



# THE IMPACT OF THE NATIONAL AGRICULTURAL ADVISORY SERVICES PROGRAM ON HOUSEHOLD PRODUCTION AND WELFARE IN UGANDA

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*Abstract:*

This paper examines the level of participation of vulnerable households headed by females, youths or people living with disabilities in Uganda's National Agricultural Advisory Services (NAADS) program, and the program's impact on agricultural households' access to extension services, the use of improved technologies, crop yield and share of output sold, consumption expenditures and poverty level. We use the difference-in-differences method to analyze panel data derived from matching data from the Uganda National Household Survey 2005/6 and Uganda National Panel Survey 2009/10. In addition, we validate and complement panel data results with qualitative data from focus group discussions. Our results indicate a lower participation rate of vulnerable households in NAADS and further indicate that households participating in NAADS, irrespective of vulnerability status, had higher access to extension services and credit, but the quality of services was of concern. No clear evidence of the program's impact on the increased use of improved technologies, crop yield and sales by households was observed. Households that participated in NAADS in both 2005/6 and 2009/10 exhibited relatively higher consumption expenditures than their counterparts that participated in NAADS in one period only or were non-NAADS. On the policy front, we argue that the Ministry of Agriculture and NAADS management need to implement an affirmative plan targeting more vulnerable farmers in NAADS phase II, recruit competent and dedicated extension workers, increase farmer capacity building activities and provide farmers with effective technical and input support.

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## 1. INTRODUCTION

In the 1990s, developing countries, including Uganda, witnessed wide-ranging reforms in the agricultural sector. In Uganda, these reforms included, among others, liberalization of trade in agricultural inputs, services and output; privatization of state-owned enterprises that supported production and marketing; and downsizing of civil servants who provided extension services. The reforms had both positive and negative consequences. Some of the negative effects of the reforms were income inequality and an increase in the proportion of the very poor in the early 1990s (Muwanga 2001); the collapse of public extension, credit and marketing services (Semana 2004); and falling agricultural productivity, according to the Ministry of Agricultural, Animal Industry and Fisheries (MAAIF 2010).

To overcome the negative consequences of agricultural reforms, the government of Uganda, with support from the World Bank and other donors, restructured the country's extension system, as part of the Plan for Modernisation of Agriculture (PMA), from unified public extension to a public-private partnership (PPP) extension system. The reforms of the agricultural

sector culminated in 2001 with the establishment of the National Agricultural Advisory Services Organization (through an act of Parliament, the National Agricultural Advisory Services Act of 2001) as a semiautonomous agency of the MAAIF, to manage the 25-year National Agricultural Advisory Services (NAADS) program.

In the PPP arrangement, the government contracts out extension services' provision to private individuals and agencies, which were hailed as an efficient means of delivering services to only those farmers who would demand the service, hence creating a demand-driven extension system that would minimize costs (World Bank 2001). Moreover, under the PPP extension system, it is envisaged that the central government will initially shoulder a greater share of the cost of extension services provision but later gradually shift the cost to the local government and the farmers through their organizations—thus making extension services demand-driven by the private sector.

The overall development objective of the new NAADS extension system was to assist poor male and female farmers to become aware of and be able to adapt to improved technology and management practices in their farming enterprises so as to enhance their productive

efficiency, their economic welfare and the sustainability of farming operations (World Bank 2001). In particular, according to the legal act that established NAADS, the program was to pay more attention to women, people living with disabilities (PLWDs) and young people who were considered to be those most affected by the economic reforms of the 1990s (Republic of Uganda 2001).

Given that NAADS is a long-term program, its implementation is planned to take place in phases. The first phase of its implementation was originally designed to last seven years (2001-2007), at a cost of \$108 million, but the project stretched on to June 2010. The second phase of NAADS (July 2010-June 2015), under the Agricultural Technology and Agribusiness Advisory Services (ATAAS) project, will cost at least \$450 million. Besides NAADS, the ATAAS project has another component focusing on agricultural research as well as joint activities on research and extension, and the whole project is estimated to cost \$666 million.

Despite the attention and resources devoted to the NAADS program to support households in accessing extension services in order to improve their productivity and hence welfare, there is limited public information on the impact of the program. Previous studies—including those by Benin and colleagues (2007 and 2011)—that have assessed the impact of the NAADS program are perceived by most people as internal evaluation reports of program performance, given the fact that the studies were partly funded and implemented by the NAADS

secretariat. The scarcity of additional, independent evidence on the impact of NAADS has heightened public concern regarding the effectiveness of the program in augmenting household productivity and incomes. This is particularly significant considering the fact that several audit and media reports have indicated some level of abuse of the program's resources by both NAADS administrators and beneficiaries.<sup>1</sup>

Using the nationally representative data collected by the Uganda Bureau of Statistics (UBoS) through its Uganda National Panel Program of 2009/10 (UNPS) linked to the Uganda National Household Survey (UNHS) of 2005/6, this paper provides new insights on the impact of NAADS.<sup>2</sup> These secondary data sources were complemented with qualitative data gathered through focus group discussions. Specifically, the paper seeks to investigate the extent of participation in the NAADS program by the most vulnerable households (i.e., those headed by women, youths and PLWDs), along with the impact of NAADS in enhancing farm households' access to extension services, the use of improved technologies, productivity, market participation, income and poverty reduction.

The paper is organized as follows: A brief overview of the NAADS program is presented in the next section. Section 3 discusses the relevant literature, and Section 4 presents and discusses the data and methods used to achieve the study objectives. The results are presented and discussed in Section 5, which is followed by the conclusion.



## 2. OVERVIEW OF THE NAADS PROGRAM

The NAADS program is a 25-year public-funded private sector-contracted extension system that is being implemented in phases. Its first phase started in July 2001 and ended in June 2010, and its second phase started in July 2010 and ends in June 2015. In 2001/2, NAADS started in 24 subcounties in six districts of Uganda, and by the end of 2006/7, the program had reached 545 subcounties—representing 83 percent of the total subcounties in Uganda at the time (Benin et al. 2007; Benin et al. 2011). In its second phase, NAADS is being implemented in all the districts and constituent subcounties of Uganda.

The NAADS program was initially designed to build the capacity of farmers to form and operate farmer associations, demand advisory services and adopt improved agricultural technologies and practices—through demonstration of the technologies by model farmers in the community (MAAIF 2000). Technology demonstration sites were managed by six model farmers per parish.<sup>3</sup> Revisions of the NAADS implementation guidelines in 2005/6, however, mandated program administrators to distribute free or subsidized inputs to more beneficiaries per parish.

The funding of NAADS is mainly through long-term multilateral and bilateral credit financing, which is a mixture of grants and loans. It is evident from table 1 that in the first phase of the program, 80 percent of the \$108 million NAADS budget was provided by multilateral and bilateral “cooperating partners,” while the central government contributed 8 percent; local governments, 10 percent; and participating farmers, 2 percent. However, there are notable significant changes in the funding modalities under phase II. In phase II, under the Ugandan government’s ATAAS project, multilateral and bilateral funding of NAADS and National Agricultural Research Organisation (NARO) indicate that the Ugandan government will pick 73.7 percent of the budget while its multilateral and bilateral partners will contribute 25.3 percent. Government counterpart funding is mainly through annual budgetary allocations and existing physical assets such as office equipment and infrastructure rollovers from NAADS phase I. Following the dismal performance by the local government and farmers toward NAADS co-funding in the first phase, this component of funding has been removed from phase II of the NAADS budgeting process.<sup>4</sup> Lack of counterpart funding from farmers, however, weakens farmers’ commitment toward program implementation unless robust program monitoring and evaluation mechanisms are in place.

**Table 1. The NAADS Financing Plan (millions of US\$)**

Source	NAADS I (2001/2–2009)		ATAAS (NARO & NAADS II ) (2010/11–2014/15)	
	Millions of Dollars	%	Millions of Dollars	%
International Development Agency (IDA)	45	41.7	120	18
International Fund for Agricultural Development (IFAD)	17.5	16.2		
Global Environment Facility (GEF)			7.2	1.1
Bilateral agencies and IFAD	23.34	21.6	41	6.2
Government of Uganda	9.12	8.5	497.3	74.7
Local government (district and subcounty)	10.8	10		
Farmers’ organizations	2.16	2		
<b>Total</b>	<b>107.92</b>	<b>100</b>	<b>665.5</b>	<b>100</b>

Sources: World Bank 2001; 2010.

Note: NAADS I refers to the first phase and NARO/NAADS II to the second phase.

In phase I, NAADS interventions were through five components: (1) advisory and information services to farmers; (2) technology development and linkage with markets, (3) quality assurance regulations and technical auditing; (4) private sector institutional development; and (5) program management and monitoring (MAAIF 2000). Under component one, for example, NAADS contracts private agricultural services providers (ASPs) to train selected farmers in modern production practices of crops, livestock and other enterprises such as apiary and aquaculture. Under this component, NAADS also hires ASPs to deliver solicited and unsolicited extension advice and information. Under the second component, the government contracts business agencies to supply and distribute improved inputs, such as seeds, fertilizer, heifers, day-old chicks and feeds to beneficiary farmers.

Implementation of the NAADS program has not been without challenges. For example, although NAADS guidelines indicate that participation of farmers in NAADS is supposed to be through the self-selection

of farmers through their farmer groups (NAADS 2007), in practice, it is mainly at the discretion of program administrators to determine who is eligible to participate (Okoboi et al. 2011). Also, the guidelines indicate that farmers selected to participate in NAADS under the three levels of the NAADS phase I hierarchy—demonstration, model and nucleus—should have specific credentials. The level of entry in NAADS determines the value of the goods and services that the farmer receives from NAADS. Nonetheless, due to political interference and nepotism, the guidelines are often overlooked such that some farmers are categorized in a level into which they do not fit and provided with goods and services for which they are not qualified. Other challenges in NAADS implementation include late disbursement of funds to district and subcounties where activities are implemented, embezzlement of funds, distribution of poor-quality inputs and government disruption of activities (Office of the Auditor General 2007; *Monitor*, February 5, 2008; Okoboi et al. 2011). These challenges obviously have implications for outcomes.

### 3. REVIEW OF SELECTED STUDIES ON IMPACT EVALUATION

**W**omen, PLWDs and youth constitute a large share of the portion of Uganda's population that actively works in agriculture. However, they face inequities in terms of access to productive resources, including land and credit as well as extension services—leading to productivity outcomes, according to the MAAIF and the Ministry of Finance, Planning and Economic Development (MAAIF and MoFPED 2000). A report by the International Fund for Agricultural Development, for example, notes that 72 percent of all employed women and 90 percent of all rural women in Uganda work in agriculture, compared with 53 percent of rural men (IFAD 2000). Nonetheless, women are marginalized in access to resources, information and participation in extension (Opio 2003). In addition, both women and other marginalized persons face other constraints such as low levels of education and economic power that affect their production efficiency (UBoS 2006).

According to the Youth Council Statute (1993) as well as the 1995 Constitution, "youth" are defined as young people within the age range of 18 to 30 years. However, government youth programs such as the Youth Capital Venture Fund have extended the upper age bound to 35 years. Like rural women, rural youth in Uganda depend on agriculture, in particular crop farming, but tend to be marginalized due to a lack of resources to access agricultural technologies (Kibwika and Semaana 2001). Conversely, marginalization and a failure of access to resources by PLWDs in Uganda is evident and tied to economic and social exclusion, isolation and neglect, resulting in increased poverty (Lwanga-Ntale 2003).

Both governmental and nongovernmental organizations establish programs to provide citizens with goods and services that they may not be able to afford or get through the market mechanism. It is the desire of insti-

tutions that put in place such programs to know the impact of the interventions on the livelihoods of targeted persons. Here, we review select impact evaluation studies of agricultural interventions.

In 1982, the Kenyan government adopted a training and visit extension management system supported by the World Bank. The project had the objectives of institutional development for extension services and a sustained increase in agricultural productivity. Gautam (2000) conducted a systematic review of the project to assess its achievement of these stated objectives. The evaluation results indicated that the project had some impact in terms of increased geographical coverage and an increased research-extension linkage but limited institutional development impact. Furthermore, the study indicated that the extension system was ineffective and inefficient in delivering the desired services to farmers, had only a limited impact on productivity, and, more important, was not financially sustainable.

In Bangladesh, nongovernmental organizations, such as the World Vegetable Center and the World Fish Center, had for a long time disseminated vegetable and polyculture fish production technologies, as well as provided extension services to farmers to enable them to optimally use their limited land. Using the methodology known as the average treatment effect on the treated, Kumar and Quisumbing (2010) examined the impact of the adoption of these technologies on household welfare. The researchers found a positive and significant increase in consumption expenditures and asset accumulation by farmers who adopted polyculture fish production technologies, but no significant change in consumption expenditures and asset accumulation was registered by farmers who adopted improved vegetables. The results for the nutritional status of vegetable and fish technologies adopters were mixed. For example, the authors found an increase in

vitamin A consumption by adopters of improved vegetables but a worsening long-term nutritional status of fish technology adopters.

In Uganda, the NAADS program was evaluated twice; in 2007 (Benin et al. 2007) and in 2011 (Benin et al. 2011). In the first round of evaluation, Benin and colleagues (2007) used simple difference in means analysis on cross-sectional data to compare the adoption of technology and new agricultural enterprises, productivity, commercialization, income, food security and nutrition across NAADS and non-NAADS households. The authors observed that NAADS appeared to have had a substantial positive impact on the availability and quality of advisory services provided to farmers; promoted the adoption of new crop and livestock enterprises, including modern agricultural production technologies and practices; and led to a greater use of postharvest technologies and commercial marketing of commodities. The authors found no significant changes in yield between NAADS and non-NAADS households for most crops. In the second round of the NAADS evaluation, Benin and colleagues (2011) used the propensity score matching (PSM) and average treatment effect on the treated methods on data collected in 2007 and 2005. Their findings revealed that NAADS had a great impact on access to advisory services but weak or no impact on the adoption of improved agricultural technologies, practices, and new crops and livestock enterprises. Furthermore, the authors found mixed results regarding change in agricultural revenue, food security and nutrition of participants in NAADS program. For example, NAADS impact on income was found to be positive and significant for adopters of livestock enterprises and insignificant for adopters of crops technologies.

The Independent Evaluation Group (2011) provides perhaps the most comprehensive review of impact evaluation studies to date of agricultural interventions by

diverse individuals and groups, including the World Bank. The authors observe that most agricultural evaluations applied quasi-experimental or nonexperimental methods and only a few evaluations considered the counterfactual to measure change resulting from the intervention. The common denominator for comparing results is whether an intervention has a positive impact on the targeted outcomes. In their meta-analysis, the authors indicate that impact evaluations of World Bank-supported interventions accounted for one-quarter of the evaluations covered by the analysis; of these, two-thirds had positive effects on various agricultural dimensions. The authors concluded that interventions that sought to improve yields or farm income by addressing market-linkage failures, easing access to technologically enhanced inputs and promoting farmer knowledge through advisory services had the highest share of positive effects.

Unlike the previous studies on the NAADS program, this paper employs a nationally representative panel data set with the ability to provide insights into the dynamics of household participation in the NAADS program and the associated agricultural-related outcomes. Moreover, the quantitative results in the paper are validated and augmented with qualitative information that sheds some light on the challenges and opportunities for improvement during the implementation of NAADS phase two. In particular, this paper examines factors influencing vulnerable households' (women, PLWDs and young people) participation in NAADS, which is very pertinent to the objective of establishing NAADS. Therefore, the results are expected to be important in the identification of levers relevant for policy intervention. By using the difference-in-difference (DID) method and associated significance tests, this paper provides policy-relevant evidence of the actual impact of NAADS program on crop yields, consumption expenditures and the poverty level. No previous study has provided these estimates.

## 4. DATA AND METHODS

### Data

This paper employs the nationally representative household survey data collected by UBoS. This study employs the panel survey based on the UNHS and the 2009/10 resurvey—the panel followed households. According to Ssewanyana and Kasirye (2012), the UNHS III survey covered 7,421 households with 42,111 individuals from May 2005 to April 2006. The survey was based on a two-stage, stratified, random-sampling design. In the first stage, enumeration areas were selected from the four geographical regions. In the second stage, 10 households were randomly selected from each of the enumeration areas. The seven-year Uganda National Panel Programme, which was first implemented in 2009/10 by UBoS, was targeted to resurvey 3,123 households from the UNHS sample. In the 2009/10 resurvey, UBoS was able to track 2,888 households out of the targeted 3,123 households. We further note that out of 2,888 households, 41 had partially filled questionnaires, whereas 281 households refused to participate in the survey. As such, only 2,566 households of the original target sample of 3,123 had complete information. This sample was reduced to 2,181 since the focus of the paper was on agricultural households.

The two waves collected information at the individual, household and community levels on a wide range of characteristics, including household roster, consumption expenditures, agricultural information including the crop production and sales, the use of improved technologies, access to extensions services and the area of land owned, among others. Households were visited twice in both waves to capture information related to agriculture on the entire farming calendar in both waves. It is also evident from the two surveys that 2009/10 captured more information on the NAADS program compared with 2005/6. Given this fact, the

paper focuses on those relevant questions that were captured in this exact manner (for further discussion see Ssewanyana and Kasirye 2012).

*Qualitative data collection:* Given the fact that the UBoS data collection exercise took place prior to the phase II of NAADS and that the relevant information was collected at the household level, there was a need to complement this data source with qualitative data. Qualitative data were obtained through focus group discussions (FGDs) that were held in nine districts of Uganda in the months of September and October 2012. The FGDs were conducted in the following districts: Lira and Apac (northern Uganda); Soroti, Mbale and Tororo (eastern Uganda); Luwero (central Uganda); and Kabarole, Kasese and Kibaale (western Uganda). The choice of the district for FGDs was based on the following reasons: the agro-ecological zone where the district was located, the number of years the district had been involved in NAADS program and enterprises promoted by NAADS in the district. In terms of agro-ecological zone, for example, the Lira, Apac and Soroti districts are located on the Kyoga plains; Kabarole and Mbale are in the highland ranges; Kasese and Kibaale are in the western savannah grasslands, and Luwero is in the Lake Victoria crescent. Regarding the number of years of district involvement in NAADS, the Kibaale, Soroti and Tororo districts have participated in NAADS since 2001/2, while Luwero, Kabarole, Kasese and Lira joined in 2002/3, Apac joined in 2003/4, and Mbale joined NAADS in 2004/5.

A guiding checklist of questions was used to conduct separate FGDs with NAADS and non-NAADS beneficiaries. A total of 36 FGDs were conducted; four FGDs per district in four randomly selected subcounties. In each district, two FGDs in two subcounties were conducted with NAADS beneficiaries and two FGDs in two subcounties with non-NAADS beneficiaries.

The size of focus groups ranged between 10 and 20 participants. In some FGDs, participants were mainly women, PLWDS or youths. Holding discussions with farmers of similar background enhanced openness and the level of participation in the discussion.

## Methods of Analysis

Evaluation of the impact of a program ideally necessitates comparing the intervention outcome with the counterfactual—that is, what the outcome would be without the program (Gertler et al. 2011). It is not possible, however, to observe at the same time two different outcomes of the same individual participating in an experiment or social program. The option, according to the authors, is to compare the outcomes of nonparticipants that are similar in characteristics in every respect with those participating in the program except for non-participation in the program.

One way to compare outcomes of program participants and nonparticipants of similar backgrounds and characteristics is to conduct randomized control trials (Gertler et al. 2011). In programs for which such trials were not built into the design, other impact evaluation techniques, including PSM and regression discontinuity design, have been developed as alternatives to randomizing. Despite the fact that impact evaluation of NAADS was conceived at the program design stage, no baseline data were ever collected to generate information on the recipients' backgrounds and production outcomes prior to intervention. Besides, due to nepotism and political influence in beneficiary participation, household participation in NAADS is not random. A lack of background data and nonrandomness in participation can pose evaluation challenges.

To overcome data-related challenges, this paper followed a two-stage modeling procedure. At stage 1,

the paper employed the PSM technique to generate comparison (non-NAADS) households that had similar characteristics as households participating in NAADS (treated). Thereafter, at stage 2 the difference-in-differences (DID) technique—also called double difference (DD) analysis—was employed on matched data derived from the PSM, as discussed below.

*Propensity score matching (PSM):* To generate closely matching comparison (non-NAADS) and treated (NAADS) households, we estimated a modified version of the Rosenbaum and Rubin (1983) PSM that is expressed in equation (1). That is, equation (1) is the probability ( $Pr$ ) of a farm household participating in NAADS in 2009/10 ( $T = 0, 1$ ), given its background characteristics in 2005/6 ( $X$ )—which is the conditional mean of the treatment ( $T$ ). Where  $p$  is the propensity score,  $Pr$  is the probability,  $T = \{0, 1\}$  is an indicator of exposure to treatment:  $T = 1$  if participating in NAADS, 0 otherwise, and  $X$  is the multidimensional vector of background characteristics.  $E$  is the mathematical expectation symbol:

$$p(X) = Pr(T = 1|X) = E(T|X) \quad (1)$$

Unlike Benin and colleagues (2011), this paper disaggregated the treated households further during the panel period, as follows:

1. NAADS I: if at least one household member participated in the NAADS program in 2005/6 only;
2. NAADS II: if at least one household member participated in the NAADS program in 2009/10 only;
3. NAADS III: if at least one household member participated in the NAADS program both in 2005/6 and 2009/10 and;
4. Non-NAADS: if no household member participated in the NAADS program both in 2005/6 and 2009/10. This is the comparison group, for which the PSM

analysis was used to generate matching comparison households for NAADS 1, NAADS 2 and NAADS 3.

The ( $X$ ) vector included background characteristics in 2005/6 as follows: characteristics of household head (age, years of schooling, sex, disability status); household characteristics (monthly consumption expenditures as a proxy for permanent income, land area owned); and community characteristics (place of residence urban/rural area). For the detailed construction of the household consumption expenditures (CEE), see Ssewanyana and Okidi (2007).<sup>4</sup> Conversely, a household is said to be living in poverty if its equivalent consumption expenditure per adult is below the minimum income of \$1 per day, or \$30 per 30-day calendar month, defined as the money required to meet the costs of basic needs (Ssewanyana and Kasirye 2012; UBoS 2009). Information on household CEE and poverty level are calculated by UBoS and provided as one of the variables in data for the UNHS and the UNPS.

The UNHS and UNPS data do not contain details of actual support that households get when they enroll and participate in NAADS. Progress reports of NAADS' implementation (available on the NAADS Web site, [www.naads.go.ug](http://www.naads.go.ug)) indicate, however, that farmers participating in NAADS get training in the development of farmer groups, enterprise selection and management, and modern agronomic practices. NAADS beneficiaries also receive other services, including extension advice and visits by contracted ASPs; free inputs (e.g., seeds, fertilizers, hoes or day-old chicks and feeds); and agro-processing and marketing information. In this paper, we have assumed that those farm households participating in NAADS received at least some of these interventions, most especially extension services and free inputs.

Although Uganda's 1995 Constitution considers youth as people within the age range of 18 to 30 years, in this study we categorized youth as age 15 to 35 years based on government youth programs, including the Youth Capital Venture Fund, that extend the eligible youth age to 35 years (MoFPED 2012). Additionally, we lowered the youth age to 15 years following the UBoS's categorization of the minimum age of agricultural household heads (UBoS 2009).

Equation (1) was estimated using the STATA *pscore* algorithm of Becker and Ichino (2002), whose default is the probit model. The STATA *pscore* algorithm includes an automatic function to test for the balancing property of matched observations. All estimates are weighted based on the UBoS re-weights for the panel.

*The difference-in-differences (DID) method based on PSM:* At stage 2, we used the DID method based on matched treated and comparison observations derived from the PSM analysis to assess the effect of participation in NAADS on household access to extension services, the use of improved technologies, productivity, market participation, and income and poverty levels. The assumption here was that treated (NAADS 1, 2 and 3) and comparison (non-NAADS) household observations would have similar characteristics, except for participation in NAADS.

The DID method is illustrated in table 2, where the outcomes before (e.g.,  $X$  output) and after (e.g.,  $Y$  output) of a population that is participating in a program (treated group) are compared with the outcomes before (e.g.,  $A$ ) and after (e.g.,  $B$ ) of a population that is not participating in a program (comparison group).

**Table 2. Illustration of the DID Method**

Type of Household	Before	After	Difference
Treated (households participating in NAADS)	Z	Y	$M_1 = (Y - Z)$
Comparison (households not participating in NAADS)	A	B	$M_2 = (B - A)$
Difference	$M_2 = (Z - A)$	$M_1 = (Y - B)$	$DID = M_1 - M_2 = (Y - Z) - (B - A)$

Source: Adopted from Gertler et al. 2011.

To estimate the DID, first, we used the two-sample t-test to get the mean and standard error values for treated and comparison households for before and after periods. Then we obtained the differences and the DID's values, using the calculation illustrated in table 2. In order to assess the statistical significance of the DID values, the standard error of the DID statistic was derived as expressed in equation (2):

$$\sigma(M_1 - M_2) = \sqrt{\left(\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}\right)} \quad (2)$$

where  $M_1$  and  $M_2$  are the mean differences of outcomes for treated and comparison households,  $\sigma_1$  is the standard error of  $M_1$ ,  $\sigma_2$  is the standard error of  $M_2$ ,  $n_1$  is the size of treated, and  $n_2$  is the size of comparison households. Besides the studies highlighted in the literature, other studies that have applied the DID method in

impact evaluation include Duflo (2001), Buddelmeyer and Skoufias (2004), Cattaneo and colleagues (2009), and Buttenheim, Alderman and Friedman (2011).

Summary statistics for the variables used in the analysis are presented in table 3. The descriptive statistics for the yield and share of output sold for the six crops (bananas, beans, maize, coffee, potatoes and groundnuts) that are analyzed in this paper are, however, not presented in table 3 due to space limitations but are available upon request. The summary statistics, which are further disaggregated by household participation in NAADS (appendix A1), indicate slight differences in household characters but noteworthy variations in some of the outcome variables, such as household access to extension services and access to credit.



**Table 3. Description and Summary Statistics of the Variables**

Variable	Definition	2005/6			2009/10	
		Obs.	Mean	Std. Dev.	Mean	Std. Dev.
<i>Individual/household characteristics</i>						
NAADS	Any member of household participating in NAADS: 1 if yes, 0 otherwise	2,181	0.06	0.24	0.27	0.44
Female	Household headed by woman: 1 if yes, 0 otherwise	2,181	0.25	0.43	0.24	0.43
PLWDs	Household headed by a PLWD: 1 if yes, 0 otherwise	2,181	0.15	0.35	0.23	0.42
Youth	Household headed by a youth (15–35 years): 1 if yes, 0 otherwise	2,181	0.36	0.48	0.23	0.42
Age	Household head's age in years	2,181	43.40	14.89	46.23	13.66
Education	Household head's education in years of schooling	2,181	6.92	3.62	7.02	3.76
Urban	Household resident in urban area: 1 if yes, 0 otherwise	2,181	0.13	0.34	0.12	0.33
Household size	Household size: number of persons	2,181	5.96	2.96	6.50	2.89
Land	Total land area owned by household in acres	1,992	7.18	34.07	2.62	6.36
<i>Outcome variables</i>						
External access	Household accessed any extension services: 1 if yes, 0 otherwise	1,992	0.09	0.28	0.44	0.50
Organic fertilizer	Household use of organic fertilizers: 1 if use, 0 otherwise	1,992	0.04	0.19	0.07	0.25
Inorganic fertilizer	Household use of inorganic fertilizers: 1 if use, 0 otherwise	1,992	0.01	0.09	0.01	0.10
Pesticide	Household use of pesticides/herbicides: 1 if use, 0 otherwise	1,992	0.02	0.14	0.04	0.18
Imp-seed	Household use of improved planting materials: 1 if use, 0 otherwise	1,992	0.05	0.22	0.27	0.44
Credit	Household access to formal/semiformal credit: yes = 1, 0 otherwise	1,992	0.07	0.26	0.11	0.31
Credit use agric.	Household loan use for agricultural production: yes = 1, 0 otherwise	1,992	0.16	0.37	0.15	0.36
CEE	Monthly household consumption expenditures equivalent: \$	2,181	29.22	28.48	31.49	28.13
Poverty	Household poverty status: poor = 1, non-poor = 0	2,181	0.29	0.46	0.21	0.41

Sources: UNHS 2005/6 and UNPS 2009/10; and Bank of Uganda for exchange rate: 2005/6 \$1= Ush 1819.76; 2009/10 \$1= Ush 1989.

## 5. RESULTS AND DISCUSSION

### Households' Participation in NAADS

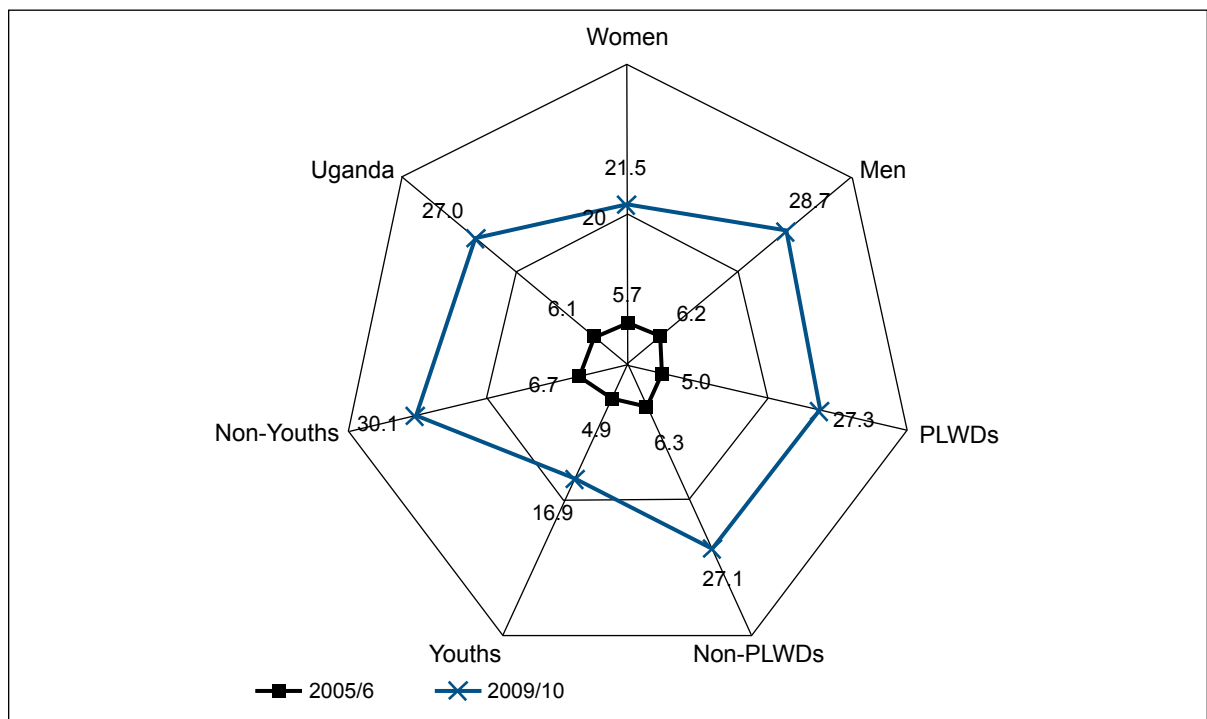
While the issue of *vulnerable* groups in the NAADS program might have meant to target individuals, the UBoS data were collected at the household level. To circumvent this data challenge, a household was classified as vulnerable if headed by a female, youth or a PLWD. But that said, the qualitative data gathered through FGDs provide insights on what is happening at the individual level.

The share of households participating in NAADS program in 2005/6 and 2009/10 by household type is shown in figure 1. Although NAADS is said to cover the whole country, the share of households who participated in the program in 2009/10 was only 27 percent of about 5 million agricultural households in the

country, having increased from 6 percent of 4.2 million agricultural households in 2005/6. Notwithstanding the fact that NAADS was established to prioritize support to households headed by women, young people and PLWDs; there appears to be an increasing gap in participation of these categories of households in the NAADS program. For example, the gap between youth (16.9 percent) and non-youth (30.1 percent) household heads participating NAADS has increased to 13 percent in 2009/10 when it was just 1.8 percent in 2005/6. Similarly, the gap between female- and male-headed households participating in NAADS in 2009/10 significantly increased to 7.2 percent from 0.5 percent in 2005/6.

Evidence from FGDs indicates that prejudice, lack of awareness and nepotism were the main reasons for lower participation of women, PLWDs and youth in the

**Figure 1. Participation of Households in NAADS Household Type of Beneficiaries, %**



Source: Authors' calculations based on UNHS 2005/6 and UNPS 2009.

NAADS program. The FGDs participants observed that women, particularly widows and those separated from spouses were reluctant to attend NAADS meetings due to prejudice and intimidation from some of the men who attend these meetings. Also, FGDs participants noted that women who were participating in NAADS were mostly those who were married, and often whose husbands were either participating in the NAADS administration or in leadership of farmer groups.

Despite the fact that youths revealed in the FGDs that they were interested in participating in NAADS, they decried the lack of information and discrimination by older persons as the most limiting factor to their participation. In particular, the youths observed that when it comes to participation in NAADS, program administrators use door-to-door communication through village leaders who pass on information to only the few people they desire to participate in NAADS. The PLWDs, conversely, noted that their exclusion from NAADS was premised on their apparent lack of or limited

involvement in farming, which the PLWDs countered as untrue. According to Hoogeveen (2004), subsistence farming followed by petty trade are the main sources of livelihood for PLWDs in Uganda.

### Factors Influencing Households' Participation in NAADS

Results of the PSM (probit model) to identify key factors influencing household participation in NAADS as well as to generate comparison households (non-NAADS) for the three categories of participation in NAADS (NAADS I, NAADS II, and NAADS III) are presented in table 4. Balancing tests results (see appendix A2) indicated no statistically significant ( $p > 0.05$ ) differences in mean  $p$ -scores for NAADS participants and comparison households, which implies that the treated (NAADS participants) and comparison households had similar characteristics and—as per Heckman, Lalonde, and Smith (1999)—fall in the region of common support.

**Table 4. Factors Influencing Participation in NAADS: PSM-Probit Model Estimates**

Dependent variable: participation in NAADS = 1						
Explanatory variables	NAADS I		NAADS II		NAADS III	
	Coef.	Z	Coef.	Z	Coef.	z
Woman	0.27*	1.91	-0.09	-0.92	0.01	0.09
PWD	-0.23	-1.22	0.06	0.61	-0.04	-0.22
Age	0.03	1.4	0.11**	6.82	0.07***	3.07
Age (square)	0.00	-0.99	-0.00***	-6.33	-0.00**	2.63
CEE (ln)	0.29***	3.05	0.13**	2.25	0.32	3.56
Educ (ln)	0.22**	2.18	0.48***	7.52	0.08	1.00
Land owned (ln)	-0.01	-0.07	0.10***	2.84	0.14**	2.62
Urban	-0.75***	-3.14	-0.15	-1.42	-0.36	-1.92
Intercept	-3.63***	-6.4	-4.49***	-11.43	-3.44***	-6.92
Observations	1,427		1,840		1,447	
Chi	37.99		175.53		43.58	
Pseudo R <sup>2</sup>	0.06		0.08		0.06	

Note: \*\*\*, \*\*, and \* indicate statistical significance at the 1, 5 and 10 percent levels, respectively.

The results given in table 4 indicate that household head participation in NAADS was not influenced by the fact that the household head was a woman, PLWD or youth, which confirms results in figure 1. Factors that positively and significantly influenced the household head's participation in NAADS, however, were: seniority in terms of age, education level, size of land owned and consumption expenditures equivalent. These results were corroborated with qualitative information from FGDs that indicated that the social status (informally measured by assets such as income, land holding, education and seniority in terms of age) of the household head weighed highly in the likelihood of participation in NAADS. The results, moreover, confirm the long-held opinion by some sections of society—for example, Rwakakamba, Sunday and Katungisa (2011)—that NAADS interventions target mostly well-to-do farmers.

### NAADS' Impact on Access to Extension Services

One of the short-term benefits of household participation in NAADS is access to extension services provided by the ASPs. The relationship between participation in NAADS and access to extension services is

shown in table 4. The results of the DID analysis based on matched data (table 4) show that up to 90 percent of households participating in NAADS in 2009/10 had access to extension services, compared with only 28 percent of non-NAADS households. In 2005/6, NAADS households' access to extension services ranged between 14 and 33 percent, compared with 7 percent for non-NAADS households, leading to the high DID.

Overall, results indicate a positive and statistically significant difference in the level of access to extension services by households participating in NAADS II (59.7 percent) as well as those who participated in NAADS III (38.8 percent). For households whose members were in NAADS I, however, there were no significant changes in access to extension services in 2009/10 compared with non-NAADS households. Benin and colleagues (2011) also found a high and statistically significant increase in access to advisory services by farmers participating in NAADS in the period 2004 to 2007.

Evidence from FGDs revealed that the apparently low level of access to extension services by NAADS beneficiaries in 2005/6 compared with 2009/10 was due to the fact that in the early NAADS (2001/2–2005/6), extension service delivery was undertaken by local gov-

**Table 5. Household Participation in NAADS and Access to Extension Services**

Participation in NAADS	2005/6	2009/10	Difference	Difference in difference (DID)
Non-NAADS (comparison)	6.99 (0.63)	25.78 (1.05)	18.79 (0.03)	
NAADS I	21.70 (4.02)	40.57 (4.79)	18.87 (0.61)	0.08 (0.61)
NAADS II	13.51 (1.45)	91.99 (1.11)	78.48 (0.08)	59.69*** (0.08)
NAADS III	33.33 (4.49)	90.99 (2.73)	57.66 (0.50)	38.87*** (0.50)

Note: \*\*\*, \*\* and \* indicate significance at the 1, 5 and 10 percent levels, respectively; figures in parentheses are t-values derived from differences in means t-test.

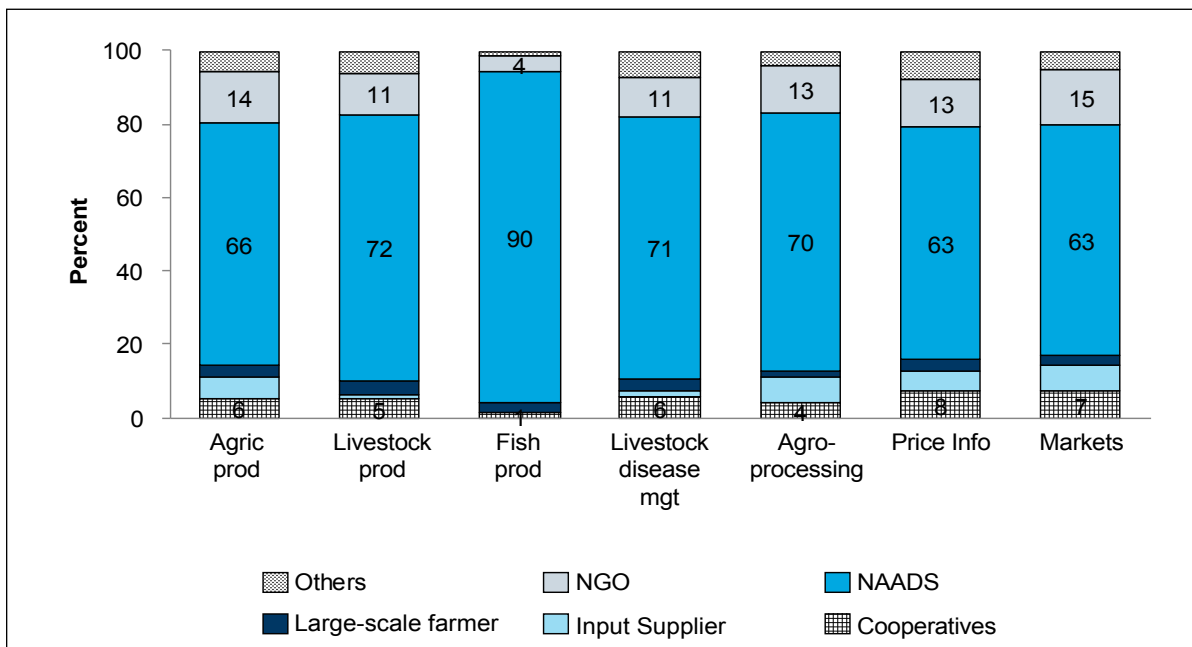
ernment extension staff who were few in number (one staff per subcounty), and in most instances doubled as subcounty NAADS coordinators. In the later years (2006/7 to date) of NAADS implementation, however, two ASPs per subcounty were contracted and, moreover, well facilitated with good remuneration and a motorcycle by NAADS to carry out regular extension services, both solicited and unsolicited. Usually, in each subcounty there is one ASP in charge of crops and another one in charge of livestock and poultry.

Although the share of NAADS beneficiaries accessing extension services from ASPs has increased, ensuring the quality and frequency of the services is a major challenge. During the FGDs, farmers complained that NAADS extension workers (i.e., ASPs) lacked the knowledge, skills and/or time to satisfactorily attend to their problems. For example, our interactions with some ASPs during the FGDs' fieldwork revealed that

some of the ASPs were qualified in nonagricultural disciplines such as social work and secondary school teaching. Besides, most ASPs had other regular jobs and considered extension work part time.

Apart from the low service frequency and inexperience of ASPs, the farmers we interviewed also revealed that most of the training they received from ASPs was theoretical in nature and not subject specific in content—that is, neither specific to the enterprise promoted nor sufficiently detailed on the subject matter to be practically applicable. For example, some participants disclosed that they were trained—theoretically and without concrete in-field demonstration—on how to apply fertilizer and fungicides on crops. It was also noted that sometimes the training conducted by the ASPs was not matched with the planting seasons; for example, training on plant spacing is sometimes held long after farmers have planted.

**Figure 2. Sources of Extension Advice in Uganda in 2009/10 (%)**



Source: Authors' calculations based on UNPS 2009/10.

Note: Agric stands for agriculture; prod, production; mgt, management; info, information, and NGO, non-governmental organization.

Notwithstanding the challenges of service quality, the NAADS program has become the major source of extension services in Uganda, particularly for specialist enterprises such as fish and exotic livestock farming (figure 2). The significance of NAADS as the source of extension is apparent when, in table 5, one compares the 40 percent level of access to extension services by households participating in NAADS in 2005/6 but excluded in 2009/10 with the 90 percent access rate by households participating in NAADS in 2009/10.

The second most important source of extension services are nongovernmental organizations, which, among others, include the Northern Uganda Social Action Fund, Heifer International, the Uganda Women Concern Ministry and CARITAS.

### Participation in NAADS and Access and Use of Credit

Access to credit by agricultural households does not necessarily imply the use of credit for agricultural production. The results given in table 6 show the relationship between household participation in NAADS and access to and use of credit from formal and semiformal financial institutions such as commercial banks,

microfinance institutions, and savings and credit co-operatives (SACCOs). Regarding access to credit, the results clearly indicate that a significantly higher share of households participating in NAADS had access to credit compared with non-NAADS households. The notable increase—albeit starting from a low percentage—in the share of NAADS participants accessing credit may be due to the fact that farmers participating in NAADS are encouraged and supported to form and operate SACCOs at the subcounty level, then linked to microfinance institutions and commercial banks for access to credit products either as individuals or in groups.

Although table 6 shows signs of improvement, access to credit by agricultural households nonetheless remains low. The FGD participants cited the untrustworthiness of SACCOs' administrators and high interest rates charged on loans as the main turn-off to their participation in SACCOs. Much as the NAADS initiative may help farmers to access credit, it appears—as shown in table 6—that few farmers actually use credit for agricultural production. Moreover, the share of households who participated in NAADS in 2009/10 that allocated credit for agricultural production declined significantly ( $p < 0.01$ ) in 2009/10 compared with 2005/6 and when contrasted with non-NAADS households.

**Table 6. Participation in NAADS and Access and Use of Credit**

Participation in NAADS	Access to Credit				Use of Credit for Agriculture			
	2005/6	2009/10	Diff.	DID	2005/6	2009/10	Diff.	DID
Non-NAADS	6.7 (0.6)	7.3 (0.6)	0.6 (0.06)		12.0 (1.4)	12.4 (1.2)	0.4 (0.07)	
NAADS I	11.3 (3.12)	20.7 (3.91)	9.4 (0.40)	8.8*** (0.40)	18.8 (7)	34.4 (6.1)	15.6 (0.82)	15.2*** (0.82)
NAADS II	14.5 (1.5)	18.6 (1.6)	4.1 (0.08)	3.5*** (0.10)	26.5 (2.9)	17.1 (2)	-9.4 (0.18)	-9.8*** (0.20)
NAADS III	18.9 (3.7)	23.4 (4)	4.5 (0.39)	3.9*** (0.39)	31.7 (5.9)	18.4 (4.5)	-13.3 (0.32)	-13.7*** (0.33)

Note: \*\*\*, \*\*, and \* indicate significance at the 1, 5 and 10 percent levels, respectively; figures in parentheses are t-values derived from differences in the means t-test.

## **Participation in NAADS and the Use of Improved Agricultural Technologies**

Though not originally designed as a program activity, the distribution of inputs by NAADS is now perhaps one of the program's most prominent supportive activities for participating farmers. According to the NAADS goals, those farmers receiving free improved inputs—coupled with extension training, advice and market information—are expected to exhibit higher levels of sustained use (adoption) of the technology compared with those farmers of similar backgrounds who are not participating in NAADS. This issue is assessed in table 7, by examining the dynamics in the proportion of NAADS and non-NAADS households using manure, fertilizer, pesticides/herbicides and improved seeds.

Overall, all the DID coefficients for fertilizer use were negative and not statistically significant, whereas the results for pesticide/herbicide use were positive but not statistically significant. Two of the results for manure use were positive and statistically significant, whereas those for improved seed carried mixed signs and statistical significance. Positive and statistically significant results—for example, for manure for households NAADS I and NAADS II—implies that there was a remarkable increase in the share of NAADS participants using manure compared with non-NAADS households. Negative and statistically significant results—for example, for improved seed for participants in NAADS, both in 2005/6 and 2009/10—conversely, imply that the change in the proportion of NAADS participants using improved seeds was less than the proportionate change of the share of non-NAADS households using the same input. In their study, Benin and colleagues (2011) found no clear-cut impact of participation in NAADS on the adoption of improved agricultural technologies.

Reasons for the meager impact of the NAADS program on participants' adoption of improved inputs—especially purchased inputs, such as certified seed and fertilizer—may be due to the cost of these inputs. In a recent study, Okoboi and Barungi (2012) found that high prices were the reason most frequently cited by farmers for not using improved inputs. In the FGDs, participants revealed that even with training and advice on the benefits of using improved technologies, most farm households still were not using these inputs due to high prices, let alone the distance to farm-input shops to which the farmers had to trek to buy the inputs.

The results indicate that farm households joining NAADS for the first time, either NAADS I or NAADS II, passionately embraced manure preparation and use, compared with their counterparts that were not in NAADS or those participating in NAADS III. High interest in manure use by first-time NAADS farmers was probably due to extension training and advice received and the fact that materials such as animal dung and plant residues for making manure were freely available in the community. Waning interest in the adoption of manure by farm households that continuously participate in NAADS may be related to the bulkiness, laborious nature and stench associated with manure use. Nunez and McCann (2004) found that one-fifth of farmers in Iowa were unwilling to adopt manure due to the discomfort of the bad smell.

## **NAADS' Impact on Crop Productivity and Commercialization**

One of the key result areas of NAADS' performance record was that participating farm households would be associated with the entrepreneurial characteristics of higher productivity and market-oriented production. Tables 8 and 9 assess the changes in crop yields and

Table 7. Household Participation in NAADS and Percentage Using Agricultural Improved Inputs

Participation in NAADS	Manure			Fertilizer			Pesticide/Herbicide			Improved seed		
	2005/6	2009/10	Diff	2005/6	2009/10	Diff	2005/6	2009/10	Diff	2005/6	2009/10	Diff
Non-NAADS	4.04 (0.55)	4.50 (0.50)	0.46 (0.74)	0.30 (0.15)	0.60 (0.19)	0.30 (0.24)	1.24 (0.31)	2.95 (0.41)	1.71 (0.51)	3.97 (0.54)	24.25 (1.13)	20.28 (1.25)
NAADS I	6.59 (2.62)	13.20 (3.30)	6.61 (4.21)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.19 (1.54)	5.66 (2.26)	3.47 (2.73)	4.40 (2.16)	23.75 (4.79)	19.35 (5.25)
NAADS II	2.64 (0.75)	11.56 (1.33)	8.92 (1.53)	2.64 (0.75)	2.28 (0.62)	-0.36 (0.97)	2.64 (0.75)	5.25 (0.93)	2.61 (1.19)	9.69 (1.39)	36.18 (2.17)	26.49 (2.58)
NAADS III	8.51 (2.89)	9.00 (2.73)	0.49 (.27)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.80 (1.27)	1.80 (0.12)	5.32 (2.33)	22.99 (4.50)	17.67 (0.43)

Note: \*\*\*, \*\*, and \* indicate significance at the 1, 5 and 10 percent levels, respectively; figures in parentheses are t-values derived from differences in means t-test.

Table 8. Household Participation in NAADS, and Associated Crop Yield (metric tons per hectare)

Crop	Participation in NAADS												Difference in Differences (DID)		
	Non-NAADS			NAADS I			NAADS II			NAADS III			(2-1) (5)	(3-1) (6)	(4-1) (7)
	2005/6	2009/10	Diff (1)	2005/6	2009/10	Diff (2)	2005/6	2009/10	Diff (3)	2005/6	2009/10	Diff (4)			
Maize	1.52 (0.06)	1.63 (0.06)	0.11 (0.00)	2.28 (0.32)	1.88 (0.25)	-0.40 (0.06)	1.6 (0.1)	1.57 (0.09)	-0.03 (0.01)	1.63 (0.23)	1.64 (0.24)	0.01 (0.05)	-0.51*** (0.06)	-0.14*** (0.01)	-0.10*** (0.05)
Groundnuts	0.69 (0.04)	0.72 (0.04)	0.03 (0.00)	0.76 (0.22)	1.12 (0.26)	0.36 (0.09)	0.68 (0.06)	0.73 (0.07)	0.05 (0.01)	0.91 (0.18)	1.29 (0.19)	0.38 (0.05)	0.33*** (0.09)	0.02* (0.01)	0.35*** (0.05)
Coffee	0.82 (0.04)	0.86 (0.04)	0.04 (0.00)	0.49 (0.13)	0.93 (0.3)	0.44 (0.11)	0.85 (0.06)	0.84 (0.05)	-0.01 (0.01)	0.85 (0.11)	0.92 (0.15)	0.07 (0.04)	0.40*** (0.11)	-0.05*** (0.01)	0.03 (0.04)
Beans	0.75 (0.03)	0.67 (0.02)	-0.08 (0.00)	0.76 (0.09)	0.74 (0.08)	-0.02 (0.02)	0.76 (0.59)	0.72 (0.04)	-0.04 (0.04)	0.87 (0.1)	0.63 (0.07)	-0.24 (0.02)	0.06*** (0.02)	0.04 (0.04)	-0.16*** (0.02)
Bananas	4.51 (0.25)	6.36 (0.31)	1.85 (0.02)	6.61 (1.49)	7.18 (1.37)	0.57 (0.32)	5.35 (0.44)	6.79 (0.46)	1.44 (0.04)	4.2 (0.48)	5.73 (0.85)	1.53 (0.13)	-1.28*** (0.32)	-0.41*** (0.04)	-0.32*** (0.13)
Potatoes	3.85 (0.63)	4.1 (0.62)	0.25 (0.11)	3.93 (1.55)	1.7 (0.5)	-2.23 (0.46)	2.99 (1.09)	4.32 (1.01)	1.33 (0.39)	3.86 (1.07)	2.32 (0.5)	-1.54 (0.33)	-2.48*** (0.47)	1.08*** (0.40)	-1.79*** (0.34)

Note: \*\*\*, \*\*, and \* indicate significance at the 1, 5 and 10 percent levels, respectively; values in parentheses are standard errors.



Table 9. Household Participation in NAADS and Percentage of Crop Output Sold

Crop	Participation in NAADS												Difference in Differences (DID)		
	Non-NAADS			NAADS I			NAADS II			NAADS III			(2-1)	(3-1)	(4-1)
	2005/6	2009/10	Diff (1)	2005/6	2009/10	Diff (2)	2005/6	2009/10	Diff (3)	2005/6	2009/10	Diff (4)	(5)	(6)	(7)
Maize	25.40 (2.07)	27.28 (3.04)	1.88 (0.13)	63.46 (4.08)	29.54 (0.25)	-33.92 (0.66)	51.77 (22.49)	65.14 (26.46)	13.37 (2.18)	30.37 (4.84)	27.41 (4.85)	-2.96 (0.94)	-35.80*** (0.68)	11.49*** (2.19)	-4.84*** (0.95)
Groundnuts	19.45 (1.8)	50.63 (20.08)	31.18 (1.17)	25.18 (8.02)	26.02 (6.57)	0.84 (2.49)	26.83 (3.54)	26.14 (2.92)	-0.69 (0.46)	8.98 (4.51)	28.40 (6.64)	19.42 (1.55)	-30.34*** (2.75)	-31.87 (1.25)	-11.76*** (1.94)
Coffee	95.04 (1.15)	93.69 (1.21)	-1.35 (0.11)	92.86 (7.14)	91.67 (5.69)	-1.19 (2.88)	96.78 (1.11)	93.69 (1.76)	-3.09 (0.17)	97.27 (16.43)	95.24 (4.76)	-2.03 (3.07)	0.16 (2.88)	-1.74*** (0.20)	-0.68 (3.08)
Beans	28.09 (9.61)	29.92 (5.69)	1.83 (0.41)	27.87 (4.72)	18.44 (3.22)	-9.43 (0.78)	16.70 (1.71)	38.56 (1.16)	21.86 (0.13)	26.00 (4.19)	27.53 (4.21)	1.53 (0.77)	-11.26*** (0.89)	20.03*** (0.43)	-0.30 (0.88)
Bananas	12.76 (0.97)	14.32 (0.96)	1.56 (0.05)	27.67 (5.85)	28.07 (4.48)	0.40 (1.17)	16.29 (1.71)	25.86 (1.68)	9.57 (0.10)	14.66 (3.11)	26.66 (4.07)	12.00 (0.68)	-1.16 (1.18)	8.01*** (0.11)	10.44*** (0.69)
Potatoes	24.48 (3.84)	22.33 (3.68)	-2.15 (0.62)	21.11 (7.18)	18.33 (11.67)	-2.78 (5.11)	32.23 (8.19)	15.13 (5.29)	-17.10 (2.61)	40.00 (11.01)	40.46 (11.10)	0.46 (4.34)	-0.63 (5.15)	-14.95*** (2.68)	2.61 (4.38)

Note: \*\*\*, \*\*, and \* indicate significance at the 1, 5, and 10 percent levels, respectively; values in parentheses are standard errors.

shares of output sold by households participating in NAADS vis-à-vis those that are non-NAADS. Although farmers in Uganda cultivate a wide range of crops, only six crops—bananas, maize (i.e., corn), coffee, groundnuts, potatoes and beans—are considered in the analysis here due to a lack of complete data on other crops for the years 2005/6 and 2009/10. Notwithstanding the relatively small quantity of data, all the crops considered in this analysis except groundnuts are priorities in the current Agricultural Development Strategy and Investment Plan of Uganda.<sup>5</sup>

Starting with yield (table 8), generally the average yield for all crops was far below the potential that farmers could achieve with high-quality inputs and good agronomic practices. For example, according to the NARO, farmers in Uganda are capable of harvesting 7 metric tons of maize grain per hectare; yet in table 8, we notice that the highest maize yield recorded is 2.28 metric tons per hectare for households that participated in NAADS only in 2005/6. Turning to the DID results, they were mixed. For example, changes in maize, banana and potato yields were negative and statistically significant ( $p < 0.01$ )—pitting households participating in NAADS against their non-NAADS peers with regard to the dynamics of yield growth. With regard to changes in groundnut yield, all categories of farmers participating in NAADS exhibited a significantly higher increase in yield compared with non-NAADS households. As for coffee and beans, positive and statistically significant changes ( $p < 0.01$ ) in yield were registered by households that participated in NAADS I when compared with non-NAADS households. In a recent study, Benin and colleagues (2011) also reported mixed findings about NAADS' impact on agricultural productivity.

Participants in FGDs attributed the negligible impact of NAADS on yield to poor-quality inputs (e.g., seeds) supplied by NAADS to beneficiaries. Actually,

numerous media reports (e.g., *Daily Monitor*, July 14, 2008) fault NAADS and contracted service providers for supplying poor-quality inputs. A late supply of inputs when the rainy/planting season was ending was reported by FGD participants as another important cause of poor yields. In a previous study, Okoboi and colleagues (2011) found out that a late supply of inputs by NAADS was mainly due to delays in the disbursement of funds to subcounty NAADS offices by the MoFPED. Indeed in a recent report, MoFPED's Budget Monitoring and Accountability Unit (BMAU) found that disbursement of funds from MoFPED to NAADS offices at the subcounty level takes an average of 79 days (MoFPED 2011). Other factors contributing to low crop yields by NAADS farmers were poor farm management practices—particularly of new/exotic crops, poultry and livestock—due to resource (labor, financial and technical) constraints to manage such enterprises (Okoboi et al. 2011).

Regarding the shares of crop output sold, matched DID results were mixed, with significantly ( $p < 0.01$ ) declining shares of the output of maize, groundnuts, and beans sold in 2009/10 compared with 2005/6, by households that participated in NAADS I vis-à-vis non-NAADS, for the two periods under review. Farm households that had participated in NAADS both in 2005/6 and 2009/10 (NAADS III) also exhibited weaker or negative growth in the commercialization of maize and groundnuts when compared with non-NAADS households. Positive and statistically significant changes in the shares of crop output sold by NAADS compared with non-NAADS farm households were, however, observed in the case of banana production by farmers who participated in both NAADS II and NAADS III. Much as FGDs participants in the districts such as Luwero, Kabarole and Kibaale acknowledged increased commercialization of crops such as bananas, they revealed that an increase in the share of crops'

output sold was not really driven by the production inputs, extension advice or market information provided by NAADS to beneficiaries. Rather, it was high demand and the price offered for the crop by traders that motivated them to sell more. Even then, FGD participants disclosed that they sell their produce from home to intermediaries because NAADS does not help them access premium markets.

### Participation in NAADS, Consumption Expenditures and Poverty Status

The relationship between households' participation in NAADS and their monthly consumption expenditures equivalent and poverty status is presented in table 10. Consumption expenditure results for 2005/6 and 2009/10 indicate that households that participated in NAADS had average consumption expenditures above the poverty line threshold of \$30 per 30-day calendar month. Non-NAADS farm-households, on the other hand, had their CEE in 2009/10 barely averaging \$30 per 30-day calendar month. Even though average CEE of households participating in NAADS (NAADS

I and NAADS III) was above \$30, the increase over the periods 2005/6 and 2009/10 was on average meager compared to that of non-NAADS households. It is households who participated in NAADS III that posted robust increase in CEE that was significantly above that of non-NAADS households.

Turning to the issue of poverty status, the story is somewhat different. Despite the fact that households participating in NAADS were associated with higher CEE and hence a lower poverty level compared to non-NAADS households for the periods 2005/6 and 2009/10, the decline in poverty was much higher in non-NAADS households. It is only in the case of households who participated in NAADS II where the decline in poverty was higher than non-NAADS households, even though their average CEE increased marginally.

According to FGD participants, the higher average CEE exhibited by NAADS beneficiaries may be related to engagement in high-value enterprises such as exotic cows, goats, or chickens and consequently the consumption of some of the output (e.g., milk and

**Table 10. Participation in NAADS, Consumption Expenditures and Poverty Level**

Participation in NAADS	Consumption Expenditures Equivalent (CEE) in Dollars				Poverty Level (%)			
	2005/6	2009/10	Diff.	DID	2005/6	2009/10	Diff.	DID
Non-NAADS	27.62 (0.57)	29.55 (0.66)	1.93 (0.02)		31.89 (1.12)	24.86 (1.03)	-7.03 (0.04)	
NAADS I	30.97 (2.17)	31.80 (1.70)	0.83 (0.27)	-1.10*** (0.27)	16.98 (3.66)	13.21 (3.30)	-3.77 (0.48)	3.26*** (0.48)
NAADS II	33.63 (1.60)	35.14 (1.27)	1.51 (0.09)	-0.42*** (0.09)	22.65 (1.75)	14.11 (1.45)	-8.54 (0.10)	-1.51*** (0.10)
NAADS III	33.10 (1.67)	42.80 (2.82)	9.70 (0.31)	7.77*** (0.31)	13.51 (3.43)	9.90 (2.85)	-3.61 (0.42)	3.42*** (0.42)

Note: \*\*\*, \*\*, and \* indicate significance at the 1, 5 and 10 percent levels, respectively; values in parentheses are standard errors; exchange rate for fiscal year 2005/6 \$1= ush 1,819.76; for fiscal year 2009/10 \$1= ush 1,989.1.

eggs) or other products using income from the sale of the enterprise's output. Farmers participating in NAADS were also associated with higher access to credit, which in most cases was used for the settlement of social costs such as education and medical bills. Other potential sources of income for long-time

participants in the NAADS program were the supply of inputs such as potato seeds and citrus tree seedlings. This is true because it is a common practice for NAADS to train farmers to multiply and supply seeds and other planting materials to other farmers supported by NAADS.

## 6. CONCLUSIONS AND RECOMMENDATIONS

In this paper, we have examined the level of participation of *vulnerable* households headed by a female, youth or PLWD in the NAADS program and the impact of the program on agricultural households' access to extension services, use of improved technologies, crop yield and share of output sold, consumption expenditures and poverty level. We used the DID method to analyze panel data derived from matching UNHS 2005/6 and UNPS 2009/10 data. Additionally, we used qualitative data from FGDs carried out in nine districts of Uganda to validate and complement quantitative results from panel data.

Our results indicate that the percentage of households headed by women, young people and PLWDs participating in NAADS has declined compared with men, non-youths and non-PLWDs, respectively. Additionally, the results indicate that households participating the most in NAADS are those with higher education, land size and consumption expenditures—they are considered rich in the community. Given that NAADS is one of the strategic institutions established by the government of Uganda to help improve the productivity and income of poor subsistence farmers—most especially women, youths and PLWDs—it is important that in phase II of NAADS implementation, the government puts in place and implements an affirmative action plan to target and include more of these farmers into the NAADS program.

The results also suggest that NAADS beneficiaries have more leverage in access to credit—which perhaps is an outcome of NAADS capacity-building programs to empower farmers to establish and operate SACCOs, and access credit in microfinance and commercial banks. This suggests the need for NAADS program managers in phase II to focus more support on

institutional capacity-building activities so as to reach out, recruit and develop the capacity of more farmers to form and manage SACCOs.

Despite the fact that the NAADS program has had a commendable impact on participants' access to extension services, the quality of extension services is still a major challenge due to the large pool of unqualified ASPs, the limited attention that ASPs give farmers and the theoretical nature of their training. This is perhaps the main reason for the program's limited impact on increasing the technology adoption, productivity and output commercialization of its beneficiaries. To improve the quality of its extension and consequently technology adoption and productivity, MAAIF, NAADS program managers and local governments must jointly and urgently address the loopholes impairing the recruitment of competent and dedicated extension workers to offer real-time advisory services to farmers.

Households that continuously participate in NAADS exhibit relatively higher consumption expenditure outcomes than those receiving piecemeal or no support from NAADS. This suggests that piecemeal support to farmers from NAADS has only a limited impact on productivity and income. Thus, if the government is committed to using NAADS as a vehicle to improve household income, then program participants should not only be provided with continuous technical and input support but also with the whole package of services.

The DID analysis done for this study was based on data generated from the PSM results. Because the PSM analysis was based only on observable variables, it is possible that other unobservable factors—such as nepotism—may influence household participation in NAADS but were not included in the model, thus leading to an underestimation or overestimation of the

program's measured impact. The main limitation for not including other variables in the PSM model was the unavailability of data. Whether additional variables and data—either actual or instrumental variables—would improve the PSM results and hence minimize bias in the DID results can only be tested empirically, and this can add a new dimension to our research.

## ENDNOTES

1. Audit reports include, e.g., Auditor General Report of 2007 and media reports include, e.g., *Monitor*, February 5, 2008.
2. Throughout, years styled with a slash (e.g., 2009/10) indicate a fiscal year.
3. A parish is a second-tier local government administration. Local government, organized from smallest to largest, goes from village, parish, subcounty, county and, finally, district.
4. According to the 2006/7 NAADS annual report, local government and farmers contributed 62 percent of their allocated NAADS budget contribution in 2006/7, while in 2005/6 their contribution was only 47 percent of the allocated budget contribution.
5. The monthly household consumption expenditure is equivalent to the amount of goods and services consumed out of purchases, home produce and in-kind gifts expressed in 2005/6 prices.
6. The other crops considered as priority in Agriculture Development Strategy and Investment Plan 2010/11–2014/15 of MAAIF are cassava and tea (MAAIF 2010), for which household level production data were completely unavailable or incomplete in the UNHS 2005/6 and UNPS 2009/10 data.

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## APPENDICES

**Appendix A1: Summary Statistics, by Year and Household Participation in NAADS**

Characteristics or variables	2005/6						2009/10					
	NAADS			Non-NAADS			NAADS			Non-NAADS		
	Mean	Std. Dev.	Std. Dev.	Mean	Std. Dev.	Std. Dev.	Mean	Std. Dev.	Std. Dev.	Mean	Std. Dev.	Std. Dev.
<b>Individual/household characteristics</b>												
Female	0.24	0.43	0.43	0.25	0.43	0.43	0.19	0.39	0.39	0.26	0.44	0.43
PLWDs	0.12	0.33	0.35	0.15	0.35	0.35	0.24	0.42	0.42	0.23	0.42	0.42
Youth	0.28	0.45	0.48	0.36	0.48	0.48	0.15	0.35	0.35	0.27	0.44	0.42
Age	45.83	14.23	14.92	43.24	14.92	14.89	47.64	11.86	11.86	45.71	14.24	13.66
Education	7.56	4.11	3.58	6.88	3.58	3.62	8.17	3.70	3.70	6.54	3.68	3.76
Urban	0.06	0.24	0.34	0.14	0.34	0.34	0.12	0.33	0.33	0.12	0.33	0.33
Household size	6.20	2.40	2.99	5.94	2.99	2.96	7.31	2.94	2.94	6.20	2.81	2.89
Land	4.46	12.66	164.64	7.38	164.64	34.07	3.04	3.87	3.87	2.45	7.11	6.36
<b>Outcome variables</b>												
Ext. access	0.30	0.46	0.26	0.07	0.26	0.28	0.92	0.27	0.27	0.27	0.44	0.50
Organic fertilizer	0.06	0.24	0.19	0.04	0.19	0.19	0.11	0.31	0.31	0.05	0.22	0.25
Inorganic fertilizer	0.00	0.00	0.09	0.01	0.09	0.09	0.02	0.14	0.14	0.01	0.08	0.10
Pesticide	0.01	0.09	0.14	0.02	0.14	0.14	0.05	0.21	0.21	0.03	0.17	0.18
Imp-seed	0.04	0.20	0.23	0.05	0.23	0.22	0.34	0.47	0.47	0.24	0.43	0.44
Credit	0.15	0.35	0.25	0.07	0.25	0.26	0.19	0.40	0.40	0.08	0.27	0.31
Credit use agriculture	0.26	0.44	0.36	0.15	0.36	0.37	0.17	0.38	0.38	0.14	0.35	0.36
CEE	31.42	19.67	28.96	29.08	28.96	28.48	36.38	30.46	30.46	29.68	27.00	28.13
Poverty	0.18	0.38	0.46	0.30	0.46	0.46	0.13	0.34	0.34	0.24	0.43	0.41

Sources: UNHS 2005/6 and UNPS 2009/10; and Bank of Uganda for exchange rate: 2005/6 \$1= Ush 1819.76; 2009/10 \$1= Ush 1989.

**Appendix A2: Test of Balancing Property of  
Propensity Scores, by Blocks**

Blocks	NAADS Participants		Non-NAADS		Diff of mean P-score
	Obs.	Mean P-score	Obs.	Mean P-score	
<b>NAADS I</b>					
Block 1	96	0.141	545	0.133	0.008
Block 2	30	0.227	242	0.224	0.004
Block 3	68	0.274	209	0.274	0.000
Block 4	175	0.345	306	0.347	-0.002
Block 5	161	0.456	146	0.464	-0.008
Total	530		1,448		
<b>NAADS II</b>					
Block 1	17	0.031	535	0.035	-0.004
Block 2	50	0.075	570	0.070	0.005
Block 3	28	0.132	205	0.128	0.004
Total	95		1,310		
<b>NAADS III</b>					
Block 1	62	0.061	1,098	0.056	0.005
Block 2	37	0.129	264	0.128	0.001
Block 3	2	0.209	6	0.204	0.005
Total	101		1,368		

Sources: UNHS 2005/6 and UNPS 2009/10.

Note: The mean propensity score (P-score) is not different for treated and controls blocks.



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