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*Full length Research*

# Effect of Farmer Field School on Adoption of Improved Cotton Production Technologies in Eastern Uganda

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**Cotton is an important cash crop with high potential to reduce rural household poverty in eastern Uganda and yet, on-farm productivity is low. The Government of Uganda in partnership with the private sector and donor agencies therefore promoted improved cotton production technologies through the farmer field school approach in eastern Uganda. The motivation of this study was to assess the role of farmer participation in farmer field schools in enhancing the adoption of improved cotton production technologies among farmers in eastern Uganda. A stratified sampling method was used to select 93 participant and 88 non participant cotton farmers in eastern Uganda. Farm-level data were collected and a binomial logit regression model was used to identify key factors that influenced farmers' adoption of single or bundle of technologies. Results showed that farmers' participation in a farmer field school as well as their perceptions of technology characteristics and socio-economic environment influenced technology adoption. Policies that engender farmers' active participation in farmer field schools and improved access to critical cotton inputs are thus recommended**.

**Keywords:** Adoption, technologies, farmer field school, cotton, Uganda.

## INTRODUCTION

Farmers' adoption of new agricultural production technologies in developing countries is influenced by their subjective assessment of technology characteristics and socio-economic environment (Maumbe and Swinton, 2000; Pannell, 1999; Batz et al., 1999; and Adesina and Baidu-Forson, 1995). The current emphasis on farmers' participation in the process of technology development and adaptation is thought to be one way of making sure that agricultural research and development builds upon farmers' local expertise and knowledge and thus, essential for adoption to occur (Reed, 2001). In many developing countries in Africa, agro-technologies have increasingly been developed and disseminated through the use of participatory extension approaches to foster agricultural development (Reij and Waters-Bayer, 2001).

Farmer field schools are rather a new participatory extension method introduced in the late 1980s by the international donor organizations in developing countries (Braun et al., 2006). By building on other existing extension methods, farmer field schools have been more effective in disseminating modern agricultural technologies to participant farmers in developing countries as reported in many studies (Okorley et al., 2014; Malima et al., 2014; Erbaugh et al., 2010; Doly, 2009; and Bunyatta et al., 2006). Moreover, farmer field schools have facilitated the diffusion of knowledge and information about new agricultural technologies from participant to non participant farmers, resulting in their wide adoption and diffusion (Witt et al., 2008). Impacts beyond adoption of agricultural technologies and productivity enhancement, such as improved individual, household and community economic and social well being, have also been attributed to FFS (Friis-Hansen et al., 2012 and Davis et al., 2012).

In eastern Uganda, on-farm productivity of cotton is low and standing at 300 – 400 kg/ha mainly due to soil deterioration, pests and diseases, and farmer use of poor agronomic practices (USAID, 2002). Consequently, the Cotton Development Organization (CDO) in partnership with United States Agency for International Development (USAID) and Uganda Cotton Ginners and Exporters Association (UGCEA) set up on-farm model technology trial demonstration plots starting from 2002/03 cotton season to train farmers on improved cotton production technologies with emphasis in the areas of agronomy and soil fertility management. Dissemination of the above cotton production technologies was done using farmer field school approach. Essentially, clusters were formed; each cluster was made up of 5-6 site coordinators each managing 10-12 farmer groups of 15-20 cotton farmers and each farmer group managing a model demonstration plot on improved production technologies. By use of farmer field schools, it was thought that these technologies could be disseminated widely to cotton farmers in eastern Uganda.

The main objective of this study was to examine the effect of farmers' participation in farmer field schools on extent of adoption of improved cotton production technologies in eastern Uganda. Results from this study will provide useful information to CDO, UGCEA, USAID and other stakeholders involved in the revitalization of the cotton sector, which is still a major source of income to 10% of the rural population in Uganda (USAID, 2002).

## MATERIALS AND METHODS

### *Analytical Framework*

The logistic regression technique was used to address the key empirical question of what factors were critical determinants of farmers' adoption behavior in regard to improved cotton production technologies. The farmer's choice to adopt or not to adopt a given improved cotton production practice was assumed to be influenced by various factors. According to Greene (1993), the logit model is specified as:

$$P_i = E(Y = 1/X_i) = \frac{1}{1+e^{-(\beta_1+\beta_i X_i)}} \quad \text{......................(1)}$$

Where $P_i$ is the probability that the $i^{th}$ farmer will make the choice to adopt a given cotton production practice and *e* is base of natural logarithms.

On taking $Z_i = \beta_O + \beta_1 X_1 + \beta_2 X_i$, equation (1) above can be re-written as thus:

$$P_i = \frac{1}{1+e^{-Z_i}} = \frac{e^Z}{1+e^Z} \quad \text{.....................................(2)}$$

Equation (2) above is the cumulative/logistic distribution function that can extensively be written as:

$$Z_i = \beta_O + \beta_1 X_1 + \beta_2 X_2 + \text{.........} + \beta_n X_n + \mu_i \quad \text{.......(3)}$$

Where: $\beta_o$ ......$\beta_n$ coefficients to be estimated; $X_1$.......$X_n$ are explanatory variables; and $\mu_i$ is the error term.

Since $P_i$ is the probability that the $i^{th}$ farmer makes the decision to adopt the new cotton production practice, then (1 - $P_i$) is the probability that the decision will not be made. Hence,

$$1 - P_i = \frac{1}{1+e^{Z_i}} \quad \text{..................................................(4)}$$

Therefore, the odds ratio is computed as follows:

$$\frac{P_i}{1-P_i} = \frac{1-e^{Z_i}}{1+e^{-Z_i}} = e^{Z_i} \quad \text{.......................................(5)}$$

To obtain the logit ($L_i$), we take the natural log of equation (5) as below:

$$L_i = \ln\left[\frac{P_i}{1-P_i}\right] = Z_i = \beta_O + \beta_1 X_1 + \beta_2 X_2 + \text{.........} + \beta_n X_n + \mu_i$$

$$\text{....................................................................(6)}$$

Where, *L* is the log of the odds ratio, linear in *X* and parameters.

From previous empirical studies on adoption of improved agricultural technologies, different sets of explanatory variables and, to some extent with varying definitions as well as measurements have been used (Batz et al., 1999 and Adesina and Baidu-Forson, 1995). In this study, these variables were categorized into socio-economic (farmers' age, household size, area under cotton), institutional (access to extension services, technology trial demonstration participation), and farmers' perceptions of improved technologies (perception of relative advantage, perception of compatibility and perception of complexity). That is,

$$ADOPT = \beta_O + \beta_1 AGE + \beta_2 HSIZE + \beta_3 AREA + \beta_4 EXTN + \beta_5 FFSP + \beta_6 RADV + \beta_7 COMPT + \beta_8 COMPX + \mu$$

$$\text{....................................................................(7)}$$

Where: *ADOPT* is farmer adoption of improved cotton production technology or bundle of technologies (1 = adopt, 0 = not adopt); *AGE* is the age group of cotton farmer (0 = < 30 years, 1 = 30- 44 years, 1 = 45 – 60 years, 1 = > 60 years); *HSIZE* is farmer's household size (number of people); *AREA* is area under cotton production (hectares); *EXTN* is farmer access to extension services (1 = yes, 0 = no); *FFSP* is farmer participation in farmer field school (1 =yes, 0 = no); *RADV* is composite index for farmer perception about relative advantage of production technologies; *COMPT* is composite index for farmer perception about compatibility of production technologies; *COMPX* is composite index for farmer perception about complexity of production technologies; $\beta_0$ is intercept; $\beta_1$ – $\beta_8$ are coefficients to be estimated; and $\mu$ is the error term.

### *Data Collection*

The study was conducted in eastern Uganda. Cotton used to be a major cash crop grown in eastern Uganda particularly in the cotton-finger millet zone (cattle corridor). But, its production started declining in late 1980s due to both production and marketing constraints. Thus, in early 2000s CDO and UGCEA in partnership with USAID combined efforts to revitalize cotton production in eastern Uganda through the promotion of improved production technologies using a farmer field school approach.

A stratified sampling method was used in which cotton farmers were divided into two groups: FFS participants and non FFS participants. To serve as a sampling frame for FFS participants, a list of farmers who participated in the farmer field school was drawn with the assistance from project extension workers. From this list, a random sample of 100 farmers was drawn. For pair-wise comparison purposes, a list of farmers who did not participate in FFS was also created with help of project extension workers and sub county cotton mobilizers, and out of which, 100 farmers were randomly selected to participate in this study.

Data used in this study was primary data and it was collected in a survey using standard questionnaires. Eight sub-county extension personnel and cotton mobilizers who were conversant with the local language of respondents undertook an intensive one-day training session on data collection techniques prior to the survey. Data collection was done between the months of June and August 2007 and covered 200 randomly sampled cotton farmers. After cleaning of the data, 181 questionnaires were used in the analysis. The questionnaire captured farmers' socio-economic characteristics (e.g. gender, age, educational level, household size, land and labor availability); institutional arrangements (access to extension and credit, group membership, and FFS participation); and farmer perceptions towards new technologies (relative advantage, compatibility, and complexity).

To complement the survey data and to have a detailed insight into adoption of cotton production technologies in the study area, informal interviews with agricultural extension agents, CDO and UGCEA staff were also conducted.

## RESULTS

### *Characteristics of Cotton Farmers*

Generally, these findings show that cotton farmers in both counties were smallholders. There were no significant differences in gender, age, household size, group membership between respondents who participated and those who did not participate in the Farmer Field School (Table 3). Ninety-two percent of the respondents were males, 73% were in the age bracket of 30 to 60 years, and 63% belonged to a farmers group or an association. However, there was a significant difference between groups of respondents as regards education level, average area under cotton production, and cotton farming experience as shown by both the Chi-square and F-test. FFS participants tended to be more educated as well as had more land under cotton production of over 1.2 acres compared to 0.7 acres for non participants(Table 1) .

**Table 1:** Characteristics of cotton farmers in eastern Uganda

| Characteristic | FFS Participants (n =93) | Non FFS Participants (n = 88) | Total (n = 181) | $\chi^2$-/ F- test |
|---|---|---|---|---|
| Gender (%) | | | | |
| Male | 92.4 | 90.9 | 91.7 | 0.146 |
| Female | 7.5 | 9.1 | 8.3 | |
| Age (%) | | | | |
| < 30 | 8.6 | 9.1 | 8.8 | |
| 30 – 44 | 35.5 | 37.5 | 36.5 | 0.195 |
| 45 -60 | 36.6 | 36.4 | 36.5 | |
| > 60 | 19.3 | 17.0 | 18.2 | |
| Education level (%) | | | | |
| None | 17.2 | 29.5 | 23.2 | |
| Primary | 47.3 | 50.0 | 48.6 | |
| Secondary | 35.5 | 17.1 | 26.5 | 12.002*** |
| Tertiary | 0.0 | 3.4 | 1.7 | |
| Group membership (%) | | | | |
| Yes | 69.7 | 54.9 | 62.6 | 3.437 |
| No | 30.3 | 45.1 | 37.4 | |
| Access to extension (%) | | | | |
| Yes | 94.6 | 34.1 | 65.2 | 73.013*** |
| No | 5.4 | 65.9 | 34.8 | |
| Household size | 9.1 | 8.2 | 8.7 | 1.488 |
| Area of cotton field (ha) | 1.2 | 0.7 | 0.9 | 9.731*** |

**Note:** *** Significant at the p < 0.01 level

**Table 2:** Farmer Perceptions of Plant Configuration

| Technology characteristic | Type of farmer | Distribution of farmers by perception scale (%) | | | | | Average score |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | |
| Relative advantage[a] | FFS | 0.0 | 2.2 | 3.2 | 59.1 | 35.5 | 4.28 |
| | Non FFS | 2.3 | 15.9 | 10.2 | 54.5 | 0.7 | 3.68 |
| | Total | 1.1 | 8.8 | 6.6 | 56.9 | 26.5 | 3.99 |
| Compatibility[b] | FFS | 1.1 | 1.1 | 0.0 | 72.0 | 25.8 | 4.20 |
| | Non FFS | 5.7 | 5.7 | 0.0 | 75.0 | 13.6 | 3.85 |
| | Total | 3.3 | 3.3 | 0.0 | 73.5 | 19.9 | 4.03 |
| Complexity[c] | FFS | 29.3 | 65.9 | 0.0 | 4.9 | 0.0 | 1.80 |
| | Non FFS | 25.8 | 48.5 | 0.0 | 24.2 | 1.5 | 2.27 |
| | Total | 27.7 | 58.1 | 0.0 | 13.5 | 0.7 | 2.01 |

**Note:** Chi-square tests: a = 21.104***; b = 9.210***, and c = 13.451***
**Note:** Relative advantage (1 = very disadvantageous, 5 = very advantageous);
Compatibility (1 = very incompatible, 5 = very compatible); and
Complexity (1 = very simple, 5 = very complex).

***Farmers' Perceptions toward Improved Cotton Production Technologies***

Since farmers' perceptions of technology attributes are varied, it is first important to rank them. Hence, a five-point likert scale was used to capture farmer perceptions of three different improved cotton production technology attributes, namely: relative advantage (1 = very disadvantageous, 5 = very advantageous); compatibility (1 = very incompatible, 5 = very compatible); and complexity (1 = very simple, 5 = very complex). Respondents' perceptions of cotton production technologies that were promoted in eastern Uganda (plant configuration, weed control, pest and disease control, and inorganic fertilizer application) are summarized in Tables 2–5.

**Table 3:** Farmer Perceptions of Weed Control

| Technology characteristic | Type of farmer | Distribution of farmers by perception scale (%) | | | | | Average score |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | |
| Relative advantage[a] | FFS | 1.1 | 5.4 | 0.0 | 75.3 | 18.3 | 4.04 |
| | Non FFS | 3.5 | 36.0 | 0.0 | 48.8 | 11.6 | 3.29 |
| | Total | 2.2 | 20.1 | 0.0 | 62.6 | 15.1 | 3.68 |
| Compatibility[b] | FFS | 2.2 | 9.7 | 0.0 | 69.9 | 18.3 | 3.92 |
| | Non FFS | 8.0 | 26.1 | 1.1 | 55.7 | 9.1 | 3.32 |
| | Total | 5.0 | 17.7 | 0.6 | 63.0 | 13.8 | 3.63 |
| Complexity[c] | FFS | 24.7 | 68.8 | 0.0 | 3.2 | 3.2 | 1.91 |
| | Non FFS | 17.0 | 48.9 | 0.0 | 27.3 | 6.8 | 2.58 |
| | Total | 21.0 | 59.1 | 0.0 | 14.9 | 5.0 | 2.24 |

**Note:** Chi-square tests: a = 28.362***; b = 15.262***, and c = 23.018***
**Note:** Relative advantage (1 = very disadvantageous, 5 = very advantageous);
Compatibility (1 = very incompatible, 5 = very compatible); and
Complexity (1 = very simple, 5 = very complex).

***Plant configuration***

Plant configuration encompassed planting in straight lines using plant spacing of 75 cm between rows and 30 cm between holes with two plants per hill. This would give a uniform spatial plant arrangement in the field and this spatial arrangement was to facilitate subsequent crop management operations, such as weeding, pesticide application, and fertilizer application.

Farmer's perception of the new plant configuration was elicited and compared to the old technologies. On average, respondents perceived the new technology to be of relative advantage, simple, and compatible to the existing farming technologies. It was found that over 95% (55%) of FFS participants (non FFS participants) perceived the new plant configuration to be of an advantage relative to the old technology, 98% (89%) felt it was compatible with the existing technologies, and 95% (74%) said it was a simple technology (Table 2).

***Weed control***

Cotton is a crop that is not tolerant to weed infestation and hence, weed control was emphasized in the demos as being a big determinant in affecting yield and quality of cotton. It was recommended to farmers to carry out at least three rounds of weeding depending on the initial field preparation, with the first one starting 15 days after cotton germination.

In Table 3 below, it can be seen that 94% of FFS participants perceived new weed control technology to be of advantage relative to the old weeding technology, 88% thought it to be compatible to the traditional weeding technology, and 94% said it was simple compared to the old weeding technology. Similarly, this practice was also rated by a majority of non FFS participants as being at least simple (66%), compatible (65%), and advantageous (60%).

***Pest and disease control***

Cotton is greatly affected by both pests and diseases during its growth phases. Thus, depending on the level of infestation and economic damage at least four (4) pesticide applications were deemed to be adequate for the entire crop season. At 6 weeks after germination, spraying was recommended to target sucking pests, 8 to 10 weeks chewing pests and at boll opening stage against cotton strainers.

Respondents gave their general perception of the new pest and disease control regime. It was found that 95% of the FFS participants considered it to be advantageous compared to the old spraying regime, 99% perceived it to be compatible with their farming practices, and 83% said it was a relatively simple technology. In contrast, a small proportion of non FFS participants found this practice to be simple (15%), compatible (50%), and advantageous (27%) as shown in Table 4 below:

***Fertilizer application***

Soil fertility management in cotton production by way of inorganic fertilizer application was emphasized in the demos as being critical to attaining high yields. Technology recommendations were expressed in terms of number of kilograms of fertilizer to be applied per acre. It was recommended that 50 kg of Diammonium phosphate (DAP) per acre be applied as a basal fertilizer at planting and 100 kg of Urea per acre as top dressing

**Table 4:** Farmer Perceptions of Pests and Disease Control

| Technology characteristic | Type of farmer | Distribution of farmers by perception scale (%) | | | | | Average score |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | |
| Relative advantage[a] | FFS | 0.0 | 4.3 | 1.1 | 68.8 | 25.8 | 4.16 |
| | Non FFS | 6.8 | 48.9 | 17.0 | 27.3 | 0.0 | 2.65 |
| | Total | 3.3 | 26.0 | 8.8 | 48.6 | 13.3 | 3.43 |
| Compatibility[b] | FFS | 0.0 | 1.1 | 0.0 | 91.4 | 7.5 | 4.05 |
| | Non FFS | 1.1 | 46.6 | 2.3 | 50.0 | 0.0 | 3.01 |
| | Total | 0.6 | 23.2 | 1.1 | 71.1 | 3.9 | 3.55 |
| Complexity[c] | FFS | 28.0 | 54.8 | 0.0 | 16.1 | 1.1 | 2.08 |
| | Non FFS | 1.1 | 13.8 | 0.0 | 72.4 | 12.6 | 3.82 |
| | Total | 15.0 | 35.0 | 0.0 | 43.3 | 6.7 | 2.92 |

**Note:** Chi-square tests: a = 92.726***; b = 61.035***, and c = 85.057***
**Note:** Relative advantage (1 = very disadvantageous, 5 = very advantageous);
Compatibility (1 = very incompatible, 5 = very compatible); and
Complexity (1 = very simple, 5 = very complex).

**Table 5:** Farmer Perceptions of Inorganic Fertilizer Application

| Technology characteristic | Type of farmer | Distribution of farmers by perception scale (%) | | | | | Average score |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | |
| Relative advantage[a] | FFS | 13.0 | 51.1 | 33.7 | 2.2 | 0.0 | 2.25 |
| | Non FFS | 0.0 | 23.3 | 74.4 | 2.3 | 0.0 | 2.79 |
| | Total | 6.7 | 37.6 | 53.4 | 2.2 | 0.0 | 2.51 |
| Compatibility[b] | FFS | 4.3 | 50.5 | 26.9 | 17.2 | 0.0 | 2.55 |
| | Non FFS | 1.1 | 21.8 | 73.6 | 3.4 | 0.0 | 2.79 |
| | Total | 2.8 | 36.7 | 49.4 | 10.6 | 0.0 | 2.67 |
| Complexity[c] | FFS | 1.1 | 11.8 | 29.0 | 53.8 | 4.3 | 3.47 |
| | Non FFS | 2.3 | 1.1 | 67.8 | 27.6 | 1.1 | 3.22 |
| | Total | 0.0 | 2.3 | 14.8 | 47.2 | 35.8 | 3.35 |

**Note:** Chi-square tests: a = 36.027***; b = 5.248***, and c = 4.806***
**Note:** Relative advantage (1 = very disadvantageous, 5 = very advantageous);
Compatibility (1 = very incompatible, 5 = very compatible); and
Complexity (1 = very simple, 5 = very complex).

applied 50% at the on set of flowering and, the last 50% two weeks after.

Generally, respondents perceived the technology to be of no relative advantage, incompatible and complex (Table 5). Results show that only 2% of the FFS participants perceived the technology to have any relative advantage; only 17% perceived it to be compatible to their farming technologies, and 58% said it was complex. Same or worse off results were obtained in the case of non FFS participants, with a majority of them being undecided in giving their opinions about this practice.

### *Farmer Adoption of Improved Cotton Production Technologies*

Results on incidence of adoption of improved production technologies among cotton producers are shown in Table 6 below. Generally, incidence of adoption of single or combination of technologies was higher among FFS participant than non FFS participant farmers. However, adoption of weed control and plant configuration was found to be high among both FFS participants and non participant farmers. It is important to note that use of inorganic fertilizers was not registered on any farmer's field at the time of the study.

### *Factors Affecting Adoption of Cotton Production Technologies*

Results from the logistic regression models presented in Table 7 below depict that socio-economic and institutional factors together with farmers' perceptions towards the technology had differing impacts on the decision to adopt any new technology by cotton farmers. The logistic regression models explained 70.2 – 92.1% of the total variation in farmer adoption of improved cotton technologies. Most of the variables tested had the

**Table 6:** Incidence of farmer adoption of improved cotton production technologies, %

| **Technology/Bundle of technologies** | FFS Participants (n=93) | Non FFS participants (n=88) | Total **(N=181)** | $\chi^2$-test |
|---|---|---|---|---|
| Plant configuration | 97.8 | 63.6 | 81.2 | 34.692*** |
| Weed control | 98.9 | 70.5 | 85.1 | 28.876*** |
| Pest & disease control | 94.6 | 22.7 | 59.7 | 97.121*** |
| Plant configuration & weed control | 96.8 | 50.0 | 74.0 | 51.458*** |
| Plant configuration & pest & disease control | 92.5 | 6.8 | 50.8 | 132.700*** |
| Weed control & pest & disease control | 93.5 | 19.3 | 57.5 | 101.900*** |
| Plant configuration & weed control & pest & disease control | 91.4 | 4.5 | 49.2 | 136.500*** |

hypothesized signs and are systematically discussed below:

### *Socio-economic factors*

Socio-economic factors considered in the study were age group of farmer (AGE), household size (HSIZE), and area under cotton (AREA). These factors had varying effects on the decision to adopt a given improved production technology the farmer. The farmer's age group (AGE) significantly influenced the decision of a farmer to adopt weed control as a single technology and as a package with pest and disease control. The odds of adopting improved weed control (or package) decreased by factors of 0.051 (0.126) for farmers in age groups of 30 – 44 compared to those in < 30 years age group (Table 7) below.

Household size (HSIZE) was found to be positively affecting the decision of farmers to adopt improved weed control technology. The odds of adopting weed control as a single technology or its joint adoption with plant configuration was increased by a factor of 1.376 (or 1.160) with increasing household size. However, as household size increases, the odds of a farmer adopting pest and disease control technology were found to decrease by a factor of 0.863.

Area devoted to cotton production (AREA) was found to significantly and positively influence the decision of a farmer to adopt pest and disease control or in combination with plant configuration. As the area under cotton increased, the odds of a farmer adopting pest and disease control (or package) increased by a factor of 3.040 (2.558). In contrast, the odds of a farmer adopting new plant configuration simultaneously with weed control decreased by a factor of 0.435 with increase in area under cotton.

### *Institutional factors*

Two institutional factors namely access to extension services (EXTN) and participation in FFS (FFSP) were included in the model. Access to extension services positively influenced farmer adoption of pest and disease control. The odds of adopting pest and disease control increased by a factor of 8.84 for a farmer who had access to extension than the one who did not have.

As hypothesized, farmer participation in FFS was indeed found to be significantly and positively influencing the adoption of improved cotton production technologies, separately or jointly. For example, the odds of adopting plant configuration as a single technology was raised by a factor of 12.223 for those farmers who had participated in FFS compared to those who had not; 15.119 for the joint adoption of plant configuration with weed control, 51.276 plant configuration with pest and disease control; and 147.104 for adoption of all the three technologies.

### *Farmer perceptions about technologies*

As shown in Tables 2-4, farmer perceptions were elicited with respect to technology relative advantage (RADV), compatibility (COMPT) and complexity (COMPX). Generally, the relationship between these characteristics and the adoption of technologies in question were found as hypothesized.

**Table 7:** Logistic Regression Results for Determinants of Adoption of Improved Cotton Technologies

**Table 7: Logistic Regression Results for Determinants of Adoption of Improved Cotton Technologies**

| Variable | Adoption of plant configuration | | Adoption of weed control | | Adoption of pest & disease control | | Adoption of plant configuration with weed control | | Adoption of plant configuration with pest & disease control | | Adoption of weed control with pest & disease control | | Adoption of all 3 technologies | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **B** | **EXP(B)** | **B** | **EXP(B)** | **B** | **EXP(B)** | **B** | **EXP(B)** | **B** | **EXP(B)** | **B** | **EXP(B)** | **B** | **EXP(B)** |
| **Constant** | 2.387 | .092 | -1.248 | .287 | 2.002** | .135 | -1.891 | .151 | -23.833** | .000 | -8.093 | .000 | -24.754* | .000 |
| | (2.881) | | (3.070) | | (.884) | | (3.759) | | (11.236) | | (5.002) | | (13.191) | |
| **AGE (30-44 years)** | 17.684 | 4.789E7 | -1.659 | .190 | -.334 | .716 | -.024 | 1.024 | 2.583 | 13.241 | -.437 | .646 | 2.746 | 15.574 |
| | (1.039E4) | | (1.558) | | (1.098) | | (1.229) | | (3.125) | | (2.222) | | (3.109) | |
| **AGE (45-60 years)** | .686 | 1.985 | -2.967** | .051 | -.374 | .688 | .124 | .884 | .260 | 1.297 | -2.072* | .126 | -1.099 | .333 |
| | (1.182) | | (1.305) | | (.764) | | (.892) | | (1.612) | | (1.210) | | (1.541) | |
| **AGE (>60 years)** | .332 | 1.393 | -.904 | .405 | .258 | 1.294 | .781 | 2.184 | 2.263 | 9.608 | -.616 | .540 | 1.410 | 4.098 |
| | (1.126) | | (1.347) | | (.771) | | (.907) | | (2.037) | | (1.184) | | (1.702) | |
| **HSIZE (Total No.)** | .143 | 1.154 | .319*** | 1.376 | -.149** | .863 | .149** | 1.160 | -.047 | .954 | -.071 | .931 | .040 | 1.041 |
| | (.108) | | (.118) | | (.062) | | (.075) | | (.094) | | (.079) | | (.086) | |
| **AREA (Ha)** | - .626 | .535 | .074 | 1.076 | 1.112** | 3.040 | -.831* | .435 | .939* | 2.558 | .561 | 1.753 | .193 | 1.213 |
| | (.522) | | (.750) | | (.471) | | (.437) | | (.571) | | (.724) | | (.490) | |
| **EXTN (Yes)** | - .106 | .899 | 2.024* | 7.571 | 2.179*** | 8.840 | .144 | 1.155 | 1.320 | 3.743 | 1.209 | 3.351 | 2.211 | 9.129 |
| | (1.134) | | (1.062) | | (.602) | | (.827) | | (1.409) | | (.889) | | (1.554) | |
| **FFSP (Yes)** | 2.503* | 12.223 | 1.201 | 3.325 | 3.603*** | 36.717 | 2.716*** | 15.119 | 3.937*** | 51.276 | 3.017*** | 20.422 | 4.991*** | 147.104 |
| | (1.377) | | (1.332) | | (.648) | | (.986) | | (1.529) | | (1.050) | | (1.340) | |
| **RADV (Index)** | 1.155** | 3.173 | .570 | 1.769 | .387 | 1.472 | .817** | 2.264 | 1.995** | 7.350 | 1.062*** | 2.891 | 1.187* | 3.277 |
| | (.485) | | (.629) | | (.509) | | (.384) | | (.853) | | (.402) | | (.653) | |
| **COMPT (Index)** | .325 | 1.384 | .768 | 2 .156 | .234 | 1.263 | -.173 | .841 | .880 | 2.411 | .714* | 2.043 | .650 | 1.915 |
| | (.465) | | (.541) | | (.145) | | (.333) | | (.618) | | (.393) | | (.475) | |
| **COMPX (Index)** | -1.208*** | .299 | -.878* | .416 | -.157 | .855 | -.714** | .489 | -.536 | .585 | -.976** | .377 | -.285 | .752 |
| | (.433) | | (.515) | | (.586) | | (.295) | | (.456) | | (.400) | | (.424) | |
| **Chi- square** | **77.491*****| | **93.672*****| | **128.853*****| | **87.661*****| | **166.272*****| | **180.846*****| | **157.539*****| |
| **-2loglikehood** | **41.831** | | **45.043** | | **60.733** | | **63.881** | | **29.942** | | **49.502** | | **38.299** | |
| **Nagelkerke $R^2$** | **.739** | | **.759** | | **.809** | | **.702** | | **.921** | | **.882** | | **.896** | |
| **% predicted** | **96.5** | | **95.3** | | **92.3** | | **91.5** | | **97.2** | | **95.3** | | **93.7** | |

**Note:** *Indicates significance at the 10% level, **Indicates significance at the 5% level, ***Indicates significance at the 1% level; standard errors of coefficients are in parentheses

The coefficients associated with RADV were positive and significant in the case of adoption of plant configuration and in combination with other technologies. As the technology was perceived to be more profitable, the odds of a farmer adopting plant configuration was raised by a factor of 3.173 and for joint adoption with weed control (2.264) pest and disease control (7.35). Moreover, the likelihood of adoption of all the three technologies was raised by a factor of 3.277 as farmers perceived this technology package to be more advantageous (profitable) than traditional ones.

Farmers' perception of technology compatibility (COMPT) was somehow positively correlated with joint adoption of weed control and pest and disease control. The likelihood of a farmer adopting the above technology package increased by a factor of 2.043 with increase in total compatibility perception index.

In contrast, farmers' perception of technology complexity (COMPX) was found to negatively influence farmer adoption of plant configuration, and to a lesser extent weed control. As farmer complexity perception index increased, the odds in favour of adoption of plant configuration (weed control) decreased by a factor of 0.299 (0.416). Furthermore, there was a less likelihood of a farmer jointly adopting plant configuration and weed control (0.489) or weed control and pest and disease control (0.377) as their total complexity perception index increased.

## DISCUSSION

Generally, participation in farmer field schools by cotton farmers raised the odds in favour of single or joint adoption of improved cotton production technologies except fertilizer application. This can be attributed to reduced perception of risk of use of new technologies since farmer field schools help farmers get knowledge and first hand experience with the technology (Witt et al., 2008). Farmer adoption of plant configuration and weed control technologies was also high among non FFS participants suggesting diffusion of knowledge. That could explain why these technologies were perceived by non FFS participants as being easy and compatible compared to traditional technologies. In addition, cotton is a labour intensive crop, especially weeding, and this might be the reason why farmers with larger households were more likely to adopt new weed control regime or in combination with plant configuration. In contrast, older farmers were not taking up recommended weed control regime probably because they were not able to hire labour considering their large household needs.

Despite the fact that there was a pesticide credit system implemented by CDO and UGCEA, it seems that it did not greatly improve non FFS participants' access to pesticides. This scheme benefited mainly cotton farmers who had access to extension services because in addition to training, extension workers also distributed pesticides on credit. However, farmers with larger households were less likely to adopt recommended pest and disease control regime as opposed to findings by De Souza Filho *et al.* (1999). This could be attributed to reduced affordability of pesticides by larger households that face other more pressing needs. Further, consistent with findings from Shively (1997), adoption of pest and disease control technology was higher with farmers owning larger cotton area. Large-scale cotton farmers might be wealthier and hence, able to afford agrochemicals, spray pumps, and hired labor for spraying compared to their counterparts.

Regarding lack of adoption of fertilizers by cotton farmers, other studies have also reported low use levels (1 - 3 percent) of fertilizers by smallholder farmers in Uganda (Okoboi, 2010; and Nkonya and Kaizzi, 2002). Besides the perceived high cost and unavailability of fertilizers, there is a general misperception among traditional farmers in most rural areas of Uganda that fertilizer 'destroys' natural soil fertility or soil as often blatantly mentioned by them.

Finally, the likelihood of a farmer adopting a single or bundle of improved technologies depended on their perceptions about these technologies as found in other studies (Maumbe and Swinton, 2000; and Pannell, 1999). Adopting the recommended plant configuration leads to higher cotton yields and hence, profits. With further farmer adoption of weed control and pest and disease control technologies, cotton yields and profits are enhanced and sustained. However, the complexity of some of these technologies could have inhibited less knowledgeable farmers, such as non FFS participants from adopting them.

## CONCLUSION

Following the findings from this study, it can be concluded that farmer participation in farmer field schools positively influences adoption of improved cotton production technologies. Therefore, if farmer adoption of these improved cotton production technologies is to be increased and sustained, there are three policy implications. Firstly, farmer direct involvement in a FFS needs to be encouraged for knowledge creation and to demystify negative perceptions about improved cotton production technologies. Secondly, the information dissemination system to farmers needs to be strengthened by increasing the number of farmer field schools in cotton production areas of Uganda. Lastly, farmer access to crucial cotton production inputs, such as fertilizers and pesticides, needs to be enhanced through establishment of input credit schemes.

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