-cost basis the gross margin for improved varieties (UGX 240,402/acre) was three times higher than for local varieties (UGX 9,223 /acre).

Keywords: HOPE, Uganda, finger millet, improved varieties, Small Seed Packs

JEL classification: Q160

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Acronyms

BMGF	Bill & Melinda Gates Foundation
ESA	Eastern and Southern Africa
FCS	Food Consumption Score
HOPE	Harnessing Opportunities for Productivity Enhancement
Kgs	Kilograms
NaSARRI	National Semi-Arid Resources Research Institute
ODK	Open Data Kit
SAARI	Serere Agricultural and Animal Research Institute
SPSS	Statistical Package for the Social Sciences
SSP	Small Seed Pack
UGX	Uganda Shilling
USD	United States Dollar
WFP	World Food Programme

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1 Introduction

This study was conducted as one of three country-specific baseline assessments to provide a broad overview of the production and marketing of sorghum and millets in Eastern and Southern Africa (ESA). Reports for the baseline surveys conducted in Tanzania and Ethiopia are available (Schipmann *et al.*, 2013; Adam *et al.*, 2012). The present survey was designed to provide background information on finger millet production in areas where ICRISAT and the Serere Agricultural and Animal Production Research Institute (SAARI) are conducting research on finger millet as part of a project called Harnessing Opportunities for Productivity Enhancement for Sorghum & Millets (HOPE) funded by the Bill & Melinda Gates Foundation (BMGF).

The general objective of this survey is to provide a baseline against which to measure the impact of project activities. Specifically, the survey objectives were to measure:

1. The adoption of improved varieties of finger millet;
2. Farmers' trait preferences;
3. Farmer's perceptions of production and marketing constraints; and
4. The profitability of improved varieties of finger millet.

2 Methods

2.1 Sampling framework

The aim of the survey was to establish a baseline to measure the impact of HOPE project activities. This required the selection of a sample of households that had been exposed to HOPE interventions (the treatment group) and a sample of households that had no exposure to project activities (the control group).

Project activities were concentrated in two research areas: eastern and northern Uganda. Four villages were selected from each region: two treatment villages where HOPE activities were underway and two control areas. Village elders provided a listing of households in each village, which was used to select a random sample of households for survey. A total sample of 94 treatment households and 96 control households were interviewed.

In Eastern Uganda, activities were concentrated in the former Soroti district, which has now been sub-divided with the former counties split into new districts with sub-counties. Soroti was split into six districts: Soroti, serere, Kumi, Ng'ora, Kaberamaidu, and Amoria. The districts where HOPE had much activity were Serere, Kaberamaidu, and Kumi. In the new Serere district where most HOPE activities were concentrated, the sub counties with most project activities were Atiira, Kyere, and Oklonyo. The sub-counties with minimal HOPE activities were Bugondo and Pingile, while those with no HOPE activities were Kateta, Adungol, and Laboro. Two villages in Serere district with most project activity were selected as treatment areas, namely Omugenya village in Asilang parish, Atiira Sub County, and Udoo village in Abuket parish, Kyeere sub-county. Kateta subcounty in Serere district was selected as a control, and two villages in Kateta parish – Kateta Moru and Chwi – were selected as control villages.

In northern Uganda, project activities were concentrated in the former Lira district. Two villages in the larger Lira district were selected as treatment areas. Apami village in Banya parish, Amach sub county. The second was Kuluyago village in Telela parish, Ayier sub county, Kole district. A neighboring sub-county to the treatment area in Kole district was selected as a control area where there were no HOPE activities. Apala village in Apuru parish, Aboke Sub County and Abwor village in Aboke parish were selected.

Because of language differences in Lira and Serere, we employed different enumerators in the two areas.

2.2 Analysis and Reporting

ICRISAT provided the enumerators with training in electronic data collection (ODK). The survey was conducted in April-May 2015. The survey captured information for the agricultural year 2014. The data was transformed and exported to Statistical Package for Social Sciences (SPSS), cleaned and analyzed. A set of master tables was prepared to summarize the most relevant survey data using descriptive statistics (cross-tabulation methods and ANOVA/ Chi-square tests).

3 Results

3.1 Sampled households

Among the sampled households in the treatment area, 79 (84%) of the farmers were finger millet growers, there was almost a similar percentage of finger millet growers in the control area 80 (83.3%) (Table 1).

Table 1: Sample households (no.)

Region	District	Village	Treatment Households	Control households	Total
Total number of households					
Eastern Uganda	Serere		24	0	24
		Omugenya			
		Odoo	19	0	19
			0	41	41
		KateteMoru			
		Chwi	0	9	9
Total for Eastern Uganda			**43**	**50**	**93**
Northern Uganda	Lira	Apami	26	0	26
	Kole	Kuluyago	25	0	25
		Apala	0	25	25
		Abwor	0	21	21
Total for Northern Uganda			**51**	**46**	**97**
Total sampled households			**94**	**96**	**190**

Total number of Finger millet growers					
Eastern Uganda	Serere		23	0	23
		Omugenya			
		Odoo	17	0	17
			0	38	3
		KateteMoru			
		Chwi	0	8	8
Total for Eastern Uganda			**40**	**46**	**86**
Northen Uganda	Lira	Apami	17	0	17
	Kole	Kuluyago	22	0	22
		Apala	0	17	17
		Abwor	0	17	17
Total for Northern Uganda			**39**	**34**	**73**
Total No. of growers			**79**	**80**	**159**

3.2 Socioeconomic characteristics

Table 2 summarises the socioeconomic characteristics of the sampled households in the treatment and control areas. The majority of the households in both the treatment (68 %) and control areas (80%) were headed by men. The age of the household head was not significantly different between the treatment (44.6 years) and control households (46.5 years). The average household size was 6.9 family members with control areas reporting a household size of 6.99 and treatment areas 6.81. The number of adults (aged over 15 years) averaged 3.6 members per family, with treatment households having 3.49 and control households 3.76 adults. The number of children (aged below 15 years) averaged 3.3 for both treatment and control households. The average years of formal education of the household head averaged 6.3 years with treatment households reporting an average of 6.06 and control households 6.5 years. The main primary occupation among both treatment and control households was farming (over half of the respondents), followed by off-farm self-employment (14% of treatment and 10% of control households). Households in the control areas owned significantly more land than those in the treatment areas: the average farm size was 4.7 acres and 3.8 acres respectively, which was significantly different at the 90% confidence level. Over 90% of the households in both treatment (93.7%) and control areas (96.3%) owned livestock. However, significantly more households in control areas owned cattle (71.3 %) compared to those in treatment areas (58.2%). Seventy-six percent of households in the control areas also owned goats as compared to 68 % in treatment areas. Half of the sampled households have at least one member of their household holding a leadership position in the community: 51% of households in the control areas and 49% in the treatment areas. Finally, households in the treatment areas reported a significantly higher number of years of experience in finger millet production (24.4 years) as compared to control areas who reported 17.6 years (significantly different at 99% confidence level).

Table 2. Socio-economic profile of sample households (finger millet growers only).

Variables	Treatment (n=79)	Control (n=80)	Total (n=159)
Households (no)	79 (49.7%)	80 (50.3%)	159
Sex of household head			
Female	25 (31.65%)	16 (20%)	41 (25.79%)
Male	54 (68.35%)	64 (80%)	118 (74.21%)
Age of HH (years)	44.62	46.45	45.54
Household size	6.81	6.99	6.90
Number of Adults (>15)	3.49	3.76	3.63
Number of Children (15 years & below)	3.32	3.2	3.26
Average education (years)	6.06	6.53	6.30
Primary Occupation (%)			
Farming	49 (62.02%)	56 (56%)	105
Salaried employment	5 (6.33%)	8 (10%)	13 (8.18%)
Self-employment of-farm	11 (13.92%)	8 (10%)	19 (11.95%)
School/college child	2 (2.53%)	7 (8.75%)	9 (5.7%)
Household chores	2 (2.53%)	1 (1.25%)	3 (1.9%)
Casual labourer off-farm	2 (2.53%)	1 (1.25%)	3 (1.9%)
Elderly/aged	5 (6.33%)	2 (2.5%)	7 (4.4%)
Average farm size (ha)	3.8	4.7*	4.2
Households owning livestock (%)	74 (93.7%)	77 (96.25%)	151 (95.0%)
Owning cattle (%)	46 (58.23%)	57* (71.25%)	103 (64.78%)
Owning goats (%)	54 (68.35%)	61 (76.25%)	115 (72.32%)
Community responsibility	39 (49.37%)	41 (51.25%)	81 (50.94%)
Years of experience growing finger millet (no.)	17.61	24.38***	21.01

**** 0.001, **0.05, * 0.1 significance level*

3.3 Finger millet varieties and production

Table 3 presents results for the number of households growing different finger millet varieties and the areas planted in the first season (March – July) and the second season (August – November) in 2014. In the first season, the majority of households in both the treatment and control areas grew local varieties of finger millet. Three quarters of the households in the control area (75.64%) and half of the households in the treatment area (51.9%) planted local finger millet. Among the treatment group, 39 farmers (52%) had adopted improved varieties compared to just eight farmers (10%) in the control group. In the first season, there were five improved varieties planted in the treatment area and only two improved varieties in the control area. The most popular improved variety in both treatment and control areas was Seremi, with 33.3% and 7.6% of the households planting this variety, respectively. The second most popular improved variety was Engenyi, which was planted by 13.3% of households in the treatment area and by 2.6% in the control area. A number of households planted finger millet varieties whose names they did not know (7.6% in the treatment and 15.4% in the control area, respectively). The average area planted to finger millet in the first season was around one acre or slightly lower for each of the varieties except for an area of 3.5 acres reported in the treatment area for Seremi 3. No significant differences were found in the area planted to finger millet between treatment and control areas in the first season.

In the second season, both the treatment and control areas planted local varieties and two improved varieties each (Table 3). Among the treatment group, 13 farmers (59%) had adopted improved varieties compared to two farmers (17%) in the control group. Generally, fewer farmers planted finger millet in the second season than in the first season. For the treatment area, the majority of the households (54.6 %) planted Seremi 2, followed by local varieties (31.8 %). In the control area, half of the respondents planted a variety they did not know while 33.3% planted local varieties. Each of the two improved varieties planted in the control area was planted by a single farmer. Generally, the area allocated to each variety was one acre or below, except for 0.4 acre reported for an unknown variety in the control area.

Table 3: Varieties of finger millet grown and area planted

Varieties	Number growing			Area planted		
First season (Mar-July)	*Treatment n=75*	*Control n=78*	*Total n=153*	*Treatment n=75*	*Control n=78*	*Total n=153*
Engenyi	10 (13.33%)	2 (2.56%)	12 (7.84%)	1.03	1.0	1.02
Seremi 2	25 (33.33%)	6 (7.69%)	31 (20.26%)	0.95	1.0	0.96
Seremi 3	2 (2.67%)	-	2 (1.3%)	3.5	-	3.5
P224	1 (1.3%)	-	1 (0.65%)	0.7	-	0.7
U15	1 (1.3%)	-	1 (0.65%)	1.0	-	1.0
Local variety	41 (51.9%)	59 (75.64%)	100 (65.36%)	0.8	0.91	0.86
Variety unknown	6 (7.59%)	12 (15.38%)	18 (11.76%)	1.3	0.99	1.1
Second season (Aug-Nov)	*Treatment (n=22)*	*Control (n=12)*	*Total (n=34)*	*Treatment (n=22)*	*Control (n=12)*	*Total (n=34)*
Engenyi	-	1 (8.3%)	1 (2.94%)	-	1.0	1.0
Seremi 2	12 (54.55%)	1 (8.3%)	13 (38.24%)	0.76	1.0	0.78
U15	1 (4.54%)	-	1 (2.94%)	1.0	-	1.0
Local variety	7 (31.82%)	4 (33.33%)	11 (32.35%)	0.74	0.78	0.75
Unknown variety	2 (9.1%)	6 (50%)	8 (23.53%)	0.75	0.41	0.49

Table 4 presents the main sources of seeds for the particular finger millet varieties grown in first and second seasons in 2014. In the first season, most farmers (50%) sourced Engenyi seed through exchanges of seed with other farmers, which mainly included friends, neighbours and relatives. The second main source of Engenyi seed was own saved seed (33.3%) followed by local grain trader (16.7%). The main source of Seremi 2 seed was SHEARS[1] sourced by 60% of the farmers followed by farmer to farmer seed exchange (20%) and Victoria Seed Company[2] (11.4%). During the first season only a single farmer planted the variety P224,

[1] A civil organization that works with farmer groups to disseminate seed to farmers.

[2] A local seed company, a partner of HOPE project that disseminates seed through farmers groups.

which she sourced from a fellow farmer. Similarly, two of the farmers who planted U15 also sourced the seed from fellow farmers. For local varieties in the first season, the majority of farmers (61.4%) used their own saved seeds, with 27.3% sourcing through farmer exchanges, and 11.4% from local grain traders. Of the farmers that grew unknown varieties, the majority (43.8%) acquired seed through farmer to farmer exchange with a similar percentage (43.8%) using their own saved seeds.

In the second season, of the two farmers who planted the Engenyi variety, one sourced seed from a local grain trader and the other from a fellow farmer. For the variety Seremi 2, both the farmers sourced seeds from fellow farmers. Of the farmers who planted local varieties in the second season, the majority used their own saved seeds (64.7%), while 17.6% sourced seed from local grain traders and a similar percentage (17.6%) from farmer to farmer seed exchange. In the second season only one farmer planted an unknown variety, which was acquired from a local grain trader.

Table 4: Main sources of seeds for finger millet in 2014

Variety	Local grain trader	Farmer to farmer seed exchange	Agro dealers /seed stockist	Own saved seed	NaSARRI	SHEARS	Victoria seeds	Total
First Season (March-July) (n=152)								
Engenyi	2 (16.7%)	6 (50%)	0	4 (33.3%)	0	0	0	12 (100%)
Seremi2	0	7 (20%)	0	1 (2.9%)	2 (5.7%)	21 (60%)	4 (11.4%)	35 (100%)
P224	0	1 (100%)	0	0	0	0	0	1 (100%)
U15	0	1 (100%)	0	0	0	0	0	1 (100%)
Local variety	10 (11.5%)	24 (27.6%)	0	53 (60.9%)	0	0	0	87 (100%)
Variety unknown	1 (6.2%)	7 (43.8%)	1 (6.2%)	7 (43.8%)	0	0	0	16 (100%)
Total	13 (8.6%)	46 (30.3%)	1 (0.7%)	65 (42.8%)	2 (1.3%)	21 (13.8%)	4 (2.6%)	152 (100%)
Second season (Aug-Nov) (n=22)								
Engenyi	1 (50%)	1 (50%)	0	0	0	0	0	2 (100%)
Seremi 2	0	2 (100%)	0	0	0	0	0	2 (100%)
Local variety	3 (17.6%)	3 (17.6%)	0	11 (64.7%)	0	0	0	17 (100%)
Variety unknown	1 (100%)	0	0	0	0	0	0	1 (100%)
Total	5 (22.7%)	6 (27.3%)	0	11 (50%)	0	0	0	22 (100%)

Table 5 presents results for the volumes and prices of seed sourced in the first and second seasons of 2014. In the first season, the quantity of seed sourced ranged from 9.5 to 5.0 kg, with the highest volume for Engenyi (95 kg) followed by Seremi 2 (9.4 kg) and local varieties (8.9 kgs). P224 and U15 had the lowest volumes in the first season of 5.0 kg each. The prices of seed in the first season differed significantly between varieties (*p-value*=0.000) with Seremi 2 having the highest prices (2308 UGX/kg) followed by P224 (2000 UGX/kg). The lowest seed prices were for local varieties (435 UGX/kg) followed by unknown varieties (916 UGX/kg).

In the second season, the quantity of seed sourced was much lower than for first season ranging from 2.8 to 7.0 kg. The highest price was paid for the variety Engenyi (1000 UGX/kg) followed by local varieties (676 UGX/kg). Seremi 2 was distributed free so no price was captured.

Table 5: Quantities and prices of finger millet seed varieties

Variety	First Season (n=152)		Second Season (n=34)	
	Quantity (Kg)	Price (UGX/Kg)	Quantity (Kg)	Price (UGX/Kg)
Engenyi	9.5	250.0	6.8	1000
Seremi 2	9.4	2308.6	2.8	0.0[3]
P224	5.0	2000.0	-	-
U15	5.0	1000.0	-	-
Local variety	8.9	435.6	5.8	676.5
Variety unknown	6.7	912.4	7.0	0.0
Total	8.8	916.4	5.7	613.6
p-value	0.997	0.000***	0.989	0.129

Exchange rate: 1 USD = 2,600 UGX

Table 6 ranks the varietal traits that farmers consider important for finger millet. Farmers were asked to mention the traits they considered when selecting finger millet seeds, which have been presented in 'Tick for yes' column in Table 6. They were also asked to rank the three most important traits. A sum of ranks was calculated by multiplying the ranks with respective weights. Rank 1 was given a weight of 1, rank 2 a weight of 0.8, and rank 3 a weight of 0.6. The weighted scores were then summed to get the sum of ranks. The traits that farmers considered most important were yielding capacity/high yield. The majority of farmers (79%) ticked yes for yielding capacity trait was also ranked as the most important trait with a sum of ranks of 65.3%. Early maturity was the second most important trait as reported by 67% of the farmers and with a sum of ranks of 42.5%. The third most important trait was drought resistance, reported by 45% of the households and with a sum of ranks of 25.4%. Resistance to lodging, browning of grain, resistance to pests, resistance to bird damage were considered the least important traits respectively, with a sum of ranks less than 2% for each of the traits.

[3] Price is zero as the seeds were distributed for free.

Table 6: Variety traits considered when selecting finger millet seeds to plant (n=159)

	Tick for yes	Rank 1	Rank 2	Rank 3	Sum of Ranks
Yielding capacity/High yielding	125 (79%)	68 (42.8%)	38 (23.9%)	9 (5.7%)	103.8 (65.3%)
Early maturity	106 (67%)	34 (21.4%)	30 (18.9%)	16 (10.1%)	67.6 (42.5%)
Drought resistance	72 (45%)	13 (8.2%)	19 (11.9%)	21 (13.2%)	40.8 (25.7%)
Marketability	60 (38%)	8 (5.0%)	15 (9.4%)	9 (5.7%)	25.4 (16%)
Grain size	58 (36%)	10 (6.3%)	12 (7.5%)	9 (5.7%)	25 (15.7%)
Taste/aroma	50 (31%)	5 (3.1%)	10 (6.3%)	15 (9.4%)	22 (13.8%)
Good for brewing	35 (22%)	2 (1.3%)	8 (5.0%)	6 (3.8%)	12 (7.5%)
High flour quality	43 (27%)	5 (3.1%)	3 (1.9%)	7 (4.4%)	11.6 (7.3%)
Colour	42 (26%)	4 (2.5%)	4 (2.5%)	6 (3.8%)	10.8 (6.8%)
Multiple tillers	14 (9%)	4 (2.5%)	-	4 (2.5%)	6.4 (4.0%)
Tolerant to much rain	32 (20%)	-	3 (1.9%)	5 (3.1%)	5.4 (3.4%)
Resistance to diseases	24 (15%)	1 (0.6%)	4 (2.5%)	1 (0.6%)	4.8 (3%)
Fair price/Affordable	26 (16%)	-	4 (2.5%)	2 (1.3%)	4.4 (2.8%)
Availability of seed	30 (19%)	1 (0.6%)	1 (0.6%)	4 (2.5%)	4.2 (2.6%)
Resistant to *striga*	22 (14%)	1 (0.6%)	1 (0.6%)	3 (1.9%)	3.6 (2.3%)
Less labour demand	11 (7%)	1 (0.6%)	-	4 (2.5%)	3.4 (2.1%)
Resistance to bird damage	15 (9%)	-	3 (1.9%)	1 (0.6%)	3 (1.9%)
Resistance to pests	27 (17%)	1 (0.6%)	-	3 (1.9%)	2.8 (1.8%)
Browning of grain	15 (9%)	1 (0.6%)	1 (0.6%)	1 (0.6%)	2.4 (1.5%)
Resistance to lodging	2 (1%)	-	-	-	2 (1.3%)

3.4 Finger millet utilisation

Table 7 presents results for the utilization of finger millet harvested in the first and second season of 2014. On average, the quantity of finger millet harvested was higher in the first season (95 – 215 kg) compared to second season (139-157 kg). Generally, the results show that finger millet harvested was primarily used for sale, with around 60% of the total output being sold in both first and second seasons. The next main use was for home consumption, with an average of 42 kg and 25 kg consumed in the first and second seasons, respectively. Thus, around 20% of the total harvest was used for consumption. Finger millet kept for seed ranged from 6 to 9 kg, representing around 5% of the total harvest. In the first season, the control area had a significantly higher volume of finger millet left over compared to the treatment area (*p*-value=0.05). Left-over finger millet was either used for future consumption, sold or maybe given as gift. However, the use of the millet left over at the time of the survey was not yet established.

Table 7: Average quantities utilized per household (finger millet growers only)

	Season 1 (March-July)			**Season 2 (August-Nov)**		
Quantities (Kgs)	Treatment n=75	Control n=78	Total n=153	Treatment n=20	Control n=14	Total n=34
Total harvested	195.9	215.0	205.7	157.5	139.8	150.2
Sold	124.3	122.8	123.5	120.3	68.9	99.1
Saved for seed	7.3	9.2	8.3	6.3	8.0	7.0
Gift	4.3	3.9	4.1	1.3	0.07	0.8
Labour payment	6.6	3.2	4.9	2.8	3.6	3.1
Ceremonies(bride price/wedding)	0.4	1.5	0.9	0.9	0.0	0.5
Home brewing	4.4	1.4	2.9	3.5	-	2.1
Home consumption	41.2	47.9	44.6	17.8	32.8	23.9
Left Over	7.6	24.8**	16.4	4.8	26.4	13.7

**** 0.001, **0.05, * 0.1 significance level*

Table 8 presents results for quartile analysis of finger millet sales in kilograms (kg) by farm sizes for both treatment and control farmers. In the first season, there were no significant differences in finger millet sales between the two groups, irrespective of farm size. However, the finger millet sales were higher among the treatment farmers than control in for all the farm size quartiles except r farm size quartile 3. Similarly in the second season, finger millet sales were higher in all the farm size quartiles except quartile 3. Moreover, there were some significant differences amongst farmers with the smallest farms. Farmers with the smallest farm sizes in the treatment area sold higher volumes of finger millet (31.9 kg) than those in control areas (5.2 kg). The difference was statistically significant at the 95% confidence level. Overall, the second season saw farmers in the treatment area selling more finger millet (32.1 kg) as compared to those in control areas (12.4 kg) irrespective of farm size.

3.5 Finger millet sales and marketing

Table 8. Total quantity of finger millet sold by farm size, by quartiles

Season 1 (March-July)	*Treatment (n=75)*	*Control (n=78)*	*Total (n=153)*	*P-value*
I (smallest)	122.6	82.8	104.3	0.246
II	83.2	122.8	100.3	0.242
III	111.5	101.5	105.2	0.775
IV (largest)	216.7	190.2	201.0	0.719
Total	124.3	122.8	123.5	0.947
Season 2 (August-Nov)	*Treatment (n=20)*	*Control (n=14)*	*Total (n=34)*	*P-value*
I (smallest)	31.9**	5.2	19.8	0.047
II 2	26.1	3.3	14.7	0.270
III 3	7.5	25.0	18.6	0.503
IV (largest)	55.8	25.0	38.8	0.436
Total	32.1*	12.4	22.0	0.074

Respondents were asked to highlight the constraints they face in marketing of finger millet, and rank the three main constraints in order of priority (Table 9). As in Table 7, a sum of ranks for each constraint was calculated summing the weighted ranks. Table 9 shows that the main constraint to marketing finger millet was low prices, with a sum of ranks of 74.8%. The majority of the farmers cited this as their main constraint because the labour requirement for finger millet production was considered to be high in relation the sale price. The second most important constraint was price fluctuation (30.6%). Lack of predictability and stability in prices makes it difficult for farmers to sell their finger millet for good returns. The third main constraint is that brokers fix the prices (17.5%), ie. buyers determine prices and farmers are only price takers with little or no bargaining power. Constraints with regard to access to market information were ranked as least important. Lack of information about buyer preferences, lack of information about prices, and lack of information about places where to sell had the lowest sum of ranks respectively (below 10%).

Table 9: Major constraints/limitations in selling finger millet (n=159).

Constraints	Rank 1	Rank 2	Rank 3	Sum of Ranks
Low price	98 (61.6%)	15 (9.4%)	15 (9.4%)	119 (74.8%)
Price fluctuations	12 (7.5%)	33 (20.8%)	17 (10.7%)	48.6 (30.6%)
Broker fixes the price	10 (6.3%)	17 (10.7%)	7 (4.4%)	27.8 (17.5%)
High transport costs	6 (3.8%)	18 (11.3%)	11 (6.9%)	27 (17%)
Lack of transport to the market	5 (3.1%)	20 (12.6%)	5 (3.1%)	24 (15.1%)
Need to travel long distances	8 (5.0%)	5 (3.1%)	12 (7.5%)	19.2 (`12.1%)
Low demand for finger millet	2 (1.3%)	13 (8.2%)	6 (3.8%)	16 (10.1%)
Lack of information about places where to sell	6 (3.8%)	4 (2.5%)	8 (5.0%)	14 (8.8%)
Lack of information about prices	1 (0.6%)	5 (3.1%)	6 (3.8%)	8.6 (5.4%)
Lack of information about buyer preferences	1 (0.6%)	2 (1.3%)	4 (2.5%)	5 (3.1%)

3.6 Participation in HOPE project activities

Farmers participated in HOPE activities mainly through project field days and demonstration activities which were conducted in the treatment areas. Table 10 gives a breakdown of the farmers who have participated in HOPE activities since 2010. As expected, a significant number of respondents in the treatment area (37%) participated in HOPE activities as compared to those in control areas (1%).

Table 10: Participation in finger millet HOPE activities in the last 5 years (2010-2014)

	Treatment (n=93)	Control (n=96)	All households (n=189)
Yes	34*** (36.56%)	1 (1.2%)	35 (18.52%)
No	59 (63.3%)	95 (98.96%)	154 (81.48%)
Total	93 (49.2%)	96 (50.8%)	189 (100%)

**** 0.001, **0.05, * 0.1 significance level*

Farmers were also asked if they had had access to Small Seed Packs (SSPs) in the last five years (Table 11). Again, significantly more farmers in the treatment area had accessed SSPs than farmers in the control area (33% and 2%, respectively. This is unsurprising since SSPs were often distributed during field days held in treatment areas. Some treatment farmers also received SSPs for use in the project's demonstration plots.

Table 11: Access to a finger millet Small Seed Pack in last 5 years (2010-14).

	Treatment (n=93)	**Control (n=96)**	**All households (n=189)**
Yes	31**	2	33
	(33.33%)	(2.08%)	(17.46%)
No	62	94	156
	(66.67%)	(97.92%)	(82.54%)
Total	93	96	189
	(49.2%)	(50.8%)	(100%)

**** 0.001, **0.05, * 0.1 significance level*

Respondents who reported they had not received SSPs were asked why (Table 12). The main reason was that they were unaware of these packs (33.9% and 44.7% of farmers in the treatment and control areas, respectively). Moreover, almost a third of respondents (22.6% and 33% in the treatment and control areas, respectively) identified unavailability in their locality as the main reason why they had not accessed SSPs. About one in ten respondents (12.9% and 9.6% in treatment and control areas, respectively) reported that they had not attended any event (field days) where SSPs were distributed and gave this as the main reason why they had never received them. Not being chosen to get an SSP was considered the third most important reason for farmers in the treatment area (15%). This may be because farmers who were selected to hold demonstration plots on their farms were given SSPs to plant on these plots.

Table 12: Main reason for not receiving a finger millet Small Seed Pack

Reasons	Treatment (n=62)	Control (n=94)	Total (n=156)
I am not aware of Small Seed Packs	21 (33.9%)	42 (44.7%)	63 (40.4%)
Small Seed Packs are not available locally	14 (22.6%)	31 (33.0%)	45 (28.8%)
I did not attend the event where Small Seed Packs were issued	8 (12.9%)	9 (9.6%)	17 (10.9%)
I was not chosen to get a Small Seed Pack	9 (14.5%)	2 (2.1%)	11 (7.5%)
I did not want Small Seed Packs, I had seed from other sources	1 (1.6%)	2 (2.1%)	3 (1.9%)
There were not enough Small Seed Packs	1 (1.6%)	2 (2.1%)	3 (1.9%)
I do not plant varieties issued with the Small Seed Packs	1 (1.6%)	2 (2.1%)	3 (1.9%)
I cannot afford to pay for the Small Seed Pack	2 (3.2%)	0	2 (1.3%)

3.7 Household income

Table 13 gives a breakdown of the average incomes per household as generated by different income sources in the year 2014. The total household income in the treatment area was slightly more than double that in the control area, with treatment households having total average incomes of UGX 13.2M/year compared to UGX 5.7M/year for control households. The major source of income among households in the treatment group was livestock enterprise contributing more than half (56.2%) to total household income. This was followed by income from wages / salaries contributing 27%, other non-farm sources (13%) and finally crop income with less than 5%. For households in control areas, the major contributor was income from wages/ salaries, contributing almost half (48%) of the total household income. This was followed by income from non-farm sources (27%), crop income (14%) and lastly livestock income (11%). It is interesting that livestock, the main income source among treatment households, was the smallest source of income among households in the control areas. There was however no significant difference found in the incomes between treatment and control households.

Table 13. Average income per household (UGX) for the year 2014

	Treatment (n=90)	Control (n=96)	Total (n=186)
Income from crops (n=186)	534,710.0 (4.1%)	778,473.4 (13.6%)	660,523.4 (6.9%)
Income from livestock (n=177)	7,394,718.4 (56.2%)	648,166.1 (11.4%)	3,964,268.1 (41.6%)
Income from non-farm sources (n=122)	1,728,803.3 (13.1%)	1,525,554.2 (26.7%)	1,637,174.6 (17.2%)
Income from wages/salaries (n=19)	3,493,846.2 (26.6%)	2,755,000.0 (48.3%)	3,260,526.3 (34.2%)
Total Household income	13,152,077.9	5,707,193.7	9,522,492.4

Exchange rate: 1 USD = 2,600 UGX

3.7 Household decision making

Gendered household decision making processes differ between crops. Table 14 reveals who makes decisions on different aspects of finger millet production, use and marketing. The choice of finger millet variety, cleaning and preparing the seed, seed-saving and seed-sharing are decisions mostly made by women, as reported by more than half of the households. On the other hand, decisions on the area to plant, and buying finger millet seed, are mostly made by men. On the marketing of finger millet, decisions are mainly made by men or jointly. For instance, the majority of households reported that decisions on how much to sell (44%) and when to sell (45%) are made by both men and women. At the same time, decisions about when and where to sell are mainly made by men (36.5%). On the use of income from finger millet, the majority (52%) reported that decisions were made jointly by both men and women.

Table 14: Household decision making on finger millet production and use (n=159)

	Male	Female	Both
Decides which finger millet varieties to plant	44 (27.7%)	72 (45.3%)	42 (26.4%)
Decides the area to plant to different varieties	57 (35.8%)	55 (34.6%)	47 (29.6%)
Buys finger millet seed	73 (45.9%)	62 (39.0%)	20 (12.6%)
Cleans and purifies the seed	7 (4.4%)	146 (91.8%)	5 (3.1%)
Saves finger millet seed from the previous harvest	11 (6.9%)	116 (73.0%)	28 (17.6%)
Decides to share seed with others	25 (15.7%)	83 (52.2%)	48 (30.2%)
Decides when and how much labour to hire	57 (35.8%)	52 (32.7%)	43 (27.0%)
Decides how much to sell	40 (25.2%)	48 (30.2%)	70 (44.0%)
Decides when to sell	40 (25.2%)	46 (28.9%)	72 (45.3%)
Decides who or where to sell	58 (36.5%)	48 (30.2%)	52 (32.7%)
Decides how to use income from finger millet sales	33 (20.8%)	42 (26.4%)	83 (52.2%)

3.8 Food security

Food security was assessed through a Food Consumption Score (FCS) (World Food Programme, 2009, 2011). The Food Consumption Score tool developed by the World Food Programme (WFP) is commonly used as a proxy indicator for access to food. This is a weighted score based on dietary diversity, food frequency and the nutritional importance of food groups consumed. Data was collected on the number of days in the last 7 days a household consumed specific food items. A seven day recall period is used to make the FCS as precise as possible and reduce recall bias. WFP assigns specific weights for each food group.

Table 15 shows the number of days that food items were consumed in the last seven days and their respective food consumption scores. The scores have been calculated by multiplying the number of days by their respective weights. A total FCS, calculated from the summation of all food type give the status of the household with respect to their food consumption status. The following FCS categorizes the household:

- Poor food consumption : 0 to 28;
- Borderline food consumption : 28.5 to 42;

- Acceptable food consumption : > 42; and
- Maximum FCS =112.

Results show that both treatment and control households were within the acceptable food consumption levels (Table 15). However, the FCS for maize and wheat/bread was significantly higher (*p*-value = 0.000) among the treatment households compared to the control households. On the other hand, the FCS for fish was significantly higher for control households compared to the treatment households (*p*-value = 0.000) with households in control areas having a score of 9.3 compared to 5.5 in the treatment group. Comparatively, treatment households significantly consumed more sweets/sugars than the control households (*p*-value=0.01).

Table 15: Food Security Score

Food type	Average No. of meals in a week		Food Consumption Scores		
	Treatment (n=93)	Control (n=96)	Treatment (n=93)	Control (n=96)	Total (n=189)
Maize	2.06	0.95	4.1***	2.0	3.0
Rice	0.67	0.39	1.2	0.8	1.0
Wheat/bread	1.62	0.68	3.4***	1.6	2.5
Sorghum/millet	3.38	3.80	6.2	7.4	6.8
Tubers/roots	5.53	5.80	10.9	11.4	11.2
pulses (Beans, pigeon peas	4.81	4.65	14.7	14.3	14.5
Fish	1.52	2.46	5.5	9.3***	7.4
Red meat	1.04	0.92	3.9	2.9	3.4
White meat	0.30	0.28	1.1	1.2	1.2
Vegetable oils, fats	3.47	2.81	1.7	1.3	1.5
Eggs	0.19	0.19	0.7	0.8	0.7
Milk and dairy products	1.66	1.81	6.5	7.0	6.7
Vegetables (including	2.14	2.45	2.2	2.5	2.3
Fruits	1.10	0.96	1.1	0.9	1.0
Sweets, sugar	4.47	3.49	2.2*	1.8	1.9
Total FCS Score			65.4	65.2	65.1

**** 0.001, **0.05, * 0.1 significant level*

Besides the FCS, we also collected information on the number of meals consumed by household within the different seasons. The number of meals consumed after the harvest season was slightly higher than the number of meals consumed before harvest for both treatment and control groups. However, on average the households generally consumed 2 meals in a day before harvest and 2.5 meals after harvest. The number of months that the household reduced the number of meals was significantly higher for the treatment group (2.3 months) than the control group (1.8 months). This is consistent with the FCS findings in Table 15, where control households could afford to consume fish for more days than treatment households, while treatment households had more days consuming maize. Maize in Uganda

is generally regarded as 'low status' food that is eaten only when there is no alternative cereal available.

Table 16: Food security coping strategies

	Treatment (n=93)	Control (n=96)	All households (n=189)
Number of meals in the past year (including breakfast) that the household consumed after harvesting	2.6	2.5	2.6
Number of meals in the past year(including breakfast) that the household consumed before harvesting	2.2	2.3	2.2
Number of months in the past year the household reduced the number of meals	2.3*	1.8	2.1

**** 0.001, **0.05, * 0.1 significance level*

3.9 Gross Margin Analysis

Table 17 presents a breakdown of revenues, costs and returns for finger millet comparing local and improved varieties. The analysis is performed per acre of finger millet production. The results presents data for first production season which is the main season. On average, the yield per acre of improved varieties of finger millet was more than double that of local varieties, presenting a significant difference of over 200 kg/acre (*p*-value = 0.000). The price at which farmers sold improved finger varieties was significantly higher (UGX 1,131/kg) than the price of local varieties (UGX 958.3/kg). As a result, the gross revenues generated by improved varieties were more than double those of local varieties at 99% confidence level. With respect to material costs; seeds and bags were most common cost. None of the sample farmers applied fertilizer or manure on finger millet, and only a single farmer sprayed herbicide. While the quantity of seed per acre used for improved and local varieties was the same, the cost of seed more than three times higher than for local varieties. Likewise, the number of bags and the cost of bags were significantly higher for improved than for local varieties. In total, therefore, the material cost for improved varieties was significantly higher (UGX 14,187.5/acre), almost four times higher than the material cost for local varieties (UGX 3787.8/acre).

In terms of labour, men contributed significantly more labour hours for improved finger millet varieties than for local varieties. On average, the number of hours men worked for improved varieties (18.3 hours) was double what they worked for local varieties (9 hours). The hired labour costs on improved finger millet were likewise higher than the amount spent on local varieties. Total labour costs, including both hired and family labour, were UGX 182,614 /acre for local varieties and UGX 256,662/acre for improved varieties.

For local varieties, a full cost calculation (capturing the cost of materials, cost of hired labour and the opportunity cost of family labour) shows a negative gross margin (UGX -530/acre). On cash-cost basis, the gross margin was UGX 97,223.3/acre. For improved varieties, a full-cost calculation shows a positive gross margin of almost UGX 130,000/acre. On a cash-cost basis, there was a significant difference (*p-value* =0.05) in the gross margin for improved

varieties. The gross returns on improved varieties was almost three times that of local varieties.

In sum, while the cost of production for improved varieties was higher than for local varieties, the yields and unit price for improved varieties was also higher, which made improved varieties of finger millet more profitable.

Table 17: Profitability of finger millet: Gross margin analysis

	Local (n=12)	Improved (n=8)	Total (n=20)
Revenues and costs (UGX/acre)			
Yield (Kg/acre)	185.8	391.4***	268.0
Price (UGX/Kg)	958.3	1131.3***	1027.5
Gross Revenues	185,872.2	400,777.1***	271,834.2
Inputs (Kgs/acre)			
Seed (qty)	4.0	4.0	4.0
Fertiliser (qty)	0.0	0.0	0.0
Manure (qty)	0.0	0.0	0.0
Herbicides (qty)	0.0	0.13[4]	0.05
Bags	1.3	2.9*	1.9
Material costs (UGX/acre)			
Seed	2,673.9	8218.8***	4891.8
Fertiliser	0.0	0.0	0.0
Manure	0.0	0.0	0.0
Herbicides	0.0	2,500.0	1000.0
Bags	1113.9	3468.75**	
Total material cost	3787.8	14,187.5***	7185.0
Labour			
Family (8 hour days/acre)			
• Men	9.0	18.3**	12.7
• Women	18.8	16.9	12.7
• Children	7.2	2.4	5.2
Hired Labour costs (UGX)	84861.1	146187.5*	109391.7
Family labour costs	97753.3	110475.0	102842.0
Total labour cost (Hired +Family)	182,614.4	256,662.5	212233.7
Gross margin (UGX/acre)			
Full-cost basis (Materials+family+hiredlabour)	-530.0	129,927.1	51652.8
Cash-cost basis (materials+hiredlabour)	97,223.3	240,402.1**	154494.8

**** 0.001, **0.05, * 0.1 significance level*

Exchange rate: 1 USD = 2,600 UGX

[4] Only one farmer sprayed herbicide.

4 Conclusion

This paper reports results from a household survey to provide baseline information on finger millet production in Serere and Lira districts of Uganda where ICRISAT and SAARI conduct research on finger millet as part of the HOPE project. The paper analyses adoption of improved varieties, farmers' trait preferences, perceptions of production and marketing constraints, and the profitability of improved finger millet varieties in both treatment and control areas.

The HOPE project had stimulated the adoption of improved varieties. The majority of treatment households (52%) grew improved varieties of finger millet in the main season (March-July), compared to just 10% of households in the control group. The most popular improved varieties were Seremi 2 and Engenyi. Fewer farmers (12%) planted finger millet in the second season (August-November). Among the treatment group, 13 farmers (59%) had adopted improved varieties compared to two farmers (17%) in the control group.

Farmers considered high yield, early maturity/drought resistance and marketability as the most traits for finger millet varieties. Resistance to pests and diseases, Striga, and to bird damage, were considered less important traits.

Farmers perceived the major constraints to be the low prices received for sale of finger millet, high price fluctuations and their lack of bargaining power in setting prices which were determined by buyers. The emphasis on market constraints reflects the status of finger millet as a cash crop, with 60% of finger millet sold and only 20% kept for home consumption. Decisions about crop sales and use of income from the sale of finger millet were mostly shared between men and women.

Improved finger millet varieties were more profitable than local varieties. On a cash-cost basis, margins for improved varieties were almost three times higher than for local varieties. When we take into account the opportunity cost of family labour, local varieties showed negative returns (UGX-530 per acre) while improved varieties showed positive returns (UGX 130,000 per acre).

The majority of treatment households (52%) had adopted improved varieties of finger millet in the main season (March-July), compared to just 10% of households in the control group. Farmers' top three trait preferences were for high yield, early maturity/drought resistance, and marketability

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