Sasakawa Africa Association

Adoption and Impact of SG 2000 - Uganda Crop Productivity Enhancing Technologies in Tororo, Buikwe and Kamwenge Districts of Uganda



Report

By

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Monitoring, Evaluation, Learning and Sharing Theme

SASAKAWA AFRICA ASSOCIATION

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ACRONYMS AND ABBREVIATIONS

BDS	Business Development Services
CBF	Community Based Facilitators
CGDs	Community Group Discussions
CPE	Crop Productivity and Enhancement
CVP	Community Variety Plots
DIFA	District Farmers' Association
EA	Extension Agents
FLPs	Farmer Learning Platforms
INSETT	Innovations for Technical and Economic Transformation
NARO	National Agricultural Research Organization
PTP	Production Test Plot
SACCO	Savings and Credit Savings Organizations
SG 2000	Sasakawa Global 2000
SPSS	Statistical Package for Social Scientists
TOP	Technology Option Plot
WAD	Women Assisted Demonstration

EXECUTIVE SUMMARY

The objective of this study was to analyze the impact of improved seed varieties, fertilizer use and line planting technologies on farming outcomes. Both quantitative and qualitative methodologies were used to examine the bearings of the interventions. The bulk of the data was collected using formal survey techniques based on 375 structured questionnaires. A supplemental participatory qualitative approach was used by covering the three Districts of Tororo, Buikwe and Kamwenge, as well as a multi-stage, purposive and random sampling procedure on selected sub-counties and households.

The majority of household heads in the study ranged from 43 to 48 years of age and on average owned between 1.7 and 2.2 hectares of land, and cultivated between 1.0 and 1.3 hectares of land. Farm family labor of 3 household members per season shows that half of the household members offer labor on the farm. Close to 60% rely on hired labor and 40% of the households belonged to farmer groups. Hand hoe was the main tool used in tilling land (85%) and oxen were only used in Tororo (31%). Over 40 % of households had adopted SG 2000 interventions. Technologies with high adoption rates were improved crop varieties (56.0%) and row cropping (82.4%). One of the main reasons for SG 2000 – Uganda's crop extension model to be effective was the location of 90% of its participants in the intervention areas. The main routes of interventions were TOPs (38 %) and WADs (24%) with training of SG technology promotion (76%). Beneficiaries saw a significant increase in crop yields. Assets acquired by SG 2000-Uganda beneficiaries included a motorcycle valued at shillings 1.8 million, two houses valued at shillings 2 and 5 million, and two acres of land valued at shillings 3 million.

This study shows that TOP and WAD in addition to farmer trainings were more effective in attracting communities to SG interventions. The results of the study also demonstrate the wide use of line planting practices amongst participants as well as improved seed and fertilizer technologies indicating the success of the SG 2000 extension model. SG 2000-Uganda interventions also introduced new crops such as beans in Tororo and rice in Kamwenge districts. This has occasioned the rise of income in addition to ancillary improvements such as the quality of education.

TABLE OF CONTENTS

List of Tables

List of Figures

List of Plates

1 BACKGROUND

Sasakawa Global 2000-Uganda has supported Uganda's agricultural and rural development for the last 15 years and in particular Government's effort in the fight against hunger and poverty. It has remained a strong and principal partner to Government in agricultural extension to achieve food and income security. Since its inception, SG 2000-Uganda has covered over 70 % of Tororo, Buikwe and Kamwenge Districts in Uganda. Remarkable efforts and achievements have been made in adapting and promoting several and different agricultural technologies on value chains of cereal, legume, roots and tuber crops. At the center of the FLP approach, SG 2000-Uganda aims at offering resource-poor smallholder farmers who are constrained with low crop productivity a range of technology options and trainings (through field demonstrations and indirectly through skills, information and knowledge transfer). This is in turn intended to improve productivity of on-farm activities but at the same time strengthening capacities of national extension systems in Uganda.

Target farmers have been exposed and trained by the extension agents on the following technologies/practices: new and improved seed varieties, fertilizer use, proper seed rating, timely planting, line planting, proper spacing, timely weeding, use of herbicides, integrated pest management strategies (such as aversive), use of timely planting to escape weed proliferation and invasion and the use of chemicals to control pest and diseases. Better cropping systems land preparation methods (to control major weeds like Striga), soil and water conservation, integrated soil fertility management as well as judicious cropping calendars that manage pests and diseases. Considering that the main technologies and management packages/practices promoted have been adopted with varying impacts, SG 2000-Uganda found it imperative to undertake an adoption and impact study to provide evidence of the extent to which target farmers have been transformed and to guide formulation of future interventions.

1.1 Objectives

The main objectives of this study were to have evidence on the use, adoption and impact of promoted improved technologies particularly improved seed varieties, fertilizer use and line planting and to identify determinants of adoption of technologies by target farmers. Specifically, the study set out to:

1) Assess level of knowledge and attitudes towards the disseminated technologies/practices
2) Quantify levels of adoption of the different crop technologies disseminated
3) Examine enabling and unfavorable factors to adoption of the crop technologies
4) Establish benefits and multiplier effects from use of technologies or practices
5) Document lessons and good practices from the interventions

1.2 Scope and Rationale for the Study

The study covered farm households of roots and tubers, cereals and legumes. At least one sub-county per each district was selected. Districts included in the study were Tororo, Buikwe and Kamwenge. These are Districts where SG 2000-Uganda (in particular the Crop Productivity Enhancement theme) spent over five years. It would therefore be expected that farmers there had sufficiently been exposed to SG 2000-Uganda interventions and had assessed, adopted and/or dis-adopted some with consistent transformation on individual household and community livelihood patterns in general. The study exclusively focused on household level assessment of experience and benefits as a result of SG 2000-Uganda promoted interventions. Levels and rates of adoption as well as social and economic impacts of the technologies were particularly examined.

2 METHODOLOGIES

This section explains how the study was conducted. It gives detailed information about the study design that was used, the sampling procedure and size (both quantitative and qualitative). It further shows how data were collected, analyzed and reported.

2.1 Study Design

A descriptive cross sectional design was used to collect both quantitative and qualitative data. Both quantitative and qualitative approaches were used in this study. The approaches and methodology that guided the study hinged on the following phases:

i. **Start-up Phase:** In this phase, data collection tools were developed and shared with SG 2000-Uganda office through consultative meetings organized to check on content validity of the tools. A structured questionnaire was developed for the formal survey at household level. Checklists developed for the qualitative studies
ii. **Preparation for field data collection:** This involved developing the implementation schedule including field data collection plan, assembling data collection teams/enumerators, training and orienting of the data collection team/enumerators on the methodology, tools and ethical issues as well as pre-testing the tools.
iii. **Literature Review and Field Survey (Formal and Semi-formal):** Actual data collection involved; review of relevant documents like CPE concepts and procedures, quarterly reports, individual household interviews and community group discussions.

2.2 Data types

Quantitative data involved capturing numerical and categorical data from farmers using standard questionnaires. Qualitative data was collected using participatory approaches.

2.3 Sampling Procedure and Size

The study was conducted in three purposively selected Districts of Tororo, Buikwe and Kamwenge. These are Districts where SG2000-Uganda (and CPE theme) has intervened for over 5 years.

2.3.1 Selection of Study Sub-counties and Parishes

The survey targeted one sub-county in each of sample Districts. Purposive and multi-stage sampling procedures were used to select sample Sub-counties, Parishes and farmers. A total of 3 sub-counties were selected for the study. A total of 7 corresponding Parishes for the household interviews were randomly selected in the study Sub-counties. In all, at least 50 respondents were selected per Parish (Table 1).

Table 1: Study Parishes

Region	District	Sub-County	Category of Parish Selected	
			Intervention	Non-Intervention
Eastern	Tororo	Rubongi	Panyangasi	Kidera
			Nyakesi	
Central	Buikwe	Najja	Kisimbi	Mawoto
Western	Kamwenge	Ntara	Nyakachwamba	Kichwamba

2.3.2 Sampling of Farmers

Stratified random selection was used to select households for the survey. Stratification was done by categorizing households into SG 2000-Uganda beneficiaries and SG 2000-Uganda non-beneficiaries. Systematic random sampling was then employed to select 400 households (Table 2). Specific gender categories of men, women and youth were selected.

Table 2: Distribution of sampling units by district

Region	District	Sub-County	Formal survey Sample			
			Intervention Parishes		Non-Intervention	
			Parish Selected	Number of HH	Parish Selected	Number of HH
Eastern	Tororo	Rubongi	Panyangasi	60	Kidera	50
			Nyakesi	50		
Central	Buikwe	Najja	Kisimbi	60	Mawoto	60
Western	Kamwenge	Ntara	Nyakachwamba	60	Kichwamba	60
Total HH	400			230		170

However, the sample returned a slightly lower number of respondents of 375 instead of the target of 400 households. Some households included among selected parishes belonged to SG 2000-Uganda groups in one parish but had their farms in different parishes that had not been selected.

2.4 Sample of Key Informants and Community Discussion Groups

The semi-formal survey was used to supplement the qualitative data captured using key informant Interviews and CGDs. In all at least 3 key informants were interviewed per sub-county and one CGD per sub-county.

2.5 Data Collection Methods

The bulk of the data used for the study was quantitative supplemented with qualitative data. The primary data was obtained through surveys, key informant interviews, community group discussions and in-depth conversational interviews structured around guided interview schedules and checklists.

Secondary data was collected from the review of literature in line with the study objectives. This guided in generating detailed qualitative information.

2.6 Data Management

Data collection was followed by coding, data entry, cleaning and analysis. Quantitative data was analyzed using T-tests, F-ratios and descriptive statistics (percentages and means). A Logistic regression (Logit) was used to determine factors affecting adoption of crop management technologies. A farm household was used as the unit of measure at data capture and analysis.

The logistic regression focused on probability of adopting SG 2000 Uganda promoted improved crop variety package (Y) due to decision maker, household level, community wide, labor, farmer skills/experience and land resources, sex of farmer, education, location, income, credit, extension, market and other technology access factors (Xi). The function form of the logistic regression equation was specified as:

$$Y_i = \alpha + \beta_1 Sexhh + \beta_2 Expr + \beta_3 Educ + \beta_4 Lnd + \beta_5 Membr + \beta_6 FAMcat + \beta_7 FINPUT$$
$$+ \beta_8 Mkt + \beta_9 COM + \beta_{10} EXT + \beta_{11} Livso + \beta_{12} HHsze + \beta_{13} Cred + \beta_{14} Flab + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

Y_i = Binary dependent variable for 1 = Improved crop variety, 0 otherwise

$Sexhh$ = Sex of household head (1 = female, 0=otherwise)

$Expr$ = Years of crop enterprise farming experience of household head

$Educ$ = Years of formal education of household head

Lnd = Total household land holding under the crop enterprise

$Membr$ = Membership to farmer groups/associations

$HHsze$ = Total number of members in the household involved in farm work

$FAMcat$ = Farm category (1 = exclusively crops; 2 = Crop-mix)

$FINPUT$ = Presence of farm input supply shops

Mkt = Distance to local crop produce markets in kilometers

EXT = Access to regular SG 2000 extension services

COM = Degree of commercialization of farm enterprise

$Livso$ = Main source of livelihood by the household (1 = farm; 0 otherwise)

$Cred$ = Status of farm investment credit financing (credit = 1; 0 otherwise)

$Flab$ = Farm labor source (family = 1; hired = 2)

α = Intercept

β_i = Coefficient on the independent variables

ε = the error term following a normally distributed function

Qualitative data was summarized using diagramming, matrices and ranking techniques

3 RESULTS AND DISCUSSIONS

In this part of the report, field results are discussed in relation to the specific objectives of the study.

3.1 Socio-economic and Demographic Characteristics

Socio-demographic characteristics can have observable influence on household's levels of technology adoption. The study collected information on the socio-demographic characteristics of the sample households. This information included; sex of the household head, marital status of the household head, mean age of the household heads, number of years spent in formal education, household size, income levels and farming experience in years. The results are presented in the proceeding sub-sections.

3.1.1 Farm Household Characteristics

Overall results showed that majority (80%) of households were headed by men. Findings also revealed that majority (82%) of the sample households were married. A study by Tecklewold et.al (2006) revealed that marital status greatly influences opportunities for technological adoption. Results by District and area are summarized in Table 3. Area and District specific data showed that there were less (6%) female headed households in the intervention areas of Kamwenge District than the non-intervention areas (94%) of the same District. Key informants reported that households that are married are more stable to make agricultural investments.

Table 3: Percentage responses on household characteristics

Characteristic	District (Per cent of Households)					
	Buikwe (N = 80)		Kamwenge (N = 83)		Tororo (N = 112)	
	Intervention Area	Non-Intervention	Intervention Area	Non-Intervention	Intervention Area	Non-Intervention
Materials for main dwelling						
Brick under iron roofing	93	88	57	42	69	53
Brick under grass thatch	0	0	3	4	7	15
Wattle iron roof	4	6	34	45	14	14
Wattle/grass	3	6	6	12	9	18
Marital Status						
Divorced	7.1	12	0	7.5	2.4	1
Married	89	66	85	76	90	81
Single never married	0	4	0	0	0	0
Single not yet married	0	0	9.1	10.5	0	1
Widowed	4	18	6	6	7	16
Sex of household head						
Female	11	46	6	10	17	19
Male	89	54	94	90	83	81

Source: Adoption Study 2012

3.1.2 Household Domestic/Farm Resources and Enterprises

Study findings on domestic resources and farm enterprises are presented in Table 4 below.

Mean age of household head: The results indicated that household heads in the intervention Parishes were slightly older (49 years) than those in non-intervention areas (45 years). In all, however, the mean age of heads of households depicts middle economically active age bracket. This implies that such farmers still have potential for experimenting into new practices and would be enthusiastic to adopt new practices.

Household size: The mean household size of 7 persons across the intervention and non-intervention areas was slightly higher than the national average of 5 persons in rural households (Uganda Bureau of Statistics, 2010). Results also indicated that Tororo and Buikwe had statistically the same number of household members but both were significantly higher than that of Kamwenge (Table 4).

Table 4: Domestic Resources and Farm Enterprises

Characteristic	District (Per cent of Households)					
	Buikwe (N = 80)		Kamwenge (N = 83)		Tororo (N = 112)	
	Intervention Area	Non-Intervention	Intervention Area	Non-Intervention	Intervention Area	Non-Intervention
Age of household head	52	46	42	43	52	47
Education of household head (Years)	11	15	7	7	12	12
Total number of household members	8	8	6	6	8	7
Total number of HH members involved in farming activities	6	6	4	4	5	5
On farm annual amount (USD)[1]	357	248	438	236	362	188
Nonfarm annual amount (USD)	586	451	614	655	373	303
Farming experience in Years	20	19	17	15	23	22
Acreage under crop cultivation (Ha)	3.8	2.4	3.2	2.1	3.8	2.8
Total land under use (Ha)	5.5	3.8	6.1	3.9	7.9	4.3
Bean acreage (Ha)	0.9	0.7	0.8	0.6	1.3	0.9
Ground nut acreage (Ha)	0.7	0.6	0.5	0.5	1.0	0.8
Cassava acreage (Ha)	0.5	0.4	0.4	0.5	0.4	0.7
Maize acreage (Ha)	1.3	1.0	1.5	0.8	1.5	1.1

Source; Adoption Study 2012

[1] Exchange rate One USD ($) is equivalent to about 2560 Uganda shillings

Education and years of schooling: Farmers in Buikwe and Tororo Districts had more years of education compared to Kamwenge (Table 4). Ezeh and Nwachukwu (2010) observed that the level of education attained by a farmer not only increases his/her farm productivity but also enhances ability to understand and evaluate new production technologies and that the ability to read and write would enable farmers to better utilize effectively and efficiently whatever resources exist in the area.

Farm and Non-Farm Incomes: Overall, annual average farm cash income in all the Districts was at about USD 305[2] and non-farm cash income was at USD 497. Results in Table 4 indicate farm income levels in the intervention areas being higher than non intervention areas. Even for the non-farm income apart from Kamwenge, significant differences were revealed in the intervention areas than the non-intervention.

Land ownership and use: Average land owned by a typical household was at least 1.7 hectares while on average, households cultivated about 0.97 hectares (Table 4). The average family farm labor of 3 household members shows that half of the household members offer labor on the farm.

3.1.3 Collective Action

Overall Results in Figure 1 indicated that about 42% of the households belonged to farmers' groups with more membership in the intervention (80%) Parishes compared to the non-intervention (27%). Membership in farmer groups was significantly (x^2=85.35, ρ=0.000) related to category of area. This was expected because, by the nature of SG 2000 operation, farmers are encouraged to be in groups. Data by District revealed a similar trend of membership.

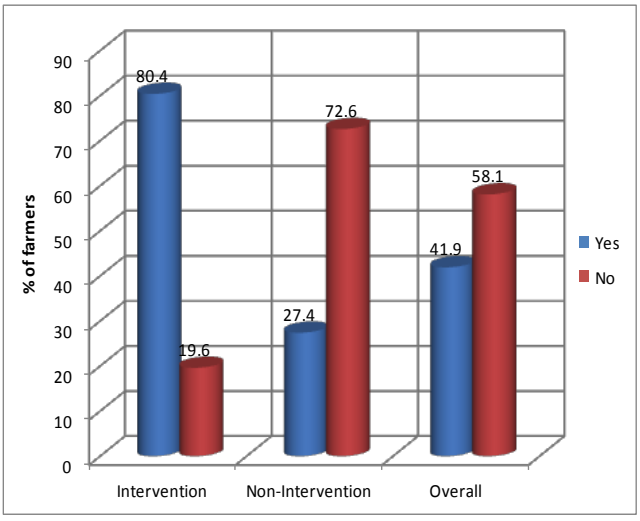

Figure 1: Household Membership in Groups

[2] At the time of this study, 1$ was about UGX 2650/=

3.1.4 Access to Farm Credit Finances

Overall, there was limited access to farm credit (23.3%). Results from the intervention Parishes revealed higher (37%) proportions of farmers that accessed credit than the non-intervention (18%) indicating a significant relationship (x^2=15.38, ρ=0.000) between category of area and access to farm credit (Figure 2). The implication of this is that an area that receives interventions has better access to credit than the one not attended to. District disaggregated data shows that Tororo (28%) District followed by Kamwenge (27%) had a higher proportional of farmers that accessed farm credit. Key informant and community group discussions indicated that the lower proportions of households accessing farm credit, was attributed to the limited orientation of farmer groups towards the activities of informal financial institutions like SACCOS, absence of banks offering favorable agricultural loans and the common practice of farmers not keeping their saving in formal financial institutions. The risks involved in farm production in a situation of absence of farm insurance further inhibits farmers' ability to get input credit or use of anticipated crop produce as a collateral in financial institutions.

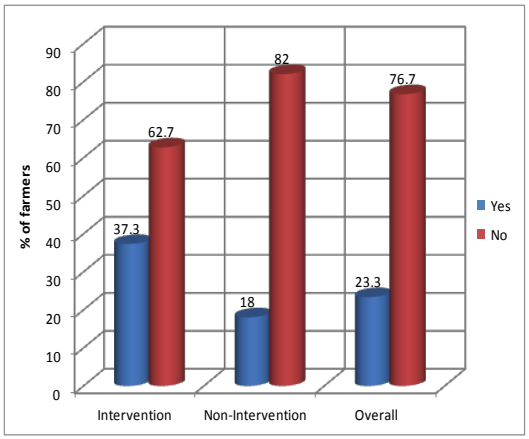

Figure 2: Access to financial credit

3.2 Knowledge, Perceptions and access to SG 2000 - Uganda technologies

3.2.1 Access to SG 2000-Uganda' Technology Interventions

A producer must make decisions on cultivating certain crops, use of crop inputs, pest management, harvest, postharvest, marketing, and sale based on information available to them about potential effects of the practices on the productivity at the agricultural product value chain cycle (Naomi & Priya 2012). As such, SG 2000 Uganda's interventions focus on providing knowledge and skills to enable farmers make decisions geared towards improving their productivity. The study results revealed that 41% of the farmers across the study Districts had received SG 2000 Uganda promoted technologies (Figure 3). These interventions come in the form of trainings and dissemination of specific technologies for adoption. On average, about 9 male and 12 female farmers were reported to be trained by the direct beneficiary. This therefore signifies a more two-fold multiplier effect by the initial nucleus

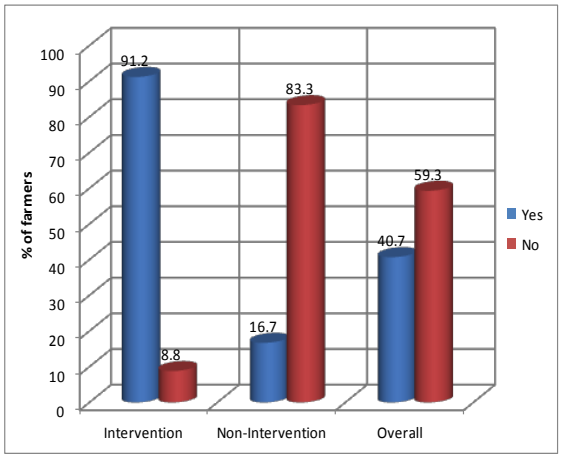

Figure 3: Access to SG 2000-Uganda' Interventions

demonstration host households. District disaggregated data revealed higher proportions (51%) of farmers in Buikwe reporting access to SG 2000-Uganda interventions through secondary sources compared to their counter parts in Tororo (37%) and Kamwenge (30%). This suggests technology spill-over was higher in Buikwe compared to the other two districts.

3.2.2 New technologies and skills learnt from SG 2000 – Uganda trainings

The extension approaches of SG 2000–Uganda focus on exposure to farmers about: existence and benefits of improved crop varieties from NARO, planting practices that ensure optimum plant populations and ease of subsequent agronomic operations and availability of soil nutrients to support crop growth. Results indicated that acquisition of new skills and technologies was skewed in favor of the intervention Parishes. Timely weeding (100%), use of herbicides (100%), use of improved seed (83%), fertilizer use (87%) and line planting (77%) were the key elements cited by farmers in the intervention Parishes as the major SG 2000 - Uganda interventions that had transformed their traditional practices of using local home saved seed broadcasted at planting (Table 5).

Table 5: New technologies/skills acquired

Practice/technology	Category of Parish	
	Intervention	Non-Intervention
Improved Seeds	83	17
Fertilizer use	88	13
Proper seed rate	50	50
Timely planting	50	50
Line planting	77	23
Timely weeding	100	0
Use of herbicides	100	0

Source: Adoption Study 2012

Plate 1: Farmers displaying acquired skills & knowledge in their own gardens

3.2.3 Major Crop Enterprises and Control of Farm Produce

Information on access to and control of farm enterprises by gender as shown in Tables 6, 7 and 8 was captured from Community Group Discussions. In Tororo District, sweet potatoes, sorghum and cow peas were largely managed by women. Farm produce was also commonly controlled by women. This is because such enterprises were reported to be produced mostly for home consumption. Women had a traditional role of catering for food needs of households. Soya beans are mainly managed by and their output is commonly controlled by men since these are predominantly produced for cash. Men have a conventional role of fending for cash needs for their households. Cassava, maize, rice, ground nuts and beans are jointly managed by men and their spouses. Such crops were reported to double as food and cash crops.

Table 6: Major crop Enterprises & Control of Farm produce in Tororo

Crop ranking	Crop	HH managing & controlling benefits		
		Men	Women	Jointly
Root and stem tubers				
1	Cassava			
2	Sweet potatoes			
3	Cocoa yams			
Cereals				
1	Millet			
2	Maize			
3	Sorghum			
4	Rice			
Legumes				
1	Ground nuts			
2	Bush beans			
3	Cow peas			
4	Soya beans			

Source: Adoption Study 2012

In Buikwe District, (Table 7), it was reported that maize and rice operations require the farmer to stay away for long hours from home whereas bananas and ground nuts demand multiple but shorter duration frequent activities and are hence planted near homestead to ease management. The former hence largely managed by men and the latter by women. Cassava and sweet potatoes were reported as jointly managed enterprises.

Table 7: Major crop Enterprises and Control of Farm produce in Buikwe

Crop ranking	Crop	HH managing & controlling benefits		
		Men	Women	Jointly
1	Cassava			
2	Sweet potatoes			
3	Bananas			
4	Maize			
5	Upland rice			
Legumes				
1	Bush beans			
2	Ground nuts			

Source: Adoption Study 2012

In Kamwenge District (Table 8), sweet potatoes, millet and sorghum are catered for by women due to their domestic consumption role compared to other enterprises. Men mainly controlled Soya bean which is considered a cash crop. The rest of the crops are jointly managed by men and women.

Table 8: Major crop Enterprises, and Control of Farm Produce in Kamwenge

Root and stem tubers				
Crop ranking	Crop	HH managing & controlling benefits		
		Men	Women	Jointly
1	Cassava			
2	Sweet potatoes			
3	Irish potatoes			
Cereals				
1	Maize			
2	Millet			
3	Sorghum			
4	Rice			
Legumes				
1	Ground nuts			
2	Bush beans			
3	Soya beans			

Source: Adoption Study 2012

3.2.4 Farmers' Production Constraints

Farmers' rankings of production constraints for Tororo and Buikwe are presented in Tables 9 and 10). The biggest problem cited was failure to plough in time, followed by high cost of labor and poor soil fertility. This implies that by addressing the issue of animal traction it will be easier to adopt timely planting. Besides, the cost of labor will be reduced.

Table 9: Pair – wise Ranking of Production Constraints in Tororo District

Constraint	Weeds	Poor soil fertility	Poor seed quality	Pests & diseases	Scanty knowled	High cost of labor	Delayed plowing	Poor drying methods	Poor storage	Storage pests	Total score	Ranking
Weeds		PSFERT	PSEEDS	WEEDS	WEEDS	HCLAB	FPLOWT	WEEDS	WEEEDS	WEEDS	5	6
Poor soil fertility			PSFERT	PSFERT	PSFERT	HCLAB	FPLOWT	PSFERT	PSFERT	PSFERT	7	2
Poor seeds				PESDIZS	PSEEDS	PSEEDS	FPLOWT	PSEEDS	PSEEDS	PSEED	6	4
Pests/diseases					PESDIZS	PESDIZS	FPLOWT	PSEDIZS	PESDIZS	PESDIZS	6	4
Scanty knowledge on recommended practices						HCLAB	FPLOWT	SKNOW	SKNOW	SKNOW	3	7
High cost of labor							HCLAB	HCLAB	HCLAB	HCLAB	7	2
Failure to plough on time								FPLOWT	FPLOWT	FPLOWT	8	1
Poor crop drying practices									PSTOSTR	SPEST	0	10
Poor storage structures										PSTOSTR	2	8
Storage pests											1	9

In Buikwe, farmers ranked deficiency in technical knowledge as top most priority, followed by poor soils, poor storage facilities for seed and seed quality (Table 10)

Table 10: Ranking of Farm Crop Production Constraints in Buikwe District

Constraints	Pests	Seed	Poor soils	Lack of Pesticides	High labor cost	Low technical knowledge	Poor storage facilities	Total score	Ranking order
Pests		SEED	PSOIL	PESTICIDE	PESTS	TECHKNO	POORSTR	1	6
Poor seed quality			PSOIL	SEED	SEED	TECHKNO	POORSTR	3	3
Poor soils				PSOIL	PSOIL	TECHKNOW	PSOIL	5	2
Lack of Pesticides					PESTICIDE	TECHKNOW	POORSTR	2	5
High labor cost						TECHKOW	HLAB	1	6
Low technical Knowledge							TECHKNO	6	1
Poor storage facilities								3	3

Results of the participatory constraints diagnosis indicate that inadequate technical knowledge, poor soils, poor storage structures and practices and poor seed quality are the major crop production constraints. Technical knowledge is required especially in areas of crop protection (integrated methods, pesticide types, application rates, timing and compatibility with target crops), crop fertility amendments (soil nutrient and water conservation, organic and inorganic fertilizer use, and fertility maintenance).

3.3 Levels of adoption of the different crop technology packages

This section presents and discusses results addressing the specific objective of determining the levels of adoption of the different SG 2000 – Uganda crop technologies by smallholder farmers. It is divided into three major sub-sections. The first sub-section presents the use of promoted crop technologies. The second sub-section reveals the major adopted technologies, types of technologies adopted first, preferences for the adopted technology and dis-adopted technologies. Reasons for dis-adoption are discussed in the third section.

3.3.1 Adoption of Productivity Enhancing Technologies

In their study of adoption of imported technology, Enos and Park (1988) define technology as "the general knowledge or information that permits some tasks to be accomplished. Although their focus was non-agricultural, the definition fits agricultural technologies given that technology is aimed at easing work of the entity to which it applies. Most technologies are therefore consequently termed 'labor-saving', 'time-saving', 'capital-saving' or 'energy-saving'. To economists this implies saving on resources that are scarce. While quoting Roger's earlier work of 1962, Feder (1985) define adoption as "a mental process an individual pass from first hearing about an innovation to final utilization". The interest for this study was the level of adoption.

3.3.1.1 SG 2000-Uganda Adopted Crop Technologies

Adoption of productivity enhancing technologies/practices namely improved seeds; line planting, timely planting, use of herbicides and fertilizer use are presented in Table 11. Overall, results revealed that timely planting (90%) followed by line planting (82%) for crops like maize, groundnuts, and beans had the highest rate of adoption in Tororo District compared to Buikwe (80%) and Kamwenge (74%). Use of improved crop varieties was 56% while use of chemical fertilizers was the lowest (30 %). There was a significant difference between the intervention and non-intervention Parishes in terms of technology adoption.

Plate 2: Use of Line planting

Table 11: Adoption of Farming Technologies/Practices

Technology	Category of Area		Overall	x^2
	Intervention	Non-Intervention		
Use of Improved crop variety	81	45	560	**37.73*[3]**
Use of chemical fertilizer	64[4]	15	30	**75.92***
Timely planting	98	86	90	**11.14***
Line planting	96	77	82	**17.69***
Herbicide use	**62**	**30**	**39**	**28.22***

Source: Adoption Study 2012

Crop disaggregated data revealed that maize (Longe 5 - Nalongo and Longe10 - Salongo), beans - K132, Sweet potatoes – NASPOT10, Upland rice - NERICA1 and NERICA2 and groundnuts - Red Beauty registered higher increases in the proportion of households growing crops using improved seeds compared to simsim, soya beans and millet. Results of the study on adoption by adopter status are presented in Table 12.

Table 12: Adoption and Adopter Status

Characteristic	Status of adoption				T-test
	Adopters		Non-Adopters		
	Mean	Std. Deviation	Mean	Std. Deviation	
Age of household head (Years)	47.83A	13.47	45.69A	13.90	1.343NS
Education - household head	12.68B	11.85	12.82B	11.66	0.058NS
Household size (Number)	7.38A	3.45	6.64A	3.58	1.405NS
Family labor (Number)	4.96	3.11	4.58	2.85	1.095NS
Farming experience (Years)	20.89	12.68	19.65	13.71	0.802NS
Cattle herd size (Number)	2.97	2.19	3.24	3.19	0.571NS
Maize area (Ha)	0.53	0.15	0.40	0.13	2.901*
Beans area (Ha)	0.40	0.28	0.30	0.11	2.622**
Ground nuts (Ha)	0.28	0.13	0.29	0.97	0.211NS
Cassava (Ha)	0.08	0.01	0.25	0.07	0.793NS
Non- farm annual income (UGX[5])	1,524,150	1,391,814	1,000,157	944,435	2.586***
Area under crops (Ha)	1.32A	0.34	1.05B	0.09	2.638**
Farm annual income (UGX)	980,370	941,228	522,186	485,704	5.236***
Household total land area (Ha)	2.36B	1.12	1.81B	0.45	1.671NS

*Figures followed by different letters are significantly different, ***, and ** denotes significance at 1 and 5 per cent, respectively*

[3] Significant at 95% Confidence Level

[4] Fertilizer use in terms of rates of application may not have increased a lot but the innovation of using one soda bottle top of DAP fertilizer at maize planting per hole has attracted higher proportions of households using fertilizers

[5] 1 USD ($) is about 2650 Uganda shillings

Adopters and non-adopters had household heads of the same age of about 46 years, with same number of years of schooling of about 12 years, and had households of about 7 members, had the same amount of land of about 0.5-4.74 hectares. In terms of cultivated areas, incomes and farm enterprises, adopters had significantly larger cultivated areas, had larger plots of maize and beans and earned more from farm and non-farm income sources. Studies on adoption of land conservation practices in Niger, such as Baidu (2009); Caswell *et al* (2001); and Khana (2001) observed that age was not a significantly relevant factor to adoption. However, Daku (2002); Doss and Morris (2001) observed that education positively affected adoption of Integrated Pest Management. This is because education is expected to create a favorable mental attitude for the acceptance of new practices especially of management and intensive practices (Caswell *et al*., 2001). Education also is assumed to reduce the complexity perceived in a technology thereby increasing a technology's adoption. However, most studies that designed to establish the effect of education on adoption in most cases have always related it to years of formal schooling. Table 13 examines the distribution of adopters in the participating Districts by intervention and non-intervention areas.

Table 13: Technology Adopters by District and Intervention Areas (IAs)

Characteristic	**District (Per cent of Households)**					
	Buikwe (N =80)		Kamwenge (N = 83)		Tororo (N = 112)	
	Intervention Area (IA)	Non-Intervention Area (NIA)	Intervention Area (IA)	Non-Intervention Area (NIA)	Intervention Area (IA)	Non-Intervention Area (NIA)
Non-adopters	18	68	12	86	11	84
Adopters	82	32	88	14	89	16
Adopters (%)	50		32		40	
Status of adoption (%)	Intervention Area (IA)		Non-Intervention Area (NIA)			
Non-adopters	9		84			
Adopters	91		16			
Overall (%)	Non-adopters		Adopters			
	60		40			

Source: Adoption Study 2012

Results showed that Buikwe had the largest proportion of adopters (50%), followed by Tororo (40 %) and Kamwenge (30%) respectively. With respect to geographical areas of SG 2000 – Uganda technology promotion, intervention areas had significantly (χ^2 = 159.59; ρ =0.001) larger proportions of adopters compared to non-adopters. Corresponding figures were 82 %, 88 % and 89 % for Buikwe, Kamwenge and Tororo, respectively. Overall the adoption rate was 40 % of which 90% were found in the intervention areas.

3.3.1.2 Determinants of Technology Adoption

In the logistic regression used to assess determinants of adoption, interferences by independent variables with similar effects on the dependent variable were anticipated. In order to avoid this interference (multi-colinearity) any two variables with similar effects are not entered jointly in the model. Close association between independent variables was done by correlating all suspect variables. Correlations conducted on explanatory variables indicate that age and experience of household head both in years were significantly correlated (ρ=0.001). In addition, total number of household members (household size) and number of household members involved in farming activities were significantly correlated (ρ =0.001); and annual farm income was positively and significantly correlated with cultivated area. The model was therefore fitted with either of the two significantly related variables.

Results of the logistic regression on adoption of SG 2000 promoted technologies are presented in Table 14. Overall the model specification is good with a specificity of 72 % and overall correctly prediction variables at 70 %.

Table 14: Variables in the Logistic Model on Adoption of SG 2000 Promoted Technologies

Observed		Predicted					
		ADOPTION		Percentage Correct			
		0	1				
Adoption	Non-adopter (0)	125	58	68			
	Adopter (1)	35	91	72			
Overall Percentage				70			
Variables in the Equation		Coefficient on X	Standard Error.	Wald statistic	Degrees of freedom	Significant.	Odds ratio
Sex of Household head(1)		0.349	0.331	1.113	1	0.291	1.418
Age of Household head		0.000	0.010	0.000	1	0.989	1.000
Household members Involved in farming activities		-0.032	0.045	0.510	1	0.475	0.968
Use of hired labor(1)		-0.137	0.293	0.220	1	0.639	0.872
Membership to farmers' groups(1)		-1.761	0.274	41.334	1	0.000***	0.172
Size of cultivated area		0.103	0.062	2.697	1	0.101*	1.108
Constant		0.286	0.503	0.322	1	0.570	1.331

Source: Adoption Study 2012

Adoption of SG 2000-Uganda promoted technologies was, however, affected by group membership and size cultivated area (degree of commercialization). Similar to Nanyeenya et al., 1997 group membership had a positive and significant effect on adoption. In the study area, groups are a vehicle used by several agencies to enhance communities and member household exposure to technical interventions. They are an arena of cross learning, skills improvement, source of farmer –to-farmer technical advice and information flow. In addition, it is a channel of flow of knowledge, technologies and skills by formal extension/advisory service providers. Technology adoption requires use of purchased inputs that includes crop seed varieties, fertilizer application, herbicide use, and in many cases labor, tools, equipment and machinery to open up land and effect subsequent husbandry practices. This suggests that investment in these inputs is justified by substantial investment in land. It is therefore not surprising that in this study technology adoption was positively and significantly

affected by increase in cultivated land sizes. In addition, since all technologies are of input nature, demand for inputs is derived demand from products. Adoption of technologies was hence positively affected by the tendency for commercialization. Farmers who are market-oriented are motivated to invest in technologies. Increase in productivity does not only translate in additional food surpluses but also determines profits and revenue generation. This concurs with Nanyeenya et al., 2011 who observed that adoption of chicken vaccination technology was positively influenced by the degree of commercialization of chicken farmers. Market –oriented producers tend to invest and intensify (technology) application to accelerate growth and/or boost yields so as to increase profitability, improve on profits and recover the investment in technology.

However, there was no difference between cattle herd sizes and access to farm inputs of adopters and non-adopters. With respect to determinants of technology adoption, findings of the study indicated that the odds in favor of adoption of SG 2000 promoted technologies were not affected by sex of household head, age (and farming experience) of household head, total number of household members (household size) and family members involved in farming activities as well as use of hired labor. This implies that the interventions being promoted were viewed as being gender neutral, were not age or years of farming experience driven and do not exclusively depend on hired labor.

3.3.1.3 General Reasons for Dis-adoption Technologies

Dis-adoption was low across the 3 Districts with improved seeds at (5%), fertilizer (6%), timely planting (2%), line planting (1%) and fertilizer use (7%). There were no significant differences across the three Districts. For example, high prices/costs of inputs, lack of access to inputs, poor quality inputs were reported as most constraining factors in the SG 2000 beneficiary Parishes. While reasons like unfavorable weather conditions, lack of knowledge and skills and pests and diseases were cited by farmers in the non SG 2000 Parishes.

3.4 Benefits and Impact of SG 2000 – Uganda Promoted Technologies

Direct farm productivity and husbandry advantages stemming from SG 2000 interventions were examined and results are shown in Table 15.

3.4.1 Benefits of SG 2000 Interventions

Direct farm productivity and advantages stemming from SG2000 interventions were examined. Results revealed that over 90% of all the interviewed farmers in the three Districts reported increase in yield partly because of SG 2000- Uganda interventions. Increase in income was recorded as the most important effect of SG 2000 –Uganda interventions on household livelihoods. It has been noted that farm incomes of adopters were significantly different from that of non-adopters (Table 15). As far as yields are of concern, the before SG 2000-Uganda interventions period (in one major season) and after SG 2000-Uganda in 2011 Major Season were used as the reference period on crop by crop basis. Results indicated that SG 2000 interventions led to a general increase in maize yields from 1.2 MT to 2.7 MT; beans moved to 1.2 M T compared to 0.3 M T before adoption and Sweet potato yields increased to 10 MT compared to 4 MT - all per Ha of land of the crop in question. In Kamwenge rice was newly introduced with about 25 farmers each with at least 0.2-0.4 Ha registering yields of about 3.7 MT/Ha.

Table 15: Benefits and Effects attributed to SG 2000 – Uganda Interventions

Factor	District (Per cent)			Overall
	Buikwe	Tororo	Kamwenge	
Productivity and management benefits of SG 200O interventions				
Increase in yields	97	96	91	95
Reduction in postharvest losses	3	4	0	2
Reduction in weed control costs	0	0	9	2
Effects on household livelihoods attributable to SG 2000 - Uganda				
Higher incomes	55	58	82	63
Changed (mud to brick) house	0	2	4	2
Changed (thatched to iron) roof	3	2	0	2
Eased school fees burden and shifted better schools	7	17	7	11
Bought livestock - goats	0	2	0	1
Bought household items (beddings, kitchen utensils)	0	2	0	1
Bought more land	15	23	9	15
Able to acquire bank loans	5	22	18	16

Source: Adoption Study 2012

3.4.2 Case studies: Success stories Associated with SG 2000 Interventions

Specific case studies are presented in Figures 3 and 4. Several households reported benefits attributed to SG 2000 interventions that are detailed in the following discussion.

In Tororo District, Tereza Alowo (Plate 3) hosted a WAD demo, grew maize (Longe 5), cassava and soya beans. She would sell about 3000 Kg of maize at USD 0.2 per kg and was able to accumulate savings that she kept in hiding from thieves in a grass thatched. She was able to construct a brick-iron roofed house valued at about USD 781. The house is where they stay currently although it is still incomplete. She plans to fix doors, windows and plaster the walls. As a WAD demo host, she transfers improved skills to about 50 new farmers per season.

Plate 2: Tereza Alowo (Panyangasi, Rubongi Tororo with her children at their old and new houses

In Kamwenge district one youth produced about 2.2 MT of maize from 0.84 Ha. He sold each kilogram at shillings USD 0.3[1]/= and bought a mechanically sound motorcycle at USD 781.3. He has now diversified into motor cycle (Boda boda) transport business as well as farming. In the same district, married woman growing rice on rented land harvested and sold it fetching USD 781.3 which she used to buy 0.4Ha of land of her own.

Plate 3: Mr. & Mrs. Ochieng Lawrence at their bigger new house & children at the smaller old house

4 KEY EMERGING OBSERVATIONS/LESSONS FROM THE INTERVENTIONS

The following observations signify areas of consolidation and/or adjustment in implementation of SG 2000 promoted interventions owing to experiences that beneficiaries have noted.

a) Poor publicity, low coverage and multiple treatments limits farmer comprehension of the disseminated technologies and practices.
b) Inadequate technical knowledge on fertilizer technologies, distant supply sources contributing to high costs; and poor soils lead to low adoption
c) Lack of accessible and reliable input supply deters technology adoption.
d) Introduction of new crops like beans improves overall food availability
e) Increase in acreage, labor and commercialization has a relationship with adoption.

5 RECOMMENDATIONS AND IMPLICATIONS FOR FUTURE INTERVENTIONS

The following recommendations were drawn from the study

- Farmer learning platforms notably CVP and Farmer Group coverage should consider shorter radii; broaden group membership (or tolerance to non-members) to effectively cover more households and communities.
- Increase/improve publicity of SG 2000 approach: Implementation of SG activities at community level should involve more local leaders especially village Local Councils (LCs) to enhance publicity, and farmer mobilization. Field days at sub-county level and at demonstration sites at Parish level tend to have low outreach and attendance by the few group members or those already associated with SG 2000 activities yet all learning platforms are nuclei for accelerating scaling – up exposure to new beneficiaries.
- More demonstrations with longer observation periods should be conducted on fertilizer use to enable farmers understand crop nutrient requirements, fertilizer types, application rates, sources, and advantages.
- Improve farmer access to inputs: Identify stockists from among local entrepreneurs who should preferably be residents and already engaged in some farm development business activity in the locality and are interested in widening their income streams to establish farm supply shops. Initial Business Development Services (BDS) offered by SG 2000 support would enable them stabilize stock accumulations and cash flows such that the agro-input line of business continues after the project kick-start boosts are withdrawn.
- Establishment of Savings and Credit Schemes: Encourage formation of Savings and Credit Cooperative Organizations (SACCOs) to enable farmers save extra income as well as get credit to finance timely input purchases. Farmers should also be trained in exploring available financial services including formal banking and insurance as they get commercialized.
- Getting market for increased yields could be handled by linking up with District Farmer Associations (DIFAs) and produce buyers such as Mukwano and Mt Meru for soya beans so as to enhance forward contracting and clearance of surplus production. In addition, strategies for access to market information should be enhanced.
- Draught cattle are a key element of crop management especially in Tororo district. Much as SG 2000 focuses on crop production, limited attention on cattle by way of improving their health and improving access to draught implements cripples crop technology adoption in the area. SG 2000 should orient target farmers and/or link farmers to institutions like World Vision that support animal health and draught implements.
- Promote market oriented enterprises that address food security and household income.

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